Locomotive Operation

QUESTIONS AND ANSWERS

DEFECTS AND REMEDIES

EXAMINATION QUESTIONS

By ALONZO W. DEAL, Sr.
A. B. I. and M. Ex.

THE WESTINGHOUSE

AUTOMATIC AND STRAIGHT AIR-BRAKE

COMBINED

E. T. EQUIPMENT AND MACHINERY

QUESTIONS AND ANSWERS

with

THEIR DEFECTS AND REMEDIES.

PRICE, $2.50

Published by

ALONZO W. DEAL, SR.,

Air-Brake and Machinery Examiner

Philadelphia & Reading Railroad

MR. DEAL'S BIOGRAPHY

Born January 31, 1864.

Entered the service of North Pennsylvania Railroad, November 1, 1876, as a messenger boy to shop foreman and was apprenticed to learn machinist trade.

Promoted to house engineer, March, 1883.

Resigned N. P. R. R., 1883.

Entered the service of Pennsylvania Railroad.

1886, placed in charge of the air-brake system, Powelton Avenue Engine House.

Resigned that position, 1893.

Transferred to Jersey City, 1893. Leading machinist, Waldo Avenue.

Resigned Pennsylvania Railroad, 1895. Entered the service P. & R. R. R. to look after air-brake system, Ninth and Green Streets, Philadelphia.

Appointed air-brake instructor, Y. M. C. A., Third and Berks Streets, 1898 and 1899.

Appointed air-brake instructor, Philadelphia and New York Division, 1902.

1904, appointed general inspector at Baldwin Locomotive Works to receive 179 locomotives for the P. & R. R. R.

1907, general inspector at Baldwin's Locomotive Works to receive 25 locomotives for the Georgia Central R. R. Mr. F. F. Gaines' choice as an inspector.

1908, March 8th, appointed air-brake instructor, Philadelphia & Reading R. R. system.

1917, forwarded to Baldwin's Locomotive Works to receive information concerning the Mallett Compound Locomotives, so as to demonstrate same on Frackville grade.

1918, January and February, forwarded to Baldwin's Locomotive Works to receive 47 foreign locomotives.

1918, April, forwarded to Lehigh University to train soldiers for General Pershing for overseas duty.

1918, December 7th, appointed machinery examiner, P. & R. R. R. system.

Now representing P. & R. R. R. system, air-brake and machinery examiner.

GOVERNMENT CONTROL OF RAILROADS

January 8, 1918

The Well-known Railroad Expert and Patriotic Trainer of Engineers and Firemen for Overseas Duty.

ALONZO W. DEAL, SR.

Born January 31, 1864. Entered the service of North Pennsylvania Railroad, November 1, 1876.

20-26658

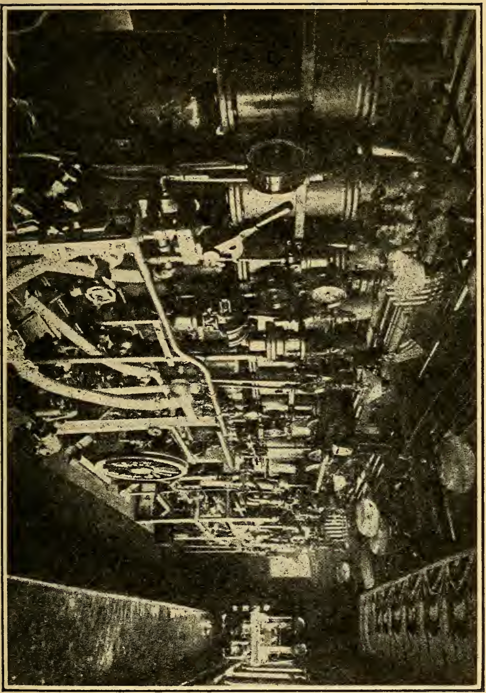
A RAILROAD CATECHISM

Treating on the Westinghouse air-brake equipment and the questions and answers on machinery, to be used for examination of firemen to be promoted to engineers.

This little catechism contains the information the young man desires when entering railroad work, or one who has already been employed for a short period of time, as well as the old experienced railroad man. It contains the different branches of information which the writer used for training the engineers and firemen for overseas duty in France on General Pershing's railroad.

No. 1. Field Test of Colors.
No. 2. Book of Rules.
No. 3. Bulletin Board Reading.
No. 4. Watch Registering.
No. 5. Air-Brake Instructions.
No. 6. Machinery Instructions.

This book is written and published by Alonzo W. Deal, Sr., an air-brake instructor for the past twenty years, having the knowledge of inspecting and repairing of same ever since November, 1876. Starting in that branch of work as an apprentice, and having had practical experience for the past forty-three years, and at the present time an air-brake instructor. It is an understood fact that an air-brake instructor can be a bill of expense to his company or he can be a great saver. The loss of time to a train is an expense to the company; therefore, if the engineers, firemen, conductors and trainmen can be enlightened on the subject of air-brakes, so that when they have a defect, they can remedy it and bring the train to its destination on time or as close to the time as possible with safety, and live within the bounds of the State and Interstate laws, he is considered one of the most reliable men the company has in their employ. As his knowledge of the business makes him quite popular among the officials of the corporation, such as superintendents and train-masters, it is well to remember that it is no burden to carry knowledge, and it is received at very little expense.



Interior of Air-Brake Instruction Car

This car is directly under the management of Mr. Alonzo W. Deal, Sr. It makes its yearly trips over the railroad, stopping at all railroad centres. This car is scheduled to arrive and leave on a designated time, the same as a train schedule.

The first list of questions and answers in this book are used for newly-employed students who have just been placed in road service.

In the month of June of each year this car is forwarded to Camden for the benefit of newly-employed men who are hired for train service on the Atlantic City Railroad for a period of four months to protect and take care of the summer travel, as it is well known that this railroad takes in a large number of seaside places and most of the travel is done by pleasure-seekers during the summer months.

QUESTIONS AND ANSWERS

For the Newly-Employed Brakeman on the Air-Brake Subject.

Q. 1. What is an air-brake?

A. 1. A brake operated by compressed air.

Q. 2. What kind of an air-brake is used on this railroad?

A. 2. The Westinghouse automatic quick-action air-brake.

Q. 3. Where does the conductor's and brakeman's duties start in reference to an air-brake on a train and where do they stop?

A. 3. They start at the angle-cock on the rear of the tender or the front of the engine and stop at the angle-cock on the rear of the train.

Q. 4. What are their duties in reference to an air-brake on a train?

A. 4. First, to see that all hand-brakes are off; second, that all retaining valve-handles are pointing down in line with the pipe; third, that all triple-valves are cut into service; fourth, that all bleed-valves are closed; fifth, that all hose are coupled properly; sixth, that no leaks exist in hose-couplings or brake pipes; seventh, that all angle-cocks are open except the one on rear of train, which must be closed, and the one on head end of the train closed until after the hose is coupled between tender and car.

Q. 5. What are their duties before coupling air-hose on tender to air-hose on car?

A. 5. Stretch the train and see that all lock-pins are in their proper position. This will prevent damage to air-hose.

Q. 6. What should be done before coupling the hose on tender to the hose on car?

A. 6. First open the angle-cock on tender, blowing out the brake-pipe so as to be sure no dirt or water is retained in the pipe or hose before coupling.

Q. 7. After engine and tender are coupled to train, what angle-cock should be opened first?

A. 7. First open the angle-cock on tender, filling the vacant space of hose with air; then open the angle-cock on car.

Q. 8. How should the air be turned in from the tender to the train?

A. 8. By slowly opening the angle-cock on car.

Q. 9. Why should the angle-cock be opened on the tender first?

A. 9. To prevent putting the brake on engine and tender too suddenly. This will prevent damage to the brake-rigging.

Q. 10. Where should we start to get a train ready in reference to an air-brake?

A. 10. Begin at the rear of train.

Q. 11. Why should we start at rear of train?

A. 11. So as to be sure the angle-cock and whistle-cock on rear of train are closed.

Q. 12. What would happen if these cocks were left open?

A. 12. It would mean the loss of air and also time.

Q. 13. After coupling the hose and turning the angle-cocks, are we ready to look over the brakes?

A. 13. No; not until the pump has pumped the train up to the standard pressure and is fully charged.

Q. 14. Who should tell when it is time to test the brakes?

A. 14. The engineer.

Q. 15. Why should the engineer be the one to tell you when it is time to test the brakes?

A. 15. The engineer is the one who has the air-gauge located in the cab of the engine, and this informs him of the pressure the brake-pipe and auxiliary reservoirs have under the engine, tender and cars.

Q. 16. What should be done when the engineer is signaled to apply brakes?

A. 16. The train crew should look over the train and see that the pistons are out of the cylinders a proper distance and also see that there is no leak at the brake-cylinders or high-speed reducing valves.

Q. 17. What should be done after the engineer is signaled to release brakes?

A. 17. To see that all pistons have returned into the cylinders in their proper positions, that there is no blow at the triple-valve exhaust or that there is no blow at the exhaust of the retaining valve or no leaks in the air-brake apparatus.

Q. 18. What piston travel should be looked for under a car when the brake is applied?

A. 18. A piston travel of not less than six (6) inches and not more than eight (8) inches.

Q. 19. What effect will a short piston travel have under a tender or car?

A. 19. It will increase the braking power on that car or tender, and it will not work uniform with the rest of the brakes in the train.

Q. 20. In testing the train brakes is it proper to have a brakeman open an angle-cock on the rear of train?

A. 20. That is decidedly a very poor practice and must never be put into effect by train crews.

Q. 21. When inspecting a train if we were to find a brake that would not apply with the rest of the brakes, what should be done?

A. 21. First, see that the brake on that car is cut in properly; try the bleed-valve, so as to be sure that there is air in the auxiliary reservoir. If air is found in the reservoir signal the engineer for another brake-pipe reduction.

Q. 22. If the brakes then apply what may have been the cause?

A. 22. A dirty feed groove in the triple valve, a stuck triple piston or a leaky brake-cylinder leather or a gummed slide valve.

Q. 23. What are the principal working parts of the automatic air-brake that is applied to a car?

A. 23. The triple valve, auxiliary reservoir and brake-cylinder?

Q. 24. What is the triple valve used for?

A. 24. To charge the auxiliary reservoir, to apply the brakes and to release the brakes.

Q. 25. From the "brake-pipe," where does the air go?

A. 25. From the "brake-pipe" to the "triple valve," then to the auxiliary reservoir.

Q. 26. What is the auxiliary reservoir pressure used for?

A. 26. The auxiliary reservoir pressure is used as a storage of air to set the brake.

Q. 27. What is the "brake-cylinder" pressure used for?

A. 27. To hold the brake on after the brake is applied.

Q. 28. When the air leaves the auxiliary reservoir, where does it go?

A. 28. It passes the "graduating valve" and "slide valve" to the brake-cylinder.

Q. 29. Where does the air go when it leaves the brake-cyliner?

A. 29. Air passes from the brake-cylinder out through the triple-valve exhaust port to the atmosphere.

Q. 30. To where is the retaining valve connected?

A. 30. It is connected to the triple-valve exhaust port.

Q. 31. What position does the retaining valve handle occupy when not in service?

A. 31. Direct in line with the pipe, pointing down.

Q. 32. What would you look for if the brake were applied and then released and you found the brake-cylinder piston would not return to the cylinder?

A. 32. First, notice the position of the retaining valve handle to see if that is correct; disconnect the union at the triple-valve exhaust port, and look for a plugged-up retainer pipe.

Q. 33. What would you do if you found a retaining valve broken off of the pipe or the pipe disconnected from the triple-exhaust port?

A. 33. Nothing. Leave it alone. Card the car and have it repaired by the car inspector at the end of the trip.

Q. 34. What is the pipe called that extends the full length of the car?

A. 34. The brake-pipe.

Q. 35. What cocks are found in this pipe?

A. 35. Angle-cocks, with a loose hose and coupling.

Q. 36. How does the angle-cock handle stand when opened and closed?

A. 36. In line with the brake-pipe when open and at right angles when closed.

Q. 37. If the handle comes loose from the plug, how could you tell if the cock is open or closed?

A. 37. By the groove in the top part of the plug.

Q. 38. What is the name of this groove?

A. 38. A port-way groove. The groove and the port in the plug are in direct line with one another.

Q. 39. What is the pipe called that leads from the brake-pipe to the triple valve?

A. 39. The cross-over pipe.

Q. 40. Is there a cock located on the cross-over pipe?

A. 40. There is, and it is known as a straight-cock or a cut-out cock for the brake.

Q. 41. How does the handle of the cut-out cock stand when open and closed?

A. 41. Right angles when open and in line with the pipe when closed.

Q. 42. What is the cut-out cock used for?

A. 42. It is used to cut out the brake in case of a defect to the triple valve, auxiliary reservoir or brake-rigging.

Q. 43. What is located on the cross-over pipe between the cut-out cock and the triple valve?

A. 40. A centrifugal dirt collector, used to protect the triple valve from foreign matter.

Q. 44. What position should the handle of the cut-out cock occupy? In case you wanted to cut out a brake?

A. 44. In line with the cross-over pipe.

Q. 45. How would you proceed with a brake cut-out in a train?

A. 45. Close the cut-out cock on the cross-over pipe, release all of the air out of the auxiliary reservoir and proceed.

Q. 46. How should you leave cars stand in a siding so as to remain there?

A. 46. Always release all of the air out of the auxiliary reservoirs; then put on hand-brakes.

Q. 47. After stopping a train on a descending grade, should the air or hand-brake be used to hold the train for a period of time over 2 minutes?

A. 47. The hand-brakes should always be used.

Q. 48. Explain in detail how the train should be secured with hand-brakes.

A 48. On descending grades sufficient hand-brakes should be set on the front end of a train to fully secure it. On ascending grades sufficient hand-brakes should be used on the rear of the train to fully secure it.

Q. 49. How should release valves on the auxiliary reservoirs be operated to release brakes?

A. 49. Release valves should be tipped open and closed until the triple valve exhaust starts to blow.

Q. 50. How many different ways can the automatic brake be applied from the train?

A. 50. First by opening the conductor's emergency valve; second, the angle-cock; third, the parting or bursting a hose or a defective brake or crossover pipe.

Q. 51. If necessary to drill a car to rear of train, what should be examined before placing it there?

A. 51. First see if it has a good hand-brake.

Q. 52. A car having a defective air and hand-brake, in what part of the train can it be safely moved to the nearest terminal point?

A. 52. On the rear of the train with a car that has a good hand-brake in the rear of the defective one.

Q. 53. What is a conductor's valve?

A. 53. A conductor's valve is a valve located in a passenger car, and is used to set the brake when the conductor so desires.

Q. 54. Where is the conductor's valve located?

A. 54. In the saloon of the car, and has a cord attached running lengthwise through the car.

Q. 55. Is there a cut-out valve attached to the upright pipe leading up to the conductor's valve?

A. 55. No.

Q. 56. Where is the pipe connected that leads up to the conductor's valve?

A. 56. It is connected direct to the brake pipe, and leads upright through the floor of car to the conductor's valve.

Q. 57. How must the air-hose couplings be parted?

A. 57. Hose couplings must be parted by hand, so as to prevent damage to the brake-pipe, angle-cocks, hose couplings and gaskets.

Q. 58. When is it proper to close an angle-cock on a train before releasing or after releasing a brake?

A. 58. After releasing the brake.

Q. 59. How should the conductor's valve be operated?

A. 59. According to the speed of the train; when running at a low rate of speed, gradually open; when running at a high rate of speed, wide open, if the emergency brake is desired, and if necessity calls for it.

Q. 60. What is the use of the automatic slack adjuster on passenger cars?

A. 60. To prevent a running piston travel of more than 8 inches.

Q. 61. What is the high-speed reducing valve used for?

A. 61. High-speed reducing valves are to be adjusted to close at 60 pounds and are connected direct to brake-cylinders.

Q. 62. When will the high-speed reducing valve go into operation?

A. 62. When the brake-cylinder pressure is increased above 60 pounds; then the pressure in the brake-cylinder places the reducing valve into action, and the pressure of air will continue to flow out of the brake-cylinder until it is reduced to a fraction below 60 pounds; then the valve will close.

Q. 63. What is a pop valve used for that is attached to brake-cylinder pressure?

A. 63. It takes the place of a high-speed reducing valve and is used to decrease the pressure of air in the brake-cylinder under an automatic action.

Q. 64. If you have a blow-out of the exhaust port of the triple valve, or a retaining valve, how would you overcome it?

A. 64. First, tap the check case; second, cut out the brake, bleed the air out of the auxiliary reservoir, cut it in quickly; third, shut the angle-cock on each end of the car, part the hose, open the angle-cock on defective car, drawing the air out of the brake-pipe, recouple the hose, open the angle-cocks again and recharge the auxiliary reservoir. If these remedies do not stop the blow, then close cut-out cock, bleed all of the air out of the auxiliary reservoir and proceed.

Q. 65. What other pipe extends the full length of a passenger car?

A. 65. Signal train pipe.

Q. 66. What cocks are found on this pipe?

A. 66. Straight cocks.

Q. 67. How does the handles of these cocks stand when open and when closed?

A. 67. In line with the pipe when closed and at right angles when open.

Q. 68. How is the car discharge valve connected to the signal train pipe?

A. 68. There is a tee strainer located in the train signal pipe with a half-inch outlet, to which a half inch pipe is attached, and the car discharge valve is connected to this pipe.

Q. 69. Is there a cut-out cock located on this pipe?

A. 69. Yes, and is used to cut out the car discharge valve in case of a defect to the valve.

Q. 70. What pressure of air is carried in the train signal pipe?

A. 70. 40 to 45 pounds.

Q. 71. In coupling a signal hose on a tender to a signal hose on a car (and the hose is properly coupled), which cock should be opened first?

A. 71. Open the cock on the car first, then on the tender.

Q. 72. Has the signal train pipe any connection with the brake-pipe?

A. 72. No. They are both independent of one another.

Q. 73. How must car discharge valves be operated to make a reduction in the signal train pipe?

A. 73. By pulling down on signal cord by quick wide open pull.

Q. 74. What period should intervene between each blast of the car discharge valve?

A. 74. About two seconds between each pull of the car discharge valve.

NOTICE.

After the students have learned these questions, located in the book they are taught to place in hose gaskets, how to detect air-hose from whistle-hose, how to operate slack adjustors by hand so as to run the slack in and out in the brake rigging, how to operate the air whistle by using the whistle cord, also the conductor's valve, how to operate retaining valves, how the handle of the retaining valve stands when in service and when not in service, and how to bleed a brake off through the opening of the bleed valve at the auxiliary reservoir.

A man being placed in an air-brake instruction car as an instructor has many things to contend with and must answer many questions pertaining to the air-brake subjects. This question is often asked: How long will it take to charge up a train of 80 cars? And my first answer is that it depends on the condition of the train; also the leaks that exist in the brake apparatus and the condition of the pump. Then the man that asks the question says: I mean with everything in first-class condition. And this is my answer: That depends on the equipment. Let us say we have three trains, all the same length; one train has all 8-inch equipment, that means 8-inch brake-cylinder, auxiliary reservoir 10x24. No. 2 train has one-half of the train with 8-inch equipment and the other half of the train equipped with 10-inch equipment, that means 10-inch brake-cylinders and auxiliary reservoirs 12x33. No. 3 train has all 10-inch equipment. Then we understand that No. 1 train will be charged up quicker than No. 2 train; No. 2 train will be charged up quicker than No. 3 train, as the small auxiliary reservoirs will charge quicker than the large ones. Again, after the train is all charged and the brakes are applied, then released, it will take longer to charge the 10-inch equipment because it took more air to fill the 10-inch brake cylinders out of the auxiliary reservoirs than it did the 8-inch, providing all piston travels are near to the standard travel of 6-inch and not to exceed 8 inches.

MR. DEAL

has the honor attached to his name of talking to 140,000 students, promoting over 3500 firemen to engineers and investigating over 500 cases of discipline in this past 20 years.

MR. DEAL

being located at Belmont, Philadelphia, Pa., for a period of time looking after the U. S. A. lomocotives that were built for General Pershing's railroad in France, and after their deliverance to the Philadelphia & Reading Railway from Baldwin's Locomotive Works were put in his charge. The writer was very much surprised when he was called away from that position and was ordered to report at Reading on April 13th, 1918. Upon his arrival at Reading, and, calling on the Superintendent of Motive Power, he was informed by Mr. I. A. Seiders that he was to place the air-brake instruction car in first-class condition, locate anything in the car you desire and be prepared to go to South Bethlehem and locate there indefinitely to be in connection with the Lehigh University to train soldiers who had previously been firemen to locomotive engineers for oversea duty. This call being very sudden, did not give the writer very much time to realize what he had to do, but he came to the conclusion very quickly that he would start right in on the work and educate and train them, under brotherhood rules, using the motto, sobriety, truth, justice and morality, which was done so naturally that the writer felt highly honored to know that he was the one picked out by the officials of the Philadelphia & Reading Railway to do that patriotic work. At the same time, never having had any experience with a college, but being a practical railroad man, it only took a short period of time to become acquainted with college rules.

After arriving at the college and being introduced to the president, Dr. Henry S. Drinker, it was impressed upon Mr. Deal that he must take full charge of the training, and it all depended upon him the kind of engineers he would turn out. This gave confidence to Mr. Deal, and he proceeded direct under railroad rules, first using the field test for their eyes; after the eye-test book of rules, watch registering, bulletin board reading, air-brakes and machinery examination, giving them one and all the same opportunity for promotion to engineers.

First class opened for their training 8th Day of May, 1918.

MR. DEAL

being invited up to the College by Captain Chenning, Jr., to meet the boys for the first time, he passed a few remarks of welcome.

The speaker said he was highly honored to know that the Railroad Company had forwarded him to Bethlehem to be connected with the Lehigh University in this most wonderful and patriotic training, and was more than honored to know that God had given him the strength and ability to perform such duties that were required at this critical time—a time when not only we boys must be patriotic, but the time when it takes everyone in the U. S. A. to be patriotic. Just let us stop and think for a moment what it means to General Pershing and the boys over there in the trenches if we can be educated to perform our duties successfully, so we can take full charge of one of those locomotives that is all ready over there awaiting our coming, and to take charge of one of them that will pull the train that is loaded with ammunition from the docks to the trench lines, where it will be delivered direct to our soldier boys. Again, let us all put our minds down to the training so we can perform our duties most wonderfully. And I must say I would be more than pleased if one of you will operate the locomotive that will pull the train that will have the cars connected to it and they be loaded with the ammunition that will win this great war. Now you all have my best wishes. May God be with you in your great work, both here and abroad, and may you also have a speedy return home to your family and friends.

INTRODUCTION.

The first introduction the soldier boys received in regards to their training was to appear at the stadium at 9 o'clock P. M. and there undergo a field test, using four different colors to test their eyes—red, white, green and blue. Those that passed a satisfactory examination received a certificate and were eligible to proceed further with their training.

A certificate each and every soldier received who passed the eyesight test satisfactorily.

Form 539.

LEHIGH UNIVERSITY

Camp Coppee

Field Test of Engineers Entering U. S. A. Service with Red, White, Green and Blue Lights.

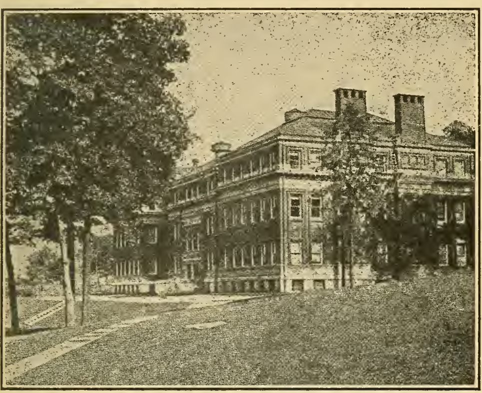
This is to certify that William D. Noll on this date, June 23d, 1918, satisfactorily passed the field test of colors previous to his promotion to engineer for overseas duty.

(Signed) ALONZO W. DEAL, SR.
Examiner.

After passing the field test satisfactorily they were presented with a book of rules and were allotted a period of time to study them. When they were ready to go ahead and write the answers out on a form provided for them, this form was presented to them, with all the questions and a place provided for the answers. After they were through writing their book of rules they were looked over carefully, giving each and every one an average, according to the number of questions correct, using an average of 85 per cent. to promote them to engineers and 65 per cent. to be a fireman. If neither average was received they were disqualified.

WILLIAMS HALL.

This photograph represents Williams Hall, the place where the soldier boys sat and studied their book of rules; also wrote the answers. Below is a copy of the certificate forwarded to each soldier who received the average of a per cent. great enough to receive one.



Form 416.

CAMP COPPEE

Certificate of Examination

Book of Rules.

This is to certify that William D. Noll this date, June 28th, 1918, satisfactorily passed the examination in the book of rules for promotion to engineer for overseas duty.

Average 100.

(Signed) ALONZO W. DEAL, SR.,
Examiner.

THIRD LESSON.

As the eye test and book of rules were passed satisfactorily, the third lesson was the bulletin board reading as they entered the air-brake instruction car to be trained on the subject of air-brakes. The bulletin board was constructed so as to plainly show them where water columns were located along the division that they were being trained on and what it meant to the company if neglect to read same, the loss of time and the service of their engine which was in their charge if they had to draw fire while en route.

BULLETIN BOARD.

Phila. & Reading Railway Co.
Rdg. Div.
Office Road Foreman of Eng's
Rdg., Pa., May 17, 1918
Notice
To all Engineers:

There is a serious complaint that our engineers are again using sand over interlocking switches.

This practice must be discontinued at once.

JOHN SCHEIFLE,
Road Foreman of Eng's.

Water Stations

0	Bethlehem
0	Perkasie
0	Telford
No water at	Lansdale
0	Gwynedd
0	Glenside
0	Jenkintown
0	Philadelphia

No water at, represents a plug with the above words, can be moved from one place to the other.

FOURTH LESSON.
WATCH REGISTERING.

Using one of the company's books to which watches are compared with a standard timepiece they are located at every railroad centre. Engineers, conductors and flagmen must register their watches, teaching them to keep their minute and second hands together so they could register correctly or if their watches were slow or fast they could register correctly the number of seconds on the place marked so in the books.

REGISTER OF WATCHES COMPARED BY TRAIN CREWS.

Bethlehem Station.

Movement No.	Comparded Date	Time	Fast Seconds	Slow Seconds	Sginature	Occupation
90506	7-11-18	8.45	5		W. B. Smith	Fireman
84806	7-11-18	8.46		5	Jos. W. Brown	Fireman

June 30, 1918.

ALONZO W. DEAL, SR.,
Watch Examiner.

FIFTH LESSON.

Air Brake Instruction and Examination. Each soldier was supplied with an air brake book with the questions and also a typewritten form with the answers. In the air brake instruction car they were instructed six hours a day for twenty days, then examined and a certificate issued according to their knowledge.

Marked. Fair. Good. Very Good. Excellent.

Philadelphia & Reading Railway Company.
CERTIFICATE OF EXAMINATION
on
AIR BRAKES.

This is to certify that Joseph W. Brown has been thoroughly examined as to his knowledge of the operation and management of the Westinghouse air brake and is ranked excellent.

ALONZO W. DEAL, SR.,
July 10, 1918. Examiner.

The interstate laws covering the safety appliance act makes it compulsory that all locomotives leaving the engine house must have a good driving wheel-brake and tender-brake, and in good working condition. When a driving wheel-brake or tender-brake is found to be defective or inoperative before leaving the engine house the locomotive must not be permitted to leave, but must be substituted for a locomotive having a good driving wheel-brake and tender-brake. If the brakes on the engine and tender become disabled while en route and you have a sufficient amount of cars attached in a train so as to allow you to retain 85 per cent. of air-brakes in good condition, the locomotive may proceed to its destination, the engineer using all precaution necessary by the lost power of the driving wheel-brake or tender-brake.

FIRST CLASS AIR-BRAKE INSTRUCTION.

opened on the morning of May 10th, 1918. The number of soldiers in session was 15 in the morning and 15 in the afternon, making a total of 30 soldiers a day undergoing the training.

This photograph represents the first 15 soldiers undergoing the training at Camp P. & R., South Bethlehem.

used while training the soldiers to be engineers and firemen for overseas duty on General Pershing's railroad in France:

Q. 1. What is an air-brake?

A. 1. A brake operated by compressed air.

Q. 2. What kind of an air-brake is used on this railroad?

A. 2. The Westinghouse quick action automatic air-brake and straight air-brake combined.

Q. 3. What is the meaning of automatic?

A. 3. Anything that is self-acting.

Q. 4. What is meant by a straight air-brake?

A. 4. A brake that receives its air for its braking power direct from the main reservoir.

Q. 5. What extra attachment is required when using a high-speed brake?

A.5. High-speed reducing valve, pop valve or safety valve.

Q. 6. On what class of engines is the high-speed brake used?

A. 6. On any class of engines having wheel-base sufficiently large enough to guarantee a high-speed movement; also one carrying steam pressure high enough to accumulate a high pressure of air.

Q. 7. Name the ten principal parts of an air-brake.

A. 7. Air pump governor 1
Air pump 2
Main reservoir 3
Engineer's equalizing discharge valve...... 4
Duplex air gauge 5
Equalizing drum 6
Brake-pipe hose and couplings 7
Triple valves 8
Auxiliary reservoirs 9
Brake cylinders 10

AIR PUMP.

Q. 8. What is the air pump used for?

A. 8. To compress air to the main reservoir.

Q. 9. What part of the pump contains the differential piston?

A. 9. The top head of the air pump.

Q. 10. To what is the slide valve connected?

A. 10. To the differential piston.

Q. 11. To what is the reversing valve connected?

A. 11. To the reversing valve rod.

Q. 12. To what is the reversing valve rod connected?

A. 12. To the reversing plate.

Q. 13. To what is the reversing plate connected?

A. 13. To the steam piston.

Q. 14. To what is the lower end of the steam piston rod connected?

A. 14. To the air piston.

Q. 15. On what side of the pump are the receiving valves?

A. 15. The receiving valves are on the side that the air strainer is located.

Q. 16. On what side of the pump are the discharge valves?

A. 16. They are on the opposite side of the air cylinder, the side to which the discharge pipe is connected.

Q. 17. Do both the receiving valves operate with each stroke of the pump piston?

A. 17. No, the upper receiving valve operates on the down stroke and the lower receiving valve operates on the upper stroke of the pump piston.

Q. 18. Do both the discharge valves operate with each stroke of the pump piston?

A. 18. No, the upper discharge valve operates on the upper stroke and the lower discharge valve operates on the down stroke of the pump piston.

Q. 19. What is the first thing you should do before starting an air pump?

A. 19. Open the drip cocks.

Q. 20. Explain how a standard 11-inch air pump operates.

A. 20. When the globe valve is opened, steam comes from the boiler to the globe valve, to the steam pipe, then to the governor, passing into the steam passage leading to the top head of the pump, and enters between the differential pistons. The area of the large end of the piston being so much greater than the small end of the piston, the steam moves these pistons toward the right side, carrying with them the slide valve; to this position the steam port to the left of the slide valve is unseated and the steam port to the right side is now in communication with the exhaust port in the slide valve seat and the exhaust cavity in the slide valve. Any steam above the piston is free to pass to the atmosphere as the steam port to the left of the slide valve is unseated, steam is free to pass to the lower end of the main steam piston. As the steam piston is forced upward by the steam pressure, and just before it reaches the top of its stroke the reversing plate strikes the shoulder of the reversing valve rod, lifting the rod. As the rod is lifted up the reversing valve is carried with it, blanking off the exhaust port to the right of the differential piston and unseating the steam port to the right of the differential piston. At this move steam is permitted to flow into the right side of the differential piston, and at this move the steam pressure becomes equal on both sides of the large piston. The small end of the piston having steam only on one side of the piston, and this steam being located on the inside of the piston, moves the differential pistons to the left, which gives the pump the reverse action. At this move the steam port to the right side of the slide valve is unseated and the steam port to the left is in communication with the exhaust port in the valve seat, and the exhaust cavity in the slide valve and any steam in the lower end of the steam cylinder below the steam piston is free to pass out to the atmosphere. The steam port to the right side of the slide valve being unseated steam is free to pass direct on top of the main steam piston as the piston is forced down by the steam pressure, and just before the piston nears its stroke the button on the reversing valve rod comes in contact with the reversing plate as the piston moves down; so does the reversing valve rod and reversing valve. At this move the steam port to the right of the differential piston is blanked off and the exhaust port is uncovered. All steam to the right of the differential piston passes out through the exhaust port to the atmosphere, thus permitting the differential piston and slide valve to be carried to the right side, which gives the pump the reverse action.

Q. 21. How is the condensation in the steam cylinder taken care of?

A. 21. When the governor is in action by a small hole drilled through the steam valve, and when the pump is at rest by the drip-cocks.

Q. 22. When should the drip-cocks be left open?

A. 22. When steam is turned off of the pump.

Q. 23. How long should the drip-cocks be left open?

A. 23. Until all the water is worked out of the steam cylinder.

Q. 24. When should oil be fed to the pump?

A. 24. Not until all the water is worked out of the pump and the drip-cocks closed.

Q. 25. How many drops of oil per minute does the steam cylinder of the pump require?

A. 25. On a through line passenger engine, one drop per minute; on a local train, two drops per minute; on a freight train, three to four drops per minute.

Q. 26. When should the air cylinder of an air pump be oiled?

A. 26. Just before starting the pump; also at intervals when the pump requires it. Valve oil should be used.

Q. 27. How can you oil the air cylinder of an air pump when the piston and rod are in motion?

A. 27. Fill the oil-cup with oil when the piston is moving on the down stroke; open it quickly, then close immediately.

Q. 28. How should an air pump be started?

A. 28. The air pump should be started and run slowly until there is a cushion of air in the air cylinder.

Q. 29. What pressure should the main reservoir gauge hand register before increasing the speed of the pump piston?

A. 29. The main reservoir gauge hand should register 30 to 40 pounds before increasing the speed of the pump piston. If called to get an engine ready on short time, 30 pounds; if you have ample time, 40 pounds. The more cushion of air you have in the air cylinder the easier it is on the steam piston and rod.

Q. 30. At what rate of speed should the pump piston be increased?

A. 30. After there has been 30 or 40 pounds of air accumulated in the main reservoir; the pump piston should be regulated to run at a speed of 120 strokes per minute and not to exceed 140 strokes.

Q. 31. How can you locate a dirty discharge port or a loose discharge valve seat or a stuck discharge valve in the upper end of an air cylinder?

A. 31. By the movement of the piston and rod in the pump.

Q. 32. What kind of a movement would the piston and rod of an air pump have if the upper discharge port were dirty, or the valve seat were loose, or the discharge valve should stick?

A. 32. The piston and rod would show a slow movement on the up stroke.

Q. 33. What would you do to overcome the defects mentioned in Question 32, so you could proceed and have air on your engine and train?

A. 33. First open the oil-cup on the centre piece of the pump. If oil-cup is stopped up screw it out. If that does not give results slacken gland on the centrepiece above the air cylinder.

Q. 34. What would you do to overcome a lower stuck discharge valve in the air cylinder or a dirty port?

A. 34. Take out the plug underneath the air cylinder head.

Q. 35. How can you determine whether the discharge valve is broken?

A. 35. By the movement of the piston and rod. If the valve is broken there will be a fast movement away from the broken valve.

Q. 36. How would you detect a worn-out set of packing rings in the air cylinder?

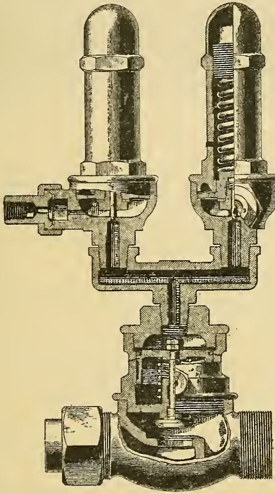
A. 36. If the rings are worn out in the air cylinder the piston will move a considerable distance before any vacuum is created in the air cylinder, and the atmospheric pressure will follow the piston for a short distance, receiving very little free air.

Q. 37. What will cause an air pump to knock?

A. 37. Loose frame on the boiler, loose pump on the frame, loose steam head, loose air piston, loose nut on the rod, too much lift on the valves, dirt or gum on the cylinder heads, worn reversing valve rod or plate, loose set screws in reversing plate.

Q. 38. How will any obstruction in the air strainer affect the action of the pump?

A. 38. It will increase the speed of the pump piston and very little free air will be accepted to the air cylinder.



AIR PUMP GOVERNOR.

Q. 39. What is the air pump governor used for?

A. 39. To control the action of the steam pressure to pump and the air-pressure in the main reservoir.

Q. 40. What pressure of air does the pump governor control?

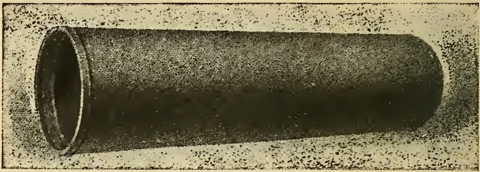
A. 40. Main reservoir pressure.

Q. 41. Where is the pump governor connected to the air pumps?

A. 41. It is located between the steam pipe and steam cylinder of the air pump.

Q. 42. To what is the diaphragm portion of the governor connected?

A. 42. Direct to main reservoir pressure.



MAIN RESERVOIR.

Q. 43. What is the main reservoir used for?

A. 43. It is used to receive the air that the air pump is compressing and to hold it as storage; also to catch all the moisture that is in the air.

Q. 44. Where does the air go when it leaves the pump?

A. 44. To the main reservoir.

Q. 45. To what is the main reservoir piped?

A. 45. To the air pump, air pump governor and brake valve.

Q. 46. When should the main reservoir be drained?

A. 46. Once after each trip in road service or once every 24 hours in switching service.

Q. 47. What effect will water have in the main reservoir in summer.

A. 47. Takes the place of air; also rusts the pipes.

Q. 48. What effect will water have in the main reservoir in the winter time?

A. 48. It is liable to work its way back and freeze up the brake-pipe and triple valves; also takes the place of air.

Q. 49. What pressure of air is carried in the main reservoir?

A. 49. Main reservoir or excess pressure.

Q. 50. Why do we obtain the best results when two main reservoirs are located on a locomotive?

A. 50. One reservoir receives the air direct from the pump and the other one distributes the air to the brake system.

Q. 51. How are the reservoirs connected up to the pump?

A. 51. The use of two main reservoirs are always preferable, and of a long and small diameter, and cooling pipe of about 25 feet between the pump and the first reservoir, and about the same number of feet between the first and second reservoir.

Q. 52. Where is the best location for a main reservoir?

A. 52. At the lowest point possible, in connection with the brake system.

ENGINEER'S BRAKE VALVE.

Q. 53. What is the engineer's equalizing and discharge valve used for?

A. 53. The engineer's equalizing discharge valve is used to control the flow of air from the main reservoir to the brake-pipe in two positions, known as full release and running position, and also to charge the equalizing reservoir in full release position and running position; to apply the brakes either in service or emergency position and to hold the brake on the desired force the operator requires it to do after the brake is applied and brake valve handle is moved to lap position. In full release position the brake-pipe and the equalizing reservoir is charged direct and in running position in an indirect feed through the feed valve attachment to the brake-pipe and equalizing reservoir.

Q. 54. How many positions are there for the engineer's equalizing discharge valve? Name them.

A. 54. Five. No. 1, full release position; No. 2, running position; No. 3, lap position; No. 4, service position; No. 5, emergency position.

Q. 55. What are the different positions used for?

A. 55. Full release is used to charge the brake-pipe and auxiliary reservoirs. Running position is used while pulling the train en route. Lap position is used to hold the brakes on. Service position is used to graduate the brakes on. Emergency position is used to make an emergency stop.

Q. 56. Explain the flow of air through the brake valve with the valve in full release.

A. 56. A direct opening between the main reservoir brake-pipe and equalizing reservoir.

Q. 57. Explain the flow of air through the brake valve with the valve in running position.

A. 57. In running position there is an indirect feed through the rotary valve and seat to the feed valve attachment to the brake-pipe and equalizing reservoir.

Q. 58. What is the lap position used for?

A. 58. To hold the brake on after the brake has been applied, either in service or emergency position.

Q. 59. How many ports are open in the brake valve in lap position?

A. 59. All ports are closed.

Q. 60. Explain the flow of air through the brake valve with the brake valve handle in service position.

A. 60. The first pressure of air is drawn off of the top of the equalizing piston out of Chamber D, and the equalizing reservoir brake-pipe pressure being the greater raises up the equalizing piston and discharges the air from the brake-pipe to the atmosphere through the elbow placed at the brake-pipe exhaust.

Q. 61. Explain the flow of air through the brake valve when the brake valve handle is placed in the emergency position.

A. 61. Direct opening between the brake-pipe and the atmosphere.

Q. 62. When the air enters the brake-pipe below the equalizing piston, why is the piston not moved to its upper position?

A. 62. The same time the air pressure is charging below the equalizing piston it is also charging above the piston.

Q. 63. What volume of air is at all times in the small chamber above the equalizing piston?

A. 63. Chamber D, or equalizing pressure.

Q. 64. What pressure of air is at all times below the equalizing piston?

A. 64. Brake-pipe pressure.

Q. 65. What is the object of having the equalizing reservoir always connected to the small chamber above the equalizing piston?

A. 65. So as to give an increased volume of air to Chamber D and permit the brake valve to operate under a graduated action.

Q. 66. Why is there a blow from the exhaust opening in the back of the brake valve when the valve is placed in full release position?

A. 66. This is known as a warning port and is placed there to notify the engineer that the brake valve is in the wrong position.

Q. 67. What air pressure escapes through the warning port?

A. 67. Main reservoir pressure.

Q. 68. What will happen if the brake valve handle is left in full release position?

A. 68. Brake-pipe will become overcharged above that pressure that the feed valve is set for; therefore, when the valve is placed in running position the brake will apply, providing there is a leak in the brake-pipe.

Q. 69. How long should the brake valve handle be left in full release position?

A. 69. Until the brake-pipe and main reservoir pressure is equalized with the pressure that the feed valve is regulated for.

Q. 70. To what position must the brake valve handle be moved so as to prevent the brake-pipe from becoming overcharged?

A. 70. Running position.

Q. 71. Why will the brake-pipe not become overcharged with the brake valve handle in running position?

A. 71. The feed valve automatically takes care of the brake-pipe at a standard pressure.

Q. 72. What air pressure is always present above the rotary valve?

A. 72. Main reservoir pressure.

Q. 73. What pressure of air is above the equalizing piston and below the rotary valve?

A. 73. Equalizing pressure.

Q. 74. When do you keep the brake valve handle in running position?

A. 74. When the brake-pipe is charged up to the pressure for which the feed valve is regulated.

Q. 75. When do you place the brake valve on lap position?

A. 75. Whenever you make a reduction in Chamber D and the equalizing reservoir and you desire to cease making any further reduction; on lap always remember all ports are closed.

Q. 76. For what is the service position used?

A. 76. To make a graduated reduction in Chamber D and the equalizing pressure. This in return makes a graduated reduction in the brake-pipe pressure and sits the brakes with a graduated application.

Q. 77. In making a service application, from what part of the brake valve is the air pressure first drawn?

A. 77. Off of the top of the equalizing piston out of Chamber D and the equalizing reservoir.

Q. 78. Why does the equalizing piston move to its lower position and close off the discharge from the brake-pipe exhaust?

A. 78. As soon as the brake valve handle is placed to lap position the preliminary exhaust port is closed off, this preventing any more air to escape from Chamber D and the equalizing reservoir; the brake-pipe pressure will keep on discharging air until the pressure in Chamber D is a trifle stronger than the brake-pipe pressure; then the brake-pipe exhaust is closed off by the movement of the equalizing piston to its seat.

Q. 79. When making a five-pound reduction in Chamber D and the equalizing reservoir pressure above the equalizing piston, how much air will escape from the brake-pipe?

A. 79. About five pounds.

Q. 80. Is it possible for the air to escape from the brake-pipe exhaust opening fast enough to apply the brakes in the emergency?

A. 80. No; the exhaust elbow at the brake valve is designed so as to allow the air to escape from the brake-pipe to the atmosphere just as fast as the graduated port in the triple valve will admit air from the auxiliary reservoir to the brake cylinder.

Q. 81. When the brake valve occupies the emergency position does any air escape from the exhaust fitting in the brake valve?

A. 81. No.

Q. 82. If you apply the brakes gradually do you take air from the brake-pipe?

A. 82. No; the engineer controls the equalizing pressure only.

Q. 83. Name the five different pressures of air located on the locomotive.

A. 83. 1. Main reservoir pressure.

2. Brake-pipe pressure.

3. Equalizing pressure.

4. Auxiliary reservoir pressure.

5. Brake-cylinder pressure.

Q. 84. Name the three pressures of air located on the tender.

A. 84. 1. Brake-pipe pressure.

2. Auxiliary reservoir pressure.

3. Brake-cylinder pressure.

Q. 85. In running position, when the pump stops and you have 90 pounds of air in the main reservoir and 70 pounds of air in the brake-pipe and equalizing reservoir, what is the difference between the pressure in the main reservoir brake-pipe and equalizing reservoir called?

A. 85. Excess pressure.

Q. 86. For what is the excess pressure used?

A. 86. To release brakes, recharge the brake-pipe and auxiliary reservoirs.

Q. 87. What will cause the brake-pipe exhaust to operate in the brake valve when you place the brake valve in full release position, with the engine and tender only, after the brake has been applied?

A. 87. The brake-pipe is charged through a large opening in the rotary valve and seat; Chamber D pressure is charged through the preliminary exhaust port and the equalizing port; the brake-pipe, being short, it will charge to a standard pressure quicker than Chamber D pressure; the brake-pipe pressure being the stronger of the two pressures, raises up the equalizing piston from its seat and discharges air from the brake-pipe to the atmosphere, until both the brake-pipe pressure and Chamber D pressure equalizes.

Q. 88. What would you look for if the brake valve were to start and operate water through the preliminary exhaust port?

A. 88. Look for water in the equalizing reservoir.

FEED VALVE.

Q. 89. For what is a feed valve used?

A. 89. To maintain a standard pressure in the brake-pipe and equalizing reservoir when the brake valve handle is in running position.

Q. 90. Where is the feed valve located?

A. 90. On the brake valve between the main reservoir pressure brake-pipe and equalizing reservoir pressure.

Q. 91. How would you regulate a feed valve?

A. 91. Remove cap-nut, turn adjusting nut in to increase brake-pipe pressure and out to reduce it.

Q. 92. Explain how a feed valve operates.

A. 92. When the handle of the brake valve is placed in running position air pressure from the main reservoir enters the slide valve chamber and forces supply valve piston forward, drawing supply valve with it, and compressing the supply valve piston spring, uncovering a port opening leading to the brake-pipe, then to the equalizing reservoir. The resulting increase of pressure in the brake-pipe and in the small chamber over the diaphrgam continues until it becomes sufficient to overcome the tension of the regulating spring, adjusted to 70 pounds. The diaphragm, now above the regulating spring, yields and permits the regulating valve to close, cutting off communication to the rear of the slide valve piston and brake-pipe. This small chamber to the rear of the piston is now being charged through the leakage past the slide valve piston. As soon as the air pressures are equal on both sides of the piston the supply valve piston reacts and forces supply valve piston and slide valve to normal positions, closing off communication between the main reservoir and brake-pipe.

INDEPENDENT BRAKE VALVE.

Q. 93. How is the independent brake valve connected up?

A. 93. Between the main reservoir, double-seated check valve and brake cylinders.

Q. 94. In what position would you place the brake valve handle to apply the brakes?

A. 94. In application position, moving the handle of the brake valve to the right.

Q. 95. How would you release the independent brake?

A. 95. In release position, moving the handle of the brake valve to the left.

Q. 96. Describe how the air passes through the independent brake valve in lap position.

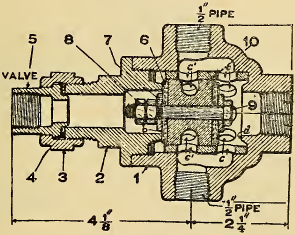
A. 96. In this position the tappet pieces clear both valves and the valves are forced to their seats with the help of a spring and air and all ports are closed.

Q. 97. What position should the independent brake valve handle occupy when using the engineer's equalizing discharge valve?

A. 97. Release, or running position, so as to insure a prompt release of the automatic brake, and so a slight leak from the main reservoir pressure by the valve cannot creep the brake on.

Q. 98. Describe how the independent brake valve operates.

A. 98. When the brake valve handle is moved to the right the tappet piece on the shaft engages the stem of the valve controlling main reservoir pressure that is supplied by the reducing valve. This pressure being beneath the valve, is permitted to enter the brake valve and the pipe leading to the double-seated check valve, forcing the valve over toward the automatic connection and forming an air-tight joint. At this move the air is permitted to pass the check valve to the brake-cylinder pipes, thence to the brake-cylinders. To release the brake the brake valve handle is moved to the left, the tappet piece on the shaft now engages with the exhaust valve, forcing it from its seat, and the air from the brake-cylinder comes back through the brake-cylinder pipes by the check valve through the brake valve by the unseated exhaust valve to the atmosphere, thus releasing the air from the brake-cylinders.



DOUBLE-SEATED CHECK VALVE.

Q. 99. Where is the double-seated check valve located?

A. 99. Between the straight air-brake valve, triple valve and brake-cylinders.

Q. 100. For what is the double-seated check valve used?

A. 100. To control two independent pressures of air.

DOUBLE-HEADED VALVE.

Q. 101. Where is the double headed valve?

A. 101. On the brake-pipe directly underneath of the automatic brake valve.

Q. 102. For what is the double-headed valve used?

A. 102. For double-heading, when two or more engines are coupled together in a train.

AIR GAUGES.

Q. 103. Why do we have air gauges on engines?

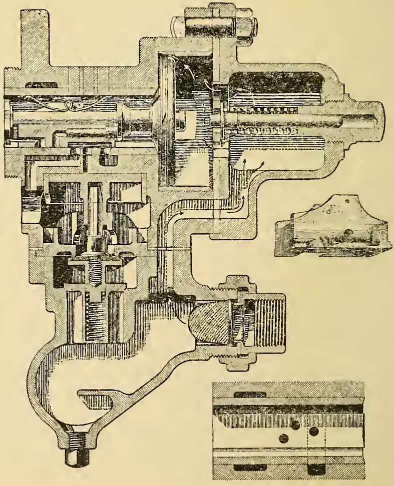
A. 103. To indicate the pressures of air located on the engine.

Q. 104. How are the air gauges connected up?

A. 104. Straight air gauge is connected to the brake-cylinders and the double air gauge to the brake-pipe equalizing pressure and main reservoir pressure.

Q. 105. What pressure does the double air gauge register?

A. 105. The black hand registers brake-pipe pressure and equalizing reservoir pressure; red hand main reservoir pressure.



Q. 106. For what are triple valves used?

A. 106. To charge, apply and release brakes.

Q. 107. How many different style triple valves do we use on this railroad?

A. 107. Two, plain and quick action triple valves.

Q. 108. Explain in a general way why more than one style triple valve is used on this railroad.

A. 108. Plain triple valve in service position graduates the brake on and in the emergency gives a sudden brake, but no increased braking powers. Quick action triple valve gives a graduated brake in service position, and when used in the emergency position gives us an increased braking power in the brake-cylinder, due to brake-pipe pressure entering the brake-cylinder.

Q. 109. Explain how the air passes through the plain triple valve in release position.

A. 109. Air enters the plain triple valve from the crossover-pipe, leading down through a passage into the graduated stem case, through the stem case to ports leading to the piston chamber, moving up the triple piston, uncovering a feed groove on the side of the piston chamber to the feed groove on the piston shoulder, then to the slide valve chamber to the auxiliary reservoir by the means of a pipe. This is a continuation of the slide valve chamber.

Q. 110. How does the air pass through a quick action triple valve in release position?

A. 110. The quick action triple valve is charged in the same way as the plain triple valve in release position; instead of the brake-pipe being attached to the triple valve body it is connected to the check case, and the air passes through the check case to the graduating stem case, then to the piston chamber. While the auxiliary reservoir is being charged a small chamber above the check valve and below the emergency rubber-seated valve is being charged.

Q. 111. Explain how the air passes from the auxiliary reservoir to the brake-cylinder with a plain triple valve in service position.

A. 111. Brake-pipe and auxiliary reservoir pressures are equal, but when there is a reduction in brake-pipe pressure that weakens brake-pipe pressure, the auxiliary reservoir pressure being the greater forces the triple piston down, covering the feed groove on the side of the piston chamber; as the piston moves the graduating valve is carried with it by the help of a graduating pin. This valve is now unseated. The triple piston keeps on moving until the shoulder of the piston stem comes in contact with the slide valve, carrying the slide valve with it. At this movement the exhaust port is closed and the graduating port is now in communication with the brake-cylinder port; the triple piston now has moved as far as the graduating stem and spring will permit it. At this movement the air from the auxiliary reservoir passes by the graduating valve to the brake-cylinder. Just as soon as the auxiliary reservoir pressure is a trifle less than the brake-pipe pressure the triple piston moves up and the graduating valve is closed off, thus cutting off communication between the auxiliary reservoir and the brake-cylinder.

Q. 112. Do both the plain and quick action triple valves work alike in service position?

A. 112. Both the plain and quick action triple valves work alike in service position.

Q. 113. Explain how the air passes from the auxiliary reservoir to the brake-cylinder in the emergency position with a plain triple valve.

A. 113. Brake-pipe pressure is suddenly reduced below auxiliary reservoir pressure. The auxiliary reservoir pressure being the greater of the two pressures, forces the triple piston and slide valve down to its extreme travel, compressing the graduating stem and spring. At this movement there is a direct opening between the auxiliary reservoir and brake-cylinder over the top of the slide valve.

Q. 114. Explain how the air passes from the auxiliary reservoir to the brake-cylinder in the emergency position with a quick action triple valve.

A. 114. A sudden reduction in the brake-pipe pressure causes the auxiliary reservoir pressure to force the triple piston out the full length of the piston chamber; the graduating stem and spring are compressed. This gives the slide valve a communication between the auxiliary reservoir and brake-cylinder. At this movement the slide valve has uncovered a port leading to the top of the emergency piston. The auxiliary reservoir pressure forces the emergency piston down, which comes in contact with the emergency rubber-seated valve. This valve is unseated. The air pressure, now in the small chamber above the check valve, is permitted to enter the brake-cylinder and at the same time the brake-pipe pressure raises the check valve and brake-pipe pressure enters the brake-cylinder. As soon as the pressures of air are equal in the brake-cylinder and auxiliary reservoir and brake-pipe the emergency rubber-seated valve and check valve return to their normal positions.

Q. 115. Do we receive any greater braking power with a plain triple valve, when the brake valve occupies the emergency position, than we do when it is placed in full service position?

A. 115. No. The air passes from the auxiliary reservoir to the brake-cylinder and enters direct in the emergency action, which gives a more sudden brake, but the braking powers are not increased at all.

Q. 116. Do we receive any more braking powers with a quick action triple valve when the triple valve occupies the emergency position?

A. 116. We do. Brake-pipe pressure and auxiliary reservoir pressure enter the brake-cylinder together; plain triple valve auxiliary reservoir pressure enters only.

Q. 117. Why is it necessary for the auxiliary reservoir pressure to enter the brake cylinder first?

A. 117. So as to prevent quick action.

A. 118. What will happen if brake-pipe pressure enters the brake-cylinder first?

A. 118. Quick action will be obtained.

Q. 119. For what is a check valve used?

A. 119. Brake-pipe check valve prevents the brake-cylinder pressure from flowing back into the brake-pipe when the brake-pipe pressure is reduced below brake-cylinder or auxiliary reservoir pressure, or when there is a burst hose; it prevents the air flowing out of the bursted opening. If this valve leaks, brake-cylinder pressure can leak back by the check valve over into the crossover-pipe to the brake-pipe.

Q. 120. For what is the emergency rubber-seated valve used?

A. 120. First, it prevents brake-pipe pressure from entering the brake-cylinder when not desired; second, it permits brake-pipe pressure to enter the brake-cylinder during the emergency action of the triple valve.

AUXILIARY RESERVOIR.

Q. 121. For what is the auxiliary reservoir used?

A. 121. Auxiliary reservoirs are used for a storage of air, used for setting the brake.

Q. 122. How much larger is the auxiliary reservoir than the brake-cylinder?

A. 122. Auxiliary reservoirs are built a fraction three times larger than the brake-cylinders.

BRAKE CYLINDERS.

Q. 123. For what is a brake-cylinder used?

A. 123. The brake-cylinder is used to hold the brake on.

Q. 124. What is the standard piston travel on engines?

A. 124. Engines with four wheels, 4½-inch piston travel. Engines with six wheels, 5-inch piston travel. Engines with eight wheels or more, 5½-inch piston travel. Where a trailing wheel-brake is connected to the driving wheel-brake levers and controlled by the same triple valve and auxiliary reservoir, I always count that as one pair of driving wheels in reference to piston travel on that engine.

Q. 125. What is the standard piston travel on tenders?

A. 125. Tenders, 7 to 9-inch travel.

Q. 126. What is the standard piston travel on cars?

A. 126. Cars, 6 to 8-inch travel.

Q. 127. What care should be taken when setting up a brake on an engine?

A. 127. Be sure and see that there is shoe back clearance enough so as to prevent the binding of wheels on curves.

Q. 128. How much farther does a piston travel when a running test of the brakes is made?

A. 128. That depends on the condition of the brake-rigging journal boxes. Lost motion between the pedestals and boxes. Centre castings. A variation from one to two inches.

Q. 129. What effect will a short piston travel have on a tender or car?

A. 129. Increase the braking powers and liable to do damage to brake equipment.

AUTOMATIC SLACK ADJUSTER.

Q. 130. Why are slack adjusters used on brake equipment?

A. 130. Slack adjusters located on cars and tenders prevent running piston travel of more than eight inches.

Q. 131. Explain how the slack adjuster operates.

A. 131. When there is a sufficient amount of slack in the brake rigging so that the brake piston can travel eight inches the port opening in the brake cylinder is uncovered by the piston leather passing by it. This permits the air to flow through the small quarter-inch pipe leading from the brake-cylinder to the slack adjuster cylinder. At this movement the slack adjuster piston will be moved up compressing the piston spring. The movement of the piston disengages the pawl from the lug and the pawl spring causes the pawl to engage with the teeth on the ratchet nut. When the brake is released and the piston returns to release position the slack adjuster port is now in communication with the none-pressure head and the air from the slack adjuster cylinder passes to the atmosphere. The piston spring in the slack adjuster cylinder reacts, returning to its normal position, carrying with it the slack adjuster piston back, and through this movement the pawl turns the ratchet nut, which draws the screw in the cylinder, which is fastened to a cross head attached to the slack adjuster screw; hence the lever is moved correspondingly. The effect of which is to draw all the brake-shoes closer to the wheels.

Q. 132. On cars fitted with the automatic slack adjuster, what use should be made of the dead levers and other connections where slack can be taken up?

A. 132. The dead levers and other connections should not be touched. All adjustments must be made with the slack adjuster.

Q. 133. What would you do if the piston travel was found to be short on a car fitted with the automatic slack adjuster?

A. 133. Turn the ratchet nut to the left; that will increase the piston travel.

Q. 134. How can the automatic slack adjuster be tested?

A. 134. By running the slack adjuster out until piston travel will exceed eight inches.

Q. 135. How can the slack be left out by the use of a slack adjuster when replacing the brake-shoes?

A. 135. Turn the ratchet nut to the left until the slack adjuster is turned back far enough so as to allow clearance enough to place brake-shoes on.

Q. 136. What care does the slack adjuster require to keep it in good condition?

A. 136. It should be cleaned and oiled every time the brake-cylinder is cleaned.

HIGH SPEED REDUCING VALVES.

Q. 137. What are the duties of a high speed reducing valve?

A. 137. High speed reducing valves are to be used in connection with the brake cylinder so as to reduce the pressure of air admitted to the cylinders when they exceed the pressure of 60 pounds.

Q. 138. How is the variable pressure regulated?

A. 138. Through the action of the triangular port located in the slide valve.

Q. 139. Explain how the reducing valve operates.

A. 139. When the brake is applied and fully set, and the pressure in the brake cylinder is greater than the tension spring is set for, the piston is forced down, carrying with it the slide valve, thus opening the triangular port in the slide valve with the port opening in the slide valve seat, allowing the surplus of air to escape to the atmosphere.

Q. 140. In the emergency application of the brake, how does the high speed reducing valve operate?

A. 140. If the brake-cylinder pressure exceeds that of the tension spring sufficiently great enough the piston is forced down full stroke and cylinder pressure escapes slowly through a small end of the triangular port. As cylinder pressure lessens regulating spring raises piston and slide valve, giving the larger part of the triangular port an opportunity to allow brake-cylinder pressure to release faster until it is reduced to 60 pounds; then the valve is closed off; no more air can escape from the brake-cylinder.

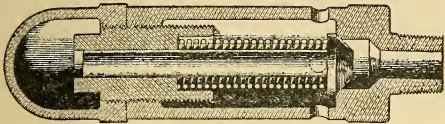
Q. 141. In service application of the brake, how does the high speed reducing valve operate?

A. 141. If the pressure in the brake-cylinder only exceeds the tension spring slightly the large part of the triangular port is in communication with the brake-cylinder and the atmosphere, and the air is reduced suddenly out of the brake-cylinders down to 60 pounds; then the valve is closed.

Q. 142. What care should be given high speed reducing valves?

A. 142. Cleaned and oiled every time the brake-cylinder is cleaned.

SAFETY VALVES.



Q. 143. What benefit are safety valves attached to brake-cylinders?

A. 143. So as to allow all air pressure that enters the brake-cylinder above 53 pounds to escape to the atmosphere.

Q. 144. Where are safety valves located?

A. 144. In direct communication with brake-cylinders.

Q. 145. Describe how a safety valve operates.

A. 145. Safety valves are a valve and stem combined, with the valve facing downward on the valve seat and a tension spring encircled around the stem above the valve. As the air pressure exceeds the tension spring the valve is forced upward and the brake-cylinder pressure escapes to the atmosphere through the port openings located in the valve body, thus permitting the air to escape to the atmosphere.

PRESSURE RETAINING VALVES.

Q. 146. For what purpose are pressure retaining valves used?

A. 146. To retain a pressure of air in the brake-cylinder while the brake-pipe and auxiliary reservoirs are being recharged.

Q. 147. Where are retaining valves connected and where are they usually located?

A. 147. They are connected to the exhaust port of the triple valve and located on the B end of a car.

Q. 148. Describe the construction and operation of the pressure retaining valves.

A. 148. When the pressure retaining valve handle is pointing down in line with the pipe it is out of service, but when pointing on an angle or direct out, then it is in operation. When the triple valve is placed in release position the air from the brake-cylinder must escape to the atmosphere, but when the handle of the retainer is turned up the brake-cylinder pressure passes through the retainer until it strikes the weighted valves. Any pressure above what the retainer is set for passes to the atmosphere through a restricted port. When the pressure in the brake-cylinder is reduced below the pressure the valve retains for the valve returns to its normal position and the air is retained in the brake cylinder.

SIGNAL REDUCING VALVES.

Q. 149. What is the object of the air signal equipment?

A. 149. To transfer signals from the train to the engineer.

Q. 150. What pressure of air should be carried in the train signal pipe?

A. 150. Forty to forty-five pounds.

Q. 151. What kind of a reduction in the train air signal pressure should be made in order to operate the signal valve properly?

A. 151. A sudden reduction of train signal pipe pressure.

Q. 152. Explain the flow of air through the signal reducing valve.

A. 152. The tension spring controls the movement of the piston and check valve. When the tension spring exceeds the air pressure the piston is moved up, unseating the check valve; main reservoir pressure flows through the restricted port to the check valve by the check valve on top of the piston, thence through a port leading to the pipe connecting train signal pipe. When the air pressure exceeds that of the tension spring the piston is moved down and the check valve returns to its seat by the helpmate of a spring and main reservoir pressure. No more air is admitted to the train signal pipe unless the pressure is reduced in the train signal pipe, which will permit the reducing valve to react and recharge the train signal line.

AIR SIGNAL VALVE.

Q. 153. What are the duties of the air signal valve?

A. 153. It is used to convey air to the air signal whistle under an automatic action.

Q. 154. Explain the flow of air through the air signal valve while it is being charged.

A. 154. After the air leaves the reducing valve it is free to pass back in the train signal pipe and signal valve. As it passes into the signal valve from a half-inch pipe it enters the valve and passes through a restricted port in a cavity on top of the diaphragm and down through a port leading to the lower half of the stem which is three-sided, so that the air can pass up to where the round part of the upper half of the stem has a neat fit in the bushing sufficiently tight so as to allow air to feed into the chamber below the diaphragm slowly, so the air pressure can equalize on both sides of the diaphragm and at the same time give ample time to charge the train signal pipe.

Q. 155. Explain how the air signal valve operates when a reduction is made in the train signal pipe.

A. 155. To place the signal valve in action the pressure is reduced in the train signal pipe and above the diaphragm in the signal valve, and the air passes out of the restricted port off of the top of the diaphragm. This permits the pressure to be reduced. The air pressure in the chamber below the diaphragm being the greater, raises up the diaphragm and stem, uncovering the small port opening in the lower end of the signal valve bushing. This permits the air pressure to escape to the small pipe leading to the air whistle, which in return gives a blast. This will occur as often as the air pressure is reduced above the diaphragm.

Q. 156. Explain how the air passes through the whistle valve so it passes to the whistle and causes it to blow.

A. 156. As the diaphragm and stem are raised through an automatic action of the signal valve the round part of the stem is raised a sufficient distance to permit the stem, that is three-sided, to be raised a short distance above the bushing so as to permit the air to pass from the lower part of the signal valve chamber down through the bushing and out of the restricted opening to the pipe leading to the air signal whistle, through the action of the air passing up to the signal whistle bowl.

CAR DISCHARGE VALVES.

Q. 157. For what purpose are car discharge valves?

A. 157. To reduce the pressure of air in the train signal pipe.

Q. 158. Explain how a car discharge valve operates.

A. 158. A signal cord is attached to the stem of the valve. When the cord is pulled the small valve is forced from its seat, allowing the air in the train signal pipe to escape to the atmosphere as soon as the cord is free again. The pressure in the train signal pipe along with the helpmate of a spring automatically closes the valve.

GENERAL INSTRUCTION TO LOCOMOTIVE ENGINEERS.

Q. 159. When you receive an engine at the engine house what attention should you give to the brake equipment on engine and tender?

A. 159. To see that the brake equipment on the engine and tender are in first-class condition before proceeding.

Q. 160. What is the meaning of brake equipment?

A. 160. Everything that is used in connection with an air-brake on the engine and tender.

Q. 161. What should you do before moving the engine?

A. 161. Make an application of the brake; note the condition of piston travel on engine and tender; also condition of brake.

Q. 162. While moving the engine from the engine house to the train?

A. 162. Apply the brakes and note their holding powers before attaching engine to train.

Q. 163. After the engine has been coupled to the train?

A. 163. Place the brake valve handle in full release position; see that the standard brake-pipe and auxiliary reservoir pressures are obtained before testing brakes.

Q. 164. After the brakes have been tested and you have been informed as to the number of cars in the train?

A. 164. Yes, by the brake-pipe pressure leaving the exhaust elbow attached to the brake valve; longer the train, longer the blow.

Q. 165. Why should you make a running test?

A. 165. To be sure that all brakes are in working condition attached to the train.

Q. 166. After you have made a running test, can you tell how many cars are in air-brake service?

A. 166. Yes; the manner in which the brakes hold and check the speed of the train.

Q. 167. What should you do if you notice that the brake-pipe exhaust does not represent the number of cars you have been informed are in air-brake service?

A. 167. Call for brakes and stop immediately.

Q. 168. Why are you required to make a running test two miles previous to a junction or meeting point?

A. 168. To be sure that all valves will respond to the call of the brake valve.

Q. 169. If you find the brakes do not respond to the action of the brake valve, what should you do?

A. 169. Call for brakes and stop immediately.

Q. 170. What air pressure is carried on the standard brake?

A. 170. 70 pounds brake-pipe pressure; 90 pounds main reservoir pressure.

Q. 171. What air pressure is carried on the high speed brake?

A. 171. 110 pounds brake-pipe pressure; 130 pounds main reservoir pressure.

Q. 172. What air pressure is carried on the standard brake and the high main reservoir pressure control?

A. 172. 70 pounds brake-pipe pressure; 90 pounds main reservoir pressure; 110 pounds main reservoir pressure on high main reservoir pressure control governor.

Q. 173. What pressures of air are carried in the main reservoir of a high speed brake where the duplex governor is in service?

A. 173. 130 main reservoir pressure on the standard governor; 140 main reservoir pressure on the high main reservoir pressure control governor.

Q. 174. When making a test of the brakes at the terminal point, with the standard pressure of air, what reduction should be made in the brake-pipe pressure?

A. 174. 25 pounds brake-pipe reduction.

Q. 175. What reduction should be made in the brake-pipe pressure where there is 110 pounds in the brake-pipe?

A. 175. 30 pounds brake-pipe reduction.

Q. 176. Why is it necessary to make a heavier reduction in the brake-pipe of high speed brakes than when using the standard pressure?

A. 176. So as to give the car inspector an opportunity to see that all high speed reducing valves and pop valves are in good working condition.

Q. 177. What reduction should be made in the brake-pipe pressure to make a stop when the brake-pipe pressure is 110 pounds?

A. 177. With a local train the same as with a standard brake-pipe pressure.

Q. 178. What reduction should be made in the brake-pipe pressure to make a stop when the brake-pipe pressure is 110 pounds on a high speed train?

A. 178. Make a seven-pound brake-pipe reduction; then follow up with 10 or 15 pounds increased reduction. After the train is slowed down to a speed of 10 miles per hour release the train brakes and immediately reapply the brakes with a light reduction of brake-pipe pressure, 7 to 10 pounds, sufficient to stop the train.

Q. 179. When would you set, also release, the brakes in order to steady a train on a curve?

A. 179. Just before entering the curve on a straight line; release on the curve if necessary.

Q. 180. What reduction should be made in the brake-pipe pressure when applying brakes on a curve, and why?

A. 180. Ten pounds, so as to be sure all brakes and slack adjusters will operate.

Q. 181. What pressure is required to operate the slack adjuster piston?

A. 181. Twenty-three pounds will place the slack adjuster piston into full operation.

Q. 182. When should you sand the rail?

A. 182. Just before applying the brakes to make a stop if necessary; ordinarily sand is destructive.

Q. 183. In stopping a passenger train, when should you release the brakes?

A. 183. Just before the train comes to a full stop.

Q. 184. In stopping a freight train, when should you release the brakes?

A. 184. When the train comes to a full stop.

Q. 185. Should you reverse the engine with the driver-brake set?

A. 185. No. This is detrimental to the running gear and the wheels are liable to go skidding.

Q. 186. What reduction would you make in the brake-pipe pressure provided your train consisted of the following number of cars—10 cars, 20 cars, 30 cars, 40 cars, 50 cars, 100 cars?

A. 186. Brake-pipe reductions.

5 to 7 pounds reduction in brake-pipe for 10 cars.

7 to 8 pounds reduction in brake-pipe for 20 cars.

8 to 10 pounds reduction in brake-pipe for 30 cars.

10 to 12 pounds reduction in brake-pipe for 40 cars.

12 to 15 pounds reduction in brake-pipe for 50 cars.

Over 50 cars, not less than a 15-pound brake-pipe reduction on the first reduction to apply brake; over 75 cars, 20 pounds reduction in brake-pipe; 80 to 100 cars, place the brake valve in service position. Leave it remain there until the train comes to a full stop.

Q. 187. If you should make a brake-pipe reduction on account of a signal being set at "stop," and the latter should be changed to clear, when should the brake valve handle be moved to release position?

A. 187. If the reduction in brake-pipe pressure is started on account of signal being set at "stop," and suddenly moved to clear, brake valve handle should not be moved to release position until air has ceased to discharge from the brake-pipe exhaust at the brake valve. Do not release while the brakes are applying.

Q. 188. Explain how you would stop a passenger train at a water station.

A. 188. The first application should be made to decrease the speed of the train. Just before stopping, say, three- or four-car lengths short of water station, the brakes should be released; the brake valve handle moved to lap position; the brake then applied lightly, just sufficiently hard enough to make the stop.

Q. 189. Explain how you would stop a freight train of 20 cars at a water station.

A. 189. Stop short of the water station, then pull the train up slowly and make the water station stop with a light brake-pipe reduction.

Q. 190. What would you do if you have more than 20 cars attached to your engine when making a water station stop?

A. 190. Stop short of the water station, detach the engine from the train and proceed to the water station with the light engine.

Q. 191. When would you make an emergency applibcation of the brakes?

A. 191. Only in case of emergency; first, to save life; second, company's property.

Q. 192. When would you release the brakes on a passenger train after making an emergency application?

A. 192. Not until the danger point is passed or the train has stopped. Sand should also be applied to the rail.

Q. 193. When would you release the brakes on a freight train after making an emergency application?

A. 193. Not until the train has come to a full stop. Sand should be used if necessary.

Q. 194. Should the straight air-brake be used to take the slack up on a train?

A. 194. No.

Q. 195. What air pressure should the safety valve be set for?

A. 195. Safety valves should be set to close at 53 pounds.

Q. 196. Do you understand why the straight air-brake should not be used to control the movement of a long freight train?

A. 196. Yes. It is liable to do damage to draw-bars; also the laden of freight.

Q. 197. When are you permitted to use the straight air-brake on a long freight train?

A. 197. After the automatic brake is applied and you are going to release the brakes, then it is proper to apply the straight air-brake to hold the engine and tender back against the train, while the train brakes are releasing.

Q. 198. Why is it necessary to alternate the automatic and straight air-brakes?

A. 198. So as to prevent the overheating of tires.

Q. 199. Why is it necessary to see that the straight air-brake has the exact pressure the feed valve is set for?

A. 199. So as to prevent a high braking power, as the straight air-brake applied to an engine and tender is almost as powerful as the automatic brake.

Q. 200. Why should the safety valve not reduce the brake-cylinder pressure below 53 pounds?

A. 200. It serves to destroy the action of the automatic brake when full set.

Q. 201. Why should the automatic brake never be used in connection with the straight air-brake?

A. 201. Automatic brake must not be applied while the straight air-brake is applied, as it increases the brake-cylinder pressure both on engine and tender.

Q. 202. Can the straight air-brake be applied before the automatic brake has been released?

A. 202. No, as the automatic brake-cylinder pressure equalizes at 50 pounds and the straight air-brake pressure is adjusted for 45 pounds, the straight air-brake pressure cannot move the double-seated check valve back with a retarded pressure of 50 pounds in the brake-cylinder.

Q. 203. If you want the straight air-brake valve to hold the brakes on engine and tender, when coming to a stop, what position should the valve handle occupy?

A. 203. Application position at all times, so as to be sure the brake will remain applied.

Q. 204. Where is the bleed-cock located on a long road engine?

A. 204. The bleed cock on a long road engine should be connected between the triple valve and the double-seated check valve and used to release the automatic brake only.

Q. 205. Where is the bleed cock located on a switching engine?

A. 205. It is connected direct to the brake-cylinder, so it can be used to release a straight or an automatic air-brake on engine and tender.

Q. 206. When do you make use of the bleed cock?

A. 206. On a long road engine it is termed a mountain cock, and is to be left open when used on grades so the engineer can alternate the straight and automatic brake on engine and tender. On swtiching engines it is used to release both the automatic and straight air-brake when so desired.

Q. 207. What other benefit is the bleed cock on a long road engine?

A. 207. In cases where an air-hose should burst and the brake on the engine should go skidding, the bleed cock can be opened and the straight air-brake be applied when you so desire.

Q. 208. On what class of engines is the bleed cock not in use?

A. 208. On any class of engines where the latest design of straight air-brake valve is in service. This valve has a connection between the triple valve and double-seated check valve with a pipe leading over to the straight air valve, where it is connected to a double-seated valve direct underneath of the straight air-brake valve, and when you so desire to release the automatic brake all that is necessary is to place the straight air-brake valve handle in full release position. This in return will permit the air in the brake-cylinder to pass by the check valve at the brake valve and exhaust valve to the atmosphere.

WHAT WOULD YOU DO

Q. 209. If the brake-pipe broke off on the front of the engine?

A. 209. Drive in a wooden plug and proceed in that manner.

Q. 210. What would you do if the brake-pipe broke off under the pilot of the engine and you could not (quickly) repair it?

A. 210. Disconnect the first joint ahead of the drain cup, put in a blank washer and proceed in that manner.

Q. 211. If the brake-pipe should break off at rear of a passenger engine?

A. 211. Drive in a wooden plug in the pipe where it is broken. Go to the front of the engine, couple the brake-hose and whistle-hose together; after that is done go to the rear end of the engine, couple the air whistle hose on the engine to the air-brake hose on the tender. After they are coupled properly, cut out the air signal reducing valve in cab, test brakes and proceed. This rule applies to an engine equipped with a train air signal. With this break down the air whistle is out of service.

Q. 212. If the brake-pipe should break off the tender of a locomotive when it is equipped with the train air signal?

A. 212. Couple air-brake hose on the rear of engine to the air-whistle hose on front of the tender. After they are coupled properly, couple the air-whistle hose on the rear of tender to the air-brake hose on car. After they are coupled properly, cut out the air signal reducing valve in cab, test brakes and proceed.

Q. 213. If the pipe should break off between the triple valve and brake-cylinder or between the triple valve and auxiliary reservoir?

A. 213. Close the cutout cock on the crossover pipe and proceed. This rule applies either to engine or tender.

Q. 214. If the pipe should break off leading from the brake-pipe to the triple valve?

A. 214. If broken between the drain cup and the cut-out cock, drive in a wooden plug; if broken between the cut-out cock and the triple valve, close the cut-out cock, release all of the air out of the auxiliary reservoir and proceed in that manner. This rule applies either to engine or tender.

Q. 215. What would you do if you broke the triple valve and auxiliary reservoir loose from the engine or tender?

A. 215. Close the cutout cock and proceed.

Q. 216. What would you do if you have a triple piston broke on engine or tender and you desired to return home with the engine and tender light, and you have a G 6 A valve?

A. 216. Remove the broken triple piston, plug the exhaust port; also remove the triple piston on the triple valve that is not disabled, plug that exhaust port, place brake valve on lap position and proceed to apply the brake. Place the brake valve either in running or release position to release the brake, place the brake valve in service or emergency position. A good motto is to blank the equalizing drum, as the equalizing piston will raise quickly when placed in service position to relense the brake. This can be operated either with a plain or quick action triple.

Q. 217. What would you do if you had charge of a locomotive and it had four driver brake cylinders attached, two triple valves, two auxiliary reservoirs, and you desired to cut out one triple valve?

A. 217. Where two driver brake cylinder are used to operate the brake on two independent pair of driving wheels, and you desire to cut one triple valve out of service, it is always proper to close the cutout cock on the brake-cylinder pipe leading from the triple valve to the brake-cylinder, so if you are using the straight air-brake valve to operate all four brake cylinders and one of the double-seated check valves started to leak it would not force the slide valve attached to the triple piston from its seat that was out of service just as soon as all of the air had been bled out of the auxiliary reservoir. That reduces all the air pressure away from the triple valve. Therefore the piston triple, through the jar of the locomotive, will drop down until the triple piston strikes the graduating stem. This blanks off the exhaust port of the slide valve and any air pressure striking the slide valve to the opposite side will force it from its seat and give a constant blow at the triple valve that is out of service.

It is well to remember that the braking powers on a locomotive remain the same at all times. While the braking powers on the tender variate for every mile the tender is drawn over the road, the braking powers are brought closer to its full power of percent of the light weight of the tender. The reason of this is that for every gallon of water taken out of the tender, its weight is 8 1-3 pounds, and every cubic foot of coal weighs 52 to 54 pounds. This permits the tender to retain closer to its light weight. While the water that leaves the tender is being placed in the boiler and every cubic foot of coal that leaves the tender enters the fire-box, as it is understood that most enginemen work their locomotive with three gauges of water registered in their water bottle, this permits the brake on the engine to retain the same at all times, while the decreasing weight of the tender retains the brake power closer to its normal powers of the light weight of tender.

Q. 218. What would you do if you were double-heading and you had two locomotives with no whistle line or straight air-brake and the air pump gave out on one engine and the brake valve became disabled on the other? (For an illustration use the engines Nos. 267 and 284.)

A. 218. Engine No. 267, air pump disabled; engine No. 284, brake valve disabled. Remove the brake valve off of No. 267 and place it on engine No. 284, close the cutout cock on the brake-pipe of engine No. 267. Proceed, leaving engine No. 284 to take care of the train.

Q. 219. What would you do if you broke the pipe off leading from the main reservoir to the brake valve which represents main reservoir pressure?

A. 219. If using the G 6 A brake valve and the air sander connection is located on the pipe leading from the main reservoir up to the brake valve, screw the connection off at the tee, leaving the ¼-inch nipple remain in the tee. Then disconnect the gauge pipe at the air gauge representing main reservoir pressure, screw the connection off at the air gauge and connect onto the ¼-inch nipple; then attach the gauge pipe to the connection, plug the brake valve, also the broken pipe. After you have the pressure of air accumulated test the brakes. When releasing the train brake wait until the train comes to a full stop.

Where it is possible, it is always advisable to have a pipe tapped in the main reservoir three-quarters of an inch in diameter and have it connected to the whistle pipe with a ¾-inch cutout cock, and then when there is a disabled pump or brake valve all that is necessary is to close the cutout-cock at the reducing valve and open the ¾-inch stopcock. This will always give a supply of air from one locomotive to the other, doing away with the air whistle only.

What would you do if the equalizing pipe was to break off at the main reservoir and you had to have the engine in a hurry, and you did not have ample time to make a new 1¼-inch pipe? Place in blank washer at the union of the 1¼-inch pipe and make a connection at the drain plugs with a ½-inch pipe. This will assist when the engine must proceed in a hurry.

EXAMINATION QUESTIONS.

CONDUCTORS AND TRAINMEN.

When placing cars on a side track and you are to leave them stand there always drain the air out of the auxiliary reservoirs and secure them with hand-brakes; always place the hand-brakes on the cars on the end that leads towards the grade.

On September 11th, 1919, a crew backs a train of seven or eight cars in a siding a little up-grade. The brakeman riding on the rear end secured the cars with hand-brakes and paid no attention to the opposite end of the train. During the night cars were backed in at the other end of the side track. When they came in contact with those cars the heavy jar uncoupled four cars at the opposite end. These cars ran back, doing damage to the four cars; also an interlocking plant. This was directly up to the men in charge of the train that placed the cars on the side track.

Q. 1. Do you understand what an air-brake is?

A. 1. A brake operated by compressed air.

Q. 2. What kind of an air-brake is used on this railroad?

A. 2. The Westinghouse quick action automatic air-brake.

Q. 3. What is the meaning of automatic?

A. 3. Anything that is self-acting.

Q. 4. Where does a conductor's duty and also a brakeman's duty start in reference to an air-brake on a train, and where do they stop?

A. 4. They start at the angle-cock behind the tender and stop at the angle-cock on the rear of train.

Q. 5. What are their duties in reference to an air-brake on a train?

A. 5. First to see that the air-hose are all properly coupled, see that there is no leaks in the hose couplings, and when the brakes are applied to see that the pistons all travel out of the cylinders their proper distance, and when the brakes are released to see that all brakes are released and pistons have returned in the cylinders proper.

Q. 6. Where should they start to get a train ready?

A. 6. At the rear end.

Q. 7. Why do we always start at the rear end?

A. 7. So as to be sure the rear angle-cock is closed.

Q. 8. What would happen if the angle-cock on the rear of train was left open?

A. 8. It would mean the loss of air and also the loss of time.

Q. 9. What should be done before coupling the air-hose on the tender to the air-hose on the car?

A. 9. Blow out the brake-pipe on the engine and tender, so as to be sure it is free from dirt and water.

Q. 10. After the air-hose is properly coupled, which angle-cock should be opened first?

A. 10. Always open the angle-cock on the tender first and then the angle-cock on the car.

Q. 11. How should the air be turned in from the tender to the train?

A. 11. By opening the angle-cock slowly on the car.

Q. 12. Why should the angle-cock be opened on the tender first?

A. 12. So as to fill up the vacant space of hose with air. This will also tell you if the hose couplings are leaking.

Q. 13. After coupling the hose and turning the angle-cocks, are we ready to test the brakes?

A. 13. No; not until the air pump has the train charged up to the standard pressure.

Q. 14. Who should tell when it is time to test the brakes?

A. 14. The engineer.

Q. 15. Why should the engineer be the one to tell when it is time to test the brakes?

A. 15. The air-gauge being located in the cab of the engine indicates the pressure of air located in the brake-pipe and auxiliary reservoirs.

Q. 16. What should be done after the brakes are applied?

A. 16. The train crew should look over the train for piston travel; also to see there is no leaks.

Q. 17. What should be done after the engineer is signaled to release brakes?

A. 17. See that all brakes are released and pistons returned in the cylinders.

Q. 18. What piston travel should be looked for under a car?

A. 18. Piston travel 6 to 8 inches.

Q. 19. In testing a train of brakes, if the brake does not apply on the train what does that denote?

A. 19. An angle-cock not open, a plugged-up brake-pipe, a defective hose or coupling, or hose crossed the air-hose coupled to the whistle hose.

Q. 20. Does this very often happen?

A. 20. Quite frequently by newly-employed men on the railroad, who have not had the opportunity to enter the air-brake instruction car.

Q. 21. If a train should leave the departing point in that condition, who should be held responsible?

A. 21. The full crew—engineer, conductor and trainmen.

Q. 22. In testing a train of brakes, is it proper to have a brakeman open an angle-cock from the rear end, or a conductor to open a conductor's valve to test the brakes?

A. 22. This is decidedly very poor practice and must never be put into effect by the train crews.

Q. 23. Is it proper to open the bleed valve at the auxiliary reservoir to see if it is charged up so as to be ready to test brakes-

A. 23. No; all tests must be made by the engineer from the engine, so as to be sure all brakes will respond to the call of the engineer's brake valve located in the cab.

Q. 24. After the brakes have been tested in the proper way, is it the brakeman's duty to see that there is air located at the rear angle-cock?

A. 24. It is always proper to open the angle-cock slightly so as to be sure air has passed through the brake-pipe to the angle-cock in case of necessity.

Q. 25. When inspecting a train of brakes, if we were to find a brake that would not apply with the rest of the brakes, what should be done?

A. 25. First see that the car-brake is properly cut in. If that is O. K., try the bleed valve to see that the air is entering the auxiliary reservoir through the triple valve. If you find air in the auxiliary reservoir that proves it was not charged up as quickly as the other auxiliary reservoirs in the train, signal the engineer for another brake-pipe reduction.

Q. 26. What other defect may have been the cause why the brake did not apply, with a reduction in brake-pipe pressure, when the brake valve was placed into action?

A. 26. A sticky slide valve, a dirty feed grove in the triple valve bushing, a slight leak in the brake-cylinder.

Q. 27. What are the principal defects that put a quick action triple valve into the emergency action when making a gradual brake-pipe reduction?

A. 27. A bad leak in the brake-pipe, a broken graduating spring or a weak spring, broken graduating pin, a sticky slide valve or piston, a bad leak in the check-case gasket, a bad leak at the check-case union, emergency rubber-seated valve leaking.

Q. 28. What is the triple valve used for?

A. 28. To charge the auxiliary reservoir; second, to apply the brake; third, to release brake.

Q. 29. What position is located in the triple valve that is not spoken of?

A. 29. Lap position.

Q. 30. How many pounds of pressure of air is carried in the brake-pipe and auxiliary reservoirs of a high-speed brake in service with a passenger train?

A. 30. 110 pounds brake-pipe and auxiliary reservoir pressure.

Q. 31. What pressure is carried in the brake-pipe and auxiliary reservoirs of a freight train?

A. 31. The standard pressure, 70 pounds, in the brake-pipe and auxiliary reservoirs.

Q. 32. What is the auxiliary reservoir used for?

A. 32. Auxiliary reservoir is used as a storage of air and used to set the brake.

Q. 33. What pressure of air is wasted to set the brake?

A. 33. Brake pipe pressure.

Q. 34. What is the brake-cylinder pressure used for?

A. 34. To hold the brake on after the graduating valve has gone to lap position.

Q. 35. When the air leaves the auxiliary reservoir where does it go to?

A. 35. Passes the graduating valve and slide valve and enters the brake-cylinder.

Q. 36. When the air leaves the brake-cylinder where does it go to?

A. 36. Air passes from the brake-cylinder out through the triple valve exhausts, to the atmosphere.

Q. 37. If all the air leaves the brake-cylinder out through the triple valve exhaust port and the brake-cylinder piston does not return to the cylinder what would you look for?

A. 37. A hand-brake on, a brake-rod or lever caught on a bolt. A dirty brake-cylinder or a release spring broken.

Q. 38. Will a broken release spring hold the brake applied?

A. 38. No. Just as soon as the wheels start to revolve the shoes will jar away from the wheels.

Q. 39. How is the service application of the brake obtained, also the emergency action?

A. 39. Service application is obtained by a gradual reduction in the brake-pipe pressure, and the emergency action is obtained by a quick, sudden reduction in the brake-pipe pressure.

Q. 40. How many different ways can the automatic brake be applied from the train?

A. 40. Five ways. Opening the conductor's valve, the angle-cock, the parting of an air-hose, a bursted hose or broken brake-pipe.

Q. 41. How should the bleed valve be operated on an auxiliary reservoir when you desire to release a brake?

A. 41. Held open until the triple valve exhaust starts to exhaust air.

Q. 42. If you had a brake in a train that would not respond to the first call of the brake valve what would that indicate?

A. 42. A defective brake; one that usually gives us undesired quick action and known as a kicker among railroad men.

Q. 43. How would you locate that brake?

A. 43. In passenger service take three cars at a time; in freight service ten cars. If there are two brakemen to look after the defective brake five cars. If there is only one brakeman, take a position in the centre of the number of cars you have, give the engineer signal to apply brakes, notice the brake that does not move on the first reduction of brake-pipe pressure. That will be the brake giving you undesired quick action.

Q. 44. What will you do with the defective brake?

A. 44. If you have a sufficient amount of cars attached in your train so you can cut that brake out of service without getting below your per cent., cut that brake out, card it and proceed.

Q. 45. What would you do if your cars in the train did not allow you to cut that brake out of service?

A. 45. Very often the defect can be remedied by the engineer using the emergency brake three or four times and cutting the gum loose from the slide valve. If impossible to remedy it notify the officer in charge and have same repaired on arrival at destination.

Q. 46. What is the pipe called that extends the full length of the car?

A. 46. The brake-pipe or train-pipe.

Q. 47. What cocks are found on this pipe?

A. 47. Angle cocks with loose hose and couplings.

Q. 48. How does the handle of the angle-cock stand when open and closed?

A. 48. In line with the pipe when open and at right angles when closed.

Q. 49. If the handle comes loose from the plug, how would you tell if the cock was open or closed?

A. 49. By the groove in the top of the plug.

Q. 50. What does this groove indicate?

A. 50. A port way groove and is in line with the port opening in the angle-cock plug.

Q. 51. How many branch pipes lead away from the brake-pipe on passenger cars?

A. 51. Two; one leads to the triple valve and the other one to the conductor's valve.

Q. 52. Is there a cutout cock located on the branch pipe leading to the triple valve?

A. 52. Yes. It is at right angles of the pipe when open and in line with the pipe when closed.

Q. 53. What benefit is this cock located on the crossover pipe leading to the triple valve?

A. 53. So as to cut out the brake in case of a defect to the triple valve, auxiliary reservoir, brake-cylinder or brake-rigging if necessary.

Q. 54. In what position should the handle be placed to cut out a brake?

A. 54. In line with the pipe.

Q. 55. Do you find a cock located on the pipe leading to the conductor's valve?

A. 55. No. There must be no cutout cock located on this pipe at any time.

Q. 56. Do you find more than one conductor's valve on a pullman or private car?

A. 56. Yes; two; one is located at each end of the car.

Q. 57. How many working parts are found in a quick action triple valve?

A. 57. Triple piston and ring, slide valve, graduating valve, graduating pin, graduating stem, graduating spring, emergency piston, emergency rubber, seated valve, check valve and check valve spring.

Q. 58. Name the different operating positions of the quick action triple valve.

A. 58. Release position, lap, service and emergency positions.

Q. 59. What are the duties of the triple piston?

A. 59. To open and close the feed groove on the side of the piston chamber and to operate the slide valve and graduating valve.

Q. 60. What are the duties of a slide valve?

A. 60. To open and close the exhaust port, also to form a communication between the auxiliary reservoir and brake-cylinder.

Q. 61. What are the duties of the graduating valve?

A. 61. To measure the flow of air from the auxiliary reservoir to the brake-cylinder.

Q. 62. What are the duties of the emergency piston?

A. 62. To operate the emergency rubber seated valve.

Q. 63. What are the duties of the emergency rubber seated valve?

A. 63. To prevent brake-pipe pressure from entering the brake cylinder when not desired and to permit brake-pipe pressure to enter the brake-cylinder when desired.

Q. 64. What is the duty of the check valve?

A. 64. To retain the air in the brake-cylinder in case of a bursted hose, or retain the brake-cylinder pressure after brake-pipe pressure is below equalization.

Q. 65. What is the check valve spring used for?

A. 65. To hold the emregency rubber seated valve and check valve to their seats when not in service.

Q. 66. What are the operating parts of a brake-cylinder.

A. 66. The piston and its parts and release spring.

Q. 67. What is the leakage groove used for in the brake-cylinder?

A. 67. To prevent the brake from going on where there is a slight leak through the triple valve to the brake-cylinder or when there is a slight leak in the brake-pipe pressure so as to make a light reduction in the brake-pipe side of the triple piston.

Q. 68. What effect will a short piston travel have on a car?

A. 68. A short piston travel on a car attached in a train is liable to do damage to drawheads through the increased braking powers.

Q. 69. What effect will a long piston travel have on a car?

A. 69. Decreases the braking powers on the car it is attached to and will not permit the car to having the proper braking powers.

Q. 70. If you had a blowout of the exhaust port of a triple valve or retaining valve how would you overcome it?

A. 70. First tap the check case, second cut out the brake, bleed all of the air out of the auxiliary reservoir, then cut the triple valve in quickly. If these two remedies do not stop the blow, shut the angle cocks on both ends of the car, part the hose and drain all of the air out of the brake-pipe, and below the check valve re-couple hose open angle cocks. If this does not stop the blow then cut out the brake, bleed all of the air out of the auxiliary reservoir and proceed.

Q. 71. What would you do if you did not have cars enough attached in your train to give you 85 per cent. of air?

A. 71. Notify the superintendent and receive an order what to do.

Q. 72. What would you do if you broke the brake rigging off of both trucks while enroute in freight service?

A. 72. Remove the broken parts and let the triple valve operate. Do not cut the triple valve out.

Q. 73. What would you do if you broke the brake rigging on one truck and you did not want to operate the brake on one truck.

A. 73. Disconnect the push rod, take it out of the sleeve, place it on the car and proceed, leaving the triple valve cut in. Always permit a triple valve to operate when possible.

Q. 74. What would you do if the brake rigging became disabled on a passenger coach?

A. 74. Disconnect the piston from the lever, remove the lever, place it in the car, take and disconnect the nut at the high speed reducing valve. This will overcome the high pressure in the brake-cylinder.

Q. 75. What would you do if you could not take out the lever connected to the pushrod?

A. 75. Take the one-half-inch plug out of the cylinder head or remove the pipe from the high-speed reducing valve. Always allow a triple valve to remain in action wherever it is possible.

Q. 76. If this defect was to occur to the brake rigging under the first car behind the tender and you had an engine with a plain triple valve attached to the tender what benefit is derived from permitting the triple valve to remain in action?

A. 76. This will guarantee a quick action brake when so desired.

Q. 77. When would you cut out a triple valve?

A. 77. When it becomes disabled. Never cut it out for a defective brake rigging.

Q. 78. Is it advisable to cut out two passenger car brakes together in a train?

A. 78. No.

Q. 79. Would it be advisable if you found more than one brake stuck in a train to release the brake by the use of a bleed valve?

A. 79. No. First ascertain the cause from the engineer and find out if the air pump has stopped, or see if he has the engineer's brake valve on lap, or if the feed valve is disabled.

Q. 80. If you had a defective triple valve by having the exhaust port blowing, or there was a defect in the triple valve and you remedied it, would it be advisable to start the train before calling in the flag?

A. 80. First give the engineer a signal to start the train; as soon as the train is moving give him a signal to stop, then have him call in the flagman so as to be sure you can start the train, especially if you are in a dangerous locality.

Q. 81. What would you do in case you found your brake rigging geared up too tight on a passenegr car while enroute?

A. 81. Run the slack out with the slack adjuster by turning the ratchet handle to the left.

Q. 82. What would you do in case you found your brake rigging geared up too tight on a freight car while enroute?

A. 82. Leave the slack out by dropping the dead lever down a hole or two, if it cannot be done with the dead levers leave it out on the spreader rods.

Q. 83. What would you do in case you could not remove the pins due to the car being unloaded and the shoes came closer to the centre of the wheels as the car body raised up?

A. 83. Have the engineer to make an emergency application of the brake. In many cases that will loosen the brake when he releases.

Q. 84. If you had a car with the brake connected up with two independent triple valves, two auxiliary reservoirs, two brake cylinders, two crossover pipes, two cutout cocks, how would you tell which brake to cut out if necessary?

A. 84. Always cut out the brake with the piston working out of the cylinder towards the defective brake.

Q. 85. How would you count the per cent. of air on that car?

A. 85. Just one-half of the per cent. of the braking powers on the whole car, as the cylinders are connected up to the brake rigging so one brake cylinder piston works the brake on one truck and the other one the opposite truck.

Q. 86. In picking up cars at a place while enroute how would you couple them up to a train so as to prevent putting the brake into quick action on the cars that are already charged with air?

A. 86. Always leave the angle-cock closed on the car you are going to couple up to, then after the couplings are made open the angle-cock on the car towards the engine, then the opposite angle-cock slowly. This will prevent a sudden brake or undesired quick action.

Q. 87. How would you open the stop-cocks in reference to the air whistle after the hose couplings are united?

A. 87. Open the stop-cocks on the whistle pipe opposite to the angle-cocks, first on the car then the tender. This will only give one long blast of the whistle.

Q. 88. Do you understand what a centrifugal dirt collector is?

A. 88. A device to collect all foreign matter that works its way through the brake-pipe and crossover pipe before entering the triple valve.

Q. 89. Where is the centrifugal dirt collector located?

A. 89. On the crossover pipe between the cutout cock and the triple valve.

Q. 90. What will be the cause if the auxiliary reservoir will not charge up?

A. 90. A dirty screen in the drain cup, the check case screen dirty, the feed groove in the triple valve dirty or the bleed valve leaking.

Q. 91. If the train parts at any point while enroute what should be done?

A. 91. The angle-cock at the rear portion of the first section closed and the engineer signaled to release brakes. Give a signal to back up and re-couple. After coupling correct couple the air-hose, have the engineer release the brakes, so as to be sure all brakes respond to the call of the brake-valve.

Q. 92. What would you do if the train should part enroute in passenger service?

A. 92. After the train is in motion making a running test so as to be sure all brakes in the train will respond to the call of the brake valve.

Q. 93. What is the difference between cutting out a car and cutting out a brake?

A. 93. To cut out a brake close the cutout cock on the crossover pipe; to cut out a car close the angle-cock on the brake-pipe.

Q. 94. What would you do if you had a defective brake-pipe and the car had to be placed at the rear of the train?

A. 94. After coupling up the defective car to the rear of the train and the hose are coupled properly, open the angle-cock on the good car and proceed.

Q. 95. Should a car ever be placed at the rear of a train with a defective hand-brake?

A. 95. When a car has a defective hand-brake and air-brake it must always be placed at the rear end of a train with a car behind it with a good hand and air-brake, so as to protect the defective car in case it would part at the coupling.

Q. 96. How must the air-hose couplings be parted?

A. 96. The hose couplings must be parted by hand so as to prevent damage to the brake-pipe, angle-cocks, hose couplings and gaskets.

Q. 97. If you find an air-hose gasket leaking what does it mean to the engineer, also the air-pump?

A. 97. Increased speed of the pump and a defective brake-pipe, increasing the brake-pipe reduction under an automatic action, with the engineers' brake valve in service position.

Q. 98. When is it proper to release the brakes on a freight train, after the train stops or before it stops?

A. 98. After the train comes to a stop.

Q. 99. When is it proper to release the brakes on a passenger train?

A. 99. Just before the train stops.

Q. 100. When is it proper to close the angle-cocks before releasing, or after releasing the brakes?

A. 100. After releasing the brakes, except in specified places where instructions are given on grades and places in dangerous location.

Q. 101. How would you leave cars stand in a side track so they would be safely secured?

A. 101. Always release all of the air out of the auxiliary reservoir, then put on hand-brake.

Q. 102. What would you do if you found a retaining valve pipe broke loose from the exhaust port of the triple valve or the retaining valve broke loose from the pipe?

A. 102. Nothing. Leave it alone and proceed.

Q. 103. What is the conductor's duty in reference to a defective retaining valve or pipe?

A. 103. Card it and have it repaired at the end of the trip.

Q. 104. What is the conductor's duty as his train leaves a terminal point?

A. 104. To note that the engineer makes a running test.

Q. 105. Is there any other place enroute the conductor should note a running test?

A. 105. Yes, at a junction or meeting point.

Q. 106. If the conductor operates a car discharge valve and the engineer does not answer same, what is the proper way to call the engineer's attention?

A. 106. Open the conductor's valve slightly, and as soon as the engineer notices the brakes are dragging it is his duty to release brakes and answer with the steam whistle. If the engineer finds the brakes released, then it is his duty to make the next station stop. If they do not release then it is his duty to place the brake valve to lap position, and leave it there until the train stops or the conductor notifies the engineer to release.

Q. 107. What is a good rule for a stuck brake while enroute?

A. 107. A good rule when running and you discover a stuck brake, give the engineer one blast of the air whistle. He will answer by two calls of the steam whistle and operated by return answer with the air whistle indicates a stuck brake, then it is the engineer's duty to apply and release brakes, and if the brake still remains stuck stop at once and ascertain the cause.

Q. 108. What are the rules of the air signal whistle while enroute?

A. 108. Two blasts when standing proceed.

Two blasts when running stop at once.

Three blasts when standing back up.

Three blasts when running stop at the next station.

Four blasts when standing apply and release brakes.

Five blasts when running increase speed.

Four blasts when running reduce speed.

Five blasts when standing call in flagman.

Q. 109. What extra attachment is required when using a high-speed brake?

A. 109. A high-speed reducing valve, pop valve or safety valve.

Q. 110. To what pressure is the high-speed reducing valve connected?

A. 110. Brake-cylinder pressure.

Q. 111. At what pressure is the high-speed reducing valve set to close off?

A. 111. To close at 60 pounds is the rule; some railroads, 55 pounds.

Q. 112. Is a higher brake-cylinder pressure obtained in the emergency application of the brakes than when made in the service application?

A. 112. Yes, there is an additional pressure obtained from the brake-pipe.

Q. 113. How long will it take the high-speed reducing valve to reduce the brake-cylinder pressure from 88 pounds down to 60 pounds.

A. 113. From 16 to 24 seconds of time or a very close margin to same.

Q. 114. What is the object of retaining valves?

A. 114. To hold a desired pressure in the brake-cylinder while the engineer releases the brakes and recharges the brake-pipe and auxiliary reservoirs.

Q. 115. Where are retaining valves used?

A. 115. On special designated grades.

Q. 116. If you received orders to set up retaining valves on a grade, from what part of the train would you start to set them up?

A. 116. Always start at the head end of the train.

Q. 117. At what part of the train would you start to take them out of service?

A. 117. At the rear end of the train.

Q. 118. How many different styles of retaining valves are in service on railroads?

A. 118. There are two, the standard, the high and low pressure retaining valves.

Q. 119. At what pressure of air does the standard retaining valve retain?

A. 119. The standard retaining valve will retain 15 pounds pressure of air in the brake-cylinder.

Q. 120. What pressure of air does the high and low pressure retaining valve retain?

A. 120. Some retain at 15 and 30 pounds, others at 25 and 50 pounds.

Q. 121. What position does the handle of the retaining valve occupy when not in service?

A. 121. Direct in line with the pipe.

Q. 122. What position does the handle of the high and low pressure retaining valve occupy when in service?

A. 122. To retain a high pressure midway of the valve, for low pressure direct at right angles.

Q. 123. How does the handle of the standard retaining valve stand when to retain a pressure of air?

A. 123. At right angles.

Q. 124. What would you look for if the brake was applied and then released and you discovered the brake-cylinder piston would not return in the cylinder?

A. 124. Notice the position of the retaining valve handle. If that is correct look for a plugged retainer pipe.

Q. 125. How can we discover a plugged up retainer pipe?

A. 125. Disconnect the union joint next to the triple valve exhaust port, then if the brake releases it indicates a plugged pipe or a bent retaining valve handle.

Q. 126. What is the per cent. of air that should be carried on a train?

A. 126. One hundred per cent.

Q. 127. What percentage of air does the law require?

A. 127. 85 per cent. of air, all cars attached in a train.

Q. 128. If you had less than the number of cars attached in a train, in an inoperative condition what would you do?

A. 128. Under no circumstances must a train be moved with less than the required percentage of air-brakes without orders from the superintendents or trainmasters with the superintendent's signature.

Q. 129. What is the benefit of the latest improved conductor's valve over the old style self-closing conductor's valve?

A. 129. The latest design of conductor's valve does not require a man to hold it open, once opened it will remain open until you close it up.

Q. 130. With a self-closing conductor's valve how should it be operated.

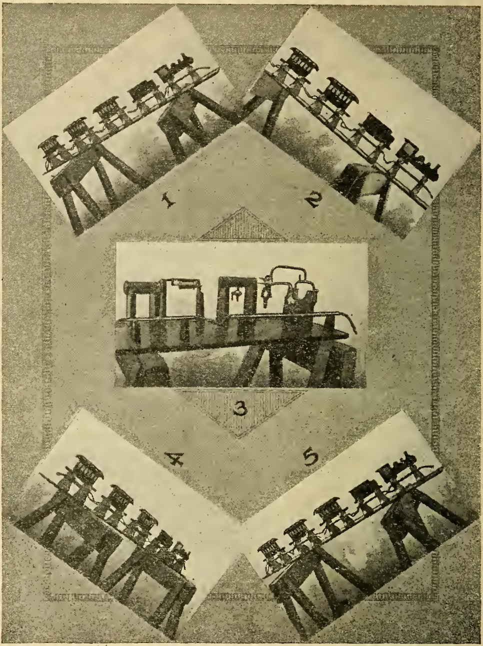
A. 130. Held open until the train stops or the necessity of its uses are over.

Q. 131. Do you understand how many cars you must have attached in a train before you can disable one and proceed with your per cent. of air-brakes in a train?

A. 131. Yes. There must be seven in all.

Q. 132. Do you understand that the engine and tender represents a car each?

A. 132. I do.



This photograph represents the defects of brake-pipe under cars while pulling the train enroute.

No. 1 represents a broken brake-pipe on tender air-hose crossed from engine to tender connecting to whistle-hose on tender and from the tender to the air-hose on car permitting the use of brake on engine and three cars; no brake on tender.

No. 2 represents a broken-air pipe on the rear of engine, air-pipe plugged on the rear of engine, air and whistle-hose coupled on front of engine, whistle-hose on the rear of engine coupled to air-hose on tender, having a brake on the whole train.

No. 3 represents a lost triple valve on tender brake-pipe plugged at crossover pipe, proceeding with brake on engine and cars but no brake on tender.

No. 4 represents brake-pipe broken on the head end of last car, pipe plugged at head of drain cup, air-hose on car two coupled to whistle-hose on the head end of car three. At the rear of car three air and whistle-hose coupled together, making a run-around of the air.

No. 5 represents the air-pipe broken on car two. Air-hose on car one coupled to whistle-hose on the head end of car two. Whistle-hose on car two at the rear coupled to the air-hose on the head end of car three, giving a brake on engine, tender, car one and car three.

Q. 133. What would you do if you broke the angle-cock off the rear end of the last car or between the angle-cock and drain-cup?

A. 133. Plug the pipe and proceed.

Q. 134. What would you do if you broke the pipe off leading from the brake-pipe over to the triple valve and it was broken between the drain-cup and the cutout cock?

A. 134. Plug the pipe up, bleed all of the air out of the auxiliary reservoir and proceed.

Q. 135. What would you do if broken between the cutout cock and the triple valve?

A. 135. Close the cutout cock, bleed the air out of the auxiliary reservoir and proceed.

Q. 136. When would you cross hose between passenger cars?

A. 136. Only in cases of emergency where the brake-pipe cannot be repaired while enroute.

Q. 137. What would you do if you broke the conductor's valve off the pipe or the pipe broke off at the tee connection at the brake-pipe?

A. 137. Plug the pipe or valve, if possible, if not cross the hose and proceed.

Q. 138. What would you do if you broke the brake-pipe off under a passenger car?

A. 138. In cases where a brake-pipe is broken under a passenger car take the air-hose coupling on the car ahead of the defective one and connect it to whistle hose coupling on the car that is defective, using the whistle train pipe as a conveyor of air through the car, then go to the rear of the defective car, take the whistle hose coupling and connect it to brake-pipe air-hose, coupling on the car directly back of defective one, on which the whistle-pipe is used for a conveyer of air only. There will be no brake on the car with the broken brake-pipe, but on all cars ahead and behind the defective car there will be a brake. Be sure and close the whistle-cock on the car ahead of the defective car so as you can use air whistle on all cars ahead of defective car. Be sure and make a test of brakes before leaving this point in the usual way, that is, the same as a terminal point.

Q. 139. What would you do if you broke the brake-pipe off between the drain-cup and the angle cock on the forward end of the last car?

A. 139. Plug the pipe ahead of the drain-cup, take the air-hose connection on the rear end of the car ahead of it and connect it into the whistle hose on the defective car then go to the rear end of the defective car, connect the air hose and air-whistle hose together and proceed in that manner.

Q. 140. What would you do if you broke the pipe off leading from the triple valve over to the auxiliary reservoir under a car?

A. 140. Screw the piece out of the triple valve, also out of the auxiliary reservoir, take a whistle hose and screw it into the valve, also screw one in the auxiliary reservoir, clutch them together and proceed in that manner.

Q. 141. How many branch pipes lead away from the train signal pipe?

A. 141. On ordinary cars there is one branch pipe and on private cars or parlor cars there are two.

Q. 142. To what are these branch pipes connected?

A. 142. To the car discharge valve.

Q. 143. Is there a cutout cock located on this branch pipe?

A. 143. Yes, and it is located in the saloon close to the discharge valve.

Q. 144. For what is this cutout cock used?

A. 144. To be used when the car discharge valve is defective.

Q. 145. How long should this car discharge valve be held open?

A. 145. Just long enough to give it a quick wide open pull.

Q. 146. How much time should be allowed between each pull of the car discharge valve?

A. 146. About two seconds of time should elapse.

Q. 147. Do you understand what a signal valve is?

A. 147. Yes, a valve that returns the answer to the engineer when the car discharge valve is operated.

Q. 148. Do you understand how much pressure of air is carried in the train signal pipe?

A. 148. Yes, 45 pounds.

Q. 149. Has the train signal pipe any connection with the brake-pipe?

A. 149. No, both the brake-pipe and signal-pipe are independent of one another.

Q. 150. What kind of cocks do we find on the train signal pipe?

A. 150. Three-quarter inch straight cocks with a loose hose and coupling.

Q. 151. What is the position of this cock when opened and closed?

A. 151. When closed in line with the pipe and when opened at right angles to the pipe.

Q. 152. Can the car discharge valve be used as a conductor's valve when the train signal pipe is used as a brake-pipe so as to convey air through the car in case of a defective brake-pipe?

A. 152. Yes, by opening the car discharge valve and keeping it open, the air reduction in that pipe is sufficiently great enough to set the brakes throughout the train.

Q. 153. Is it liable to receive undesired quick action when using the car discharge valve as a conductor's valve.

A. 153. No, it is impossible to receive quick action, as the car discharge valve will not discharge air fast enough to allow the triple valve to receive quick action.

Q. 154. What protection is given a car discharge valve so that dirt cannot accumulate at the valve?

A. 154. Located in the train signal pipe is a tee with a half-inch outlet, to which the branch pipe is connected on the inside of the tee, there is a piece of perforated brass encircles around it which prevents the dirt from entering the car discharge valve.

AIR GAUGES AND CONDUCTOR'S VALVES, LOCATED IN CABINS

Q. 155. What benefit are air gauges and conductor's valves in cabins?

A. 155. Air gauges located in cabins are to notify the flagman that there is an angle-cock closed in the train and also informs him of any stoppage in the brake-pipe, and the conductor's valve is to be used to operate the train brakes in case of emergency.

Q. 156. After the train is enroute what is liable to happen to an angle-cock or brake-pipe?

A. 156. An angle-cock can be closed by a train rider and in winter time it will notify the flagman the brake-pipe is starting to close up, due to its being frozen.

Q. 157. What would you do if you discovered the air decreasing on the air gauge in the cabin and the train brakes were not operating?

A. 157. Tie up several hand-brakes on the rear end and that will notify the engineer that the train is pulling hard and when he looks back swing him down. After train has come to a stop investigate the cause of the air gauge decreasing in pressure.

Q. 158. What is the proper way to use the air gauge and conductor's valve?

A. 158. After the train is all made up and the cabin is attached to the train and the angle-cocks all open, it is the flagman's duty to notice the pressure of air registered on the gauge; that will notify him just what is going on at the head end of the train. After the train is started enroute, look at the gauge frequently. If the pressure increases above the standard pressure the feed valve is regulated for, that will indicate that the engineer has his brake valve in full release position. Then if the brake valve handle is returned to running position, that will show you that the engineer has made a mistake and left the valve in full release too long, then watch for the brakes to creep on. If he makes a reduction in the brake-pipe pressure that will prove that he is reducing the brake-pipe and auxiliary reservoir pressures so as to prevent the brakes from applying while enroute. This move is done so as to decrease the brake-pipe and auxiliary reservoir pressures below what the feed valve is regulated for.

Q. 159. How can you tell when the train is coming to a stop if the automatic brake has been placed into action or the straight air-brake is being operated?

A. 159. Watch the gauge in the cabin. If the hand on the air gauge moves towards the zero mark that proves that the automatic action of the brake is being operated if the air gauge hand does not move that proves that the straight air-brake valve is being used to stop the train.

Q. 160. What other good features is attached to the air gauge in the cabin?

A. 160. It will indicate if the engineer made to a light reduction in the brake-pipe pressure, for the number of cars attached in train, and when he makes a second reduction in brake-pipe pressure, if quick action occurs that will prove the brakes were not operated correctly.

Q. 161. What bad results are obtained if the air gauge in the cabin is not looked after?

A. 161. At any time if you break loose and the engineman does not discover same, due to the fact that there was an angle-cock closed in the train and you broke loose back of the closed angle-cock, that is up to the flagman and not the engineer and it proves you did not pay any attention to the air gauge in the cabin.

Q. 162. What would you do if the pipe broke loose from the air gauge located in the cabin?

A. 182. Plug the pipe at pressure end and proceed.

Q. 163. What would you do if you broke the conductor's valve off in cabin?

A. 163. Plug the pipe at pressure end and proceed, never cut out the brake on the cabin for either defect.

Q. 164. What would you do if you broke the pipe off where it is connected to the tee connection at the brake-pipe?

A. 164. If at all possible plug it at the pressure end and proceed. Always retain the cabin brake if at all possible.

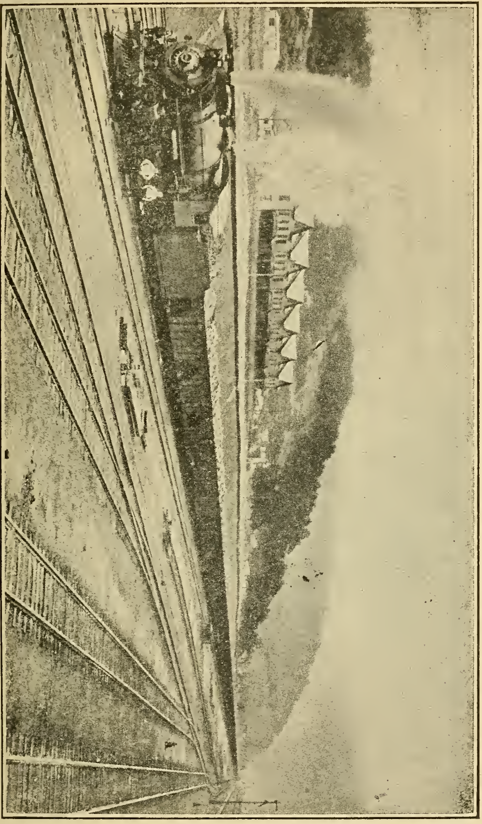
AIR BRAKE SCHEDULE.

A. 165. Showing the number of air brakes in a train that can be disabled and still retain the 85 per cent. It also will show you the numoer of cars with the air brakes in good condition, and the number of cars with the air brakes that can be cut out of service, starting with the engine and tender.

A. 166. A locomotive and tender is represented as two separate and distinct cars, therefore it takes a locomotive tender with five cars attached to make a train of seven cars. With a train of this size we can loose one air-brake under a car in the train and proceed. But with any number of cars below five attached to an engine and tender, it would be impossible to retain the desired per cent. if one brake was inoperative.

TRAIN CREWS.

A. 167. It is understood that the interstate laws at the present time demand 85 per cent. of air brakes attached together in a train in road service. It is the desire of all railroads that the trains on their departure from an initial point have 100 per cent. of air brakes attached in train or that all air brakes in a train be operated together. So if any of the air brakes in the train become inoperative they can be reduced down to 85 per cent. without the necessity of shifting out cars.



This represents engine and tender. 120 steel cars and cabin. Total, 123 car train.

				Brakes Inoperative.
Locomotive	and	tender,	5 cars. Total, 7 cars.	
"	"	"	7 to 13 cars inclusive.	1
"	"	"	14 to 19 " "	2
"	"	"	20 to 26 " "	3
"	"	"	27 to 33 " "	4
"	"	"	34 to 39 " "	5
"	"	"	40 to 46 " "	6
"	"	"	47 to 53 " "	7
"	"	"	54 to 59 " "	8
"	"	"	60 to 66 " "	9
"	"	"	67 to 73 " "	10
"	"	"	74 to 79 " "	11
"	"	"	80 to 86 " "	12
"	"	"	87 to 93 " "	13
"	"	"	94 to 99 " "	14
"	"	"	100 to 106 " "	15
"	"	"	107 to 113 " "	16
"	"	"	114 to 119 " "	17
"	"	"	120 to 126 " "	18

The number of brakes marked inoperative are the number of air brakes in a train that can be cut out of service in any number of cars that are represented on the above schedule.

INFORMATION FOR CONDUCTORS AND TRAINMEN.

Q. 168. What would you look for if the brakes would not apply from the action of the engineer's brake valve?

A. 168. Look for a closed angle cock, hose coupling plugged up, brake-pipe plugged up, or air hose crossed and connected to whistle hose.

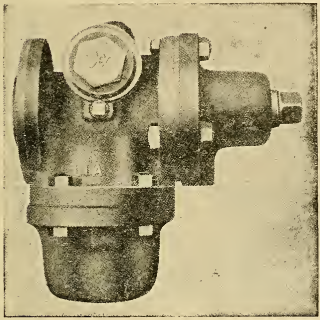
Q. 169. If you had a train of cars attached to an engine and the engineer notified you it was an impossibility to receive any air?

A. 169. If a passenger train, take 3 to 5 cars at a time; if a freight train, take 10 cars at a time and it will only be a short time when you can discover the car that is defective.

Q. 170. How would you test the air gauge in the cabin car?

A. 170. Couple the tender of the engine up to the cabin car, couple air hose, open the angle cocks proper. Then have the engineer place his valve in full release, then running position and note the difference in the pressures. If only five pounds out of the way, leave it alone. If it shows a difference of more than five pounds report it. Never undertake to test an air gauge in a cabin when attached to a train of cars.

L TRIPLE VALVE



Q. 1. What is an L triple valve?

A. 1. A valve designed and constructed for high speed trains.

Q. 2. What features are obtained in the L triple valve that are not in the standard triple valve?

A. 2. It has a graduated release, brakes in a train can be partially released when so desired. Quick service movement by means of which service applications are obtained throughout long trains in much less time. It has a quick recharge during release of the brakes. It obtains a much higher brake cylinder pressure.

Q. 3. Is a high-speed reducing valve used with the L triple valve?

A. 3. No. A safety valve or pop valve.

Q. 4. What is the extra attachment used with an L triple valve?

A. 4. A supplementary reesrvoir.

Q. 5. What is the object of the supplementary reservoir?

A. 5. First, it is used as a hold-up on the triple piston, giving it the graduated release, also quick recharge of the auxiliary reservoir, and a high emergency pressure in the brake cylinder.

Q. 6. What changes must be made when applying the L triple valve to a passenger brake cylinder?

A. 6. The brake cylinder pressure head must be changed, for the one that has all necessary pipe connections in the head, as the L triple valve to an extent serves to be a much less piped triple valve.

Q. 7. How does the outside of the L triple valve differ from a standard triple valve?

A. 7. There is a vent valve portion on the upper side of the triple valve body, at right angles to the slide valve movement where the safety valve is connected.

Q. 8. How many connections are there to the L triple valve?

A. 8. There are three. The crossover pipe leading from the brake pipe to the triple valve, the connection to the auxiliary reservoir, and a connection to the supplementary reservoir.

Q. 9. How much larger is the supplementary reservoir than the auxiliary reservoir?

A. 9. The supplementary reservoir is twice as large as the auxiliary reservoir.

Q. 10. How can the supplementary reservoir be inoperative?

A. 10. Closing the cutout cock on the pipe leading to the supplementary reservoir, and then open the bleed valve.

Q. 11. How would you proceed to bleed the brake off where there is an L triple valve attached to a car, and you desire to place this car in a side track due to a defective triple valve or brake?

A. 11. Close the cutout cock on the supplementary reservoir pipe, bleed the air out of the auxiliary reservoir, put on a hand brake.

Q. 12. How would you proceed to bleed the brake off if the brake was dragging on the wheels?

A. 12. Where there are two reservoirs attached in service it is always advisable to bleed the supplementary reservoir slightly, then while the pump is accumulating pressure in the main reservoir, and the brake valve is placed in full release position, the pressure will be built up in the brake pipe in advance of the auxiliary pressure, and the triple valve will release.

Q. 13. What is the object of bleeding the supplementary reservoir slightly?

A. 13. So when the triple piston moves to release position and there is a communication between the auxiliary reservoir and supplementary, the supplementary pressure will not recharge the auxiliary reservoir in advance of the brake pipe pressure.

Q. 14. What is meant by charging position?

A. 14. When the auxiliary reservoir and supplementary reservoir is being charged through the triple valve action, before the brakes are being tested.

Q. 15. What is meant by full service position?

A. 15. In this position the air that supplys the brake cylinder comes direct from the auxiliary reservoir. No brake pipe pressure enters the brake cylinder.

Q. 16. What is the meaning of quick service position?

A. 16. This is the position where auxiliary reservoir pressure and brake pipe pressure enter into the brake cylinder.

Q. 17. Where is quick service position obtained?

A. 17. Only on a long train, then the retarding air pressure in the brake pipe is prevented from traveling as fast as the auxiliary reservoir pressure can enter the brake cylinder and through this action brake pipe pressure enters the brake cylinder, and assists in brake pipe reduction, and a higher brake cylinder pressure.

Q. 18. What is the meaning of release position?

A. 18. After the train brakes have been applied, then released, and the triple valve is placed into release position, the air from the brake cylinder passes to the atmosphere.

Q. 19. What is quick charging position?

A. 19. After the brakes have been placed into release position the pressure of air in the supplementary reservoir not being disturbed, and the auxiliary pressure having been reduced through the application of the brake, while the brake pipe is being charged and the auxiliary reservoir, so is the supplementary reservoir pressure fed back into the auxiliary reservoir, and it keeps on charging the auxiliary reservoir until both of the pressures equalize the brake pipe pressure keeps on charging until the brake pipe auxiliary reservoir and supplementary reservoir pressure are equal to the pressure that the feed valve is regulated for.

Q. 20. What is the meaning of emergency position?

A. 20. In this position brake pipe pressure, auxiliary reservoir pressure and supplementary reservoir pressure enter the brake cylinder, giving an increased brake cylinder pressure.

Q. 21. What air-pressure is obtained in the brake-cylinder in the emergency action with 70 pounds pressure registered in the brake-pipe?

A. 21. Brake cylinder pressure with 70 pounds brake-pipe pressure will equalize at about 65 pounds and with 110 pounds pressure registered in the brake-pipe the pressures will equalize at about 105 pounds.

Q. 22. What is the meaning of release lap position?

A. 22. After the brake has been applied and the engineer's brake valve has been placed into release position, and the brake-pipe pressure is built up gradually then the supplementary reservoir pressure comes into action on the triple piston on the auxiliary side and moves it back far enough to put the valve to release lap position.

Q. 23. For what is service lap position used?

A. 23. After the triple valve has been placed into action and the auxiliary reservoir pressure is entering the brake-cylinder, then the engineer places his valve to lap position, brake-pipe pressure keeps on exhausting at the brake valve exhaust until the brake-pipe pressure is a fraction greater than reservoir pressure. Then the brake-pipe pressure moves the triple piston ahead carrying with it the graduatng valve, at this movement the port opening between the auxiliary reservoir and brake cylinder is blanked off, and there is no more air admitted to the brake-cylinder.

Q. 24. Why is the position called service lap position?

A. 24. This is the position to which the graduating valve and piston is moved ahead, and the graduating valve closes off communication with the auxiliary reservoir and brake-cylinder.

Q. 25. Why do they term it surface lap position in an L triple valve?

A. 25. In the L triple valve there are two independent lap positions, service lap position and release lap position.

Q. 26. Are there any ports in the valve in communication with the service lap position, or release lap position?

A. 26. There is a port leading from the brake-cylinder to cavity in the slide valve. This cavity is in communication with a port leading to the pop valve connection.

Q. 27. What is the object of having this port opening which leads to the safety valve in communication with the brake-cylinder at all times except in the emergency action?

A. 27. So that the safety valve can be ready for action in all positions and reduce any pressure that will enter the brake-cylinder above what the valve is set for.

Q. 28. What pressure does the safety valve control?

A. 28. Brake cylinder pressure only.

Q. 29. What cylinder pressure is retained in the brake-cylinder with a pop valve?

A. 29. A pop valve with an L triple valve is set to operate at 50 pounds and in some cases 60 pounds. The pressure in the cylinder is reduced on the same principal as the high-speed reducing valve, through the pop valve action on the standard equipment with the standard brake is set for 60 pounds.

Q. 30. How often can a graduated release be obtained?

A. 30. A graduated release can be obtained until all the air is released out of the brake-cylinder.

Q. 31. Can the L triple valve be operated with success without the supplementary reservoir?

A. 31. It can be operated just as successfully as with the supplementary reservoir.

Q. 32. Can graduated release be obtained without the supplementary reservoir?

A. 32. No.

Q. 33. What pressure of air can be obtained in the brake-cylinder in full service position?

A. 33. The same pressure that can be obtained in the brake-cylinder with the standard quick-action triple valve.

Q. 34. Why is it that the same pressure is not obtained in the brake-cylinder with the L triple valve in the emergency position without the use of the supplementary reservoir, as the standard quick-action triple valve?

A. 34. The pressure in the brake-cylinder will retain at 88 pounds, due to the fact that in the emergency action there is no communication between the brake-cylinders and the pop valve, therefore there is no air pressure, reduced out of the brake-cylinders.

Q. 35. What pressure can be obtained in the brake-cylinder with the L triple valve with the supplementary reservoir attached when applied in the emergency position?

A. 35. The pressure in the brake-cylinder will equalize at about 103 to 105 pounds.

Q. 36. Then in the emergency action of the L triple valve, the port leading to the safety valve is blanked off.

A. 36. It is.

Q. 37. Is there any other position in the L triple valve where the pop valve is blanked off?

A. 37. In all other positions of the L triple valve, the pop valve is in communication with the port leading to the brake-cylinders.

Q. 38. In what position does the vent valve operate?

A. 38. In the emergency position only.

Q. 39. What is liable to happen if the vent valve was to leak?

A. 39. After the engineer had applied the brake in service position, and returned his valve to lap position, the chances are that the valve with a leaky vent valve will not permit the valve to go to lap position, as the supplementary reservoir pressure would leak into the auxiliary reservoir, and return to high brake-cylinder pressure, the pressure obtained would be higher than desired.

Q. 40. What would be the results if the vent valve was held from its seat from foreign collection on it?

A. 40. That depends on what kind of a leak would occur between the supplementary reservoir and auxiliary reservoir. If the valve was open far enough to allow supplementary reservoir pressure to enter the auxiliary reservoir pressure as fast as the triple valve was passing the air to the brake cylinder, quick action would not be obtained. If supplementary reservoir pressure could feed the auxiliary reservoir faster than the auxiliary reservoir pressure was entering the brake-cylinder undesired quick action would follow.

Q. 41. What should be done if the valve was leaking or stuck open?

A. 41. On the arrival at your destination of the trip, report same at once, have it looked after, so as to prevent any undesired effect that may occur to the train brakes.

Q. 42. How can the above trouble be remedied?

A. 42. Remove the cap nut from the vent valve portion, and look for a weak or broken spring. Back of the vent valve, also look at the valve and seat. Dirt or foreign matter has lodged on the seat.

Q. 43. What effect will a weak vent valve spring have on a triple valve?

A. 43. When equalization takes place between the auxiliary reservoir and supplementary reservoir, the port opening leading to both sides of the vent valve piston is equal. It only takes a light pressure over equalization to hold the valve to its seat.

Q. 44. What effect would there be to the operation of the L-triple valve if the port to the left of the vent valve piston has become clogged up?

A. 44. The pressure to the right of the piston would keep the piston forced to the left, and in return would open the vent valve, this would be a connection between the supplementary reservoir and the auxiliary reservoir at all times.

Q. 45. What effect would it have on the L triple valve, if the port in the slide valve seat was to clog up?

A. 45. There would be no pressure to enter the auxiliary reservoir from the brake pipe with the triple valve in full release, through that defective port, the only air entering the auxiliary reservoir would be through the feed groove on the side of the piston chamber.

Q. 46. If the port in the slide valve seat was clogged up, could quick service movement be obtained?

A. 46. No, quick service movement would be destroyed, but full service application can be obtained.

Q. 47. If the port in the slide valve seat was clogged up, would it affect the charging of the supplementary reservoir, and auxiliary reservoir?

A. 47. It would, the only admission of air would be through the feed groove in the piston chamber, and it is easily understood that the two volumes of air entering into a vacant space will fill them up quicker than if one was out of service.

Q. 48. What would be the results if the vent valve piston stuck so it could not be moved, or the vent valve was stuck so as not to open?

A. 48. In a service position of the brake, it would not be noticed, but when releasing, graduated release could not be obtained; when used in the emergency the pressure in the brake cylinder and auxiliary reservoir would equalize at a low pressure.

Q. 49. What would you do if you broke the bleed valve off in the supplementary reservoir?

A. 49. Close the cutout cock on the pipe leading to the supplementary reservoir and proceed.

Q. 50. What would you do if you broke the bleed valve off in the auxiliary reservoir?

A. 50. Put in a half-inch gas pipe plug, or plug the hole up with a wooden plug.

Q. 51. What would happen if the safety valve was leaking?

A. 51. This is in accordance with the leak. If it were only a slight leak, the brake would decrease in power; if the leak was great enough, the brake would release quickly. If the valve was stuck open the chances are that the brake would only apply in the emergency position.

Q. 52. Would the brake leak off in the emergency position with a leaky safety valve?

A. 52. No, in this position the safety valve is not in communication with the brake cylinder.

Q. 53. What precaution is taken to protect the safety valves from accumulating dirt on the valve or seat?

A. 53. An air strainer is located at the passage way leading to the safety valve.

Q. 54. With the L triple valve is there any precaution taken to prevent dirt from entering the triple valve?

A. 54. A thimble screen is placed at the connection from the crossover pipe, at the union where it comes to the pressure head. Also in many cases a centrifugal dirt collector is placed in the branch pipe between the cutout cock and the triple valve.

Q. 55. What defects are liable to be found in the L triple valve?

A. 55. The same defects that are in the old standard triple valve.

Q. 56. What effect would a slight leak in the auxiliary reservoir have on the brake?

A. 56. After the brake was applied and the valve returned to lap position, the leak would decrease the pressure in the auxiliary reservoir. Brake-pipe pressure being the greater of the two pressures, would move the triple piston to release position, but as soon as the piston moved a sufficient distance the supplementary reservoir pressure would recharge the auxiliary reservoir again and as soon as the pressure was increased above brake-pipe pressure, it would move the triple piston into application position again.

Q. 57. What effect will a leak have in the supplementary reservoir.

A. 57. After the brake was released, it would fail to recharge the auxiliary reservoir pressure quickly, therefore the action of quick recharge would be destroyed.

Q. 58. After the valve has been placed into the emergency action and you desire to release the brake, how is the triple valve placed to release position?

A. 58. When the L triple valve is placed into full release position after an emergency action, and the triple piston has moved a sufficient distance, there is a release through the release port of the triple valve, and also an escape of air out of the safety valve, as the safety valve is in communication with the brake-cylinder pressure in all positions except into the emergency position.

TYPE U COMMON STANDARD UNIVERSAL VALVE.

Q. 1. Engineers, conductors and trainmen, have you noticed under Government control of railroads and operating equipment of different railroads, that there is a variation of the design and construction of triple valves on steel passenger cars?

A. 1. Yes, there is the L triple valve, the Universal valve and the standard triple valve.

Q. 2. Will these different classes of valves all work in congenial action with one another?

A. 2. Yes, if the brakes are operated according to instructions.

Q. 3. What are the essential parts of this equipment?

A. 3. Angle cocks and hose couplings, brake-pipe conductors valve, special branch pipe tee and strainer, branch pipe cutout cock, centrifugal dirt collector, Universal valve, auxiliary service and emergency reservoirs, cutoff valve in emergency reservoir pipe, brake-cylinder, cutout cock in brake-cylinder pipe, slack adjuster and brake rigging.

Q. 4. How many parts complete compose the Universal brake?

A. 4. Three-faced pipe bracket, equalizing portion, quick action portion, with high pressure cap.

Q. 5. What part of the equipment is being applied to cars at the present?

A. 5. All the above parts except the electric portion. This is easily applied, all that is necessary is to remove the plain flat cap.

Q. 6. Can the bracket used with the Universal valve be used for any other purpose?

A. 6. Yes; for all the pipe connections ana it contains the quick-action chamber, and quick-action closing chambers as explained later.

Q. 7. What are the duties of the equalizing portion?

A. 7. It controls the charging of the reservoirs, the application and release of brakes in service and through the medium of the quick action portion, the application and release of the brakes in emergency.

Q. 8. What does the equalizing portion consist of?

A. 8. Equalizing piston, slide and graduating valve, graduated release piston, reduction limiting valve, release piston and slide valve, service port check valve, emergency reservoir charging port check valve and graduated release cap.

Q. 9. What is the duty of the equalizing piston?

A. 9. It controls the opening and closing of the auxiliary reservoir feed groove and emergency reservoir charging port and actuates the movement of the equalizing slide valve and graduating valve.

Q. 10. What is the duty of the equalizing slide valve?

A. 10. In release position it separates the service reservoir from the auxiliary reservoir; connects the release end of release piston to atmosphere by the way of the graduating valve; blanks the port leading to application end of release piston; and closes the service port. In application position it connects the service reservoir to the auxiliary reservoir; blanks the port leading to release end of release piston; connects the port leading to application end of release piston to atmosphere, and opens the service port to brake-cylinder.

Q. 11. What is the duty of the graduating valve?

A. 11. In release position it closes the service port in the slide valve, connects the release end of the release piston, through the slide valve to the atmosphere, and connects the auxiliary reservoir pressure to the resistance increasing cavities in the slide valve. In application position it opens the service port in the equalizing slide valve, connects the application end of release piston to the atmosphere; closes the communication from the release end of release piston to the atmosphere and connects the resistance increasing cavities to the atmosphere.

Q. 12. What is the duty of the release piston and its slide valve?

A. 12. The release piston in release position operates the release slide valve. The release slide valve opens the emergency reservoir charging port, service reservoir charging port, graduated release port, high-pressure valve port and brake-cylinder exhaust port. In application position it closes the emergency reservoir charging port. Service reservoir charging port, graduated release port, brake-cylinder exhaust port and connects the high-pressure valve port to the port that leads to the emergency slide valve and port that leads through the equalizing slide valve to the atmosphere.

Q. 13. What is the duty of the service reservoir charging valve?

A. 13. Its duty is to prevent the charging of the service reservoir until the auxiliary reservoir has been charged to within five pounds of the emergency reservoir pressure.

Q. 14. What duties does the service port check valve perform?

A. 14. It allows the air pressure to pass from the auxiliary reservoir and service reservoirs to the brake-cylinder, and prevents it from flowing back from the brake-cylinder into these reservoirs.

Q. 15. Why is it necessary to have this check valve?

A. 15. In emergency applications the service and auxiliary reservoirs first equalize into the brake-cylinder. Then the connections between these reservoirs and the brake-cylinder is closed, permitting the emergency reservoir to equalize with the brake-cylinder at a higher pressure. The service port check valve prevents the air in the brake-cylinder from flowing back into the auxiliary and service reservoirs through the service port.

Q. 16. What are the duties of the emergency charging port check valve?

A. 16. To prevent emergency reservoir pressure from passing back to equalizing piston chamber and brake-pipe.

Q. 17. What are the duties of the graduated release piston?

A. 17. To stop the equalizing piston and slide valve in graduated release position when operating with graduated release cut in.

Q. 18. What are the duties of the graduated release cap?

A. 18. To change the valve from direct to graduated release or vice versa.

Q. 19. What does the quick action portion and high-pressure cap consist of?

A. 19. Emergency piston, graduating valve, slide valve, protection valve, high-pressure valve, intercepting valve, cutout valve, safety valve, quick-action piston and valve, quick-action chamber and quick-action closing chamber.

Q. 20. What are the duties of the emergency piston and its slide valve?

A. 20. The emergency piston opens and closes the quick-action chamber feed groove, and operates the graduating valve and slide valve. The duties of the slide valve in release position are to open the quick-action closing chamber port, and connect the face of the high-pressure valve and cutout valve to the atmosphere. In application position it first connects the quick-action chamber to the quick-action piston, and emergency switch piston, then closes these ports and opens a connection from the quick-action closing chamber to quick-action piston and emergency switch piston; closes the quick-action closing chamber port, connects the back of the high-pressure valve to the atmosphere through the cavity in the release slide valve, and connects the quick-action chamber to the brake-cylinder.

Q. 21. What are the duties of the emergency graduating valve?

A. 21. To open and close the communication between the quick-action chamber and the quick-action piston and emergency switch piston.

Q. 22. What are the duties of the protection valve?

A. 22. To cause automatic emergency application of the brakes when the brake-pipe pressure is from any cause reduced below a predetermined point, namely, 35 pounds.

Q. 23. What are the duties of the high-pressure valve?

A. 23. The high-pressure valve is used as a pilot to control the operation of the intercepting valve, and it opens and closes the large port to the brake-cylinder in emergency applications.

Q. 24. What is the duty of intercepting valve?

A. 24. It allows the auxiliary and service reservoirs to equalize into the brake-cylinder quickly in advance of the emergency reservoir, and then cuts off the auxiliary and service reservoirs and allows the emergency reservoir to equalize with the brake-cylinder, thereby giving a high emergency brake-cylinder pressure.

Q. 25. What are the duties of the safety valve cutout valve?

A. 25. The duty of this cutout valve in service applications is to allow brake-cylinder pressure to pass to the safety valve. In emergency applications it admits auxiliary, service and emergency reservoir pressure to the brake-cylinder, and cuts out and unseats the safety valve.

Q. 26. What are the duties of the safety valve?

A. 26. To prevent brake-cylinder pressure from increasing to a high pressure in service application.

Q. 27. To what pressure is the safety valve set to close off?

A. 27. 60 pounds.

Q. 28. Name the different reservoirs that are used with this equipment for air supply to the brake-cylinder on each car.

A. 28. Auxiliary, service and emergency reservoirs.

Q. 29. What is the object of using a service reservoir in addition to the auxiliary reservoir?

A. 29. The auxiliary and service reservoirs combined form the reservoir volume for the brake-cylinder in service application and are so connected that when recharging the equipment, (graduated release feature cutout), after a brake application, the service reservoir is temporarily cut off from the source of air supply and only a small auxiliary reservoir volume is connected with the brake-pipe. This in return, as you can understand, reduces to a minimum the amount of air required to release all brakes on the train. With a graduated release cut in dividing of the compressed air volume for service applications only, into two volumes, (auxiliary and service reservoirs) permits a flexible graduated release with a minimum emergency reservoir volume.

Q. 30. What are the duties of the emergency reservoirs?

A. 30. It is used to control the graduated release pneumatically and also to recharge the service reservoir when the service reservoir charging valve opens and to give a high brake-cylinder pressure in emergency application.

Q. 31. Where there are two emergency reservoirs used, why is there a cut-off valve in the pipe leading to the large emergency reservoir?

A. 31. First, it serves to furnish a volume of air that is to be used for quick recharge of the service reservoir, and take care of the graduated release feature when in operation, at the same time by the action of the cut-off valve to prevent the air from the large emergency reservoir when used in the emergency application to enter the brake-cylinder, the small emergency reservoir pressure enters the brake-cylinder only, and protects the brake cylinder-pressure, to a limited pressure desired during the period of time.

Q. 32. How many cutout cocks are used with this equipment?

A. 32. There are two, one located on the crossover pipe, to the valve, and the other located in the brake-cylinder pipe.

Q. 33. Are the reservoirs equipped with a bleed valve?

A. 33. Yes.

Q. 34. While enroute if the brake becomes disabled on a car what is necessary to cut out of service?

A. 34. A defective brake rigging—close the cutout cock on the brake-cylinder pipe. If the valve itself is disabled the cutout cock in the branch pipe closed, and all reservoirs be bled out, except the large emergency reservoir, which must be left in service for use of the water raising system.

UNIVERSAL VALVE DEFECTS.

Q. 35. Where would you look for the trouble if the brake fails to operate in service position?

A. 35. In the equalizing portion.

Q. 36. Where would you look for the trouble if the brake refused to operate in the emergency action, all reservoirs in service?

A. 36. In the quick-action portion.

Q. 37. What would you look for if the brake was applied in service position and undesired quick action was obtained?

A. 37. In the quick-action portion.

Q. 38. If the brake was applied either in service or emergency position and it refused to release, where would you look for the trouble?

A. 38. In the quick-action part.

Q. 39. If any of the triple valves attached to other cars in the train go into quick action, will it affect the new equipment as well as the old?

A. 39. Yes. They are designed and constructed to operate either in service or emergency position with all quick action triple valves in service.

Q. 40. If the equalizing portion becomes defective will it give you undesired quick action?

A. 40. No, the quick action features of the Universal brake are separate from the service features of the valve.

Q. 41. When a continuous reduction of a brake-pipe pressure of 35 pounds is made either by the action of the brake valve or through leaks in the brake-pipe is the valve defective?

A. 41. No, the valve is so designed to hunt the emergency action after brake-pipe pressure is reduced down to that pressure.

Q. 42. What benefit is this brake above the old style equipment?

A. 42. If the air pump became disabled and the engineer did not notice it while enroute, and the brake-pipe pressure was reduced down to 35 pounds the brake would apply in the emergency action.

Q. 43. What effect would an angle-cock have on this valve if it become closed enroute?

A. 43. Just as soon as the air pressure back of the closed angle-cock was reduced down in the brake-pipe to 35 pounds, the brake would then apply in the emergency.

Q. 44. What pressure is required in the brake-pipe to release the brake after an emergency application?

A. 44. 90 pounds or a fraction more.

Q. 45. In making up trains why is it important that brake-pipe pressure should not be reduced down sufficient to cause the brake to hunt quick action?

A. 45. This means a loss of time as it would require an increased brake-pipe pressure to release brakes.

Q. 46. What brake-pipe reduction is required to apply the brakes in service position?

A. 46. Seven pounds brake-pipe reduction is sufficient to place the valve into service position; a reduction of less than 5 pounds will not have any action on the valve due to the resistance of increasing cavities being open to the atmosphere, requiring this difference to move the slide valve.

Q. 47. Why is it proper to see that the graduated release pointer is in the proper position?

A. 47. So as to be sure the valve will release properly.

Q. 48. When should it occupy the graduated release position?

A. 48. When there are a sufficient amount of cars attached in a train to guarantee its use.

Q. 49. When should the pointer occupy the position of release?

A. 49. When there are not a sufficient amount of cars attached in a train to guarantee its use.

Q. 50. In what part of this valve is this pointer located?

A. 50. On the graduated release cap.

Q. 51. If you discovered a leak at the exhaust of the equalizing slide valve with the valve in release position, what would you look for?

A. 51. A leaky equalizing slide valve, or graduating valve or the seal at the release end of the release piston.

Q. 52. If the valve was placed in application position and the exhaust of the equalizing slide valve leaked what would you look for?

A. 52. A leaky equalizing slide valve, graduating valve leaking, or the seal at the application end of the release piston.

Q. 53. If the release slide valve exhaust showed a blow when the valve was in release position what would you look for?

A. 53. A leaky release slide valve, due to foreign matter on the valve or seat or the valve worn.

Q. 54. What would cause a blow at this valve's exhaust port with the valve in application position?

A. 54. There are two defects that can occur to this valve in application position; a leaky release slide valve, or equalizing slide valve.

Q. 55. What would you look for if there was a blow at the emergency slide valve exhaust port in release position?

A. 55. A leaky emergency slide valve or high-pressure valve.

Q. 56. What would you look for if there was a leak at this exhaust with the valve in emergency position?

A. 56. A leaky emergency slide valve, leaky release slide valve or leaking at the outside seal of the high-pressure valve.

Q. 57. What would you look for if there was a leak at the quick action exhaust port, when the valve is in release position?

A. 57. A quick-action valve leaking, an emergency graduating or slide valve leaking.

Q. 58. What would you look for if the protection valve exhaust leaked with the valve in release position?

A. 58. A leaky atmospheric seal.

Q. 59. What would you look for if this valve had a leak at the exhaust when the brake was applied in the emergency position?

A. 59. Emergency piston gasket leaking, combined with a leaky emergency piston packing ring.

Q. 60. What would you look for if you had a leak at the brake-cylinder exhaust in release position?

A. 60. A release slide valve leaking.

Q. 61. What would you look for if a leak occurs at the brake-cylinder exhaust port in application position?

A. 61. Release slide valve or equalizing slide valve leaking.

Q. 62. When removing any part of the valve to be cleaned or if defective why is it necessary to examine all gaskets and ports?

A. 62. So as to be sure that all gaskets are in good condition and no defects in them between port openings, also to see that all ports are clean and free from dirt, and gaskets are located properly.

Q. 63. What kind of a cutout cock is located on the brake-cylinder pipe?

A. 63. A cutout cock of a special design so as to release all of the air out of the brake-cylinder when in a closed position.

Q. 64. When is it necessary to close this valve?

A. 64. In case of a defect to brake rigging, or when the air brake or car inspectors desire to make repairs to the equipment.

Q. 65. What benefit is derived from a cutout attached to the brake-cylinder?

A. 65. It prevents the loss of time in charging reservoirs after repairs to brake rigging.

INFORMATION TO CONDUCTORS AND TRAINMEN.

Q. 66. Why is it necessary at the present time for an air brake instructor to study and be ready to give information to the class of men in road service nuder the present control of Government?

A. 66. At the present time all class of equipment being operated over the railroads, it is the instructor's duty to familiarize himself with the operations of the different valves so he can furnish the desired information the train crews require while enroute, and to note that the engineer in charge operates the brakes according to instructions so as to protect the traveling public and the equipment. Where valves of all designs are placed under different equipment it requires a little more care in operating the brakes as heavy reductions on the first application very often make the brakes hold too hard on the rear portion and triple valves of different design variate in pressures entering the brake-cylinder. Under these conditions you can notice how quick the slack can be pulled back from the rear portion of the train and in return a very unpleasant feeling to the train rider.

ALERT, WATCHFUL, LIVELY.

Why train crews should be on the alert for the engineer's call for hand brakes. With my past experience of 43 years in road service, both with the North Pennsylvania Railroad, Pennsylvania Railroad and the Reading Railroad, there has come to my notice many cases of where train crews have prevented accidents by the use of hand brakes.

Below you will find some of the causes where hand brakes did their duty:

Angle-cocks closed from unknown causes.
Angle-cock bushings working loose in the angle-cock.
Air hose trapped with the lining of the air hose.
Brake-pipe frozen up between engine and tender and between tender and cars.
Brake-pipe defective, almost closed up.
Air hose clutches defective, almost closed up.
Rotary valve key leaving the rotary valve.
Air pump stopping while enroute.
Angle-cocks only partly opened.
Neglect of train crews to properly test brakes.
Air and whistle hose driven together.

Double-headed valves closed beneath brake valves.

Flimsy air hose parting and fastening themselves under draw heads.

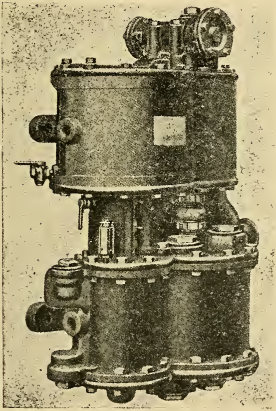
Brake valves left on lap position.

Feed valves out of order.

Air gauges out of order, steam valve in governor stuck partly shut.

WESTINGHOUSE CROSS COMPOUND AIR PUMP.

In the past few years it is understood that larger locomotives and cars are being constructed, and in return it demands large brake-cylinder and auxiliary reservoirs to effect the braking powers on the locomotive increased in size as well as the cars, the increased weight of cars and their length increases their weight so in return they must be supplied with a storage of air to set the brake ,and this requires an air pump well able to perform this work satisfactorily.



Q. 1. How many cylinders has the Westinghouse cross compound pump?

A. 1. There are four cylinders, 2 steam and 2 air cylinders.

Q. 2. If there are four cylinders attached to a cross compound pump which cylinders represent the steam cylinders?

A. 2. The upper cylinders are the steam cylinders, and the lower cylinders the air cylinders.

Q. 3. What are the different diameters of the cylinders?

A. 3. High pressure steam cylinder is 8 1-2 inches in diameter, the low pressure steam cylinder is 14 1-2 inches, the high-pressure air-cylinder is 9 inches, the low pressure air cylinder 14 1-2 inches.

Q. 4. How are the steam cylinders and air-cylinders connected?

A. 4. The high-pressure steam cylinder is connected direct above the large air cylinder, the large steam cylinder is connected direct above the high-pressure air-cylinder.

Q. 5. What action does the valve motion have in the top head of the air pump, and the action on the steam cylinders?

A. 5. On the same principal as the single expansion air pump.

Q. 6. How are the steam pistons and rods connected to the air pistons?

Q. 6. High-pressure steam piston rod connected to the low-pressure air piston, the low-pressure steam piston rod is connected to the high pressure air piston.

Q. 7. How many air valves are located in the air cylinders?

A. 7. There are 10 in all.

Q. 8. Name the different air valves located in the air cylinders.

A. 8. Four receiving valves: four intermediate valves; two discharge valves.

Q. 9. Which air cylinder has the receiving valves?

A. 9. The low-pressure air cylinder and the cylinder which accepts the free air.

Q. 10. Where are the intermediate valves located?

A. 10. Between the high and low-pressure air cylinder.

Q. 11. Where are the discharge valves located?

A. 11. They are located in the upper and lower end of the high-pressure air cylinder.

Q. 12. Why is the large air cylinder called the low-pressure cylinder?

A. 12. That is the cylinder that receives the free air direct from the atmosphere.

Q. 13. Why is the small air cylinder called the high-pressure air-cylinder.

A. 13. After the admission of free air to the low-pressure air-cylinder on the movement of the piston away from the receiving valve, it then is compressed on the return or opposite movement of the piston by the intermediate valves to the high-pressure cylinder as the high-pressure cylinder is smaller in diameter than the low-pressure cylinder, the air is compressed to a high pressure because it is admitted into a smaller space.

Q. 14. As the air is compressed from the low-pressure air cylinder to the high does it affect the action of the air piston in the high-pressure air-cylinder.

A. 14. As the steam and air pistons of both cylinders travel in opposite directions it serves to increase the pressure of the high pressure air piston, and assists the steam action of the steam piston.

Q. 15. Why is the high-pressure steam cylinder in connection with the low-pressure air-cylinder?

A. 15. As the boiler pressure enters the high-pressure steam cylinder direct, and only actuates the high-pressure piston and air piston in the low-pressure cylinder, and through its movement free air is received to the low-pressure cylinder and on reverse movement the free air is compressed to the high-pressure cylinder.

Q. 16. What difference is there between the main valve in a cross compound pump and the ordinary D slide valve of a 9 1-2-inch air pump.

A. 16. The main valve in the cross compound pump is made up of five pistons connected together, a large one on one end, a small one on the other end, and three intermediate pistons of uniform size.

Q. 17. Explain the movement of the high-pressure steam piston and the low-pressure steam piston .

A. 17. Steam from the boiler enters the pump at the place marked steam inlet, flows through a passage to the top head of the pump, filling the main valve chamber between the small piston and the first intermediate piston, also between the third intermediate piston and large piston. It also flows into the reversing valve chamber. The chamber to the right of the large end of the main valve piston is connected to the exhaust port, and the outside of the small end of the main valve piston is always in connection with the exhaust port. The three intermediate pistons being of one size is always balanced. The large and small pistons have steam pressure inside and exhaust on the outer sides, which results in moving the main valve to the right. This brings a chamber in the bushing leading to ports and a passage way leading to the lower end of the high-pressure piston this allowing the live steam pressure direct under the high-pressure piston starting the piston on its upward movement.

Q. 18. Where does the steam pass to, that was used to operate the high pressure steam piston on the down stroke?

A. 18. There is a port in the main valve chamber which leads direct into the upper end of the high-pressure steam cylinder connecting through a chamber into a port in the seat, which leads to the upper side of the low-pressure piston, steam above the high-pressure piston exhausts through this port to the chamber in the valve bushing, then to the port leading into the upper side of the low pressure piston and this permits the steam to follow the piston on the down stroke.

Q. 19. How is the steam pressure below the low pressure steam piston released as the piston moves on the down stroke?

A. 19. There is a port in communication with a passage in the lower end of the steam cylinder, and the top head, which is connected with a chamber and a port leading to the exhaust pipe.

Q. 20. Does the low-pressure steam piston make its down stroke as the high-pressure steam piston makes its up stroke?

A. 20. They work in opposite directions; as the high-pressure steam piston makes its upper stroke, the low-pressure steam piston makes its down stroke.

Q. 21. Explain how the reverse action of the pump operates?

A. 21. When the high-pressure steam piston reaches near its full travel in the upper end of the cylinder, the reversing plate engages the shoulder on the reversing valve rod, which is carried upward; also the reversing valve. At this move the reversing valve blanks off the exhaust to the right of the large end of the main valve, and permits live steam to enter direct below the reversing valve, to the right of the main valve. This balances the large piston, and leaves the small end of the piston unbalanced, having steam pressure to the right and exhaust opening on the left. This allows the main valve to move to the left. In this position live steam is permitted to enter the upper end of the high-pressure piston, which follows the piston on the down stroke. At this move the steam in the cylinder below the high-pressure piston, exhausts over into the low-pressure cylinder, through a port and chamber in the main valve bushing and a port and passage to the low-pressure cylinder. This starting the low-pressure steam piston on the upper stroke, the steam above the low-pressure piston posses to the atmosphere through a port and chamber in the main valve bushing to the exhaust port to the atmosphere.

Q. 22. Explain how the operation of the air-cylinder is affected under a compound action?

A. 22. Starting with the low-pressure air-cylinder, it will be seen that the low-pressure air-cylinder is the large cylinder, and as the piston is making its upward stroke, there is a vacuum formed behind the piston. The atmospheric pressure then raises the lower receiving valves and air flows past these valves to fill the partial vacuum formed in the cylinder. The air continues to flow into the cylinder until the cylinder is filled with free air, the air that has been received into the air-cylinder above the piston is now to be compressed over to the high-pressure air-cylinder. As the low-pressure air-piston is moving on its upper stroke, the air above the piston is compressed past the intermediate valves into the upper end of the high-pressure air-cylinder. The upper set of receiving valves in the low-pressure air-cylinder are forced to their seats, while the low-pressure piston is moving on the upper stroke. This prevents any air to flow to the atmosphere. As the air is compressed on the upper stroke of the low-pressure piston over to the high-pressure piston, the compression of air is admitted direct above the high-pressure piston and aids the action of the piston on the down stroke, along with the steam pressure acting on the upper end of the steam piston.

Q. 23. How is the high-pressure air-piston effected on the return stroke?

A. 23. All air that was compressed from the low-pressure air-cylinder over to the high-pressure air-cylinder on the down stroke must pass out of the discharge valve to the discharge pipe on the return stroke of the high-pressure piston. On the down stroke of the high-pressure piston, the air directly under the high pressure piston, which was previously admitted by the low-pressure piston on its down stroke, is now being compressed into the main reservoir and forced past the lower discharge valve to the discharge pipe and main reservoir.

Q. 24. Is the action of the high-pressure piston the same on both the upper and lower strokes of the piston?

A. 24. On the downward stroke of the low-pressure air piston, and the upper stroke of the high-pressure piston, the actions are the same, only the air admitted from the atmosphere passes the upper set of receiving valves on the down stroke, of the low-pressure piston and that air that is located in the air-cylinder below the piston, is compressed by the lower intermediate valves, into the high-pressure cylinder, and the air above the high-pressure piston is discharged by the upper discharge valve to the main reservoir, and the air below the high-pressure piston is discharged by the lower discharge valve to the main reservoir.

Q. 25. At what pressure does the high-pressure air-cylinder receive air from the low-pressure air-cylinder?

A. 25. The low-pressure air-piston will deliver air to the high-pressure air-cylinders at 38 to 40 pounds pressure.

Q. 26. What pressure of air does the high-pressure piston work against?

A. 26. Whatever pressure of air is located in the main reservoir.

Q. 27. Is the low pressure piston rod made hollow or is it solid?

A. 27. It is a solid piston and cuts no figure in operating the action of the main valve.

Q. 28. What pressure of steam operates the low-pressure steam piston?

A. 28. The exhaust steam from the high-pressure piston.

Q. 29. What pressure of steam will operate the compound pump so as to receive the best results?

A. 29. A high boiler pressure variating from 175 to 240 pounds of steam pressure.

DEFECTS OF A COMPOUND AIR PUMP.

Q. 1. What will cause a compound pump to knock?

A. 1. Mostly the same defects that will cause a 9½ or an 11-inch pump to knock.

Q. 2. What effect will a leaky receiving valve have on a compound pump?

A. 2. It will serve to destroy the action of the pump. When the low-pressure air-piston is compressing, it will force a per cent. of air out of the air inlet, in the position the low-pressure air-piston is compressing toward the leaky valve, and also decrease the air-pressure being compressed through the intermediate valves, to the high-pressure cylinder.

Q. 3. What effect will a leaky intermediate valve have in a compound pump?

A. 3. When an intermediate valve is leaking it will permit a per cent. of air to flow back into the low-pressure air-cylinder when the piston is moving in a position away from the intermediate valve that is leaking, and it will prevent the full supply of free air to be admitted to the low-pressure air-cylinder.

Q. 4. What will happen if the upper discharge valve was broken in the high-pressure cylinder?

A. 4. This will permit main reservoir pressure to flow back into the high-pressure air-cylinder and destroy the action of the compression of air from the low-pressure piston to the high-pressure piston on the upper stroke of the low-pressure piston.

Q. 5. What will happen if the lower discharge valve was broken in the high-pressure air-cylinder?

A. 5. The same results will happen if the lower discharge valve is broken, only in the opposite direction the low-pressure piston is moving.

Q. 6. Worn-out packing brings in the low-pressure air-cylinder?

A. 6. If the packing rings are worn out in the low-pressure air-cylinders, it prevents the proper vacuum, and very little free air is accepted to the air-cylinder. Second, it will form a poor compression between the low and high-pressure air-cylinder.

Q. 7. What effect will a leaky discharge valve have in a high-pressure air-cylinder?

A. 7. First, it will increase the speed of the high-pressure piston in the direction it is moving, away from the leaky discharge valve. Second, it will destroy the compression between the low-pressure air-piston and the high-pressure air-piston.

Q. 8. What effect will worn-out packing rings have in a high-pressure air-cylinder?

A. 8. First, it will not give the piston the proper movement away from the low-pressure piston. Second, it will not compress the proper amount of air to the main drum.

Q. 9. What will be the cause of the compound pump has uneven exhausts?

A. 9. Air valves leaking, piston-packing rings worn out, so the air will churn from one side to the other; valves unequal lift; clogged air passages in the air-cylinder, worn out packing rings on the main steam valve.

Q. 10. What will make the pump slow in accumulating the proper amount of air?

A. 10. Leaky valves, worn-out packings rings, worn out valves; valves with improper lift; dirty air inlet strainers.

Q. 11. What will give the pump a slow action in the steam cylinder?

A. 11. Worn out packing rings in the steam cylinders, worn out main valve rings in the top head.

Q. 12. What will be the cause if the air pump runs hot?

A. 12. Sticky receiving val--es, or valves having the improper lift, a dirty air inlet strainer, packing rings worn out.

Q. 13. What effect will a worn reversing plate or a worn reversing valve rod have on an air pump?

A. 13. The pump will knock, due to the fact that it over reaches its travel on the steam piston and does not cut off the steam at the proper time.

Q. 14. What causes the air pump to groan?

A. 14. Improper lubrication from the lubricator to the steam cylinder, dry air cylinder, a dry swab on the piston rod, and worn rings.

Q. 15. Why does an air pump refuse to start?

A. 15. Lack of lubrication; when a pump has been idle for several days, rust collected in cylinder. The pump should be well oiled and steam turned on quickly, this will very often start the pump.

Q. 16. What may be the cause if the pump then refuses to start?

A. 16. Loose air piston on the low pressure piston rod, nuts loose on the piston rod, reversing plate loose on the high pressure steam piston, loose steam piston head on the high pressure piston. Broken reversing valve rod. Bent reversing valve rod, bolt out of the reversing plate, broken rings on the main steam valve.

Q. 17. What may be the cause if the high-pressure steam piston operated and the high pressure air piston would not compress air to the main drum?

A. 17. The action of the steam piston may be perfect but the air piston may be loose from the low-pressure piston rod.

Q. 18. Why will the low-pressure steam piston operate if the nuts were loose from the piston rod in the high pressure air cylinder?

A. 18. This is a floating piston and can be operated through the action of the high-pressure steam piston, through the movement of the main valve in the top head.

Q. 19. What rule should be adopted to stop a compound air pump?

A. 19. The same rule adopted for a 9 1-2 inch or a 11-inch air pump.

Q. 20. How can you tell if the trouble is in the pump or pump governor, if the pump refuses to start?

A. 20. Open the drip cocks to the steam cylinder, if steam comes out of the cylinder cocks it proves the governor is O. K., trouble is in the pump. If no steam is shown at the drip cocks, it indicates the trouble is in the governor.

A. 21. How many air strainers are in use with a compound air pump?

A. 21. There are two, one for the upper set of receiving valves and one for the lower set.

Q. 22. What positions are the steam piston and rods in when the steam is shut off of the pump?

A. 22. The weight of both pistons will always find the low point in the air cylinders and steam cylinders and that is at the extreme low point of the cylinders.

Q. 23. What piston controls the action of the main steam valve?

A. 23. The high pressure piston.

Q. 24. What piston controls the action of the reversing valve rod?

A. 24. High pressure piston.

Q. 25. What does the reversing valve rod control?

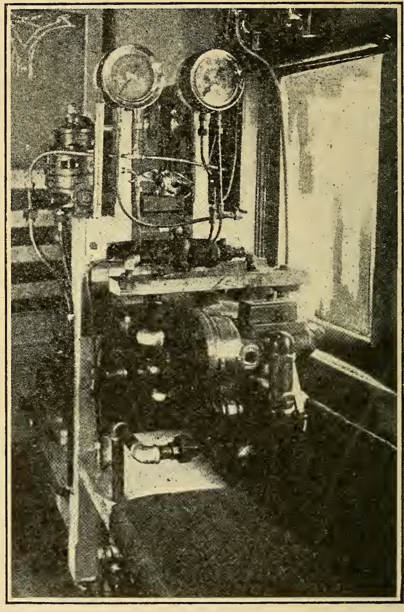
A. 25. The reversing valve.

Q. 26. What does the reversing valve control?

A. 26. It controls the action of the main steam valve, through its movements, admits steam to the right of the main valve piston, and exhausts the steam to the right of the main valve piston.

Q. 27. What does the main valve control?

A. 27. Controls the action of the high and low steam pistons both in admitting steam to the cylinders and exhausting the steam from the cylinders.



E T
EQUIPMENT.

INSTRUCTIONS AND EXAMINATION QUESTIONS.

Q. 1. What is the meaning of E. T.?

A. 1. Engine and tender also a truck brake when so desired.

Q. 2. What is the benefit of the E. T. equipment over the old style brake?

A. 2. It takes the place of triple valves, auxiliary reservoirs, gives better service, and lessens the upkeep.

Q. 3. What are the principal parts of the E. T. equipment?

A. 3.
1. Air pump governor.
2. Air pump.
3. Main reservoirs.
4. H6 brake valve.
5. Independent brake valve.
6. Duplex air gauges.
7. Distributing valve.
8. Feed valves.
9. Reducing valve.
10. Brake cylinders.

Q. 4. What are the uses of the air pump governors?

A. 4. To control the action of the air pump when the desired pressures are obtained. To which they are regulated for.

Q. 5. What are the uses of the air pump?

A. 5. To compress air to the main reservoir to be used to control the action of the air brakes.

Q. 6. What are the uses of the main reservoirs?

A. 6. They are used to store the air. The air pump is compressing, cool the air and collect all the moisture that's in the air.

Q. 7. What are the uses of the automatic brake valve?

A. 7. To operate the engine, tender, truck and train brakes.

Q. 8. What are the uses of the independent brake valve?

A. 8. To operate the engine and tender brakes only; truck brake when installed.

Q. 9. What are the uses of the duplex air gauges?

A. 9. The large duplex air gauge, the red hand indicates main reservoir pressure, the black hand equalizing pressure, the small duplex air gauge, the black hand brake-pipe pressure, the red hand brake-cylinder pressure.

Q. 10. What are the uses of the distributing valve?

A. 10. It is a small double chamber reservoir to which is attached pipe connections to distribute the air to the brake cylinders through its action and is located on the locomotive, to perform the functions of the triple valves, auxiliary reservoirs, double-seated check valves, high-speed reducing valves, etc.

Q.11. What are the uses of the feed valve?

A. 11. To regulate the standard brake-pipe pressure, when the handle of the brake valve is placed in running or holding position.

Q. 12. What are the uses of the reducing valve?

A. 12. To reduce the main reservoir pressure for the independent brake valve, and for the signal system.

Q. 13. What are the uses of the brake-cylinder?

A. 13. To hold the brake applied after an application of air is made to the cylinder.

Q. 14. What pipe is connected to the upper portion of the excess pressure head?

A. 14. The feed valve pipe pressure is connected to the upper portion of the excess pressure head.

Q. 15. What pipe is connected to the lower portion of the excess pressure head?

A. 15. The excess or main reservoir pressure pipe connects the lower section of the excess pressure head.

Q. 16. What pipe is connected to the diaphragm portion of the maximum head.

A. 16. Main reservoir or the excess pipe pressure is connected direct to the diaphragm portion of the maximum head.

Q. 17. What are the uses of the discharge pipe?

A. 17. Connects the air pump to the first main reservoir.

Q. 18. What are the uses of the connecting pipe?

A. 18. Connects the two main reservoirs together.

Q. 19. What are the uses of the main reservoir pipe?

A. 19. Connects the second main reservoir to the automatic brake valve, distributing valve, feed valve, reducing valve and air pump governor.

Q. 20. What are the duties of the feed valve pipe?

A. 20. Connecting the feed valve to the automatic brake valve.

Q. 21. What are the uses of the reducing valve pipe?

A. 21. Connects the reducing valve to the independent brake valve and to the signal system.

Q. 22. What are the uses of the brake pipe?

A. 22. Connects the automatic brake valve with the distributing valve. All the triple valves on the cars in the train.

Q. 23. What are the uses of the brake cylinder pipe?

A. 23. Connects the distributing valve with the driver brake, tender brake and truck brake cylinders.

Q. 24. What are the uses of the application cylinder pipe?

A. 24. Connects the application cylinder of the distributing valve to the independent brake valve and automatic brake valve.

Q. 25. What are the duties of the release pipe?

A. 25. Connects the application cylinder exhaust port of the distributing valve to the automatic brake valve, through the independent brake valve.

Q. 26. What are the duties of the pipe that leads from the automatic brake valve up to the duplex air gauge representing main reservoir pressure?

A. 26. To convey the air from the main reservoir up to the air gauge.

Q. 27. What are the duties of the pipe that leads from the automatic brake valve up to the air gauge that represents equalizing pressure?

A. 27. To convey the air pressure out of chamber D and the equalizing drum up to the air gauge.

Q. 28. What are the duties of the pipe that leads from the brake pipe up to the small duplex air gauge?

A. 28. To convey the air from the brake pipe up to the air gauge.

Q. 29. What are the duties of the pipe that leads from the brake-cylinder up to the small duplex air gauge?

A. 29. To convey the air from the brake-cylinder up to the air gauge representing brake-cylinder pressure.

Q. 30. What does the red hand and the black hand on the large duplex air gauge represent?

A. 30. Red hand main reservoir pressure; black hand chamber D and equalizing pressure.

Q. 31. What does the red hand and the black hand on the small duplex air gauge represent?

A. 31. Red hand brake-cylinder pressure; black hand brake-pipe pressure.

Q. 32. What are the duties of the pipe that leads from the automatic brake valve down to the equalizing drum?

A. 32. To convey the air from chamber D pressure and the equalizing pressure.

Q. 33. What are the duties of the pipe that leads from the reducing valve to the train signal pipe?

A. 33. To convey the air from the reducing valve to the train signal pipe, to which the pipe receives its air to operate the train air signal.

Q. 34. What are the duties of the back pressure valve that is located between the reducing valve and straight air pipe and signal train pipe?

A. 34. So when the straight air brake is placed into operation the train signal pipe air cannot flow back into the application chamber pipe through the action of the straight air brake valve.

Q. 35. What are the duties of the pipe that leads from the train signal pipe up to the signal valve?

A. 35. To convey the air to the signal valve.

Q. 36. What are the uses of the pipe that leads from the signal valve up to the air whistle?

A. 37. To convey the air to the signal whistle.

Q. 38. What are the uses of the back pressure valve that is located between the brake-pipe and the main reservoir pipe leading to the distributing valve known as a dead engine feature combined air strainer and check valve?

A. 38. This dead engine feature is for the operation of the locomotive brakes when the air pump on a locomotive in a train is inoperative from any cause. This figure shows the combined strainer check valve and choke. This device is not required at all times; a cutout valve is provided. This cutout valve must be kept closed except under conditions just mentioned. The air for operating the brakes on such a locomotive must be supplied through the brake pipe from the locomotive operating the train brakes.

Q. 39. In what position must the device be located between the brake pipe and main reservoir pipe?

A. 39. When the cutout valve is open, air from the brake pipe enters at the connection leading the way the arrow points, passes through the curled hair strainer, lifts the check valve held to its seat by a strong spring, passes through the choke bushing and out to the main reservoir, thus providing pressure for operating the brakes on locomotive and tender. It is a back pressure check valve and prevents the air from flowing back into the brake-pipe when brake-pipe pressure is reduced below main reservoir pressure.

Q. 40. What is the main reservoir cutout cock used for and where is it located?

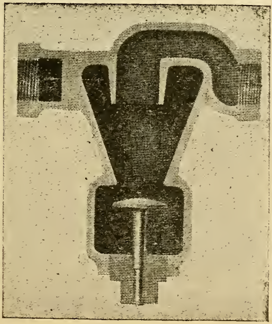
A. 40. It is located on the pipe leading to the engineer's brake valve, and must be closed and vent the air from the pipe when removing the feed valve, reducing valve, etc. Before this cutout cock is closed, the double heading valve should be closed and the brake valve handle placed in full release position? This is to prevent the slide valve, feed valve and the rotary valve of the brake valve from allowing the valves to be lifted from their seats?

Q. 41. What is the double-headed cock used for and where is it located?

A. 41. It is located on the brake-pipe underneath of the automatic brake valve and is used for double heading. This cock must be closed on the brake-pipe of all locomotives except the one on the lead to which must have full charge of the train brakes, and the handle of all brake valves must be in running position. With the handle of the valves in this position, the leading man can have full control of the brakes on all locomotives as well as the train brakes, the engineer on the second engine can apply the brakes, also release them independently of the train brakes when he so desires.

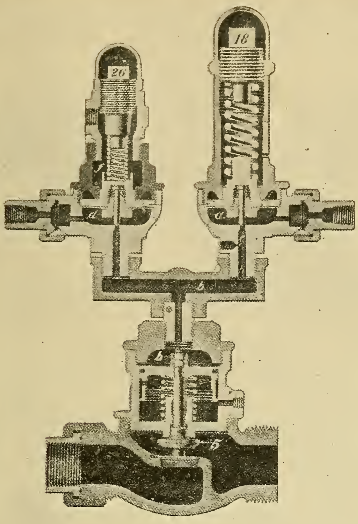
Q. 42. What are the cutout cocks used for that are located on the brake-cylinder pipes?

A. 42. Cutout cocks are placed in brake-cylinder pipes for cutting out the brake cylinders when necessary and in the engine truck and tender brake cylinders, cut out cocks are provided with a choke plug to prevent serious loss of main reservoir pressure, and the release of the locomotive brakes during a stop in case of a bursted brake-cylinder hose.



Q. 43. What benefit is derived from the centrifugal dirt collector?

A. 43. The centrifugal dirt collector is so constructed that due to the combined action of centrifugal force and gravity, all dirt and foreign matter is automatically eliminated from the air flowing through the collector, as when brakes are applied or released without reducing the area of the opening in any way. The efficiency of this method of keeping dirt out of the brake system is remarkable and the importance of this fact will be appreciated by those who are familiar with the troubles which result from the entrance of dirt, pipe scale, etc., into the brake system and especially the distributing valve. The design of the collector is such that the dirt and foreign matter eliminated falls into the bottom chamber, and by means of a plug may be removed at intervals without breaking pipe connections whatever.



THE SF-4 PUMP GOVERNOR

Q. 44. How many types of governor heads are used in connection with the steam portions of governor attached to the E. T. equipment?

A. 4. Two; the excess pressure head and the maximum head.

Q. 45. What is the benefit of the excess pressure head?

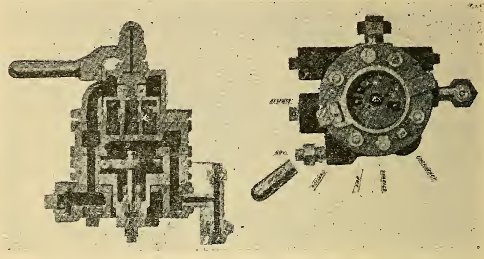
A. 45. It automatically takes care of the main reservoir pressure, through the action of the feed valve pressure, and an excess pressure spring of 20 pounds.

Q. 46. How does the action take place?

A. 46. By the change of the feed valve or brake-pipe pressure.

Q. 47. Does the change of the brake valve handle affect the maximum head?

A. 47. No. This head of the governor is connected direct to main reservoir pressure.



H 6 Automatic brake valve.

Q. 48. How many positions has the H 6 brake valve?

A. 48. There are six positions: 1. Full release; 2. running position; 3. holding position; 4. lap position; 5. service position; 6. emergency position.

Q. 49. Explain the flow of air through the brake valve in full release position?

A. 49. In release position there is a direct opening between the main reservoir brake-pipe and equalizing drum, to permit a rapid flow of air into the brake-pipe, so as to charge the brake system quickly, release and recharge the auxiliary reservoirs, but not to release locomotive or tender brakes if they are applied.

Q. 50. Explain the flow of air through the brake valve into running position.

A. 50. This is the proper position for the automatic brake valve handle, when the brakes are charged and ready for service, when the brakes are not being operated, and to release the engine and tender brakes in this position there is a large opening for air to flow from the feed valve to brake-pipe ,this opening is sufficiently large enough to charge the brake-pipe as fast as the feed valve will supply it. But the pressure cannot exceed that of the feed valve, also the equalizing reservoir charges uniformly with the brake-pipe, keeping the pressures on both sides of the equalizing piston equal, main reservoir pressure is at all times above the rotary valve. It also passes to the lower portion of the excess pressure head of governor, the distributing valve release pipe is in connection with the atmosphere.

Q. 51. Holding position?

A. 51. This position derives its name "holding" because the locomotive and tender brakes remain applied while the train brakes are releasea and the auxiliary reservoirs are recharged to the feed valve pressure.

Q. 52. What are the uses of lap position with the H 6 brake valve?

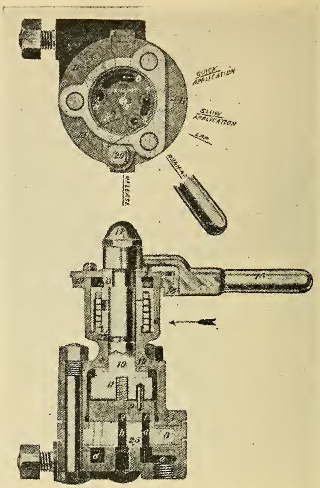
A. 52. The position to which all ports are closed and used to hold the brakes applied after a service application, until it is desired to make a further reduction in brake pipe pressure or release them.

Q. 53. What are the uses of the H 6 brake valve in service position?

A. 53. Service position. This position gives a gradual reduction of brake-pipe pressure to cause a service application, the gradual reduction prevents quick action, the brake-pipe discharge is so gradually stopped so as to prevent the pressure at the head end of brake-pipe being built up by the air flowing from the rear, which in turn would release some of the head brakes.

Q. 54. What are the uses of the emergency position?

A. 54. This position is used in case of danger or when the operator of the valve desires to make a prompt and heavy application of the brakes. It prevents the loss of main reservoir pressure and insures that the brakes remain applied in the event of a bursted hose, the use of a conductor's valve, or train parting. In this action of the brake valve and a sudden reduction of brake-pipe pressure causing the triple valves and distributing valves to move to emergency position, giving the full braking powers in a short period of time. In this position, locomotive, tender and truck brakes the cylinder pressure is maintained against leakage.



S6 Independent Brake Valve.

Q. 55. How many positions has the S6 independent brake valve?

A. 55. There are five positions:

1. Release position.
2. Running position.
3. Lap position.
4. Slow application position.
5. Quick application position.

Q. 56. What are the uses of release position?

A. 56. This position is used to release the pressure from the application cylinder when the automatic brake valve is not in running position.

Q. 57. What are the uses of running position?

A. 57. The position that the independent brake-valve should be carried in at all times when the independent brake is not in use. This position of the brake-valve handle opens communication through the distributing valve release pipe between the application cylinder of the distributing valve and a port in the automatic brake-valve, so that the distributing valve can be released by the latter. If the automatic brake-valve handle is in running position and the independent brakes are being operated, they can be released by simply returning the independent valve to running position, as the application cylinder pressure can then escape through the release pipe and automatic brake-valve.

Q. 58. What are the uses of lap position with the independent brake-valve?

A. 58. This position is used to hold the independent brake applied, after the desired cylinder pressure is obtained, at which time all communication between operating ports are closed.

Q. 59. What is the benefit of slow application position?

A. 59. To apply the independent brake lightly or gradually move the brake valve handle to the slow application position. This admits reducing valve air through the application cylinder pipe to the application cylinder of the distributing valve.

Q. 60. How can quick application be obtained if so desired?

A. 60. To obtain quick application of the independent brake move the handle of the independent valve to quick application position. This position provides a larger opening between the reducing valve pipe and application cylinder pipe than it did in slow application position, allowing the supply of air to flow more rapidly from the reducing valve pipe to the application cylinder of the distributing valve.

Q. 61. What prevents the brake-cylinder pressure from exceeding 45 pounds?

A. 61. The reducing valve being regulated at 45 pounds, this is the maximum cylinder pressure that can be obtained with the use of straight air-brake valve.

Q. 62. What is the benefit of the return spring on the independent brake-valve?

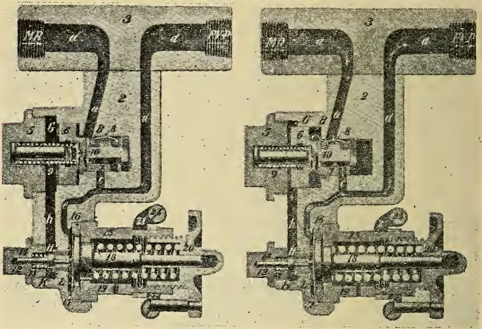
A. 62. To automatically return the handle from release to running position or from quick application position to slow application position.

Q. 63. How will the engineer be warned if the spring breaks that controls return action from release position to running position?

A. 63. As a warning in case of a broken spring air is allowed to escape from the reducing valve pipe to the atmosphere.

Q. 64. What will happen if the independent brake valve handle is left in full release position?

A. 64. It would be impossible to operate the locomotive brake with the automatic brake valve.



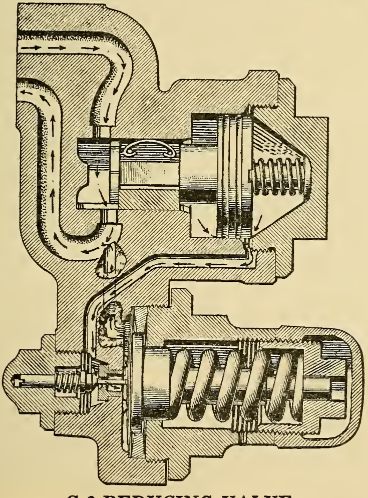
A. 65. Explanation of the B. 6 feed valve furnished with the No. 6 equipment is an improved form of the slide-valve type. It differs from previous ones in charging to the regulated pressure somewhat quicker and in maintaining pressure more accurately under the variable conditions of short and long trains, and of good and poor maintenance. Also gives high and low brake-pipe control. It is supplied with air directly from the main reservoir. It regulates the pressure in the feed valve pipe and in the brake-pipe when the handle of the automatic brake valve is in running position or holding position, these two pipes being connected through the brake valve. It is connected to a pipe bracket located in the piping between the main reservoir and the automatic brake valve and is interchangeable with previous types.

Q. 66. What pressure of air escapes through the warning port?

A. 66. Automatic brake valve in release position. The warning port is supplied from the feed valve pipe. This insures that the excess pressure governor head will register the brake-pipe pressure in release position even though the feed valve is leaking slightly but not enough to do otherwise.

Q. 67. What are the distinguished features of the feed valve?

A. 67. The distinguished feature of this type of feed valve is the duplex adjusting arrangement by which it eliminates the necessity of two feed valves in high and low service. The spring box has two rings encircled around it, which are split through the lugs and which can be secured in any position by the screw. The pin forming part of adjusting handle limits the movement of the handle to the distance between the stops 21 and 22, and when testing the valve the stop 21 is located so that the compression of the spring will give desired high brake pressure and stop 22 so that the spring compression is enough less to give the low brake-pipe pressure. Thereafter, by simply turning handle 20 until the pin strikes either one of these stops the



C 6 REDUCING VALVE.

regulation of the feed valve is changed from one brake-pipe pressure to the other.

Q. 68. At what pressure should the B 6 valve be set to close?

A. 68. The feed valve should be set to give 110 pounds brake-pipe pressure and 70 pounds brake-pipe pressure.

Q. 69. What caution should be taken when placing on a feed valve?

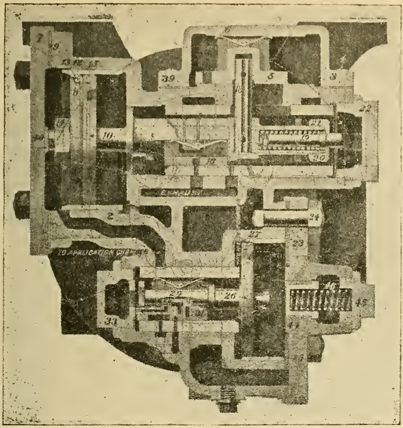
A. 69. When replacing the feed valve on its pipe bracket after removal, the gasket located between the feed valve and bracket should always be renewed so as to insure a tight joint.

Q. 70. Where has the C 6 reducing valve been in use for the past few years?

A. 70. The C 6 reducing valve is the well-known feed valve that has been used for many years in connection with the G 6 brake valve, but in this equipment is attached a pipe bracket. The only difference between the C 6 valve and the B 6 valve just described is in the adjustment, it being designed to reduce main reservoir pressure in a single fixed pressure, which in this equipment is always set to adjust 45 pounds. To adjust this valve remove cap-nut on the end of the spring box. This will expose the adjusting nut, by which the adjustment is made. It is called a reducing valve when used with the independent brake valve and air signal system simply to distinguish it from the feed valve supplying the automatic brake valve.

Q. 71. When the signal valve is installed on a locomotive with the E. tee equipment, where does it receive its air supply from?

A. 71. When the air signal system is installed it is connected to the reducing valve pipe, in which case the reducing valve takes the place of the signal reducing valve formerly employed. In the branch pipe supplying the air signal system is a combined strainer check valve and choke fitting. The strainer prevents any dirt from reaching the check valve and choke fitting; the check valve prevents air from flowing back from the signal pipe when the independent brake is applied; the choke fitting prevents the reducing valve from raising the signal-pipe pressure so quickly as to destroy the operation of the signal.



Q. 72. How is the air admitted to the pressure chamber of the distributing valve?

A. 72. Precisely in the same manner as the triple valve charges the auxiliary reservoir, brake-pipe pressure enters the distributing valve at brake-pipe connection, filling the chamber on the lower side of the piston, passes through the feed groove located in the chamber above the piston, thence to a port opening leading to the pressure chamber. This continues until the pressures equalize in the pressure chamber and brake-pipe.

Q. 73. How is the distributing valve placed into action by the use of the automatic brake valve?

A. 73. The pressure chamber and the brake-pipe pressures are equal. A reduction in the brake-pipe pressure weakens the pressure in the lower side of the piston. This in return permits the air in the pressure chamber to be the greatest and moves the equalizing piston to the right, carrying with it the slide valve. The piston keeps on moving until the knob on the piston strikes the graduating sleeve, which closes the exhaust port leading from the application chamber to the distributing valve release pipe, and the graduating valve is moved to the right until it uncovers the service port, which leads to the application chamber and cylinder. This movement allows air from the pressure chamber to flow to application cylinder and chamber. This pressure forces the application piston and exhaust valve and application valve to position to apply brakes in an automatic service application. When the pressure in pressure chamber falls slightly below brake-pipe pressure equalizing piston moves back, carrying with it the graduating valve, without moving the slide valve, until the graduating valve closes off communication between the pressure chamber and application chamber. The valve is now moved to service lap position.

Q. 74. How is the automatic brake released on the engine and tender?

A. 74. As soon as the brake valve is placed in release position the brake-pipe pressure is increased above the air located in the pressure chamber of the distributing valve. This forces the equalizing piston to the left, and the parts controlled by the piston, in this position the pressures from the application cylinder and chamber are free to pass through the openings leading to the independent brake valve to the automatic brake valve from there to the atmosphere as soon as the automatic brake valve handle is placed in running position. The escape of these pressures from the application cylinder is reduced; the pressure on the opposite side of the piston forces it to the left, carrying all valves attached in connection with it. This permits the air to escape from the brake cylinders to the atmosphere through the ports in the seat and slide valve. The brakes on the locomotive then releases.

Q. 75. How is the automatic emergency application made with the H 6 brake valve?

A. 75. When there is a quick reduction made in the brake-pipe pressure the equalizing piston slide valve and graduating valve are moved to their full travel with sufficient force to permit the knob on the equalizing piston to compress the graduating spring, the piston striking the cylinder cap gasket. At this move the port to the application cylinder is wide open and the port to the application chamber is blanked off. The application cylinder being so small in proportion to the chamber, this allows the air from the pressure chamber to build up faster and higher than when the application chamber is in service. This, then, in return applies the brakes much quicker and with a greater force than in full service position.

Q. 76. Is there any other time when the application chamber and application cylinder are not connected?

A. 76. No; only in emergency position.

Q. 77. Why does the application cylinder pressure build up higher in the emergency position than when in service position with the H 6 valve?

A. 77. When the automatic brake valve occupies the emergency position, main reservoir pressure feeds through the ports in the rotary valve and seat into the application pipe to the application cylinder.

Q. 78. Does this increase the brake-cylinder pressure?

A. 78. If the brake-pipe pressure is 70 pounds the brake-cylinder pressure will be about 65 pounds.

Q. 79. How is the automatic brake released after an emergency application?

A. 79. Release after an emergency application is brought about by the same action of the automatic brake valve as in full service position, but the effect on the distributing valve is somewhat different. When the equalizing piston and slide valve and graduating valve are moved to release position by the increased brake-pipe pressure and the pressure spring the application chamber is at zero. This is then connected to the application cylinder, the pressure in the application cylinder flows back into the application chamber, until both pressures are equal to about 15 pounds pressure, and brake-cylinder pressure will be reduced in the same amount until brake valve handle is placed in running position.

Q. 80. How is the increased pressure in the brake cylinder protected?

A. 80. By a safety valve set for 68 pounds.

Q. 81. Can the E. T. equipment be used in connection with all style of car brakes?

A. 81. Yes; it can be operated on high speed or local trains, fast freight or slow freight; also switching service without modifying its parts.

Q. 82. Are there any special instructions given to operate the E. T. equipment?

A. 82. The instructions for operating the E. T. equipment are practically the same as those used to operate the old combined automatic and straight air-brake. Therefore it is not necessary to change the instructions to receive any better results.

Q. 83. What positions should the H 6 and the independent brake valve handle occupy while pulling a train en route?

A. 83. The handles of both valves should occupy running position.

Q. 84. How do you apply the brakes in service position?

A. 84. To apply the brakes in service position move the handle of the automatic brake valve to service position. Make the required reduction off of the top of the equalizing piston and out of Chamber D and the equalizing drum. Brake-pipe pressure will then follow on down to the decreased pressure equal to the pressure taken off of the top of the equalizing piston. Then move the handle of the valve to lap position. This is the position to hold the brake applied.

Q. 85. How should you operate the brake valve to make a two-application stop with a passenger train of 10 cars or less?

A. 85. Make the first application sufficiently heavy enough to bring the speed of the train down to 15 miles per hour at a proper distance before going to stop; then release and immediately return to running position for an instant. This will permit the brake-pipe and equalizing drum pressure to equalize and also to release part of the brake-cylinder pressure. Then move the handle of the valve to lap position, and from there to service position. To operate the valve in these positions the time allotted should be governed according to the length of train, the number of cars and brake-pipe reduction.

Q. 86. When should the final release on a train of 10 cars or less in passenger service be?

A. 86. Just before the train comes to a stop.

Q. 87. How should the brakes be released on a train of more than 10 cars in passenger service?

A. 87. After the train comes to a stop place the automatic brake valve handle into full release position, then to running position to release engine and tender brakes.

Q. 88. How should the brakes be released on a freight train?

A. 88. With a long freight train and cars attached to the locomotive and tender, wait until the train stops.

Q. 89. How should the brake be released on a freight train of 25 cars, if speed is reduced to 15 miles per hour?

A. 89. With a train of 25 cars equipped with the K triple valves, the brake valve handle should be moved to release position and held there long enough to move as many triple valves to release position as possible without overcharging the brake-pipe on the head-end of the train; then returned to running position to release the engine and tender-brakes; also to complete the charging of the brake pipe and auxiliary reservoir a few minutes after the valve is moved to running position. Then return to full release for a second of time so as to release any brake in the train that may have crept on, and then back to running position.

Q. 90. How to hold engine and tender brakes applied?

A. 90. When releasing train brakes, and it is desired to hold the engine and tender brakes applied, move the handle of the automatic brake valve from release position to holding position. When desired to release the engine and tender brakes immediately, move handle of automatic brake valve to running position. If you desire to graduate the brakes off, move the handle quickly from holding position to running position and back to holding position. The valve may be operated in this manner until the engine and tender-brakes are entirely released.

Q. 91. In what position would you place the automatic brake valve handle if short-flagged or you desire to stop in a short space?

A. 91. To apply the brakes in the emergency position the handle of the automatic brake valve should be moved to emergency position and left there until the train stops.

Q. 92. For what is release position used?

A. 92. Release position is used to release train brakes without the release of engine and tender-brakes, after all brakes in the train have been applied.

Q. 93. What will happen if the brake valve is left in full release position too long?

A. 93. If the brake valve handle is left in full release position too long the brake-pipe pressure will equalize with main reservoir pressure. To avoid this there is a warning port to notify the engineer that the valve is in the wrong position. It must be returned to running or holding positions, just as the engineer desires.

Main reservoir pressure also will flow to the lower connection of the excess pressure head.

Q. 94. What air pressure escapes through the warning port?

A. 94. Feed valve air pressure.

Q. 95. Should the brake valve handle occupy running position when attaching empty cars?

A. 95. No; release position at all times. If the valve handle is left in running position the brake-pipe pressure will be reduced so rapidly that the pressure above the excess pressure head will not be supplied with air. Therefore, the main reservoir pressure will place the governor into action and the air pump will cease to operate until the main reservoir pressure hand on the gauge registers 20 pounds. Hold the handle of the valve in full release position until the feed valve pressure is within 20 pounds of what the feed valve is set for.

Q. 96. When should release position be used while pulling train en route?

A. 96. Release position should always be used on heavy-descending grades so as to guarantee a recharge of the brake system quickly. In release position the excess pressure head will permit the brake-pipe pressure to maintain a constant pressure of 20 pounds above the feed valve regulations.

Q. 97. How is the excess pressure head of the governor connected so as to control the speed of the air pump?

A. 97. The excess pressure head is so arranged to restrict the speed of the pump when the desired main reservoir pressure is obtained while pulling the train en route. The automatic brake valve occupying running position, little excess pressure is needed, only a sufficient amount to operate the feed valve automatically and correctly. But main reservoir pressure is always in advance of the brake-pipe pressure 20 pounds. But when the valve handle occupied lap position to hold the brakes applied, after there was a reduction in brake-pipe pressure, then the excess pressure head is out of service and the maximum head is in service. High main reservoir pressure is needed to release the brakes promptly and to insure a quick recharge of the brake system. After the automatic brake valve is placed in full release position with the action of the maximum governor in service, while the automatic brake valve was in lap position, the maximum head permitted the pump to operate until the pressure in the main reservoir reached the pressure the maximum pressure the governor was set for. Through this action the pump was under control of the maximum head. Again, when there is a change in the brake-pipe pressure, so is there a change in the main reservoir pressure through the action of the excess pressure head.

DOUBLE-HEADING.

Q. 98. How can the engineer on the rear engine protect his engine, tender and truck-brakes if so desired?

A. 98. Both the automatic and independent brake valve handles must occupy running position. Then the brakes on all engines, tenders and trucks can be applied and released from the leading engine. In the case where a brake must be operated or released on any of the assisting engines, it can be done with the independent brake valve either in release or application positions.

Q. 99. How can the engine, tender and truck-brakes be used independently of the train-brakes?

A. 99. Engine, tender and truck-brakes may be used with or without train-brakes if so desired, without regard to the position of the engine in the train.

Q. 100. How much variation in pressure should there be between the excess pressure head and the maximum head of the air-pump governor?

A. 100. There must always be a variation of not less than 20 pounds. If the excess pressure head is adjusted to control the pump at 90 pounds, the maximum head must be adjusted to control the pump at 110 pounds. This is to insure a prompt release of all brakes.

Q. 101. How should the brakes be operated on a grade?

A. 101. The brakes on the engine and train may be operated together or alternated on special designated grades where conditions require it so as to prevent the overheating of tire. Care must be taken in use of driver-brakes to prevent overheating of tires.

Q. 102. How can the engine and tender-brakes be released?

A. 102. If all the brakes in the train are applied the engineer can graduate the engine, tender and truck-brakes off, if so desired, with the independent brake valve, or he can release the brakes immediately by using the valve in full release position.

Q. 103. In what manner should long trains be operated?

A. 103. In operating long trains the independent brake valve should be operated with good judgment, running in slack or out, so as to prevent damage to draw-heads and the laden of freight. In cases where damage appears while using the independent brake valve apply the automatic brake immediately. The safety valve will protect the brake-cylinder pressure.

Q. 104. What pressure does the black hand register on the large duplex air-gauge; also the red hand?

A. 104. Black hand represents equalizing pressure; red hand main reservoir pressure.

Q. 105. What pressure does the red hand on the small duplex gauge indicate?

A. 105. Brake-cylinder pressure, when the brake is applied.

Q. 106. What pressure does the black hand on the small duplex gauge indicate?

A. 106. Brake-pipe pressure at all times, and is very beneficial to all helper engines. When the double-head valve is closed it will indicate the pressure of air the leading engine has in the brake-pipe; also will show you the amount of air reduced in the brake-pipe when the automatic brake valve is placed into action, and when he releases the brake how fast brake-pipe pressure is built up. It will also tell you if the angle-cock is closed anywhere ahead of the engine you are operating.

Q. 107. What benefit is the red hand on the gauge which represents brake-cylinder pressure?

A. 107. It will tell you if the brake is creeping on while pulling the train en route.

Q. 108. What position should the automatic brake valve occupy when you want to adjust the excess pressure head?

A. 108. Running position at all times.

Q. 109. When is the emergency action of the brake necessary?

A. 109. First, to save life, and, second, company's property.

Q. 110. When moving the engine and tender at any time, or the engine is to remain standing, what position should the independent brake valve handle occupy?

A. 110. Application position, to apply the brake, and, after engine and tender have come to a full stop, application position at all times.

Q. 111. What course should the engineer pursue in case an emergency brake with a passenger train, either by a bursted hose or a defective pipe?

A. 111. Passenger service, move handle of the automatic brake valve to full emergency position and leave it there in that position until notified by the train crew.

Q. 112. In freight service?

A. 112. In freight service, move the handle of the automatic brake valve to lap position so as to protect main reservoir pressure. Leave it there until the train crew notifies you that they are ready to release brakes.

Q. 113. What is the object of using the brake valve in the above manner?

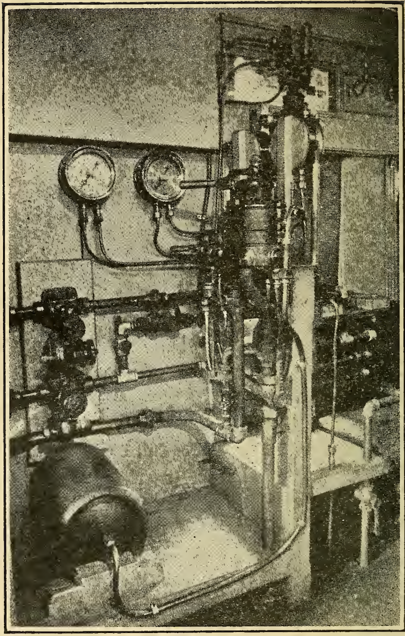
A. 113. This prevents the loss of air from the main reservoir; a guaranteed full set brake after train is stopped, the cause of the application can be located and trouble remedied before proceeding.

Q. 114. What are the instructions issued where two or more locomotives are attached together in a train?

A. 114. The instructions issued are the same as with those of the G 6 valve; all double-headed valves closed underneath of the brake valves except the one on the leading engine. This must remain open, as the engineer on the leading engine must take full charge of the train-brakes and engine's brakes.

Q. 115. What is the engineer's duty before leaving the engine house?

A. 115. See that both brake valves are in good working condition; no leaks occur at the valves or the distributing valves or pipes. If there are any, have same repaired at once. If this is done, then the engineer can rely on good brakes.



DEFECTS AND REMEDIES E. T. EQUIPMENT.

Q. 1. What would you do if you broke the pipe off leading up to the air gauge representing equalizing pressure?

A. 1. Plug the pipe at pressure end, proceed, using the black hand on the small duplex air-gauge representing brake-pipe pressure.

Q. 2. What would you do if you broke the pipe off leading to the air-gauge that represents brake-pipe pressure?

A. 2. Plug the pipe at pressure end, proceed, using the gauge-pipe pressure that represents the equalizing pressure.

Q. 3. What would you do if you broke the pipe off leading to the air-gauge that represents main reservoir pressure?

A. 3. Plug the pipe at pressure end, proceed, place the handle of brake valve in running position. You must receive main reservoir pressure before you can receive equalizing pressure and brake-pipe pressure.

Q. 4. What would you do if you broke the pipe off leading to the air-gauge representing brake-cylinder pressure?

A. 4. Plug the pipe up, proceed, depending on safety valve to take care of brake-cylinder pressure.

Q. 5. What would you do if you broke the pipe off leading from the brake valve down to the equalizing drum?

A. 5. Plug the pipe at the brake valve; also brake-pipe exhaust; carry the brake valve handle in running position. To make a stop, use it in the emergency position with care.

Q. 6. What would you do if you broke the tee off in the engineer's brake valve representing the equalizing pressure and equalizing drum pressure?

A. 6. Plug the hole at the pressure end, carry brake valve handle in running position, let the hand that represents brake-pipe pressure be the register, use valve in the emergency position with care when wanting to apply brakes, plug brake-pipe exhaust, at the same time plugging the tee connection.

Q. 7. What would you do if you broke the brake-pipe off below the double-head valve, and you wanted to proceed?

A. 7. Close the double-headed cock off beneath the brake valve; also close the cutout cock to the driver and truck brake cylinders; couple the straight air-brake hose on the engine to the automatic hose on the tender; place the straight air-brake valve into application position; set the reducing valve up to register a pressure of 70 pounds. To apply the brakes place the independent brake valve into full release position, graduating the train brakes on. To release them put it in full application position. If the choke at the cock at the rear of the engine interferes with making a reduction in the brake-pipe remove it and place the hose on the pipe without three-quartercock attached. Test the brakes before proceeding, leaving the brake-pipe pressure release out of the exhaust of the distributing valve and the application cylinder pressure release out of the straight air-brake valve to apply brakes. "I tested this out on a nine-car train."

Q. 8. What would you do if you broke the brake-pipe off between the distributing valve and cutout cock?

A. 8. Close the cutout cock, proceed, using the independent air-brake.

Q. 9. What would you do if you broke the pipe off between the brake-pipe and cutout cock?

A. 9. Plug the pipe at pressure end, proceed, using the independent air-brake.

Q. 10. What would you do if you broke the pipe off ahead of the tee connection leading to the distributing valve?

A. 10. Plug the pipe at pressure end, proceed, using the automatic brake and independent brake.

Q. 11. What would you do if you broke the pipe off leading from the brake-pipe to the dead engine feature?

A. 11. If broken between brake-pipe and dead engine features, plug the pipe. If broken between the cutout cock and dead engine features close the cutout cock. If double-heading, this would prevent the use of engine and tender-brake, providing the air pump was disabled on that engine.

Q. 12. What would you do if the pipe broke off between the dead engine feature and the connection to the main reservoir pipe that supplies the main reservoir with air?

A. 12. Close the cutout cock on the dead engine features, plug the pipe at the pressure end and proceed, using the automatic and independent brakes.

Q. 13. What would you do if you broke the pipe between the tee and cutout cock on pipe supplying distributing valve with air?

A. 13. Plug the pipe at pressure end, shut the cutout cock, open the cock leading to the dead engine features, leaving the brake-pipe supply the air to the brake-cylinders when using the independent brake valve.

Q. 14. What would you do if you had a train attached to the engine and tender?

A. 14. First, set the engine and tender brakes with the independent brake valve, filling the brake-cylinder with air from the brake pipe, then use the automatic brake valve to operate train brakes. The check valve will prevent the brake-pipe from receiving any air back that is located ahead of the back-pressure valve.

Q. 15. What kind of a leak would it be if the cylinder cover gasket was leaking?

A. 15. A cylinder leak or application leak.

Q. 16. What kind of a leak would it be with the cylinder cap gasket leaking?

A. 16. Represents a brake-pipe leak.

Q. 17. What kind of a leak would it be with the application valve cover leaking?

A. 17. Main reservoir leak.

Q. 18. What kind of a leak would it be with the upper cap nut leaking?

A. 18. Brake-cylinder leak.

Q. 19. Lower cap nut leaking, what would it represent-

A. 19. Pressure chamber leaking.

Q. 20. What kind of a leak would it be with the graduating spring nut leaking?

A. 20. A brake-pipe leak.

Q. 21. What effect will a leak have on the application cylinder leather?

A. 21. When the leather is leaking on the application cylinder piston the air passes by the leather, destroys the action of the brake and, with a slight leak in the brake-cylinder pipes, the brake will leak off, when either brake valve is on lap position.

Q. 22. What will prevent the brake from applying on the engine and tender with the automatic brake valve?

A. 22. Equalizing pressure not charged up with brake-pipe pressure. When there is a reduction in the brake-pipe pressure, the pressure chamber not being charged up to the equal pressure, will not move the equalizing piston.

Q. 23. If there is a burst hose between the engine and tender, or between the driver-brake and truck-brake, or the hose was leaking, will that affect the brake-cylinder on the opposite side of the leak?

A. 23. No; choke fittings of a special design will take care of application pressure which comes direct from the main reservoir.

Q. 24. What pressure of air sets the brake either with the automatic brake valve or independent brake valve?

A. 24. Main reservoir pressure.

Q. 25. What pressure of air works the application piston?

A. 25. With the operation of the automatic brake valve. The air out of the pressure chamber.

Q. 26. What pressure of air works the application piston when the independent brake valve is placed into operation?

A. 26. The reduced main reservoir pressure passing through the straight air-brake valve to the application pipe and cylinder, then to the application piston, gives the movement of the application piston and valve permitting main reservoir pressure to apply brakes.

Q. 26. What would you do if the branch pipe leading to the feed valve and reducing valve was to break?

A. 26. Drive wooden plugs in both ends of the broken pipes. Through this action the independent brake valve, signal system, feed valve to the automatic brake valve are out of service. This does away with running position and holding position with the automatic brake valve. Also the excess pressure head of the governor is out of service. Place in a blank washer at the lower portion of the governor, allowing the maximum head to control the pump, set the governor for 20 pounds in advance of what the feed valve was regulated for, as the independent brake valve is now free from any air pressure on top of the rotary valve, it is impossible to hold the valve to its seat. Under these conditions automatic application of the brakes are impossible. To overcome this defect move the independent brake valve handle to slow application position before applying brakes and leave it in that position until you desire to make a release of brakes. When the automatic brake is to be released on the engine and tender return the independent brake valve handle to running position. Remember, the train brakes are released by carrying the automatic brake valve handle in release position. The brakes on the locomotive can be released by moving the handle of the automatic brake valve to running position or the independent brake valve to release position.

Q. 27. What would you do if you broke the pipe leading to the feed valve, and the reducing valve and pipe work was O. K.?

A. 27. This break renders the feed valve useless. Plug the pipe at both ends, place the automatic brake valve in full release position, set the maximum head of governor 20 pounds in advance of the feed valve pressure, place a blank washer in at the lower end of the excess pressure head, carry the automatic brake valve handle in full release position while pulling train en route, apply and release the engine, tender and train brakes just the same as if there was no defect to the feed valve. Release the engine and tender brakes with the independent brake valve in running or full release position, just as desired.

Q. 28. What would you do if you broke the pipe off leading from the main reservoir up to the automatic brake valve, and it was broken between the tee connection leading to the distributing valve and brake valve?

A. 28. Plug the pipe at the pressure end; also put a blank washer in at the feed valve pipe next to the automatic brake valve; plug the application pipe next to the automatic brake valve; set the maximum pressure head of governor for 20 pounds advance of feed valve pressure, providing it is connected to main drum pressure direct, if not, control the speed of the pump with pump throttle. After the brake valve and governor is fixed so as to give you the desired amount of air pressure, plug the distributing valve, release pipe next to the distributing valve, apply the straight air-brake and set the reducing valve to 70 pounds pressure registered on the gauge. Release the brake by placing the straight air brake valve into full release position, then connect the straight air-hose on the engine to the automatic hose on the tender, shut the cutout cock to the driver and truck brake cylinders, carry the independent brake valve into application position. To charge the train-brakes to apply the brakes place the independent brake valve into full release position, graduating the application cylinder pressure out of the independent brake valve, and the brake-pipe pressure will be released out of the brake cylinder exhaust port at the distributing valve. Test brakes before proceeding.

Q. 29. What would you do if you broke the pipe off between the reducing valve and the feed valve?

A. 29. Plug the pipe at both ends. This does away with the straight air-brake signal system. But the automatic brake can be operated on engine, tender and train; the independent brake valve must be operated the same as Question 26.

Q. 30. Where a pipe is broken beyond a feed valve or reducing valve, what other course can be taken to save main reservoir pressure?

A. 30. Run the adjusting nut back and relieve the pressure against the regulating valve. This will prevent the escape of main reservoir pressure. If there is an escape of air due to a defective valve, then plug the pipe.

Q. 31. What other way can the automatic brake be operated on the engine, tender and truck?

A. 31. If the pipe is broken beyond the reducing valve so no air can be supplied to the straight air-brake valve, plug the broken pipe at the independent brake valve; also plug the exhaust port at the bottom of this valve. The automatic brake can then be operated on the engine, tender and truck brakes by placing the independent brake valve in running position?

Q. 32. What would you do if you broke the brake-pipe off ahead of the tee connection leading to the distributing valve?

A. 32. If the brake-pipe is broken at any point ahead of the tee connection leading over to the distributing valve plug the pipe and proceed. This will not affect the action of the distributing valve.

Q. 33. What would you do if you broke the brake-pipe off at the rear of the tee connection leading over to the distributing valve?

A. 33. Plug the pipe; also drain the air out of the equalizing chamber. The automatic brake on the engine and tender is useless, but the independent brake can be applied and released with the independent brake valve.

Q. 34. What would you do if you broke the brake-cylinder pipe off leading from the distributing valve to brake-cylinders?

A. 34. This renders both brakes useless, and the cutout cock on the main reservoir supply pipe to the distributing valve must be closed; also close the cutout cock on the branch pipe leading to the distributing valve from the brake-pipe, open the drain-cock on pressure chamber.

Q. 35. What would you do if the application cylinder pipe broke off next to the distributing valve?

A. 35. Plug the pipe at the distributing valve. The independent brake cannot be applied, but the automatic brake can be operated with the automatic brake valve.

Q. 36. What would you do if the application cylinder pipe broke off between the automatic brake valve and the tee to the independent brake?

A. 36. The independent brake can be applied and released in the usual way, but the emergency maintaining features are lost.

Q. 37. What would you do if the pipe was broken off between the tee and the independent brake valve?

A. 37. The locomotive brake cannot be operated by the independent brake valve, but the emergency features are retained.

Q. 38. What would you do if the release pipe of the distributing valve was to break next to the distributing valve?

A. 38. Plug the pipe next to the distributing valve. The locomotive brake can be held applied as above, but to release them the independent brake valve handle must be placed in full release position.

Q. 39. What would you do if the release pipe broke off between the independent and the automatic brake valve?

A. 39. The locomotive brakes can be applied while the train brakes are being released and recharged; place the independent brake valve to lap position to hold the engine and tender brake applied, and to release them place the independent brake valve handle in running position.

Q. 40. Is there any other remedy for a broken release pipe between the independent brake valve and automatic brake valve?

A. 40. Yes; plug the broken release pipe on the distributing valve side. The engine and tender brakes can be released by placing the independent brake valve in full release position.

The above photograph represents the first number of soldiers undergoing the training in the air-brake instruction car in reference to the machinery questions and answers. While the first class was being instructed on the air-brake subject, the second class had the machinery training.

U. S. A.

This photograph represents one of the locomotives that was built for General Pershing's railroad in France. The number is 416, U. S. A., and was used while training the old experienced firemen to be promoted to engineers for overseas duty either in France or Siberia, and also to be used as engineers in America when they return if so desired. The writer of this book was their manager and trainer, and he will guarantee they can take an examination on any railroad in this country or a foreign country for the above positions.

CAMP COPPEE.

ARMY CAMP OPENS AT LEHIGH UNIVERSITY TO TRAIN ENLISTED AND DRAFTED MEN FOR GENERAL PERSHING FOR OVERSEAS DUTY IN FRANCE.

During the winter there came a call from General Pershing for specially trained men to act as locomotive engineers and firemen. To help fill this need it was decided to open army vocational schools at all approved technical colleges, so the trustees and faculty by unanimous action placed at the disposal of the War Department our teaching force and equipment, so, naturally, the Lehigh College was chosen as the site of one of these schools. Dr. Drinker and Dr. Emery worked hard, with the aid of the faculty and the entire staff of the University, in preparing for this camp. The courses were so arranged that an appeal was made to the officials of the Philadelphia & Reading Railroad to assist in this patriotic training and was secured. Mr. Charles H. Ewing, the Federal Manager, placed at Bethlehem the Air-Brake Instruction Car Engine 416, U. S. A., and also a camp, for the disposal of the college. This camp was directly under the management of Mr. A. W. Deal, Sr., the well-known railroad expert and demonstrator, who gave the soldiers their instruction and examination; also the practical handling of locomotives in railroad service, both in firing and engineering.

Lieutenant Colonel Granville Clarke, the gentleman who is at the head of the Education Board at Washington, D. C., made an unexpected call on the Air-Brake Instruction Car located at South Bethlehem, Pennsylvania, on Sunday, June 23, 1918, about 3.30 P. M. In company with the Lieutenant Colonel there were a number of gentlemen who desired to have a class held in the Air-Brake Instruction Car, the same that was given to the soldiers. To make a thorough inspection of the training this was done. After the trainer was through with the class of instructions, the Lieutenant Colonel congratulated the man in charge; also complimented the work and the manner in which it was performed; also the Air-Brake Instruction Car for the way it was equipped for the work. He also informed Mr. Deal that he would hear from him in the near future. You will notice on the advanced page just how enthused he was with the work and the car. The letter of congratulation forwarded to the trainer proved so, when such great interest was taken in the work to have the signature of the Secretary of War attached to the letter.

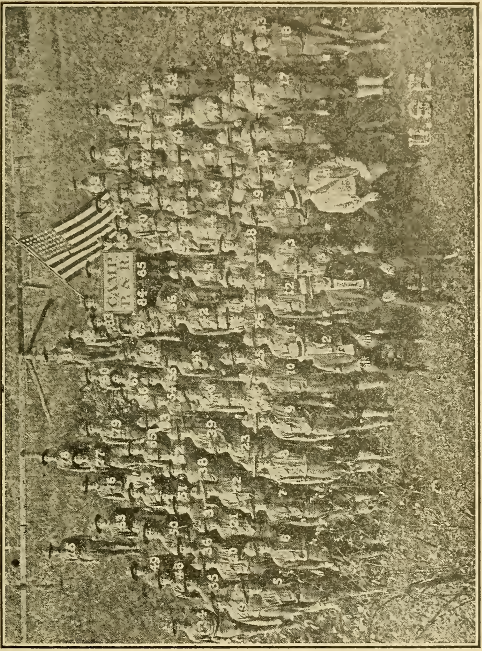
GRADUATION OF THE FIRST CLASS OF SOLDIER BOYS WHO WERE PROMOTED TO ENGINEERS FOR OVERSEAS DUTY IN FRANCE, JUNE 23, 1918, 6.30 P. M., DROWN'S HALL.

Shortly after the Lieutenant Colonel was through making his inspection at the Air-Brake Instruction Car he made a proposition to the President of the college, Dr. Henry S. Drinker, that they graduate the first class of engineers at Drown Hall at 6.30 P. M. The President of the college agreed to this, and the graduating exercises proceeded at the above time. All soldier boys connected with the college were present, representing five hundred. The President of the college made the opening address, which was quite patriotic, and also bestowed the honors upon the engineers of Camp P. & R. by presenting to them their certificates of promotion acknowledging that they were now full-fledged engineers and capable of operating locomotives either in the United States or abroad. As soon as he was through the exercises with the first fifteen engineers, which photograph appears in this book, he opened the exercises for the next number of sixty, which photograph appears, grouped around the U. S. A. Locomotive 416. After the President of the college was through with the presentation of the certificates to the soldier boys, the Lieutenant Colonel was introduced and passed a few remarks to the boys, congratulating them in reference to the wonderful opportunity presented to them by the Government; also the opportunity the officials of the Philadelphia & Reading Railroad Company had presented to them and the college. He thanked the manager in charge of the car and the interest he had taken in the boys, as well as the interest in the Government. After the Lieutenant Colonel had finished his address Captain Chenning, Jr., in charge of Camp Coppee, spoke a few words to the boys, but acknowledged that he believed the boys would be much more pleased to hear from their manager, Mr. Deal. The manager was introduced, who made a short address in their behalf. He said he felt highly honored to know that the opportunity presented itself to be at a graduation of this kind to take place between a railroad and college, and at no time in his railroad experience had the opportunity ever presented itself before. He thanked the soldiers one and all for the attention given during these class hours and the great strain they were under while taking this training. But at last the battle is won and today the debt is paid by the college President presenting to you your certificates of honor as a full-fledged engineer. The speaker also stated that he hoped that God would be with them in the trials of life, making them successful in all their undertakings, be a credit to the Government and the company they once represented, and also their families whom they would leave behind. And again, "May God give you a speedy journey and a safe one. May you soon arrive on the other side, where your services are so much needed, and when the great war is over you will all return as well and hearty as you are at the present. As I am about through, I thank you one and all for your kind attention."

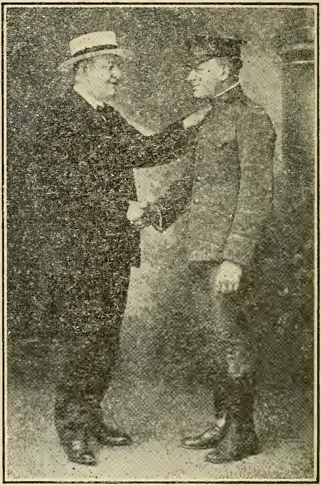
JULY 10, 1918.

The second class, representing 114 soldier boys, to undergo the training that the first class had, arrived at Camp P. & R. on the above date. On the morning of July 10, 1918, the second class of soldiers that was eligible to a promotion arrived at Camp P. & R., at

South Bethlehem, to undergo the training that the previous class of soldiers had, presenting to them all the examination questions necessary to promote them to engineers. After they all passed a satisfactory examination they were graduated at Camp P. & R. September 10 and ready to be presented to the Government as full-fledged engineers, either for overseas duty in France or to remain in America. As a truthful statement and a credit to all boys whose photograph appears in this group, there is a large percentage of them old experienced firemen, representing the number of years in service averaging all the way from 18 months up to 10 years of a practical experience as a fireman, and it is well understood they are all eligible for promotion to engineers. The number of boys represented in this photograph is a total of 90, and they represent forty-four different railroads in America.



Arriving at this Camp P. & R. on the above date, July 10, 1918, there was a young lieutenant by the name of William Witt Haggard. He was only here for a short time when the manager in charge recognized the young man's ability, noticing he was far superior to the ordinary intelligent man. Like all other railroad men in a position as an instructor, he considered it his duty to endeavor to train him for a position of responsibility, as his past record presented proved he had previously been employed by the Atchison, Topeka & Santa Fe Railroad. So he was trained either to fill the position of road foreman or master mechanic.



Mr. Deal congratulating Lieutenant Haggard, acknowledging the receipt of his ability to be trained either to fill the position of a road foreman of engines or a master mechanic.

Mr. Deal had a talk with the lieutenant before he left Camp P. & R., giving him good advice in reference to taking charge of locomotives and men. "If the good luck comes your way, so you are placed in charge of a body of men, always remember the men are human, just the same as you are, and must be given consideration. Be fair and just to all; never make bone out of one and flesh out of the other; remember they are all equal. And if you follow the motto of justice, so will you find them always ready to assist you. Never have favorites, because they are your enemies in the future. They always look for something they should not have. They are always ready to receive a good locomotive on a poor train, and you know it does not belong there, and the man who should receive the good locomotive receives the poor one. How can you expect good results from that kind of management?

"Always place your locomotives to the best advantage, where they belong, and not for favoritism. A large locomotive on a heavy train and a light one on the light train. Then results will follow as well as success. Never ask a man to do what you cannot do; never go to a district where men are raised and have railroaded for years and endeavor to show them what to do, or they may show you what you cannot do; never chastise men before the public or before other employees. Remember you have an office for that work, and if all men in positions of responsibility would deal square with men and give them justice the railroads today would be far better off, men would work with a will-power; but when you yourself disgust them your power is lost and your resignation to the company would be far better to them than to retain you in a position where you are disliked, for once respect of man is lost so is the energy lost to all, and it is only a period of time when you are lost."

Bethlehem, Oct. 1, 1918.

Mr. George Deguire,
General Supervisor of Equipment,
U. S. Railroad Administration.

Dear Sir: For the information of the readers of this catechism, on this date Mr. George Deguire received orders direct from Mr. William G. McAdoo, Director General of Railroads, to call on Mr. Deal, Sr., at South Bethlehem, and receive a full written statement from him as to just how the men were trained and what class of men were being trained to be promoted to engineers for overseas duty. The trainer of these men was very well pleased indeed to have the opportunity of explaining just how the work was done, and, furthermore, to present to Mr. Deguire a sample copy of all certificates that were presented to the engineers and firemen when they had finished their course of training and were graduated to engineers and firemen.

Also a letter explaining just how the work was carried on while the men were undergoing the training, and the difference in the ability of men presented at the different classes.

Philadelphia, Oct. 2, 1918.

Mr. Deguire.

Dear Sir: For your information, last P. M. while in conversation in your office you spoke about the students at the last classes held at Camp P. & R. and that so many of them were eligible for promotion to engineers. That is easily explained. They were picked men from all over the United States, who had been located in camps for a period of time; some from Mexico, California and the South. They were all uniformed and all of them had been employed on different railroads in the position as firemen, average time of firing from 18 months up to 10 years, and that was practical experience, which made them eligible for promotion.

Very sorry to say the last number of men received at Camp P. & R. were men forwarded direct from local boards and all without railroad experience, and they were very much surprised when I informed them that they would be educated for firemen but none of them for engineers. Of course, this was a great disappointment to them, as these local boards who forwarded them to the Lehigh University told them they were going there to be trained as locomotive engineers. We, as railroad men, understand that firemen in the United States do not need any training; the only training that is necessary is to be placed on a locomotive, go out on the railroad and learn to fire. After they have had five or six days' experience with a practical man then they are turned in to the road foreman's office and his name is then placed on the crew board ready for service. Now, it is his duty when called to take out a locomotive to show his ability and just what he can do. Some men have a gift to a firebox, while others never have, and those are the men who never make railroad men.

I suggested to the president of the college, Dr. Henry S. Drinker, that if he could and would make arrangements with the Educational Board at Washington, D. C., it would please me if the opportunity would present itself so I, the manager and trainer of these soldier boys, could go to the different camps where these men were located and pick out the thoroughbred and practical railroad man for this work. If that would be granted, I know there would be many men picked out who would not need training. If this could not be done, it would be impossible for me to train men for France or Siberia who never have had any practical railroad experience. So you can depend on this: men to be trained must be railroad men or none. No man will be promoted by me unless he has had experience on a railroad. My determination and ability will not permit me to do otherwise, and if I did I know that I would not be doing justice either to the Government, the railroads or the brotherhoods or myself. To place a man on a locomotive to take charge of it without having had any practical experience would be a crime. That would be just the same as if you were going to place a gun-pointer at a gun and he had never seen one.

Yours truly,

ALONZO W. DEAL, SR.,

Manager and Trainer Railroad Men, Camp P. & R.

WAR DEPARTMENT COMMITTEE ON EDUCATION AND SPECIAL TRAINING.

Mr. Charles H. Ewing, Federal Manager Philadelphia & Reading Railroad Company, Reading Terminal, Philadelphia.

Committee—Col. Robt. I. Reese, General Staff Corps; Colonel John H. Wigmore, Provost Marshal General's Department; Major Granville Clarke, Adjutant General's Department; William H. Lough, Executive Secretary; C. R. Dooley, Educational Director.

Advisory Board Representing Educational Interests—James R. Angell, Samuel P. Capin, J. W. Dietz, Hugh Trayne, Charles R. Mann, Herman Schneider.

Dear Sir: The War Department Committee on Education and Special Training beg to express to you, through President Drinker, their renewed and very hearty thanks for any appreciation of the aid that the Philadelphia & Reading Railroad Company has rendered in the matter of training locomotive engineers for war service in France. I beg by this letter to supplement the acknowledgment we have already made to your company for this service.

It is being wonderfully well performed through your Mr. Deal. He has unusual capacity for teaching and for interesting men in the work. It was very evident in the classes that Major Clark attended in his recent visit of inspection to the University that Mr. Deal had a good grip on his men and was turning out excellent material.

May I also express to you personally for our committee an appreciation of your own efforts in forwarding this work.

With hearty thanks of the committee I am

Very respectfully yours,

(Signed) GRANVILLE CLARKE,
Major, U. S. A., Secretary.

I cordially indorse the above.

(Signed) NEWTON D. BAKER,
Secretary of War.

AIR PUMP GOVERNOR.

DEFECTS AND REMEDIES.

Q. 1. What would you do if you broke the pipe off leading from the main reservoir up to the single diaphragm portion of governor?

A. 1. Plug the pipe at pressure end, then proceed and control the movement of the air pump with the pump throttle.

Q. 2. What would you do if you broke the pipe off leading to the high and standard diaphragm portion of governor?

A. 2. Plug the pipe at pressure end and then proceed; control the movement of the air pump with the pump throttle.

Q. 3. What would you do if you broke the pipe off leading to the standard diaphragm portion of the duplex governor controlling the standard and high-speed main reservoir pressure?

A. 3. Close the cutout cock on the pipe leading to the diaphragm portion of the stand governor and proceed, letting the high-speed governor control the pump.

Q. 4. What would you do if you broke the pipe off between the tee connection and the cutout cock leading to the diaphragm portion of the standard governor?

A. 4. Plug the pipe at pressure end and proceed, letting the high-speed governor control the pump.

Q. 5. What would you do if you broke the pipe off leading to the diaphragm portion of the high-speed governor?

A. 5. Plug the pipe leading to the diaphragm portion of the high-speed governor at pressure end and proceed, letting the diaphragm portion of the standard governor control the pump.

Q. 6. What would you do in case you were using a high-speed brake?

A. 6. Take the cap-nut off of diaphragm portion of the standard governor; screw down on the regulating nut until main reservoir pressure registered 130 pounds on the air-gauge.

Q. 7. What would you do if you broke the pipe off leading to the diaphragm portion of the standard governor when you were using a duplex governor controlling the high main reservoir pressure control and the standard pressure?

A. 7. Plug the pipe at pressure end and proceed; control the movement of the pump with the high main reservoir pressure control.

Q. 8. What would you do if you broke the pipe off leading to the diaphragm portion of governor of high main reservoir pressure control?

A. 8. Plug the pipe at pressure end leading to the diaphragm portion of high main reservoir pressure control and proceed; control the movement of the air pump with the standard diaphragm portion, either in full release or running position; but when the brake valve handle is moved to lap service or emergency position control the air pump with the pump throttle.

Q. 9. How many kinds of diaphragm portions are used on a duplex governor?

A. 9. There are two—the maximum head and the excess pressure head. In cases where the excess pressure head is used in connection with a duplex governor the standard pressure is operated from the excess pressure head.

Q. 10. What extra attachments are used on a high-speed brake and the standard brakes on some railroads?

A. 10. Some railroads adopt the above attachments and are ready for a change in main reservoir pressure and brake-pipe pressure immediately. Two diaphragm portions of governor to be used with a Siamese connection, reversing cock, two feed valves, feed valve pipe bracket and pipe connections, high-speed reducing valves, pop valves or safety valves.

Q. 11. Is there any other place where two complete diaphragm portions are used?

A. 11. There is; on the high main pressure control and the standard pressure.

Q. 12. How many different pressures of air are used on this railroad?

A. 12. There are three different pressures. 1. High speed pressure. 2. High main reservoir pressure control. 3. Standard pressure.

Q. 13. What are the two diaphragm portions used on one steam portion of governor called?

A. 13. A duplex governor.

Q. 14. What is the object of a duplex governor?

A. 14. Two have two pressures of air and ready for a change in pump service from one pressure to the other without the necessity of readjusting diaphragm portions.

Q. 15. When there are two diaphragm portions attached to one steam connection of governor by the use of a Siamese connection, a high and standard pressure one set for 130 pounds main reservoir pressure and the other set for 90 pounds, how can I change the air pressures immediately?

A. 15. By closing the cutout cock leading to the diaphragm portion of the standard governor. That will allow the high-speed diaphragm portion of governor to go into operation, and when the cutout cock is open that will allow the diaphragm portion of the standard governor to go into operation.

Q. 16. Where are the two diaphragm portions of a high and standard pressure connected?

A. 16. Direct to main reservoir pressure.

Q. 17. Where there are two diaphragm portions attached to one steam connection of governor by the use of a Siamese connection on a high main reservoir pressure control and a standard main reservoir pressure, how can I change the main reservoir pressures immediately?

A. 17. By placing the brake handle to lap position.

Q. 18. Where are the two diaphragm portions of a high main reservoir pressure control and a standard main reservoir pressure connected?

A. 18. High main reservoir pressure control is connected direct to main reservoir pressure, and the standard main reservoir pressure is connected to a feed port leading through the rotary valve and seat to the feed valve attachment in running position known as main reservoir air pressure.

Q. 19. What is the air pump governor called?

A. 19. An automatic throttle.

Q. 20. Where there are two diaphragm portions attached to one steam connection of governor by the use of a Siamese connection for a high main reservoir pressure control and the standard main reservoir, how can the two diaphragm portions operate the steam portion of governor independently?

A. 20. The diaphragm portion of the standard governor is connected to the feed port leading through the rotary valve seat to the feed valve. When the handle of the brake valve is moved to lap position then the feed port is closed off and the diaphragm portion of the standard governor is out of service and the diaphragm portion of the high main reservoir pressure control comes into service. The high main reservoir pressure control is in communication with main reservoir pressure at all times, independent of the movement of the brake valve handle. After the brake valve handle is moved to running position, then the standard diaphragm portion comes into service.

Q. 21. How is the excess pressure head of the duplex governor connected?

A. 21. The pipe leading from the brake-pipe to the excess pressure head is connected to the upper portion and the pipe leading to the lower portion of the excess pressure head is connected to main reservoir pressure. This main reservoir pipe is connected to feed port leading through the rotary valve and seat to the feed valve, so when the brake valve is in running position the excess pressure head is in operation. But when the brake valve handle is moved to lap position then this feed port opening is closed off and the excess pressure head is cut out of service, the diaphragm portion of the high main reservoir pressure control comes into operation, controlling the movement of the air pump on lap service or emergency positions, as the high main reservoir pressure control is connected direct to main reservoir pressure.

Q. 22. What would you do if you broke the pipe off leading to the upper portion of the excess pressure head?

A. 22. Plug the pipe at pressure end, also put a blank washer in at the lower portion of the excess pressure head, and then control the air pump with high main reservoir pressure control; place the brake valve in running position and proceed.

Q. 23. What would you do if you broke the pipe off leading to the lower portion of the excess pressure head?

A. 23. Plug the pipe at pressure end, leaving the high main reservoir pressure control the pump, place the handle of the brake valve in running position and proceed.

Q. 24. What would you do if you broke the pipe off leading from the main reservoir pressure up to the diaphragm portion of the maximum head which controls high main reservoir pressure?

A. 24. Plug the pipe at pressure end, carry the brake valve handle in running position, letting the excess pressure head control the movement of the air pump; but when the handle of the brake valve is moved to lap, service or emergency positions control the movement of the pump with the pump throttle.

Q. 25. What would you do with the brake valve handle in running position where the excess pressure head is used with a duplex governor, your air pump would ease off in speed and the pressure registered on the air-gauge would show 25 pounds.

A. 25. Disconnect the pipe at the upper portion of the excess pressure head and see if the pipe is not gummed up or full of dirt. If so, put a blank washer in at the lower portion of the excess pressure head, place the brake valve handle in running position and proceed, letting the high main reservoir pressure control the pump.

Q. 26. What would you do if the diaphragm portion of a single governor or the Siamese connection was to break off where it screws into the steam portion of governor?

A. 26. Take a piece of cord or bell rope and make the connection fast to the pump and proceed, controlling the movement of the pump with the pump throttle.

Q. 27. What would you do if you broke the standard diaphragm portion of governor off where it screws into Siamese connection on the high main reservoir pressure and the standard pressure?

A. 27. First, plug the hole at the Siamese connection where it is broken, then close the cutout cock leading to the standard portion of governor and proceed, letting the high-speed governor control the pump.

Q. 28. What would you do if you broke the diaphragm portion of the high main reservoir pressure off where it screws into the Siamese connection on the high main reservoir pressure and the standard pressure?

A. 28. First, plug the hole at the Siamese connection where it is broken; do not interfere with the high main reservoir pressure governor; leave the pump to be controlled by the standard governor, unless you were using a high-speed brake; then set the diaphragm portion of governor for 125 pounds pressure, and under these conditions you will find no blow at the broken connection of the high-speed diaphragm portion of the governor, as this is set for 130 pounds.

Q. 29. What would you do if you broke the diaphragm portion of the standard governor off at the Siamese connection on the high main reservoir pressure control?

A. 29. First, plug the hole at the Siamese connection where it is broken, then take the cap nut off of the standard governor, screw down on the regulating nut above the pressure that carried on the high main reservoir pressure control. That will prevent a blow of air out of the diaphragm portion of the standard governor. Place the brake valve handle in running position and proceed.

Q. 30. What would you do if you broke the diaphragm portion of governor off at the Siamese connection that is connected to high main reservoir pressure control.

A. 30. First, plug the hole at the Siamese connection where it is broken, place the brake valve handle in running position and proceed, leaving the diaphragm portion of the standard governor to control the pump. But when the brake valve handle is moved to lap, service or emergency positions control the pump with the pump throttle.

Q. 31. What would you do if you broke the excess pressure head off at the Siamese connection where it is used on the standard and high main reservoir pressure control?

A. 31. First, plug the hole at the Siamese connection, place the brake valve handle on lap position, disconnect the brass union sleeve at the lower portion of the excess pressure head, put in a blank washer, place the nut and sleeve on again and tighten it up, place your brake valve handle in running position and proceed, leaving the diaphragm portion of the high main reservoir pressure to control the pump.

Q. 32. What would you do if you found the governor at any time would not ease the pump down, due to a dirty governor or a plugged pipe or a pipe frozen leading from the main reservoir up to the diaphragm portion of governor?

A. 32. Proceed to control the pump with the pump throttle.

Q. 33. What would you do if the air gauge registered more than the standard pressure for which the governor was set?

A. 33. If the governor was in working order and the gauge was correct, it would be proper to reset the governor. How can you tell if the gauge is correct? Place the brake valve handle in full release position; if both hands on the gauge equalize then you know the gauge is correct.

Q. 34. What would you do if you looked up at the air-gauge and found the main reservoir pressure increasing and the pump governor did not control the pump?

A. 34. First, look at the vent-hole in the governor, and, if the air is flowing freely, that indicates the trouble is in the steam end and the air end is all right.

Q. 35. What would you look for if the trouble was experienced on a cold day?

A. 35. The drain or waste pipe or the governor is frozen up, or a blind gasket in the pipe, or the pipe clogged with dirt or gum or otherwise closed would cause it.

Q. 36. Is that the only defect that would cause the same trouble?

A. 36. No; the pin valve located beneath the diaphragm may be too long or its port clogged with dirt or gum so as not to allow the air pressure to enter on the piston.

Q. 37. Any other cause that would prevent the governor from controlling the pump?

A. 37. A leak past the packing ring on the piston or leaks around any of the joints above the piston, when combined together, are so great as not to allow the proper amount of air to accumulate above the piston so as to force the piston down.

Q. 38. What effect will a leaky steam valve have in a governor?

A. 38. It will allow steam to enter the pump after the steam valve has made its seat by being forced down with the air piston. The valve or seat, being cut or worn, allows steam to pass through to the steam cylinder.

Q. 39. What would you do if the pump worked up to the standard pressure and the governor went into operation and stopped the pump and refused to start promptly?

A. 39. First, open the vent-hole in the governor. If that failed, then it would indicate a tight or gummed packing ring on the piston. A slight jar at the lower end of the steam part of governor will often start it to operate.

Q. 40. Some governors have a bad blow of air at the waste pipe of the governor. What does that indicate?

A. 40. A worn-out packing ring on the air piston or the little cylinder it operates in, is worn out.

Q. 41. Some governors have a continuous blow of steam from the waste pipe of the governor at all times. What does that indicate?

A. 41. The piston stem being a loose fit and the upper side of the steam valve seat leaking and not making a good joint.

Q. 42. What is the small hole drilled in the spring box for which is above the diaphragm?

A. 42. To release any pressure of air that will leak back into the spring box from a buckled or cracked diaphragm in the governor.

Q. 43. Where there are two diaphragm portions used on one steam connection of a governor by the use of a Siamese connection, what is the object of keeping one vent-hole in the governor plugged up?

A. 43. The pressure of air blowing out of both governors at the same time reduces the pressure above the piston too quickly, and this allows the piston to keep partly raised, carrying with it the steam valve, which keeps the pump continuously in motion. It is proper at all times to see that the air is working from the vent-hole of one governor after it has gone into operation to stop the pump.

Q. 44. What is the object of having a small hole drilled in through the steam valve?

A. 44. It will allow steam to pass through the small port and enter the steam cylinder, which serves to keep the pump working slowly to avoid condensation.

Q. 45. What would you do if you had a locomotive with two pumps, two steam portions of governors and one diaphragm portion and you broke the pipe off leading from the lower part of the diaphragm over to the steam portion of governor?

A. 45. Set down on the regulating nut on the diaphragm portion of governor and control the movement of the pumps with the pump throttle and proceed in that manner.

Q. 46. What would you do if you broke the pipe off leading to the diaphragm portion of governor where one governor is used to control both pumps?

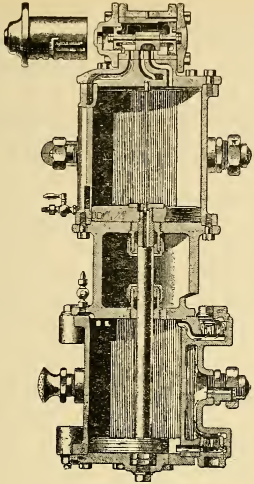
A. 46. Plug the pipe at the pressure end, proceed and control the air pumps with the pump throttle.

Q. 47. What would you do if one pump became disabled in road service where there are two independent pump throttles?

A. 47. Close the throttle on the disabled pump, so as to save the steam pressure; also to prevent a heavy exhaust on the fire.

REMARKS.

Always remember if you plug the broken end of a governor which remains in the Siamese connection, if it be the one with the vent-hole, remove the little screw from the opposite one and be positive that the air can escape from the diaphragm portion that is left in service.



AIR PUMP.

WITH ITS DEFCTS AND REMEDIES.

Q. 1. How many air valves are there in each air-cylinder of a 9½-inch and 11-inch air pump?

A. 1. There are four air valves in an air-cylinder—two receiving valves and two discharge valves.

Q. 2. Which set of valves is in communication with one another?

A. 2. The upper receiving valve and discharge valve; the lower receiving valve and discharge valve.

Q. 3. What separates the upper set of valves from the lower set?

A. 3. The air piston and rings in the air-cylinder.

Q. 4. Are the air valves of a 9½-inch air pump interchangeable with the 11-inch air pump?

A. 4. No; the air valves in each air pump have the same lift, but the valves of an 11-inch air pump are larger in diameter than a 9½-inch air pump.

Q. 5. Can the air valves in a 9½-inch air pump and an 11-inch air pump be changed from the receiving side to the discharge side?

A. 5. Yes.

Q. 6. How can you tell if the discharge valve is broken?

A. 6. Air would pass back from the main reservoir by the broken valve on to the air piston, and that would give you an extra pressure to move the piston and rod away from the broken valve.

Q. 7. Is there any other way you can tell if the discharge valve is broken?

A. 7. Yes; if the upper discharge valve is broken you could not receive any air through the air strainer to the upper receiving valve on the down stroke, and if the lower discharge valve is broken you could not receive any air through the lower receiving valve on the upper stroke. It also will show you a very slow movement of the piston and rod when moving toward the broken valve.

Q. 8. How can you detect a stuck or broken receiving valve?

A. 8. The exhaust of the pump will be uneven and there will be no air received in through the air inlet through the receiving valve that is stuck or broken. It will be shown by the movement of the piston and rod. While the piston is in position moving away from the broken valve there will be no air received in the air cylinder.

Q. 9. How would you test for a stuck or broken receiving valve?

A. 9. Start the air pump, and when the piston and rod are moving on the down stroke, and there is no air received in the air strainer, it will indicate an upper receiving valve. On the return or upper stroke of the piston and rod and there is no air received at the air strainer, it will be the lower receiving valve.

Q. 10. How can you tell whether it was the upper or lower receiving valve leaking?

A. 10. By the movement of the piston and rod. If the piston and rod were moving up and there was a leak at the air strainer, that would indicate the upper receiving valve was leaking; on the down stroke if there was a leak of air at the air strainer, that would indicate the lower receiving valve.

Q. 11. What other way could you tell if you had a broken discharge valve?

A. 11. First, stop the pump, then open the oil-cup on the top of the centerpiece above the air-cylinder. If the upper discharge valve is broken or leaking there will be a continuous flow of air out of the oil-cup from the air-cylinder. If you find that there is no escape of air that will show that the upper discharge valve is tight; unscrew the plug out of the lower air cylinder head, and if there is a flow of air from the air-cylinder that will show that a lower discharge valve is broken or leaking.

Q. 12. What would you do with the upper discharge valve broke in the air-cylinder?

A. 12. First stop the air pump, then place the brake valve handle in full release position, open the angle-cock on the front or rear of engine and release all of the air out of the main reservoir; then take the cap-nut off both the receiving valve and discharge valves, take the receiving valve out and put it in where you took out the broken discharge valve, plug the receiving side of the valve seat if possible, if not, let it alone, put the cap-nut back on again, start the pump. Use the lower set of valves to compress the air to operate the brakes on the engine and train.

Q. 13. What would you do if it were the lower discharge valve broken in the air-cylinder?

A. 13. Proceed according to Rule 12, except that you would use the lower receiving valve in the place of the broken discharge valve in the lower end of the air-cylinder, leaving the upper set of valves to compress the air to operate the brakes on engine and train.

Q. 14. What effect will there be to the air-cylinder if the piston rings are worn out?

A. 14. It will cause the air-cylinder to get overheated and is liable to burn the joints out of the discharge pipe, and also keep the pump from making the desired pressure of air needed.

Q. 15. What effect will it have on the pump if the wing on the discharge valve was to break and enter the air-cylinder?

A. 15. If a wing should break off of an upper discharge valve or the dowel was to work out of the stuffing-box and enter the air-cylinder it would cause a bad knock in the air-cylinder; it also would find its way down to the lowest point on the air piston, and that would be where the piston is champered off, and every time the piston comes up on the upper stroke it would strike the centerpiece, causing the upper ring to fasten itself in the groove of the piston and destroy the function of the top ring.

Q. 16. How should the air pump be packed?

A. 16. Just tight enough to prevent the leak around the piston rod. Never pull the packing nut up too tight to cause too great a friction against the rod, as it is liable to get hot and burn out the packing. A swab should always be used on the rod and kept moist with valve oil.

Q. 17. What kind of a leak would it be with either an upper or lower discharge valve cap-nut leaking?

A. 17. A main reservoir leak.

Q. 18. What effect will a leaky receiving valve cap-nut have on the air-pump?

A. 18. It will destroy the amount of air that should be compressed into the main reservoir on the side of the air piston toward which it is compressing.

Q. 19. What effect will a leaky joint have on the upper end of the air-cylinder or the lower end?

A. 19. It will destroy the amount of air that should be compressed into the main reservoir on the side of the air piston toward which it is compressing.

Q. 20. What effect will a leaky piston rod have on the air-cylinder?

A. 20. It also will destroy the amount of air that should be compressed into the main reservoir on the upper stroke of the air piston.

Q. 21. What would you look for if you had a pump that would work one speed, no difference how the globe valve was turned on, and your boiler showed the standard pressure of steam, your air pump and the exhaust pipe of the pump in good condition; also the governor working properly?

A. 21. The steam pipe may be clogged or screwed too far in an elbow fitting in the air-pump, throttle will not open far enough to allow the volume of steam to pass through the openings, the opening in the valve is too small, the steam box too small, to which all steam valves are connected, or a lapped copper gasket at the globe valve or governor, so when it is tightened up it closed in on the gasket, or the discharge pipe or exhaust pipe may be partly clogged up.

Q. 22. What would you do if you had a locomotive with two air pumps and one steam valve to supply both pumps with steam, and you broke the steam pipe off of one pump?

A. 22. Plug the broken steam pipe and proceed, using one pump to accumulate the air with which to handle the train.

Q. 23. What would you do if you lost the plug out of the lower cylinder-head of the air-pump?

A. 23. Take the three-quarter plug out of the air-sander trap.

Q. 24. What would you do if you lost the receiving valve cap out of the lower end of the air-cylinder?

A. 24. Go on using the upper set of valves to compress air to operate the engine, tender and train-brakes.

MAIN RESERVOIR.

DEFECTS AND REMEDIES.

Q. 1. What are main reservoirs used for?

A. 1. Main reservoir on engines must be maintained to carry gauge pressure required for releasing brakes and must be drained after each trip, and in switching service every 24 hours. Always remember that for every cubic inch of water it takes the place of a cubic inch of air. The red hand on the gauge represents main reservoir pressure and the other hand-brake pipe pressure, equalizing drum pressure and auxiliary reservoir pressure.

Q. 2. How often should air gauges be tested?

A. 2. Air gauges should be tested for readjustment once each sixty days and a record kept of tests.

Q. 3. What would you do if you broke the pipes off, or the pipe was split or leaking that connects both main reservoirs together, providing the pipe in size was 1¼ inches?

A. 3. Disconnect the pipe from main reservoirs, unscrew the 1¼-inch brass union sleeves off the pipe, then take and screw each of the union sleeves on a 1¼-inch air-hose, take and connect the union sleeves back on the main reservoirs again, clutch the hose together and proceed in that manner.

Q. 4. What would you do when two main reservoirs are connected together with a connecting pipe and the discharge pipe leading from the pump and the pipe leading from the main reservoir to the engineer's equalizing discharge valve were connected to one main reservoir, and the connecting pipe became disabled?

A. 4. Put a blank washer in at the end of the connection at main reservoir pipe where both the discharge pipe and main reservoir pipe is located; use one main reservoir to carry the excess pressure.

Q. 5. What would you do if the pipe connecting both main reservoirs together was one inch in size?

A. 5. Disconnect the pipe from the main reservoirs, unscrew the 1-inch union sleeves off of the pipes, then screw the 1-inch to three-quarter reducer in the union sleeves. After that is done screw a three-quarter whistle hose on the reducers, then place the sleeves and unions back on the main reservoirs again, connect the whistle hose together; proceed.

Q. 6. What would you do if the brass union sleeves were stripped and you could not use them?

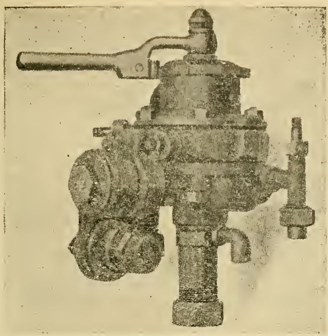
A. 6. Put blank washers in at the unions next to main reservoirs. After that is done, take the ½-inch drain plugs out at the lower end of the main reservoirs, put in a ½-inch nipple in length to suit an elbow attached ¾ to ½-inch, screw a whistle hose in each ¾ elbows and clutch them together. Proceed in that manner.

Q. 7. What would you do if the discharge pipe broke off between main reservoir and the air-cylinder of air-pump?

A. 7. Screw the union sleeves off of the discharge pipe at both ends, then take the brass union sleeves and screw them on the 1¼-inch air-hose, put the sleeves and unions back on the main reservoirs and the air-cylinders, clutch the hose together and proceed.

REMARKS.

This information for the benefit of engineers and roundhouse men, providing any of the above failures should occur to the main reservoirs while the engine is en route, on arriving at a roundhouse or shop where temporary repairs could be made in cases of emergency, so the locomotive could proceed to its destination.



ENGINEER'S EQUALIZING AND DISCHARGE VALVE, WITH ITS DEFECTS AND REMEDIES.

Q. 1. What is the pipe used for between the main reservoir and the engineer's equalizing and discharge valve?

A. 1. It is used to convey the air from the main reservoir to the brake valve, and is known as a supply pipe, and contains main reservoir pressure.

Q. 2. What are the pipes used for that lead from the engineer's brake valve up to the air gauge?

A. 2. These pipes are used to convey the air pressure from the main reservoir and brake-pipe up to the air-gauge.

Q. 3. What kind of an air gauge do we use in connection with the automatic air brake where the engineer's equalizing and discharge valve is in service?

A. 3. A duplex air-gauge.

Q. 4. What is a duplex air-gauge?

A. 4. An air-gauge that registers two independent pressures of air on one dial.

Q. 5. What is the pipe used for that leads from the engineers equalizing and discharge valve down to the equalizing drum?

A. 5. It is used to convey the air pressure from the engineer's equalizing and discharge valve down to the equalizing drum.

Q. 6. What is the pipe used for that leads from the engineer's equalizing and discharge valve down to the front of the engine and the rear?

A. 6. The brake-pipe is used to convey the air from the engineer's equalizing and discharge valve, the brake-pipe being connected to the engineer's brake valve leads down to a tee connection under the footboard; the forward part of the tee has the pipe connected that leads to the front of the engine, to which there is an angle-cock connected with a loose hose and coupling, while the opposite side of the tee has the brake-pipe connection that leads to the rear of the engine, where there is an angle fitting and loose hose and coupling connecting to the hose coupling on the tender is a brake-pipe with angle fitting and loose hose and coupling, which is coupled to the hose on the engine. This brake-pipe extends the full length of the tender at the rear of the tender. On the brake-pipe is an angle-cock connected and a loose hose and couplings. This hose coupling is connected to the hose coupling on the car.

Q. 7. How is the brake-pipe coupled up between the cars?

A. 7. By means of loose hose and couplings attached to the angle-cocks and brake-pipe.

Q. 8. How is the brake-pipe closed off at the rear end of a train?

A. 8. By closing the angle-cock on the brake-pipe at the rear end of the last car.

Q. 9. What is the pipe used for that leads from the brake-pipe to the triple valve?

A. 9. This pipe is known as a crossover pipe and used to convey the air from the brake-pipe to the triple valve, and on this pipe is located a cutout cock used to cut out the triple valve in cases of necessity.

Q. 10. What would you do if you broke the pipe off leading from the engineer's equalizing and discharge valve up to the air-gauge, which represents main reservoir pressure?

Q. 10. What would you do if you broke the pipe off leading from the engineer's equalizing and discharge valve up to the air-gauge, which represents main reservoir pressure?

A. 10. Plug the pipe at the brake valve, place the brake valve handle in running position, as the brake-pipe air-gauge will notify you the amount of air in the brake-pipe and the governor will control the pump.

Q. 11. What would you do if you broke the pipe off at the engineer's equalizing and discharge valve leading up to the air-gauge which represents brake-pipe pressure?

A. 11. Plug the pipe up at the engineer's brake valve and place the handle of the brake valve in full release position. If you have a passenger train, leave the governor be set for 90 pounds or 110 pounds, and if you have an empty freight train reduce the governor down to 70 pounds, and if a loaded train let the governor be set for 90 pounds, proceed in that manner.

Q. 12. What would you do if you were using a high-speed brake?

A. 12. Cut in the standard governor of 90 pounds, take the cap-nut off the top of the governor, screw down on the regulating nut until you have 110 pounds registered on the red hand of the air-gauge. But if you desire you may leave the standard governor for 90 pounds be registered. Always bear in mind that you do away with 20 pounds of excess pressure and a prompt release of brakes is not as readily obtained as if you had the extra excess pressure.

Q. 13. What would you do if you broke the pipe off leading from the engineer's brake valve down to the equalizing drum, or if the pipe had a hole worn in it, or the pipe or drum became disabled?

A. 13. Plug the pipe up at the brake valve; also plug up train pipe exhaust, carry the brake valve handle in running position, use it as a three-way cock in the emergency position with care when you are going to make a stop.

Q. 14. What would you do if you broke the tee connection off in the engineer's brake valve that represents the brake-pipe, air-gauge and equalizing pressure?

A. 14. Plug the connection at the brake valve; also plug the brake-pipe exhaust, carry the brake valve in full release position, so as to have the red hand on the gauge represent main reservoir pressure and brake-pipe pressure. Use the brake valve in the emergency position with care when going to make a stop. Always remember the governor on an empty train. Cut the governor down to 70 pounds. If a loaded train, let it remain at 90 pounds; on a high-speed brake set the governor for 110 pounds if you so desire.

Q. 15. What would you do if you broke the pipe off leading from the engineer's brake valve down to the reversing cock, known as main reservoir pressure?

A. 15. Place the brake valve handle in full release position, move the handle of the reversing cock to lap position; that is, at right angles with the feed valves; cut in the 90-pound governor, set it down to 110 pounds main reservoir pressure if you so desire, then proceed in that manner.

Q. 16. What would you do if you broke the pipe off leading from the reversing cock up to the engineer's brake valve, known as brake-pipe pressure?

A. 16. Place the brake valve handle to lap position until the half-inch pipe is plugged at the brake valve, then move the handle of the reversing cock to lap position; that is, at right angles with the feed valves; when that is done carry the brake valve handle in full release position and operate governor as Rule 15.

Q. 17. What would you do if you were using the single diaphragm portion of governor, and it was set to carry 130 pounds main reservoir pressure?

A. 17. Take the cap-nut off of the governor, unscrew the regulating nut until the gauge registers 110 pounds main reservoir pressure.

Q. 18. What would you do if you found a leak at the feed valve case gasket and you found you could not stop the leak by tightening up on the feed valve?

A. 18. Close the cutout cock underneath the engineer's brake valve, place the brake valve handle in the service position, then loosen the ½-inch nuts at the feed valve, take a piece of string or lamp wick and wind it around from one stud to the other, then tighten up ½-inch nuts again. After that is done place the brake valve handle in running position, open the cutout cock again, set the governor for 70 pounds; with an empty freight train leave it set at 90 pounds; for a loaded train or a passenger train with the high-speed brake set the governor to 110 pounds main reservoir pressure, if you so desire, and proceed in that manner.

Q. 19. What would you do if when tightening up one of these ½-inch nuts at the feed valve you were to break off one of the studs in the engineer's brake valve?

A. 19. Place the brake valve handle to lap position, shut the cutout cock underneath the brake valve, take the ½-inch nut off the stud opposite the one broken, remove the feed valve, take a piece of wood and whittle two plugs, drive them into the port openings on the brake valve, open the cutout cock again, place the brake valve handle in full release and proceed. Remember, the governor same as Rule 18.

Q. 20. What would you do if you found your feed valve would not operate at all, or you only could receive a low pressure of air in the train pipe?

A. 20. Place the brake valve handle in full release position and proceed. Set the governor same as Rule 18.

Q. 21. What would you do if you should break both pipes off leading from the engineer's brake valve down to the reversing cock or the reversing cock became disabled?

A. 21. Take off the feed valve pipe bracket, put in a blank washer, put the feed valve pipe bracket back on again, tighten up the ½-inch nuts, place the brake valve handle in full release position and proceed. Set the governor as Rule 18.

Q. 22. On the arrival at the roundhouse with the engine you found that you did not have time to have the pipes repaired, as you were ordered to return at once, what would you do?

A. 22. Take and close the cutout cock underneath of the engineer's brake valve, place the handle of the brake valve in the service position and take a feed valve loose from the reversing cock. After that is done take your feed valve pipe bracket off at the brake valve, remove the blank gasket, place the feed valve on in place of the bracket, then place your brake valve in running position, open the cutout cock, charge the train pipe up to the standard pressure required. Be sure and operate your brakes on the engine and tender. When you know you are correct then proceed.

Q. 23. What would you do to operate your brakes on the engine tender and train in a graduated movement if you discovered gasket 32 was worn out or a hole burned through the gasket so it would admit air from the main reservoir direct on top of the equalizing piston?

A. 23. Just before you are going to operate the brake valve to make a stop shut the cutout cock underneath of the engineer's brake valve; after that is closed then place your brake valve handle in the emergency position; then do your braking with the cutout cock; open it gradually and let the flow of air pass through the cutout cock from the train pipe to the atmosphere through the emergency opening in the brake valve. After the reduction has been made to apply brake close the cutout cock and make all reductions in train pipe in the same manner by closing the cutout cock after the brake has been applied. This will represent putting the brake valve to lap position. When the train has come to a full stop and you desire to release your brakes first place your brake valve handle in full release position. After that is done, then open the cut-out cock, allowing main reservoir pressure to pass into the train pipe to release the brakes. Proceed in that manner.

Q. 24. What would you look for, if when placing the brake valve handle on lap position, train pipe exhaust would start to operate in the engineer's brake valve?

A. 24. First, look for a leak at the equalizing reservoir or a leak in the pipe leading down to the equalizing reservoir, or a leak at the train pipe air-gauge connection, either at the brake valve or at the gauge; a hole worn in the equalizing pipe or a leak at the diaphragm of the gauge, or a bolt-head leaking at the brake valve, or a hole worn in the gauge-pipe.

Q. 25. What would you look for if you made a reduction in Chamber D above the equalizing pistion and the black hand would not move?

A. 25. The first to look for is a stopped-up air-gauge pipe, either at the gauge or the brake valve, or gasket 32 leaking.

Q. 26. What would you look for if on making an application of the brake in service movement the preliminary exhaust was correct, but train pipe pressure would not respond?

A. 26. Due to a dirty equalizing piston, stuck in Chamber D or the piston stem 17 broken loose from the equalizing piston.

Q. 27. What would you look for after making an application of the brake and on releasing the red hand would not move?

A. 27. Look for a stopped-up air-gauge pipe, a stuck gauge or the hand loose on the air-gauge, or a blank washer at the connection of the valve, or the connection itself may be stopped up.

Q. 28. Where would you look for the trouble if in placing the brake valve handle in full release position the black hand or the red hand would move ahead of one another in full release position. These hands should register equal pressures.

A. 28. That would indicate that the air-gauge is out of order. First we would look for stopped-up gauge pipes. If they were O. K., then look for a stuck gauge.

If you found that was correct, then it would be proper to test the gauge. Very often in putting in a new air-gauge glass it does not fit the rim of the gauge properly and in screwing it up tight the glass pinches on the pinion that controls the movement of the hands.

Q. 29. What would you look for if you made a reduction in train pipe pressure and you placed the brake valve handle to lap position, and the black hand started to move down toward the pin?

A. 29. That would indicate a train pipe leak.

Q. 30. What would you look for if you placed the brake valve handle on lap position, then started the pump and as air was being accumulated in main reservoir the black hand would move up toward the red hand?

A. 30. That would indicate a leaky rotary valve or a leaky leather gasket 32.

Q. 31. How would you tell if the rotary valve was leaking or the leather gasket 32 was leaking?

A. 31. Close the cutout cock underneath of the engineer's brake valve, then place the handle of the brake valve into service position, draining the air out of the equalizing reservoir and the train pipe between the cut-out cock and the rotary valve seat. After that is done remove the plug from the equalizing reservoir, then place the brake valve handle to lap position. If the air comes out of the equalizing reservoir slowly that would indicate a leaky rotary valve. If it comes out in a rush that would indicate the leather gasket 32 was leaking.

Q. 32. Very often a brake valve handle when placed into running position the black hand on the gauge moved up to meet the red hand, and when a test has been made of the rotary valve it is found to be O. K. and the feed valve test proves that the feed valve is O. K. Where would you look for the trouble?

A. 32. Very often it is in the feed valve case gasket leaking air from the main reservoir over into the train pipe connection. When replacing a brake valve or putting on another feed valve it is always proper to have a new case gasket.

Q. 33. If you put in a new case gasket and still the brake valve registered above the required pressure the feed valve was set for, where would you look for the trouble?

A. 33. It would be a leaky rotary valve in running position, and the proper way to detect the leak would be to remove the feed valve and put in a blank washer in between the feed valve and the brake valve. Shut the cutout cock underneath of the brake valve, then place the brake valve handle in running position, start the pump, and as soon as there was a pressure registered in main reservoir (if there was a pressure to accumulate in Chamber D), that would indicate the leak was at the rotary valve.

Q. 34. What would you look for if you made two or three stops with your engineer's brake valve and when you had occasion to use your brake valve again there was no movement to the rotary valve at all?

A. 34. That would indicate that the brake valve had been cleaned and the party in charge of cleaning same put a new rubber gasket 31 on and did not remove the old one. The valve and seat being faced off below the proper distance, gave the key very little hold in the rotary valve. A new washer being put on the key, allowed it to hold until the pressure of air raised the key up and pressed the washer thin, thus allowing the key to raise out of the rotary valve.

Q. 35. What would you do to make a stop with a valve in that condition?

A. 35. Remove the air-gauge pipe union at the brake valve on the train line side or the nut connecting the equalizing reservoir pipe at the brake valve.

Q. 36. What would you do if you had to make a stop in a hurry, due to a red flag appearing, or something unforeseen should appear?

A. 36. Take a wrench or hammer and break the tee connection off at the brake valve where the air-gauge pipe is connected that represents train air-pipe pressure, and where the equalizing reservoir pipe is connected. As soon as that is done shut the pump off. When the train has come to a full stop have the brakes bled off in the train and proceed carefully to the first siding. If you understand how to clean an engineer's brake valve take it apart and remove the old rubber gasket 31. That will allow the body of the valve to lower itself down and allow the key to go back into the rotary valve. You can plug the connection that is broken at the brake valve, same as Rule 14, and proceed. If you cannot repair same report the air-brake failure to the superintendent or trainmaster and be advised as to what to do.

Q. 37. Engineers very often complain about the engineer's brake valves registering the pressure of air on the black hand of the air-gauge improperly with the valve in running position with the engine and tender, but when connected to the train the black hand registers correctly.

A. 37. That is due to a slight leak in the rotary valve or the feed valve. The train pipe being short on the engine and tender, will gradually fill up, so the gauge pressures may be very near equal, but when connected up to a train that increases the train pipe capacity. This very often overcomes the slight leak in the brake valve, as most all trains have small leaks in some parts of the apparatus.

Q. 38. For what is the warning port in the engineer's brake valve used?

A. 38. To notify the engineer that the brake valve handle is in the wrong position.

Q. 39. What air does the warning port discharge?

A. 39. Main reservoir air.

Q. 40. If you had a leak around the key handle of the engineer's brake valve, what kind of a leak would that be?

A. 40. A main reservoir leak.

Q. 41. If you had a leak below the rotary valve seat and above the equalizing piston, what kind of a leak would that be?

A. 41. A leak in the eoualizing pressure.

Q. 42. If you have a leak below the equalizing piston what kind of a leak will that be?

A. 42. A train pipe leak.

Q. 43. If the preliminary exhaust port was partly clogged up with dirt, how would that be recognized?

A. 43. It would make the brake valve slow in acting.

Q. 44. What size is the preliminary exhaust port?

A. 44. One-sixteenth of an inch in size.

Q. 45. How should the brake valve feed valve be tested in running position.

A. 45. After the brake-pipe is charged up to the pressure that the feed valve is regulated for, make an application of the brake with a 10-pound reduction, release the brakes by placing the brake valve handle in full release position and immediately bring the handle of the valve to running position and note the sensitiveness of the feed valve. If the feed valve charges the brake-pipe and equalizing drum direct up to the pressure the feed valve is regulated for then we can realize the feed valve is O. K.

Q. 46. How can the preliminary exhaust port be tested in the brake valve?

A. 46. By making a 20-pound reduction registered on the air-gauge. Note the time it takes the pressure to escape from Chamber D and the equalizing drum. With a drum 10x12 about four seconds or a close margin to it; 10x14½ five to six seconds.

Q. 47. What will it note if it takes longer than the above time?

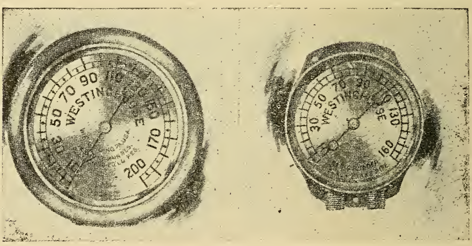
A. 47. A dirty or gummed preliminary exhaust port or a worn out packing ring in Chamber D.

Q. 48. If the time should exceed above that time allotted, what would it indicate?

A. 48. Increased preliminary exhaust port or an equalizing drum partly filled with water. The reservoir cannot retain its full volume of air with a partly frozen equalizing pipe or the pipe partly clogged.

Q. 49. How can you detect the sound of the preliminary exhaust port?

A. 49. Close the cutout cock underneath of the brake valve so as to prevent the escape of air out of the brake valve exhaust elbow, providing the cutout cock is located close to the brake valve.



AIR GAUGES. WITH THEIR DEFECTS AND REMEDIES.

Q. 1. What kind of air-gauges do we use on this railroad?

A. 1. The duplex air-gauge and the single air-gauge.

Q. 2. What pressure of air does the red hand indicate on a duplex air-gauge?

A. 2. Main reservoir pressure.

Q. 3. What pressure of air does the black hand indicate on the duplex air-gauge?

A. 3. Train pipe pressure.

Q. 4. When does the red hand on a duplex air-gauge register main reservoir pressure?

A. 4. At all times.

Q. 5. When does the black hand on a duplex air-gauge register train pipe pressure?

A. 5. When the brake valve handle is in full release or running position.

Q. 6. When does the red hand register train pipe pressure?

A. 6. When the brake valve handle is in full release position or when there is a leak admitting main reservoir pressure into the train pipe in running position or on lap position, so both the red and black hands will register equal pressures.

Q. 7. When does the black hand register main reservoir pressure?

A. 7. When the brake valve handle is moved to full release position or when there is a leak admitting main reservoir pressure into the train pipe, either in running position or lap position, so both the red hand and black hand will register the main reservoir pressure.

Q. 8. In what position is the brake valve handle moved so the black hand will not register train-pipe pressure?

A. 8. When the brake valve handle is moved to lap position, service position or emergency position, then it registers equalizing pressure.

Q. 9. What is the single air gauge used for that is attached to driver brake-cylinders direct?

A. 9. The single air gauge is attached to the driver brake-cylinders and used to register both the straight air pressure and the automatic pressure when the brake is applied.

Q. 10. When will it register the straight air-brake pressure?

A. 10. When the straight air brake is applied.

Q. 11. When will it register the automatic brake pressure?

A. 11. When the automatic brake is applied.

Q. 12. When will it register two pressures of air?

A. 12. When the straight air-brake is applied it will register the amount of air placed in the driver brake-cylinders with the straight air-brake valve, then when the automatic brake is applied it will register the extra pressure put in the brake-cylinders from the auxiliary reservoirs.

Q. 13. What is the other duty of the air gauge located on the dirver brake-cylinders?

A. 13. First, it will show the proper adjustment of the straight air feed valve and safety valve; it also will show if there is a leak in cylinders or in the pipe connections; it will show the amount of air placed in the cylinders in service or emergency applications; it also will show if the piston travel on the driver brakes is too short or too long when applying the automatic brake alone; it will show when the feed valve is leaking or if the safety valve is leaking; it will show a leak at the driver brake retaining valve after the automatic brake has been released and the retainer is set; it will show if there is a leak at the straight air-brake valve on lap position.

Q. 14. Will the single air gauge attached to driver brake-cylinders register the air placed in the tank brake-cylinder?

A. 14. It will register the amount of air placed in the tank brake-cylinder with the straight air-brake valve only, it will not register the automatic pressure.

EQUALIZING DRUM.

Q. 1. What is the equalizing reservoir used for and where is it connected to the brake valve?

A. 1. The equalizing reservoir is connected to the port opening leading direct above the equalizing piston and is placed there to increase a volume of air in chamber D so as to use the engineer's brake valve in an automatic action.

Q. 2. Where does the first pressure of air come from when the brake valve is used in service movement?

A. 2. The first reduction of air is taken off the top of the equalization piston out of chamber D and the equalizing reservoir, train-pipe pressure then being the greater moves up the equalizing piston and discharges the air from the train pipe to the atmosphere, when the brake valve handle is moved from service position to lap position, then the preliminary exhaust port opening above the equalizing piston in chamber D is closed off and the train-pipe pressure keeps on discharging the air to the atmosphere until the train-pipe pressure becomes a fraction less than equalizing pressure. Then the equalizing piston is moved back to its normal position and train-pipe pressure is closed off. The equalizing piston will then remain seated unless there is a leak above the equalizing piston, or the brake valve handle is again moved to service position.

Q. 3. Then by this you understand that the operator of the engineer's brake valve in service movement does not control train-pipe pressure?

A. 3. We do; the operator of the brake valve controls equalizing pressure only.

Q. 4. What size equalizing reservoirs should be used with the Westinghouse brake valve 10 x 12 and 10 x 14 1-2 inch?

A. 4. When more than 70 pounds pressure of air is to be carried in the train pipe and auxiliary reservoirs the brake valve should be supplied with a reservoir 10 x 14 1-2 inches.

Q. 5. Should there be a drain cock in the equalizing drum?

A. 5. Never place a drip-cock in the equalizing drum. If it comes open while enroute, it will cause the brakes to apply on train.

TRAIN AIR PIPE.

DEFECTS AND REMEDIES.

Q. 1. What would you do if you broke the train pipe off on the front of the engine?

A. 1. Drive in a wooden plug and proceed in that manner.

Q. 2. What would you do if you broke the pipe off under the pilot and it could not be repaired in a hurry?

A. 2. Disconnect the first union joint ahead of the drain cup, put in a blank washer and proceed in that manner.

Q. 3. What would you do if you broke the train pipe off on the rear of the engine?

A. 3. Drive a wooden plug in the pipe where it is broken, then go to the front of the engine, take the train pipe air hose and couple it into the train pipe whistle hose; after that is done then go to the rear of the engine and couple the train pipe whistle hose on the engine to the train air pipe hose on the tender. After they are coupled properly then cut out the reducing valve in the cab that supplies the train whistle pipe with air, then release the brakes and charge them up to the standard pressure, notify the conductor that you are ready to apply the brakes, and see if they are working correctly on the engine, tender and train. We will then have a perfect brake, but no air whistle.

Q. 4. What would you do if you broke the train pipe off under the tender?

A. 4. Take the train pipe air hose on the rear of engine and couple to train pipe whistle hose on the front of tender, after they are coupled, then go to the rear of the tender and couple the train pipe whistle hose on the tender to the train air pipe hose on the car, after they are coupled properly, then cut out the reducing valve in the cab so as to prevent the wasting of main reservoir pressure. Always bear in mind to try the brakes before proceeding. In this case we have a driver brake and no tank brake, and also have done away with the air whistle.

Q. 5. What would you do if you were running a local train and on the arrival at the end of your trip you were to turn your engine and in doing so you had a mishap as the tender backed off the turntable and you broke the whistle and train pipe off your tender?

A. 5. First notify the superintendent's office of the defect and tell him you can return with the train providing he will allow you to turn your engine and tender and return running backwards. If he grants you permission plug the train air pipe and the train whistle pipe on the rear of the engine and proceed in that manner, giving you an air-whistle and an air-brake on the engine and train but doing away with the automatic tank brake.

Q. 6. What would you do if you broke the angle-cock off on the front of the engine while using the engine and tender to bring the train to the end of the trip while running backwards.

A. 6. First plug the train pipe on the front of the engine, then go to the rear of engine, couple the train pipe air-hose on the engine to the train pipe whistle hose on the engine. After that is done return to the front of the engine and couple the train whistle hose on the front of the engine to the train air-pipe hose on the car, cut out the reducing valve in the cab that supplies the train whistle pipe with air, then charge the train up to the standard pressure and try the brakes. Proceed in that manner. We do away with the air-whistle.

Q. 7. What would you do if you broke the angle-cock off on the front of the engine if you were running backwards, the train pipe on the engine and tender in good condition. Also the train whistle pipe in good condition?

A. 7. First plug the train pipe on the front of the engine, then go to the rear of the tender and couple the whistle train pipe hose on the tender to the train pipe air-hose on tender; after that is done, return to the front of the engine and couple the train whistle pipe hose on the front of the engine to the train hose on the car. Cut out the reducing valve in the cab that supplies the train whistle pipe with air, (proceed in that manner), giving you a driver brake, a tender and train brake, but you do away with the air whistle.

Q. 8. What would you do if you broke the pipe off leading from the train pipe over to the triple valve?

A. 8. If broken between the drain cup and the cut-out cock drive in a wooden plug if broken between the cutout cock and the triple valve, close the cutout cock, release all of the air out of the auxiliary reservoir and proceed in that manner.

Q. 9. What would you do if you broke the pipe off between the triple valve and the brake-cylinder, or between the triple valve and auxiliary reservoirs?

A. 9. Close the cutout cock on the crossover pipe and proceed. This rule applies either to engine or tender.

Q. 10. What would you do if you broke the pipe off leading to the truck brake-cylinder where one triple valve is used to operate both brakes?

A. 10. Close the cutout cock leading to the truck brake-cylinder; also cut out the auxiliary reservoir that supplies the truck brake-cylinder with air and proceed.

Q. 11. What would you do if you broke the pipe off leading to the driver brake-cylinders where one triple valve is used to operate both brakes?

A. 11. In cutting out either brake when one triple valve is used to operate both brakes always bear in mind to cut out the auxiliary reservoir with the brake you cut out. If you do not you will increase the breaking powers on the brake that is left in working order.

Q. 12. What would you do if you broke train line air-pipe off under a passenger car?

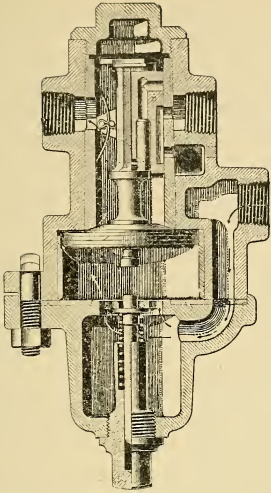
A. 12. In cases where train line air-pipe is broken under a passenger car, take the air-hose couplings on the car ahead of the defective one and connect it to whistle hose coupling on the car that is defective, using the whistle train pipe for a conveyer of air through the car, then go to the rear of the defective car, take the whistle hose coupling and connect it to the train line air-hose coupling on the car directly back of defective one, then we can charge up all cars, except the defective one, on which the whistle pipe is used for a conveyor of air only. There will be no brake on the car with the broken train line air-pipe, but on all cars ahead and behind defective car there will be a brake. Be sure to close whistle cock on the car ahead of defective car so that you can use the air whistle on all cars ahead of defective car. Be sure to make test of brakes before leaving this point in the usual way, that is the same as a terminal point.

Q. 13. What would you do if you broke the train air line pipe off between the drain cup and the angle-cock on the rear end of the last car?

A. 13. Plug the pipe at pressure end and proceed.

Q. 14. What would you do if you broke the train air pipe off between the drain cup and the angle-cock on the forward end of the last car?

A. 14. Plug the pipe ahead of the drain cup, take the air hose connection on the rear end of the car ahead of it and connect it into the air whistle hose on the defective car, then go in the rear end of the defective car, connect the air and whistle hose together and proceed in that manner.



TRIPLE VALVES ON ENGINE, TENDER AND CARS. DEFECTS AND REMEDIES.

Q. 1. What would you do if you found a bad leak at the exhaust port of the triple valve on the engine, tender, or cars and it was impossible to stop it?

A. 1. Close the cutout cock on the crossover pipe leading from the train pipe to the triple valve, bleed the auxiliary reservoirs and proceed in that manner.

Q. 2. What kind of a leak would it be if the exhaust was leaking on a plain triple valve?

A. 2. A train pipe and auxiliary reservoir leak when the brake valve handle is in full release or running position, and a brake-cylinder and auxiliary reservoir leak when the brake is applied.

Q. 3. What kind of a leak would it be if the leather gasket connecting the graduating stem case to the valve body was leaking?

A. 3. A train pipe leak.

Q. 4. What will cause a blow from the exhaust port of a quick-action triple valve?

A. 4. A leaky slide valve, a leaky rubber-seated emergency valve, a leaky check valve case gasket, a leaky triple valve body gasket or a tube leaking in an auxiliary reservoir.

Q. 5. What parts would be defective to cause a train pipe leak?

A. 5. The emergency rubber-seated valve or the check valve case gasket.

Q. 6. How could you detect train-pipe leaks from auxiliary reservoir leaks?

A. 6. By cutting out the brake and watching its action. If the brake applies and the blow stops, after being cut out, it shows a train pipe leak; if the blow continues and the brake does not apply it indicates an auxiliary reservoir leak.

Q. 7. Will a leak from the train pipe to the atmosphere through the triple valve cause a blow when the brake is applied?

A. 7. That depends on what part of the valve is defective. A leaky slide valve will cause a blow at the exhaust port in release or application position, while a leaky auxiliary tube or a body gasket will show a leak in release position.

Q. 8. What kind of a leak would it be with the cap-nut leaking on top of a plain triple valve?

A. 8. In release or running position a train pipe and auxiliary reservoir leak, but when the brake is applied an auxiliary reservoir leak.

Q. 9. What kind of a leak would it be with the graduating stem nut leaking or the half-inch plug leaking on the check case of a quick-action triple valve?

A. 9. A train pipe leak.

Q. 10. What kind of a leak would it be with the graduating stem nut leaking on a plain triple?

A. 10. A train pipe leak.

Q. 11. What kind of a leak would it be if the pipe was leaking that connects the triple valve to the auxiliary reservoir, or if there was a leak in the release valve, or a hole worn in the auxiliary reservoir?

A. 11. In release or running position, a train pipe leak and auxiliary reservoir leak; but in application position a auxiliary reservoir leak.

Q. 12. What is the usual defect if a triple valve becomes dry and gummy?

A. 12. It serves to destroy the action of the valve in service position and causes it to apply in the emergency position.

Q. 13. Are there any other defects in the triple valve that will produce the same results?

A. 13. A broken graduating pin, a weak or broken graduating spring, a graduating stem stuck down in the graduating stem nut, gummed graduating valve or a gummed slide valve, a packing ring fit too tight in the brass bushing in which it operates, so when there is a light reduction made in train pipe pressure the triple piston does not respond to train pipe reduction.

REMARKS.

A gummed or sticky triple valve or any of the above defects will cause quick action triple valve to apply the brakes in an emergency action when a gradual reduction in train pipe pressure has been made. When a triple valve sticks it does not respond to the first reduction in train pipe pressure, and the brake on that car does not set; but when the second reduction is made in train pipe pressure the auxiliary reservoir pressure, not being reduced, forces the triple piston back, compressing the graduating stem and spring. This movement of the piston carries the slide valve to emergency position, the sudden train pipe reduction causes the quick action part of the triple valve to come suddenly into effect, and this starts the next triple valve into quick action, which affects the one following, and so on throughout the train.

Q. 14. What will cause the auxiliary reservoir to charge too slowly?

A. 14. There may be dirt in the feed groove of the triple valve, or the screen in the drain cup may be stopped up, or the small strainer in the check case may be dirty or a bad leak in the auxiliary reservoir.

Q. 15. Will any of these causes prevent the brake from applying?

A. 15. Yes. When there is a reduction in train pipe pressure, and the auxiliary reservoir pressure is not charged up so as to allow its pressure to respond to the reduction made in train pipe, the triple piston cannot move.

Q. 16. What effect would a worn-out piston packing ring or a defective ring have in a triple valve?

A. 16. A worn-out piston packing ring will allow the air to charge the auxiliary reservoir too quickly, and on a long train a light train pipe reduction would not allow the brake to apply on the car with the defective ring, the air from the auxiliary reservoir passing by the packing ring and feed groove into the train pipe sufficiently fast so as to keep the train pipe pressure equal with the auxiliary reservoir pressure, in which case the triple piston would not be forced out and the brakes would not apply or in releasing the brakes. If the train pipe pressure is increased slowly it may feed by the packing ring fast enough to keep the brake applied by recharging the auxiliary reservoir.

Q. 17. What would produce a sudden brake with a quick-action triple valve and only affect the car it is on?

A. 17. When a quick action triple valve is put into the emergency action, and the check valve is stuck so it will not raise, then there is no train pipe air to enter the brake cylinder.

Q. 18. For what is the check valve used?

A. 18. Train pipe check valve prevents brake-cylinder pressure from flowing back into the train air pipe, in cases where the reduction in train pipe is below the brake-cylinder pressure, or when there is a bursted air-hose or a broken train pipe.

Q. 19. How can we proceed to find a car with a defective triple valve that puts the train brakes into quick action?

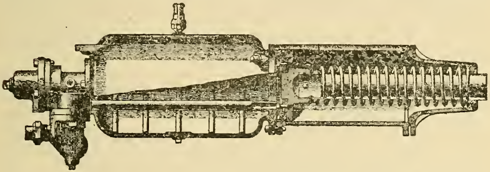
A. 19. First, have the engineer make a light reduction in train pipe pressure and look for the car that the brake is not on; then cut that brake out. If the brake still keeps going into quick action when the engineer makes a gradual reduction, take five cars at a time, stand off a distance in the centre of the third car, have the engineer apply the brakes, the brake that produces the heavy jar against the wheels or the moving of the cylinder piston quickly, and that will indicate the car. Cut out the brake and proceed. If on a passenger train, take three cars at a time.

Q. 20. What would you look for if the defective triple valve could not be found?

A. 20. A short piston travel on a car in a train is liable to do great damage to drawheads. When you decrease piston travel you increase power, and when the piston travel is shortened so as to double the braking power on a reduction of 10 pounds it acts the same as a defective triple valve; any more than the piston in the cylinder will move the same, as the rest of the cylinder pistons slowly.

Q. 21. What do you do when you increase piston travel?

A. 21. You decrease the power in the brake cylinder.



AUXILIARY RESERVOIR, BRAKE CYLINDER AND TRIPLE VALVE COMBINED.

Q. 1. For what is the auxiliary reservoir used?

A. 1. In the auxiliary reservoir air is stored for use in setting the brakes. It will charge at the rate of 1 pound per second and loses 20 pounds on each full service application with the standard pressure of 70 pounds.

Q. 2. How much larger is the auxiliary reservoir than the brake-cylinder?

A. 2. All auxiliary reservoir are built a fraction three times larger than the brake-cylinder.

Q. 3. How should the auxiliary reservoir be left under a car when its brake is to be run, cut out?

A. 3. Whenever a brake is to be run, cut out, the auxiliary reservoir must be bled to zero, so as to prevent the brake from going on.

Q. 4. What would you do if you broke a release valve off in air auxiliary reservoir.

A. 4. Drive in a wooden plug and proceed in that manner. Card it so it can be repaired at the end of the trip.

Q. 5. When a release valve is broken off or left open on an auxiliary reservoir, what kind of a leak would it be?

A. 5. A train pipe leak at all times.

Q. 6. What kind of a leak would it be if it were leaking slightly, so you could accumulate air in the auxiliary reservoir?

A. 6. Train pipe leak before the brake is applied, and an auxiliary reservoir leak after the brake is applied.

Q. 7. What would you do if you broke the pipe off leading from the triple valve over to the auxiliary reservoir under a car?

A. 7. Screw the piece out of the auxiliary reservoir, also out of the triple valve; take a whistle hose and screw it into the valve. Also screw one into the auxiliary reservoir, clutch them together, and proceed in that manner.

Q. 8. What would you do if you broke the crossover pipe off under a passenger train?

A. 8. It is always proper for a car inspector to have a hose and reducers located at their initial point, and when a car arrives in that condition to place the reducer in the connection at the train pipe; also at the triple valve; clutch them together and proceed in that manner, making a temporary crossover pipe.

Q. 9. What will make a brake leak off independent of the triple valve?

A. 9. A brake-cylinder or a cylinder-head gasket leaking, a sand hole in the piston head, a leak in the packing leather, the follower being slack or broken or one of the studs leaking where it screws into the piston head, a packing leather being put in the cylinder wrong, with the smooth side of the leather next to the wall of the cylinder, or a weak expander put in around the packing leather or an expander out of place.

Q. 10. What will cause the brakes to drag on the wheels?

A. 10. The sleeve very often splits, due to the fact that the push-rod does not ride in the center of the sleeve when the brake is applied; it binds on the side of the sleeve and causes a heavy strain. When this occurs the release spring cannot force the brake piston into release position.

Q. 11. What effect will a weak release spring have on a brake piston?

A. 11. If the release spring is weak or broken it will not move the brake piston to release position, especially when the brake-cylinder is dry or dirty. As a result of this, the piston will stay in application position after the triple valve has moved to release position, and all of the air has left brake-cylinder.

Q. 12. What will cause the brake to go on one car in a train while the train is en route?

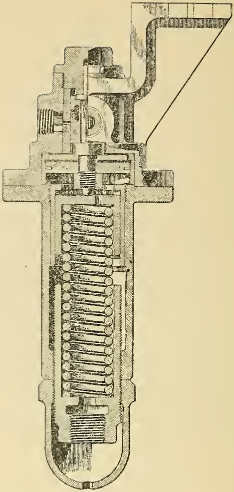
A. 12. Due to a defective triple valve on the car and a dirty leakage groove in the cylinder. If the leakage groove is clean and there was some of the auxiliary reservoir pressure to enter the brake-cylinder through the defective triple valve it would pass through the groove and out of the non-pressure head. But as the groove is dirty, the air gradually fills the cylinder and forces the brake piston out into application position.

Q. 13. What will cause the brake to hold on regardless of the triple valve?

A. 13. A rusty or dirty brake cylinder or a piston that has traveled out the full length of the cylinder so as to allow the release spring to be compressed so close together that the coils of the spring will lap over one another and catch around the sleeve of the piston.

Q. 14. What will cause the brake to go on very suddenly on a car with a defective brake-cylinder?

A. 14. Due to a dirty leakage groove and a rusty or dirty brake-cylinder. When there is a light reduction made in the train pipe pressure the auxiliary reservoir pressure entering the brake-cylinder was not sufficient to move the piston and rod, but when the second reduction was made in the train pipe pressure then the auxiliary reservoir pressure moved the brake, piston and rod very suddenly.



HIGH-SPEED REDUCING VALVES.

Q. 1. For what is the high speed brake reducing valve used?

A. 1. The high speed reducing valves are to be adjusted to close when the brake-cylinder pressure reduces to 60 pounds, and when they are defective should be repaired at once. The raised figures cast on the body of the Westinghouse valves will indicate the size of cylinder on which they are to be used. Safety valves set at 60 pounds may be used in emergency or on cars that are put in train service carrying 110 pounds train pipe and auxiliary reservoir pressure.

Q. 2. What would you do if you had a car to be operated under a high speed pressure and it was not equipped with one of these valves?

A. 2. To run a car not equipped with one of these valves in a train operated under a high speed pressure, if you have a sufficient number of cars to allow your percentage of braking powers, the brake can be cut out to prevent wheel-sliding or the train pipe pressure may be reduced down to 80 pounds by notifying the engineer to that effect.

Q. 3. What would you do if you broke the pipe off between the brake-cylinder and the high speed reducing valve?

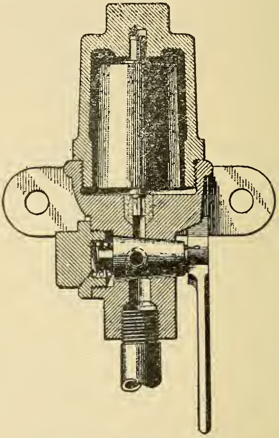
A. 3. Plug the pipe and proceed, as Rule 2.

Q. 4. What would you do if you had a high speed reducing valve leaking while in road service, so as to leak the brake off the car before coming to a stop?

A. 4. Disconnect the union at the high speed reducing valve, put in a blank washer and proceed, as Rule 2.

REMARKS.

The high speed reducing valve is connected to the brake cylinder with a half-inch pipe when the air is admitted to the brake-cylinder. It is also admitted to the high speed reducer on top of the piston. Underneath the piston is a regulating spring which is set for 60 pounds, and as long as the brake-cylinder pressure does not exceed 60 pounds the piston cannot move. But just as soon as the pressure in the brake-cylinder becomes a fraction greater than 60 pounds, then the piston moves down carrying with it the slide valve. The exhaust port in the slide valve is made in a triangular shape, with the small part of the triangular facing upward. As the air is admitted on the top of the piston it is moved so as to bring the triangular port in the slide valve in communication with the exhaust port in the slide valve seat. The heavier the air pressure on top of the piston the farther down the piston will move, until it comes in contact with the shoulder. In the case it is operated in and the regulating spring is compressed closer together. When the piston is against the shoulder the small part of the triangular port is brought in communication with the exhaust port in the slide valve seat, which is in communication with the atmosphere, and as the air is passing out through the exhaust port off the top of the piston the pressure in the brake cylinder is decreasing. The regulating spring is now uncompressing and the slide valve and piston are being shoved up. As the slide valve moves up the larger part of the triangular port is leaving the air out of the cylinder more rapidly, and when the pressure in the cylinder is reduced to what the spring is set for then the triangular port is carried by the exhaust port in the slide valve seat and the pressure is retained in the brake-cylinder. Under this explanation you can realize that if the heaviest pressure is admitted to the brake-cylinder when the train is running at high speed, and as the air is decreasing in the brake-cylinder, the train is decreasing in speed, as the greatest braking power was when the train was at its highest speed.



RETAINING VALVES.

Q. 1. What are the uses of retaining valves?

A. 1. Retaining valves are for the purpose of holding a pressure of air in brake-cylinder while the auxiliary reservoirs are being recharged on descending grades, and are to be used on head cars to any number desired by the engineer. The handle must always point down when not in use and be turned to the position the valve calls for when required to retain. They must be tested before going down specially designated grades.

Q. 2. To what part of a triple valve is the retaining valve connected?

A. 2. They are connected to the exhaust port of the triple valve.

Q. 3. How many different style pressure retaining valves are there in use?

A. 3. There are retaining valves adapted for the driver brake-cylinders and the standard retaining valves, which retains 15 pounds, and the high and low pressure retaining valves.

Q. 4. What position does the handle of the 15-pound pressure retaining valve stand when in release position, and when placed in a position to retain?

A. 4. The 15-pound pressure retaining valve should have the handle always turned down in line with the pipe when in release position, and when moved to retaining position should point directly out.

Q. 5. What position does the high and low pressure retaining valve handle stand when in release position, and when placed in a position to retain?

A. 5. When the handle of the high and low pressure retaining valve is not in use the handle should point directly down. When you desire to set the valve for the high pressure move it to a position on an angle to where the letters cast H. P. on the valve body, and to retain a low pressure the handle should point directly out.

Q. 6. When should the high and low pressure retaining valves be used?

A. 6. The high pressure retaining valve should be used on a loaded car and the low pressure on an empty car.

Q. 7. When should retaining valves be placed in service.

A. 7. Only when notified by the proper authority.

Q. 8. How should retaining valves be used on long grade work?

A. 8. If retaining valves are used on long grades they should be set up to the number of cars the engineer desires. Starting at the head end of the train, if the grade is short, set them on every car until you have the number desired. If the grade is long, it is a good policy to set up every other one for half the distance, then alternate the other half for the remainder of the grade. Under this condition, we do not run chances of getting wheels hot.

Q. 9. What would you do if you found a pressure-retaining valve broken or the pipe that connects the retaining valve to the triple valve exhaust broken?

A. 9. Leave it alone in that position and proceed in that manner. Card the car and report to the proper authority and have it repaired.

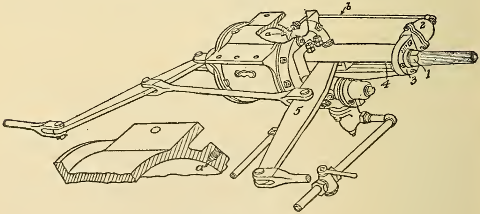
Q. 10. How should you test for a leak at the pressure retaining valve or a leak in the pipe connecting it to the triple valve exhaust?

A. 10. First, place the retaining valve handle in release position and charge the auxiliary reservoir with air up to the standard pressure. If there is no blow at the retaining valve that will show you that the triple valve is O. K. in release position. Then have the brake applied, and when the triple valve goes to lap position that will show that the triple valve is O. K. when the brake is applied. Then set up the retaining valves and have the brake released. If the valve stops blowing at the required pressure it is set for, and the brake remains set, that will indicate that the valve and piping is O. K. If the brake leaks off it will indicate a leak from the triple valve up to the retainer. If the retainer keeps blowing it will indicate a leak in the valve.

Q. 11. Where do we start to set up retaining valves?

A. 11. Always start on the first car behind the tender to set up retaining valves, and start from the rear end to take them off.

AUTOMATIC SLACK ADJUSTERS.



REMARKS.

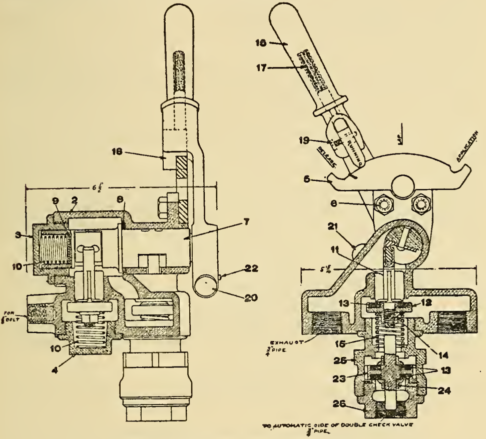
Automatic slack adjusters on cars and tenders prevent a running piston travel of more than 8 inches. All hand adjustments should be made with these adjusters standing in zero position. To replace worn shoes it is only necessary to screw adjuster handle to left. They should be cleaned and oiled each time their brake-cylinder receives attention.

Q. 1. How would you test for a leak in the slack adjuster pipe?

A. 1. Run the slack out until the piston travel exceeds 8 inches, apply the brakes and test the slack adjuster pipe and cylinder for leaks.

Q. 2. What would you do if you found the pipe was broken off that leads from the brake-cylinder over to the slack adjuster?

A. 2. Run the slack in by hand, so you will not permit the piston to travel up to the opening in the brake-cylinder where the pipe is tapped.



STRAIGHT AIR BRAKE. WITH ITS DEFECTS AND REMEDIES.

REMARKS.

Engineers must always keep both brakes cut in and ready for operation unless failure of some parts requires cutting out and always carry an excess pressure in the main reservoirs, as this is necessary to insure a release of brakes. When not in use they must keep the straight air-brake valve handle in release or running position. The straight air-reducing valve should be set to carry 45 pounds and the safety valve is set for 53 pounds. The double-seated check valves located between triple valves and brake-cylinders and straight air-brake valve have leather seats which must be replaced when necessary. Never use the straight air-brake to take the slack of a train.

Q. 1. What is the difference between a straight air-brake and an automatic brake?

A. 1. A straight air-brake receives its air for its braking powers direct from the main reservoir, the automatic brake receives its air for its braking powers from the auxiliary reservoir.

Q. 2. What is a straight and automatic air-brake combined?

A. 2. A device to apply the straight air-brake or the automatic air-brake on an engine and tender independent of one another.

Q. 3. Is it necessary to get either brake ready for service by the use of cutout cocks or handles, or otherwise, to work either brake?

A. 3. No, they are so arranged in parts that the operator of the brake can use either brake, at his desire, without any alterations being made to either brake.

Q. 4. How many positions has the first straight air-brake valve?

A. 4. There are three positions.

No. 1. Release position.
2. Lap position.
3. Application position.

Q. 5. How many positions has the latest improved straight air-brake valve?

A. 5. There are five positions:

1. Release position for the automatic driver brake.
2. Lap position for the automatic driver brake.
3. Release position for the straight air-brake.
4. Lap position for the straight air brake.
5. Application position for the straight air-brake.

Q. 6. What is the meaning of lap position for the straight air-brake valve?

A. 6. The position in which both the exhaust valve and main reservoir pressure valve is closed.

Q. 7. What is the meaning of lap position for the automatic driver brake on the straight air-brake valve?

A. 7. Lap position or running position. In that position the leather-seated valve can form a tight joint against the valve seat and prevents the air from escaping when the automatic driver brake is applied.

Q. 8. What is the object of having an automatic release for the driver brake with the straight air-brake valve?

A. 8. First, it will do away with the mountain cock or release cock and give the engineer one valve to handle.

Q. 9. Explain a good feature of the automatic release with the straight air-brake valve.

A. 9. First, if the engineer was to open the mountain cock on starting to descend a grade, and he forgot to close it at the end of the grade, every time he applied the automatic brake the air would pass through the cock and render the driver brake useless, but there is a spring that controls the movement of the straight air-brake valve; when placed in release position the spring forces the valve to running position under an automatic action closing off the check valve, and will always protect the automatic brake on the driver brake. The next good feature with the automatic release, on the engine for the driver brake with the straight air-brake valve is that if there was an air-hose to burst in the train, while running at low speed and the engineer saw that the driver brake had fastened itself so as to allow the wheels to go skidding, all he has to do is to place the handle of the straight air brake valve in full release position. As soon as he sees that the driver brake has released and the wheels start to revolve all that is necessary is to drop a little sand and set the straight air brake.

Q. 10. How is the automatic side of the driver brake brought in communication with the straight air-brake valve?

A. 10. Located on the pipe between the triple valve and the double-check is a T connection, extending from the T is a 3-4-inch pipe leading to the check valve on the straight air-brake valve. When the air is admitted to the brake-cylinders through the movement of the triple valve it is also admitted to the pipe leading up to the check valve. When the straight air-brake valve handle is moved to running position, that allows the check valve to seat itself, but when the handle of the valve is moved to release position, that releases the air from the driver brake-cylinders to the atmosphere on the automatic side.

Q. 11. How does release position of the straight air-brake valve release the automatic brake?

A. 11. When the straight air-brake valve is moved to release position the tappet piece is brought in communication with the exhaust valve, this in turn comes in contact with the check valve located direct below it and through this action the valves are both unseated, this permitting the air to escape to the atmosphere.

Q. 12. How does running position permit this check valve to seat itself?

A. 12. In that position the tappet piece allows the exhaust valve to go closer to its seat by the help of a spring, in that position the check valve direct below it is permitted to take its seat when the air pressure from the action of the triple valve comes in contact with tho valve.

Q. 13. What kind of a valve is located in this check case directly below the exhaust valve?

A. 13. A double-seat check valve with a stem extending out at each end, and leather seats attached to it forms an air-tight joint and protects the valve seat in both actions of the air-brake. When the straight air-brake is applied the valve is forced downwards by the air-pressure and prevents an escape of air from the exhaust port of the triple valve. When the automatic brake is applied it is forced upward and prevents an escape of air out of the straight air-brake valve.

Q. 14. How many ways is the release of the automatic brake protected through the action of this valve when the straight air-brake valve is on lap position?

A. 14. Two ways, one by the double-seated check valve located on the straight air-brake valve and also by the exhaust valve of the straight air-brake valve.

Q. 15. What would you do while enroute if this double-seated check valve located directly below the exhaust valve of the straight air-brake valve produced a leak?

A. 15. Place the straight air-brake valve on lap position when using the automatic brake, the exhaust valve will then take care of the leak in the double-seated check valve.

Q. 16. What kind of a leak would it be if the straight air-brake valve was placed in running position and there was a blow at the exhaust of the straight air-brake valve?

A. 16. It would be a main reservoir leak.

Q. 17. What kind of a leak would it be if your straight air brake valve was placed in application position and there was a leak at the driver brake, tank brake-cylinders, the pipes leading to the cylinders or the straight air train pipe leaking?

A. 17. That would be a main reservoir leak and a brake-cylinder leak.

Q. 18. What kind of a leak would it be if the straight air-brake valve was placed to lap position after the brake was applied and the straight air-brake valve was tight?

A. 18. A brake-cylinder leak.

Q. 19. What kind of a leak would it be if the straight air-brake valve was placed to lap position after the brake was applied and the exhaust of the straight air-brake valve was leaking?

A. 19. It would indicate a brake-cylinder leak and a leather-seated exhaust valve leaking in the straight air-brake valve.

Q. 20. What kind of a leak would it be with the straight air-brake valve in running position when the automatic brake is applied?

A. 20. A double-seated check valve that is located at the straight air-brake valve leaking, or the straight air-brake side of the double check valve that is located between the triple valve and the straight air-brake pipe.

Q. 21. What kind of a leak would it be if the straight air-brake was applied and the exhaust of the triple valve was leaking?

A. 21. A double-seated check valve leaking on the automatic side.

Q. 22. When coming to a stop, and you desire your straight air-brake valve to be used to hold the brake on your engine and tender, how should you place the handle of the valve?

A. 22. Always put the handle of the straight air-brake valve into application position. Bear in mind that the straight air-brake valve on lap position has the ports closed in that position. If there was a leak at the straight air-brake valve on the brake-cylinder side, or at the exhaust of the straight air valve, or any of the pipe connections leading to both double-seated check valve, or any of the pipes leading from the check valve to the cylinders, or if the double-seated check valves were leaking, or any part of the cylinders was leaking, the brake would leak off. But when the straight brake valve handle is moved to application position as long as the pump can overcome the leak, the brake will stay applied.

Q. 23. What would you do if you broke a safety valve off your driver brake or tank brake-cylinders?

A. 23. Plug the place where it is broken and proceed. Be careful not to apply the automatic brake on top of the straight air-brake.

Q. 24. What may make a continuous blow at the safety valve on the driver brake or tank brake-cylinders?

A. 24. A leaky valve, dirt on the valve or seat, a safety valve adjusted too low or the feed valve adjusted too high or the feed valve leaking.

Q. 25. When should the feed valve or safety valve be adjusted?

A. 25. Not until the air-gauge has been tested. If the air-gauge is out of order you could adjust the feed valve so as to carry too high a pressure of air or too low a pressure on your brakes on the engine and tender.

Q. 26. How can we test the straight air-gauge without removing same?

A. 26. All straight air train pipes should be equipped with a ¾-inch T with a ¼-inch outlet. Place the handle of the straight air-brake valve into release position, then remove the ¼-inch plug out of the T, screw in a test gauge, place the handle of the straight air-brake valve into application position. The pressure on the test gauge will be shown at the same time the gauge pressure is registered on the straight air-gauge in the cab of the engine.

Q. 27. What would you look for if the straight air-gauge were correct, the feed valve adjusted to 45 pounds and the safety valve adjusted to 53 pounds, and when the straight air-brake valve handle was placed in application position the gauge would show an increase in pressure above the amount for which the valve was adjusted?

A. 27. Look for a leak in feed valve attached to straight air-brake valve.

Q. 28. What would you look for if you had the straight air-brake applied, and when you put the handle of the valve into release position it would release the brake very slowly?

A. 28. It would indicate a plugged-up straight train air-pipe or a pipe screwed into a T connection or an elbow too far so as to prevent the flow of air proper.

Q. 29. Where is a bleed cock located on a switching engine?

A. 29. It is connected directly to brake-cylinders, so it will release a straight or automatic air-brake on the engine and tender.

Q. 30. Where is the bleed cock located on a long road engine?

A. 30. The bleed cock on a long road engine should be connected between the triple valve and the double-seated check valve, and used to release the automatic brake only.

Q. 31. What is the use of a bleed cock between the triple valve and the double check valve?

A. 31. It is placed there and termed a mountain cock, and is to be left open when being used on grades so the engineer can alternate the brake on the engine and the tender independent of the automatic brake on the train.

Q. 32. What would you do if the bleed cock was to leak on a switching engine?

A. 32. Take the cock off the pipe, plug the pipe screw on the cock again and proceed.

Q. 33. What would you do if the bleed cock was to leak on a long road engine?

A. 33. Leave it leak until you arrive at the round-house or shop and use the straight air-brake valve for applying the brake on the engine and tender.

Q. 34. Of what other use is the mountain cock?

A. 34. It is very useful on long road engines at all times. If the brake is applied a little hard by a heavy reduction or by the use of an air-hose bursting or any defect that is in the train pipe, the engineer can release the driver brakes independently through the bleed cock.

Q. 35. What would you do if you broke the pipe off leading from the straight air train pipe over to the double check valve on the engine?

A. 35. Put in a blank washer or plug the pipe; that will give you a straight air-brake on the tender only.

Q. 36. What would you do if you broke the straight air train pipe off on the tender?

A. 36. Screw the hose off the rear of the straight air train pipe on the engine, plug up the hose and put hose back again; that will give you a straight air-brake on the engine.

Q. 37. What would you do if you broke the straight air train pipe off on the engine on the rear of the T where the pipe extends over to the double-seated check valve?

A. 37. Plug the pipe, and that will give you a straight air-brake on the engine.

Q. 38. What would you do if you broke the straight air train pipe off at the head of the T where the pipe extends from the train pipe over to the double-seated check valve?

A. 38. Leave your straight air-brake valve in running position and proceed, using the automatic brake on engine and tender.

Q. 39. What would you do if you broke the pipe off leading from the feed valve attachment over to the straight air-brake valve?

A. 39. Take the cap nut off and unscrew the regulating nut until the air ceases to blow out of the broken pipe. If that will not remedy it, disconnect the feed valve loose from the pipe bracket, drive in a wooden plug in the port opening at the pressure end, called main reservoir pressure; put the feed valve back on again and proceed.

Q. 40. What would you do if you broke the pipe off between the main reservoir and the pipe bracket to which the straight air feed valve is attached?

A. 40. Drive in a wooden plug at the pressure end and proceed.

Q. 41. What would you do if you broke the pipe leading from the double check valve over to the driver brake-cylinders?

A. 41. Plug the crossover pipe leading from the straight air pipe over to the double check, leaving a straight brake to be used on the tender alone; cut out the triple valve on the driver brake so as to save the air that would be used on the automatic brake.

Q. 42. What would you do if you broke the pipe off leading from the double check over to the tank brake-cylinder?

A. 42. Plug the straight air train pipe between engine and tender, leaving you a straight air-brake on the engine; cut the triple valve out on the tender so as to save air that would be used on the automatic brake.

Q. 43. What would you do if you broke the pipe off between the triple valve and the double check valve, either on engine or tender?

A. 43. Cut the triple valve out and proceed, using the straight air-brake on engine and tender.

Q. 44. What would you do if you broke the pipe off leading from the brake-cylinder up to the air-gauge?

A. 44. Plug the pipe and proceed.

Q. 45. What would you do if you broke the auxiliary reservoir off your engine or tender when you have the straight air-brake and the automatic brake combined?

A. 45. Cut out the triple valve. If the triple valve is broken off plug up the crossover pipe at pressure end leading from the train pipe over to the triple valve and proceed, using the straight air-brake on the engine and tender.

Q. 46. What would you do if you had an engine and tender that had the straight and automatic brake combined, and you broke the automatic train pipe off the engine?

A. 46. If broken below the cut-out cock, close it. If broken between the cut-out cock and the brake valve put the handle to lap position. If the brake valve were to leak on lap position, disconnect the nut at the lower end of the brake valve on the train pipe side and put in a blank washer.

Q. 47. How would you proceed and get the engine ready so as to use the straight air-brake valve to operate an automatic brake on tender and train?

A. 47. First shut the air pump off tight, then place the brake valve handle of the automatic brake in full release position and leave all of the air out of the main reservoir. After that is done take the cap nut off of the straight air feed valve and take out the slide valve and piston, screw the cap nut back on again tight, then start the air pump. While the pump is making air blank off the double check valve on the straight air side. After that is done couple up the straight air-hose on the engine to the automatic hose on the tender. After they are properly coupled release the brakes on the tender and train by placing the straight air-brake valve in application position, which will give you a direct opening between the main reservoir and the train pipe. After the train is charged up to 70 pounds notify the train crew that you are ready to apply the brakes. When the signal is given to make an application of the brakes, take the straight air-brake valve and place it in release position, graduating the pressure out of the train pipe to make a surface reduction. After you have made a reduction proper to set the brakes, put the straight air-brake valve handle to lap position. When the signal is given to release the brakes place the brake valve handle in application position, which will release the automatic brake. If you have a train of cars that are loaded, let your governor be set for 90 pounds. If an empty train, cut the governor down to 70 pounds. Now, the excess pressure is the pressure shown by the red hand on the duplex gauge. When the straight air-brake valve is in lap position when you take the slide valve and piston out of the straight air feed valve, that gives you a direct opening between the main reservoir and the train pipe, and also gives you a train pipe register with the red hand.

Q. 48. What would you do if you had an engine that had the straight and automatic brake on and a whistle train pipe, and you broke the train pipe on your engine?

A. 48. Proceed in the following manner: Take the slide valve and piston out of the straight air feed valve, blank off the double check; if broken above the cutout cock, close it; if broken below the cutout cock, drive in a wooden plug, put the automatic brake valve handle on lap position, couple the straight air-hose on the rear of the engine to the air whistle hose on the rear of the engine; then go to the front of the engine and couple the whistle hose to the automatic hose, making a circuit of air around the front of the engine, placing the straight air-brake valve into application position, and proceed. Always bear in mind that you should try the brakes before proceeding.

Q. 49. Located on the pipe leading from the main reservoir to the automatic brake valve is a 1-inch T with a ¾-inch outlet; extending from this outlet is a ¾-inch pipe leading over to the pipe bracket to which the straight air feed valve is connected. What would you do if you broke the pipe off between the T and the automatic brake valve?

A. 49. First plug the pipe on the pressure end and proceed the same as Rule 47, but instead of blanking off the straight air side of the double check disconnect both unions at the driver brake-cylinders and put in blank washers. If the safety valve is screwed into the driver brake pipe take it out and take a ½-inch plug out of the driver brake-cylinder head and put it in the pipe in place of the safety valve. Then set up the straight air feed valve above main reservoir pressure. Now, in this case, the straight air-gauge will be the register for the automatic brake.

Q. 50. What would you do if, proceeding the same as Rule 49, and you discovered the driver brake triple exhaust leaking?

A. 50. Make a wooden plug and screw it in the exhaust of the triple valve. That leak would show that the leather seat was leaking on the automatic side of the double-seated check valve.

Q. 51. What would you do if you were running the engine in the backward motion and you broke the train air pipe off on the engine?

A. 51. If broken above the T connection, plug it up at the pressure end; if above the cutout cock, close it, and proceed the same as Rule 47, but connect the straight air-hose on the rear of the engine to the automatic hose on the engine. This will render the tank brake useless. If, arriving at a place where car inspectors are located, you could get a 1¼-inch T and a 1¼-inch reducer to 1 inch, screw that on the train air pipe on the tender, screw a hose in the outlet of the T and a hose into the end of the T, couple the straight air-hose on the engine to the hose on the tender with the outlet and the hose on the tender to the automatic hose on the engine. That will give you a tank brake and a driver brake. Then proceed. Standard signal hose and fittings should be used between engine and tender for the straight air-brake. With the straight air-brake valve with three positions there should be a bleed or release cock in service.

Q. 52. What would you do if you were running the engine in the backward motion and you broke the pipe off between the T connection and the automatic brake valve that supplies the automatic brake and the straight air feed valve with air?

A. 52. Plug the pipe at pressure end, close the cutout cock in the train pipe underneath of the brake valve set up on the feed valve above main reservoir pressure, blank off both driver brake-cylinders at the union connection, remove the safety valve. If on the driver brake pipe, take a ½-inch plug out of the cylinder head and screw it in where you took out the safety valve, couple up the air-hose the same as Rule 51, and proceed.

Q. 53. What would you do if you had an engine with the straight and automatic brake combined and a whistle train pipe, and you were running the engine in the backward motion, and you broke the automatic train pipe on the engine so it could not be used at all?

A. 53. Shut the cutcock underneath of the brake valve and proceed, as in Rule 47. Couple the straight air-hose on the engine to the automatic hose on the tender, then go to the rear of the tender and couple the automatic hose to the whistle hose. Do not interfere with the whistle hose between the engine and tender. Leave the whistle train pipe be your train air pipe. Couple the whistle hose on the front of the pilot to the train air pipe on your car and proceed, doing away with the driver brake only.

Q. 54. What would you do if you had an engine with the straight and automatic brake combined and a whistle train pipe, and you were running the engine in the backward motion, and you broke the automatic train pipe off on the engine?

A. 54. If broken above the T connection proceed the same as Rule 47. Plug the pipe, then couple the straight air-hose on the engine to the whistle hose on the tender. Then go to the rear of the tender and couple the automatic hose to the whistle hose. This will give you a tank brake and a driver brake.

Q. 55. What would you do if you broke both air-gauge pipes off leading from the engineer's brake valve up to the duplex air-gauge where you had an engine with the straight and automatic brake combined?

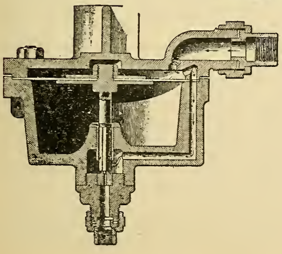
A. 55. First plug up the air-gauge pipes at pressure ends, then disconnect the straight air-hose between engine and tender, screw the straight air-hose off the engine, drive a wooden plug in the hose tight, put the hose on again, clutch the hose together, then take the ½-inch unions loose at the brake-cylinders and put in blank washers. After that is done set up on the straight air feed valve above main reservoir pressure. Place the straight air-brake valve into application position, using the straight air-gauge for the automatic register; carry the automatic brake valve in full release. If you have an empty freight train set the governor for 70 pounds; if loaded let it be set for 90 pounds. If the safety valve is placed on the driver brake-pipe, screw it off and put in a ½-inch gas pipe plug out of the cylinder head; that will do away with the driver brake.

REMARKS.

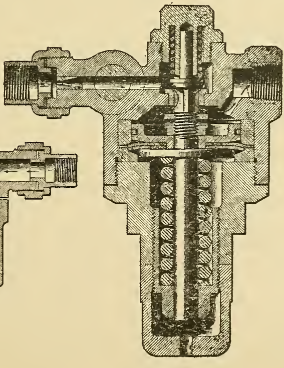
In using a whistle train pipe on the engine or tender to convey the air through so as to represent it as a train air-pipe, always cut out the reducing valve that supplies the whistle train pipe with air.

There is one thing for an engineer to remember, and that is to keep your eyes on the air-gauge, as that is the best friend you have. Many times the neglect to watch the air-gauge causes great trouble and damage to company's property, as the air pump may stop, and by having the exhaust pipe of the pump tapped into the exhaust port of the steam cylinder it may not be noticeable; but if the attention is given to the air gauge that will indicate just what the air pump is doing.

Emergency valves are placed on engines for the use of the fireman in case of emergency, and should be used at any time when found necessary. This valve is connected to the train pipe and has no cutout cock, when it is desired to stop a train with this valve by signal; otherwise it should be opened, according to necessity, and left open until train is stopped. If the pipe were to break off between the train pipe T and the valve, or if the valve was to become disabled, plug it up and proceed.



Signal Valve



Reducing Valve

AIR SIGNAL VALVE.

WITH ITS DEFECTS AND REMEDIES.

Q. 1. How much air pressure is carried on a train air signal reducing valve?

A. 1. The train air signal reducing valve on engine must be adjusted and maintained to carry 40 to 45 pounds pressure. It should be tested frequently and cleaned once in each three months, or oftener, if necessary. The signal whistle valve on engine must be looked after promptly and replaced with a good one whenever it fails to respond to proper blasts from any car discharge valve in a train of 12 or 14 cars or less; the removed valve to be repaired at once for use. The car discharge valves and all strainers must be kept free from leaks and obstructions and tested after each trip.

Q. 2. What would you look for if the air whistle gives one long blast?

A. 2. It is often due to a tight diaphragm stem in the signal valve or the reduction made to close together by the car discharge valve.

Q. 3. What would you look for if the blasts were weak?

A. 3. It is often due to a weak regulating spring in the reducing valve. So when there is less than 40 pounds in the signal pipe line, the whistle may be full of dirt or it may want adjusting or the passage through the lower cap nut may be partly stopped up.

Q. 4. What would you look for if you had a constant blow at the signal whistle?

A. 4. The diaphragm valve stem may be bent or the stem held off the seat of the lower cap nut, due to dirt or a foreign substance, or the seat may be worn out.

Q. 5. If the signal valve fails to charge, where would you look for the trouble?

A. 5. Port D may be plugged up with dirt or the ½-inch pipe leading from the signal valve down to the whistle train pipe may be screwed down too far in the T connections, so as to cut off the supply of air from the train pipe up to the signal valve.

Q. 6. What effect will a loose valve stem have in a signal valve?

A. 6. If the valve stem is too loose a fit in the signal valve it will not be affected by small leaks nor will it respond to light, quick reductions made by the car discharge valve.

Q. 7. What would you look for if the whistle train pipe was not to charge up to the standard pressure?

.A. 7 First look to see if the reducing valve is not stopped up with dirt at main reservoir connection, or the reducing valve may be partly cut out, or the pipe leading from the main reservoir to reducing valve may be partly stopped up with dirt and oil.

Q. 8. What would you look for if the signal pipe would not charge at all?

A. 8. The pipe leading from the reducing valve to train pipe is disconnected, or the pipe leading from the signal valve to train pipe is disconnected, or a split pipe in the signal line, a hole in whistle hose, in winter-time the signal pipes frozen up, or a whistle cock leaking on the front of the engine or the rear of the tender.

Q. 9. What would you look for if the signal whistle was to work on your engine when tested at the roundhouse or shop, but when connected to train it refused to respond to the car discharge valve?

A. 9. This is often due to a partly stopped-up port at the reducing valve or the reducing valve adjusted too low. The proper way to find the cause is to take one car at a time and try them independently by closing the whistle cock on the rear of each car.

Q. 10. What would you look for if the signal whistle on your engine was to operate from Car 1, would not operate from Car 2, and would work from the remainder of the train?

A. 10. It would be the fault of Car 2. The T in the train signal pipe would be clogged up with dirt. In making a reduction with the car discharge valve the air would leak through the dirty screen and fill the half-inch pipe from the train whistle pipe up to the car discharge valve, so when the car discharge valve was operated there would be a heavy discharge of air, but it would not affect the train whistle pipe.

Q. 11. What would you look for if you were to put the engine or tender up against the train, couple up the whistle hose properly and the party in charge reports no air in the train whistle pipe?

A. 11. The car discharge valve may be open from a tight cord or a piece of dirt may have lodged on the car discharge valve or seat, or the whistle hose may be only partly clutched, or a whistle cock on the rear of the train partly open; a broken or split train whistle pipe.

Q. 12. What would you look for if the car discharge valve has been operated and there was a good flow of air from the valve, and the signal whistle refused to respond?

A. 12. A tight-fitting valve stem in the signal valve chamber, a baggy diaphragm or a port stopped up in the lower cap nut, the bell of the whistle come loose, worked down and prevented the whistle from sounding, or the whistle may be full of dirt or scale.

Q. 13. What would you look for if the air whistle worked O. K. on the engine and train when standing at a station, but when the train was in motion and the car discharge valve was operated to make a flag stop and the whistle on the engine did not respond?

A. 13. It is due to a window or door in the cab being opened and the air whistle extending above the window sash or below the top of the door. The air blowing against the bell of the whistle while running at a high rate of speed destroys the sound of the signal whistle.

Q. 14. When does the signal whistle have a weak sound?

A. 14. When the bell of the whistle gets loose and works itself down too close to the air chamber, or when the pressure of air is increased above the standard pressure of 40 pounds.

Q. 15. What will make the signal whistle blow on the engine after the train brakes are released?

A. 15. When main reservoir pressure and the train pipe whistle pressure is equal. On releasing the train brakes the air comes from the main reservoir into the train air-pipe; the train pipe whistle pressure, being equal with the main reservoir pressure, flows back into the main reservoir. Then the signal whistle keeps blowing until main reservoir pressure and train pipe whistle pressure become equal.

Q. 16. Will a small, steady leak in train whistle pipe affect signal whistle?

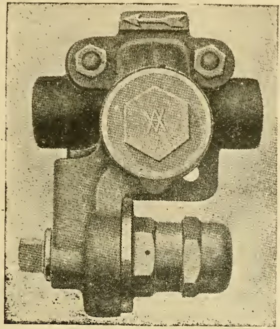
A. 16. It will not affect the whistle at all.

Q. 17. What kind of a leak will make the signal whistle operate on the engine.

A. 17. If a whistle train pipe is riding on a bolt or any hard substance and causes a hole to wear in the pipe, every time the engine gives a surge and the pipe should leave the place it is rubbing on it will let the air escape, and that will be a reduction of air in the train whistle pipe, and the signal whistle will operate on the engine.

Q. 18. What makes the signal whistle give two blasts when the car discharge valve is operated?

A. 18. When the car discharge valve is operated improperly or a valve stem is a little loose in the valve chamber.



SLIDE VALVE FEED.
VALVE DEFECTS.

Q. 1. What will cause the air pipe pressure to register below the standard pressure?

A. 1. When regulating spring is not adjusted to proper regulation or the regulating valve becomes dirty and gummed up.

Q. 2. In what way will a dirty regulating valve affect train pipe pressure?

A. 2. If the regulating valve is gummed or dirty, that will allow the air that leaks from the main reservoir by the piston to accumulate in the chamber in the rear of the piston, which is known as train pipe pressure. Just as soon as train pipe pressure and main reservoir pressure is equal, then the piston spring will move the piston and slide valve over, closing off the train pipe opening before train pipe pressure is up to the standard pressure for which the feed valve is set.

Q. 3. How can train pipe pressure be increased through a defective regulating valve?

A. 3. If the regulating valve leaks, that will allow the air to pass from the rear of the piston into train pipe, and there will not be sufficient pressure retained at the rear of the piston to cause equal pressures, and under that condition the piston spring will not move the piston and slide valve over so as to close off train pipe not until main reservoir and train pipe pressures are equal.

Q. 4. What other defect will cause train pipe and main reservoir pressures to equalize?

A. 4. A leaky slide valve or a tight fitting piston or a leaky cap nut at the rear of the piston or a leaky regulating valve cap nut or a broken piston spring.

Q. What effect will leaky diaphragms have on train pipe pressure?

A. 5. If diaphragms should leak they will not allow the movement of regulating spring to be accurate, and also give a leak of air at the regulating nut.

Q. 6. What affect will a worn piston have in feed valve?

A. 6. Main reservoir pressure will feed by the piston faster than the regulating valve can pass into the train pipe. Then the pressure in the chamber on the rear of the piston will equalize with main reservoir pressure and the piston spring will then move the piston and slide valve over and shut off the train pipe pressure before it is up to the standard pressure for which it is set.

Q. 7. What affect will a broken piston spring have in a feed valve?

A. 7. Train pipe pressure will be charged up to main reservoir pressure. As there will be but one movement to the supply valve and piston, when the main reservoir pressure moves the piston back, carrying with it the supply valve, the train pipe port is kept open, and when the pressures of air in train pipe and main reservoirs are equal there is no spring to move the piston in the opposite direction.

Q. 8. What affect will a broken piston have in the feed valve?

A. 8. There will be no movement to the supply valve under that condition; train pipe will not be charged up in running position.

Q. 9. What affect would a feed valve case gasket have if there was to be a leak of air from the main reservoir to train pipe?

A. 9. It would cause train pipe pressure to equalize with main reservoir pressure.

TRAIN WHISTLE PIPE.
DEFECTS AND REMEDIES.

Q. 1. What would you do if you broke the train whistle pipe off on the front of the engine?

A. 1. Plug the pipe on the front end and proceed in that manner. That will give you a signal whistle on the engine.

Q. 2. What would you do if you broke the pipe off leading from the signal valve down to the train whistle pipe?

A. 2. Close the cutout cock on the reducing valve and proceed.

Q. 3. What would you do if you broke the train whistle pipe off on the rear of engine or tender?

A. 3. Close the cutout cock on the reducing valve and proceed.

Q. 4. What would you do if you broke the pipe leading from the main reservoir up to the reducing valve?

A. 4. Plug the pipe at the main reservoir connection and proceed.

Q. 5. What would you do if you broke the pipe off leading from the reducing valve down to the train whistle pipe?

A. 5. Close the cutout cock on the reducing valve and proceed.

REMARKS.

Q. 6. Where is the best location for a reducing valve and signal valve on a locomotive?

A. 6. The signal valve and the reducing valve should be located in the cab of the locomotive, where good results are obtained at all times. The heat of the cab will keep everything dry and nothing will form in the signal valve but dry dirt. Where it is convenient to hang the whistle downwards directly under the whistle valve, and all dirt that passes through the air chamber will pass by the bell of the whistle to the atmosphere.

Q. 7. What would you do if you broke the pipe off between the T and the governor above the air strainer?

A. 7. Plug the pipe at pressure end and proceed with the use of the air whistle, but control the pump with the pump throttle.

Q. 8. What would you do if you broke the pipe off above the air strainer and below the T supplying signal reducing valve and governor with air?

A. 8. Plug the pipe at pressure end and control the movement of the pump with the pump throttle.

Q. 9. What would you do if you broke the pipe off above the air strainer and between the T and the signal reducing valve, supplying the governor and the signal reducing valve with air?

A. 9. Plug the pipe at pressure end and proceed, leaving the governor control the pump.

Q. 10. What would you do if you broke the pipe off above the air strainer and between the signal reducing valve and whistle valve?

A. 10. Close the valve off on the signal reducing valve, proceed and control the movement of the pump with the governor.

Q. 11. What would you do if you broke the pipe off above the air strainer and between the signal reducing valve and the signal valve, or the pipe leading to the signal line or the train signal line?

A. 11. Close the valve off on the signal reducing valve, proceed and control the pump with the governor.

Q. 12. What would you do if you broke the pipe off above the air strainer between the T and signal reducing valve?

A. 12. Plug the pipe at pressure end, leaving the governor control the pump.

A. 13. What would you do if you broke the pipe off above the air strainer and between the signal reducing valve and signal valve, or the pipe leading to the signal valve line, or the train signal line, when using a duplex governor controlling the high main reservoir pressure control and the standard pressure?

A. 13. Close the valve off on the signal reducing valve and proceed, leaving both governors control the pump as before pipe was broken.

BRAKE PIPE PRESSURE 70 POUNDS.

Piston travel		4	5	6	7	8	9	10	11
Reductions	7	25	23	18	13	11	8	0	0
	10	49	43	34	29	25	20	17	14
	13	57	56	44	38	34	29	24	20
	16	57	56	54	48	42	35	29	24
	19	57	56	54	51	48	40	36	32
	22	57	56	54	51	50	48	44	39
	25	57	56	54	51	50	48	47	45
Emergency	22	62	61	60	59	58	57	56	55

Pressure located in brake-cylinders with the above brake-pipe reductions and variation of piston travel under cars and tenders.

Piston travel.	Cylinder Pressure. Pounds.	Extra B. Power. Per Cent.	Greater.
4-inch	50	54	100
5-inch	43	42	90
6-inch	34	32	52
7-inch	29	26	24
8-inch	25	21	..
			Less.
9-inch	20	17	19
10-inch	17	12½	40
11-inch	14	9¾	54
12-inch	9	5	76

Conductors and trainmen, when reading this schedule of braking powers, you can easily understand the affect of a 4-inch travel in advance of the 8-inch travel with a 10-pound brake-pipe reduction. The 4-inch travel is in advance of the 8-inch travel. Then you decrease in per cent. as the above schedule shows you. Then the 9-inch travel shows you 17 per cent. below the standard braking powers.

Q. 1. How long will it take the brake pipe exhaust to remain open in the brake valve when attached to train, when a service reduction is made?

A. 1. That depends on the length of the train. The longer the train the longer the brake-pipe exhaust will continue to blow. It should continue to blow when a reduction of 15 pounds is made, about as follows:

Cars.	Seconds.	Cars.	Seconds.
10	6	50	30
20	12	60	36
30	18	70	42
40	24		

With a K triple valve on a long train the seconds will decrease somewhat, due to a percentage of brake-pipe pressure entering the brake-cylinder.

Q. 2. How is a good way to tell how many cars you have in a train?

A. 2. Just as soon as brake-pipe exhaust opens start and count, and when the exhaust closes stop, and the number figures you have counted up to in that time will be close to the number of cars attached in a train. With a freight train one count represents two cars; passenger train, one count one car.

Q. 3. In making a service application of brakes on a freight train, the preceding table will give you the amount of reduction necessary to force the pistons out and past leakage grooves of different lengths and with such force as to increase the braking powers sufficiently to bring the train under control ready for the second reduction to make final stop. Seven pounds reduction up to 15, according to the number of cars located in train. Look for Question No. 186. This gives you the full desired information.

Speaking of grade work, any man that ever operated a train equipped with air-brakes on a level piece of track, also one on a grade, must acknowledge that there is a vast amount of difference in operating on a grade, due to the fact that on a grade it does not always require such heavy braking, but it requires it oftener, as the retaining valves are all performing their duty, after the brakes are released and the triple valves have gone to release position, and you only desire ample time to recharge the brake-pipe and auxiliary reservoirs. That is the main object in grade braking, to know just how long to stay in release position and when to apply brakes. Now, to do this braking successfully we must have ample time between cycles to do it correctly. We must also have ample storage of air in the main reservoirs and air pumps to perform their duties correctly and quickly. Where there are accidents on grade braking the engineman is very often condemned, also the train crew, yet their part of the work has been done correctly. To do good grade braking and do it successfully requires all things necessary to do the work with—good air pumps and ones large enough to accumulate air quickly, large main reservoirs, good brakes, good retaining valves and tight brake-cylinders, cylinders that are in condition to stand the proper test. If these things are all combined together and are not congenial with one another, grade braking with air-brakes alone is not successful, and that is not up to the man. It is up to the company or the man who placed that engine on the grade by not placing one there that has all the necessary equipment, and at an investigation the man in charge of it may suggest to orifice the air pump and find its condition. The pump may be in first-class condition, but not large enough to provide air for that class of work. Finding the air-pump in good condition does not condemn the engineer and prove that the operation of his brakes were not successful and he was not performing his duties correctly. The air-pump and main reservoir supply may be correct for level road braking, but for grade braking the pump and main reservoir capacity may be too small to supply air fast enough between the cycles desired to control the train correctly. Post yourselves on the air-brake subjects so as to protect one another, and if the time comes that it requires an argument you will be ready to take care of yourselves at all times. When one understands the air-brake question and its operations he will then know from day to day the engines that can be placed on grades and those on the level road braking. He will know whether the pumps are large enough; also the main reservoir capacity. You all fire engines long enough before you are promoted to engineers to find out the necessities required on the road on which you are employed.

CAMP COPPEE.

CERTIFICATE OF EXAMINATION.

This is to certify that John R. Smith, aged 23 years, has been thoroughly examined as to his knowledge of operation and management of the locomotive and air-brake. His previous service has been a fireman. He has been found competent to fill the position of engineman on any class of locomotives on the railroads of the United States or France.

Signed. ALONZO W. DEAL, SR.,
Machinery Examiner.

Date: June 24, 1918.

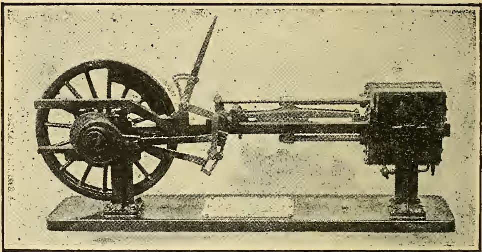
This certificate is not to be signed by the Machinery Examiner unless the applicant presents Card Form 541, signed by the Air Brake Examiner and certificate from the Examiner on Train Rules.

Fireman for promotion to engineman must come between the age of 23 and 38 years.

Machinery certificate after the boys passed the desired average of 85 per cent. on machinery questions.

MACHINERY QUESTIONS AND ANSWERS USED BY MR. DEAL, SR., WHILE TRAINING ENGINEERS AND FIREMEN FOR OVERSEAS DUTY.

The names of the different pieces connected with the Stephenson valve gear, which are used in connection with its operating parts to transmit the power of the gear:



Q. 1. What is an engine?

A. 1. A mechanical instrument of complicated parts which concur in producing an intended effect; a machine for applying any of the mechanical powers of principal of physics to a particular purpose; a power that is derived from steam to propel railroad trains.

Q. 2. What is a locomotive composed of?

A. 2. Two stationary engines combined in one working from right angles.

Q. 3. What is a locomotive?

A. 3. A pair of steam engines supported on wheels made to draw or propel a train of railroad cars from place to place. This in return is the power of locomotives.

Q. 4. What gives the locomotive the power to retain itself to the rail so as to prevent it from continuously slipping?

A. 4. The adhesion between the wheels and rail which forms an adhering or sticking power; the force with which different bodies adhere to one another; more or less firm adhesion of two parts.

Q. 5. What is steam?

A. 5. The invisible elastic fluid into which water is converted by heat, water in acriform or gaseous condition in a popular sense, water in the state of clouds or mist, a visible vapor.

Q. 6. What is a steam valve seat?

A. 6. A flat seat provided with steam ports and an exhaust port. It is used for sliding valves to admit steam to the cylinders and from the cylinders to the atmosphere through the action of the slide valve.

Q. 7. What is a steam chest?

A. 7. A box attached to the cylinder of a steam engine in which the sliding valves work.

Q. 8. What is a slide valve?

A. 8. A valve which slides on or off of its aperture; it has a cavity located in its under side capable of connecting two apertures together, while the third one is closed.

Q. 9. What is a steam cylinder?

A. 9. The cylinder of a steam engine in which the movable disk or piston moves.

Q. 10. What is an aperture.

A. 10. An opening admitting or discharging steam from one point to another.

Q. 11. What is a steam dome?

A. 11. A dome-shaped structure on a steam boiler for receiving the steam generated and allowing it to be drawn into the steam pipe free from the fine spray or mist which is apt to accompany it when drawn off near the surface of the boiling water.

Q. 12. What is a throttle box?

A. 12. A box located in the dome in which the throttle valve is located.

Q. 13. What is a throttle valve?

A. 13. A valve consisting of a partition, commonly placed in the throttle box and connected to the standpipe, which is connected to the dry pipe, and is used to measure the supply of steam to the steam chests and steam cylinders of a steam engine.

Q. 14. What is a stand pipe?

A. 14. A pipe connected to the throttle box and dry pipe.

Q. 15. What is a dry pipe?

A. 15. A pipe that is connected to the stand-pipe and the front flue sheet.

Q. 16. What is a T head or, commonly speaking, a nigger head?

A. 16. A connection made to the front flue sheet and dry pipe and located in the smoke arch, and is used in connection with the steam pipes leading to the right and left hand steam chest.

Q. 17. What is a steam pipe?

A. 17. A pipe connecting the T head to the steam pipe leading to the steam chests, and is used to convey steam to the steam chests.

Q. 18. What is a valve yoke?

A. 18. A yoke connected around the valve with a stem attached so as to be united with a valve rod.

Q. 19. What is a valve rod?

A. 19. A rod used to connect the valve stem and rocker-arm together, so as to be used at a point of measurement to control the action of the valve and stem.

Q. 20. What is a rocker-arm?

A. 20. A part of a steam engine that control the action of a valve on a movable point in the same direction or in the opposition direction; a contrary motion. While one part ascends the other descends. Oblique motion—when one part is ascending the other is descending, while the other keeps on the level.

Q. 21. What is a rocker-arm composed of when complete that is used on a locomotive?

A. 21. A rocker-arm and box. The rocker-arm is an arm attached to a centre rod in a centerpoint, one extending upright and the other downward, and when in service is working in different positions. While one arm is on a forward move the other arm is moved in the opposite direction, while the center line remains on the level.

Q. 22. What is a link?

A. 22. Link—to connect or unite one part to the other.

Q. 23. What is meant by link motion?

A. 23. Link motion, communicated by links, a term applied particularly to a system of gearing reversing a locomotive engine.

Q. 24. What is an eccentric?

A. 24. A circle not having the same circle within another circle; when one is less within another.

Q. 25. For what is an eccentric used?

A. 25. A part of a steam engine by which the valves are made to open and close alternately by a circular disk attached to the crankshaft and revolving within a strap or ring, and having its axle of revolution on one side of the center.

Q. 26. What is an eccentric gear?

A. 26. The parts which transmit the motion of the eccentric.

Q. 27. What is an eccentric strap?

A. 27. A band of iron which embraces the circumference of the eccentric and which it moves.

Q. 28. What is an eccentric rod?

A. 28. The rod that transmits the motion of the eccentric.

Q. 29. What is an eccentric rod jaw?

A. 29. The front part of the eccentric rod connecting to link.

Q. 30. Link saddle?

A. 30. Saddle connecting from one side of link to the other.

Q. 31. Link saddle pin?

A. 31. Connected to link saddle and link lifter.

Q. 32. Link lifter?

A. 32. Connecting to link saddle pin and tumbling shaft arm.

Q. 33. Link block?

A. 33. Link block is a block to which the link rides over.

Q. 34. Link block pin?

A. 34. The pin that connects the link block and link to the rocker-arm.

Q. 35. What is a tumbling shaft?

A. 35. A shaft with four arms extending outward—one to be used for a connection to the reach rod and the other two to be connected to the link lifters; the fourth connecting the reverse spring.

Q. 36. What is the use of the fourth arm attached to a tumbling shaft?

A. 36. To be used in connection with the reverse spring located in the reverse spring casing.

Q. 37. What is the use of the reverse spring?

A. 37. The use of the reverse spring is to assist the engineer in lowering and reversing the link motion.

Q. 38. How is this spring connected up?

A. 38. It is connected to the tumbling shaft arm and connected to a cross brace over the frames. The weight of the link, with its depending eccentric rods, is counterbalanced by a helical spring in the reverse spring casing. The engineer can thus rock back and forth the reverse lever, raising and lowering the link without exerting force that would be otherwise required.

Q. 39. What is a valve rod bolt?

A. 39. The bolt that connects the valve rod to the rocker-arm.

Q. 40. What is a link bolt?

A. 40. A bolt that connects the link together, and is located at each end of the link.

Q. 41. What is a link saddle bolt?

A. 41. A bolt that connects the link saddle to the link.

Q. 42. What is the use of the reverse lever?

A. 42. The reverse lever is connected to the frame and over the quadrant; the reach road is connected to the reverse lever and tumbling shaft arm, and is used to operate the operations of the link so as to be operated by the engineer.

Q. 43. When is the greatest tractive force of a locomotive required?

A. 43. The greatest tractive force in a locomotive is required at starting, when the link must be in full gear and the valve full travel. Due to a slow speed of starting, small lead is required; at high speeds much less tractive force is required, and the link must be placed in part gear. More lead is also required at high speeds. These conditions are best met by the open-rod construction. Cross rods have the advantage that, due to the smaller lead at midgear, the engine locomotive can be more certainly stopped by bringing the middle of the link opposite the block.

FIRST QUESTIONS USED IN EXAMINING RAILROAD FIREMEN TO BE PROMOTED TO ENGINEERS.

Q. 1. What is the first duty of an engineer?

A. 1. First, read the bulletin board carefully so as to be sure you understand all bulletins posted.

Q. 2. What is the second duty of an engineer?

A. 2. If a place where the standard time is located, compare your watch, so as to understand you have the correct time.

Q. 3. What is the third duty of an engineer?

A. 3. Report to the roundhouse foreman or man in charge and ascertain the number of the locomotive you are to receive for your train.

Q. 4. What should you do after you are notified of the number of the locomotive to be in your charge?

A. 4. First, inspect the interior of the firebox and note its condition; second, look after the water conditions in the boiler. If the water is O. K., test both injectors, make a complete inspection of the locomotive; see if the proper tools are located in the toolbox and the necessary supplies; then see that the locomotive is properly oiled and lubricator in proper condition.

Q. 5. What attention should be given to the boiler attachment, such as gauge-cocks, water-glass, lubricators, etc.?

A. 5. See that the gauge-cocks can be opened, steam and water to pass through them freely; notice the condition of the water-glass, see if the water is moving up and down in the glass; see that the steam valve is open at the top of the glass, and the water valve at the bottom of the glass can be opened and closed, allowing water and steam to circulate through the glass.

Q. 6. Do you consider the water-glass safe to run by, if the water in the glass is not moving up and down, while the engine is in motion?

A. 6. No; water must move freely in the glass.

Q. 7. When an engine is disabled while en route, what is the first thing you should do before starting to disconnect?

A. 7. First, it is proper to see that the train is protected; next, make an examination of the broken parts; do not remove more than necessary. If train can be moved, proceed to the nearest side-track. If unable to repair, ask for help. Always proper to clear main track if possible.

Q. 8. Describe how the steam travels from the boiler to the cylinders.

A. 8. Steam passes the throttle valve to the throttle box, to the stand-pipe, to the dry pipe, to the T head in the front end of the smoke-box, through the steam pipes to the steam chests. A slide valve or piston valve is located in the steam chests that distributes the steam to the steam cylinders through suitable ports, and out through the same ports to the exhaust cavity to the exhaust port to the atmosphere.

Q. 9. How should the water be carried in the boiler under normal conditions?

A. 9. That is directly up to the design of the boiler and locomotive. Some carry water in their boiler far better than others. As near as possible two gauges of water level showing steam and water in the third gauge cock when operating throttle.

Q. 10. Is there any advantage in having the boiler moderately full when leaving a station or before starting to pull up-grade?

A. 10. Yes; it gives the locomotive an opportunity to generate steam; also the fire a chance to burn properly.

Q. 11. What would you do in case you lost sight of water, both out of the water-glass and gauge-cock No. 1?

A. 11. Draw fire at once. Never undertake to open the throttle and try to raise water over a hot crown-sheet.

Q. 12. What would you do to prevent engine from freezing if the fire had to be drawn in cold weather?

A. 12. Open cylinder-cock, blow water out of cylinders and steam channels, drain the boiler and lubricator, break all steam-pipe joints where water is liable to lodge, drain air system, pump and reservoirs. An ounce of prevention is better than one pound of cure.

Q. 13. How can you tell if an engine is foaming or supplied with two much water?

A. 13. When a boiler is foaming the water riles and moves very fast in the water bottle. If too much water is supplied the water will move under a normal condition.

Q. 14. What would you do to overcome a foaming boiler?

A. 14. Close in on throttle very easy and note the movement of water in the bottle. If the water starts to drop, it proves the boiler is foaming. Open throttle, put both injectors to work and note condition of water, closing throttle very slowly.

Q. 15. After closing throttle, you noticed the water bottle remains full, what does that indicate?

A. 15. Proves too much water has been supplied to the boiler. Avoid use of injectors until water is at its proper height.

Q. 16. Under the above conditions, what is necessary to protect steam chests and cylinders?

A. 16. Cylinder-cocks to be left open until surplus of water has been used.

Q. 17. If cylinder-cocks are not used properly, what is liable to happen?

A. 17. Leaky cylinder heads, steam chest joints leaking, knocking out cylinder heads, cutting valves, breaking packing rings, stalling the engine.

Q. 18. Is there any more water used when an engine foams than when the water is being carried properly?

A. 18. Yes; when an engine's boiler is foaming it is throwing water away; there is water wasted.

Q. 19. Does the water remain at the same level when the throttle is closed?

A. 19. No; water drops according to the way the engine is being worked. If with a light throttle it will drop very little; but when the engine is being worked hard and the throttle is wide open, then it will drop accordingly.

Q. 20. What would you do, in taking charge of an engine, if you should find the fire-box dry, a good hot fire, plenty of water in the tender, and when going up in the cab you tried the gauge-cocks and discovered no water in the boiler?

A. 20. Notify the proper authority at once.

Q. 21. What would you do if you had a bad leak or burst flue?

A. 21. Plug it, if possible. If in the fire-box end, take a sapling which is whip-shape, put it in the burst flue, and force it in with the hoe; the fire will burn the sappling off up to the flue. If a bottom flue, cover it with ashes or green coal. Under these conditions, you are liable to maintain sufficient pressure of steam to move the train.

Q. 22. How can you tell if the dry pipe is leaking or the throttle leaking?

A. 22. When the throttle is closed and the engine is quiet, open the cylinder-cocks; if dry steam appears, throttle leaking; if water appears, dry pipe leaking.

Q. 23. What kind of oil would you use to oil an injector?

A. 23. Crude or black oil. Crude means earth. Black oil is a combination of crude oil and kerosene.

Q. 24. Would you use lard oil or valve oil in an injector?

A. 24. Never use oil that contains animal fat, as it will make the boiler foam, and cylinder oil is too heavy to be used in an injector.

Q. 25. What will steam do, air or water, when put under a pressure enclosed in a pipe or cylinder?

A. 25. Steam will expand; air will compress; water is only weight.

Q. 26. Can water be compressed?

A. 26. No; water cannot be compressed.

Q. 27. What damage is done to cylinders, cylinder-heads, steam chests and packing if you slip an engine when water is accumulated in the cylinders and chests?

A. 27. It is liable to break a cylinder, knock out cylinder heads, break steam chests, studs and break packing rings.

Q. 28. What would you do in case you ran out of water while en route?

A. 28. Proceed to the first telegraph office and find out if there is a train approaching. If there is, cut loose from the train and couple up to the train that is approaching and let it pull you to the water station.

Q. 29. What would you do if there was no train in sight?

A. 29. If I could not proceed to the water station with the light engine, would draw fire.

Q. 30. How many points are there in a steam chest and cylinder of a locomotive?

A. 30. Five. Name them? Admission of steam, expansion, compression, release and exhaust.

Q. 31. What is meant by admission of steam?

A. 31. When steam is being admitted to the cylinder through the movement of the valve in the steam chest.

Q. 32. What is meant by expansion?

A. 32. Steam expanding in the cylinder.

Q. 33. What is meant by compression?

A. 33. Steam compressing between the piston head and cylinder head.

Q. 34. What is meant by release?

A. 34. When the valve covers the steam port and will not admit any more steam to the cylinder.

Q. 35. What is meant by exhaust?

A. 35. When the steam port and exhaust port are in communication with one another exhausting steam to the atmosphere.

Q. 36. How is the steam exhausted to the atmosphere?

A. 36. When the steam port and exhaust port in the valve seat are in communication with one another through the exhaust cavity in the slide valve.

Q. 37. What is the meaning of outside admission of steam to a valve?

A. 37. When the steam is admitted to the cylinder on the outside edge of the valve.

Q. 38. What is the meaning of inside admission of steam to a valve?

A. 38. When the steam is admitted to the cylinder on the inside edge of the valve.

Q. 39. Where is the exhaust port located on an outside admission engine?

A. 39. The exhaust port is located on the valve seat in the centre of the seat, between the two steam ports.

Q. 40. Where is the exhaust port located on the valve seat of an inside admission engine?

A. 40. The exhaust port is located at each end of the valve seat.

Q. 41. Does the slide valve work in the same direction as the piston when starting to admit steam to the cylinder at the beginning of the stroke?

A. 41. On an outside admission engine the slide valve works in the same direction as the piston when starting to admit steam to the cylinder.

Q. 42. Does the inside admission engine valve work in the same direction as the piston when starting to admit steam to the cyclinder on the beginning of the stroke?

A. 42. No; to admit steam to the cylinder at the beginning of the stroke on an inside admission engine the valve works in the opposite direction from the piston when starting to admit steam to the cylinder.

Q. 43. How would you locate a pound on an engine?

A. 43. Place the engine's driving wheels on top quarter of side you desire to locate the pound, block the tank and truck wheels, have the fireman give engine steam, then reverse the motion of the valve gear several times, noticing the point where pound is visible.

Q. 44. What position would you locate the driving wheels or the crank-pin to key up the back end of the main rod?

A. 44. On the forward dead center.

Q. 45. Why would you locate the crank-pin on the forward dead center?

A. 45. First, remember if there is a half-inch clearance over all in the cylinder of the engine; there must be a division of clearance back and front for the piston. Therefore, the rear end will receive three-sixteenths clearance and the front end five-sixteenths clearance so as to allow to key the main rod ahead.

Q. 46. What other results are obtained by keying the back end of the main rod on the forward dead center?

A. 46. That is where the largest part of the pin is located, and when keying up a back end of a main rod, if the rod brass is movable at that point, it is movable on all other points on the pin. Again, you can always notice how far you have keyed the main rod ahead in relation with the clearance mark located on the guides.

Q. 47. What position would you locate the main pin so as to key up the front end of the main rod?

A. 47. Always locate the main pin on the top or bottom quarter, as this will give you the largest part of the cross-head pin or wrist pin. If the brass will move at that point it will move at all other positions in which the main rod is placed.

Q. 48. What position would you place the crank pins in so as to key up a ten-wheel engine or an engine with more than ten wheels?

A. 48. Always locate the wheels so the pins on one side are on the dead center and start at the main pin to do the keying up.

Q. 49. Is it proper to set up the wedges before keying up the side rods?

A. 49. If wedges are to be set up, never start to key up rods until wedges are all properly set up.

Q. 50. In cases where the wedge bolts become broken while en route, how can they be kept in their proper positions?

A. 50. By applying blocks between pedestal brace and wedge.

Q. 51. Is there danger of the wedge working up and fastening itself between box and pedestal?

A. 51. No; not as long as the wedge is properly oiled.

Q. 52. If the piston head is loose on piston rod, will it pound?

A. 52. It will be noticeable as soon as the throttle is closed, as the main rod must move the piston and rod through the action of the wheel.

Q. 53. What benefit are relief valves to a locomotive cylinder?

A. 53. Relieves the back pressure when the valve and piston are being trolled after the throttle is closed.

Q. 54. What would you do if you lost a relief valve out of the steam chest or cylinder while en route?

A. 54. In some cases the regulating nut in a high-speed reducing valve can be screwed in for temporary repairs.

Q. 55. How would you proceed and set up wedges?

A. 55. Screw the wedge up until it is tight, then reverse the wedge bolt and pull the wedge down one quarter of a turn of the bolt. After the wedge is in the proper position reverse the bolt again until the head of the wedge bolt just touches the upper part of the wedge. In that position the wedge will not move down.

Q. 56. What position would you locate the engine to set up wedges?

A. 56. Place two small nuts on the rail, move the engine back slowly. The moment the nuts come in contact with the wheels the boxes will go tight against the shoes. The jamming of the wheel ahead and the weight of the engine, back against the box, so the wedge is easily moved.

Q. 57. What other course can be taken to set up wedges?

A. 57. If wedges are to bet set up on both sides, with one setting of the engine, place the right crank-pin on the forward top eight, using brake; also give engine a little steam in forward motion to draw weight of engine against the shoe.

Q. 58. What is liable to result from a loose piston-rod key or main wedge down?

A. 58. Broken front cylinder-head.

Q. 59. What would you do if you received a locomotive just out of the shop, and when proceeding over the road light you discovered a bad knock in the cylinder just as soon as the throttle was closed?

A. 59. Immediately open throttle lightly, so as to form a cushion of steam. That indicates the main rod is not lined up properly.

Q. 60. What damage can be done if pedestal braces become loose and the brace works down?

A. 60. Broken cylinder-head, by fore and aft movement of driving box, account of wedge and shoe being down out of place.

Q. 61. How would you locate the leak in a steam pipe or dry pipe leaking at the flue sheet?

A. 61. Fill the boiler up with water until the injector breaks, apply brakes, keep cylinder-cocks closed, then open the throttle, noticing steam pipe joints to see if leaks develop. The object of filling the boiler full, the water being the heavier of the two pressures, will always follow ahead of the steam.

Q. 62. How do you locate the trouble whether your eccentric has slipped loose bolts in strap eccentric rod loose on the strap or valve yoke cracked?

A. 62. When engine's valves are out of square.

Q. 63. If the exhaust should get out of square on a trip, what does it indicate?

A. 63. Loose eccentrics, bushing cut out or cylinder packing broken.

Q. 64. Is there anything else not mentioned which would affect the exhaust or the sound of the exhaust?

A. 64. Different size ports, cylinders and valves or exhaust tip blown out of exhaust pot.

Q. 65. How would you set a slipped eccentric?

A. 65. Place the disabled side on the dead centre. If throttle leaks a little steam, apply the driving-wheel brake, move eccentric until steam presents itself at cylinder-cock. If it is forward motion eccentric, place it on the forward dead center; if it is the back motion eccentric, on the back dead centre. If you have a tight throttle, open up the cylinder lubricator to the disabled side just so as to admit a sufficient amount of steam to show at cylinder-cock when valve is moved to open the steam port.

Q. 66. How can you determine which eccentric has slipped?

A. 66. Knowing the position of the eccentrics in relation to the crank-pin. An inspection would show which one has slipped.

Q. 67. How does the eccentric stand in relation to the crank pin?

A. 67. The forward motion eccentric follows the crank-pin and the back motion leads the crank-pin.

Q. 68. How can you easily locate the positions of the eccentrics?

A. 68. The eccentrics are usually opposite the third spoke in the driving wheel; sometimes ahead of the crank-pin, sometimes behind the crank-pin, depending on the action of steam travel through the valve. It may be an inside admission or an outside admission valve, a forward or backward eccentric.

Q. 69. How are eccentrics kept in their place on the axle?

A. 69. Some by set screws, others by keys and set screws. This late day you will seldom find an eccentric held in its place just by set screws.

Q. 70. If you discovered a hot eccentric, what would you do to overcome it?

A. 70. Slack the bolts off at the eccentric straps just sufficient to allow it to move on the eccentric.

Q. 71. What would you do if you broke a forward motion eccentric strap or rod?

A. 71. Take down the broken parts, disconnect valve rod, cover ports, and proceed one-sided.

Q. 72. What would you do if you broke a back motion eccentric strap or rod?

A. 72. Secure the bottom of link so it will not turn over, work engine full stroke and proceed.

Q. 73. What would you do if you broke a backward motion eccentric strap, and rod was in good condition?

A. 73. Remove the three bolts out of the back motion eccentric rod from the broken strap, take the center bolt out of the forward motion strap and rod and couple the back motion eccentric rod to the forward motion strap, making a stationary engine out of that side, and proceed. You can only operate the engine in the forward motion, but you get the benefit of both engines.

Q. 74. Is it advisable to put water on a hot eccentric strap?

A. 74. No; it is liable to crack it or break it.

Q. 75. What would you do if you broke the top or bottom rocker-arm?

A. 75. Be sure and see that the rocker-arm will clear everything, so as to do no damage centre valve, and proceed one-sided.

Q. 76. What would you do if you broke link hanger or pin?

A. 76. Put a small block over top of link block and proceed.

Q. 77. If in a position so you could find no block, what would you do?

A. 77. Ball up a piece of waste and put in on top of the link block, so as to prevent the block from striking the top of link.

Q. 78. What would you do if the arm was broken off the tumbling shaft so the reverse lever could not be operated or the reach rod or quadrant?

A. 78. Block between the frame and tumbling shaft arm with a block, place links in position to operate engine, and proceed.

Q. 79. What would you do if arm broke off tumbling shaft that was connected to the link-lifter?

A. 79. Block over the top of link in desired position, and proceed.

Q. 80. What would you do if the link block pin was broken?

A. 80. Disconnect the valve rod and center valve, and proceed one-sided. See that the lower connection of rocker-arm clears link.

Q. 81. What would you do if a piston gland or stud was broken?

A. 81. If there are four studs, and only one or two were broken, you can proceed; but if repairs cannot be made disconnect valve road center ports, and proceed one-sided.

Q. 82. Describe a piston rod and its parts.

A. 82. A rod; one end is attached to cross-head, and on the other end is a piston-head, which is located in the cylinder, secured by jam nuts. The piston has grooves encircled around it in which rings are fit in the grooves so they will fit the cylinder in which they operate.

Q. 83. How is a slide valve constructed?

A. 83. The valve is rectangular in shape, with valve strips and springs. The springs are located under the strips which hold the strips up against the pressure plate. Located on the under side of the valve is an exhaust cavity so as to allow the steam to pass from the steam port to the exhaust port in the valve seat.

Q. 84. Explain how the valve strips and springs are constructed.

A. 84. They are strips made of steel or cast iron, which set in the grooves on top of the valve, and are held in their places by elliptic springs.

Q. 85. If there is a blow in the engine, can you tell if it is a valve blow or a bar blow caused by the strip being fastened in the groove?

A. 85. A balance bar blow will be a continuous blow, the same as a valve blow; but the difference can be told by the operating of the reverse bar.

Q. 86. If there was a blow in the engine, can you tell whether it was a valve blow or a piston blow?

A. 86. A blow from a valve is a constant blow; a cylinder piston packing blow is strong on the start of the stroke and lessens as stroke is completed.

Q. 87. How can you tell on which side the balance bar strip is down or the elliptic spring broken.

A. 87. Place the engine on the dead centre, put the brake on, open the throttle and rock the reverse lever backwards and forwards. If the valve motion reverses hard that proves it is on the opposite side—the side that is located on the quarter. If it reverses all right, place the opposite side on the dead center and test in the same manner.

Q. 88. What effect will a broken spring or strip have on an engine?

A. 88. There will be a constant blow out of the exhaust of the locomotive.

Q. 89. What is the object in testing for a balance bar blow in that manner?

A. 89. When the engine is placed on the dead center, the valve on that side will move only the amount of given lead when the reverse lever is rocked back and forwards, while the side on the quarter will have the full travel of the valve.

Q. 90. What is meant by given lead of the valve?

A. 90. The amount of opening allowed at the edge of the valve, so steam can be admitted to the cylinder on the start of the piston.

Q. 91. What is meant by lap of the valve?

A. 91. When the edge of the valve laps over the steam port, so no steam is admitted to the cylinder on the start of the piston.

Q. 92. If the valve has a 1-16th of an inch lead and the locomotive is placed on the dead center, how far will the valve move when the reverse lever is moved from the forward end of the quadrant to the rear of the quadrant?

A. 92. One-sixteenth of an inch only.

Q. 93. How far will the valve travel with the engine located on the quarter on the opposite side?

A. 93. Full travel of the valve.

Q. 94. What defects can occur to balance bar strips so as to cause them to have a blow?

A. 94. Strips stuck down in the grooves, broken springs, strips placed in the grooves too tight, the strips getting dry due to lack of lubrication.

Q. 95. What would you do with an engine with a broken piston or a broken cylinder-head?

A. 95. If piston is broken, remove front cylinder-head and taken broken pieces out of the cylinder. If the head is broken remove the broken pieces so they will not be liable to drop back in the cylinder, centre valve, and proceed one-sided.

Q. 96. What would you do if you broke a valve yoke?

A. 96. Disconnect valve rod from rocker-arm, cover parts, and proceed one-sided.

Q. 97. How would you start to secure valve if the stem was broken off valve yoke?

A. 97. If there is a relief valve in the front of the steam chest, screw it out. Cover the port by moving the valve stem up close to the valve. After you have disconnected from the rocker arm, then cut a block to fit between the valve and the relief valve, secure the valve stem tight, then screw the relief valve back in its place, and proceed.

Q. 98. What action must be taken to provide for lubrication before proceeding?

A. 98. If there is a lubricator feed to the cylinder, proceed; if none, provide for lubrication through indicator plugs.

Q. 99. What would you do if you broke a valve yoke and you had no relief valve located in the front end of steam chest?

A. 99. Disconnect valve rod from rocker-arm, push valve all the way ahead, take down the main rod, push piston ahead in cylinder, block cross-head, and proceed.

Q. 100. What precaution must be taken when piston is blocked at forward end of cylinder?

A. 100. See that the front crank-pin will clear cross-head; take out indicator plug in front of cylinder or front cylinder-cock.

Q. 101. What would you do if you had a broken valve seat?

A. 101. Test first, to see where the seat is broken; if broken between exhaust port and steam port, cover valve seat ports and proceed.

Q. 102. What would you do if broken at either end of the seat?

A. 102. Disconnect the main rod, move piston to accommodate break. If broken on the front of seat, move the piston in the cylinder back. If broken on rear of seat, move the piston in the cylinder ahead, block cross-head, and proceed one-sided. Always remember to remove cylinder-cock or indicator plug out of cylinder at the opposite end of cylinder to which the block is located.

Q. 103. How can you tell which side of the valve seat is broken?

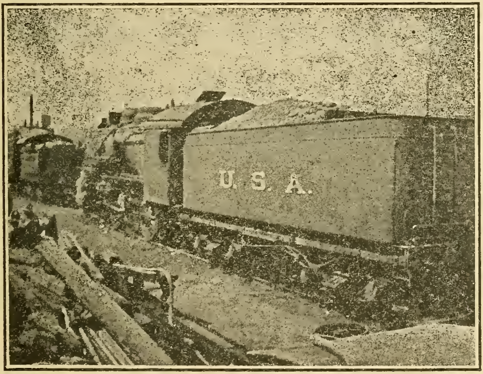
A. 103. When the engine starts to take steam in the front end of the cylinder, if there is a blow out of the exhaust port it proves that the bridge between the steam port and exhaust port is broken in the front of the valve seat; if on the opposite move, the back bridge is broken between the steam port and exhaust port.

Q. 104. How can you tell whether the valve seat is broken on the front end of the valve or the rear end?

A. 104. Center the valve on the disabled side, open the cylinder-cock; if steam comes out of the front cylinder-cock when throttle is open it proves that the valve seat is broken on the front of the valve; if out of the back cylinder-cock, it proves that the seat is broken on the back of the valve.

Q. 105. What is liable to happen with a broken valve seat.

A. 105. Pieces are liable to work their way down through the steam ports to the cylinder and break a cylinder-head or piston; pieces are also liable to catch between the valve and valve seat and disable the valve-rigging.



WALSCHAERT VALVE GEAR.

This locomotive, 416, equipped with the Walschaert valve gear, was used while training the locomotive firemen to be used as engineers in France or Siberia, and also to be used in the United States as engineers when they return home. The writer will guarantee they can take an examination on any railroad in this country or a foreign country for the above position.

Q. 106. What benefit is a Walschaert valve gear engine to a Stephenson valve gear in regards to a locomotive engineer looking for defects or when oiling the valve motion?

A. 106. The Walschaert valve gear, being located on the outside of the frames of the engine, makes all working parts visible and easier to approach than the Stephenson valve gear?

Q. 107. What care does the Stephenson valve gear need over the Walschaert valve gear?

A. 107. No more care. All valve gears must be looked after and oiled properly to receive proper results.

Q. 108. Where is the return crank located?

A. 108. It is connected to the main pin.

Q. 109. Where is the eccentric rod connected?

A. 109. Connected to the return crank and foot of link.

Q. 110. Where is the link block-lifter connected?

A. 110. Connected to the radius rod and reverse shaft arm.

Q. 111. Where is the link connected?

A. 111. Connected to the reverse shaft support and link support.

Q. 112. Where is the radius rod connected?

A. 112. Connected to link block-lifter, link block and combination lever.

Q. 113. Where is the cross-head arm connected?

A. 113. Connected to cross-head and union link.

Q. 114. Where is the union link connected?

A. 114. Connected to cross-head arm and combination lever.

Q. 115. Where is the combination lever connected?

A. 115. Connected to union link, radius rod and valve rod cross-head.

Q. 116. Where is the valve rod cross-head connected?

A. 116. Valve rod and combination lever.

Q. 117. Where is the reach rod connected?

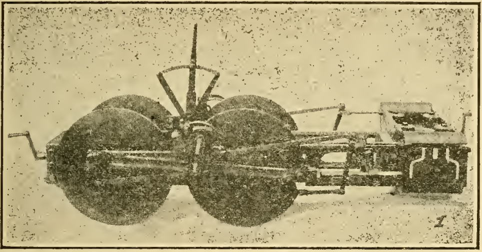
A. 117. Reverse shaft arm and reverse lever.

Q. 118. Where is the valve rod connected?

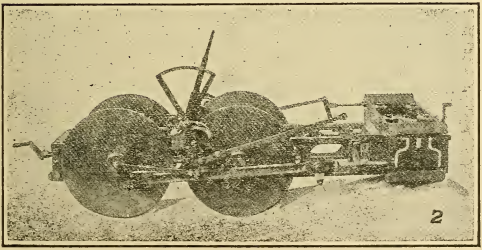
A. 118. Valve stem and valve rod cross-head.

Q. 119. Where is the valve stem connected?

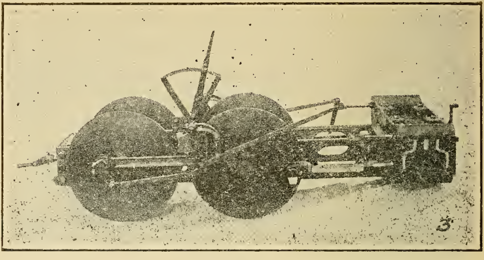
A. 119. Valve rod and valve, located in the valve chamber.



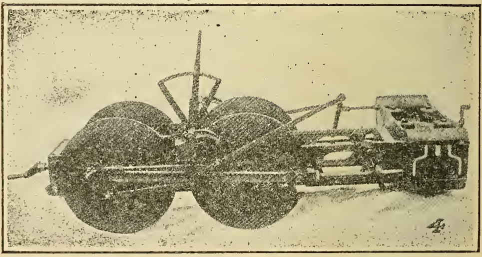
Q. 120. What does Figure No. 1 indicate?
A. 120. A link blocked so as to proceed in forward motion.



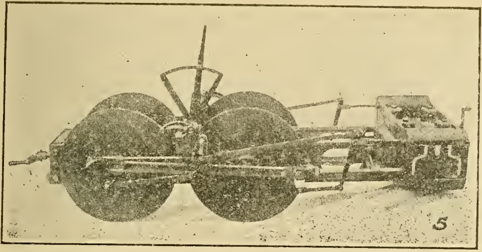
Q. 121. What does Figure No. 2 indicate?
A. 121. Valve blocked, combination lever and union link removed. Radius rod raised and chained to footboard, proceeding one-sided.



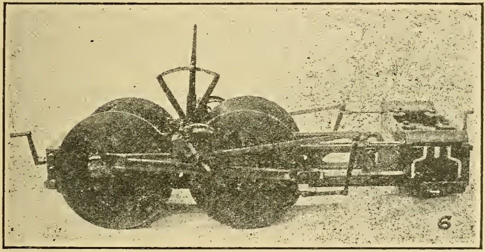
Q. 122. What does Figure No. 3 indicate?
A. 122. Main rod down, cross-head blocked, back cylinder-head removed, combination lever and union link removed. **Indicates an outside admission engine.**



Q. 123. What does Figure No. 4 indicate?
A. 123. Union link broken or cross-head arm, combination lever fastened to cylinder-cock, radius-rod chained up so as to clear combination lever.



Q. 124. What does Figure No. 5 indicate?
A. 124. Back end of radius-rod extension broken, link block-lifter removed, link blocked so to proceed in forward motion.



Q. 125. What does Figure No. 6 indicate?
A.fl125. Return crank, eccentric rod or foot of link broken, link block-lifter disconnected, link block blocked in center of link.
Q. 126. What would you do if you broke a link block-lifter tumbling shaft arm or reach rod?
A. 126. Block link so as to proceed in forward motion.
Q. 127. What would you do in case of a broken crank, eccentric rod or foot of link?
A. 127. Would remove the broken parts, disconnect the link-lifter from the radius-rod and block the link

block in the center of the link. The combination lever would then move the valve twice the amount of its lap and lead, which would be sufficient to lubricate cylinder.

Q. 128. What would you do in case of a broken radius rod, when the suspension bar or hanger is connected to an extension of the radius rod back of the link, and that back extension of the rod should break off, or the suspension bar or lifting arm should break?

A. 128. Block the link in the desired position, and proceed with both sides. The engine cannot be reversed unless link block on side with broken parts is blocked up.

Q. 129. If valve stem should break, what would you do?

A. 129. Disconnect the forward end of the radius rod, suspend it from the running-board, remove the combination lever and union link, block the valves, provide for lubrication, and proceed.

Q. 130. If the long lower section of the combination lever on its connecting link to the cross-head should break or the cross-head arm, what should be done?

A. 130. Disconnect the forward end of the radius rod and suspend it from the running-board, remove the broken parts, secure the valve in the central position, provide for lubrication, and proceed.

Q. 131. Does the lead of a valve on a Walschaert valve gear engine change when the reverse lever is hooked up?

A. 131. No; it is a constant lead.

Q. 132. How can you determine the difference between an outside admission or an inside admission?

A. 132. When the radius-rod is connected to the combination lever above the valve stem, inside admission; and when connected below valve stem, outside admission.

Q. 133. If you should break a main rod and no other damage done, what would you do?

A. 133. Take down the broken parts, block the crosshead, disconnect the radius-rod, suspend it from the running-board, cover ports, and proceed.

Q. 134. What would you do if it were an outside admission?

A. 134. Remove the combination lever and union link. If you noticed it would take a period of time to remove the latter, disconnect the eccentric rod and link block-lifter, and proceed.

Q. 135. What is the easiest way to disconnect a

Walschaert valve gear engine?

A. 135. In some cases remove the eccentric rod and link block-lifter, cover ports, and proceed.

Q. 136. Is it necessary to remove the union link?

A. 136. Disconnect the union link from the cross-head arm and combination lever and fasten the combination lever to cylinder-cock and proceed.

Q. 137. What would you do if you broke a valve stem off close to the valve on a piston valve engine?

A. 137. Remove the front valve head, cover ports, then cut a block to fit between the valve head and valve. Screw on the valve head, shove the valve ahead with the valve stem, secure with a clamp. Remove the radius-rod from the combination lever, secure to the running-board, disconnect the union link, proceed.

Q. 138. What would you do if you broke a radius-rod, link block or link block pin?

A. 138. Remove the radius-rod, cover ports, and proceed.

Q. 139. Will a piston valve center and cover its own ports?

A. 139. If the rings on both end of the valve are in good condition they will. If the front rings on the valve are in good condition and the rear ones in poor condition, the valve will move ahead. If rings are good on rear of valve and poor on the front of the valve, they will move back.

Q. 140. What benefit is derived from a Walschaert valve gear engine over a Stephenson valve gear engine, when the good side of the engine stops on the dead center?

A. 140. All that is necessary is to move the clamp and shift the valve; as soon as the engine moves cover the ports, and proceed.

Q. 141. What would you do if the piston should be broken or become disconnected from the piston rod in the cylinder? Would you remove the main rod?

A. 141. No; take off the front cylinder-head, remove the follower; cover ports, and proceed.

Q. 142. How would you proceed if you blew out the front cylinder-head?

A. 142. Cover ports, and proceed.

Q. 143. What would you do in cases where you disconnect the union link from the cross-head arm?

A. 143. I always advise when disconnecting the union link from the cross-head arm to disconnect it from the combination lever and place it up in the cab of the locomotive, as I have known cases where it became disconnected from the cylinder-cocks, hung down and got all battered before the engine could come to a stop.

Below you will find the desired information for setting the valves of the Walschaert valve gear.

Where the forward motion is taken from the lower half of the link, and you desire to move the valve ahead lengthen the eccentric rod; to move it back shorten the eccentric rod.

How should the eccentric rod be altered if you desired to move the valve ahead in the back motion?

To move the valve ahead in backward motion shorten the eccentric rod; to move the valve back lengthen the eccentric rod.

When the forward motion is taken from the upper half of the link, and you desire to move the valve ahead shorten the eccentric rod; to move it back lengthen the eccentric rod.

How should the eccentric rod be altered to move the valve ahead in backward motion?

Lengthen the eccentric rod; to move it back shorten the eccentric rod.

When the eccentric rod is lengthened it will not alter the position of the valve a like amount; the two will have approximately the same ratio to each other as that between the eccentric crank-arm throw and the travel of the valve. For instance, let us figure out like this: The eccentric crank-arm throw is 12 inches, or near that, and the valve travel is just one-half of the throw of the eccentric arm, or six inches. The ratio is two to one, or the valve travel is one-half of 12 inches, or 6 inches. In a case of this kind a change in the eccentric rod of one-eighth of an inch would move the position of the valve only one-half of the one-eighth of an inch, or one-sixteenth of an inch.

The setting of the Walschaert valve gear is equally the same of the design where constant lead is and those having variable lead. The above rule is suitable and is fit for same.

A rule which is suitable for mechanics employed on this class of work is to start in and make a check; first, to see if all levers and eccentric cranks are of the proper length the drawings call for. If they correspond and the drawings are correct there will be very little trouble attached to the valve setting. Be sure you are right then proceed.

While located at a certain place one time waiting for an engine equipped with the Walschaert valve gear, there was a small mistake made in one of the drawings, and it took a great deal of work before the trouble was discovered on the drawing.

After you discover that the levers and crank are right, start in and place the crank on in the desired position, only securing it temporarily, so it can be moved to suit if so desired.

Before starting in to raise the wheels look on the specification and note the desired distance to raise the wheels, so you are sure the wheels are raised up the proper distance specified; taking the measurement from the center of the wheel to the top of the frame, allowing for the wear of the brass the desired figures the drawing calls for; then move the main wheels in the desired way and strike off your dead center marks, proving you are correct; then remove the plugs on the valve chamber and find the port openings and mark the valve stem accordingly.

When marking the mid-gear position, place the radius-rod in the center of the link; then get the lead at each end of the valve chamber. Where the lead is constant, the average lead, or the sum of the leads on opposite ends, divided by two, should be equal to the specified lead in full gear. When the lead is variable, the average lead in mid-gear position should be equal to one-half of the sum specified, leads in full forward and full back gear. In other words, it should be the lead due to the lap and lead lever unaffected by the position of the eccentric crank. Any error in the average lead, when the radius-bar is in central position, is due to an error in the length of the upper or lower arms of the lap and lead lever.

After you have checked the lengths of the lap and lead lever correctly, you can realize what must be done. You can equalize the lead by the adjusting of the nuts on the valve stem, if so provided; if not, make the change with the radius-rod.

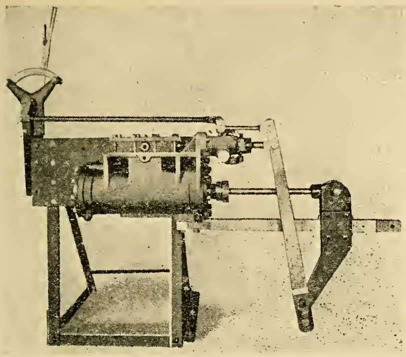
Place the reverse lever in position so as to allow the valve to have full travel. After the specified travel is received, if the average lead is equal to the specified lead in full gear, the eccentric crank is in its proper position. If it is not correct, the eccentric crank-arm should be driven in a position until you discover the error is correct. If the desired lead is less than specified, the eccentric crank should be driven forward. If in a position to lead the main pin and outward if it follows the main pin. If the lead is more than that which is specified, the crank should be driven just the opposite to the above ways mentioned.

After the eccentric crank is located correctly and the valve travel is checked up, then relocate full forward position of the reverse lever.

If the average lead is correct, but not properly divided on the front and back centers, alter the eccentric rod until properly divided. It is well to remember to change the lead a given amount, and the eccentric rod must be changed a quarter amount. Let us say we desire a one-thirty-second change on the lead; alter the eccentric rod one-sixteenth. If one-sixteenth, alter the eccentric rod one-eighth.

Place the reverse lever so as to give you full valve travel in the back-up motion, then mark the position of the reverse bar on the quadrant and check the lead in the same manner. With a variable lead the full back motion should be as much greater than the lead at mid-gear as the lead at mid-gear is greater than that at full forward gear.

Run over the cut-offs and obtain as many positions as you desire. In running over the cut-offs of locomotives of the articulated mallet type of engines, obtain all cut-offs desired before moving the reverse lever; that is, look after the four valves, as both set of valves are operated from one reverse lever.



RAGONNET POWER REVERSE GEAR.

A. Just a few words to engineers in reference to a power gear. It makes no difference what power the gear works with, if it be steam or air, we must be certain that we have that power before undertaking to move the locomotive. The neglect to do this may cost you your life, just as easily as the destruction of the locomotive. Several years ago we had steam reverse levers on the Philadelphia & Reading Railroad, and quite frequently trouble arose by being in a hurry to move the engine without first trying the steam reverse gear. When it was necessary to use the gear it was discovered that they had not turned on the steam. But it was too late, the trouble had come. Now there is no excuse to be offered from an engineer that he forgot to turn on the power. Always see that the air pressure is up to maximum pressure and reverse the gear before moving the engine. Then you are sure you are right.

B. Operate the gear and note that the globe valve is wide open; that admits air or steam to the reverse gear. It is very easy for a hostler or a mechanic when working around the locomotive to shut the valve off and forget to open it. But if the gear is operated and the reverse motion is correct, then you understand you are ready to move the locomotive. My advice to you all is to apply the brakes and see if they operate properly at the same time you test the reverse gear.

C. Remember when opening a globe valve that you open it wide. Many men open valves to suit their ideas. But there are no ideas to be connected to a globe valve unless there are special instructions covering the same. If there is a one-inch globe valve attached to a one-inch pipe, this valve is constructed in a mechanical way that the diameter of the valve when wide open is as large as the pipe, so the supply of steam or air can pass to the pipe and fill up the space desired. Bear in mind that the globe valve to the reverse gear always wants to be opened wide so as to receive a full volume of steam or air to operate the gear.

D. The air reverse gear is designed to be operated with air pressure as its power. But there is an attachment of steam in cases of necessity. Steam can be used to operate the gear.

E. If steam is to be turned on so as to operate the reverse gear, first shut off the globe valve leading to the air-pipe that supplies the gear with air; also there is a back-pressure check valve located in the air-pipe to prevent the steam entering the pipe. But if you close the globe valve and, in case of a leak by the check valve, steam cannot enter the main reservoir.

F. Never use steam on the reverse gear only in cases of emergency.

G. When steam has been used to operate the gear, always make out a report on the work book on your arrival at the engine house, so the cylinder packing may be examined. If there is no attention given the packing, it is liable to leak and produce trouble while en route.

H. Keep piston-rod packing set up tight. Do not allow it to blow at this point, as it may cause gear to creep.

I. Use engine oil in cylinder cup, filling the cup at least once a trip. In cases where there is a blow at the exhaust opening, try one or two cupfuls of signal oil, then work the gear rapidly forward and backward until blow at exhaust port ceases.

J. If this does not stop the blow at the exhaust port, it must be reported at the engine house. Then the cylinder packing and the slide valve must be examined.

K. Cylinder packing used by many corporations is the five-eighths square vulcabestion mallet quality, and is used in the cylinders. The rings in number are three, and it is squeezed up to the walls of the cylinder with follower until packing is tight against the walls of cylinder, but not so tight as to cause excessive friction.

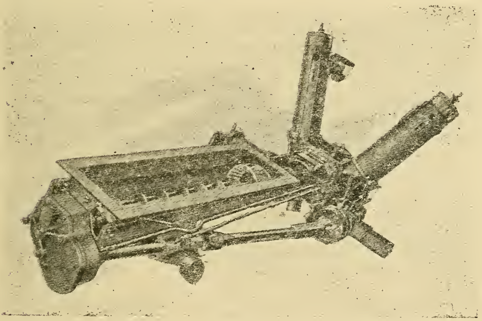
L. What care must be given the lever connections?

A. Lost motion must be taken care of in the lever and rods, so the gear can perform the duties required. Both the cylinder packing and valve can be tested by taking back cylinder-head off.

M. What would you do in case your reverse gear became disabled and it would be impossible either to operate it by air or steam pressure?

A. Raise up on the radius bars at the connection to the link block and block between the cross-head of the air reverse and the stop pins, cut block to suit and fasten with a piece of bell-rope or wire, and proceed.

STOKERS.



Q. 144. What make of stokers are used on this railroad?

A. 144. There are three: Standard, Duplex and Street.

Q. 145. What benefit is derived from a stoker?

A. 145. Elimination of physical labor, better training to become an engineer, increased safety of two men watching signals, increased tonnage per train, maximum steam pressure at all times, better working locomotives, increased average of speed, reduced time required for cleaning flues, engines ready for service quicker, due to clearer fires and elimination of fire cleaning, cleaned in a shorter time.

Q. 146. How many gauges are used with a stoker?

A. 146. Two gauges with some stokers.

Q. 147. What benefit is derived from two gauges?

A. 147. One indicates the steam admitted to the driving engine; the other one is a duplex gauge. One pointer represents the steam admitted to the right elbow and the other to the left elbow.

OILING STOKERS.

A. All stokers should be oiled before leaving terminal, and on long divisions oil holes should be filled between terminals. The points of oiling are as follows:

B. The driving engine is oiled by a pipe leading from the main lubricator to the driving engine steam inlet line. This valve should always be opened before starting stoker.

C. Before the locomotive is put in service either new or after an overhauling in the shop, the rack in the rack housing should receive an initial mixture of one quart of black oil and one gallon of water. There is a one-inch elbow tapped into the separator cover on the left back side of the housing provided for that purpose. Renewals should be at the rate of one quarter a pint of oil per day.

D. Left and right elevator drives and reverses are lubricated by lifting the pawl shifters on top of the elevators and pouring about one-eighth of a pint of engine oil into each casing every day before starting out. When first putting stoker into service, about one quart of oil should be poured into each reverse, in this manner.

E. Small holes are located in elevator drive and reverse casings, each of which leads to a cord passage in casing provided to lubricate the bearing on which elevator drive and reverse rotates.

F. The left elevator driving shaft bearing in bottom of transfer hopper is lubricated by a special tap on the left side of transfer hopper under locomotive deck.

G. The right elevator driving shaft bearing and the conveyer drive and reverse receive lubrication through an oil box, usually stuffed with curled hair, with four outlets. This box, which should be filled every day, can be reached through an opening in the locomotive deck a little to the right of the right elevator.

H. The conveyor driving shaft bearings in the slide support and gear casing are oiled by cups secured in the trough under the apron between locomotives and tenders. These should be filled at least once a day.

I. The grease boxes in the rear casing and gear casing cover on the rear of the conveyor should be filled at least once a week with soft grease and once in three months the gearing casing cover should be removed and the gears packed with grease.

J. Universal joints, slip joints, and conveyor slide support rollers should be oiled once a day with engine oil.

TO START AND OPERATE STOKER.

K. See that the stoker is oiled as per instructions.

L. See that the operating rod on back head is in center or running position.

M. Open main jet line and if the coal is very course or mine run, set the left and right elevator jets so that they register about 15 pounds on the steam jet gauge. If the coal is small or what is known as stoker coal, set the jets to register 10 pounds.

N. Next the driving engine main steam valve should be opened wide and the throttle valve opened just enough to supply the proper amount of coal to the fire box.

O. After the driving engine has started, the first slide in the tender deck over the trough, should be opened, which will allow the coal to be conveyed, crushed, elevated and distributed over the entire fire box area.

Q. 144. How is the distribution of coal regulated?

A. 144. By two separate jets in elevator elbows, dividing rib in transfer hopper.

Q. 145. How are the steam jets fitted in elbows to blow the coal over the grate area?

A. 145. Regulated according to the quality of coal, coarse coal is required by 18 pounds of steam, and for slack about 9 pounds of steam, the coarser the coal the more steam is required.

Q. 146. What would you do if you found too much coal going up towards the flues?

A. 146. Shut the steam pressure off slightly at the elbow jets, regulate as desired, increase or decrease the steam jet just as you want the coal placed in the fire box.

Q. 147. Where should the dividing rib be in starting out?

A. 147. The dividing rib in starting out should be located in the center of the transfer hopper. If it is found that the coal is feeding too much to one side the dividing rib should be set so as to place the coal where you so desire.

Q. 148. How is the amount of coal distributed over the fire box regulated?

A. 148. Regulated by the speed of the driving engine, and the plates over the trough in the tender. To vary the amount of coal, the steam pressure should be regulated, decreased or increased by regulating the controller. When you notice that there is not enough coal feeding into trough, open another slide.

Q. 149. Reversing the driving engine?

A. 149. It is possible to reverse the driving engine, the conveyor screw, or either of the two elevator screws, independently or consecutively together. To reverse driving engine during power stroke of piston, the operating rod on back head of locomotive is moved to its lower position. If it is making a return stroke the operating rod is moved to its upper position.

Q. 150. Conveyor screw?

A. 150. Always reverse driving engine before attempting to reverse conveyor screws.

Q. 151. How would you place bar provided for that purpose?

A. 151. Place bar provided for that purpose in reverse lever through slot in cab deck, pull lever away from locomotive back head, on reaching the second or middle notch, in neutral position, the conveyor screw will stop entirely and on being pulled to third or extreme notch, reverse position, the conveyor screw will reverse.

Q. 152. Elevator screws?

A. 152. Both right and left elevator screws are reversed in the same manner.

Q. 153. What would you do before reversing elevator screw?

A. 153. Always reverse driving engine and extra stop or reverse conveyor screw before attempting to reverse elevator screw.

Q. 154. How would you lift pawl shifter?

A. 154. Lift pawl shifter on top of either elevator reverse casing. In the first, lift to where it rests on a catch, the elevator screw in that casing will stop entirely. On lifting it to its extreme upper position, where it must be held, the elevator screw will reverse.

GENERAL INSTRUCTIONS.

A. 155. Before leaving terminals, see that the fire is clean and in good condition. Build up a good level fire with shovel. After starting stoker as hereinbefore explained, open one or more shields in tank and make sure that coal is getting to conveyor screw.

A. 156. Do not use hook or rake unless absolutely necessary. However, it is a good plan to feed the fire when first starting out to see what condition it is in. By doing this the proper adjustment can be made in the distribution.

A. 157. It is always proper to see what is being fed. Do not feed iron, slate, rock or waste through the conveyor.

A. 158. When train is standing on siding for a short period of time, shut stoker off by throwing operating rod on back head of locomotive boiler out of running position; when standing for a long time, shut the driving engine down, close main line inlet and lubricator connection, and in winter time drain cocks should be opened.

If sufficient coal cannot be supplied grates.

A. 159. Distributors may be warped and not in proper shape and point too low. If so report on arrival at engine house. Steam jets may be stopped up with dirt or pipe scale. It may be necessary to increase pressure on jets.

DUTIES OF FIREMEN ON ARRIVAL AT TERMINALS.

A. 160. Before leaving a stoker engine in fire track, firemen should close the slides in tank and let driving engine run long enough to remove all coal from conveyor, close driving engine throttle valve and steam jet main line valve tight, open drain cock on bottom of engine cylinder to eliminate any possibility of stoker engine freezing in extreme cold weather, and close tap on main lubricator.

DON'TS.

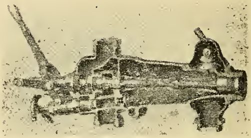
A. 161. Don't leave the tank openings uncovered while coaling tender.

A. 162. Don't let coal stand in conveyor trough between trips.

A. 163. Don't allow coal to accumulate in tank cutout and become packed around the outside of conveyor trough. This will break the trough when rounding curves with the locomotives.

A. 164. Never place hand or foot in trough while stoker is working.

A. 165. Don't run the stoker without distributors, the distribtuors are designed to spread and save coal. Leaving them off means unnecessary waste of coal.



SELLER'S LIFTING INJECTOR.

Q. 166. What is an injector?

A. 166. A device designed and constructed to receive and deliver water.

Q. 167. Describe the principals upon which an injector works.

A. 167. Its the unitation of steam and water coming in contact with one another, formed into condensation and driven by a power.

Q. 168. What is the power used to operate an injector?

A. 168. Steam.

Q. 169. How is water accepted to the injector body?

A. 169. By vacuum being created in the body of the injector.

Q. 170. What creates the vacuum?

A. 170. Steam passing through small diagonal drilled holes, drives the air ahead of it, and out through the overflow. Through this action vacuum is created.

Q. 171. What action has this on the injector?

A. 171. Steam from the boiler is admitted to the lifting nozzle by drawing the starting lever back about one inch, without drawing the plug on the end of the spindle from the center part of the steam nozzle. Steam passes through the small diagonal drilled holes and discharges from the annular nozzle, through the upper part of the combining tube and into the overflow chamber, lifts the overflow valve and water flows from the waste pipe of the injector. When water is lifted, the starting lever is drawn back at its full distance, opening the forcing nozzle wide, and the full supply of steam discharges into the combining tube forcing the water into the delivery tube, into the discharge pipe and the boiler.

Q. 172. With a high steam pressure, what will happen to all injectors?

A. 172. With a high steam pressure there is a tendency in all injectors having an overflow chamber to produce a partial vacuum in the overflow chamber. In the improved self-acting Sellers injector this vacuum is utilized to draw an additional supply of water from the supply pipe through the automatic action of the inlet valve into the body of the injector. This supplemental supply is drawn into the submerged combining tube and forced by the jet into the boiler, increasing the water capacity 20 per cent.

Q. 173. What additional pressure of steam does it take to automatically operate the inlet valve?

A. 173. The inlet valve is not placed into action unless the boiler pressure exceeds 150 pounds.

Q. 174. What is the water regulating valve used for?

A. 174. It is only used to adjust the capacity to suit the needs of the boiler; the range is unusually large.

Q. 175. How does the Sellers injector differ in construction and operation from the Hancock inspirator?

A. 175. The Sellers injector is self-acting, using the same set of tubes at all steam pressures. It will work from the highest steam pressures used on locomotives down to 35 pounds of steam without adjustment and without wasting water at the overflow, and by regulating the water valve on the injector it can be operated down to 25 pounds.

Q. 176. What other benefit is derived from the Sellers injector?

A. 176. It starts instantly under all conditions of service. It can always be depended upon to force all the water in the boiler, so that the engineer can give his whole attention to other duties.

Q. 177. Why does an injector with 180 pounds of steam pressure deliver water to the boiler with the said pressure, this water working against its own boiler pressure?

A. 177. The construction of the injector forms such action upon the injector that it is due to the high velocity with which a jet of steam strikes the water entering the combining tube, imparting to it its momentum and forming with it during condensation a continuous jet of small diameter, having sufficient velocity to overcome the pressure in the boiler.

Q. 178. How should an injector be stopped?

A. 178. Simply by pushing in on the lever.

Q. 179. How is the Sellers injector converted into a heater in cold weather when so desired?

A. 179. Close main steam valve to injector, close overflow valve, pull out starting lever, then open the main steam valve slightly and regulate steam by the water valve.

Q. 180. What would you do to prevent overflow pipe from freezing?

A. 180. After steam pressure is in the injector body, just loosen the calm lever over the top of overflow slightly until steam pressure issues from the waste pipe of the injector.

Q. 181. What will prevent the Sellers injector from priming?

A. 181. Bad leak of air above the water line in the receiving pipe, inlet valve held open, bad leak of steam ahead of priming nozzle where asbestos is encircled around it, foreign matter in the combining tube, such as small pieces of coal lodged in the diagonal holes in the tube, a leaky steam valve.

Q. 182. What is the combining tube?

A. 182. The combining tube is the tube that connects with the delivery tube, and where the steam and water unites and becomes condensed and a small jet of steam with a continuous movement having sufficient velocity to deliver water against its own pressure.

Q. 183. What will cause the water to heat in receiving pipe and prevent injector from priming?

A. 183. Badly leaking seat in starting valve.

Q. 184. What may be the cause of an injector failure?

A. 184. Defective combining tube, leaky check valve at injector or boiler check leaking, holes too small in screen at tender, water hose not the proper size, injector receiving too much saturated steam at priming nozzle.

Q. 185. How many check valves are used in connection with an injector?

A. 185. Two; a line check and boiler check.

Q. 186. Will an injector work unless all steam has been condensed by the supply of water?

A. 186. Yes, an injector will work without the full condensation of steam, but it will not deliver the proper amount of water.

Q. 187. Explain why a Sellers injector will work when steam is not all condensed.

A. 187. With a Sellers injector the water valve is used to regulate the amount of water desired to be delivered to the boiler, but the steam pressure remains the same at all times. Therefore, when the water is increased there is more water to condense the steam, but when the water is decreased there is not a sufficient amount of water accepted to the combining tube to condense the steam, and the water is delivered to the boiler in less quantity and at a higher degree of heat.

Q. 188. How should an injector be operated while en route?

A. 188. On a through train, either passenger or freight, an injector under practical experience can be set to keep the boiler at one water level.

Q. 189. How should an injector be operated on local trains or trains that are continuously stopping?

A. 189. Injector should be stopped and not used while train is stopping and being started away from station. After the train is in motion, and conditions require it, the injector should again be started and kept on continuously while the throttle is opened and engine is working.

Q. 190. What would you do if both injectors refused to operate?

A. 190. Always remember and keep a level head; do not get excited under these conditions; stop immediately, look at water in tender, if that is O. K. take down water hose and examine strainer; never draw fire unless you must. Two single injectors do not often refuse to work.

Q. 191. Why is it a duplex injector or a composite injector very often refuses to work?

A. 191. This is due to the fact that it takes three walls to make two injectors, and the walls between the injectors are quite thin. When the water is hot in one injector that water soon heats the water in the opposite injector. If both refuse to operate stop at once, take down both tank hose, leave the hot water out, cool the body of the injector and you will find they will operate.

Q. 192. How often should the hose strainer be looked after?

A. 192. Before starting out for a day's work.

WHAT MAKES A GOOD FIREMAN?

The writer expressing about a fireman.

Many rules are placed for a fireman, but I never in my experience on a railroad ever saw a fireman fire a locomotive by book theory. The only fireman we have today or ever did have is the one who studies the operation of the engine and the manner in which it works the fire, and fires it accordingly.

In my opinion it takes four rules to make a fireman:

No. 1. Ability, power and skill.

N. 2. Good judgment.

No. 3. Strength.

No. 4. Knowledge.

Ability, to know where to put the coal.

Good judgment, when to put the coal in and amount needed.

Strength, to put it where you want it.

Knowledge, how much to put in one place; too much coal at a time is loss; not a sufficient amount is loss.

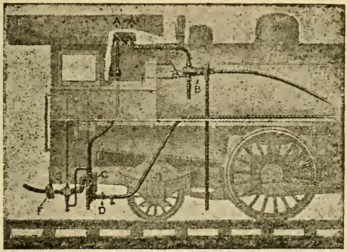
If you do not possess these qualities, all the book reading in the world will never make you a fireman.

HOW TO HAVE GOOD STEAMING ENGINES.

Engineers having charge of locomotives must first understand the locomotive and the manner in which it operates. All locomotives do not work alike, nor do they steam alike. Where a locomotive is consigned to a regular train and put in charge of a crew, it does not take long for the engineer to understand the operations of the locomotive.

First, different locomotives of different design and class are consigned to different classes of work. When a locomotive is used in long road service and the engineer is continuously operating the locomotive it can be operated to great success by the engineer in charge using a little judgment; by working the engine where the best results are obtained without the necessity of misusing it.

The injector can be operated continuously by cutting down its water supply and keeping a standard boiler pressure of three gauges of water when the throttle is opened. Do not fill the boiler up full, then shut the injector off and wait until you are down to one gauge of water, then fill it up again. That is poor judgment. In return, no steam, leaky flues, leaky firebox, due to sudden expansion and contraction.



SELLERS INJECTOR, NON-LIFTING.

Q. 193. What is the difference between a lifting injector and a non-lifting injector?

A. 193. One lifts the water to the injector and the other one the water flows to the injector under gravity.

Q. 194. Where is a non-lifting injector located?

A. 194. Non-lifting injectors should be located on a locomotive below the low water level of tender, so it can receive the water from the tender under gravity.

Q. 195. Where is the lifting injectors located?

A. 195. They are generally located on the boilerhead, about 12 to 18 inches above the high water level of tender, and should be located in easy access to the engineer.

Q. 196. Will any injector operate and receive water from the tender if the atmospheric pressure cannot get into the tender?

A. 196. No; for every foot of water removed from the tender so must there be that much atmospheric pressure received on top of the water.

Q. 197. Where there are two injectors located on a boiler, what care is required of both?

A. 197. Alternate the work of both injectors so you are sure they are both in good condition in cases of emergency.

Q. 198. What is required of a water cistern?

A. 198. Kept clean and tank valves wide open, so as to deliver clean water, and also its supply of water.

Q. 199. How should a Sellers non-lifting injector be operated?

A. 199. Open lazy cock and overflow, then turn on steam slowly.

Q. 200. How should a Sellers non-lifting injector be stopped?

A. 200. Shut off the steam and close lazy cock.

Q. 201. How should a non-lifting injector be regulated?

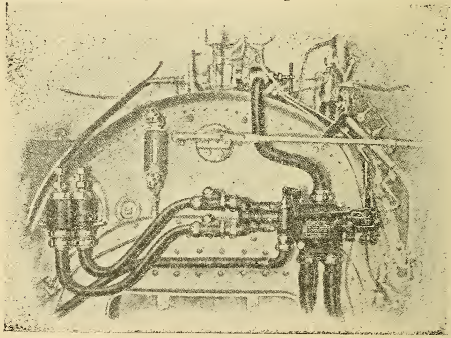
A. 201. To regulate flow of water adjust lazy cock only. Steam valve must remain wide open.

Q. 202. How must the overflow valve be operated when feeding?

A. 202. When feeding, overflow must be wide open except when feeding very hot water

Q. 203. How can you convert the non-lifting sellers injector into a heater?

A. 203. Close overflow valve, open lazy cock and steam valve to required notch of pull handle.



HANCOCK LIFTING INSPIRATOR.

Q. 204. How does the Hancock inspirator differ in construction and operating than the sellers injector?

A. 204. The Hancock inspirator is a double tube apparatus. It has an intermediate overflow and a positive overflow and works without a change of tubes, or adjustment at all steam pressures from 35 pounds up to 350 pounds.

Q. 205. How to start and operate a Hancock inspirator?

A. 205. When starting inspirator lever is drawn back slightly, unseating the inner valve, this permitting the steam to pass by the starting valve to the passage to the lifting steam nozzle. The steam continues to flow through the lifting tube driving out the air in the valve body, and creating a vacuum, and this in return causes the water to work through the lifting tube, condensing the steam and passing the water out through the intermediate overflow to the positive overflow located at the delivery chamber. At this move the water is free to pass to the atmosphere through the overflow pipe, the starting lever is pulled back until the positive overflow takes its seat. At this point the lever is stopped. At this movement the forcing steam valve is unseated, admitting steam to the forcing nozzle and the forcer to the combining tube, creating a vacuum sufficiently great enough to close the intermediate overflow, and also a pressure to open the line check valve. At this movement both overflows are kept closed, the intermediate by vacuum and a pressure from the overflow chamber, and the inspirator is in full operation.

Q. 206. What is the good feature of the intermediate overflow and positive overflow?

A. 206. It makes a quick priming inspirator due to the fact that there is a quick move of water to the positive overflow.

Q. 207. What is a good feature of a positive overflow?

A. 207. This makes it impossible for water to "spill" at the overflow and prevents its loss while running.

Q. 208. When is the inspirator delivering its maximum quantity of water?

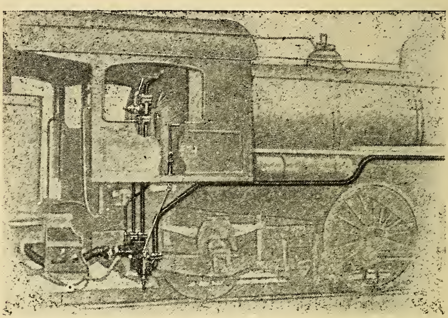
A. 208. When the pin located on the wheel of the regulating valve is at the top, then the inspirator is receiving its full quantity of water, to reduce the feed, turn the regulating valve wheel to the right.

Q. 209. How is the Hancock inspirator converted into a heater?

A. 209. First shut off the regulating valve tight, then pull the starting lever all the way back until the positive overflow has taken its seat, then lift up on the connecting rod until disconnected from the stud on the starting lever, push in on the starting lever until the steam valve has taken its seat. After that is done draw the lever back to priming position. This will give you a sufficient amount of steam pressure required for a heater, regulate steam valve so as to permit steam enough to pass by it to suit the condition of weather. If on a medium cold day slightly open, on a severe cold day, wide open.

Q. 210. How can you prevent the overflow pipe from freezing up?

A. 210. Just tap on the end of the connecting rod slightly until there is a leak of steam out of the overflow pipe.



NON-LIFTING HANCOCK INSPIRATOR.

Q. 211. How to operate the non-lifting Hancock inspirator?

A. 211. To start the inspirator open the overflow valve by its handle, draw out the operating lever, then close the overflow valve. To stop the inspirator push in the operating lever. Always leave overflow valve closed except for the moment it is opened in starting the inspirator, allow a few seconds after opening the overflow valve for the water to circulate through the inspirator before opening the operating valve, then draw out the handle of the operating valve slightly to circulate the water, then draw it back to the stop, after which close the overflow valve.

Q. 212. How to regulate the flow of water.

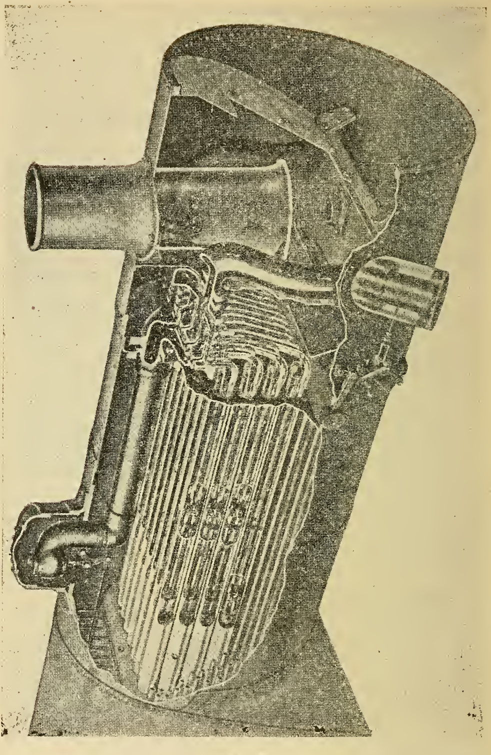
A. 212. When the pin in the wheel of the regulating valve is at the top, the inspirator will deliver its full maximum quantity of water. To reduce the feed, turn regulating wheel to the right.

Q. 213. To use inspirator as a heater.

A. 213. To use the inspirator as a heater, all that is necessary is to open the heater valve the required amount.

Q. 214. How would you protect the inspirator in case you had to draw fire enroute?

A. 214. To drain the inspirator when there is no steam in the boiler shut the tank valve, disconnect the hose at the strainer, open the overflow valve, remove the cap and take out the plug or open the drip valve in the quarter turn of the delivery connection.



SUPERHEATED STEAM BOILER AND ENGINE.

Q. 215. What is superheated steam?

A. 215. Superheat means steam with the saturation taken out of it, and turned into a dry gasy steam.

Q. 216. What benefit is derived from a superheated steam engine over a saturated steam engine in road service?

A. 216. Less water is used, less fuel, increased efficiency. It takes less coal because less water evaporated. It takes less steam to do the same work.

Q. 217. What make of superheater is in general use on this rail-road?

A. 217. Schmidt superheater.

Q. 218. How should the water be carried in a boiler of a superheated engine?

A. 218. About three gauges of water at all times.

Q. 219. What care must be given a superheated engine?

A. 219. Constant care should be given to see that all parts of the superheater operations are well lubricated.

Q. 220. What care should be given the damper cylinder?

A. 220. To see that it is oiled properly so as to permit it to work free.

Q. 221. What is a damper used for in connection with a superheated engine?

A. 221. To protect superheated units.

Q. 222. How does the damper operate when throttle is closed and when opened?

A. 222. When throttle is opened the damper is placed into operation through the action of a small cylinder connected to damper, so as to allow the heat to circulate through the superheated tubes. When the throttle is closed and the steam is released out of the small cylinder, the weight attached to the end of the rod closes the damper.

Q. 223. How should the throttle and reverse lever be operated with a superheated engine?

A. 223. In a superheated engine there should be a well-opened throttle and the reverse lever used according to suit train and speed.

Q. 224. What bad effects are derived from a throttle only being opened part way and the reverse lever worked down so as to allow the valves to be worked close to full travel?

A. 224. The steam passes through the superheated units so quickly that there is no protection for them and they soon burn out or they get leaking quickly.

Q. 225. What benefit is derived from a well-opened throttle and the valve travel regulated by the reverse lever?

A. 225. With a well-opened throttle a valve travel regulated proper, the superheated units continuously remain full of steam and the units are protected from burning out or from leaking.

Q. 226. What is the duty of an engineer when operating a superheated engine?

A. 226. Always to see that the damper is in proper working order.

INFORMATION

Concerning the care of a superheated engine in winter time, after the fire is drawn and the engine is white-leaded and taken out of service for a period of time.

It is well to remember when a superheated engine is placed on the ash-pit to have the fire drawn, it is impossible to pass all of the steam out of the superheated units, as the heat has been removed there is nothing to take the saturation out of the steam, so the saturated steam works through the units to the steam chests and cylinders and a per cent. of condensed steam remains in the units, so as to protect these units. A good policy is to fill the boiler up with compressed air, remove the relief valves, open cylinder cocks and blow all of the condensed steam out with compressed air, so as to be sure they will not freeze and burst the units.

DRIFTING VALVE.

Q. 227. How many different styles of drifting valves are used on locomotives?

A. 227. There are two different styles of drifting valves used on locomotives, the automatic and hand started drifting valves.

Q. 228. What care must be taken of the automatic drifting valve?

Q. 228. When the automatic drifting valves are used on locomotives and these valves are to be put into service, it must be understood that the globe valve attached to them must be opened before starting out on a trip, and closed when at the end of the trip, or when the locomotive is placed on a siding or any place for a period of time.

Q. 229. What will happen if the globe valve is not closed at any of the above places?

A. 229. If the valve is permitted to remain open at any of the above places the locomotive is liable to start, and we as engineers all understand that there is no excuse for neglect in regards to closing or opening of these valves, where it is reauired to do so.

Q. 230. Hand drifting valves?

A. 230. The operation of hand drifting valves are easily understood, and in all cases should be operated the way you are instructed.

Q. 231. How is the hand drifting valve designed and also operated?

A. 231. It is well understood that the hand drifting valve is connected to the superheated steam action and the saturated steam action, the pipe leading from the boiler to the drifting valve is saturated steam, and the pipe leading from the drifting valve to the cylinders is superheated steam. Located at the steam chests connections is a back pressure check valve so when the throttle is placed into operation and the cylinders are being supplied with superheated steam, the back pressure check valve prevents the superheated steam from flowing back into the pipe leading to the drifting valve, but when the throttle is closed and the superheated steam leaves the steam chests and cylinders then the drifting valve is placed into action and saturated steam is admitted to the steam chests and cylinders, this prevents carbonization of cylinders.

Q. 232. What other benefit is derived from the drifting valve?

A. 232. When the throttle is opened, then the drifting valve is closed, but when the throttle is closed then the drifting valve must come into action. When the engine is drifting and saturated steam is admitted to the steam chests and cylinders, if the engine is to come to a full stop the valve must remain open until you stop, or if when drifting and you are not going to bring the train to a full stop the valve must remain open until after the throttle is opened. After throttle is open close the drifting valve.

Q. 233. What care must be given the drifting valve after train is stopped?

A. 233. If the locomotive is to come to a full stop, and as soon as the stop is made, close the drifting valve off tight so as to prevent the locomotive from starting train.

Q. 234. What benefit is derived from a drifting valve in cold weather?

A. 234. In cold weather it is of great benefit to cylinders more than one way. Where large relief valves are used in steam chests and cylinders, and the drifting valve is placed into action, the steam being admitted to the steam chests and cylinders are retained close to the high temperature of heat and through this action cylinders and valves are protected, but if the drifting valves are not placed into action the cold air is admitted to the cylinders and their temperature is changed very suddenly.

EXPLANATION TO ENGINEERS AND FIREMEN.

Where you have a long connected engine with a group of four pairs of wheels or more, we understand when the engine is traversing curves there is a certain per cent of friction against the wheels. This in return keeps the engine and tender back against the train when the throttle is closed. Just as soon as the engine comes in contact with the straight line of track, then the friction has left and the large engine moves quickly ahead, placing a tremendous strain on the draw-heads. But if the drifting valve is placed into action and there is a sufficient amount of steam pressure admitted to the valve and cylinders, when the engine and tender is traversing curves, the power of steam in the cylinders will be sufficient to keep the engine and tender stretched in advance of the train and when the engine and tender takes the straight track there will be no opportunity to place a strain on the draw heads either of the engine or tender, as they both will be in advance of the train.

LUBRICATION.

Q. 235. How would you proceed to fill up rod cups and oil up an engine?

A. 235. Take off the lids, see that the plungers are loose, fill the cup and notice when you work the plunger up and down that oil passes through the oil holes and enters the bearings.

Q. 236. What care must be taken to insure the oil is reaching the bearings?

A. 236. When oiling a locomotive's valve gears or boxes always see that the passageways are open so as to be sure the oil will be placed on the pins or journals.

Q. 237. How do you handle grease cups located on engines?

A. 237. It is the engineer's duty to see that all cups on the engine are filled before proceeding.

Q. 238. Do you consider it an engineer's duty to see that all boxes on engine, tender and truck are properly sponged before starting on trip?

A. 238. It is the engineer's duty to see that all boxes on engine and tender are in proper condition before proceeding in road service.

Q. 239. Are you familiar with the workings of the different lubricators on this system?

A. 239. Yes.

Q. 240. Explain how to fill a lubricator.

A. 240. First, see that all valves are closed, next open the drain cock, drain all the water out of the body of lubricator. Next take out filling plug, fill oil well with oil and replace the plug.

Q. 241. What would you do if when placing the oil in lubricator you discovered you did not have a sufficient amount of oil to fill it?

A. 241. Fill up with hot water. Always remember the oil being the lighter of the two fluids, the oil will always go to the top of the water.

Q. 242. When filling a lubricator with oil and you notice you can not put any more oil in the lubricator, is the lubricator full?

A. 242. No, after putting in the filling plug there is a space between the filling plug and the top of lubricator so as to allow for the expansion of the oil.

Q. 243. After lubricator is started and placed into operation, how long does it take for the oil to reach the steam chests and cylinders?

A. 243. About 15 minutes or a close margin of time to those figures.

Q. 243B. How is the oil from the lubricator to the steam chests or cylinders operated?

A. 243B. Steam from the lubricator and steam from the steam chests are placed into the oil pipes. This steam pressure is then balanced and the oil from the lubricator flows to the cylinders under gravity.

Q. 244. What effect will a trap in the oil pipe have on the lubricator?

A. 244. The oil will not flow to the steam chests or cylinders properly and the lubricator will not feed properly.

Q. 245. How can you clean out the passage way leading to the sight feeds?

A. 245. After the lubricator is all closed off there is a per cent of boiler pressure in the lubricator until it cools down, just as soon as you have the steam valves and condensing valve closed open the sight feed valve and close it quickly taking one at a time until they all have been opened and closed. This will keep the passage way leading to the sight feeds absolutely clean.

Q. 246. How to start a lubricator working.

A. 246. Open steam valve at dome wide, also steam valve on lubricator and condensing valve, after sight feed glasses are filled up with condensed steam, open feed valves, and set for the desired number of drops required per minute.

Q. 247. Trace oil through lubricator to feed glass and cylinders.

A. 247. From the oil well through the oil tube to the passage leading down to the lower side of oil well, through the passage in the lower side of the oil well, over to the feed valves. After feed valve is opened, oil passes from the feed valve up to feed valve nozzle, which is in contact with the water located in the feed valve chamber, to which the sight glass is connected, up through the water in sight glass to small ball check on top of the sight feed chamber, from there to the oil pipe to the check valve located at the steam chests, passing the check valves to the steam chests and cylinders.

Q. 248. What kind of check valves are located over the top of the sight feed glass?

A. 248. Some are ball valves, others are valves with a hole passing down through the center and extending outwards on each side.

Q. 249. What benefit is derived from these check valves?

A. 249. Prevents a back pressure either from the cylinders or lubricator, where these valves are installed. Both in cylinder lubricators and steam chests there is a better equalization of steam, and in return the lubricator will feed much more evenly and accurately.

Q. 250. Describe the small check valves located in oil pipes over steam chests.

A. 250. A small valve with a double seat with a passage running half way through, then out on the sides.

Q. 251. After filling the lubricator, what valve should you open first?

A. 251. Steam valve at dome, steam valve on lubricator. Then condensing valve, last, the regulating or feed valve.

Q. 252. After filling the lubricator with cold oil while in the engine house, would you open the condensing valve or leave it closed?

A. 252. Leave it closed to allow the lubrication to heat up for expansion.

Q. 253. How often should a lubricator be cleaned out?

A. 253. At the end of each day's work.

Q. 254. Why should the lubricator be cleaned out after each day's work.

A. 254. To keep the passage ways and nozzle free from any sediment.

Q. 255. Should sight feed glass or feed valve on one side become broken or inoperative, can the sight feed on the other side be used?

A. 255. Yes, it can be used.

Q. 256. If one of the sight feed glasses should break what would you do?

A. 256. Shut off the regulating valve and provide for lubrication by hand either through the relief valves or indicator plug if engine is so provided.

Q. 257. How are glasses put in the different makes of lubricators?

A. 257. Remove nut, ring and gasket, put large end of glass in cavity first, replace gasket, ring and then the nut.

Q. 258. If the gauge glass should break, what would you do?

A. 258. Remove the fitting and apply plug to take its place, then replace the fitting.

Q. 259. Will any of the lubricators in service cross feed, that is feed to the cylinders on the opposite side?

A. 259. They will, only in cases where the oil pipes leading from the lubricator to the cylinders are not connected up properly; as long as the pipes are connected properly it will be an impossibility to cross feed.

Q. 260. Is there any possibility of losing all the oil out of the lubricator after shutting off both bottom feeds to steam chests, when engine is allowed to cool down.

A. 260. Yes, providing water valve and steam valve are left open.

Q. 261. When the valves appear dry while using steam and the lubricator is working, what would you do to relieve condition?

A. 261. Ease off the throttle for a few seconds, to reduce the steam pressure in the steam chests, drop the reverse lever down a few notches to give the valves an increased travel. Oil held in the pipes will then flow down to the steam chests and cylinders.

Q. 262. What benefit is the valve that is located in the lubricator between the oil passage from the oil chamber of the lubricator to the oil passage leading to the sight feed glass?

A. 262. It is located at that point in the lubricator to be used to provide oil for the sight feed glasses, or to be used to prevent the oil from being admitted to the sight feed passage.

Q. 263. How does this valve handle stand when not in service, when in service and when you desire the oil to be supplied to the air-pump feed alone?

A. 263. When the handle of the valve is pointing upwards the passageway is closed and there is no communication between the oil well and the passage leading to the sight feeds. When pointing direct down valve is wide open and all sight feeds are permitted to work. When handle is pointing directly out leading to the right, then the sight feed to the air pump is the only feed in operation.

Q. 264. What benefit is this valve?

A. 264. When a locomotive is placed on the side-track or detained in road service, all that is necessary is to move the handle of the valve as just explained, and it is not necessary to move the sight feed adjustment after the sight feed regulation is proper.

Q. 265. What benefit is derived from indicator plugs in steam cylinders?

A. 265. They are beneficial to an engineer for lubrication when valves are blocked in the steam chests; also beneficial to relieve back pressure out of cylinders when valve or valve rings leak.

ROAD REPAIRS.

Q. 266. How would you fix a cracked or broken steam chest while en route?

A. 266. Slack off the nuts holding down the lid next to the crack or break, take a brake-shoe key or wedge and wedge in between the studs and the side of the steam chest that is disabled. This will be sufficient power to bring the edges together. Then retighten the nuts on the studs and proceed.

Q. 267. How and where do you block a cross-head when disconnected from the main rod?

A. 267. Secure a wooden block between cross-head and cylinder on bottom guide. This will place cross-head at the back end of guides; also the piston will be in rear end of cylinder.

Q. 268. What is the object of always placing cross-head at the rear end of the guides?

A. 268. As the valve stem and piston rod relieve a certain percentage of square inches on the rear of valve and piston, the valve and piston are always liable to move toward the rear of the cylinder by steam being admitted to the front end of cylinder. It is always proper to block to the rear when it is possible there is no danger of the valve or piston moving.

Q. 269. In case it should become necessary to block cross-head at the front end of guide, what extra precaution should be taken?

A. 269. If you so desire, push the slide valve all the way ahead, so steam will be located at rear end of piston; take out front cylinder cock if so desired. If cylinder has an indicator plug, remove it and leave cylinder cock alone.

Q. 270. With an outside admission engine, how does the valve start to travel—with the piston or away from the piston?

A. 270. At the beginning of the stroke a valve without side admission starts and moves in the same direction with the piston. On inside admission engine the valve starts in the opposite direction to the piston. While the piston starts back the valve starts and travels ahead.

Q. 271. If necessary to block cross-head at the rear of the guides with an inside admission engine, how would you locate valve in valve chamber, especially if rings were worn on piston valve?

A. 271. If necessary to block cross-head at rear of guides and piston valve rings should leak on an inside admission engine, always move piston valve ahead. This will permit steam to rush to the front of the piston-head, while the rear of the piston will be in communication with the atmosphere through the exhaust and steam port at the rear of piston and piston valve.

Q. 272. What would you do if it became necessary to block the cross-head at the head end of the guides?

A. 272. Reverse the piston valve and move it toward the rear of the piston chamber, so as to allow steam to rush to the rear of the piston.

Q. 273. What is the meaning of the words covering ports?

A. 273. When the valve overlaps the steam admission ports to the cylinder, so as to prevent steam from entering the cylinder at either end of the valve.

Q. 274. What would you do if the main rod was to break at cross-head?

A. 274. If main rod were to break at cross-head, and no other damage was done, I would remove the main rod, block cross-head and come in one-sided by covering ports on the disabled side.

Q. 275. What would you do if the side rod or back pin should break?

A. 275. Remove broken parts; also side rod on the same portion on the opposite side.

Q. 276. When side rods or pins break on one side of a locomotive, why is it necessary to remove the side rods of the same connection on the opposite side of locomotive?

A. 276. Always remember the weight is resting upon the driving wheels. If the back driving wheels have 30,000 pounds resting upon them and there are two side rods connected together, one on one side and the other on the opposite side, realize the strain that is placed on one rod if left up in position.

Q. 277. Then, under the above explanation, why do we remove the opposite side rod?

A. 277. To prevent damage to the opposite rod. With the excessive strain on these rods and pins they are liable to break or buckle rods.

Q. 278. What bad effect is there of sanding a rail while the engine is slipping, without first shutting off steam?

A. 278. The liability of loosening tires, breaking crank-pins and side rods.

Q. 279. Can all four-wheel switching engines be operated with side rods down?

A. 279. No; only those with the eccentrics attached to the main driving wheel axle.

Q. 280. Is it proper to allow sand to operate from the sand-box on one side of a locomotive?

A. 280. No; this is considered poor judgment, and never undertake to sand the rail on one side only, as you are liable to twist axles, break crank pins and do damage to the engine.

Q. 281. How would you block up an engine for a driving spring or hanger?

A. 281. Block between the driving box affected and frame. Placing in a piece of iron or hard wood would also block the equalizer up in its proper position between the disabled end and frame over the other good end, as this type of spring requires holding the equalizer level.

Q. 282. How would you block up an engine for a broken equalizer?

A. 282. Block on top of all boxes effected, raise the engine up by running the wheels up on an incline or wedge to lift the frame while other boxes are blocked.

Q. 283. How would you block up an engine for a broken engine truck spring or hanger.

A. 283. With a four-wheel engine truck, block over equalizer and under top bar of engine truck frame close to band of spring sufficiently high to make engine ride level with other side. If hanger is broken put block under end of spring and pedestal brace.

Q. 284. How would you block up for a broken engine truck tire?

A. 284. After discovering which tire is broken or loose remove the cellar out of the broken or loose wheel, place in a block between the journal and pedestal of the broken tire. After it is properly secured raise the wheel up to clear the rail, take a chain and secure it to the truck frame and engine frame, raising the wheel up a sufficient distance to clear the rail. Proceed slowly, leaving the three good wheels perform the work.

Q. 285. How would you block an engine for a broken intermediate equalizer on a Mogul type engine?

A. 285. Wedge between equalizer and cylinder saddle opposite to where it is broken. If back end is broken wedge under the boiler and over frames with a railroad tie, securing the front of the equalizer to the tie or rail with a chain.

Q. 286. What would you do in case of a loose or broken tire on the back wheel or wheel was disabled so as to prevent you from operating the engine, and it became necessary to proceed and clear the main track?

A. 286. Block wheel up to clear rail and proceed.

Q. 287. When you block up an engine, and the blocking is placed over the top of the front box, where is the weight carried?

A. 287. It makes no difference which box is blocked. Wherever the blocking is located, that is the box carrying the weight.

Q. 288. What is the best material to use for blocking purposes at any time?

A. 288. Metal blocking, if it can be had.

Q. 289. What would you do if you were in charge of a locomotive and it was equipped with a spring saddle located over the top of the frame and resting on the box, and the brass became broken or hot?

A. 289. Run the wheel up on an incline and place blocking in between the frame and spring saddle. This will relieve the weight from the disabled box.

Q. 290. How do you proceed to a side track with a broken truck wheel?

A. 290. Block between box and pedestal brace, chain wheel on opposite side and slide wheel to first side track.

Q. 291. How would you block up and proceed to a side track with Mogul type engine with engine truck or axle broken?

A. 291. The defect seldom occurs. On modern type engines the engine crews can do very little in helping themselves. If, however, repairs can be made, a good method is to jack up the front end of engine and take out the broken parts. Then pry up the truck frame and chain the sides of the truck frame to engine frame. Bear in mind the engine must carry the load.

Q. 292. What would you do if you broke a tender truck or axle?

A. 292. The best method is to send for wreck crew and save time, as engines are not equipped with suitable chains and blocking to start and block up so as to return to engine house.

Q. 293. If necessary to assist in blocking up tender truck so as to proceed, explain in detail how to start and do the blocking.

A. 293. Place a piece of timber or rail across top of tender, jack up corner of truck that is disabled; chain it to the timber and fasten timber at the other end to hold it so it will carry the disabled truck. If possible to slide the wheel or truck, place a tie across the rail to carry the weight and keep the wheel from turning and then slide it to a siding.

Q. 294. Is it necessary to take down the main rod if the frame was broken between the forward and back driving wheel box?

A. 294. No, but use engine moderately.

Q. 295. Is it necessary to take down the main rod if the frame were broken between the cylinder and forward driving wheel box?

A. 295. No, but cover ports and proceed one-sided, leave main rod up.

Q. 296. Would you disconnect the engine for a broken guide?

A. 296. Yes.

Q. 297. How would you handle an engine if unable to close the throttle, or the dry pipe was leaking so as to allow the engine to move?

A. 297. Reduce steam pressure so as to control engine with the reverse lever and air brake.

Q. 298. How can you tell if the throttle valve or throttle box is leaking, or the lower end of the stand pipe or dry pipe?

A. 298. If throttle valve or box leaks, dry steam will be shown at cylinder cocks. If lower end of stand pipe or dry pipe leaks, water will be shown at cylinder cocks.

Q. 299. What would you do if throttle became disconnected and remained closed?

A. 299. If no other way possible, ask for assistance, but if engine is equipped with a drifting valve, proceed, using drifting valve as a throttle.

Q. 300. Can you replace a tender brass?

A. 300. Remove sponging, then jack up box and brass is easily removed.

Q. 301. Can you replace an engine truck brass?

A. 301. Remove sponging, jack up box, and brass is easily removed.

Q. 302. If the brass does not wear at an even thickness will it run hot?

A. 302. Not at all times. That is due to the line of truck or brass located in box.

Q. 303. Can a driving wheel box brass be renewed while enroute?

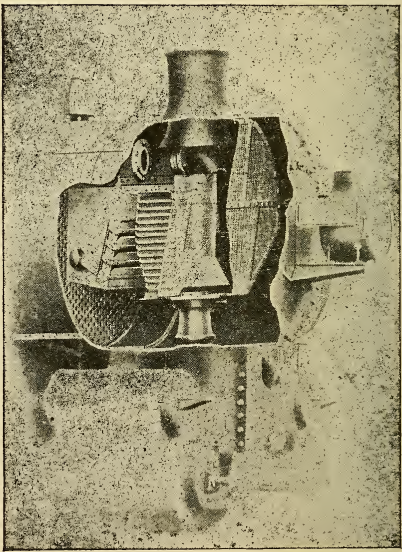
A. 303. Yes, some brasses are termed slip brasses and are used in engines on the front and rear boxes and can be replaced by raising up weight off the box and the old brass slipped out and a new one slipped in.

Q. 304. How can you proceed and bring home an engine with a broken main driving wheel?

A. 304. PRACTICAL EXPERIENCE.

Several years ago when in the employ of the Pennsylvania Railroad, I was ordered to go after a locomotive on which the driving wheel was broken on the left side. The first thing I did was to remove all side rods, and the main rod on the side disabled, blocked the cross head and covered ports on the disabled side, then placed a jack at the axle next to the box on the inside, raising up box, removed the cellar from disabled box, and placed a crown brass next to the journal and blocked up between the crown brass and the pedestal. After having it secured properly, I chained the broken wheel to the frame of engine and proceeded one sided. This engine was run a distance of 40 miles.

SECTIONAL VIEW OF FRONT END OF LOCOMOTIVE



Q. 305. What is the desirable length of front end?

A. 305. The front end or smoke arch should be of a sufficient length to provide room for steam pipe, exhaust pot, draft pipe, diaphragm and netting.

Q. 306. Name the different parts located in smoke arch of a locomotive.

A. 306. Exhaust pot and exhaust tip, draft pipe, adjustable diaphragms and deflecting plates, used to be regulated to control the proper draft, and make the fire burn correctly.

Q. 307. What effect is there to a draft on the fire, if exhaust pot tip is increased or decreased?

A. 307. Exhaust pot tips are increased in size to decrease the exhaust on the fire, and decreased in size to increase the exhaust. Where diaphragm plates are used they can be regulated to an advantage, to permit the engine to increase the burning of coal or decrease it. When the diaphragm plate is lowered down even, the engine is made to burn the coal quickly at the front end of fire box. Raising the diaphragm plate the fire is made to burn more evenly all over the fire box. If raised higher on one side than the other then it will affect the sides of the fire.

Q. 308. What bad effects arrive from the leaking of flues, steam pipes or exhaust pipe joints leaking?

A. 308. Flues leaking decrease the steaming qualities, if in the fire box portion affect the fire, if in the smoke arch portion, decrease the vacuum and prevent the proper circulation of air and gases.

Q. 309. What is the benefit in having the exhaust steam pass through the draft pipe and stack properly, after leaving the exhaust pot?

A. 309. It is always proper to notice that the steam leaving the stack has filled the stack proper, and if this is done then you can realize whether the diaphragm plate is proper. The engine will have good steaming qualities and it is always well to know that the exhaust pot is direct in line with the stack.

Q. 310. How does the exhaust steam passing through the draft pipe and stack create a draft?

A. 310. The exhaust steam passing through the draft pipe and stack creates a partial vacuum in the smoke arch, this in return permits the air to rush through the damper openings, grates, fire and tubes. This causes the oxygen to combine with the gases of the fuel and the carbon, producing the proper amount of heat and combustion.

Q. 311. How does this affect the fire, so proper results are obtained?

A. 311. Without the exhaust steam rushing through the stack, the combustion would be so slight that there would not be a sufficient amount of heat to generate steam as fast as it is used, but with this extra exertion of the rapid move of steam, this in return pulls the air at a rapid speed through the fire. This great amount of oxygen coming in contact with fuel and fire causes a perfect combustion, and this rapidly changes the water to steam.

Q. 312. Why is steam so visible from one side of the stack?

A. 312. Indicates something is out of line, nozzle's draft pipe, stack, diaphragm plate, or deflecting plate.

Q. 313. When steam leaves the exhaust nozzle how far does it expand to the foot?

A. 313. About six inches to the foot. For every foot it raises, it expands about 6 inches from the center line of the steam exhaust.

Q. 314. What are the bad effects of a leaky steam pipe, tee head, exhaust pot joint, blower leaking, air pump steam exhaust pipe leaking?

A. 314. It serves to keep the front end damp and helps to destroy the vacuum.

Q. 315. What effect will there be on a fire if there are a number of flues choked up?

A. 315. Produces an improper draft. The proper amount of vacuum is not created and boiler will not generate the proper amount of steam.

Q. 316. What prevents the fire from burning brightly?

A. 316. When fire door is opened and too much cold air is admitted there is a dead red color on the fire. That indicates the coal is not burning correctly. To have the fire burn properly, coal must be fed to the fire properly. If there is not a sufficient amount of coal admitted to the fire box the fire will be too light, and this in return will tear holes in through the fire. If fed too fast it can not receive the proper amount of air to combine with the gases, and the engine will be a poor steaming engine.

Q. 317. Is it proper for a fireman to keep his eye on the steam gauge, and why?

A. 317. Doors should not be opened wide when pops has gone into action. This means a waste of coal, and in return the expansion and contraction is liable to do damage to fire box sheets.

Q. 318. Why is there a tremendous noise when throttle is closed?

A. 318. This is due to too much gas leaving the coal and not a sufficient amount of air to equalize in proportion. This in return permits the gas to explode as fast as it comes in contact with the heat, as there are not equal proportions of air and gas combined. This is what makes that unpleasant noise.

Q. 319. Describe the ash pans and slides.

A. 319. The ash pan is connected to the engine frame by braces, and to the fire box and are located below the gates so as to receive all ashes that the fire box is discharging. The pans are provided with openings from which the ashes are removed, also with dampers with which to regulate draft. They are so designed so as to prevent fire from dropping.

Q. 320. How often should you examine ash pans, dampers and grates and slides?

A. 320. Before each day's work.

Q. 321. Why is it important to know that grates, ash pans, dampers and slides are in good condition, and that the slides are closed while enroute?

A. 321. So as to prevent fire from dropping.

Q. 322. What would you do while proceeding enroute if you discovered fire dropping along the road?

A. 322. Stop at once and investigate the cause.

Q. 323. If through accident the front end became disabled how can you proceed?

A. 323. Make temporary repairs with sheet iron or boards and proceed.

Q. 324. Why is it important that the front end be absolutely light, and no air be admitted?

A. 324. So as to give a free and perfect vacuum for combustion.

Q. 325. How can you repair a broken grate while enroute?

A. 325. Place in a piece of iron that will cover the openings, place green coal or ashes on it and proceed. By doing this there are no chances taken in burning it out until you arrive at the engine house.

Q. 326. How can you repair a whistle lever if broken while enroute?

A. 326. If whistle lever is broken so there is a sufficient amount of the lever left, take a piece of wire or cord and fasten whistle rope. If broken out at the fulcam part of the lever, remove same and repair it with a packing hook if possible.

Q. 327. What causes a driving wheel flange to cut on one side of an engine?

A. 327. Very often due to the truck being out of line. Change the truck around and that may remedy it. If in the driving wheel, boxes are tramed out of line, there is no remedy, only to have them lined back and ahead, whichever way you desire to have the engine in line.

Q. 328. What would you do if the engine were running to the right?

A. 328. Line the left side back and the right side ahead. If on the opposite side line just the reverse.

Q. 329. What would you do if you discovered your engine was throwin~ fire due to some disablement in the front end?

A. 329. Use a light throttle and proceed reporting same on arrival at engine house.

Q. 330. What would you do if a hole appeared in the ash pan while enroute?

A. 330. If you can repair same temporarily do so. If not, report same on the arrival at engine house.

Q. 331. What is the engineer's duty at expiration of a day's work, or trip?

A. 331. Before leaving the engine, see that the boiler has the proper amount of water, see that lubricator is shut off properly and engine secured so as not to move, cylinder cocks left open, and drifting valve closed.

Q. 332. What is the engineer's duty in reference to work report?

A. 333. A careful inspection of the locomotive and report all work necessary to be done, at the engine house or the one in authority.

BAKER VALVE GEAR.

Q. 334. How does the Baker valve gear differ in construction from the Walschaert.

A. 334. The Baker valve gear motion is taken direct from the eccentric crank and cross head.

Q. 335. Name the principal parts of the Baker valve gear.

A. 335. Valve stem, combination lever, gear connection rod, union link crosshead arm, and reach rod, eccentric rod, eccentric crank, radius bar, reverse yoke, bell cank arm, and bell crank.

Q. 336. What would you disconnect for a broken crank or eccentric rod?

A. 336. Place reverse lever in center of quadrant. This will locate the crank in proper position to block, take down eccentric rod, remove the pin out of short reach rod, placing reverse yoke over against the frame, block the bell crank, as holes are provided in frame for same.

Q. 337. Where was there a good view of the different makes of valve motion?

A. 337. Down at Atlantic City on Young's Pier, at the Master Mechanics' Convention.

Q. 398. What would you do if the lower part of gear connection rod should break?

A. 338. Block in same manner as you would for a broken eccentric rod or crank.

Q. 339. How would you block for a broken union link?

A. 339. Block the same as broken crosshead arm.

Q. 340. How would you block for a broken crosshead arm?

A. 340. Place the reverse lever in center of quadrant, and set the combination lever direct, fasten in that position and proceed.

Q. 341. How would you block for a broken or disabled combination lever?

A. 341. Cover ports, remove combination lever, and valve rod.

Q. 342. How would you proceed with a broken valve rod?

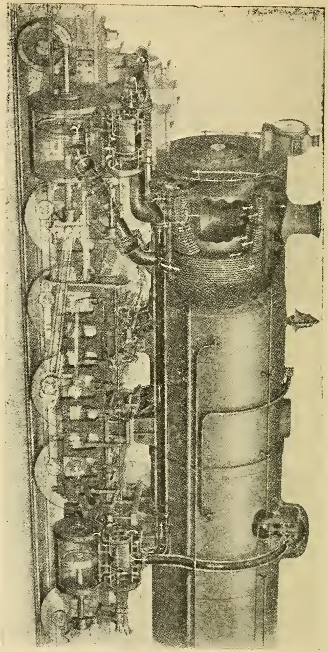
A. 342. Cover ports, remove combination lever and valve rod.

Q. 343. What would you do if the reverse yoke should be broken or disabled?

A. 343. Block in front and back of the yoke and remove reach rod. Act the same as in a broken eccentric rod if broken below the ears.

Q. 344. How would you proceed with a broken reverse arm?

A. 344. Take down reach rod and block the yoke on side disabled.



Articulated Mallet Compound Engine.

January 9, 1917.

Mr. Deal was ordered to report at the Baldwin Locomotive Works at Eddystone to familiarize himself with the above locomotive; so when they were finished and ready to be delivered to the Philadelphia and Reading system, he would be in a position to demonstrate same to those who were put in charge of them. This was so done and the first engine delivered was engine 1801.

A. 1. The writer's method of explaining the Mallet engine: First, it is the duty of every engineman or fireman who has anything to do with a Mallet Compound Locomotive to undertsand the meaning of the word articulated and mallet.

A. 2. The word articulated means movable pieces fitted together working in each other, as the joint of the skeleton of insects or animals.

A. 3. The word Mallet means the name of the gentleman who designed the locomotive. As we understand the meaning of the word articulated, and realize it is a joint within a joint working together, then we know that these joints must be kept well lubricated, so as to give access to movement.

A. 4. It is understood that the French nation in all names drop the last letter of their names, therefore the proper pronunciation of the word Mallet is Malle. That is the reason it is termed in the words "Articulated Malle."

A. 5. The most successful type of an articulated locomotive, at present, is the Malle compound locomotive, and was first introduced by a French engineer by the name of M. Anatole Mallet, and introduced on the European railroads in 1889.

A. 6. The Malle locomotive was first introduced into this country and was adopted for the use of a push-up locomotive on designated grades of a very heavy per cent, due to the fact that the tractive power is so great that it did not require as many locomotives to do the work. In other words the Malle took the place of two ordinary engines formerly used.

A. 7. The tractive force of a locomotive depends principally upon the weight carried upon the driving wheels. There is a maximum weight for each pair of wheels resting on the rails, which cannot be safely exceeded, therefore the number of driving wheels used must be such that the weight necssary for adhesion can be carried without overloading the rails.

A. 8. It is not practicable to couple more than five pairs of driving wheels together in one group, and on some railroads this could not be accomplished due to short curves, and a locomotive of this class could not traverse curves.

A. 9. The desired power when the locomotive was in use on a straight line would be all right, but when the locomotive was placed on a curve the friction produced by the binding of the wheels on a curve, would produce such a great loss of power and the extra pair of wheels attached so as to produce the greater amount of adhesion between the wheel base and rail, while on a straight line it would be more detrimental to the locomotive on the curve. So now to overcome the extra amount of friction the Malle compound locomotive was introduced.

A. 10. With a given allowable weight per axle a Malle locomotive can be designed and constructed so as to develop twice as much tractive power as a locomotive of an ordinary type, because twice as many pairs of wheels can be used under a boiler, so the weight necessary for adhesion can be safely carried and used without the slightest amount of trouble, and in proportion a greater tractive force can be developed, providing the locomotive is constructed according to dimensions.

A. 11. The high tractive force, however, can be utilized only at moderate speeds such as are maintained on any freight engine or mountain engine, as like all other types of locomotives the trailing force decreases as the speed increases, and so the locomotive has reached a point where the large adhesion weight is lost and cannot be utilized. When the Malle locomotive is designed for a certain class of service the best results are obtained.

A. 12. First, I will say to any locomotive engineer or fireman, who ever fired a compound locomotive, understands that it was far easier to fire than a straight simple expansion locomotive. On a compound locomotive the steam is used expansively twice before it is exhausted to the atmosphere. The only difference between the Vauclain compound locomotive and the Malle compound locomotive is the steam of the Vauclain compound locomotive was operated in the above manner, steam from the high-pressure cylinder was exhausted through the center of the valve to the low-pressure cylinder, then from the low-pressure cylinder to the atmosphere. By the use of the same valve, on a Malle compound locomotive the steam is operated by the use of two valves, one located in the high-pressure steam chest and the other in the low-pressure steam chest.

A. 13. The Malle locomotive the steam is admitted to the high-pressure steam chest and through the action of the valves is admitted to the high-pressure cylinders and from the high-pressure cylinders to the low-pressure receiving pipe and low-pressure valves, and through the action of the low-pressure valves to the low-pressure cylinders and from the low-pressure cylinders to the atmosphere.

Q. 14. When an engineer is to take charge of a locomotive, it is his duty to understand how the steam travels from the throttle valve to the steam cylinders and the atmosphere. The Malle engine when the throttle is operated steam passes through the throttle box to the stand pipe, to the dry pipe, to the superheated header, to the superheated units, to the steam pipes and steam chests. The movement of the valves is the movement of the steam pistons in the cylinders, both admitting and exhausting the steam, after the engine has moved and steam has been used in the high-pressure cylinders, then it is exhausted from the high-pressure cylinders to the exhaust or receiving pipe leading to the low-pressure steam channel, which leads to the low pressure steam chests, and valves, and the movement of the low-pressure valves is the movement of steam to the low-pressure cylinders, and then through the action of the valve to the exhaust to the smoke arch and the atmosphere. Through this explanation you can understand that there is no steam admitted to the low-pressure cylinders from the throttle of the locomotive, as there is no communication for boiler pressure to the low pressure cylinders but there is an intercepting valve that can be used when so desired that will admit boiler pressure direct to the low-pressure receiving pipe and steam channel leading to the low-pressure valves and cylinders.

A. 14. Explain the operations of the intercepting valve. While steam is being admitted to the high-pressure steam chests it is also being admitted to the intercepting valve through a 3-inch pipe. This steam is admitted directly in front of a differential piston, which is three inches in diameter forcing it back and unseating eleven three-quarter-inch holes. Steam passes through these holes to a three-inch pipe leading to a ten-inch receiving pipe. This ten-inch pipe leads from the high-pressure cylinder exhaust to the low-pressure steam channel in low pressure steam chests and through the action of the low-pressure valves places the steam in the low-pressure cylinders, and from there to the exhaust of the low-pressure valves to the atmosphere.

A. 15. While the steam is performing its duties to the cylinders, it is also passing live steam through an equalizing pipe, which leads to the opposite end of the differential piston which is six inches in diameter and just as soon as the large end of the piston receives 55 pounds of steam pressure the differential piston is moved ahead and the eleven 3-4-inch holes are blanked off so there is no more steam from the throttle admitted to the low-pressure receiving pipe, and the steam now used in the low-pressure steam chests and cylinders through the low-pressure receiving pipe is exhaust steam from the high-pressure cylinders.

A. 16. There is a valve connected at the king box which has a 3-4-inch pipe leading from the valve to the rear of the intercepting valve which is six inches in diameter, and when this valve is opened steam enters the differential piston directly back of the diameter of six inches and forces the valve ahead, closing off the steam from the throttle valve that is admitted to the three-inch end of the differential piston.

A. 17. When the intercepting valve is kept closed by live steam direct from the boiler, this valve is useless and you must depend on the high-pressure engine exhausting steam to the low-pressure cylinders, and through this movement the low-pressure receiving pipe must be built up to a pressure sufficiently high enough to give the low-pressure engines power to do their work, say, in figures of steam pressure admitted to the low-pressure engines just like shown below.

High pressure engines with a 26-inch cylinder contains 530 square inches less the decimal, which are close figures to same. And the low pressure cylinder contains 1256 square inches.

These figures shown here represent the valve travel on a high pressure valve and the low pressure valve.

High pressure valves—Maximum travel, 6 inches, steam lap, 1⅛ inches; exhaust clearance, ⅝ inch; lead, ¼ inch.

Low pressure valves—Maximum travel, 6¼ inches; steam lap, ⅞ inch; exhaust clearance ¼ inch; lead, ¼ inch.

One reverse lever, operating both front and back valves, so when the valve travel is shortened on the high pressure valves it affects the front valves at the same time.

Twenty pounds of steam in low pressure receiving pipe means about 25.120 pounds in the low pressure cylinders valve full travel.

Thirty pounds of steam in low pressure receiving pipe means about 37,680 pounds in low pressure cylinders valve full travel.

Forty pounds, 50.240 pounds low pressure cyclinder valves full travel.

Fifty pounds, 62,800 pounds low pressure cylinders valve full travel.

Sixty pounds, 75.360 pounds low pressure cylinders valve full travel.

Sixty-five pounds, 81.640 pounds low pressure cylinders valve full travel.

Seventy pounds, 87.920 pounds low pressure cylinders valve full travel.

Eighty pounds, 100.480 pounds low pressure cylinders valve full travel.

Ninety pounds, 113.040 pounds low pressure cylinders valve full travel.

One hundred pounds, 125.600 pounds low pressure cyllinders valves full travel.

High pressure cylinder contains 530 square inches.

One hundred and forty-five pounds of steam in cylinder, the pressure against the high pressure piston, 76.850 pounds.

One hundred and forty pounds, total, 74.200 pounds against the piston.

Low pressure cylinder contains 1256 square inches.

Sixty-five pounds of steam in cylinder, the pressure against the low pressure piston 81.640 pounds.

Sixty pounds, total, 75.360 pounds.

High pressure cylinder back pressure against the piston with 60 pounds of steam in low pressure receiving pipe, total, 31.800 pounds back pressure! 65 pounds of steam, total, 34.450 pounds back pressure.

High pressure cylinder, 76.850 pounds working pressure; receiving pipe, 65 pounds, 34.450 pounds back pressure; total working pressure, 42.400 pounds actual working pressure in high pressure cylinder.

High pressure cylinder, 74.200 pounds working pressure; receiving pipe pressure, 31.800 pounds back pressure; total working pressure, 42.400 pounds actual working pressure.

High pressure cylinder, 76.850 pounds working pressure; receiving pipe pessure, 70 pounds, 37.100 pounds back pressure; 39.750 pounds actual working pressure.

High pressure cylinder, 74,200 pounds working pressure; receiving pipe pressure, 70 pounds, 37.100 pounds working pressure; 37.100 pounds actual working pressure.

High pressure cylinder, 76.850 pounds working pressure; receiving pipe pressure, 80 pounds, 42.400 pounds back pressure; 34,450 pounds actual working pressure.

High pressure cylinder, 74.200 pounds working pressure; receiving pipe pressure, 80 pounds, 42.400 pounds back pressure; 31.800 pounds actual working pressure.

High pressure cylinder, 76.850 pounds working pressure; receiving pipe pessure, 90 pounds, 47.700 pounds back pressure; 29,150 pounds actual working pressure.

High pressure cylinder, 74.200 pounds working pressure; receiving pipe pressure, 90 pounds, 47.700 pounds back pressure; 26.500 pounds actual working pressure.

High pressure cylinder, 76.850 pounds working pressure; receiving pipe pressure, 100 pounds, 53.000 pounds back pressure, 28.850 pounds actual working pressure.

High pressure cylinder, 74.200 pounds working pressure; receiving pipe pressure, 100 pounds, 53.000 pounds back pressure; 21.200 pounds actual working pressure.

It is easily understood the higher the low pressure receiving pipe is built up in pressure the more back pressure is placed against the high-pressure piston, as the low pessure receiving pipe is the exhaust for the high pressure cylinders and valves. Therefore, while one side of the piston has the steam direct from the throttle the other side of the piston is in communication with the exhaust to the low pressure receiving pipe.

Q. 1. What is a locomotive?

A. 1. Two stationary engines combined in one, working from right angles.

Q. 2. What gives it locomotion?

A. 2. The adhesion of the wheels to the rail.

Q. 3. When is a locomotive not a locomotive?

A. 3. When the wheels slip on the rail. Then it is a stationary engine.

Q. 4. What is an articulated Mallet engine?

A. 4. Four engines combined in one, working from right angles, and working as two independent locomotives.

Q. 5. Explain how this type of engine differs from a simple engine?

A. 5. A simple engine is designed and constructed to use its steam expansively once, then pass it to the atmosphere, while a Mallet engine uses its steam expansively twice before passing it to the atmosphere.

Q. 6. Why is the front pair of engines callea the low pressure engines?

A. 6. The low pressure engines are located under the boiler in front of the high pressure engines. These cylinders being the largest of the two pair of cylinders, the steam is first admitted to the small cylinders direct from the boiler and exhausted from the small cylinders to the larger cylinder. Therefore, the low pressure cylinders receiving the steam after it once has done its work in the high pressure cylinders and the steam is decreased in pressure by its former use in the high pressure cylinders.

Q. 7. Why do we receive the same power out of the low pressure cylinders as we did out of the high pressure cylinders?

A. 7. The largest piston has the greatest area of square inches. Therefore, a decreased pressure of steam admitted to the low pressure cylinders gives the same power as th small cylinder with an increased pressure.

Q. 8. Why are the rear engines called the high-pressure engines?

A. 8. When the throttle is opened the steam passes direct from the boiler to the high pressure steam chests and cylinders.

Q. 9. Explain the travel of steam from the high pressure cylinders to the low pressure cylinders.

A. 9. When the throttle is opened steam travels from the boiler to the throttle box, to the stand pipe, to the dry pipe, to the superheated header, to the superheated units, to the steam connection in the smoke box, to the steam pipe and to the steam passage leading to the steam chest. The steam valve located in the steam chest distributes the steam to the high pressure cylinders through the admission ports after the steam has followed the piston the required distance. The valve through its action admits the steam back again through the same admission port to the exhaust port to the low pressure receiving pipe, this pipe being connected with the low pressure cylinders. The steam when being exhausted in the low pressure receiving pipe passes to the steam passage located in the low pressure steam chests. Located in those steam chests are valves designed in the same manner as in the high pressure steam chests. After the steam passes these valves into the low pressure cylinders, in the same manner as in the high pressure valves, it is exhausted from the low pressure cylinders to the exhaust port to the atmosphere.

Q. 10. When starting a train, how should the intercepting valve be used?

A. 10. The intercepting valve is an automatic operator, and is operated by one independent pressure of steam working against a differential piston which is of a different size.

Q. 11. What is the valve located at the king-box for, that has a three-quarter pipe leading down to the large end of the differential piston?

A. 11. It is to be opened at any time you do not desire the intercepting valve to be operated, or when the low pressure receiving pipe is built up to a high pressure. Then it is the duty of the engineer to open the valve and close the intercepting valve off, so as to prevent any more live steam from the throttle entering the low pressure receiving pipe.

Q. 12. When is an articulated Mallet engine doing the best work?

A. 12. When the low pressure receiving pipe registers 60 or 65 pounds of steam. Then all four engines are performing their duties the best. But when that pressure is advanced then the high pressure engine is decreased in power from the back pressure located in the low pressure receiving pipe, working against the high pressure cylinder's pistons.

Q. 13. How should a Mallet engine be lubricated?

A. 13. Through the cylinder lubricator in the cab; also through the oil flushers on the low pressure cylinders.

Q. 14. Why should there be more oil fed to the high pressure cylinders than to the low pressure cylinders?

A. 14. The high pressure cylinders receive the steam direct from the boiler through the superheated units and is a dry, gasy steam. When steam is once used and exhausted to the low pressure cylinders through the receiving pipe it returns back close to saturated steam, and where there is a moisture with the oil it will provide more lubrication than with superheated steam direct.

Q. 15. How should the water be carried in a boiler attached to a Mallet engine?

A. 15. About three gauges of water, so as to be sure there is a full boiler of water when pulling heavy trains; and when the boiler is moderately full of water and remains that way you will be sure to have a good steaming engine, because the steam must be used twice before passing to the atmosphere. A boiler containing three gauges of water will be a guarantee for good service at all times.

Q. 16. What is the meaning of intercepting?

A. 16. Act of intercepting; stoppage in course; hindrance; obstruction.

Q. 16. What is the meaning of differential?

A. 16. An infinitesimal difference between two states of a variable quantity.

Q. 17. What is the meaning of automatic?

A. 17. Noting operations carried on by self-acting machinery.

Q. 18. The intercepting valve used with an articulated Mallet locomotive can be named intercepting valve, differential valve, automatic starting valve.

A. 18. Because it first interferes with the course of steam, placing an obstruction in its passage; it is differential because it makes a difference between two variable pressures; it is automatic because it is self-acting.

Q. 19. How many ways can the intercepting valve be operated?

A. 19. First, by having the equalizing pipe connected at the front of the differential piston, where it is three inches in diameter, and leading to the rear of the differential piston, where it is six inches in diameter. Second, the equalizing pipe can be connected to the low pressure receiving pipe and connected to the rear of the differential piston at the six-inch end. Third, the equalizing pipe can be removed and depend on the engineer to open and close the saturated steam valve connected to the king-box in the cab.

Q. 20. How can you change the articulated Mallet engine from a simple engine to a compound engine?

A. 20. Open the valve at the king-box in the cab of the locomotive and the engine will work compound at all times. Keep it closed and it will work as a simple engine until the intercepting valve closes automatically.

Q. 21. What pressure of steam does the gauge hand register attached to the low pressure receiving pipe?

A. 21. Pressure of steam admitted to the low pressure cylinders.

Q. 22. What pressure of steam does the gauge hand register when the locomotive is working compound and the intercepting valve is closed off under an automatic action?

A. 22. Exhaust steam from the high pressure engines.

Q. 23. What pressure of steam does the gauge hand register when the locomotive is working as a simple engine and the intercepting valve will not close off under an automatic action?

A. 23. That indicates the intercepting valve is stuck open and must be closed by the use of the steam valve at the king-box.

Q. 24. Is there any other cause that will allow the gauge hand on the low pressure receiving pipe to increase in pressure?

A. 24. High pressure valves leaking or piston packing rings worn out or broken or cylinder packing worn out or broken.

Q. 25. What is the pipe called that extends from the side of the intercepting valve to the rear of it?

A. 25. It is termed an equalizing pipe, and this valve is designed and constructed to be used with the Baldwin articulated Mallet engines.

Q. 26. At what pressure of steam does the low pressure cylinder do the best work?

A. 26. When the low pressure gauge registers 60 to 65 pounds.

ARTICULATED MALLET ENGINES.
DEFECTS AND REMEDIES.

Q. 1. How should you lubricate the valves and cylinders of the low pressure engines, providing the lubricator feed became inoperative, either on one side or the other?

A. 1. Through the oil flushes provided on the low pressure steam chests; also through the oil pipe leading to the low pressure receiving pipe, and the oil pipe leading to the automatic starting or intercepting valve.

Q. 2. What would you do if the crosshead was to break on a low pressure cylinder?

A. 2. If the crosshead is damaged so it will not necessitate taking down the main rod, disconnect the valve rod cover ports and proceed one-sided. The opposite side can be operated. Keep the intercepting valve closed, as the exhaust steam from the two high pressure cylinders will provide steam for the one low pressure cylinder. Use a light throttle, as it does not require as much steam as if both low pressure cylinders were in operation.

Q. 3. What would you do if the main rod broke so it had to be removed on the low pressure engine?

A. 3. Take down the main rod, block crosshead at the rear end of the cylinder, cover ports and proceed as Rule No. 2.

Q. 4. What would you do if the main rod broke on the high pressure engine?

A. 4. Take down broken parts, block crosshead at the rear end of the cylinder, cover ports, blank off equalizing pipe so the intercepting valve would remain open. This would permit steam direct from the throttle to enter the low pressure valves and cylinders. In this case, the low pressure engines must do most of the work.

Q. 5. What would you do if the low pressure receiving pipe was to break?

A. 5. If broken so you had to give up train, proceed with the light engine, keep the automatic starting valve closed, then use a light throttle to operate the high pressure engines. The only steam that would escape is the exhaust steam from the high pressure cylinders. When close to a road crossing leave the engine drift; when on the level, after the engine is moving, open the drifting valve, if you have one, and close the throttle.

Q. 6. What would you do if you disabled both high pressure engines?

A. 6. Disconnect and cover ports on both sides, blank the equalizing pipe, proceed, leaving the low pressure engines move a light train, if possible. If not, proceed light. The only steam pressure admitted to the low pressure cylinders is through the three-inch pipe at the intercepting valve and low pressure receiving pipe.

Q. 7. What would you do if you broke a valve stem off close to the piston valve and it was impossible to cover ports?

A. 7. Remove the front valve head and move the valve back far enough to cover ports, cut a block to fit between the valve head and the valve, then place the valve head on, move the broken stem up to the valve, clamp the stem, disconnect the valve in the usual way and proceed.

Q. 8. What would you do if you disabled both low pressure engines so as to compel you to proceed with the high pressure engines?

A. 8. Cover the ports on one side. Go to the opposite side and remove the piston valve, place in a wooden plug at the valve stem end, placing it in from the valve chamber end, put on the valve head and proceed, leaving the exhaust from the high pressure engines pass through the exhaust ports at each end of the valve chamber. Open the valve at the king-box and keep the intercepting valve closed. This will permit the two high pressure engines to exhaust out of the two exhaust ports, one at each end of the valve chamber cap.

Q. 9. How would you detect a worn-out set of packing rings in the low pressure cylinders?

A. 9. Test the same as with a single expansion engine.

Q. 10. How would you detect valves blowing on low pressure engines?

A. 10. Place the engine so the main pins are between the quarters and the dead centers, just sufficient distance to cover the valve ports. Put the brake on, leave the intercepting valve so as to work automatically, put on a light throttle, as this will permit steam to travel directly to the low pressure receiving pipe. Through that movement the steam will enter the low pressure valve chamber and show you a blow of steam through the valves.

Q. 11. Why are the cylinder relief valves applied to the low pressure cylinders?

A. 11. They are termed cylinder pop valves and are placed there to relieve any pressure of steam admitted to the low pressure cylinders above 75 pounds.

Q. 12. In what position should the reverse lever be placed when the throttle is closed and engine is drifting?

A. 12. The reverse lever should always be dropped down so as to relieve all back pressure out of the cylinders, or relieve as much back pressure as possible, and permit the valves to have full travel. The low pressure cylinders, being large, if you were to work the engine in a short cut-off, there would be too much back pressure in the cylinders when drifting.

Q. 13. In what position should the engine be placed to test for blows in valves and piston of high pressure engine?

A. 13. Shut the automatic starting valve off and move the engine with a light throttle. If the low pressure engine continuously slips, that indicates the front cylinders are receiving more steam than the high pressure cylinders are exhausting. That is proof that steam is passing the valve rings or cylinder piston packing rings. This indicates worn or broken rings.

Q. 14. What would you do if the starting valve stuck open while in road service?

A. 14. Disconnect the back head of the starting valve, drive the differential piston forward, place in a block of wood to fit between the differential piston and the head, place the head back on and proceed.

Q. 15. How should the automatic starting valve be oiled?

A. 15. Direct in the rear of the large portion of the differential piston. Oiling this side of the piston, you are also oiling the small end of the differential piston through the equalizing pipe, after the starting valve has returned to its automatic action. When the throttle is closed and the differential piston returns to its normal position then the oil passes through the equalizing pipe to the small end of the differential piston through the eleven three-quarter-inch holes to the low pressure receiving pipe, valves and cylinders.

Q. 16. Why was the oiling of the starting valve changed from the three-inch admission steam pipe to the rear of the large six-inch piston?

A. 16. When Engine 1801 arrived at Reading from the Baldwin Locomotive Works the first test made with this Mallet engine was made on Temple Hill. The low pressure receiving gauge soon indicated that there was something wrong—either the high pressure valve rings or piston packing was leaking, and upon making an investigation at the engine house it was discovered that the intercepting valve was stuck open and could not be moved so as to close off. On taking it apart you easily could see that there was oil on the three-inch piston as far back as the first two rings, but beyond that the piston and other rings were burned red. That indicated no oil to the rear of the differential piston at the large end. Mr. Deal, having charge of those engines at that time, made the change in the oiling. He placed in a plug at the three-inch admission steam pipe to the intercepting valve where the oil pipe was attached, then had the oil pipe connected up at the differential valve, as was just explained, which is now adopted as the Baldwin standard.

Q. 17. Why is there a small hole drilled in the intercepting valve casting directly in front of the six-inch piston?

A. 17. So as to allow all steam pressure that leaks either by the large or small end of the differential piston to pass to the atmosphere.

Q. 18. What would happen if steam was to equalize on both sides of the large piston of the intercepting valve?

A. 18. The automatic action of the valve would be destroyed.

Q. 19. How can steam enter the piston so as to make it equalize on both sides?

A. 19. Small rings on the end of the differential piston leaking or the rings on the large end of the piston leaking.

Q. 20. Where steam equalizes on both sides of the large end of the differential piston, what position will the intercepting valve occupy?

A. 20. The starting of the low pressure engines immediately when the throttle is opened, as the engine will work as a simple engine and no compound action can be had, as the intercepting valve is now defective and can only be operated one way.

Q. 21. What effect would the valve at the king-box have on a starting valve where rings are leaking?

A. 21. If rings are not leaking too badly it may be possible to close the intercepting valve by opening this valve and permit boiler pressure direct against the six-inch piston.

Q. 22. Is there any other leak that will destroy the action of the intercepting valves?

A. 22. Yes; the globe valve leaking at the king-box or boiler. If this valve leaks the intercepting valve cannot open, as steam will enter the rear of the six-inch piston direct.

Q. 23. What would you do if the globe valve leaked at the king-box so as to prevent the intercepting valve from being placed into action?

A. 23. Disconnect the pipe at the starting valve, place in a blank washer, and proceed.

Q. 24. What would you do if the oil pipe to the starting valve broke off?

A. 24. Plug the pipe at broken end toward the intercepting valve, close off the lubricator and proceed.

A. 25. What would you do if the equalizing pipe broke off connecting the front section of the intercepting valve to the rear end of the intercepting valve?

A. 25. Plug the pipe and proceed. This would operate the engine simple instead of compound; but when desired to compound the engine open the globe valve at the king-box and close the intercepting valve.

Q. 26. What is the proper way to protect a Mallet compound engine on a cold day?

A. 26. Start the air pump and accumulate a maximum pressure of air. Set the brakes and use a light throttle and warm all pipes connected on the engine. If you desire, use the drifting valve. Always keep the globe valve at king-box closed. That leads to the rear of the intercepting valve.

Q. 27. How is the drifting valve connected on a Mallet compound locomotive?

A. 27. Direct to the high pressure valves and cylinders. The saturated steam passes through these valves and pistons on the high pressure engines, is then exhausted to the low pressure receiving pipe to the low pressure valves and cylinders, then to the atmosphere.

Q. 28. What would you do if the pipe broke off between the drifting valve and back pressure check valves?

A. 28. Prevent using the drifting valve and proceed.

Q. 29. What would you do if you broke the pipes off between the back pressure check valves and cylinders?

A. 29. Plug the pipes at pressure end and proceed.

Q. 30. What would you do if you blew out a relief valve on any class of engines?

A. 30. Take the regulating nut out of a high-speed reducing valve, drive a wooden plug in from the inside of the regulating nut, screw that in where the relief valve is blown out and proceed.

Q. 31. What would you do with the reducing valve you removed the regulating nut from?

A. 31. Place a blank washer in at the union connection on the high-speed reducing valve and proceed. Reduce the brake-pipe pressure to 90 pounds.

INFORMATION CONCERNING MALLET COMPOUND ENGINES.

In many cases Mallet compound engines are used to a great advantage. In road service, for example, when very heavy tonnage is to be pulled at low speeds, those trains require heavy engines, capable of exerting high tractive power for a period of time only.

The general features of Mallet type engines are very well known and only brief reference need be made to them in this connection. The cylinders are four in number and designed so the front pair of cylinders are used as a compound system. The high pressure cylinders are used to drive the rear portion of the locomotive wheels and the head cylinders are used to drive the front portion of the locomotive wheels. The front frames are hinged to the rear frames in such a way that when the locomotive curves the front group of wheels swing about on a hinge pin located in the center line of the locomotive between the high pressure cylinders.

The boiler is held in a rigid position with the rear frames, and is supported on the front frames by sliding bearings so as to give the front portion of the frame an easy access to movement.

One section of the sliding bearing is fastened to the frame and the other portion riveted to the boiler and come in contact with one another and form a rest for the front section of the boiler. These bearings are supplied with oil holes, with pipes leading to the bearings for the purpose of being oiled, and they must not be neglected, as the weight of the boiler resting on the bearings soon starts to cut unless they are oiled and left free to work.

The low pressure receiving pipe is connected to the center of the high pressure cylinders with a bald joint and is protected with a packing gland and packing. The front end of the pipe leads into the low pressure cylinders, a steam channel connecting the low pressure receiving pipe to the low pressure valves. These valves control the steam to the low pressure cylinders, both in admitting the steam and exhausting it to the atmosphere.

The front end of the low pressure receiving pipe has a slip joint to be used to control the expansion and contraction of the pipe. This joint is made of a gland and packing, and can be used to tighten and protect the pipe from leaking.

Attention is called to the construction of the ball joint at the smoke arch end of the exhaust pipe. This joint is placed immediately under the exhaust nozzle and is kept tight by a coiled spring. The spring is always in compression and is confined with a suitable casting, so that when the parts are dismantled it cannot suddenly extend to its free height and thus cause damage. The upper and lower sections are protected with a series of projections which interlock and are surrounded by a steel wire ring; each projection has a lip extending outward and this lip engages the ring and holds the sections together. The effectiveness of the spring in keeping the joint tight is not impaired by reason of the casting and the removal and replacement of the spring when making repairs are esaily effected.

In the construction of the ball joint at the front end of the pipe the ball is seated on two Babbitt-lined rings of brass and can be adjusted by a packing gland. The slip joint in the middle of the pipe has a long sliding fit and is kept tight by a pair of snap rings and a series of leakage grooves.

The ball joint in the receiving pipe is similar in construction to that used at the front end of the exhaust pipe. The joint in the receiving pipe is fitted with a packed gland, as the pressure here is sufficiently high to require this form of construction.

Q. What would you do if you broke a valve stem off close to a crosshead or broke a valve rod and the valve moved all the way ahead and it was impossible to move it back?

A. Disconnect the valve gland and take out the packing, then move the valve where you desire to place the packing and gland back and secure the valve in position desired and proceed.

When removing a valve out of the low pressure valve chamber so as to operate both high pressure engines when both low pressure engines became disabled, why is it not necessary to disconnect the main rod on that side?

The valve, being removed, permits the steam to pass to the low pressure valve chamber direct, both exhaust ports being direct on each end of the valve chamber. The steam will pass to the atmosphere, and what little steam would be admitted to the cylinder would equalize on both sides of the piston, and the weight of the engine moving would overcome equalization.

On cold days where a Mallet engine is placed on a side track of a period of time, it is always advisable to set the straight air-brake and just open the throttle very little to permit the steam to pass through the intercepting valve and warm up the receiving pipe to the low pressure cylinders. This will prevent damage to the low pressure connections and warm up the low pressure cylinders before proceeding.

ELECTRIC HEADLIGHTS.

Electric headlights used on locomotives are one of the most successful lights that can be used for the benefit of the engineman, and also the traveling public, and it only requires a little care and good judgment both to keep them in good condition and ready for service. Where the lights are continually in service, engineers must give their attention to the headlight when approaching stations or trains in the opposite direction. When a freight train is closed onto a passenger train's time, and he is approaching the station in the opposite direction, it is proper for the engineer on the freight train to quickly turn his dimmer into action, so as to give the passenger engineer full view of the station. This will permit him to make a proper stop, and, furthermore, to be sure no one is crossing the track in advance of the engine, as we all know quite frequently engineers must give a warning signal to pedestrians at stations. By doing this, we can in many cases save life. Also where trains are approaching one another, while en route, be sure to make use of the dimmer, so both engineers can have full view of signals displayed. Headlight dimmers must be used at stations or when locomotives are on sidings.

Q. 1. What are the principal parts of the electrical attachments used for lighting the locomotive?

A. 1. The electric generator, headlight, incandescent light and a number of lamps used. The two-way switch is located in the cab of the engine for the benefit of the engineer.

Q. 2. How many different kinds of electrical equipments are in service on this railroad?

A. 2. The Pyle and Schroder equipment.

Q. 3. How are the different equipments oiled?

A. 3. Oil cups provided with the Pyle equipment should be kept a little more than two-thirds full with engine oil; Schroder equipment, use soft grease that is adapted for that work.

Q. 4. How is the headlight placed in service?

A. 4. By placing the generator in action.

Q. 5. How should the generator be oiled?

A. 5. Always oil the generator before starting. Do not endeavor to fill the cup when steam is turned on.

Q. 6. How much oil is necessary to oil the generator?

A. 6. The oil cup on the side of the generator filled as ordered, and you will notice it takes a small amount of oil. To oil the generator use engine oil in both cups.

Q. 7. How should the generator be started?

A. 7. Steam turned on slowly until all condensation is worked out. After dry steam appears, open the steam valve wide.

Q. 8. Is it necessary to open the steam valve wide?

A. 8. These valves are designed and constructed to accommodate the steam openings in the generator and must be operated according to orders.

Q. 9. How is the speed of the generator controlled?

A. 9. By the governor working under an automatic action.

Q. 10. What are the uses of the governor?

A. 10. To keep the generator operating at one speed.

Q. 11. What protection is given the steam end of the generator in cold weather?

A. 11. A drain valve is located in the steam supply pipe and should be left slightly open in cold weather, so as to prevent the pipe from collecting water and free from freezing up.

Q. 12. What does it indicate when the lights in cab are exceedingly bright?

A. 12. Too high a voltage, and there is danger of burning out the lights.

Q. 13. What precaution should be taken?

A. 13. Decrease the speed of the generator until lights are burning properly.

Q. 14. What may be the cause of the generator increasing in speed and increasing the brilliancy of the headlight?

A. 14. The automatic governor failing to control the action of the generator at its normal speed.

Q. 15. What would you do in case the headlight refuses to burn or light properly?

A. 15. First, notice the globe in the headlight, and see whether it is properly secured. If not, set in on the screws; that will be the cause of the globe not making proper contact.

Q. 16. What should be done if the globe burns out or becomes broken in the headlight?

A. 16. Remove the broken globe and take one of the cab lights and place it in where the globe was removed. That will provide sufficient light to finish the trip. Do not forget to report same on the arrival at engine house.

Q. 17. What may be the cause of headlight failure?

A. 17. Generator refusing to work. When steam is turned on the valve may be opened wide, but the pipe plugged up with pipe scale or foreign matter working its way up against a steam valve strainer, this also giving the improper amount of steam. If it is only partly clogged, so the generator has no speed, the lights will not burn properly. If fuses are blown out, replace with new ones.

Q. 18. Any other defect that may be the cause of lights failing to burn properly?

A. 18. Rusted bearings, packing gland too tight, brushes out of place; both brushes must ride on the revolving commutator.

FOCUS.

The meaning of the word focus?

A meeting point of reflected or refracted rays of light, central point to concentrate focal.

When a locomotive is consigned to an engineer and to be taken out on a trip it is always proper for the engineer to notice the position of the light on the rail. This in return will inform him just how the headlight is located on the locomotive. The proper focus of the light should be adjusted to center of the rails. If you notice the light is not focused properly report same on the arrival at the engine house and have it attended to at once. When a man is placed in charge of a large body of men and his position as an examiner, both of airbrakes and machinery, he is the one who hears all of the complaints, especially where he is instructing on that class of work. My attention was called to the fact of a headlight where it focused so as to place the light toward the right side of the rail and also a little too high in the front, so when the locomotive was approaching a semaphore signal the ray of light shone against the disk so plainly that it was made to read improperly. On several different occasions engineers reported it as the red signal when it was made to read as if it were white. The light should be adjusted to center of the rail and raised up behind just far enough to place the light so as to show the ray of light between the rails at the center point. Many railroads have placed their headlights directly on the front door, in front of the smoke arch, so as to be sure the light will show in the proper place.

Q. 19. What is the meaning of headlight burning properly?

A. 19. A brilliant light in advance of the locomotive; no shadow or dark spots on the track.

Q. 20. How is the globe of the headlight connected up?

A. 20. By the use of three adjusting screws, which hold the lamp to the reflector.

Q. 21. What precaution is necessary when putting a new lamp in the headlight?

A. 21. See that it is properly placed and there is a good contact between the lamp and socket.

Q. 22. How many throw-off switches are used for a headlight in long road service?

A. 22. There is one double throw-off switch—ahead for a brilliant headlight and back for a dimmer.

Q. 23. How many throw-off switches are used for a headlight in yard service?

A. 23. One single throw-off switch.

Q. 24. Is it necessary to have a brilliant headlight at terminal points or yards?

A. 24. No; if headlight is properly burning it is not necessary to have a brilliant light.

Q. 25. What is required of the generator when day s work is finished?

A. 25. When lights are no longer required, the generator should be stopped and drain valve opened on steam pipe.

Q. 26. What would you do if all lights refused to work?

A. 26. Tighten all fuses in cab; no results, shut down generator, provide with white lights and report same out of order.

Q. 27. What kind of oil must be used in generator?

A. 27. Bear in mind, engine oil at all time, and no oil with a heavy body, or generator will not be successful. Always oil all parts that are necessary.

Q. 28. What would you do if the headlight refuses to light?

A. 28. Place in a white light and proceed.

Q. 29. Should headlights be burned in daylight hours?

A. 29. No; not unless there is a cause to have them burning.

Q. 30. What engine should the headlight be operated on where there are two or more engines coupled together?

A. 30. On the leading engine only.

Q. 31. How many watt lamps are used in headlights?

A. 31. On locomotives in road service 250-watt lamp; in yard service 100- to 150-watt lamp.

Q. 32. How are the marker lights constructed?

A. 32. So as to be lit from the lamp or closed off at the lamp.

Q. 33. When does the deck light burn?

A. 33. When generator is in action.

Q. 34. When will cab lights burn?

A. 34. They have individual switches and can be turned off or on when engineer so desires.

Q. 35. What does it indicate when cab lights refuse to work?

A. 35. A fuse is blown out and must be replaced.

Q. 36. What will be the cause of the headlight refusing to work at all?

A. 36. If switch is in proper position and working correctly, it indicates a fuse has blown out and must be renewed.

Q. 37. What would it indicate if one position of the switch was correct and the other position incorrect?

A. 37. A poor contact made by switch movement or a defect in wiring. Report same on arrival at terminal point.

Q. 38. Is there any other way you can detect the cause of poor contact?

A. 38. Try switch of classification lamps by the use of the individual key switch.

SEVERAL YEARS AGO.

The opinion recently rendered in the case of the Virginian Railway Company v. the United States of America is most important and its effect will be far-reaching. The decision in this case was to the effect that trains must be controlled by the power brakes prescribed by law, and that even though there be 100 percent. of the power brakes in the train in operative condition the use of hand brakes for the purpose of controlling the speed of the train is unlawful. It was further held that just as the object of the automatic coupler is to keep the employees from going between the cars, so the object of the train brake is to keep employees from going on top of trains to set and release hand brakes. The hand brake is an important feature of the equipment of every car, as it is necessary in controlling the speed of cars being set on sidings and made up into trains.

Another recent hand-brake decision of importance defines the word "efficient" as used in statute as comprehending the efficiency of the hand brake for the purpose of holding a car or train, as well as the efficiency as a matter of safety to employees engaged in work requiring the use of hand brakes.

The latter hand-brake decision defines the word efficient, actually producing or helping to produce effects that produces directley a certain effect, causing effects effective, competent, able, active, operative.

Comprehending the efficiency of the hand brake for the purpose of holding a car or train, as well as the efficiency as a safety to employees in work requiring the use of hand brakes.

Comprehended or comprehending.

1. That means to comprise, to include, to embrace.
2. To take into, or to contain in, the mind to understand; to conceive, to apprehend.

Comprehending has a more extensive meaning than understood or apprehend. To apprehend is simply to take an idea in the mind. What we comprehend we understand one another.

This is the way trains were taken down Frackville Grade previous to August 6, 1919.

Therefore, if one is riding on a train and he comprehends the necessity of a hand brake he understands it is proper to put it on, as the efficiency of that hand brake is the act of self-protection and a power producing effects for safety. Knowing the act of being safe and out of danger, so the employee has the power to protect himself if he so desires. I quote the following, which can be used if so desired by ourselves individually without the word compulsory. Note previous to December, 1909, we had a serious accident on a branch road where I am employed as the air-brake and machinery examiner. This accident happened on Frackville Grade and it is known to have a descent of 175 to 175 3-10 feet to the mile, and the grade is * 7-10 miles long. After that accident it was the duty of all interested to endeavor to find the best way possible to operate and handle trains for the safety of the traveling public and the men in charge of the trains. So it was finally decided that the best way to operate these trains was to have the brakes thoroughly examined and tested before the train was to start down the grade and determine that all brakes were in good working condition. There was a total of five men on the train, each man allotted seven cars apiece, and when testing for piston travel to see that the travel of the piston was six inches and not to exceed seven inches. As soon as possible after the train started to move all hand brakes be set with a brake club and all retaining valves placed in position to retain a pressure of air in the brake-cylinder. At the same time of setting hand brakes, along with that we had the feed valve on the brake valves set for 90 pounds and the governor set for 110 pounds. This gave us a brake-pipe and an auxiliary pressure of 90 pounds in running position and 110 pounds in full release position, and then if at any time on the grade the hand brakes fail to properly control the speed of the train the engineer can check the speed of the train with the air-brakes. The fact is, the hand brake, if properly used, is a positive brake, and we as railroad men believe they are. At no time does a hand brake impair the efficiency of the air-brake. A good hand brake can retain a given amount of braking power at all times, especially when the air-brakes must be released to permit time to recharge the brake-pipe and auxiliary reservoirs, and where the air-brakes are subsequently applied they will be as effective as though the hand brakes are not in service. In these days most all cars have single brake wheels, so the hand brake can be operated from one end of the car only. This in return makes the car much safer than the two brake wheels attached to one car, because it requires the operator of the brake to know which brake wheel to operate so it will work in congenial feature with the air brake, and when the proper brake wheel is placed into operation both the air and hand brake will work together. Now, the good feature of a hand brake is right here: If the air-brake fails to operate for an unknown cause the hand brake is already applied and will prevent a runaway, which could occur before the hand brake could be placed into action.

You will notice the law does not require the use of a hand brake with a power brake, and, in other words, does not want us to use it under a compulsory act; but as railroad men we can comprehend the efficiency of the hand brake for our own safety. The necessity of a hand brake where the air-brake is in service is not a case of necessity; it only protects us in cases where the air-brakes fail to work; but we all are intelligent enough to know that there has been many funny things happen to the operation of air-brakes on railroads—angle-cocks closed from unknown causes; hose in winter-time, partly frozen up; angle-cocks only open part way, through, no doubt, neglect, but was not discovered until the operator of the brake desired its use; then where there is no hand brake in operation. We can realize what will or can happen before the hand brake can be placed into action. Now, where the governor is set for

110 pounds there is no objection to the engineer placing his brake valve in full release position and carrying that high pressure, providing he desires to do so. The meaning of this way to operate a brake, without the compulsory part of anyone, but if the men understand the meaning of the word comprehend and the efficiency of a hand brake to help control a car or train, we as a body of men can so do this for self-protection, as we are all united under the words brotherly love and protection of one another is the meaning of that word.

Miles per Hr.	Time per Mile. Min. Sec.	Feet per Sec.	Miles per Hr.	Time per Mile. Min. Sec.	Feet per Sec.
8	7.30.0	11¾	58	1.02.1	85
15	4.00.0	22	59	1.01.0	86½
16	3.45.0	23½	60	1.00.0	88
17	3.31.8	25	61	.59.0	89½
18	3.20.0	26½	62	.58.0	91
19	3.09.5	28	63	.57.1	92½
20	3.00.0	29¼	64	.56.2	94
21	2.51.4	30¾	65	.55.4	95¼
22	2.43.6	32¼	66	.54.5	96¾
23	2.36.5	33¾	67	.53.7	98¼
24	2.30.0	35¼	68	.52.9	99¾
25	2.24.0	36¾	69	.52.1	101¼
26	2.18.5	38¼	70	.51.4	102¾
27	2.13.2	39½	71	.50.7	104¼
28	2.08.6	41	72	.50.0	105½
29	2.04.1	42½	73	.49.3	107
30	2.00.0	44	74	.48.6	108½
31	1.56.2	45½	75	.48.0	110
32	1.52.5	47	76	.47.3	111½
33	1.49.1	48½	77	.46.7	112¾
34	1.45.8	50	78	.46.1	114¼
35	1.42.7	51¼	79	.45.5	115½
36	1.40.0	52¾	80	.45.0	117
37	1.37.3	54¼	81	.44.4	118¾
38	1.34.8	55¾	82	.43.9	120¼
39	1.32.3	57¼	83	.43.4	121¾
40	1.30.0	58¾	84	.42.8	123¼
41	1.27.8	60¼	85	.42.3	124¾
42	1.25.7	61½	86	.41.8	126¼
43	1.23.7	63	87	.41.3	127¾
44	1.21.8	64½	88	.40.8	129
45	1.20.0	66	89	.40.4	130½
46	1.18.2	67½	90	.40.0	132
47	1.16.6	69	91	.39.5	133½
48	1.15.0	70½	92	.39.1	135
49	1.13.5	71¾	93	.38.7	136½
50	1.12.0	73¼	94	.38.2	137¾
51	1.10.6	74¾	95	.37.8	139¼
52	1.09.2	76¼	96	.37.5	140¾
53	1.07.9	77¾	97	.37.1	142¼
54	1.06.7	79¼	98	.36.7	143¾
55	1.05.5	80¾	99	.36.4	145¼
56	1.04.3	82¼	100	.36.0	146½
57	1.03.2	83½	101	.35.6	148¼

Several years ago, being authorized by the ex-President of the Philadelphia & Reading Railroad to make tests for the benefit of the General Manager and Vice President of the Poughkeepsie Railroad to find out just how long it would take an engineer to close a throttle and place his brake valve into application position, this was done with the total number of 50 engineers, and during the tests it took the quickest man 1 second and the slowest man 1½ second under an actual test with stop watches. After that I always said it was proper, when an engineer made a quick stop, to deduct the number of feet off the stop made. For instance, a man stopped a train in 1600 feet and he was running at the rate of 70 miles per hour, he actually stopped in 102 feet less, because if he was a quick man in operating the throttle and brake valve it just took him 1 second to close the throttle and place the brake valve into application position.

ALONZO W. DEAL, SR.

Road service means the starting point of the railroad and the ending point, regardless of yard limits so long as we are using the main tracks.

Yard service does not mean yard limits as long as we are in the yard and not occupying the main track it is not necessary to have the air-brake hose on the engine and tender coupled to the air brake hose on the cars, or must we use the air-brakes while in switching service, in the yard, but when the switch is opened and we are to occupy the main tracks, then the law says we must unite the air-brake hose on the engine and tender to the cars, so we can operate the brakes therefrom.

REMARKS TO ENGINEERS.

1. The air pump should be started and run slowly until 25 or 30 pounds pressure of air has accumulated in the main reservoir, after which it should be regulated to run at a speed of 110 but not to exceed 140 strokes of each piston per minute, one or two drops of valve oil per minute fed to the steam cylinders, and also used sparingly in the air-cylinders, and on the swabs on the piston rods will be sufficient, drip cocks must be opened when pump is stopped.

2. Should a pump stop enroute, its throttle valve should be closed up for a minute. The steam chest jarred and a full steam pressure turned on and seen to pass through the governor and drip-cocks, and it

should be observed that oil supply is sufficient.

3. Release position must always be used to release brakes, the handle to be left in that position sufficient time to insure the release of all brakes, then returned slowly to running position. On long trains it should then be returned to release position for a short time to secure the release of any brake that may have crept on.

4. After making a desired train-pipe reduction and placing the handle in release position and that does not release a stuck brake when running, it must be looked after immediately. In descending grades, the auxiliary reservoir must always be recharged to maximum pressure with the handle of brake valve in release position. Always bear in mind an immediate release of brakes, on long trains following an emergency application, may tear them in two.

5. Releasing the brakes should never be attempted on long trains without the high excess pressure at least 20 to 30 pounds in the main reservoirs, above train pipe pressure. When not having a high excess pressure the train pipe does not raise in pressure sufficiently fast enough to release brakes promptly, and some brakes may fail to release. It is positively forbidden to kick off a portion of the head brakes. Brakes must be released on passenger trains just before coming to a full stop to avoid shock, except on heavy grades or when heavy surging is felt, when they must be released after coming to a full stop, brakes on freight trains should never be relased until after the train has come to a full stop.

Very often an engineer complains of his driver brake or tender brake working O. K. with a light engine and tender, but when attached to a train it will not work at all and if it does work, it goes on very slowly.

This is often due to leaks in the pipes or the cylinder leathers in the cylinder not being of a proper fit to the walls of the cylinder, or the leather worn thin on one side. Where there is a reduction made in the brake-pipe pressure with the engine and tender, the short brake-pipe pressure permits the triple piston to travel its full length and permits the graduating port in the slide valve to open its full size. This in return permits the brake on the engine and tender to work O. K. But when attached to a train of a large number of cars the brake-pipe is increased in length, the retarding action of the traveling of the air pressure keeps the triple piston from its full travel, then the slide valve is not permitted to have its graduating port open in full, the air pressure now entering the brake-cylinder slowly is not sufficiently great enough to place the cylinder piston out by the leakage grooves, and in return to set the leather tightly to the walls of the cylinder. In this action the brake does not apply on that defective cylinder or cylinders.

6. The brake valve in running position allows excess pressure in the main reservoirs, and is used to secure a prompt release of all brakes, and to recharge the train-pipe and the auxiliary reservoirs, brakes must not be released with the brake valve in running position.

7. The feed valve attachment must be regulated to maintain 70 pounds of train-pipe pressure when operating the standard brakes.

8. Leaving the brake valve in full release position until the train-pipe and auxiliary reservoirs are charged, above the feed valve attachment, will cause the feed valve to stay closed when the brake valve handle is placed in running position. This may cause the brakes to creep on and drag the train.

9. Brake valve handle should always be placed in running position while a train is backing, so that the brakes can be operated from the rear end.

10. Lap position closes all ports and cuts off the supply of air to the train-pipe, and it is to be used to preserve main reservoir pressure when train-pipe loses its pressure from an unknown cause and when otherwise needed.

11. In making a service application, a continuous train-pipe reduction, 7 to 12 pounds, must first be made to close leakage grooves in cylinders. Apply shoes to wheels and take up the slack of draw bars, after which smaller amounts of train-pipe reductions will apply the brakes to any degree of force required until 20 to 25 pounds have been drawn off, when brakes are fully set. It is well to remember where brake pistons travel above 9 inches, when making a 7-pound reduction in train-pipe pressure, the brake cylinder pressure will not be registered. If the piston travel is 9 inches, the pressure in the cylinder will be registered at about 8 pounds, a 10-pound train-pipe reduction on a piston travel of 9 inches, will give us about 19 pounds. If the

piston travel would be to the standard, while the train is in motion, a 10-pound reduction in train-pipe pressure would allow the brake-cylinder to register 23 to 25 pounds. It is readily understood where piston travel would be increased above the standard or running travel a 7-pound reduction in train-pipe pressure would leave very little auxiliary reservoir pressure to be registered. Under this condition we can realize what it means with a short piston travel under cars in a train. Where piston travel is 5 to 6 inches a 10-pound reduction in train-pipe will allow the auxiliary pressure to pass to the brake-cylinder and be registered in the cylinder. On a 5-inch travel, it would register 40 to 45 pounds, while on the 6-inch travel it would register at about 30 to 35 pounds. If we have cars on the rear of a train with the short piston travel we can easily understand why the breaking of drawheads or knuckles occur.

12. For all tests when standing with a brake-pipe pressure of 70 pounds, a 25-pound continuous train-pipe reduction should be made, with a 110 pounds brake-pipe pressure a 30-pound continuous brake-pipe reduction should be made, for running tests on passenger trains, to determine whether or not angle-cocks, and cutout cocks are in proper positions and brakes responsive. Engineers must make a 10-pound continuous (per gauge) reduction; 200 yards after leaving a terminal or any point where there is a change in the make-up of trains, or where the train-pipe and hose couplings have been united, and two miles previous to a junction or meeting point or any other place where an air-brake failure may cause a disaster.

13. In making unexpected stops the handle of the valve must be placed in the emergency position at once. On freight trains it should be left there until the train has come to a full stop, and on passenger trains until not less than 5 to 7 seconds of time has elapsed and the necessity for the application has passed the emergency position must not be used on trains running at low speeds, unless absolutely necessary, as at low speeds it is very destructive to property and lading.

14. One application of the brake is all that is necessary for all stops on good rail, on slippery rails stops should be made with light applications to avoid sliding the wheels, and on passenger trains it is best to apply the brakes moderately heavy at first, thus checking

the train considerably, then release brakes and immediately follow with other applications for final stop.

A train made up with five passenger coaches, engine and tender combined and proceeding over the road at the rate of 45 miles per hour, and the train is equipped with a good brake, and the pressure of air carried in the brake-pipe and auxiliary reservoirs at 110 pounds pressure, and the brake valve is manipulated proper in service position, this train can be stopped at a distance of the length of the train and one-half of its length, therefore, if the car is 65 feet in length and the length of the engine and tender combined is 85 feet the train will be stopped in a distance of 615 feet.

Miles per hour.	Stoped in feet.	
40 to 45	615	1 1-2 times its length.
50 to 55	820	Twice its length.
60 to 65	1025	2 1-2 times its length.
70 to 75	1640	4 times its length.
80 to 85	2665 to 2700	6 1-2 times its length.

A question often arises, why is it a train of a shorter length will not stop as quickly as a train double that size? They all have a brake holding an equal amount of the weight of each car, yet many do not take into consideration the more cars attached to a train that it has that much more resistance of atmospheric pressure to the square inch to each car attached in a train.

Where a train is made up in freight service and you increase the number of cars above 20 you will notice the same pressure of air cannot be retained at the rear of the train as you have on the head end at the gauge located in the cab of the locomotive. This is due to friction of the air traveling a long distance back away from where the power is, that is generating the air pressure, the higher the pressure the more friction is produced, and while the air pressure is being forced back against the resistance of the air enclosed in a pipe, the farther the air travels the lower the pressure.

The way I explain this to a class in session in the air car, I mark off on the blackboard 100 cars in a train in sections of 10 cars just as shown below and tell the student after the air passes the 10 car mark they lose one-tenth of a pound to a car when the brake-pipe pressure is 90 pounds, where the brake-pipe pressure is 70 pounds 1-20 of a pound.

Cars.	Brake-pipe pressure 90 pounds.	Cars.	Brake-pipe pressure 70 pounds.
10	90	10	70
10	89	10	69½
10	88	10	69
10	87	10	68½
10	86	10	68
10	85	10	67½
10	84	10	67
10	83	10	66½
10	82	10	65
10	81 to 82 lbs. av.	10	64½ to 65 lbs. average.

This pressure will variate from 81 to 84 pounds due to the length of each car being different and the slight leaks in the brake-pipe.

15. When necessary to sand slipping rails it should be done before making a service application, and for emergency as soon as possible thereafter. Ordinarily sand is unnecessary on good rail and is destructive.

16. Locomotive triple valves must be drained of water once every 24 hours in switching service and before each trip in road service.

17. Engineers on receiving engines at roundhouse should test the rotary valve to see if it is O. K. before starting out on their trip.

18. The adjusting of the foundation brake gears must be made that when standing, with a full service application, the pistons will travel out of the cylinders not less than six inches on all cars and tenders, and enough more to give sufficient clearance between shoes and wheels, but not exceeding eight inches. Driving wheel brake piston's travel should be maintained between four and four and a half inches on engines having four driving wheels and four and a half to five inches on engines having six driving wheels, and five and a half inches on engines having eight driving wheels, trailers included. Engine truck brake piston travel must be maintained between five and a half and six and a half inches. Less travel is destructive, and each pair of driver brake pistons should be adjusted to equal travels.

DEFECTS IN QUICK ACTION TRIPLE VALVES GIVING UNDESIRED QUICK ACTION.

1. Dirty triple valve.
2. Gummey slide valve.
3 Graduating port plugged up.
4. Broken graduating spring.
5. Broken graduating pin.
6. Graduating stem stuck in cap-nut.
7. Leak at the graduating cap-nut.
8. Bent triple piston.
9. Packing ring fit too tight in piston chamber.
10. Leaky check valve case gasket.
11. Emergency rubber-seated valve leaking.
12. Broken emergency rubber-seated valve.
13. Stem broken off of the emergency rubber-seated valve.
14. Check case union leaking.
15. Long draw-head stretching air-hose and causing a leak.
16. Leaky train-pipe.
17. Wrong triple valve applied to passenger car.
18. Defective graduating valve.
19. Brake-pipe worn through from riding on bolt or any hard substance.

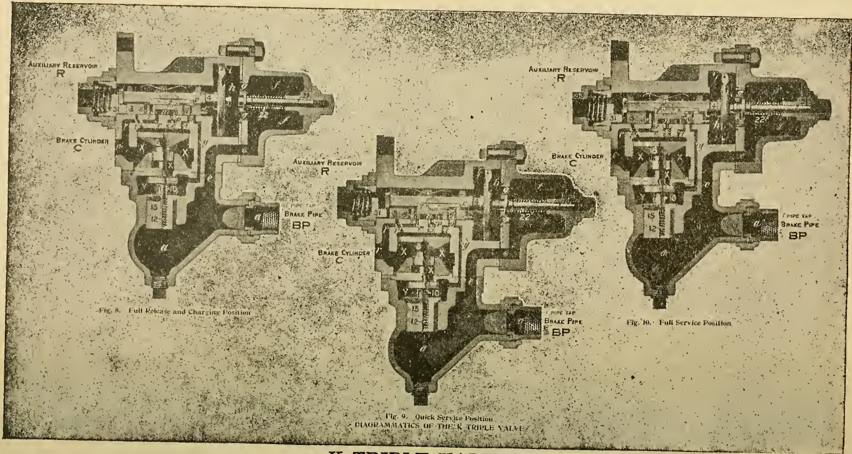


Fig. 8. Full Release and Charging Position

Fig. 9. Quick Service Position

Fig. 10. Full Service Position

DIAGRAMMATICS OF THE K TRIPLE VALVE

K TRIPLE VALVES.

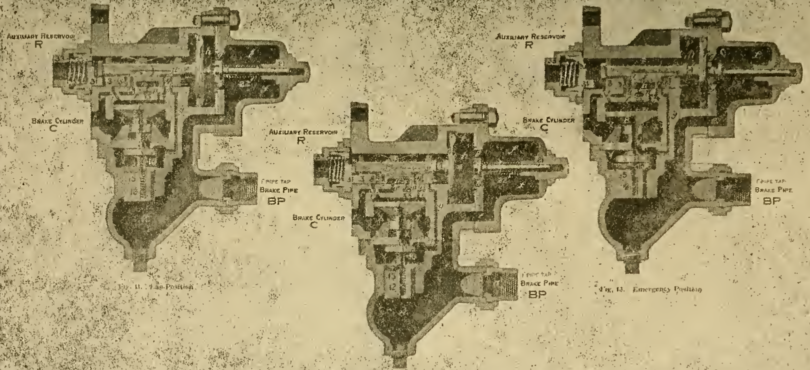


Fig. 11. Lap Position

Fig. 12. Retarded Release and Charging Position

Fig. 13. Emergency Position

DIAGRAMMATICS OF THE K TRIPLE VALVE

Fig. 8. Full release and charging position—this position as long as brake-pipe pressure is not increased to overcome the auxiliary reservoir pressure and the retarding spring.

Fig. 9. Quick service position used on long trains and is a guaranteed brake-pipe reduction, due to the fact a per cent. of air from the train pipe enters the brake-cylinder.

Fig. 10. Full service position used on short train. The brake-pipe volume being small, in proportion to a long train, it will reduce more rapidly for a certain reduction at the brake valve. Therefore quick service position is not desired on a short train.

Fig. 11. Lap position when the brake-pipe reduction ceases. Air continues to flow from the auxiliary reservoir to the brake-cylinder until the pressure in the auxiliary reservoir becomes a fraction less than the brake-pipe pressure, this causing the triple piston to move back, carrying with it the graduating valve, closing off communication between the auxiliary reservoir and brake-cylinder.

Fig. 12. Retarded release and charging position were added in order that the release of brakes at the rear end of the train might take place as soon as that at the head end of the train. It is known when a release of the brakes on a long train is made with old style triple valves, the release of brakes would occur on the head end of the train before the rear end would start to release, this causing slack to run out and parting the train, with the head end of train being placed into retarded release it prevents the head end from advancing ahead of the rear end and prevents a break in two.

Fig. 13. Emergency position is the same with the K triple valve as with the H triple valve. Quick action is caused by a sudden reduction in brake-pipe pressure below the auxiliary reservoir pressure. No matter what caused this reduction, this permitting brake-pipe pressure to reduce rapidly, auxiliary reservoir pressure then being the strongest of the two pressures, forces the triple piston back, compressing the graduating spring and stem, and the same time permitting the slide valve to uncover a port leading to the emergency piston, auxiliary reservoir pressure is admitted direct on top of the emergency piston, forcing it down and unseating the emergency rubber-seated valve, brake-

pipe pressure is permitted to enter the brake-cylinder by the brake-pipe check valve and emergency rubber-seated valve. When brake-pipe pressure and brake-cylinder pressure equalizes, then the brake-pipe check valve is forced to its seat by the check valve spring. This in return prevents any more brake-pipe pressure from entering the brake-cylinder; also prevents brake-cylinder pressure from flowing back into the brake-pipe. After the brake-cylinder and auxiliary reservoir pressure are nearly equalized the emergency valve will return back to its seat. At the same time auxiliary reservoir pressure is flowing into the brake-cylinder by a small port being in communication with the slide valve and slide valve seat.

Q. 1. What will put a K triple valve to retarded release?

A. 1. As long as train-pipe pressure is increased to four pounds above the auxiliary reservoir pressure.

Q. 2. What will put the K triple valve to full release?

A. 2. As long as train-pipe pressure is not increased to overcome auxiliary reservoir pressure and the retarding spring.

Q. 3. What will put the K triple valve to retarded release in any part of the train?

A. 3. A broken or weak retarding spring, a retarding stem stuck open or a loose retarding device body.

Q. 4. What will put the K triple valve to full release in any part of the train?

A. 4. A retarding stem corroded shut so it is not movable.

Q. 5. What will put a triple valve to retarded release near the rear of the train and the triple valve in good working condition?

A. 5. When the brake-cylinder piston has traveled out to 10 or 11 inches, the auxiliary pressure and the brake-cylinder pressure will equalize at a low pressure of 40 pounds. When the brake is released the train-pipe pressure would increase up to 50 pounds. That will allow train-pipe pressure to overcome auxiliary reservoir pressure and the retarding spring. The triple piston will go to retarded movement.

Q. 6. How is the exhaust cavity in the slide valve constructed so as to allow two releases through the movement of the piston and slide valve?

A. 6. The slide valve in K triple valve has two size exhaust cavities combined in one. The small part of the cavity is in the lower end of the slide valve and the large part of the exhaust cavity is direct above it.

Q. 7. How is the slide valve connected so as to operate the movement of the two exhaust cavities with its attachment to the triple piston?

A. 7. The slide valve is connected to the triple piston and is controlled by the movement of the piston. When the triple piston is moved back by the train-pipe pressure and the train-pipe pressure does not overcome the auxiliary reservoir pressure and the retarding spring, then the large part of the exhaust cavity is brought in communication with the brake-cylinder and the atmosphere. But when the train-pipe pressure overcomes the retarding spring and auxiliary reservoir pressure, then the small part of the exhaust cavity is in communication with the brake-cylinder and the atmosphere.

Q. 8. Can a K triple valve be released on the head portion of a train any faster than retarded release, if the engineer has recharged the train-pipe pressure above the auxiliary reservoir pressure and the retarding spring?

A. 8. When the engineer has released the brake by placing the engineer's brake valve in full release position, and by recharging the train-pipe pressure above the auxiliary reservoir pressure and the retarding spring, it is useless to undertake to release the brake any faster. You must wait until the brake releases in its own time through the retarded release movements, and the engineers should not endeavor to start the train until they know the head brakes on the train have been released.

Q. 9. How should air-hose be parted?

A. 9. In parting cars always see that the air-hose is parted by hand and not pulled apart—a benefit to yourself as well as the company's property.

Q. 10. How would you couple non-air cars to cars charged with the air?

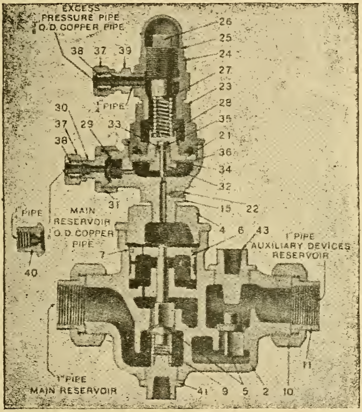
A. 10. In coupling a charged air train to a non-air train always leave the angle-cock closed on the non-air cars until after the train has been coupled and stretched, then couple the air-hose. Always open the angle-cock towards the engine first. After that hose is charged, then open the angle-cock on the non-air cars easy and there is no danger in throwing the whole train into quick action.

TRAIN PIPE AND ITS DEFECTS.

The train pipe and its hose connections are for the purpose of conveying air from the main reservoirs to the train pipe and auxiliary reservoirs. A reduction in the train pipe will cause brakes to apply, and an increase of pressure over and above that remaining in the auxiliary reservoirs will cause the brakes to release.

Hose couplings must be blown or cleaned out before uniting. Conductors and engineers must see that there is an extra supply of hose complete on hand at all times for the different train pipes they are expected to handle.

AUXILIARY DEVICES GOVERNOR.



It is well to know at the present time that compressed air on locomotives is used for many more purposes than the use of the air-brake. So it became absolutely necessary to protect the brake system from the loss of air by the use of the extra devices operated by this compressed air, so the Westinghouse Air Brake Company has designed an auxiliary device governor to be used in connection with an extra reservoir known as the auxiliary devices reservoir, and is pneumatically operated apparatus other than the air-brake. This auxiliary devices governor consists of a diaphragm portion which is the same used in connection with the S. F. steam compressor governor, and a body of valve portion containing a piston actuating a spring-resisted valve and a non-return check valve. Pipe connections are made from the feed valve pipe and main reservoirs to the governor; also the body of the governor is connected to the main reservoir and auxiliary devices.

When charging the auxiliary devices reservoir air flows from the main reservoir to the lower side of the diaphragm; air from the feed valve pipe will flow to the upper portion of the diaphragm. Adding to this pressure and increased pressures by the regulating spring holding the diaphragm down. The diaphragm valve will remain seated until main reservoir pressure advances above the feed valve pipe pressure by an amount equivalent to the pressure of the regulating spring, which is adjusted to a pressure of 10 or 30 pounds, and will then be permitted to flow to the top of the piston in the governor body. This piston is then forced downward, opening the spring-resisted check valve, this permitting air to flow past the non-return check valve to the auxiliary reservoir devices. When air is used from the auxiliary devices reservoir this pressure will fall a like amount in both it and the main reservoir until the pressure reaches that point to which the governor head is adjusted, depending on the feed valve setting. When this point is reached that is when the auxiliary devices reservoir and the main reservoir is reduced below feed valve pressure, plus regulating spring adjustment, the diaphragm valve will seat. The pressure which has been holding the piston down will now equalize with the pressure located under the piston, through the small passage in the piston, and the supply valve spring will then force the piston up, allowing the supply valve to seat, and this will prevent any more air to flow from the main reservoir. By the use of the excess pressure head the desired difference between the feed valve adjustment and the pressure at which the auxiliary devices governor prevents air flowing from the main reservoir to the auxiliary devices reservoir is automatically maintained for any adjustment of the feed valve. This prevents the necessity of readjusting the auxiliary devices governor every time the feed valve is readjusted, so when changing from 70 pounds brake-pipe pressure in freight service to 100 pounds brake-pipe pressure for grade work or to 90 pounds or 110 pounds in passenger service.

The principals of this extra device is to prevent the loss of air from the main reservoir, which is used as a storage for the brake system. It is also beneficial in cases of a broken pipe to the main reservoirs and the non-return check will prevent a flow of air back from the auxiliary reservoir devices back to the main reservoir.

Q. 1. What would you do if the pipe broke off leading to the upper portion of the governor?

A. 1. Plug the pipe and proceed. This will permit the main reservoir pressure to raise the diaphragm and unseat the pin valve as soon as it is in advance of the regulating spring. Therefore, you can receive all the air desired in the auxiliary reservoir devices.

Q. 2. What would you do if you broke the pipe off at the lower portion of the governor head, which is main reservoir pressure direct?

A. 2. Disconnect the pipe from the upper portion of the governor head and remove the diaphragm and regulating spring, placing the regulating nut back, screwing it up tight, and then plug the pipe at the lower end of the diaphragm portion next to the governor; also plug the pipe at the main reservoir and proceed. This will give you the pressure in the auxiliary reservoir devices the governor of the air pump is set for.

Q. 3. What would you do if you broke off both governor pipes, one at the top part of the governor and the other at the lower part of governor?

A. 3. Remove the governor head by screwing it out of the lower portion of the governor, then cut a plug to fit between the piston and the diaphragm portion of the governor, allowing it to be of sufficient length to come in contact with the piston, and as the diaphragm is portion screwed in this will force the piston down and unseat the spring-protected valve. Plug the governor pipes at pressure end and proceed.

Q. 4. What would you do if you broke the excess pressure head off in the governor?

A. 4. Screw down on the regulating nut so as to increase air pressure so as to overcome main reservoir pressure. If possible, drive in a wooden plug tight, so as to come in contact with the piston, forcing it down sufficient distance to unseat the spring-protected check valve.

Q. 5. What would you do if you broke a pipe off between the governor and the auxiliary reservoir devices?

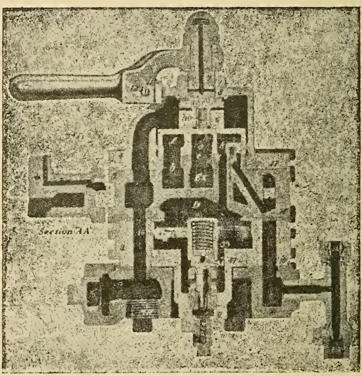
A. 5. Disconnect the union at the lower portion of the excess pressure head, place in a blank washer and proceed. This will prevent the governor from acting on main reservoir pressure.

Q. 6. What would you do if you broke a pipe off between the main reservoir and governor?

A. 6. Plug the pipe at pressure end and proceed.

Q. 7. What would you do if you had an air reverse gear?

A. 7. Look in the air reverse gear questions where it is disabled and it will tell you how to block the air reverse, and proceed.



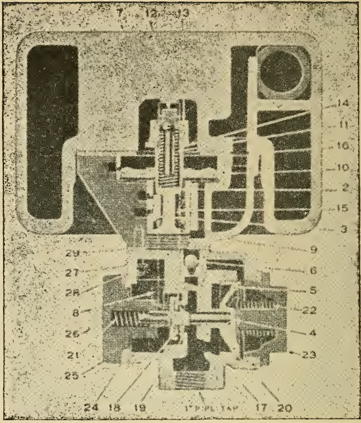
H 6 AUTOMATIC BRAKE VALVE WITH COLLAPSIBLE EQUALIZING PISTON.

The size of ports for charging equalizing reservoir and the size of those for charging the brake pipe must therefore be determined independently of each other, as the limitations are of a different character.

It is well understood after an application of a brake with an engine and tender and you release the brake you will notice the equalizing piston will raise up and discharge air from the brake valve exhaust until both the brake-pipe pressures and equalizing reservoir pressures equalize. As a result of this difference there is no provision for maintaining an equality of pressure in the equalizing reservoir and brake-pipe when charging, although, as soon as an application of the brakes is considered, it is generally understood that the equalizing reservoir and brake-pipe pressures are equal. This cannot be true, as when making a reduction in equalizing pressure the rate of time of the brake-pipe pressure is governed by the length of the train, but the reduction is governed by the pressure remaining in the equalizing reservoir. The equalizing piston is so constructed to accomplish this by the mechanical design.

At present the G-6 or H-6 brake valve has a solid one-piece equalizing piston. With this piston there is a chance of overcharging the equalizing piston at Chamber D connection or the equalizing reservoir to a pressure somewhat higher than the brake-pipe, especially on long trains. Such a condition prevents the quick movement of the equalizing piston when the brake valve handle is placed into service position, as a per cent. of a second or two of time to reduce the surplus of air out of Chamber D and the equalizing reservoir.

The object of this equalizing piston being made collapsible is to guarantee equalization when charging and recharging. That is now assumed to be when manipulating the brakes in service. The collapsible feature accomplishes this purpose far better than the solid equalizing piston itself. The equalizing reservoir being direct in connection with Chamber D, is a small volume, and close to the brake valve it is well known that its pressure will rise faster than the brake-pipe, so that this collapsible feature of the equalizing piston is always able to maintain the proper working conditions while charging and recharging. The modification required in the brake valve when substituting the collapsible piston for the solid piston consists in cutting four by-pass grooves in the bottom of the equalizing piston bushing and equally spaced around the bushing.



BRAKE-PIPE VENT VALVE

Q. 1. What is the benefit of this vent valve?

A. 1. In the past few years trains have increased in length and a large number of cars being operated with the automatic brake. The brake-pipe being located under cars in different positions, some have quite a number of bends, while others are fitted up with elbows located in such positions as to prevent the free flow of air to pass through the brake-pipe. When a sudden reduction of brake-pipe pressure is desired those who understand the action of a triple valve must remember it is one triple valve that operates the other, and so on, throughout the train. Therefore these bends and elbows in the pipe very often prevent this action, so the Westinghouse Air Brake Company has constructed a vent valve to be located on the brake-pipe directly under the tender, a suitable distance from the rear angle-cock of tender, where the best results are obtained. Service application of the brake does not affect the action of the vent valve. It only comes into effect when there is a sudden drop in brake-pipe pressure, due to the operation of the engineer's brake valve or a defect in the brake-pipe.

Q. 2. When the brake-pipe vent valve is placed into action, where does the brake-pipe pressure exhaust to?

A. 2. This valve is designed so as to exhaust the first pressure of air to the atmosphere, this making a sudden drop in brake-pipe pressure is a guarantee to place the first triple valve of the train into quick action, the other one following, and so on, throughout the train.

Q. 3. Is it considered good practice to clean a triple valve on a tender or car?

A. 3. No; it is always desirable to remove the valve and take it in the shop and have it cleaned and tested. So must the vent valve be cleaned in the same manner to receive the proper results.

Q. 4. What will cause a bad blow at the vent valve?

A. 4. If the emergency valve leaks or the emergency rubber-seated valve.

Q. 5. How could you overcome a bad leak at the exhaust port of the vent valve?

A. 5. This can be plugged with a wooden plug or a large cork screwed in, if you have one, or a 1-inch gas-pipe plug.

Q. 6. What effect does this have on the vent valve by plugging the exhaust port?

A. 6. Destroys the action of the vent valve so that it cannot be used when desired. But, conscientiously speaking, will not always destroy the quick-action feature, providing you have a quick-action triple valve on the tender and the first triple valve on the car in perfect working condition.

Q. 7. What effect would it have on a train if using the E. T. equipment on engine and tender without the use of a triple valve on the tender?

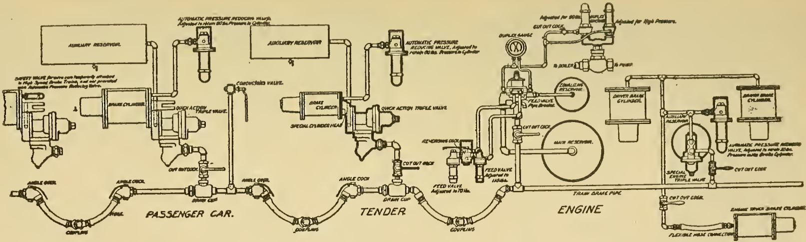
A. 7. In this case the first brake to go into quick action would be Car No. 1. If this car were in perfect working condition the chances are you would receive quick action, if so desired, but if this triple valve was defective and slow in acting, chances are no quick action could be received throughout the train.

Q. 8. Should there be a slight escape of air from the vent valve when the brake is operated in service position?

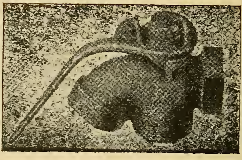
A. 8. Yes; that will be a slight leak of air out of the vent valve in service position, but not sufficiently strong enough to affect the action of the triple valve or to give you undesired quick action.

Q. 9. What benefit is this escape of air out of the vent valve in service position?

A. 9. Where a quick-action triple valve of the old style is used on the tender it is a great benefit in helping to keep the triple valve in action in service position, as the air flows ahead toward the brake valve. That escape of air at the vent valve on the tender will assist the brake-pipe pressure in reducing air at the triple valve. This will guarantee that valve to go into action on tender. It is well known with the old style triple valve, and no air vented to the brake-cylinder from the brake-pipe prevented the triple valve from going into action until the air was close to equalization on the head portion of the train, and it nearly ceased to exhaust from the brake-pipe exhaust.



This figure represents the first high-speed brake adopted with the old style poppett valve, and these valves could be removed and the slide valve feed valves adopted, or you can place the feed valve on next to the brake valve, and in the questions and answers written in this book it explains how either one of these pipes could be broken and the engine, tender and train return to its home points without delay. This brake today is in operation on many freight trains, omitting the high-speed pressures and high-speed reducing valves. The reversing cock is used when operating an empty or loaded train. Turned with the reversing cock toward the head of train gives you 90 pounds brake-pipe pressure and 110 pounds main reservoir pressure. Turn the reversing cock toward the rear of the train and it gives you 70 pounds brake-pipe pressure and 90 pounds main reservoir pressure—the standard pressure to be used with an empty freight train and the high brake-pipe pressure to be used with a loaded freight train.



COCKS.

Angle hose cocks are open when handles are lengthwise and closed when crosswise. Signal hose cocks are open when handles are crosswise and closed when lengthwise. Cutout-cocks are open when handles are crosswise and closed when lengthwise. There must be a release cock in each auxiliary reservoir, main reservoir and tender drain chamber, but never in brake valve reservoir.

GOOD ADVICE TO TRAINMEN.

Remember the law and protect yourselves in long road service.

Never use a hand-brake while the air-brake is in service, which is directly under the engineer's charge, while the train is en route, unless the engineer calls for the hand-brake or you notice the train is increasing in speed above the speed limit allotted for the piece of track you are proceeding over.

Where trains are being stopped on grades, never depend on the air-brakes to hold a train; always hand brakes. Remember that an air-brake was applied to a car to stop the cars while en route and the hand brakes to hold a car or train when placed on side-tracks or when the train is stopped.

Where one car is left standing on a side-track, and to your judgment the track is level, never depend on your own judgment, always secure the car with a hand brake, as there may be a storm come up and a high wind pressure may start the car to move and cause great damage.

INFORMATION TO CONDUCTORS AND BRAKEMEN.

Engineers and conductors should always bear in mind that they have a conductor's valve on a car, which can be used to an advantage in case the signal whistle refuses to respond on the engine when the car discharge valve is operated on the car. If a flag stop is to be made open the conductor's valve very easy and as soon as the engineer takes notice that the brake is applied it is his duty to release and answer with the steam whistle. On releasing, if he finds the conductor does not close the valve, then it is his duty to place his brake valve to lap position and keep it there until he is notified by one of the train crew to release the brakes.

Q. 1. What would you look fo it you received an order that fire was flying from the rear of your train?

A. 1. After looking at the journal boxes and the foundation gear, and you found everything was correct, have the engineer apply the brake and look for a brake geared up too tight. If on a passenger car, run the slack out with the slack adjuster; if on a freight car, drop the dead lever a hole on each truck.

Conductors, both in passenger and freight service, should always remember after dropping a car out of their train or picking up a car, to see that the airbrake is properly tested before proceeding.

Where train brakes have been examined and found to be in good condition by the train crew and reported to the engineer O. K., and there was a hose gasket or a defective train pipe discovered, so it would be necessary to close the angle-cocks and repair same, it is the duty of the party in charge to call for a second test of the brakes so as to assure you that they are working O. K.

Q. 2. In winter-time, what would you look for if the engineer made two or three stops with the brake valve and the brake worked correctly, and when he came to make the next stop the brake would not work at all?

A. 2. This is due to floating ice in the train pipe.

Q. 3. What would you look for if the brake could not be applied with the operation of the brake valve, but could be released and recharge the train pipe and auxiliary reservoirs?

A. 3. This would indicate that the lining of the air-hose had worked loose and when the air was passing through the hose it opened a passageway, but when the reduction was made ahead of the loose lining then the pressure behind forced the lining up in a bunch and closed off the opening, as the train-pipe pressure could not escape. Then there was no auxiliary pressure to move the triple piston. This is what is termed a trap door in an air hose.

The adjustment of the foundation brake gears must be so made that when standing, with a full service application, the pistons will travel out of the cylinders not less than six inches on all cars, and enough more to give sufficient clearance between the shoes and wheels, but not to exceed eight inches.

The conductor's valve is placed inside of passenger equipment cars and cabooses and is connected to the train-pipe. It has no cutout cock. When it is desired to stop a train with this valve, by signal or otherwise, it should be opened according to necessity and left open until the train has stopped.

When trains are being backed a trainman must ride on the rear end to operate the hand brakes, air brakes and air whistle. If necessary to apply the brakes gently the valve should be opened gradually until the desired force is felt and continuously drawn off until the occasion for such an application has been removed or train has stopped. To close valve while train is running will cause brakes to release. The valve should be thrown wide open in emergency cases and left so until the train has stopped. A three-quarter-inch cock and pipe fittings must be used as a valve.

When an engine and tender is coupled up to a train, and the air-hose couplings are united, and the air is turned in from the tender to the train, and after waiting a period of time the engineer discovers the air pressure is not accumulating properly, it is his duty to notify the conductor to that effect. There is something wrong. The air pressure is not increasing and the gauge is not showing the proper register. I always notify the conductor to close the angle-cock on the rear of the tender and then go up in the cab of the engine and notice just how the air pump is accumulating the pressure. If you find that O. K., then you know the trouble is on the train. Take 10 cars at a time and it will only take a short period of time to discover the car that is giving you the trouble. Always bear in mind all air pumps these day are placed under an orifice test and it is very hard to place the blame on the air pump and the apparatus located on the engine unless you are positive the trouble is there. Closing the angle-cock on the tender will tell you that. If you discover the trouble on the engine notify the engineer to hunt his trouble and make repairs. Then you will hunt for the rest of the trouble that may be on the train.

PARTING OF TRAIN.

After arriving at the point of separation trainmen will close the hose cocks, after making everything safe; will signal engineer to release brakes, back up and couple, open hose cocks and make a test to determine that rear brakes will apply and release promptly in response to brake valve on engine.

COAL OR WATER STOPS.

Locomotives handling more than 15 passenger cars should cut loose from the train to take on coal or water. In which case, if the train is directly on a level track, the air-brakes on train may be left applied. If on a grade of any per cent. the hand brake must be applied to secure a train and not an air-brake.

Locomotives handling 20 freight cars or more must cut loose from the train to take on coal or water. In which case, if the train is directly on a level track, the air-brakes on train may be left applied. If on a grade of any per cent. the hand brake must be applied to secure a train and not an air-brake. In passenger service, 15 cars at 70 feet to the car, the length of the train would be 1050 feet; 20 freight cars, 40 feet to the car, the length of the train would be 800 feet.

If repairs to a broken train-pipe or crossover-pipe cannot be quickly made, and brake and signal couplings cannot be forced together for allowing air to pass through the signal pipe, the car should be switched to the rear end of the other air-brake cars. When it is necessary to place a car having a broken train-pipe to rear of a passenger train its hose cocks should be closed and its couplings united with those ahead of it, cutting in the air pressure so that should the cars separate at that point the brakes would automatically apply and stop the train. A trainman must ride the rear car at all times when its air-brake is inoperative.

Should a burst hose stop a train in a dangerous locality, the engineman will supply sufficient air to locate it. If found on a passenger train, the angle-cock ahead of it should be closed and auxiliary reservoirs in rear of it bled and the train proceed to a safe place for making repairs, tests, etc. If on a freight train, judgment should be used whether to proceed as above or close the other hose cocks and apply new hose.

In passenger equipment, cars should not leave a shop or terminal yard with either its hand or air-brakes in defective condition.

Trains standing in road service over five minutes should have hand brakes applied so engineer could release the train brake and have an opportunity to recharge the train-pipe and auxiliary reservoirs, so when the signal is given to proceed if he needed the brake immediately it would be ready for service.

A car with both its hand brake and air-brake defective must not be run at the rear of any train.

Should a brake in passenger service become defective en route it must be reported by wire to its nearest inspetcor and the superintendent.

Hand brakes should not be used on cars having air cut in except in emergency. When a part air train is being backed the hand brakes must be used on the rear to prevent the train parting. All ordinary braking must be done by the engineer; hand brakes used only in emergency or in the event of air-brake failure.

Cars being placed on side-tracks or any place where the car is to remain, the air must be bled out of the auxiliary reservoirs so the brake on the car is released, then a hand brake put on.

Where engines and tenders are to be used to move the cabin car from the cabin track up to where the train is made up, the engine and tender must be coupled to the cabin and the air gauge tested with a short train pipe. It is a very poor policy to test air gauge in cabin with a long train.

DOUBLE-HEADING.

When two or more locomotives are coupled together on the same train, the air-brake and signal hose must be coupled through to head engine and operated therefrom. The double-headed cocks beneath brake valves on other engines must be kept closed, handle of brake valves left in running position and their pumps run and full charged, and full pressure maintained in the main reservoirs ready for assuming control of the train-pipe at any time or moment. In case of failure to the head engine, it should be placed next to the train as soon as possible, but until this is done brakes should be operated from the second engine.

All interested must endeavor to prevent air-brake failure and leaks.

Where a car brake is defective and must be put to the rear of train, put on a defective card, marking the defect.

In case of an air-brake failure the engineer must leave brake valve handle in the emergency position. Then, with the conductor and other employees, will look at the position of all cocks, retaining valves and the position of handles, number of brakes found set, inches each piston traveled out, number of brakes cut out and disabled pipes, if any; the total number of cars in train; and thus be enabled to report in detail to the proper officer.

What would you do if you broke the pipe off leading to the conductor's valve or the valve started to leak so you could not receive any train-pipe pressure?

Plug the pipe and proceed.

What would you do if coupling up engine and tender to train and the engineer notified you it was an impossibility to receive any air, or a low brake-pipe pressure?

Close the angle-cock behind the tender, climb right up in the cab of the locomotive and look at the air gauge. If the air gauge shows an increase in pressure get busy and hunt the trouble on the train by taking five to ten cars at a time, just according to the length of the train.

MAKING UP TRAINS AND TESTING BRAKES.

Switch and trainmen when making up trains and testing brakes must place all air-brake cars next to locomotives, cutting in all brakes unless carded defective with at least two quick-action triple valves in good condition next to tender, and never more than two cutout brakes together among other good brakes. They must see that cocks are in proper position and hand brakes released before air is turned in from the engine.

After train has been coupled, stretched and charged to maximum pressure the engineer must be signaled to apply brakes, when it must be noted that they do not apply in the emergency with a service application and that each working brake has between six and seven inches piston travel. Engineer must then be signaled to release brakes. When each must again be examined to know that it has released. Any triple valve that is causing improper operation of the other should be located and cut out, carded, any defects discovered must be corrected and tests repeated until it is found that all the brakes in the train work correctly.

The above test need not be complied with following the separation of couplings for local switching or when locomotive and train have parted, further than to determine that rear brakes apply and release promptly in response to brake valve on engine.

As it requires one to three minutes to charge an empty auxiliary reservoir, no attempt should be made to test a brake before it has been charged.

When extra cars are attached to passenger trains en route they must be charged by the locomotive placing them.

The conductor and engineer must always be informed as to the number of cars with the brake in good working order and general character of the make-up of train, respecting positions of loads, empties, etc.

For quick service when testing a train of brakes, two men should be employed, each taking the number of cars allotted them, the first man to start from the head end and working back to the middle of the train, while the second man working from the middle to the rear end. When signal is given to release he should return and see if brakes are all released, then he should notify the head man that his portion is O. K; the No. 1 man to notify the engineer the condition of brakes.

DEAD ENGINES.

Dead engines and tenders en route must have cutout cock beneath engineer's brake valve closed, signal reducing valve at cutout cock closed, handle of brake valve in running position, with at least one brake working either the tender or driving wheel-brake, with at least three to five cars between the engine.

When an angle-cock is opened on the rear of a train by one of the train crew it must be left in that position until the train comes to a full stop. After the stop has been made, then close it.

What would you do if you broke the crossover pipe between the cutout cock and the triple valve, the foundation gear became disabled, the triple valve, the brake-cylinder or the auxiliary reservoir?

Put a defect card on marking the defect, and proceed.

What would you do if you broke the train pipe or the angle-cock off the pipe, or broke the crossover pipe between the drain cup and the cutout cock, the drain cup or the cutout cock became disabled, or you had a burst air-hose and you could not remove it?

Put a defective card on marking the defect, put it at the rear of train, and proceed.

CLEANING OF BRAKE-CYLINDERS ON FREIGHT CARS.

To all air-brake repairmen or men who have charge of brake-cylinder cleaning just a few words of good advice in reference to cleaning of brake-cylinders: I, as well as the I. C. C. people, was very much surprised when we started in to make our tests on Frackville Grade and put the cars in condition to proceed down the grade, as each and every car was inspected individually. There was a great surprise when cylinders were taken apart which had been stenciled, cleaned and lubricated just a few days previous and discovered that they had not been taken apart for months. Some of the leathers were worn clean through at the lower part of the cylinder; others where the expander fits in the leather. The leather was cracked nearly the full diameter of the leather; others, expanders out of their places where triple valves had been removed, the auxiliary gaskets leaking and plugs in the exhaust port of the triple valves very loose and retaining valve joints and connections only partly screwed together. We all know that a good brake for grade work depends all on the condition of the above work, and I must say it is a disgrace to a man to have his initials stenciled on cylinders in that condition.

CAR INSPECTORS.

In making up trains see that all air cars are associated together and the air-brakes are in good working order. If when the train is made up and time is up for the train to start and there should be a defective brake in the train, the car should be removed and repaired at once. If a perishable car or a stock car ,and it must be moved, the car should be carded, the conductor notified and the car repaired at its destination.

In making up trains and looking over same, piston travel should be looked after and kept to a standard. See that there are no leaks in the train-pipe. Good judgment should be used in reference to air-hose and no chances taken on same. If a hose should burst while the train is running at a high rate of speed the damage done would be slight and perhaps none at all, but at low speeds it is liable to do great damage to cars and their lading.

In putting in new hose gaskets always see that the grooves are cleaned out properly before replacing same. Bear in mind, if you don't clean them out the trainmen cannot replace the gasket when it is necessary for them to do so.

To apply a freight triple valve to a passenger car brake it is liable to throw the whole train into quick action when the engineer is making a service application with the brake valve.

All hand adjustments should be made with the slack adjuster standard to zero position. To replace worn shoes it is only necessary to screw adjuster to left. They should be cleaned and oiled each time the brake-cylinder receives attention.

In absence of air pressure the piston travel on tenders and freight cars may be adjusted and determined by first forcing the push rod into cylinder as far as it will go, then making a chalk mark on the push rod next to piston sleeve and winding the hand brake tightly. The distance the chalk mark travels will equal the piston travel.

In cleaning brake-cylinders always be sure to clean the leakage groove and see that the cylinder is all cleaned out ahead of the standard piston travel. In cleaning cylinder always use a piece of emery cloth on the front of the cylinder in case a piston should travel above the standard, for some unknown cause, so the brake piston will not stick in the cylinder and hold the brake on after the triple valve has gone to release position.

In cleaning a K triple valve always remove it from the auxiliary reservoir, so you can see the condition of the retarding spring and stem and the retarding device body.

Angle-cock or cutout-cock handles found loose should be repaired at once.

Auxiliary reservoirs 16x42 to be used with 16-inch brake-cylinder.

Auxiliary reservoirs 16x33 to be used with 14-inch brake-cylinder.

Auxiliary reservoirs 14x33 to be used with 12-inch brake-cylinder.

Auxiliary reservoirs 12x33 to be used with 10-inch brake-cylinder.

Auxiliary reservoirs 10x33 to be used with two 8-inch brake-cylinders.

Auxiliary reservoirs 10x24 to be used with one 8-inch brake-cylinder.

Auxiliary reservoir 10x14½ to be used with Westinghouse automatic brake-valve.

Auxiliary reservoirs 10x12 to be used with brake valve.

Where pressure of air is to be carried in train-pipe and auxiliary reservoirs above 70 pounds, then the 10 x 14½ reservoir is applied.

ENGINEERS.

Percentage of braking powers based on 50 pounds brake-cylinder pressure driving wheels should be braked 70 to 80 per cent. and tender wheels 80 to 90 per cent. based on 60 pounds cylinder pressure, and freight cars 70 to 75 per cent. All calculations to be based on lightest weight resting on rails beneath wheels having brake shoes. Passenger equipment car wheels should be braked 90 to 95 per cent. Cabin cars braked at 40 to 45 per cent., based on 60 pounds cylinder pressure.

Let us take the highest percentage of braking powers on a locomotive and with these figures of percentage we can understand that the largest locomotive does not hold any more in proportion than the smallest one. For instance, if a locomotive was to weigh 500,000 pounds and its braking power was 80 per cent. of 500,000 pounds, it would be braked at 400,000 pounds. Therefore, if a locomotive weighing 200,000 pounds was braked at 80 per cent. the braking power would be 160,000 pounds. So you can understand that the large locomotive weighs two and a half times as much as the small one, and it just takes two and a half times the power to hold it, but the braking powers in accordance are all the same.

It is always proper when charging an auxiliary reservoir to locate a gauge in the reservoir where the bleed valve is located, and note the time it takes to charge it with the different types of triple valves. Information to air-brake inspectors.

Type of Triple Valve.	Time in Seconds To Charge Auxiliary Reservoir from 0 to 70 pounds.
F 24	36 to 46
G 24	36 to 46

F 25		19 to 26
F 1		36 to 46
F 2		18 to 27
H 1	F 36	59 to 79
H 2	H 49	36 to 46
P 1	F 27	36 to 46
P 2	F 29	18 to 27
K 1		105 to 125
K 2		68 to 78

This is taking the triple valves just as discovered when attached to engine, tender and train.

PHILADELPHIA & READING RAILROAD.
FRACKVILLE GRADE.

Located in the State of Pennsylvania, Schuylkill County. This grade is 5 1-10 miles long and is situated 865 feet higher than Pottsville. The average feet of the grade per mile is 175 3-10 and is a 3½ per cent. grade.

AUGUST 7, 1919.

First test made by the Interstate Commerce Commission to operate coal trains down this grade with air-brakes alone.

The train was made up as follows:

One articulated Mallet locomotive, No. 1806, weight 478,500 pounds, and tender, combined weight, 648,500 pounds. Size of air compressor, 8½ compound Westinghouse. Main reservoirs, three, combined capacity 74,979 cubic inches. Type of brake equipment on locomotive, A 1 S. W. B. Westinghouse. Main reservoir pressure: Minimum, 110 pounds; maximum, 140 pounds. Brake-pipe pressure registered in cab of locomotive on air gauge, 91 pounds. Brake-pipe pressure registered in cabin in rear of train, 86 pounds. Brake-pipe leakage, 8 pounds per minute from a pressure of 90 pounds. Number of cars in train, 36. Total tons behind tender, 2386. Number of brakes operating, 36; number inoperative, none; operative, 100. Number of retainers tested, 35; number effective, 34. Number mountain efficient brakes by thermal test, 32. There were 66 1-3 tons per brake. Maintain efficiency by thermal test and tons per mountain brake cannot be determined in this test, due to the use of hand brakes. Tonnage as shown for individual cars in gross tons, 2240 pounds. Total tonnage behind tender is computed on the short ton, 2000 pounds, basis.

This test was destroyed by the wasting of air on the fourth cycle made. This is where they comprehended the necessity of the efficiency of a hand brake and it was given immediately. Twenty-eight hand brakes applied and remained applied until we reached St. Clair, or the foot of the grade. Train departed Frackville at 3.10½ P. M.; passed St. Clair at 3.40½ P. M.

METHOD OF OPERATING TRAINS ON FRACKVILLE GRADE.

The following rules will obtain in preparing and operating the test trains to be run down Frackville Grade:

Brake pipe and main reservoir pressure to be the standard now in effect on that grade.

Brake-pipe leakage must not exceed 5 pounds per minute from 70 pounds pressure.

Brake piston travel on all cars to be adjusted to between 6 and 8 inches.

Retaining valves on all cars to be put in such condition that on test they will hold the shoes firmly against the wheels for two and a half minutes after the triple valve is released and will show a good blow at the exhaust port when retainer handle is turned down.

Retainers to be tested as follows: A 15-pound brake-pipe reduction shall be made and as soon as the brake valve exhaust closes the brakes shall immediately be released, the observer to begin taking test time on the retainers as soon as the triple is heard to release. At the end of three minutes, the engineman will again make a 15-pound reduction, releasing as previously when the brake valve exhaust closes, continuing this until all retainers have been tested.

The brakes shall be operated while descending the grade by the regular engineer of the locomotive drawing the train, and any instructions that it may be found necessary to give him shall be transmitted through someone selected for that purpose, and only the one selected shall issue instructions to the engineer while the train is in motion.

Upon arrival at the foot of the grade the train shall be stopped and remain standing until a thermal test has been made by the observers.

RUNNING BRAKE PRACTICE.

P. & R. Railroad train, extra, Engine 1806, August 7, 1919.

Main reservoir pressure at Summit, 110 pounds minimum, 140 pounds maximum.

Brake-pipe pressure at Summit on locomotive 91 pounds; brake-pipe pressure at Summit on cabin car 86 pounds.

Departure time, 3.10½ P. M.

Number of hand brakes, 28. Time of making first application, 3.12¼ P. M., taking from a stop watch.

Application No.	B. P. press.	Red. in lbs.	Time. held on.	M. R. press at rel.	Time in release and recharged.	Estimated Speed M. P. H. at appli.	release.
1	91	8	68	140	20	10	6
2	85	25	73	140	33	10	6
3	85	30	77	140	40	9	5
4	85	35	140	140	64	8	6
5	85	27	83	140	47	8	6
6	85	25	118	140	83	8	5
7	91	20	30	140	44	8	5
8	95	16	85	140	38	9	6
9	90	17	123	140	48	8	6
10	90	18	42	140	158	9	6
11	90	13	44	140	54	9	5
12	90	12	35	140	89	8	5
13	90	8	30	136	..	10	6

Remarks—Piston travel under cars variated from 4½ inches up to 7½ inches. This is running piston travel after the train arrived at St. Clair.

These tests were directly under the superivision of William J. Patterson, Assistant Chief, Bureau of Safety, Interstate Commerce Commission; Mr. Howard, Mr. Cash, Mr. Hamilton, Mr. Bromley, I. C. Representatives; Alonzo W. Deal, Sr., Air Brake and Machinery Examiner, P. & R. R. R.

TEST NO. 5.

There were a total of eight tests made. The first test was lost and the other seven tests were absolutely perfectly and safely conducted, the brakes being applied and released and the train kept directly under control with the air-brakes alone.

August 12, 1919.

TEST NO. 5.

One articulated Mallet locomotive, 1806. Weight and tender.

You will notice the first locomotive in test No. 1 was used in test No. 5.

Total tons behind tender, 2382.

Brake-pipe leakage, 7 pounds per minute from 90 pounds pressure.

Number of cars in train, 36.

Number of brakes operated, 36; number inoperative, 0; operative, 100.

Number of retainers tested, 36; number effective, 36; efficient, 100.

Number of mountain efficient brakes by thermal test, 30.

Number of tons per mountain effective brake, 79.4.

RUNNING BRAKE PRACTICE.

August 12, 1919.

P. & R. Railroad train, extra, 1806.

Main reservoir pressure at Summit, minimum 115 pounds.

Main reservoir pressure at Summit, maximum, 140 pounds.

Brake-pipe pressure at Summit on locomotive, 90 pounds.

Brake-pipe pressure at Summit on cabin car, 86 pounds.

Number of hand brakes used, none. Time of making first brake application, 2.19 P. M.

Application No.	B. P. press.	Red. in lbs.	Time. held on.	M. R. press at rel.	Time in release and recharged.	Estimated Speed M. P. H. at appll.	release.
1	90	10	12	120	14	8	8
2	87	7	10	119	33	8	7
3	90	8	10	120	15	8	8
4	90	10	16	125	8	8	7
5	85	10	40	140	30	8	6
6	88	12	48	140	24	8	6
7	90	16	35	140	37	10	6
8	90	13	18	130	30	8	6
9	90	12	14	130	29	8	6
10	90	10	24	140	18	7	6
11	90	15	18	135	32	8	6
12	90	11	20	131	40	7	6
13	90	10	15	128	55	6	5
14	90	10	15	128	45	8	6
15	92	10	20	132	22	7	6
16	90	12	21	135	30	7	6
17	90	14	25	135	26	8	6
18	90	16	20	131	35	7	5
19	90	13	24	135	21	7	5
20	90	15	23	131	25	8	6
21	90	13	26	132	28	8	6
22	90	15	33	135	28	8	6
23	90	15	49	140	23	8	6
24	90	18	43	137	25	8	6
25	90	20	34	138	36	8	6
26	90	15	25	135	27	8	6
27	90	15	16	130	135	8	6
28	90	12	18	129	79	8	7
29	90	10	14	125	43	8	7
30	90	9	11	122	101	7	7
31	90	6	28	130	50	10	7
Average		12.3	23.4		86.9		

Piston travel under cars variated from 4¼ inches up to 7½ inches. This is running piston travel after train arrived at St. Clair.

This is what is considered very fine braking for a grade of this per cent., the operator of the brake valve being an old and experienced engineer on this grade.

A. W. DEAL,
A. B. & M. E.

FRACKVILLE GRADE.

August 6, 1919.

To Whom it May Concern:

Your information this date. If at any time you are requested to present yourselves either before the Management of the Corporation you represent as an Air Brake Supervisor or you are called to Washington, D. C., to have an interview with the Interstate Commerce Commission, Bureau of Safety.

In reference to the operation of trains on grades by the use of air-brakes alone, take good advice and never criticise the condition of cars accepted on your tracks from the different railroads in the United States, due to the fact that under a close inspection you will find the cars that belong to the Railroad Corporation you represent to be in the same condition as the other cars you examine.

Here is the proof of same. On August 6, 1919, at 3.15 P. M., Mr. Patterson, Assistant Chief, Bureau of Safety of the I. C. C. people, and Mr. Deal, the Philadelphia & Reading representative of air-brakes made a test of six cars just as they were located in the train, and must say all of the cars were equally the same—C. & O., D., L. & W., Pennsylvania, U. R. R., K. G. J. & E. and Philadelphia & Reading. After brakes were applied and released, with retaining valves all placed in retaining position. To retain the retainers just might as well have been left in full release as to be in retaining position, as they all were useless. After we started in to put cars in condition to proceed down the grade we discovered all cars in the same condition. There were eight (8) trains taken down the grade, which represented 35 cars to a train, which made a total of 280 cars for the eight trains.

We all must say 80 per cent. of the retaining valves were useless, due to improper placing of the retaining valves on cars, which were mostly of weighted class.

Some were hung out of line; others never had been looked after, filled with dirt, worn pin valves and seats, loose retainers on cars, pipe joints corroded and pipes shaken loose; not only on one class of cars, but all cars equal in these tests made. With the 280 cars attached in these eight trains we represented about forty different railroads.

Yours truly,

ALONZO W. DEAL, SR.,

Air Brake and Machinery Examiner.

EFFICIENCY.

That means all cars must be tested equal and all put in good condition before proceeding down grades.

To all trainmen operating trains on a grade: First, it is your duty to set up as many retainers as you desire for controlling the speed of the trains on the grade. After you have the retainers all set in their proper positions, then it is the duty of the engineer to whistle on brakes and make a 20-pound continuous brake-pipe reduction. After the brake valve exhaust ceases to operate, whistle off brakes, and when the brakes are released then it is the trainman's duty to see how long the brakes will remain applied with the retaining valves in retaining position. All brakes should remain applied at least three minutes. If they remain on in that period of time then you can realize that hand brakes must not be applied unless the engineer calls for brakes or you yourself notice the train is exceeding the speed limit.

So we, as railroad men, who were at these tests made on the grade must say the eight days' work performed on Frackville Grade, which represents a grade of 3½ per cent., were perfect and safe and hand brakes are out of the question for safety so long as the air-brakes are operating O. K.. Due to the fact that a retainer when in condition represents a brakeman, and no brakeman on any railroad in the United States can place a hand brake on a car to correspond with an air-brake. That is what makes it perfectly safe. But remember, all cars must be in good condition and have the same attention as the cars that passed down the grade the days the tests were made.

No doubt there are many men who will criticise the idea of the air-brake being safer than a handbrake. Yet when one understands the air-brake operations, he must agree to the fact. First, let us say we will use hand brakes just the way we did previously. The hand brakes are all set up tight and a brake club is used. After those brakes are once set up as far as the brakeman can place them with a brake club, then they do not start in and let up on the brakes again. They remain set until the bottom of the grade is reached. Now, when they come to a let-up in the grade the engineer works steam to assist the train through the let-ups, but where the air-brake is used the engineer can place in the brake-cylinder the pressure he desires—light applications for let-ups and heavy applications for the increased depth of the grade. Why? Because the train is directly under his control.

TO THE READERS OF THIS BOOK.

August 14, 1919.

Gentlemen:

Your information this date concerning the tests made on Frackville Grade, August 7 up to August 15, omitting the Sabbath Day, August 10.

Must acknowledge as an air-brake expert that these tests made on the above grade were absolutely safe and perfect, as each and every car was placed in good condition before starting down the grade, and at no time while cars were being placed in condition did the I. C. C. people slight one car. All cars were equal. These tests were directly under the supervision of

MR. WILLIAM J. PATTERSON,
Assistant Chief, Bureau of Safety,
Interstate Commerce Commission.

Again I must acknowledge the receipt of the other four experts present on the grade in regard to the air-brake subject. I personally comprehend that we could not have had four men on that subject any better fitted for the occasion than those that were present, as each and every move they made in preparing the trains to proceed down the grade was made in a practical manner, and through those moves it acknowledges the receipt of those men thoroughly understanding their business.

Yours truly,
ALONZO W. DEAL, SR.,
Air Brake and Machinery Examiner,
P. & R. R. R. System.

Washington, D. C.
Frank McManamy, Assistant Director,
Division of Operation,
U. S. Railroad Administration,
Washington, D. C., August 18, 1919.
W. P. Borland, Chief,
Bureau of Safety,
Interstate Commerce Commission,
Washington, D. C.
Gentlemen:

In accordance with arrangements between the Railroad Administration and the Bureau of Safety, Interstate Commerce Commission, demonstrations have been conducted on the Philadelphia & Reading Railroad for the purpose of controlling the speed of trains without the use of hand brakes.

The following participated:

PHILADELPHIA & READING RAILROAD.

Mr. Borell, Engineer Motive Power.
Mr. Scheifele, Road Foreman of Engines.
Mr. Boyer, Assistant Road Foreman of Engines.
Mr. Gallagher, Road Foreman of Engines.
Mr. Deal, Air Brake Instructor.
Mr. Runkle, Foreman Car Shops.
Mr. Stillwagon, Foreman Air Brake Men.
Mr. Hess, Assistant Train Master.
Mr. Balmer, Freight Train Master.

INTERSTATE COMMERCE COMMISSION.

Mr. Patterson, Assistant Chief, Bureau of Safety.
Mr. Cash, Inspector, Bureau of Safety.
Mr. Howard, Inspector, Bureau of Safety.
Mr. Hamilton, Inspector, Bureau of Safety.
Mr. Bromley, Inspector, Bureau of Safety.

It was mutually agreed that the most severe operating conditions existed on the grade between Frackville and St. Clair, and that if trains could be controlled without the use of hand brakes on that grade they could be handled on other grades of the P. & R. Railroad without further demonstrations, and on that account the Frackville Grade was selected.

Eight trains were taken from Frackville to St. Clair yard, one each day, from August 7 to August 15, inclusive, exclusive of Sunday, the 10th. On the first day, August 7, hand brakes were applied on the train for the reason that this was the first time the engineman had attempted to control a train on said grade by power brakes alone. This inexperience on the part of the engineman, together with the fact that he failed to comply with instructions as to brake valve manipulation, caused hand brakes to be resorted to on cycle No. 4. On all subsequent trains no hand brakes were applied.

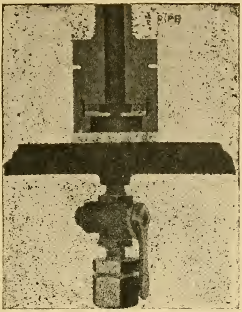
There are enclosed herewith reports showing certain standing test data, description of train, power brake equipment and running brake practice for each train.

The representatives of the railroad present while these demonstrations were being conducted stated that while their present unlawful practice is considered by them to be safe (using hand brakes), if the equipment was kept in proper condition, and the enginemen and crews instructed in handling trains on grades by use of air-brakes alone, they feel that trains can be safely handled.

After observing the demonstrations, it was apparent, and all who participated were satisfied that with proper maintenance and manipulation of the air-brakes, it is both practical and safe to control the speed of trains solely by air-brakes on the Frackville grade of the Philadelphia & Reading Railroad.

Respectfully,
E. A. BORELL,
ALONZO W. DEAL, SR.,
JOHN SCHEIFELE,
JOHN O. BOYER,
For Philadelphia & Reading R. R.

W. J. PATTERSON,
For Interstate Commerce Commission.



The above figure shows the sectional view of an orifice test to be used in connection with the different class of air pumps used on railroads.

1. Air pumps shall be tested by the use of an orifice not less than every three months, and oftener if required to be done.

2. Where altitudes are over 1000 feet, the air pump must be increased five (5) single strokes per minute.

3. Always remember the foundation of the whole brake system is the air pump. If every other piece of mechanical work connected with an air-brake is in first-class condition and the proper amount of air pressure cannot be obtained, that renders the brake system useless.

4. In using the A-1 equipment, I always instruct men to see that all connections made at the main reservoirs are perfectly tight before using the orifice to make a test of the air pump. If the air signal reducing valve is connected to the main reservoir, close the cutout cock in the reducing valve and test the pipe joints leading from the main reservoir up to the reducing valve. If the straight air-brake reducing valve is connected direct to the main reservoir always notes its condition or any connections leading from the main reservoir, such as air-sanders, bell-ringers, air doors, air reverse, ashpan slides, as any of those connections leak will deceive the one working the orifice.

5. When testing the air pump and the E. T. equip-

ment is used close the cutout cock underneath the brake valve; also the cutout cock on the supply pipe leading to the distributing valve, which is main reservoir pressure. Start the air pump and accumulate 60 pounds air pressure in the main reservoir, then close the steam valve to the air pump and note the leak in the main reservoir and its connections. If it exceeds 2 pounds per minute get busy and find the leak. After you have the leak fixed, then orifice the pump, but not before. A leak at the main reservoir may be sufficient for you to condemn the pump. Also close the cutout cock leading to the signal equipment.

6. In testing the steam action of the air pump the main reservoir pressure should be maintained at 53 pounds, with a boiler pressure of 125 pounds, and the throttle wide open. The stroke of the pump piston should be 104 to 106 strokes per minute. If the steam pressure is in advance of that pressure close the throttle until there is a stroke of the pump piston at the above number of strokes, and if it retains the 53 pounds of main reservoir pressure then the steam end is in good condition. If the pump throttle is wide open, with a boiler pressure of 125 pounds of steam, and the pressure of air is not accumulated up to 53 pounds of air in the main reservoir, then we can understand the steam action of the pump is not in condition to provide good results. The air inspector in charge should note the difference of the strokes of the pump piston with this boiler pressure, and if they decrease below the period of strokes the company desires them to be tested, and the pump should be repaired.

INFORMATION TO AIR-BRAKE REPAIRMEN.

Air-pump should be examined at engine houses to note the condition of air pistons and loose nuts once in every sixty days.

Copper gaskets should be used for the connections of steam pipes to the governors and pump.

Main piston rods worn one-sixteenth of an inch should be replaced.

Standard packing should be used on piston rods.

Main valve cylinders worn one-thirty-second of an inch should be trued up.

Where reversing valve rods are worn one-thirty-second of an inch between shoulder and button should be renewed.

Reversing plates worn one-sixteenth of an inch should be renewed.

Where air-cylinders are worn one-thirty-second of an inch they should be rebored, and the steam cylinder three-sixty-fourths of an inch.

These cylinders should be bored out at intervals until they are one-quarter of an inch increased above the standard.

Where counter bores of main cylinders have been increased, care must be exercised when placing on the heads and center castings that they be central, or trouble may exist in their operations.

Air valves should be replaced, when from wear these lift, causes pounding and overheating.

New valves must be ground to seats and fitted for three-thirty-seconds of an inch lift.

These diameters of main pistons must be carried in stock for repairs, standard and one-eighth inch larger and one-quarter of an inch larger; likewise packing rings to correspond.

GRADUATING SPRINGS.

Graduating springs made of phosphor bronze wire, 83-1000 inch in diameter, 12 coils 2½ inches long, are for plain triple valves used on locomotives.

Graduating springs made of nickeled steel wire 8-100-inch in diameter, 13¼ coils 2⅝ inches long, are for quick-acting triple valves on passenger cars and some tenders.

Graduating springs made of nickeled steel wire 49-1000-inch in diameter, 16 coils 2¾ inches long, are for quick-action triple valves on freight cars and feed valve attachments on engines, and under no condition must they be used in passenger triple valves.

October 7, 1919.

Gentlemen:

On the above date I had the honor conferred upon me, the said Alonzo W. Deal, Sr., by the General Manager, Mr. F. M. Falck, of the Philadelphia & Reading Railroad, through the office of the Superintendent of Motive Power, Mr. I. A. Seiders. It was his desire to have forwarded to his office the outlines pertaining to the training of soldiers that were performed at South Bethlehem, Pennsylvania, by their supervisor.

As this training was directly under the supervision of

Mr. A. W. Deal, it was an impossibility for anyone whatsoever to present the outlines covering this training but the one who was in charge of this patriotic work. After reading over the letter carefully, forwarded from the General Manager's office, the writer felt more than highly honored to realize that there was an appeal made by the Captain of the Coast Artillery Training Center, Fort Monroe, Virginia, as they contemplated in taking up the training of officers and men of the railway regiments in railway, and it was his desire to be furnished with the correct information regarding the schedule and subjects taught, etc., in course given by the said company pertaining to the training of engineers and firemen for overseas service at the time of the signing of the armistice.

Yours truly,

(Signed) HAROLD A. JOHNSON,
Captain.

GENERATION RECORD

Government Control of Railroads.

George W. Deal, the father of the writer of this book, entered the service of the North Pennsylvania Railroad, 1852, and departed this life 1895. Years in service, 43.

Alonzo W. Deal, Sr., entered the service of the North Pennsylvania Railroad November 1, 1876, and is in service at the present time.

Alonzo W. Deal, Jr., grandson of George W. Deal, entered the service of the Philadelphia & Reading Railroad 1904, and remained in the service until December 1917; 13 years in service.

1852 to 1895	43 years
1876 to 1919	43 years
1904 to 1917	13 years
Total	99 years

Railroad service.

September 6, 1918.

Lehigh University, South Bethlehem, Pa.
Henry Sturgis Drinker, President.

It gives me great pleasure to pay this tribute of apprecition and regard to Mr. A. W. Deal, Sr., Air Brake Instructor of the Philadelphia & Reading Railroad Company.

Last spring our University was requested by the War Department to take on drafted men from the cantonments to be assigned here by the War Department for training in several vocational pursuits. Among these it was suggested that we give intensive training to locomotive engineers and firemen, to fit them for immediate service in France. The Philadelphia & Reading Railroad Company cordially co-operated in this and placed their air-brake instruction car at South Bethlehem and detailed Mr. Deal to come here and take charge of the practical side of this training, which was supplemented at the University by instruction in our Department of Mechanical Engineering.

Mr. Deal has most patriotically and ably carried on the work in a manner highly satisfactory to the Government and to the University, and his services have been and are highly appreciated.

Very sincerely,

HENRY S. DRINKER,

President of Lehigh University.

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