PRACTICAL UP TO DATE PLUMBING

CLOW

Practical Up-To-Date Plumbing

BY

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OVER 250 ILLUSTRATIONS

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PREFACE.

This book is a practical up-to-date work on Sanitary Plumbing, comprising useful information on the wiping and soldering of lead pipe joints and the installation of hot and cold water and drainage systems into modern residences. Including the gravity-tank supply and cylinder and tank system of water heating and the pressure-cylinder system of water heating. Connections for bath tub. Connections for water closet. Connections for laundry tubs. Connections for wash-bowl or lavatory. A modern bathroom. Bath tubs. Lavatories. Closets. Urinals. Laundry tubs. Shower bath. Toilet room in office building. Sinks. Faucets. Bibb-cocks. Soil-pipe fittings. Drainage fittings. Plumber's tool kit, etc., etc.

THE AUTHOR.

HOUSE DRAINAGE.

The fact that plumbing during the past ten years has reached a most remarkable stage of development in the construction of improved systems of sewerage, house drains, ventilation and fixtures, is due to several causes.

In the first place, the manufacturers of plumbing supplies in their pursuit of commercial supremacy have employed a number of sanitary engineers, who by experimenting and investigation, have perfected systems and fixtures which are a preventative against the dangers of sewer gas and their subsequent results, such as typhoid, scarlet fever, dysentery, etc., coming as they frequently do from no apparent cause, as far as modern science will permit.

Secondly, good and safe plumbing has ceased to be a luxury. Its protection against the above mentioned diseases, and its safeguard to good health, have made it a necessity. Heretofore many earnest, well-meaning persons, not appreciating the importance of correct drainage and plumbing, were inclined to sacrifice this vital factor in their buildings, and even to-day the remark of some builder is often heard, to the effect that the balance of the house has cost so much more than was originally intended, that no more money than is absolutely necessary can be expended for the plumbing. The knowledge and skill which is employed for the construction of the rest of the house, should be as carefully applied to the sewer, ventilation, bath and toilet rooms, and their fittings.

Modern knowledge has taken the place of ignorance and neglect, and the fixtures and systems, which were thought good enough ten years ago, are to-day branded as old, on account of their not being a proper safeguard against disease. Every builder should weigh these facts well, and make himself familiar with the dangers arising from putting in a poor system, as even the smallest leak will cause sickness and often death.

The first subject to be taken up in the plumbing line, is the house drain, which are the pipes which carry from the house the liquid and soil refuse. The accumulated waste from food, clothing and bathing, tends to decay, and must be removed promptly and properly, or disease will result. The sewer which conveys the matter from the dwelling, must be absolutely perfect. In all cases, the sewer pipe within the foundation wall, should be extra heavy cast-iron pipe, coated inside and out with hot asphaltum, and should run through the foundation wall, and the connection should be made to the vitrified sewer at least ten feet outside of the building wall. The connection between the iron and vitrified soil pipe should be carefully made at X and cemented tight with a good grade of Portland cement. A good idea is to incase the connection at X in a block of concrete, which will prevent the breaking of the joint at this point.

In the drawing Fig. 1 an installation is shown which is commonly used by a great many plumb-

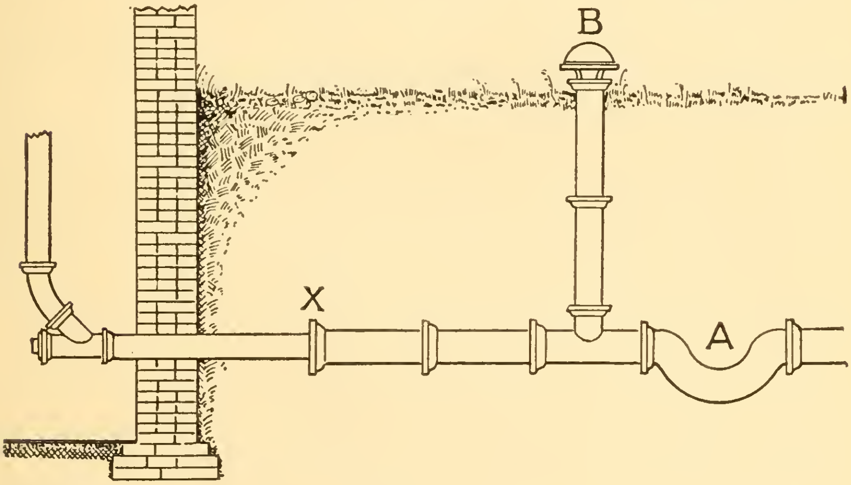

Fig. 1.

ers, but which has many disadvantages. The trap at A, which is placed in the connecting sewer, to prevent the ingress of foul gases from the main sewer, is in a poor location, on account of its inaccessibility. The vent opening to the fresh-air inlet at B ventilates the house system of drain pipes. This vent is often placed between the sidewalk and the curb, or in the front yard. The vent bonnet is very liable to become loose or broken, which will permit of dirt, stones, and sticks falling into the opening so left, and choke the sewer, which necessitates digging down to the bottom to clean it out. Another objection to placing a vent in a position such as shown, is that grass and other vegetation is liable to grow up around and into it, thereby destroying its efficiency. When a main disconnecting trap must be located outside of the building and underground, there should be built a brick manhole around it for easy access. The manhole for this purpose, should be two feet and five inches in diameter at the base, and closed on the top with a limestone cover, three inches in thickness, with an eighteen-inch diameter round cast-iron lid, which should have a one-inch bearing on the stone all around.

The drainage system illustrated in Fig. 2 is a very excellent one for a residence. The fittings as shown are standard stock articles, and consequently reduce the cost to a minimum. In the ordinary residence, a four-inch pipe is sufficiently large enough to carry away all of the sewerage. A drainage pipe must not be so large, that the ordinary flow of water will fail to float and carry away the refuse which ordinarily accompanies water. The pipe should be laid to grade, or a fall of one foot in forty feet. Care should be exercised to allow a large enough opening in the wall where the pipes pass through it, and espe-

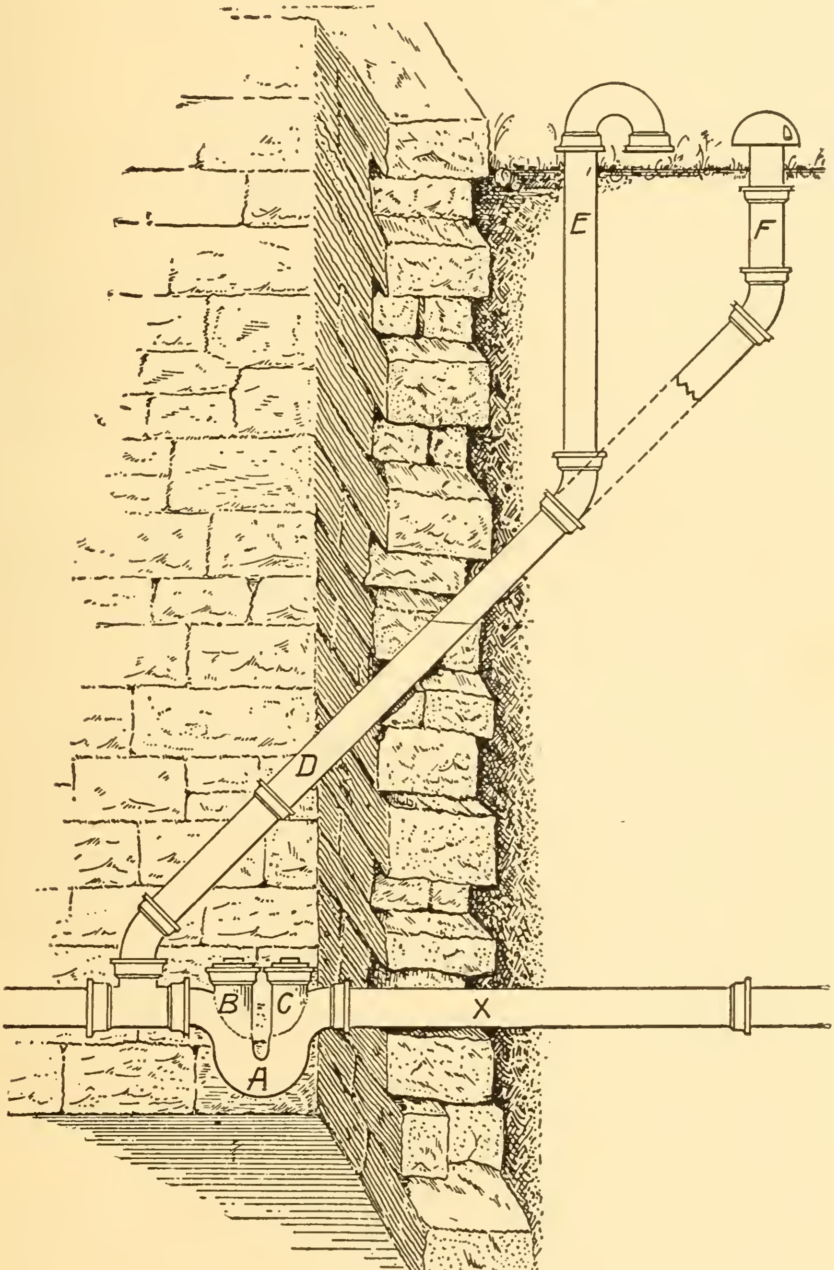

Fig. 2.

cially over them, to allow for setting of the wall without touching the pipes.

Extra heavy cast iron soil pipe, weighing thirteen pounds to the foot, coated inside and out with hot asphaltum, should be used in all cases for house drainage.

At A is shown a double-vent opening running trap. By calking a four-inch brass ferrule, with a brass-trap screw ferrule, into the hub at C, an opening which gives free access to the drainage system on the sewer end is obtained. Care should be taken in making this joint, and a good grade of spun oakum should be packed around the ferrule, with an iron yarning tool. The hub should then be run full at one pouring with soft molten lead, and then thoroughly calked with a blunt calking iron, which will make an absolutely airtight joint. The trap-screw cover should be screwed tightly into the ferrule with a good pliable gasket. It is very necessary that this joint be hermetically sealed, as the pipe X will constantly be loaded with sewer-gas from the main sewer, and any defective work at this joint will allow the gas to escape into the basement. The vent opening at B is to be treated in the same manner, giving an opening which permits easy access to the trap.

The air vent pipe D is run at an angle of forty-five degrees, and the extension E, which is run to the surface in this particular instance, is run close to the foundation wall, and the elbow calked on the top of the pipe, which prevents a possibility of any sticks, stones or other debris getting into same and retarding a thorough circulation. In order to have this drainage system properly vented, the fresh-air inlet pipe should be the same size as the drain pipe. Where it is impractical or impossible to run this fresh-air vent up close to the foundation wall and turn it over as shown, it can be run as shown by F, and when placed in the yard the inlet pipe can be capped with a regular air vent-cap fitting. Care should be taken in placing this fresh-air inlet, so that the chances of having it knocked off and broken will be as small as possible.

The extension piece in all cases should be long enough to permit of the opening in the vent-cap being, at least, eight inches above the ground. In the drawing the sewer or drain pipe is shown above the floor. In cases of this kind rests or supports should be provided at an interval of five feet, or in other words at every joint, to prevent the same from sagging and probably breaking the joints. When placed underground the top of openings B and C should be on a level with the flooring. In case of a shallow sewer in the street, the piping can be suspended from the ceiling, with a good heavy hanger supported by a joist clamp or swivel joint, which will permit the hanger being shortened or lengthened after the pipe has been hung.

BACKWATER TRAPS.

Backwater gate valves, are used on house drainage systems, where the street sewers are so small that excessive rain storms flood the system,

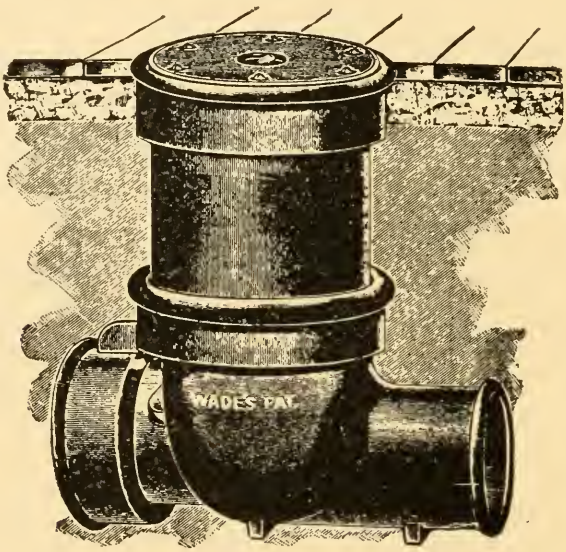

Fig. 3.

and back up into the house drain pipe. The body of the valve is of iron, and the gate valve is made of fine brass, with planed face to make it water and gas-tight. The valve is hung with heavy brass hinges, and in action is automatic, by means of which the flow of sewer water, gas and refuse from the public sewer is prevented from backing up into the house drains. The cover on the inspection clean-out is fastened down to a gasket with heavy screws counter-sunk so as to be flush with the top, and which are easily removed for inspection and flushing purposes.

The trap is shown in Fig. 3 with an iron extension man-hole, which extends from the drain in the ground to the surface of the cellar floor, and is provided with a water and gas-tight metal cover bolted to a gasket, which can be easily removed, and which prevents disturbing floors and

Fig. 4.

concrete, when there is any necessity of inspecting the interior. A combination house drain trap and back-water trap with vent opening and inspection opening or a cleanout opening, is shown in Fig. 4. A trap of this type, or, in fact, any trap should be set perfectly level with regard to the water seal. If the inlet to the trap is tipped up, it will not retain enough water to form a water seal, and if the outlet is tipped up, too much water will be retained, and will back up into the drain pipe. These traps should be placed back of the house drain sewer trap and before the air-vent opening fitting. These gates should never be used instead of a drainage trap, but in connection with same.

DISPOSAL OF SEWAGE.

The disposal of sewerage in districts where there are no public sewers at hand is often a matter of difficulty. Formerly, it was believed that if a running body of water, river or creek, was at hand, into which the sewerage could be emptied, the question of adequate sewer systems was solved. Frequent epidemics of diphtheria and scarlet fever, have called forth careful investigation, which has proven that the pollution of streams contiguous to domestic water supplies with sewerage, is one of the greatest dangers to health. This subject is being more closely studied every year, which is probably due to the wide publicity given it in discussions and reports of health departments. It is the purpose to consider some of the best sanitary systems and appliances applicable to the convenience and health of country districts. A system which is adaptable for one place will not prove an adequate or effectual system for another. It lies with the plumber or builder to study the conditions as they exist, and to exercise a little common sense.

The old out-door closet, with its revolting stench and inconvenience, is rapidly disappearing. Private and public water service have made it possible to install a modern bath room, even in the country, but the sewer disposal in most cases, is a puzzling proposition.

The primitive method of installing a leaching cesspool, which is a hole dug in the ground deep enough to allow five or six feet of space below the inlet end of the house drain pipe, and five or six feet wide, walled up with loose stones, the bottom left loose and filled with about a foot of small stones and the top walled over with a tight arch, and the earth filled in to the grade level thereby depending on the liquid to ooze away through the porous strata, has a great many disadvantages. In the first place, in communities where the neighbors depend on wells for their water supply, it is very dangerous, as it invariably pollutes the subsoil in the neighborhood and contaminates the well water supply. On a farm where plenty of ground is available, if located at a good distance from the dwelling, and at a lower level in the opposite direction from the well, it may be used without causing any harm. In case such a cesspool is used, the arch should be built up to an opening, twenty inches in diameter, and run to the surface and closed with an inspection cover hermetically sealed by a rubber gasket.

The system of sub-surface irrigation for sewerage disposal has been very well thought of by our best sanitary engineers. It consists of two absolutely tight cesspools or concrete receptables, as

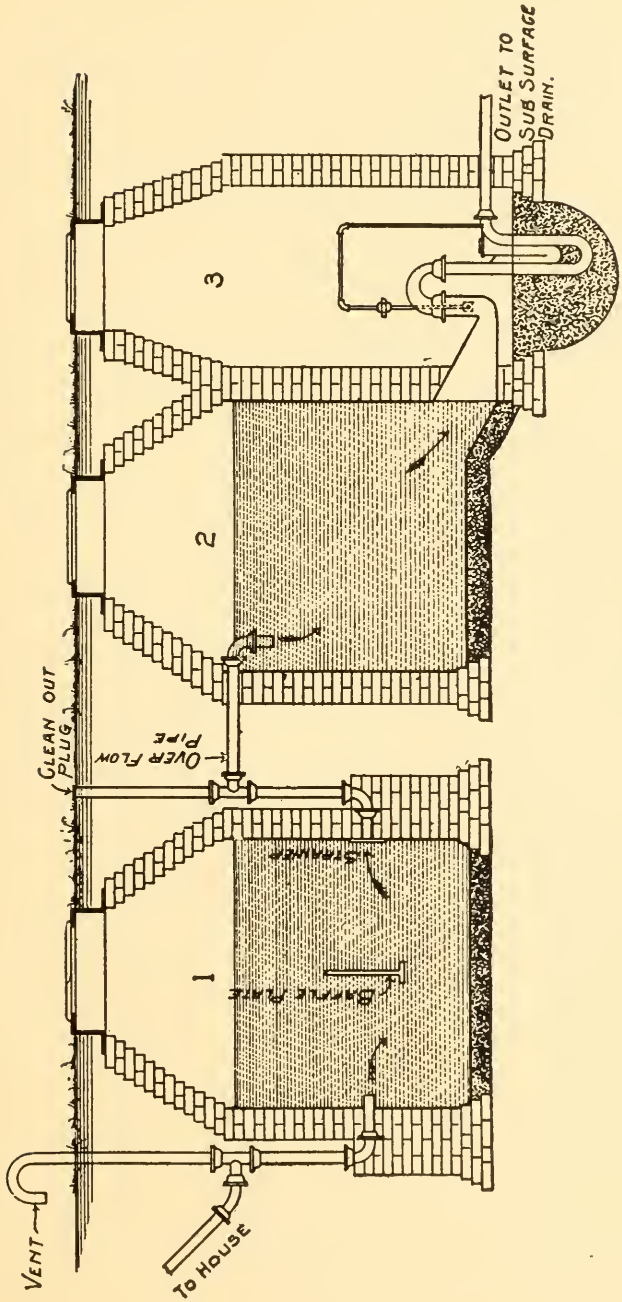
OUTLET TO
SUB SURFACE
DRAIN.
3
2
CLEAN OUT
PLUG
OVER FLOW
PIPE
1
VENT
TO HOUSE

Fig. 5.

shown in Fig. 5, built circular in shape, arched over, and with extended manholes to the surface, with tight inspection covers, also provided with an air-vest opening for the escape of gases, one tank to receive the drain from the house and to retain the solids and grease. The other for the liquid sewerage, connected together with an overflow pipe in such a manner that the first basin is drained into the second, without disturbing the grease and scum in the top of the first one, with a baffle plate, as shown, to prevent an underflow current from carrying the solids through to the second basin.

In the drawing an inspection basin is shown with the syphon for emptying the liquid outside of the second basin. The advantage of this is that in case of the syphon failing to work properly, it is accessible without disturbing the other two tanks. Another very frequent construction, which, of course, avoids the expense of the inspection basin, is to place the syphon in the second tank and protect it with a wire screen. The advantage of having the inspection basin, of course, is obvious, and hardly needs to be further commented upon here. The opening from the syphon is run with a four or six-inch vitrified salt glazed sewer pipe with tightly cemented joints, to a point down grade, where it is connected with four by two inch Y branches to a series of two or three-inch porous drain tile, which should be laid in a trench about ten inches deep, never deeper, on boards, with a very small fall about three or four inches per hundred feet, tiles to be laid with open joints, and joints to be covered with a half ring of vitrified clay or cup, to protect the same from filling up when buried. The liquid tank can be emptied in several ways, either with a sluice valve or a gate valve, both of which necessitates personal attention. The advantage of using the syphon is that it is automatic.

There are a great many different kinds of syphons on the market, and it is sometimes a matter of personal opinion as to which is the best. The liquid tank should not be emptied more often than once every twenty-four hours, which allows plenty of time for the ground to thoroughly drain, and to breathe in more oxygen, and then in a volume sufficiently large enough to fill all the drain pipes at once, to insure an even distribution. This system is, of course, preferably adapted to a porous or gravel soil. In places where clay soil conditions exist, the soil should be drained at least four feet below the level with porous drain.

COUNTRY WATER SUPPLY.

The procuring of a water supply in the country depends largely upon the surrounding conditions. Of course, when the source of the water supply is at a higher level than the house, a gravity system is the least complicated, and very often the cheapest. When the house is located at a reasonable height above the water supply, which could be made to supply an eight or ten-foot head, the hydraulic ram could be used. Rams will work, and work successfully, where the spring or brook is only three feet higher than the ram head, as the height or head increases the more powerfully the ram operates, and its ability to force water to a greater elevation and distance correspondingly strengthens. The best wearing results will be secured where the head or fall does not exceed ten feet; the head on the discharge pipe may be from five to ten times the head on the drive pipe. As a specific example: It might be said a fall of ten feet from brook or spring to the ram is sufficient to raise water to any point, say 150 feet above the machine, while the same amount of fall would also raise water to a point considerably higher, though the quantity of water discharged will be proportionately diminished as the height and distance increase.

Rule for Estimating Delivery of Water. Multiply the number of gallons supplied to the ram per minute by three, and this product by the number of feet in head or fall of drive pipe, and divide by four times the number of feet to be raised. The result is the number of gallons raised per minute. **Example:** With a supply of ten gallons per minute delivered to a ram under a head or fall of ten feet, how much water can be raised to an elevation of 100 feet?

$$\frac{10 \times 3 \times 10}{100 \times 4} = .75 \text{ gallons per minute.}$$

To obtain a water supply which will deliver water at any faucet in a house, yard or barn, it is necessary not only to pump the water, but to have some means of storing it under pressure. The elevated tank delivers it by gravity pressure, and, when used, should be placed at least eight to ten feet above the highest point from which the water is to be drawn, to insure a respectable velocity of discharge.

Compressed Air System. The principle of delivering water and other liquids by pressure of compressed air is very old, but it was not until recently that this principle was employed to furnish domestic water supply.

One of the greatest advantages of the compressed air system is that it does away with the elevated tank, and there are a great many defects in the elevated tank system. If placed in the attic, it is not high enough to afford a sufficient pressure to be any protection against fire. Another objection is the weight of the tank, when filled with water, is very liable to crack the plastering and to leak. Another serious defect of the elevated tank, when placed in an attic or on a tower is the exposure to weather, in the winter it freezes and in the summer it becomes warm.

In the compressed air system the tank is placed either in the ground below the frost line or in the basement, and the water is pumped into the bottom of the tank with a force pump, which may be operated by hand, windmill, gas engine or hot-air engine. Another opening in the bottom delivers water to the faucet in the house, yard or barn. As the water is pumped into the bottom of the tank the air above it, not having an outlet, is compressed. This pressure is increased and maintained by an automatic air valve. It does away with the elevated tank, and delivers water at an even temperature all year around. The tank and pipes leading to and from it are protected from the weather. A pressure of fifty pounds is easily obtained, which equals the pressure from an elevated tank one hundred and ten feet high. This affords first-class fire protection and enables the country residents to have all the sanitary conveniences of a city home. A double system of this kind can also be installed, one for furnishing well or drinking water to the fixtures, and another one supplying soft water from the cistern.

In Fig. 6 a steel storage tank is shown buried in the ground below the frost line, water is pumped into it by hand or windmill. This pump forces both air and water into the tank at the same time. A connection run to the surface near the house to a yard hydrant with hose connection furnishes water for sprinkling and fire protection, another branch supplies water to the barn, under pressure.

In Fig. 7 a steel storage tank is shown placed in the basement and supplied with a hand pump. These two illustrations will serve to give some idea of the extent to which a system of this kind can be put to use. The tank is practically indestructible, and, unlike the elevated tank, requires no expense after it has been put in. When the tank is one-half full of water, the air which originally filled the entire tank will be compressed into the upper half of it and will exert a pressure of fifteen pounds to the square inch, and if a straight supply pipe was run from the bottom of the tank, this air pressure would force the water to a height of thirty-three feet. For ordinary elevation the best results are obtained by maintaining in the tank excess air pressure of ten pounds, that is, enough air to give ten pounds

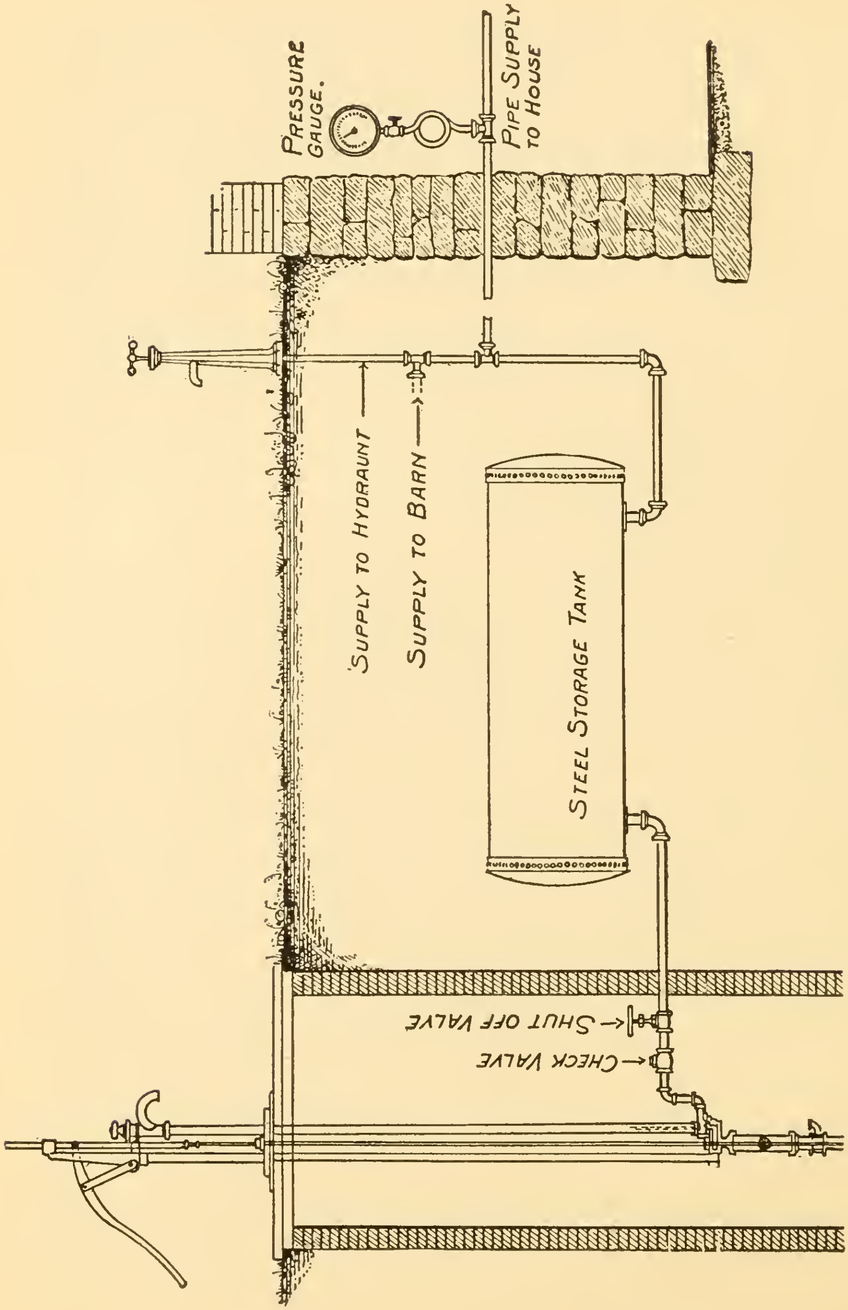
PRESSURE GAUGE.
PIPE SUPPLY TO HOUSE
SUPPLY TO HYDRAUNT
SUPPLY TO BARN
STEEL STORAGE TANK
SHUT OFF VALVE
CHECK VALVE

Fig. 6

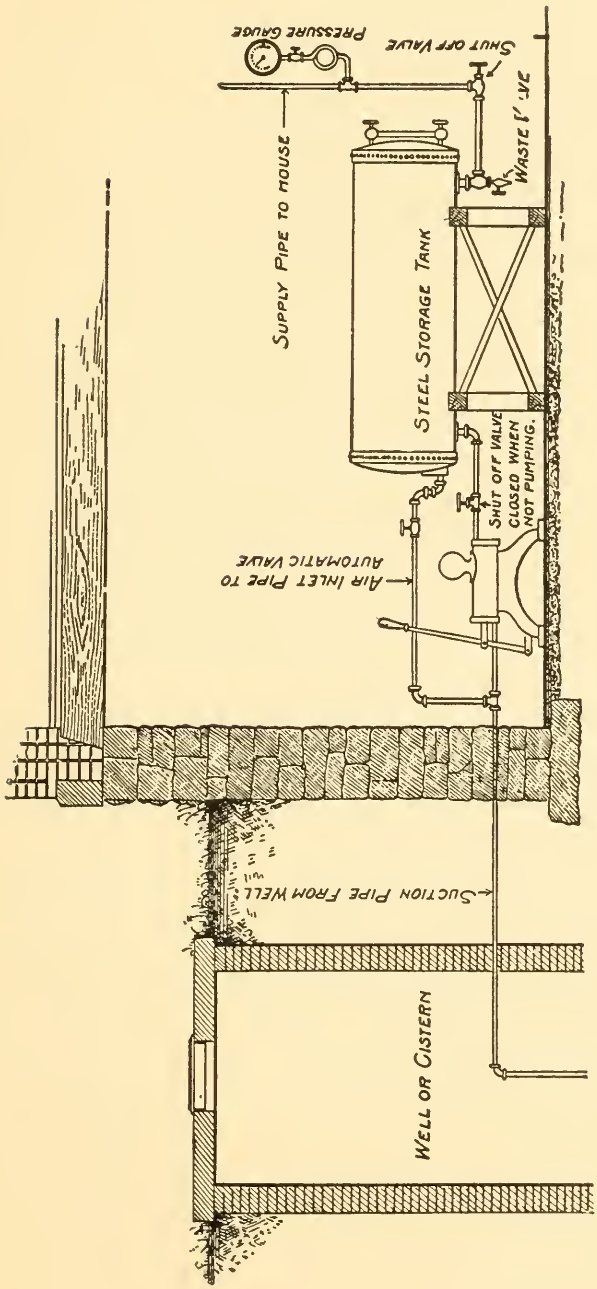
PRESSURE GAUGE
SHUT OFF VALVE
SUPPLY PIPE TO HOUSE
WASTE
STEEL STORAGE TANK
SHUT OFF VALVE CLOSED WHEN NOT PUMPING.
AIR INLET PIPE TO AUTOMATIC VALVE
SUCTION PIPE FROM WELL
WELL OR CISTERN

Fig. 7.

pressure when the tank contains no water. Thus equipped, a tank will deliver twice as much water as otherwise.

Most of the country towns at the present day are supplied with efficient water systems, and it is a very easy matter to install a hydraulic system which supplies hot and cold soft water to every fixture in the house automatically and all of the time. One of the principal objects desired in the hydraulic system is to utilize the waste water from the hydraulic pump so that there will be no loss, which is quite an item when the water is paid for at so much per thousand feet.

The system shown in Fig. 8 is a very simple and inexpensive one. The city water supply is run direct to the hydraulic pump, and the city water passing through it is piped direct to the fixtures at which cold hard water is desired. In the drawing this pipe supplies the closet tank and one faucet over the lavatory for drinking purposes in the bathroom, also one faucet over the sink and two connections to laundry tub, which is very convenient, as the cold water can be utilized for rinsing purposes, thereby saving a great deal of the soft water. The operation of the same is, that when any of these five faucets are opened, it permits the city water to pass through the pump and at the same time operate the pump, which pumps soft water from the cistern to the tank in the attic from which a pipe is run down to the basement with branches taken off at the different floors to supply cold soft water, hence, to the hot water heater tank, from there on to the heater, back to the tank and around to the different fixtures supplying hot soft water. The return pipe prevents a dead end which necessitates wasting the soft water before the hot water begins to flow.

A method is shown whereby it is possible when the cistern is emptied to fill either the city water supply only with city water, or the entire system without its passing through the pump by the manipulation of three globe valves, designated as A, B and C. When the pump is pumping cistern water to the attic tank, valve B and C are closed, and valve A is opened. When the cistern is emptied, and it is desired to fill only the cold city water pipe with water, leave valve C closed, close valve A and open valve B, which permits the water to flow into the cold water pipe without passing through the pump. If it is desired to fill the entire system with city water, all that is necessary is to open valve C, which permits the water to flow up to the attic tank and down through the balance of the system. When this is done, valve D on the overflow pipe should be closed after the water begins to overflow, and not before, as the system would become air-bound.

An overflow pipe is shown leading from the attic tank to the cistern within the house. If it is possible to run this overflow pipe out onto the roof so that the overflow will return to the cistern through the eavestrough and downspout pipe to the cistern, it is best to do so, as the cistern water then has a chance to become aerated. The pipe to supply the sill cock or yard hydrant for sprinkling purposes should be taken off at a point before the supply to pump, to prevent the unnecessary work of the pump when sprinking. In case of a basement closet being installed, a connection can be taken from the city water supply pipe run to the laundry tub, three-quarter-inch galvanized iron pipe is sufficiently large enough for all of the main supply pipes with one-half-inch branches to the different fixtures. These hydraulic rams are manufactured so as to work, and work successfully, at as low a pressure as ten pounds per square inch.

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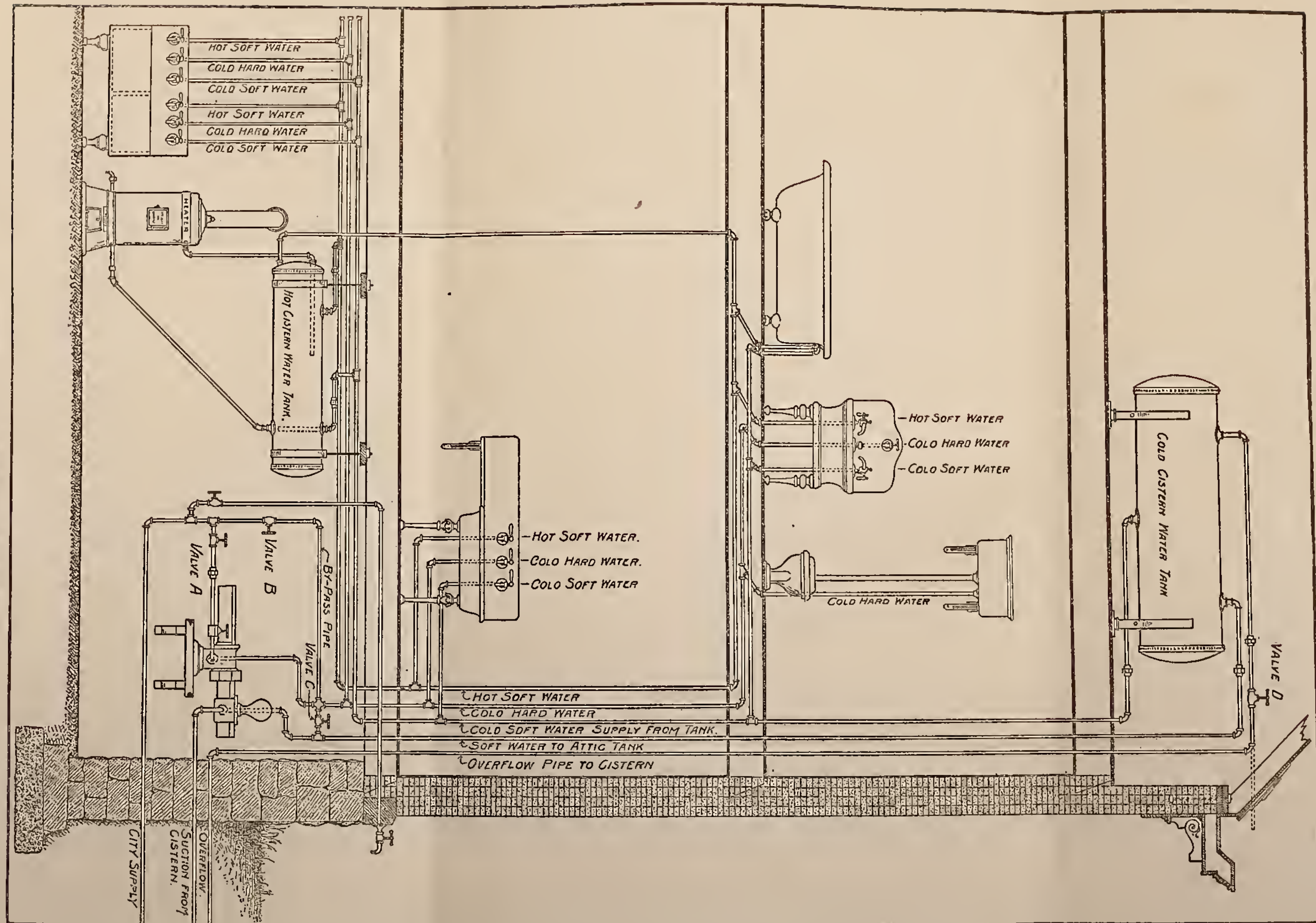

FIG. 8. THREE-PIPE SYSTEM

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CELLAR OR BASEMENT DRAINS.

Floor drains, when used in cellar or basement, should be connected to the leader side of a rain leader trap wherever it is possible. Some sanitary engineers go so far as to say that floor drains should never be used, their objection to them being that the floor is not washed often enough to furnish sufficient water to maintain a water seal at all times against sewer gas ingress, and their argument is well taken, but floor drains in a basement are very convenient, and should be part of a well-installed sanitary sewer system.

In case of a seepage of water through the foundation walls, during a rainy period, it is well to be provided with some means to carry the water away quickly, without having to resort to the laborious practice of pumping.

The evils of a floor drain are not so much due to their inefficiency, as they are to the care taken of them. The cemented floor basement of the modern home today is just as important to be kept clean as the bathroom, and the thorough housekeeper takes just as much pride in it, and realizes the necessity for having it so from a sanitary standpoint.

The old method of installing a floor drain or floor outlet which consisted of placing a running trap in the line of drain pipe to the catch-basin, and running a piece of pipe to the floor level and simply closing the opening with a bar strainer grate is wrong. The grate, even when cemented into the hub end of the pipe, will in time become loosened, and dirt and other rubbish will soon clog up the trap and render it useless.

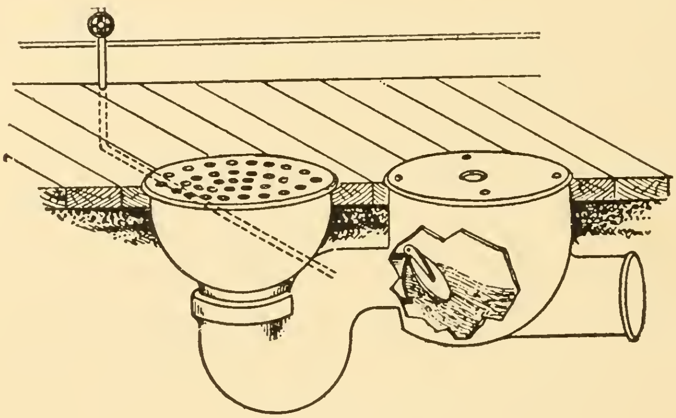


Fig. 9.

As before said, the great objection to a basement floor drain in the ordinary house, is that there is seldom sufficient water used on the basement floor, to maintain a perfect water seal in the trap. To neglect to see that the floor drain trap is not always filled with water and to argue against its installation on that point is wrong.

Floor drains should never be used without a back-water valve, which will prevent sewer water from backing up into the basement. A number of different styles of floor drains are shown, which are built on the proper lines. The one shown in Fig. 9 is a combination floor drain and back-water gate valve. This accessible cleanout cellar drain flushing cesspool and back-water gate trap valve combination has much to be commended. It has a hinged strainer, through which seeping and floor waste water finds a direct outlet to the trap and sewer. The trap has a deep water seal, which is always desirable, and is always provided with a brass back-water gate valve or flap-valve which will not rust and which will close and hold tight against a back flow from the sewer. It also has a tapped opening to which a water supply pipe can be attached, and by means of a valve being placed on the pipe at some convenient point, the drain trap can be throroughly flushed and cleansed by simply opening the valve for a few minutes at a time.

Another method oftentimes used to provide for a floor outlet to sewer is to run a piece of iron soil pipe from the trap on the sewer to the floor level, and to caulk into the hub of the pipe a brass ferrule or thimble with a brass screwed cover, which is screwed down tight against a rubber gasket, as shown in Fig. 10. An outlet of this character is only opened when occasion demands, by unscrewing and removing the cover until its need is past.

In Fig. 11 is shown an extra heavy cesspool suitable for barns, carriage room and places of

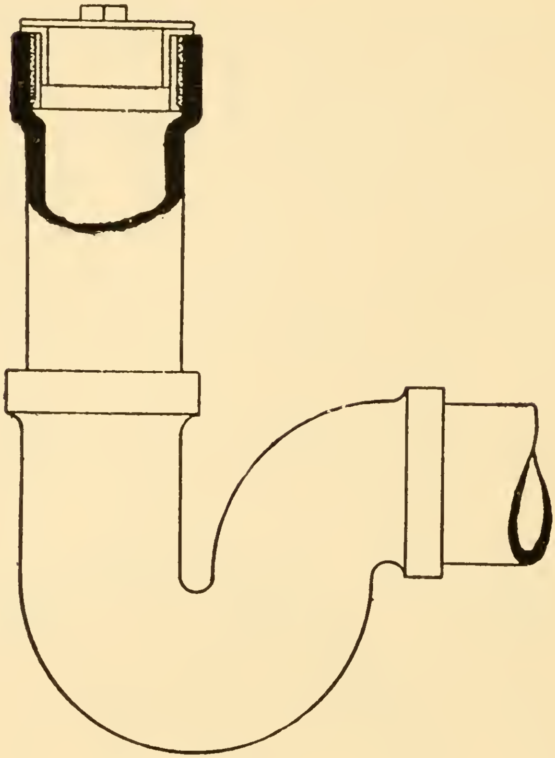


Fig. 10.

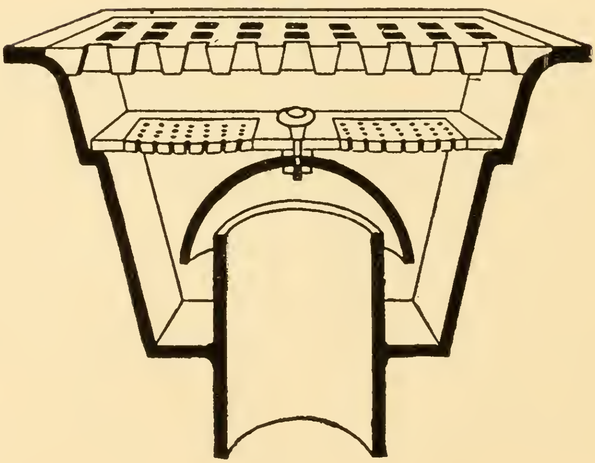


Fig. 11.

like nature. The top is sixteen inches square, the body ten inches deep and has a four-inch outlet, suitable for caulking into the hub of a four-inch iron sewer pipe. The top cover or grating is heavy enough to permit of horses, wagons and carriages passing over it. The second grating or strainer is of finer mesh, which catches any obstacles which might clog up the sewer, it can be lifted out by the knob and easily cleaned at any time. The deep water seal in this trap is one of its good features, the bell or hood not only serves to maintain a water seal, but where used in stables is a shield over the outlet to prevent oats or grain of any description which might fall through the second strainer from getting into the sewer.

Care should be taken to prevent the bottom of the cesspool from filling up with fine strainings.

Fig. 12 is a combination floor strainer and backwater seal and is used in the hub of a sewer pipe which extends down to the trap placed in the sewer run. The rubber ball prevents the flooding of the basement from backing up of water, by being floated to seat above.

In Fig. 13 is shown a floor drain and trap, designed especially for hospital operating rooms and other places where it is desirable not only to cleanse thoroughly the floor, but also to remove all sediment from the trap itself for obvious sanitary reasons. The trap is of cast iron, and is enamelled inside. This gives it an impervious

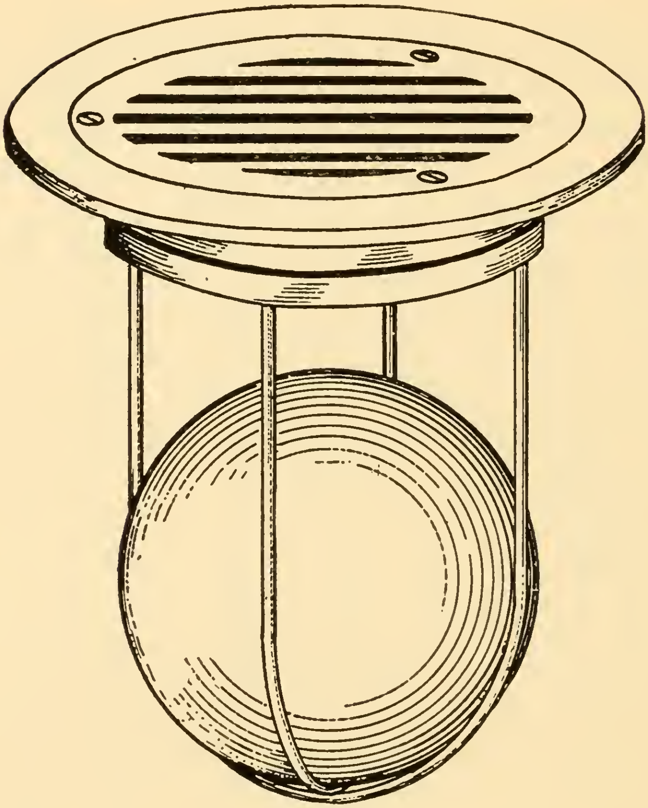


Fig. 12.

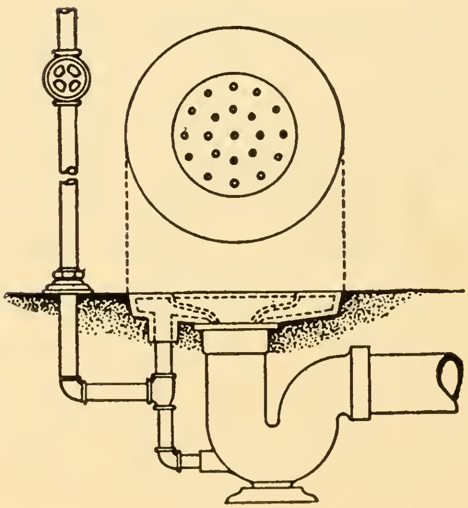


Fig. 13.

and smooth surface and prevents the trap from becoming coated and slimy. This trap is provided with heavy brass cast flushing rim and has a brass removable strainer.

In the sectional view is shown the method by which the water supply is connected to both the rim and trap, by means of which not only every portion of the body may be cleansed, but also all sediment removed from the jet inlet at the bottom.

The trap is built especially to maintain a deep seal and is three inches in diameter.

TRAPS.

A trap is a device or fitting used to allow the free passage through it of liquids and solids, and still prevent the passage of air or gas in either direction. There are two kinds of traps used on plumbing fixtures known as syphon traps and anti-syphon traps. The simplest trap is the syphon trap—a horizontal pipe bent as shown in

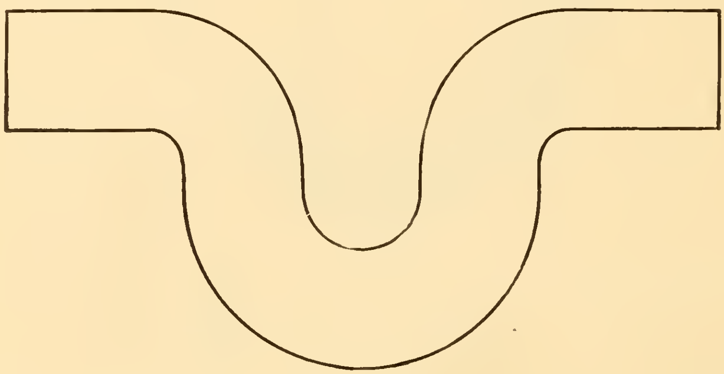


Fig. 14.

Fig. 14. This forms a pocket which will retain enough liquid to prevent air or gas from passing. The dip or loop is called the seal, and should never be less than one and one-half inches. This type of trap is what is known as a running-trap. This is not a good trap to use, and it is only capable of withstanding a very low back pressure.

The trap most generally used is what is known as the S trap, as shown in Fig 15. When this trap is subjected to a back-pressure, the water backs up into the vertical pipe, and naturally will withstand a greater pressure than the running-trap type—about twice as much.

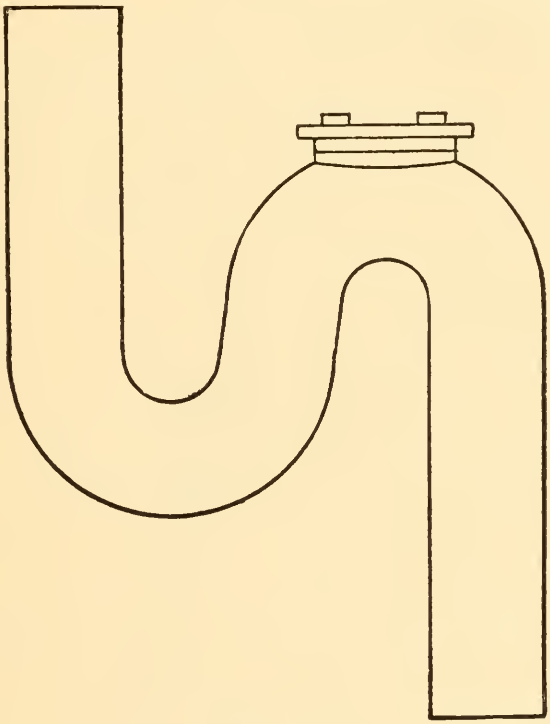


Fig. 15.

The trap shown in Fig 16 is what is known as a P trap, and in Fig 17 as three-quarter S trap, and has the same resisting power as the S trap.

A trap may lose its seal either by evaporation, self-syphonage or by suction. There is no danger of a trap losing its seal in an occupied house from evaporation, as it would take a number of week's time, under ordinary conditions, to evaporate enough water to destroy the seal.

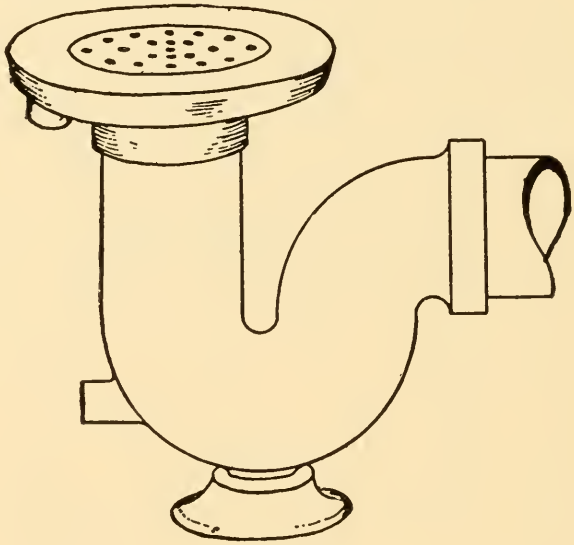


Fig. 16.

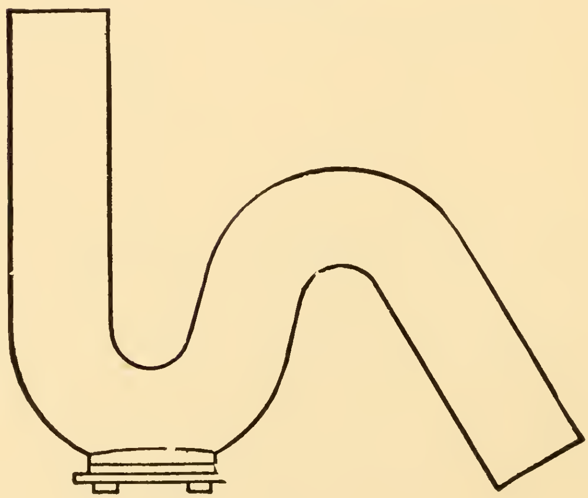


Fig. 17.

A trap can be syphoned when connected to an unvented stack, and then only when the waste pipe from the trap to the stack extends below the dip, so as to form the long leg of the syphon as in Fig. 18.

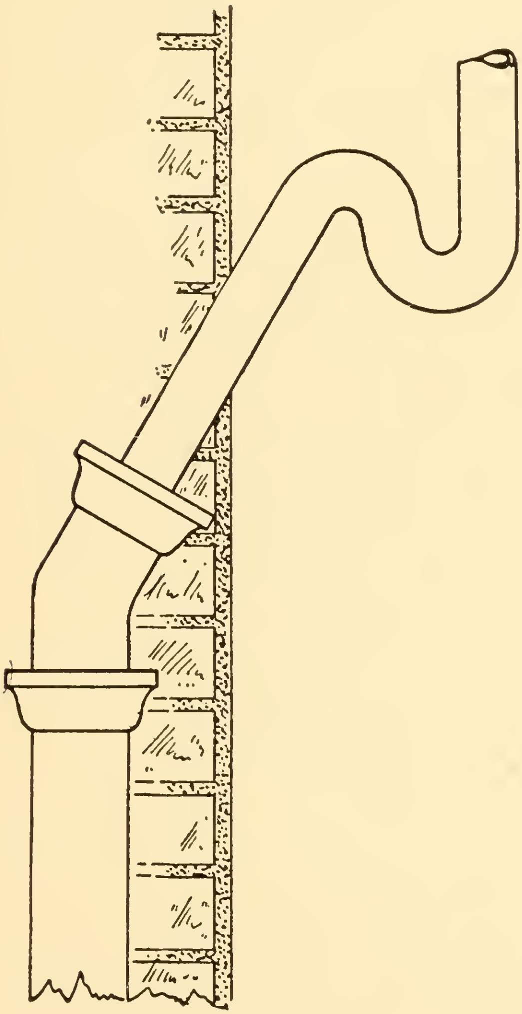


Fig. 18.

When two fixtures are installed one above the other, with unvented traps and empty into one stack, the lower trap can be syphoned by aspiration. The water emptying into the stack at the higher point in passing to the trap inlet of the lower fixture, creates a partial vacuum which sucks the water out of the trap at the lower point. To prevent this, what is known as back-venting is resorted to, back-venting not only protects the trap against syphonage, but relieves the seal from back-pressure, by equalizing the pressure on both sides of the seal. All revent pipes must be connected to vent pipes at such a point that the vent opening will be above the level of the water in the trap.

In Fig. 19 two basins are shown connected to soil pipe with S traps and back—vented into the air-vent pipe, both connecting into the attic into an increaser, which projects through the roof. This drawing is given to illustrate the proper back-venting to prevent syphonage of basin traps, and when it is necessary to run separate stacks for wash basins, such as are sometimes installed in bedrooms, the main waste stack must be two inches in diameter and the vent pipe one and one-half inches, either cast iron or galvanized wrought iron.

Non-syphon traps are those in which the seal cannot be broken under any reasonable conditions. Some water can be syphoned from the best of non-syphon traps made, but not enough to de-stroy their seal. The commonest non-syphoning

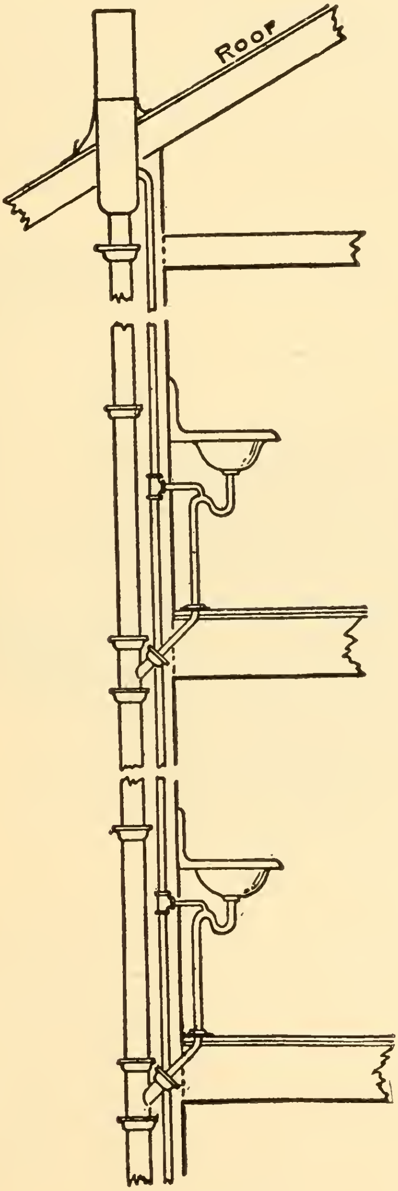


Fig. 19.

trap is known as a drum trap, which is four inches in diameter and ten inches deep. Sufficient water always remains in this trap to maintain its seal, even when subjected to the severest of tests.

Fig. 20 shows a trap, which is the type generally used to trap the bathtub. This trap is provided

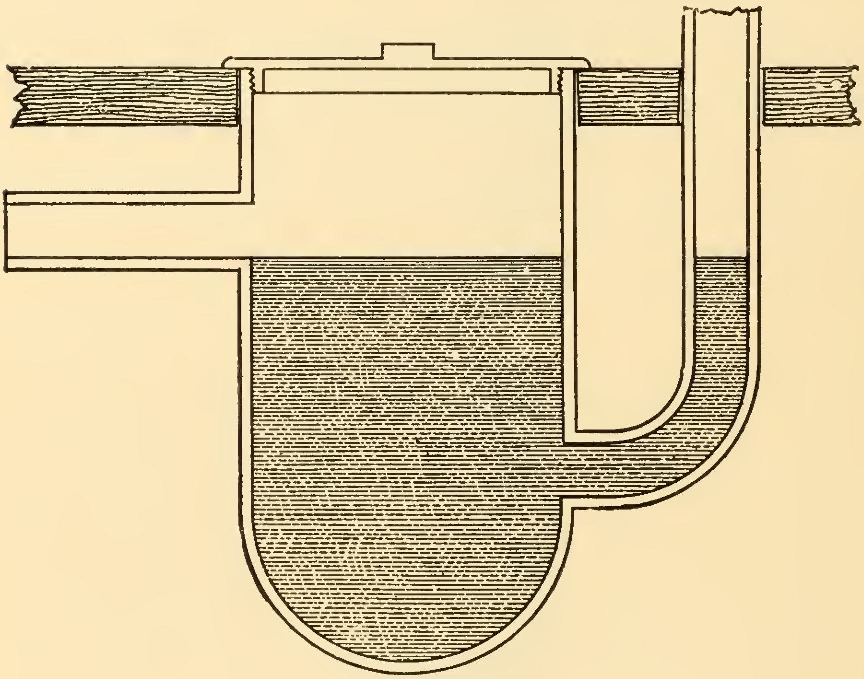


Fig. 20.

with a brass trap-screw top for clean-out purposes, made gas and water tight against a rubber gasket. A trap of this kind would not be suitable for a lavatory, its principal fault being that owing to the enlarged body they are not self-cleaning, affording a lodging place for the depositing of sediment.

The non-syphon trap to be used is one in which the action of the water is rotary, as it thoroughly scours the trap and keeps it clean, such as is shown in Fig. 21. This trap depends upon an inner partition to effect this rotary movement, and is so constructed that its seal cannot be broken by syphonic action and is permitted by health

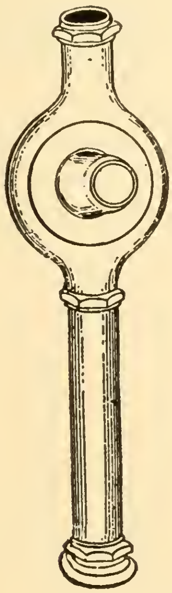


Fig. 21.

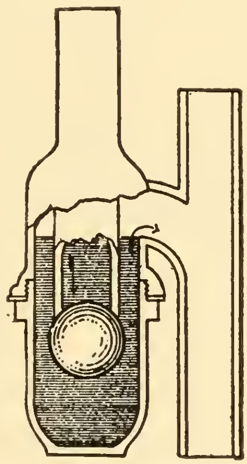


Fig. 23.

and sanitary departments, where it is impossible to run a separate vent pipe to the roof.

One of the oldest traps is the Cudell trap, as shown in Fig. 22. The rubber ball being of slightly greater specific gravity than water rests on the seat and forms a seal when the water is not flowing through the trap. This ball prevents the seal of the trap being forced by back-pressure, and acts as a check against back flow of sewerage should drain stop up, and provides a seal if water is evaporated.

Fig. 23 shows the old Bower trap. The water seal is maintained by the inlet leg, extending

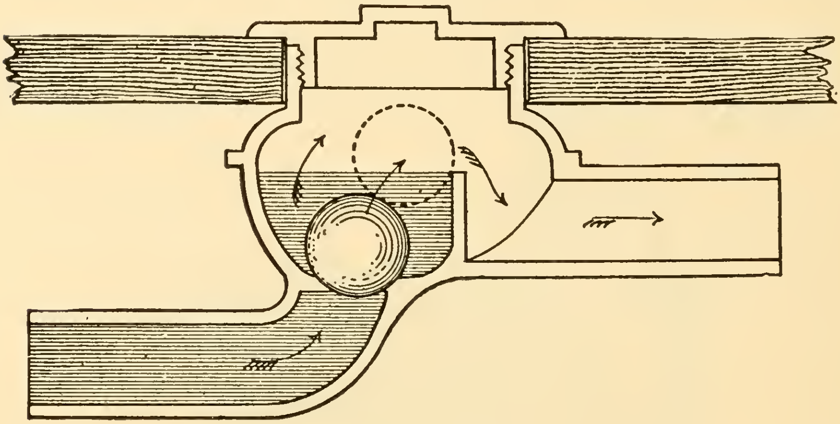


Fig. 22.

down into the body below the outlet. The bottom of this trap is glass, brass or lead, whichever is desired, and can be unscrewed from trap and thoroughly cleaned.

HOT WATER SUPPLY.

Cylinder System. In the cylinder system the principal difference from the tank system lies in the fact that the cylinder or reservoir of hot water lies beneath the draw-off pipes and not above them, as with the tank system. This being the case it is impossible to empty the reservoir unknowingly or accidentally, should the cold water supply be shut off.

Referring to Fig. 24, the flow-pipe proceeds from the extreme top of the waterback, and does not project through inside the waterback in the least degree. If it cannot be taken from the top, it must be connected to the side or back of the waterback as close to the top as it can be got, but the top connection should always be used if in any way possible. From the waterback the flow-pipe proceeds to the boiler and terminates five-eighths of the way up from the bottom. The pipe can enter the side of the boiler at the correct point, or it can come through lower down and be extended up inside with a bend and short piece of pipe together without making two holes.

The return pipe leaves the side of the boiler as close to the bottom as possible, or it can come from the bottom if desired. It then proceeds to the waterback and enters either through the top or the side, terminating half-way down with a saddle boiler. Both of these pipes, the flow and the return, must have a rise from the waterback to the boiler of not less than 1 inch in 10 feet.

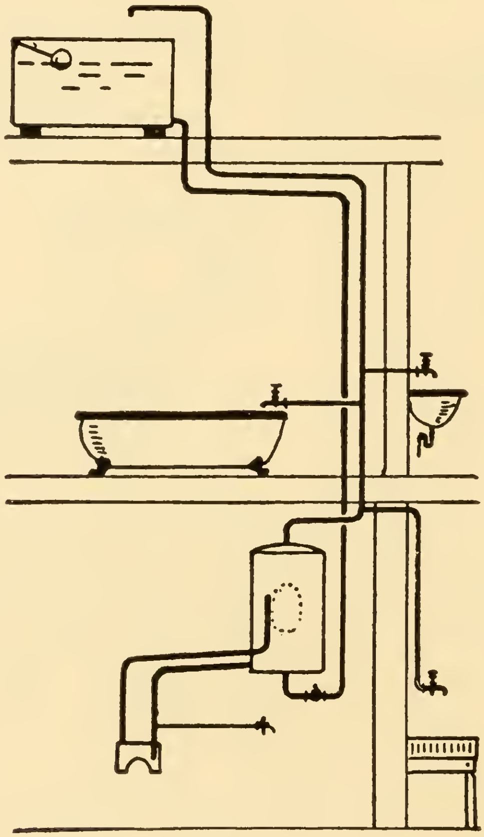


Fig. 24.

From the top of the boiler is carried the expansion pipe. This also should rise 1 inch in 10 feet from the boiler to its highest point. The highest point can be above the cold-water cistern or through the roof.

The cold water supply to the system is a pipe direct from a cistern, as shown. This pipe must not be branched for any other purpose.

It is of the highest importance that the cold water supply pipe should be of full size, and not choked or reduced in bore anywhere. The outflow at the hot water faucet is exactly in ratio with the down-flow of water through this pipe, less friction, therefore everything possible must be done to give the water full and free passage and lessen the friction. This is done by having the pipe of good size, using bends and not elbows, or lead pipe, and seeing that the stop-cock, if there be one, has a straight full way through it. The stop-cock should be put near the boiler, so that the man who cleans the waterback, or effects repairs, does not have to traverse the house to shut the water off and afterwards to turn it on. A tee should be put on the cold water supply connection, inside the boiler to spread the inflowing cold water over the bottom of the boiler. If this is not done the inflowing cold water will bore its way up through the hot water above, unless the pressure be quite low.

An emptying cock should be put somewhere beneath the boiler, but this cock must be provided with a loose key, so that only an authorised person can withdraw the water from the boiler.

The draw-off pipes are all taken from the expansion pipe as shown. This pipe should therefore be carried up by the best route to touch at the points where the faucets are, otherwise long single branches must be run. The expansion pipe, being a single tube, has no active or useful circulation in it.

It must never be forgotten that, on opening a faucet, on a secondary circulation, water will proceed from both directions to reach that faucet. The circulatory movements all cease, and quite a new action takes place. Water will come up from the top of the boiler and this will be hot. There will also be water coming up the secondary return, and the temperature of this will depend on whence it comes. If connected as shown in Fig. 25 then whatever water comes to the faucets will be hot, all there is of it, and when the temperature of the issuing water falls it may be known that the hottest has all been withdrawn. There have been several points at which the secondary return has been connected with bad results, notably at the bottom of the boiler, into the primary return (between the boiler and waterback), into the boiler, and even into the cold supply pipe just beneath the boiler. These are wrong, and only one position is correct, as shown in Fig. 25. The point is from 3 inches to 6 inches from the top of the boiler according to its size. The latter would be for a 100-gallon boiler. A 50-gallon size would have the connection 4 inches from the top.

Tank System. The usual arrangement of this system of water heating apparatus is illustrated

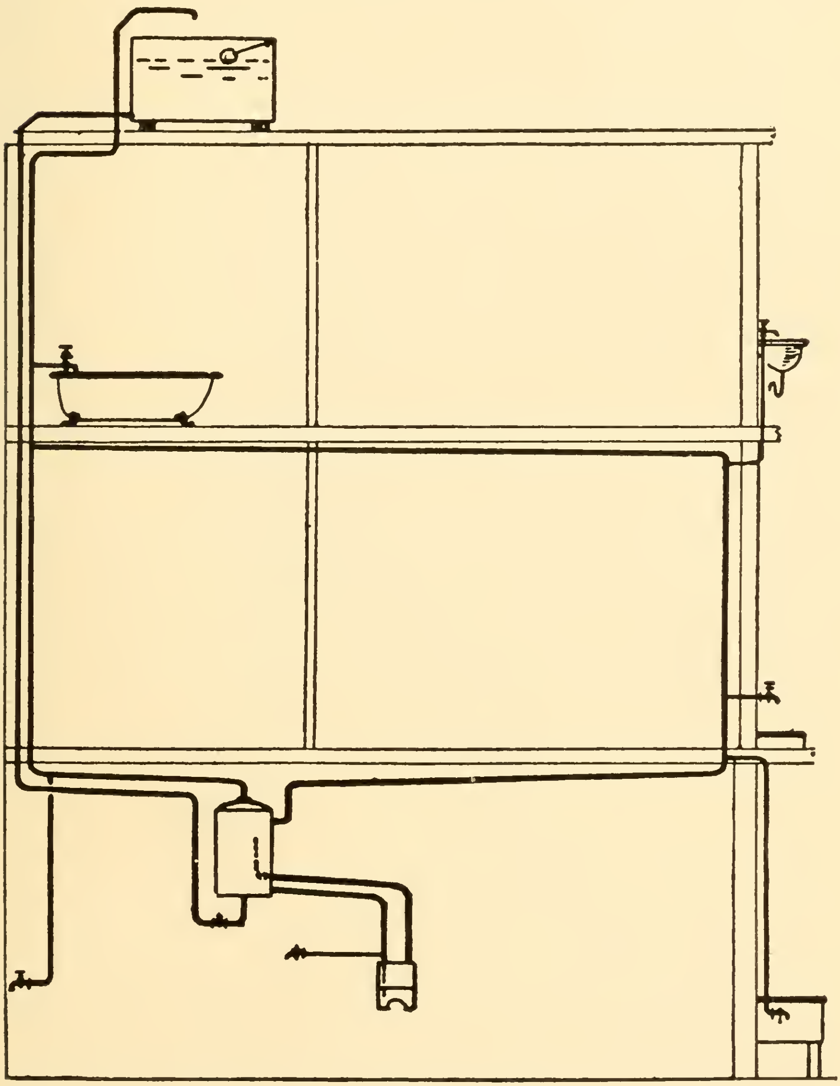


Fig. 25.

in Fig. 26. The flow pipe should proceed from the extreme top or highest point of the water-back, preferably from the top plate, and not project through to the inside of the waterback in the least degree. If it is impossible to connect

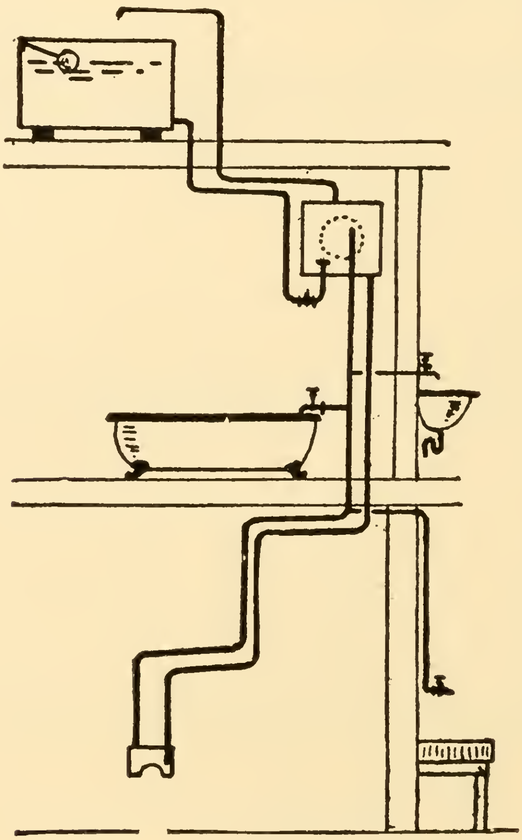


Fig. 26.

the flow pipe in the top plate of the waterback it should be located in the side or back, but as close to the top as possible. From the waterback the flow pipe should proceed to the tank and terminate in it about three-fourths of the way up, that is one-quarter of the height of the tank from the top. It may pass through the bottom and reach up inside as a stand pipe as shown in Fig. 26, or it may enter the side at the required height.

The return pipe should leave the bottom of the tank, being connected directly in the bottom or in the side of the tank near the bottom. It should never be more than an inch from the bottom. From the tank the return pipe should proceed directly to the waterback, and if entering the boiler through the top, should extend downwards, three-fourths the height of the waterback.

The draw-off pipes are taken from the flow pipe as shown. It therefore follows that the flow pipe should be carried in a direction which will bring it as near to all the faucets as possible. Instead of this, the most common practice appears to be to carry the circulating pipes by the most direct route from the waterback to the tank, and to consider the running of the branch pipes afterwards. There is no objection to the return pipe taking the shortest route, but the flow should be diverted to pass the work as near as possible. Failing this, there would have to be long single-pipe branches, and the fault of these is that so much cold water has to be drawn before the hot issues. This is not so much a fault at a bath, at which some cold water will probably be needed. At a lavatory basin, however, the fault is very pronounced, the faucets being small and slow-running, and at no point is the quick arrival of warm water appreciated more than at this one.

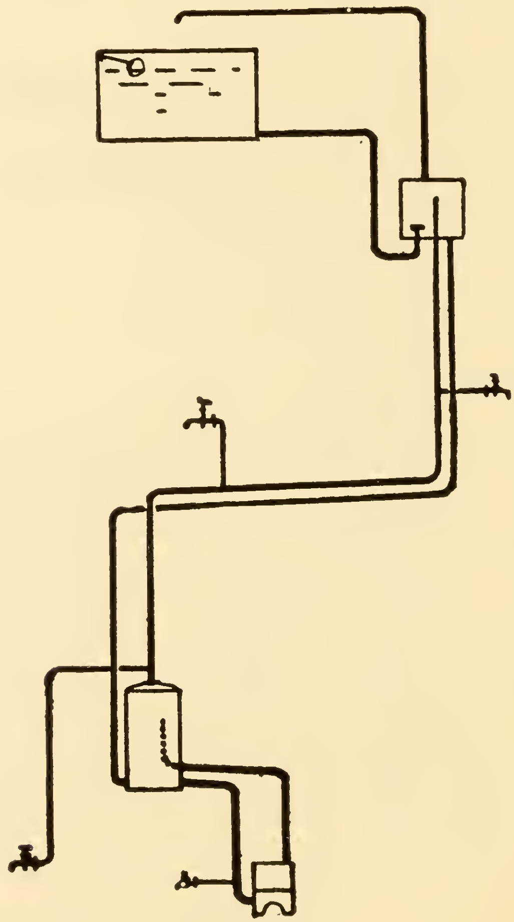


Fig. 27.

Cylinder-Tank System. This is simply a combination of the two systems previously described.

The tank system and the cylinder system both have good features which are retained in the cylinder-tank system, and also certain bad features which are eliminated in the combination system

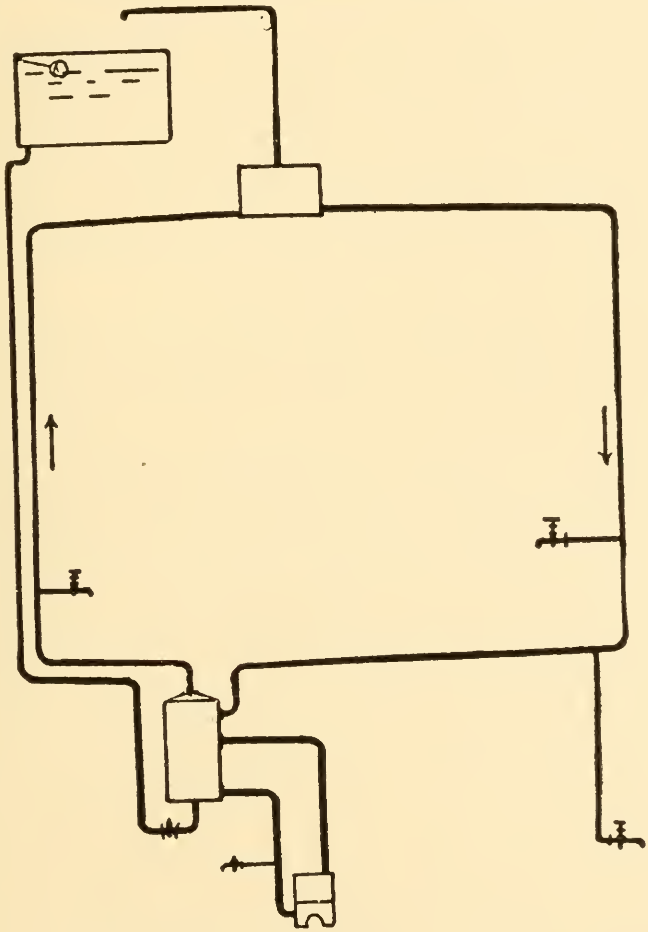


Fig. 28.

which may be here described briefly, the tank system ensures a good flow of water from the high faucets, while the cylinder system commonly has a very unsatisfactory issue of water from any faucets that are near the top of the house. On the other hand, the cylinder system is safest where the cold water supply is at all uncertain, as the cylinder—the reservoir of the apparatus—cannot be emptied. The object of the cylinder-tank system is therefore to ensure a good outflow at all taps by having a store of hot water above them, and to have a store of water which cannot be exhausted unknowingly if the cold water supply fails.

Fig. 27 illustrates this system of appartus in outline, and the parts need no general description more than that given already. As to the sizes of the tank and cylinder, the best practice for general requirements is to make them of equal capacity, and the two together should be no larger than one would be if alone. Thus, if a 50-gallon boiler would be the suitable size for a job erected on the ordinary cylinder system, then with the combined apparatus the boiler should be 25 gallons and the tank 25. In the cylinder-tank system illustrated in Fig. 27, the cold water supply is delivered into the tank directly from the cistern, while in the system shown in Fig. 28, the cold water supply is carried down to the cylinder.

HOT WATER PLUMBING.

As the drawings shown in the article on Hot Water Supply are merely diagramatic outlines of the different systems and are only intended to illustrate the principle of the circulation, which is involved in the heating of water for domestic use, further description and additional drawings are here given to illustrate the two systems of water heating in common use, viz.: the pressure-cylinder system and the gravity-supply tank and cylinder system.

In Fig. 29 is shown one of the simplest arrangements of the pressure-cylinder system for the successful heating of water for household use. The boiler, water-back and pipe connections are all plainly shown. In the boiler is a pipe extending down from the top and connected with the cold water supply, which it discharges in the boiler a short distance from the bottom. The distance down in the boiler which this pipe should extend depends upon the height that the pipe from the upper part of the water-back enters the boiler. The cold water supply should always enter the boiler at a considerable distance below the point of entrance of the pipe conveying the hot water from the water-back to the boiler.

The greater the distance that the hot and cold water pipes are apart in the boiler, the better will be the circulation and the less time it will take to heat a given amount of water.

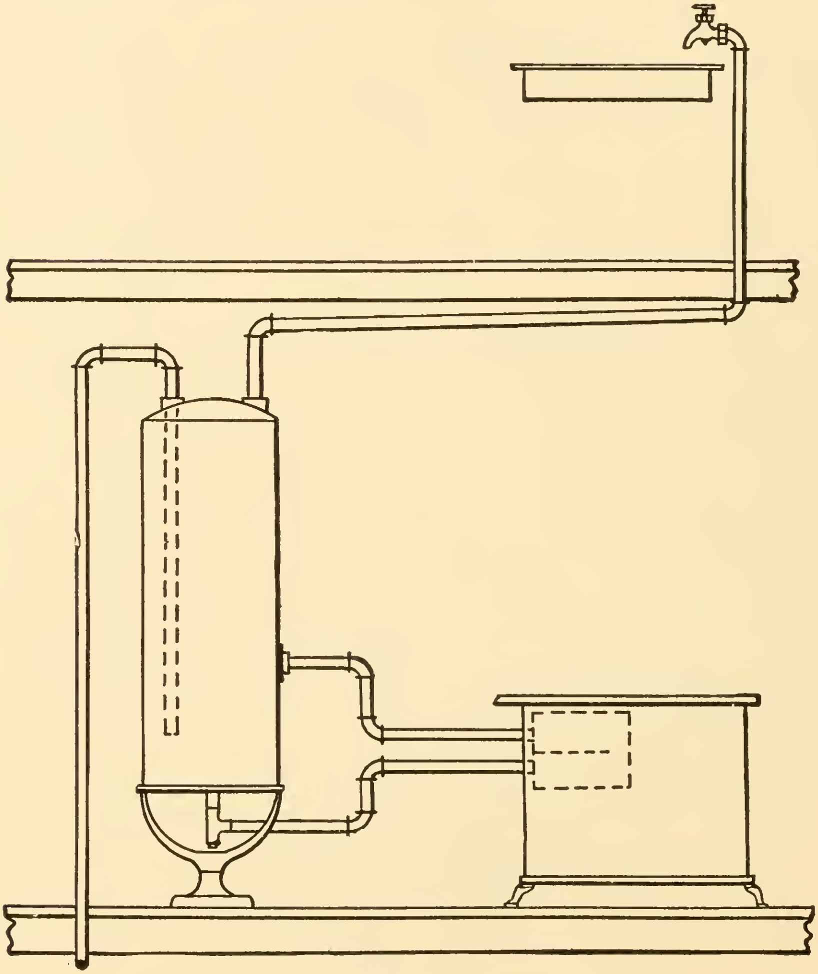


Fig. 29.

The piping in the arrangement shown in Fig. 29 is designed to deliver hot water on the floor above that on which the boiler is located. If hot

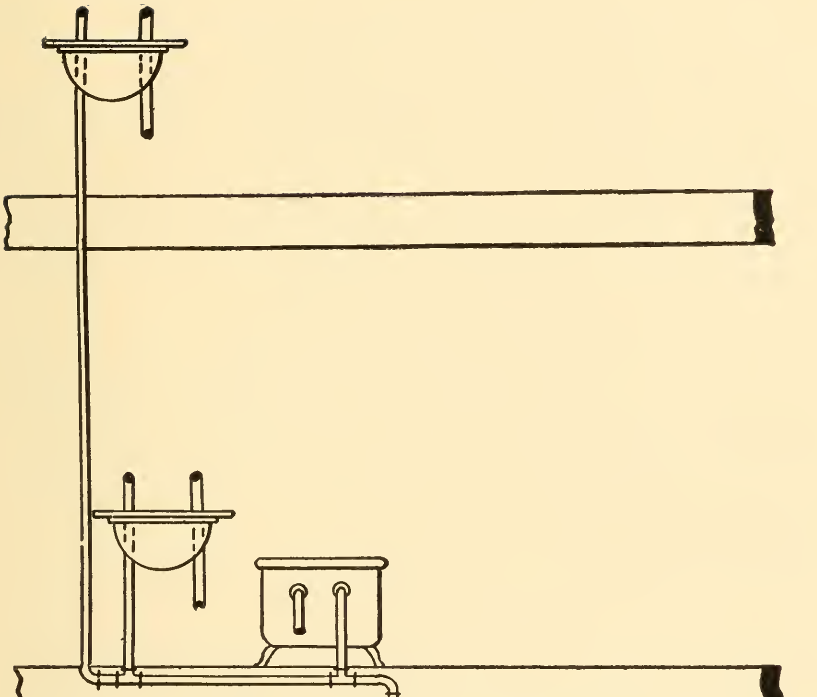


Fig. 30.

water is desired on the same floor a connection can be made in the pipe leading from the top of the boiler to the faucet on the floor above.

Fig. 30 shows an arrangement of fixtures and piping to supply hot water on three floors by the pressure-cylinder system. Hot water is supplied to the kitchen sink on the ground floor, to a bath tub and wash bowl on the second floor and to a wash bowl on the third floor. The cold water supply pipe to the boiler is shown and the cold water connection to the kitchen sink, while the cold water pipes to the bath tub and wash bowls on the upper floors are omitted for the sake of simplicity.

Fig. 31 shows one of the simplest forms of the gravity-supply tank and cylinder systems, in which the boiler, water-back and hot water connections are all on the same floor. The cold water pipe goes to the floor above or to the attic as the case may be to the supply tank, where the supply of water is regulated by a ball float cock. An expansion pipe as shown should be provided in the hot water pipe leading from the boiler and arranged to discharge into the supply tank. In Fig. 32 a gravity-supply tank and cylinder system is shown, which is arranged to deliver hot water to the kitchen sink and also to a bath tub and wash bowl on the floor above. The cold water pipe is shown running up to the supply tank and also to the kitchen sink. For the sake of clearness and to avoid confusion the cold water pipes leading to the wash bowl and bath tub are omitted.

It must be remembered that the kitchen boiler is not a heater, it is simply a reservoir to keep a

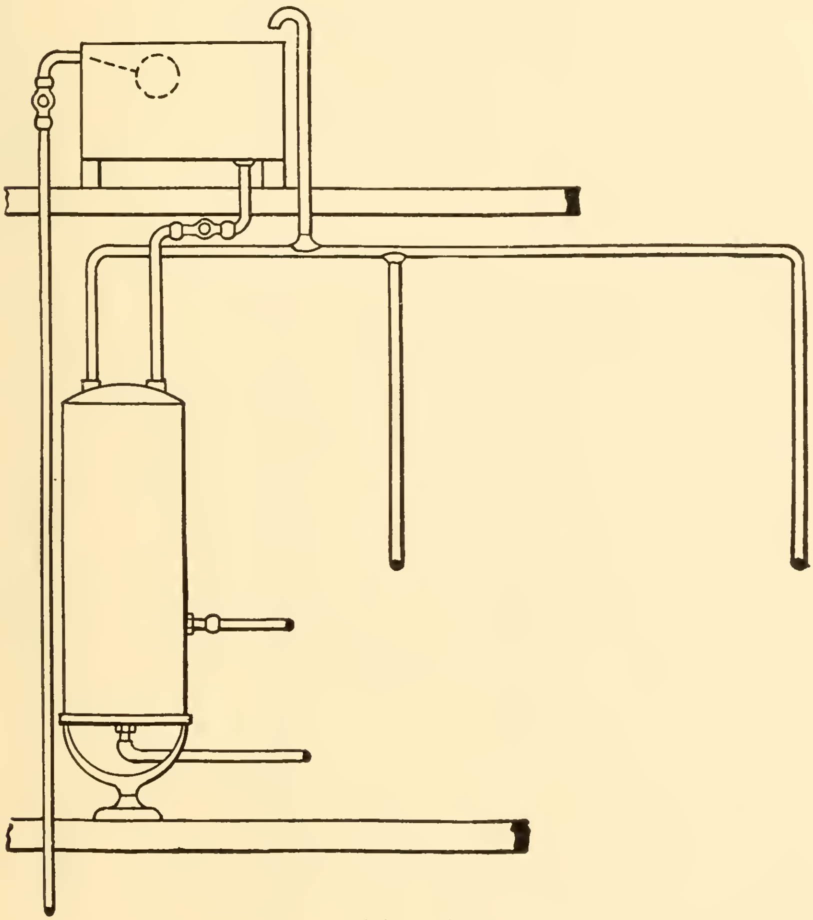


Fig. 31.

supply of hot water on hand so that it may be drawn when required. By this arrangement hot water may be had long after the fire has been extinguished in the stove, as it stores itself by the law of gravitation at the upper part of the boiler, and is forced out by cold water entering below and remaining there without mingling with or

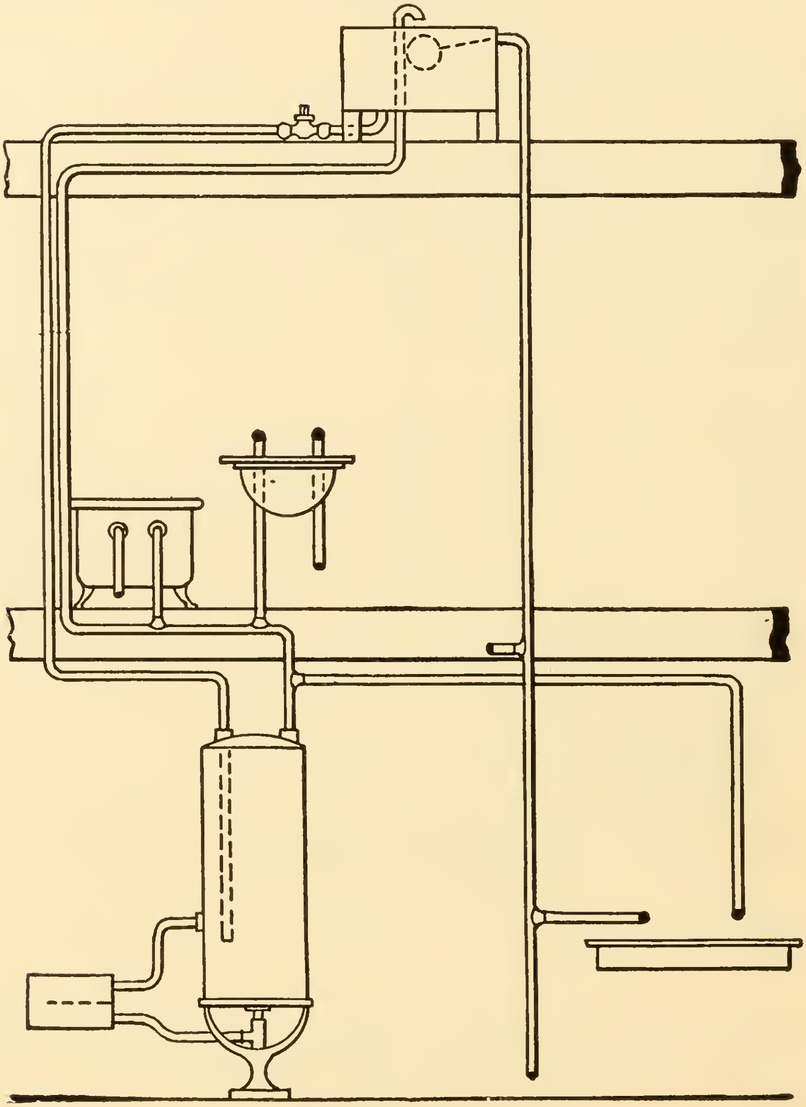


Fig. 32.

cooling the hot water in the upper part of the boiler. It should be understood that the natural course of hot water, when confined in a boiler and depending for its motion on the difference between its temperature and the temperature of other water in the same boiler, is in a perpendicular or vertical direction. And consequently when the heating apparatus or pipes which have to convey the hot water from the water back to a boiler in which the hot water is to be stored in any position other than in a vertical position, friction is added which retards the flow of hot water just in proportion to the degree of angle from the vertical of the hot water pipes.

A noise in the pipes and water-back, and also a rumbling noise in the boiler indicates that there is something wrong, and which requires attention. These noises are produced by different causes, sometimes on account of the way the upper pipe from the water-back in the stove is connected to the boiler.

This pipe should always have some elevation from the water-back to where it enters the boiler. The more elevation the better the water will circulate. But the slightest rise in this pipe will make a satisfactory job. It should be a continuous rise if possible, the entire length from the water-back to the boiler.

Another cause of this noise comes from the water-back being filled, or nearly so, with scale, which partly stops the water from circulating. Nearly all the troubles of this kind come from a bad circulation of water between the stove and boiler. If the trouble is allowed to continue very long without doing anything to improve it, it will grow worse, and perhaps stop up entirely. With the connections between the water-back in the stove and the boiler stopped up, what is to be expected? With a good fire in the stove under these conditions, an explosion of the water-back, which may blow the stove to pieces and, perhaps, kill some of the occupants of the house.

There are two conditions of things that will cause the water-back in a stove to explode. First, to have water in the water-back with its outlets or pipe connections stopped up, then have a fire started in the stove. The fire will generate steam in the water-back, and, having no outlet through which the steam might escape, an explosion must take place. The second way through which the water-back could explode is to have no water in the kitchen boiler, with a good fire in the stove and the water-back red-hot, then allow the water to be turned on suddenly into the boiler and water-back. Under these conditions steam would be generated faster than it could escape through the small pipe connections, and would naturally result in an explosion.

The different ways of connecting a water-back on any water heating device to an ordinary kitchen boiler, are governed, to some extent, by the conditions in each individual case.

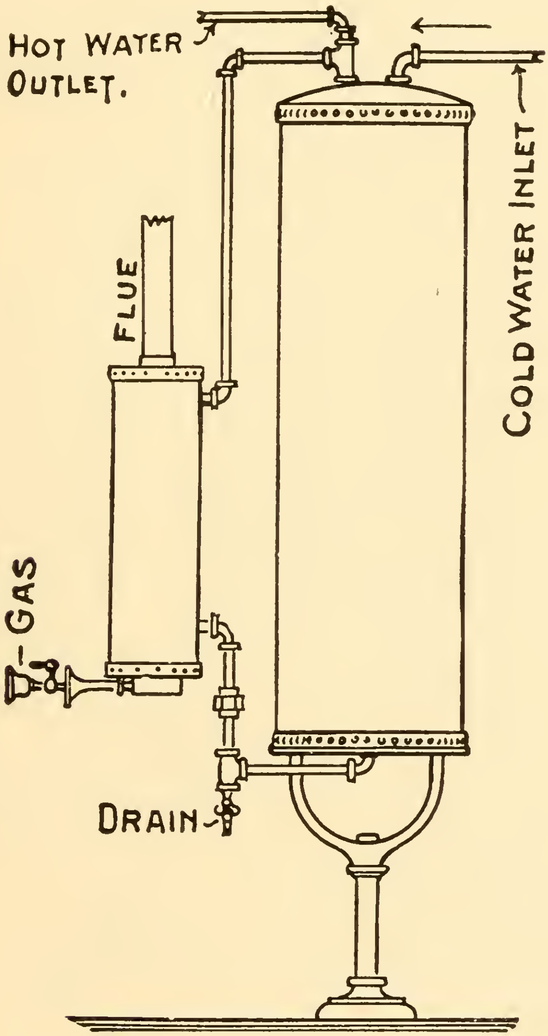


Fig. 33.

In connecting a gas-heated water device, the connections should be made as shown in Fig.

33, which is known as a top connection, the particular reason being that it is possible, with a connection of this kind, to heat small quanti-

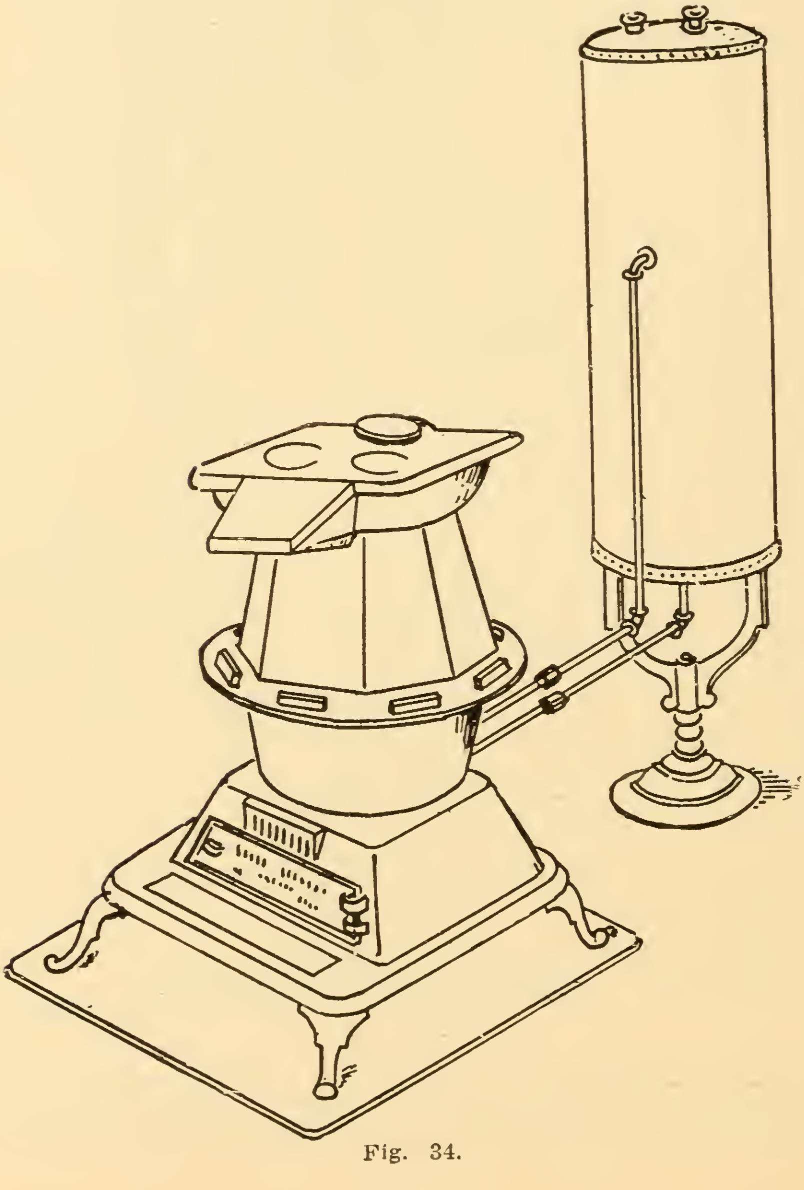


Fig. 34.

ties of water and to heat it quickly, and water can be drawn within five minutes after lighting the gas the great advantage being the economy of fuel and time. A gas-heated water device should always be connected to a flue.

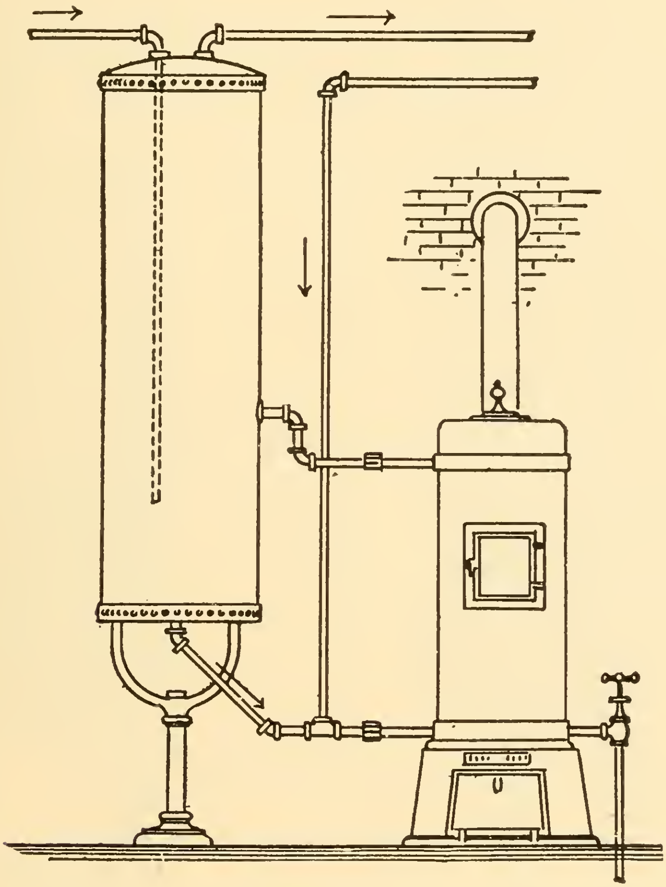


Fig. 35.

When connecting a kitchen boiler to a water-back in a range, the connection should be made as shown in Fig. 34. As the range fire will probably be kept burning all day, the question of fuel economy is not to be considered—the advantage of a connection of this kind is that it gives a large body of water from which to draw at all times.

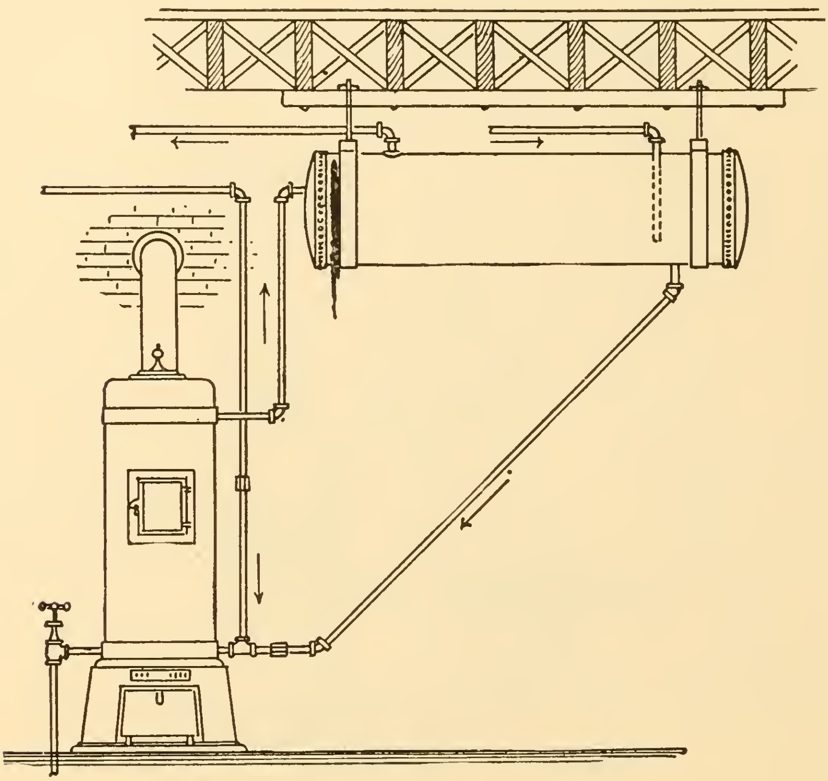


Fig. 36.

Connections to vertical and horizontal boilers, when connected to independent water heaters are shown in Figs. 35 and 36.

Another device recently put on the market and

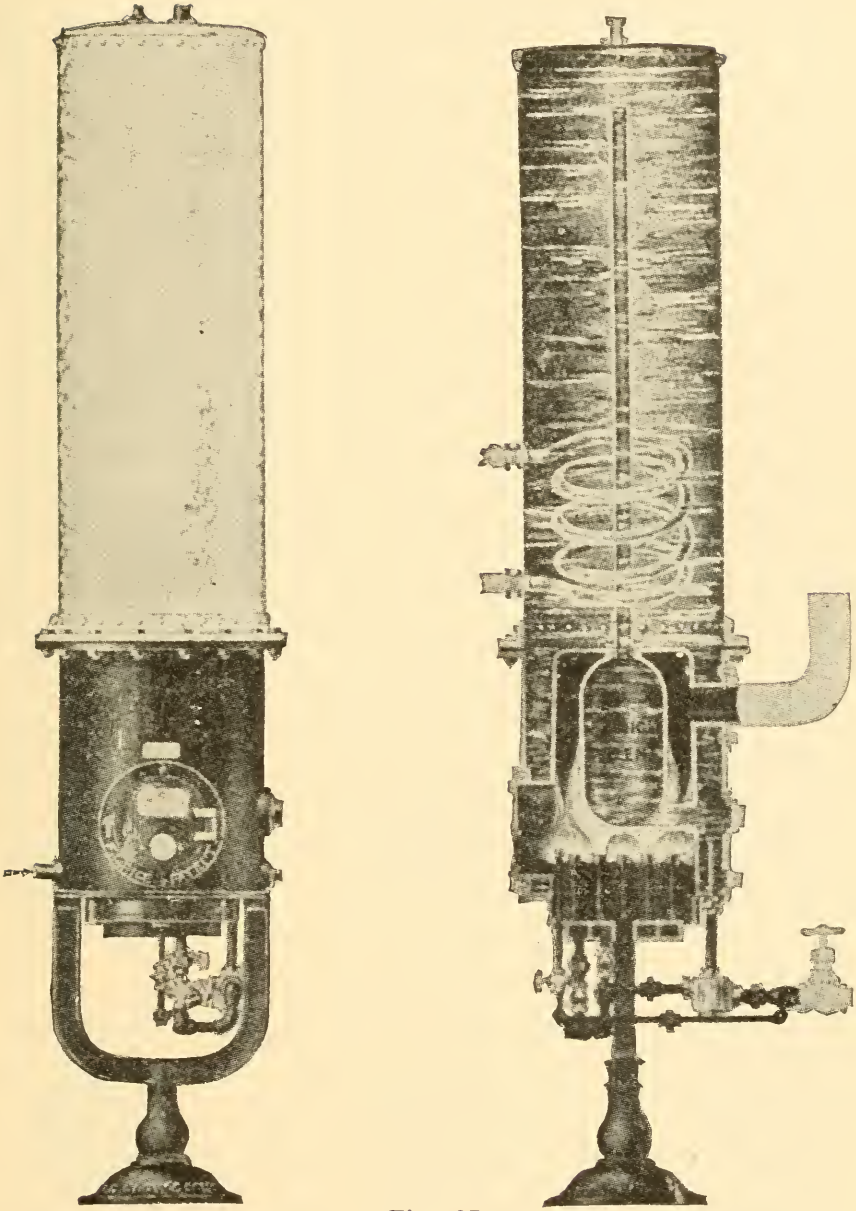


Fig. 37.

shown in Fig. 37, is a combination reservoir and heater. This heater is unique in construction of water compartments inasmuch as all surfaces are exposed very advantageously to the flame. The central water compartment being directly over the flame and the pipe which carries hot water to the top of the tank enables it to supply hot water within a very short time. The gas supply is regulated by a thermostat, which automatically decreases the flow of gas when water is heated and automatically increases the flow of gas as soon as the hot water is drawn from the tank. Two clusters of blue flame gas burners, which are independent of each other, and can be used separately or both at the same time, furnish the heating medium. The advantage of this boiler, outside of the economy of fuel consumption, is that it requires little space for the installation and a great saving in the piping. Again the automatic gas regulating feature prevents the boiler from becoming over-heated and from its subsequent dangers, as the temperature of water is maintained at about 170 degrees Fahrenheit.

In the sectional cut a steam coil is shown whereby the water can be heated with steam, in case it is installed, where steam is available.

Plumber's Tools. The illustrations given in Figs. 38, 39 and 40, show a set of plumber's tools. The name of the tool is given with each

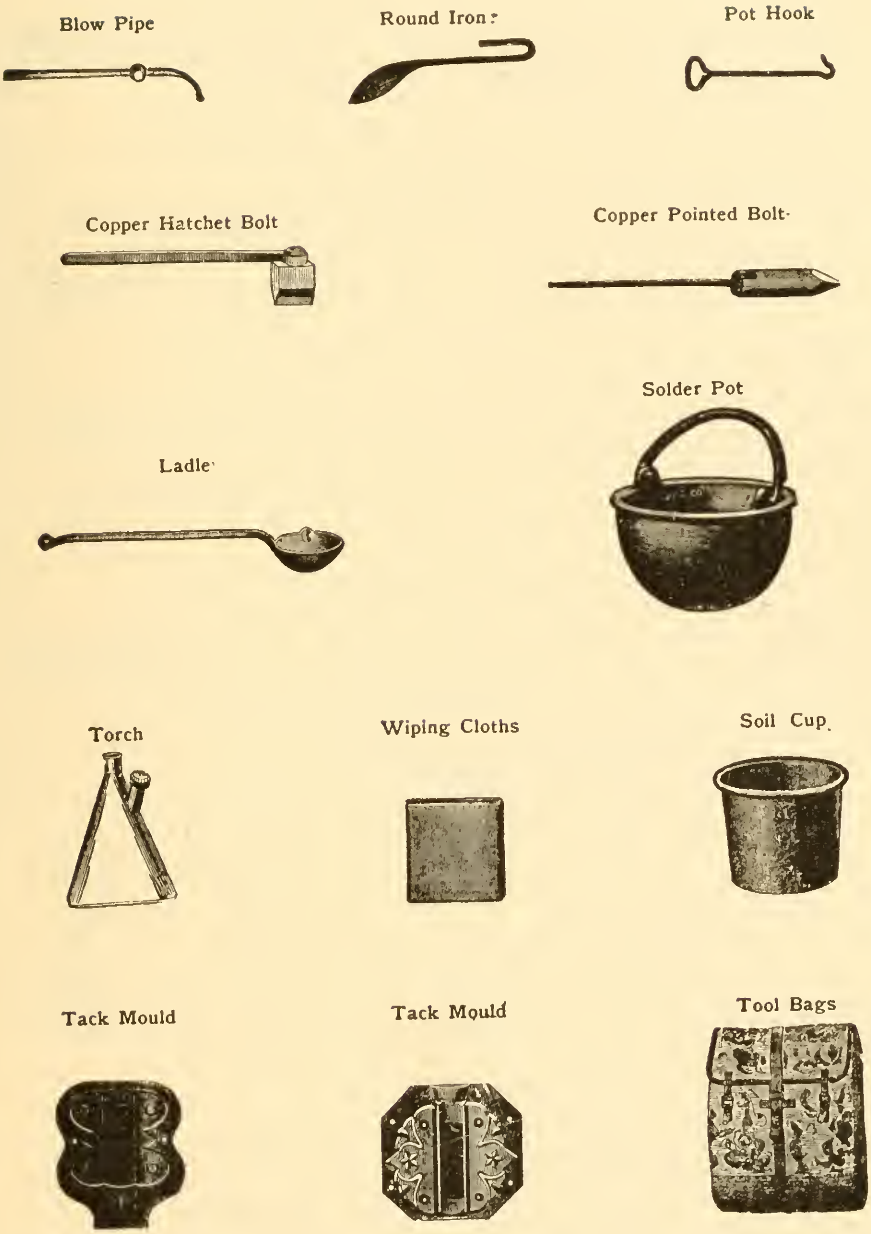

Blow Pipe
Round Iron
Pot Hook
Copper Hatchet Bolt
Copper Pointed Bolt
Solder Pot
Ladle
Torch
Wiping Cloths
Soil Cup
Tack Mould
Tack Mould
Tool Bags

Fig. 38.

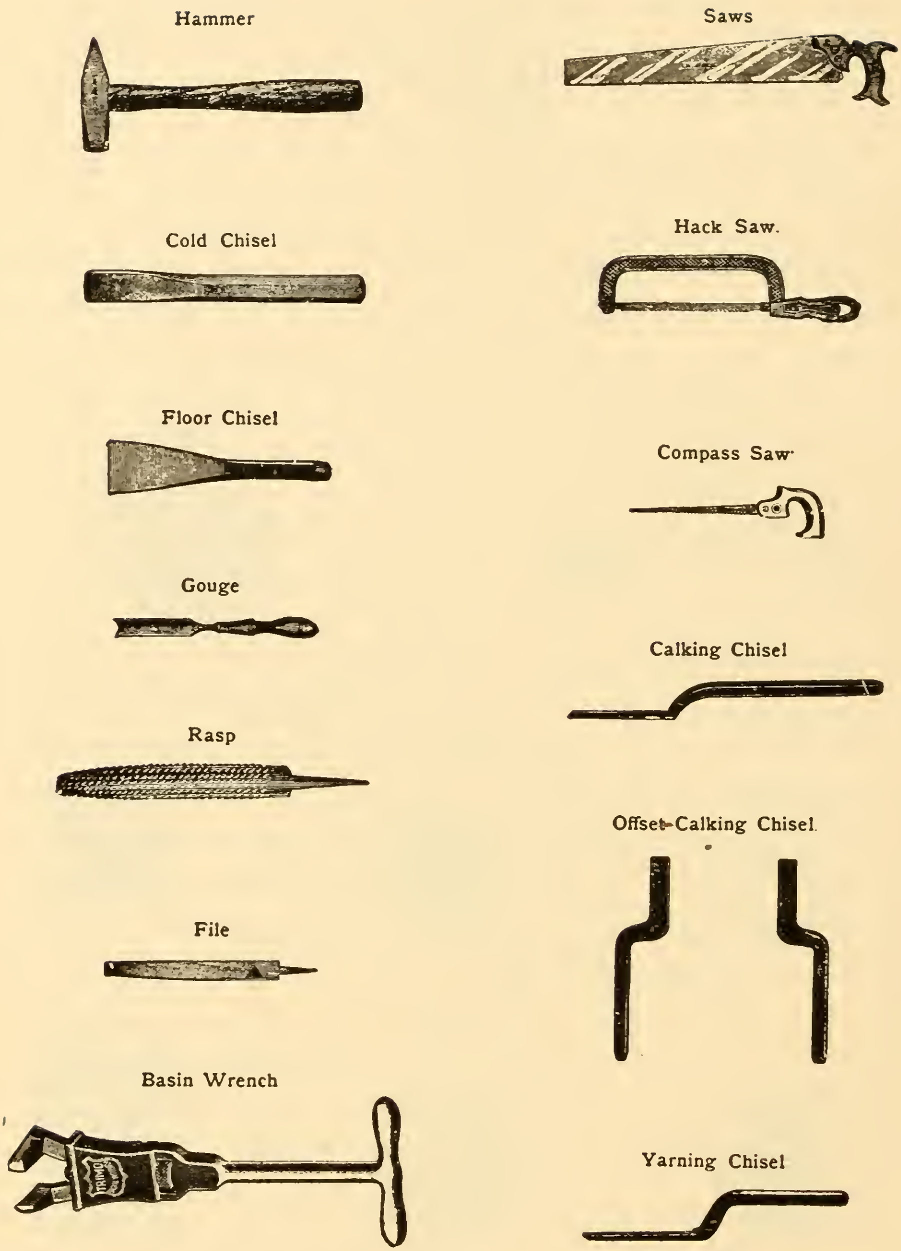

Hammer
Saws
Cold Chisel
Hack Saw.
Floor Chisel
Compass Saw
Gouge
Calking Chisel
Rasp
Offset-Calking Chisel.
File
Basin Wrench
Yarning Chisel

Fig. 39.

illustration, making further information unnecessary.

A larger number of tools than those shown

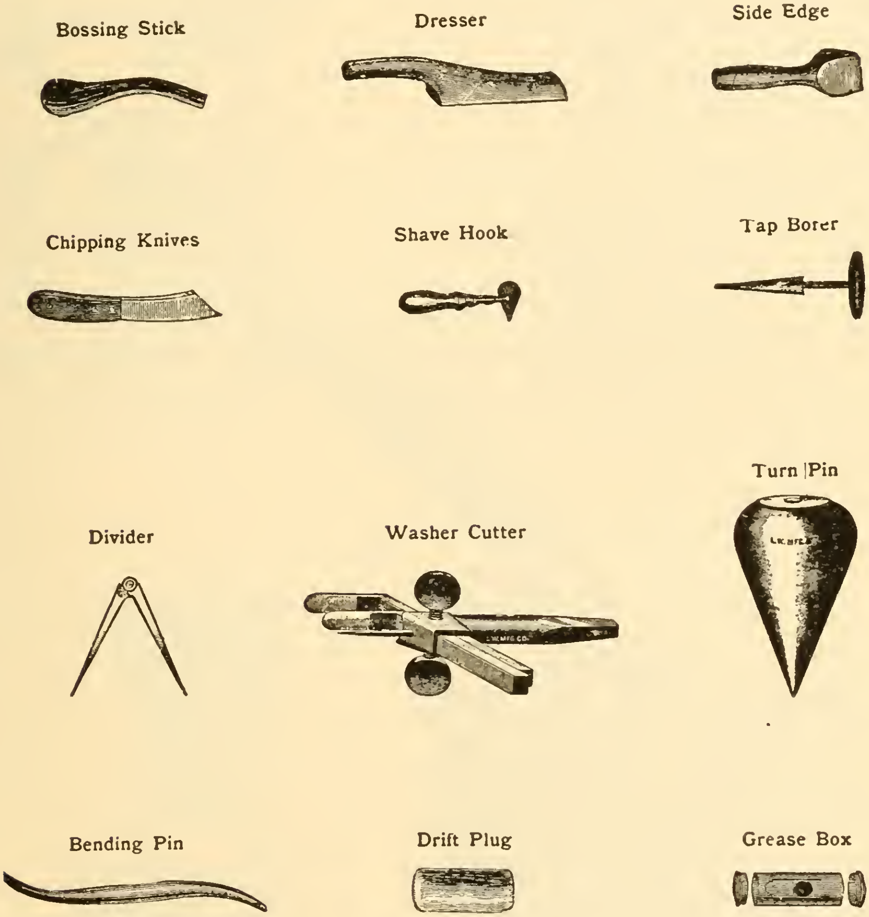


Fig. 40.

will sometimes be necessary for special work, or work that has to be done under difficulties.

Figs. 41 and 42 show two styles of plumber's blow-torches, and Figs. 43 and 44, two solder pots. The air pressure is generated by means of rubber bulb in the solder pot shown in Fig. 43, and by means of a small hand pump in the one shown in Fig. 44.

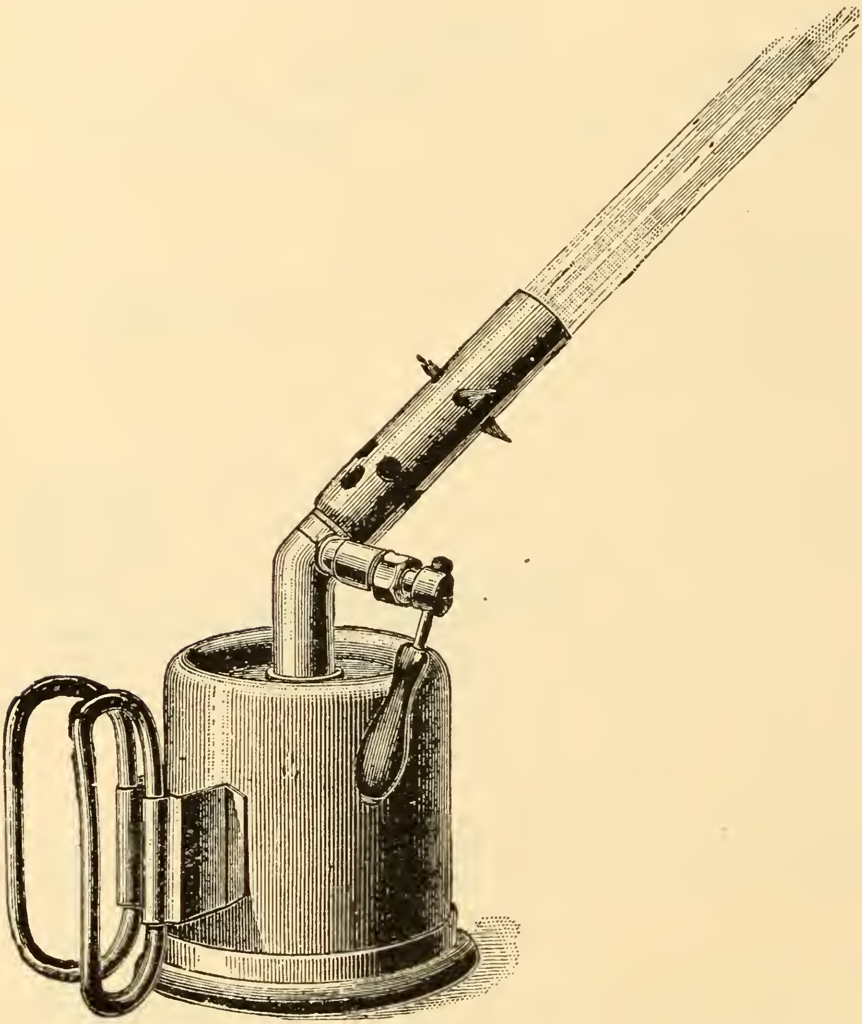


Fig. 41.

A rubber force cup for cleaning bathtubs, washbowls and sinks is shown in Fig. 45.

Fig. 42.

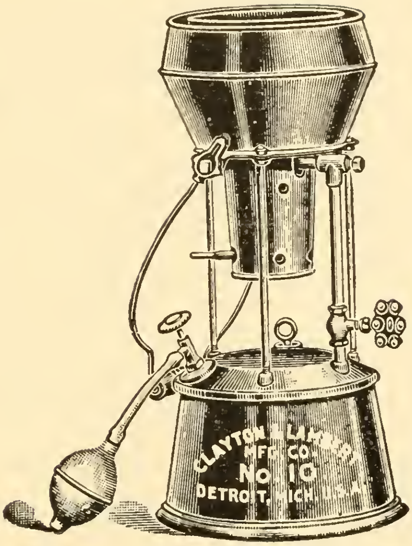


Fig. 43.

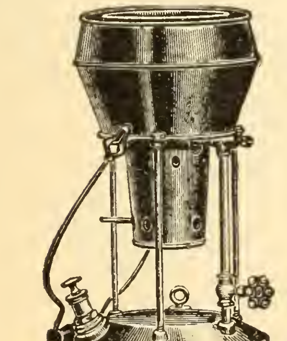


Fig. 44.

Fig. 45.

A thawing steamer for thawing pipes that have been frozen during a cold spell is illustrated in Fig. 46.

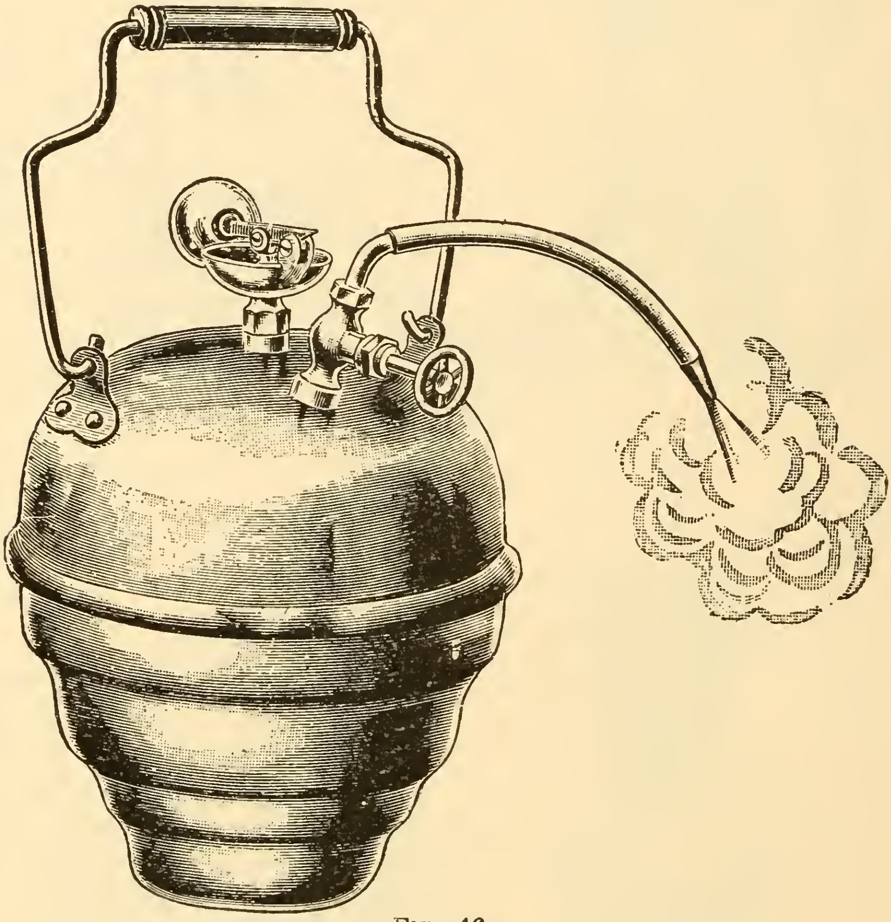


Fig. 46.

DRAINAGE FITTINGS.

Soil and Waste Pipe Fittings. One-quarter and one-sixth, and one-eighth and one-sixteenth

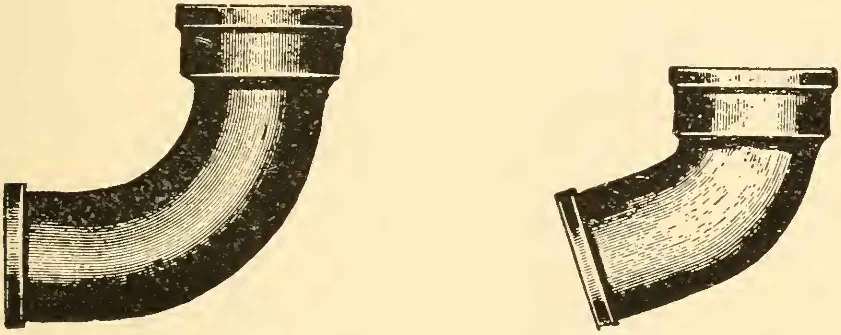


Fig. 47.

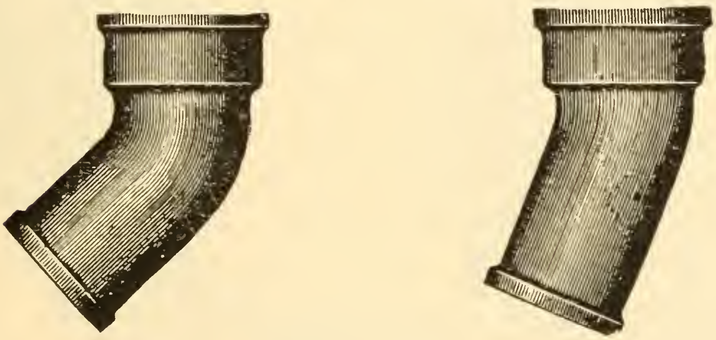


Fig. 48.

cast iron soil pipe bends or elbows are shown in Figs. 47 and 48 respectively, and long one-quarter and one-eighth bend in Figs. 49 and 50.

Quarter bends with heel and side outlets are shown in Figs. 51 and 52.

A long quarter turn or sanitary bend is shown in Fig. 53.

Figures 54, 55 and 56 show a T-branch soil pipe with left-hand inlet, a sanitary T-branch

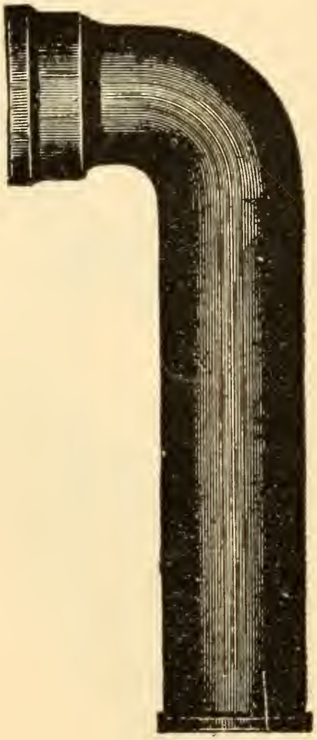


Fig. 49.

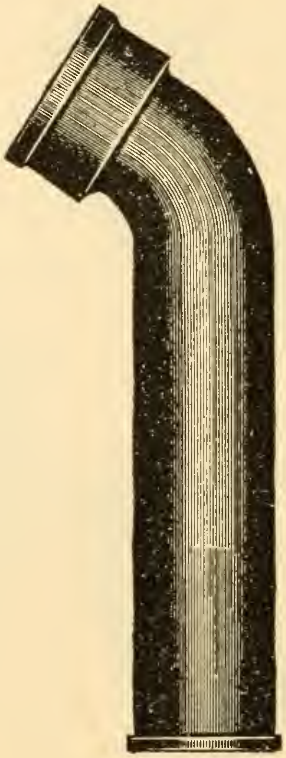


Fig. 50.

with right-hand inlet and a Y-branch with right-hand inlet, respectively.

A plain T-branch, a sanitary T-branch, a Y-branch and a half Y-branch are shown in Figs. 57, 58, 59 and 60.

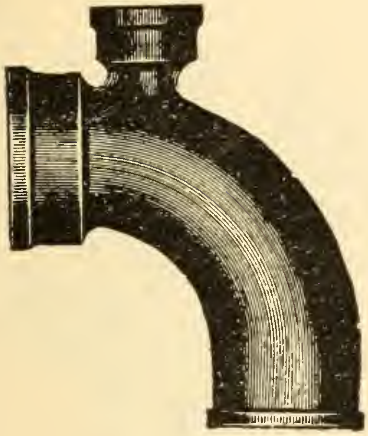


Fig. 51.

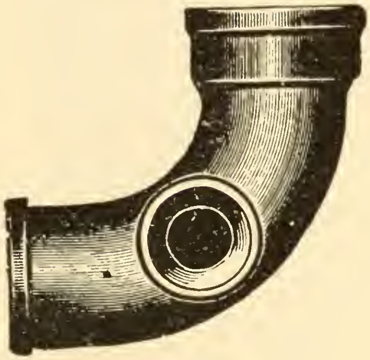


Fig. 52.

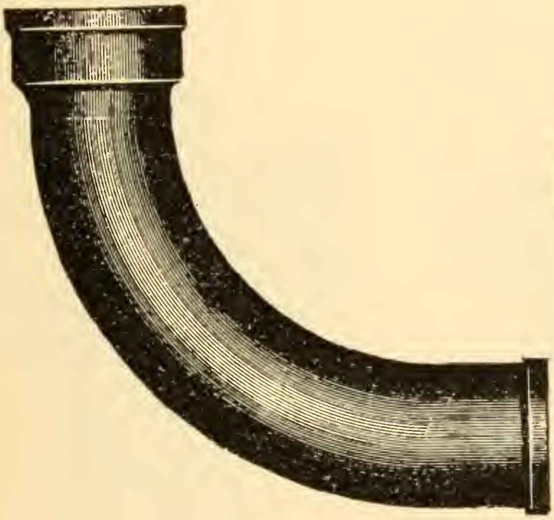


Fig. 53.

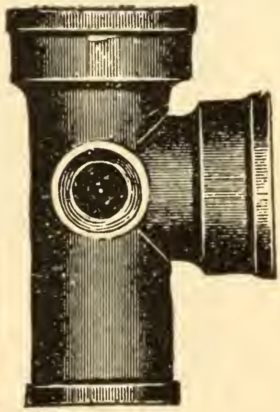


Fig. 54.

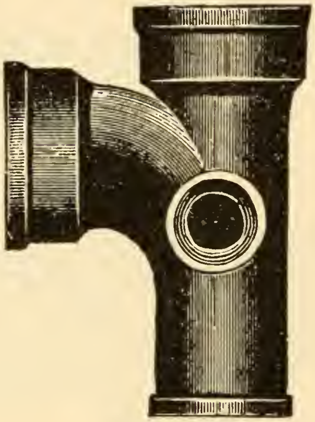


Fig. 55.

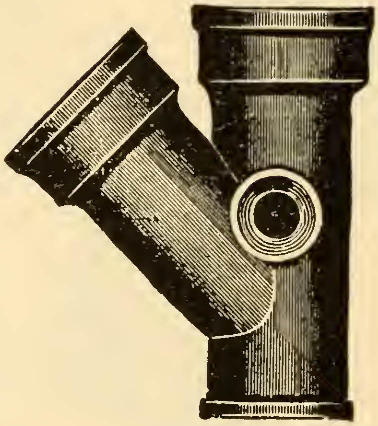


Fig. 56.

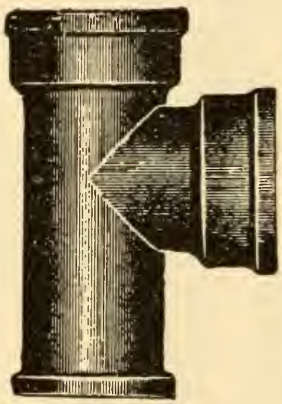


Fig. 57.

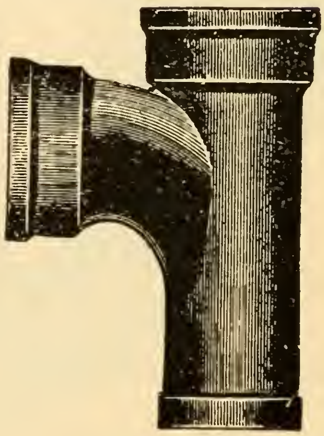


Fig. 58.

A plain T-branch, a sanitary T-branch, a cross and a sanitary cross all tapped for iron pipe are shown in Figs. 61 and 62.

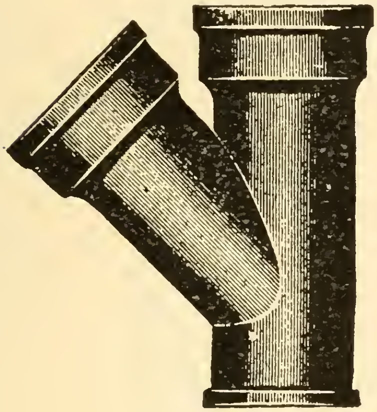


Fig. 59.

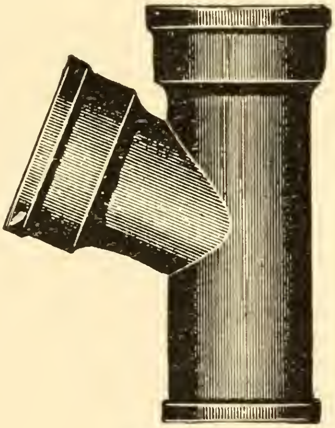


Fig. 60.

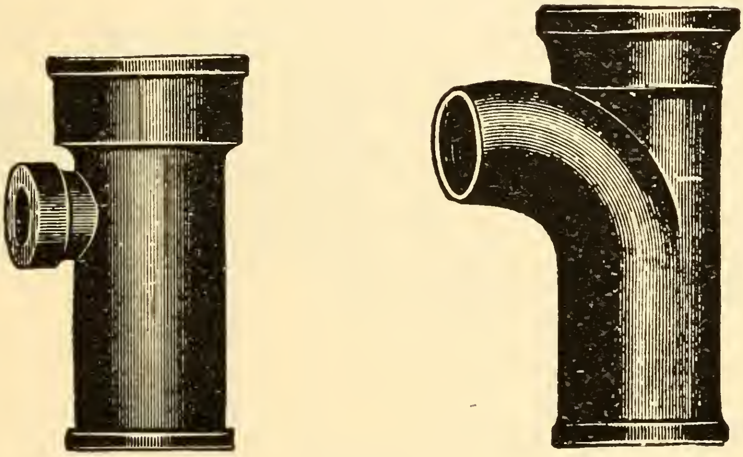


Fig. 61.

A plain cross, a sanitary cross, a double Y-branch and double half Y-branch are shown in Figs. 63, 64, 65 and 66.

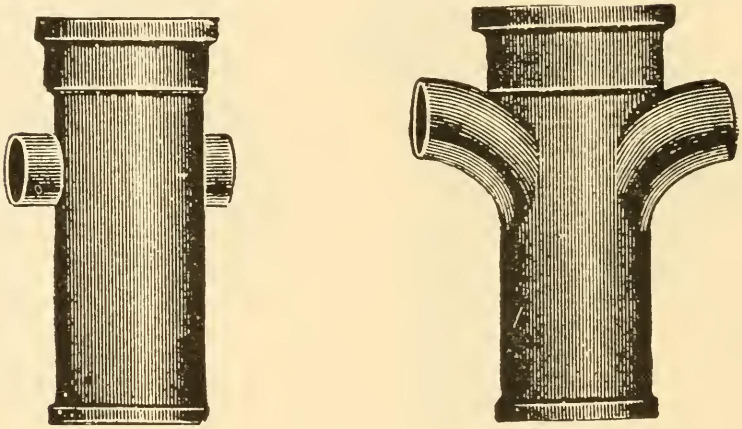


Fig. 62.

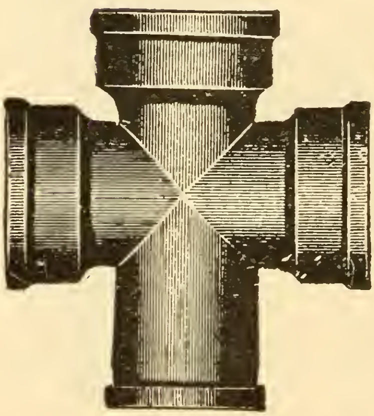


Fig. 63.

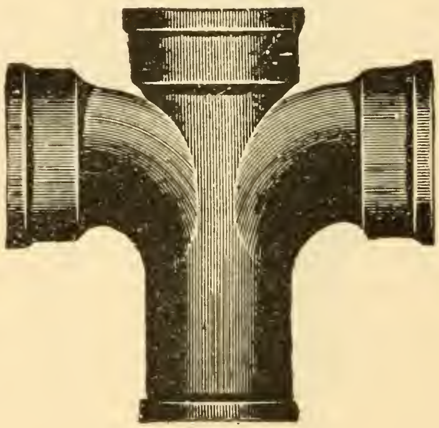


Fig. 64.

A ventilating cap and a Y-saddle hub are illustrated in Fig. 67, and half Y-saddle hub and a T-saddle hub in Fig. 68.

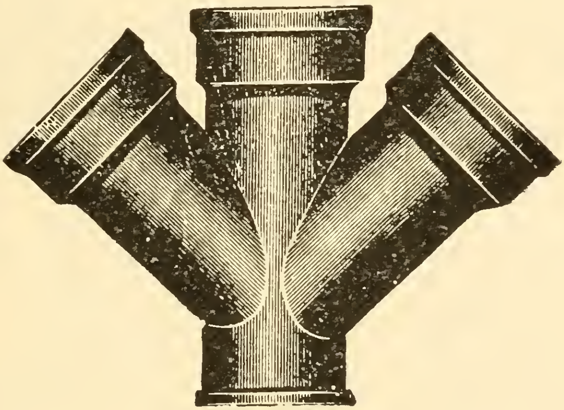


Fig. 65.

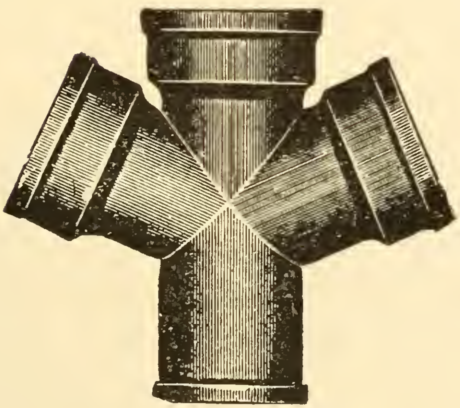


Fig. 66.

A ventilating branch tapped for iron pipe, an inverted Y-branch and a plain ventilating branch pipe are shown in Figs. 69, 70 and 71.

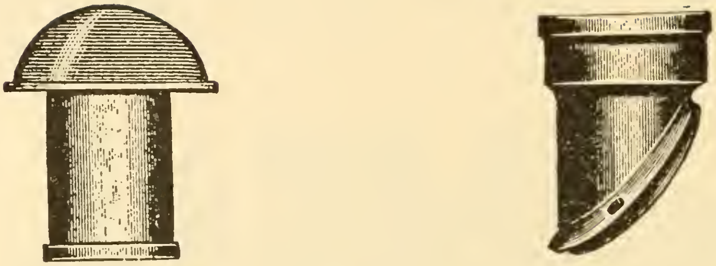


Fig. 67.

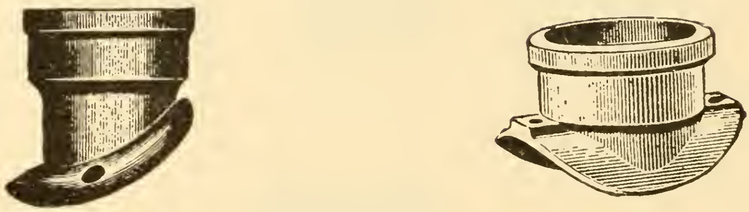


Fig. 68.

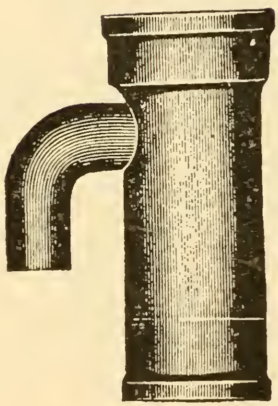


Fig. 69.

Fig. 70.

A T-branch, a sanitary T-branch and a Y-branch with trap-screw are shown in Figs. 72, 73 and 74.

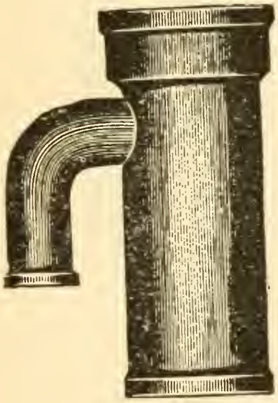


Fig. 71.

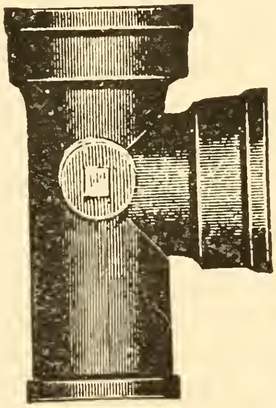


Fig. 72.

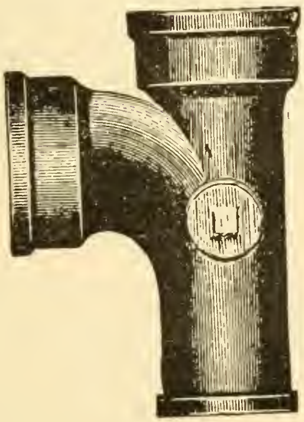


Fig. 73.

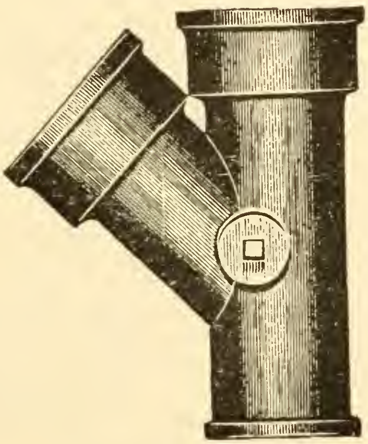


Fig. 74.

Traps. A running trap with hand-hole and cover, and one with two hub-vents are illustrated in Figs. 75 and 76.

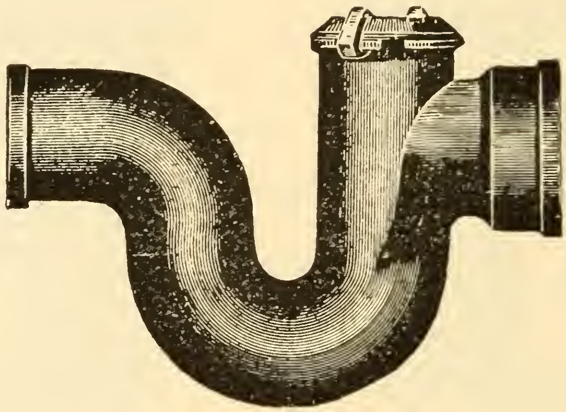


Fig. 75.

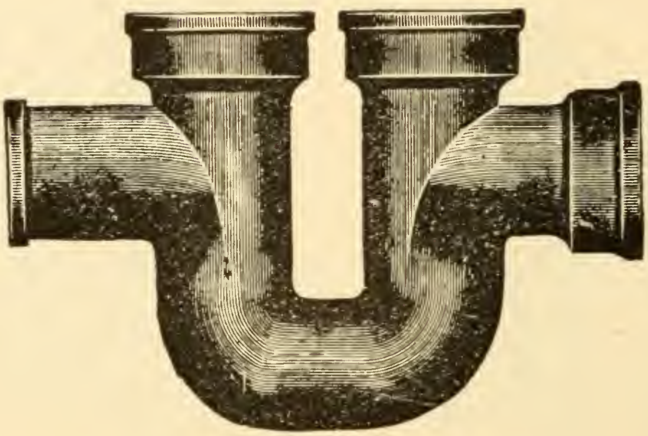


Fig. 76.

A full S-trap, a three-quarter S-trap and a half S-trap, are illustrated in Figs. 77, 78 and 79. An S-trap, a three-quarter S-trap and a half

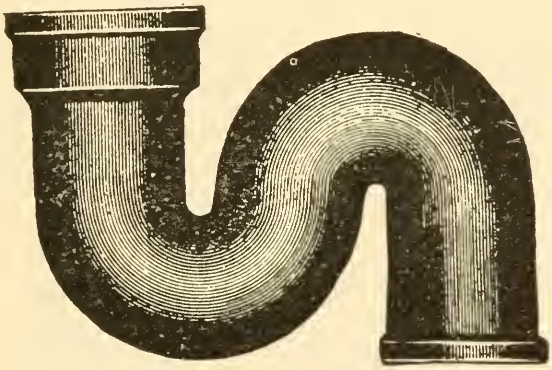


Fig. 77.

Fig. 78.

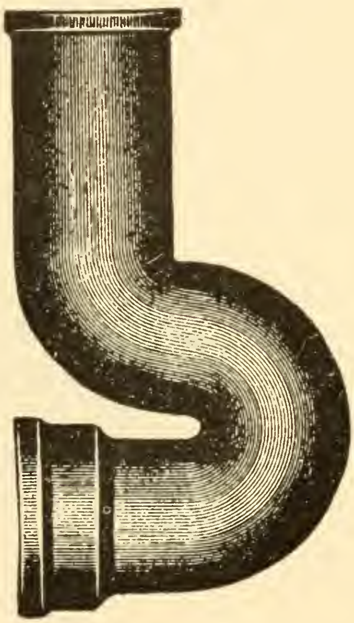


Fig. 79.

S-trap, all with hand-hole and cover, are shown in Figs. 80, 81 and 82.

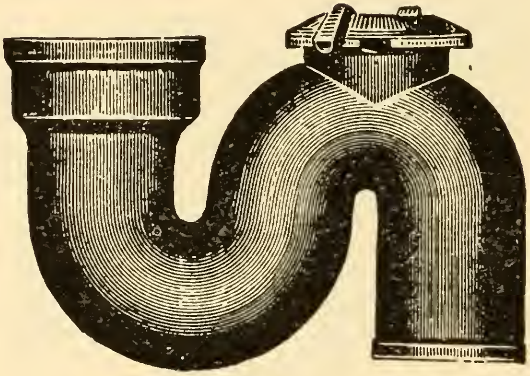


Fig. 80.

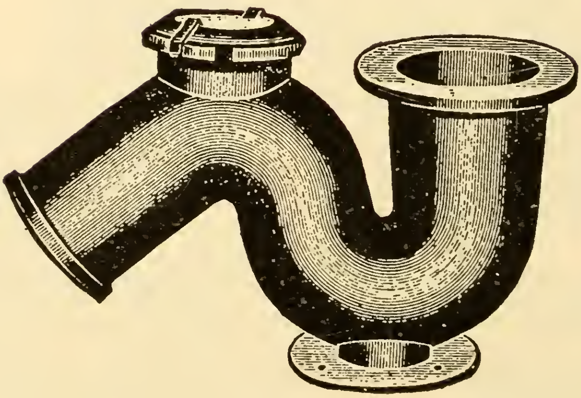


Fig. 81.

A full S-trap, a three-quarter S-trap and a half S-trap all with top vent are shown in Figs. 83, 84 and 85.

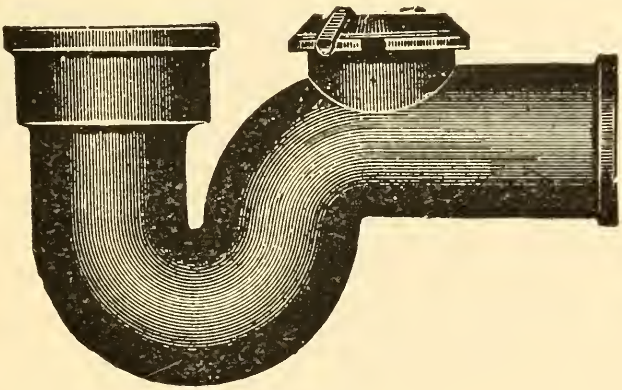


Fig. 82.

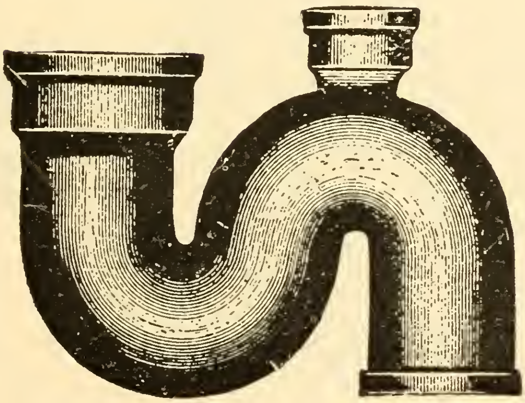


Fig. 83.

A plain running trap and a running trap with hub-vent are illustrated in Figs. 86 and 87.

Lead Traps. Traps with full S, three-quarter

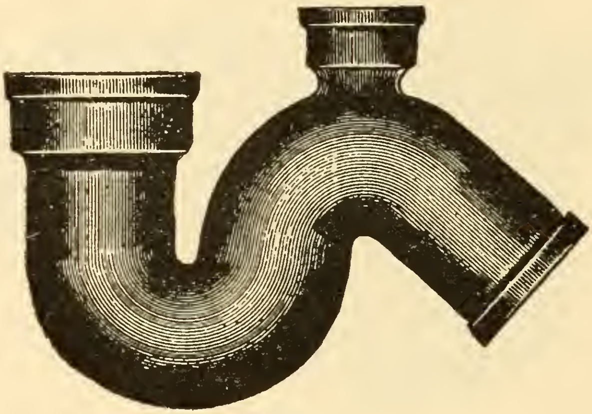


Fig. 84.

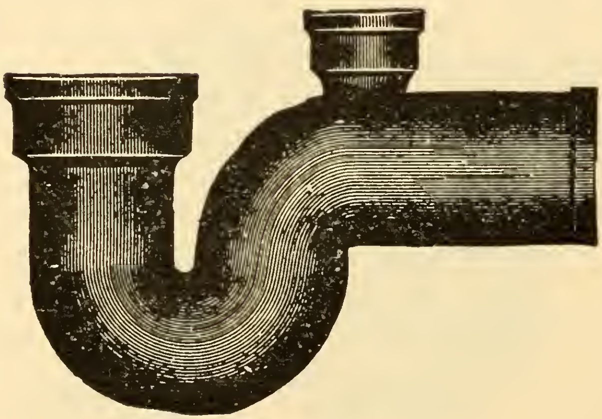


Fig. 85.

S, half S or P and running bends are shown in Fig. 88, both plain and vented.

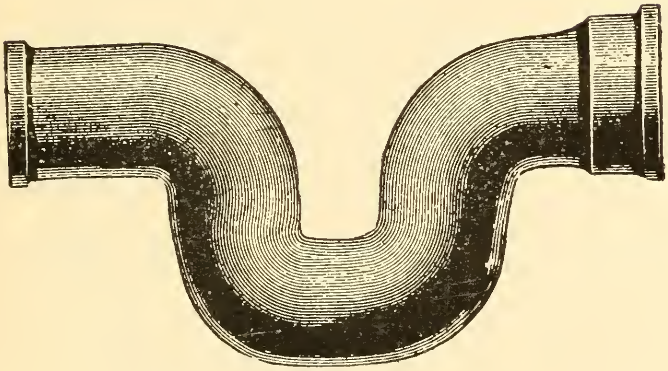


Fig. 86.

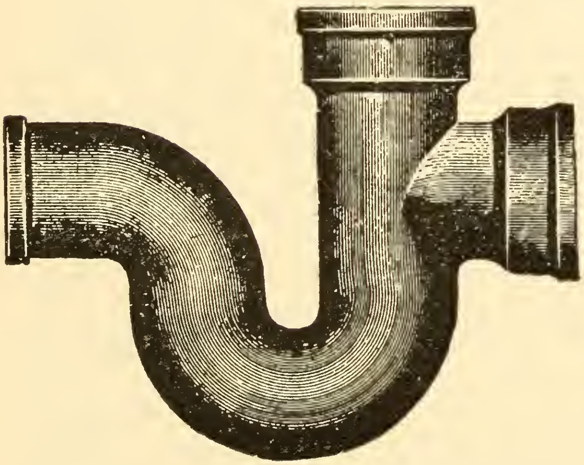


Fig. 87.

Lead Traps

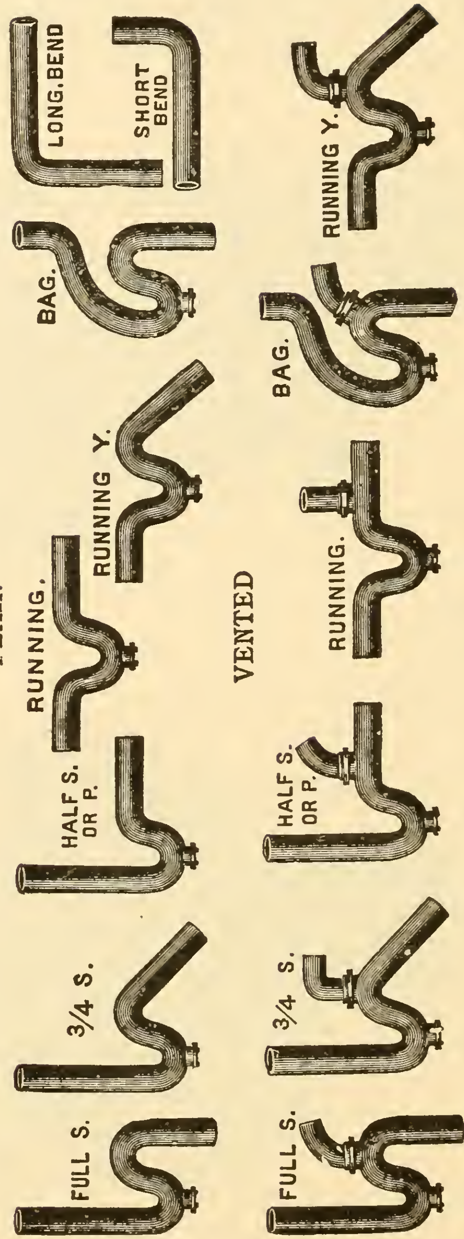
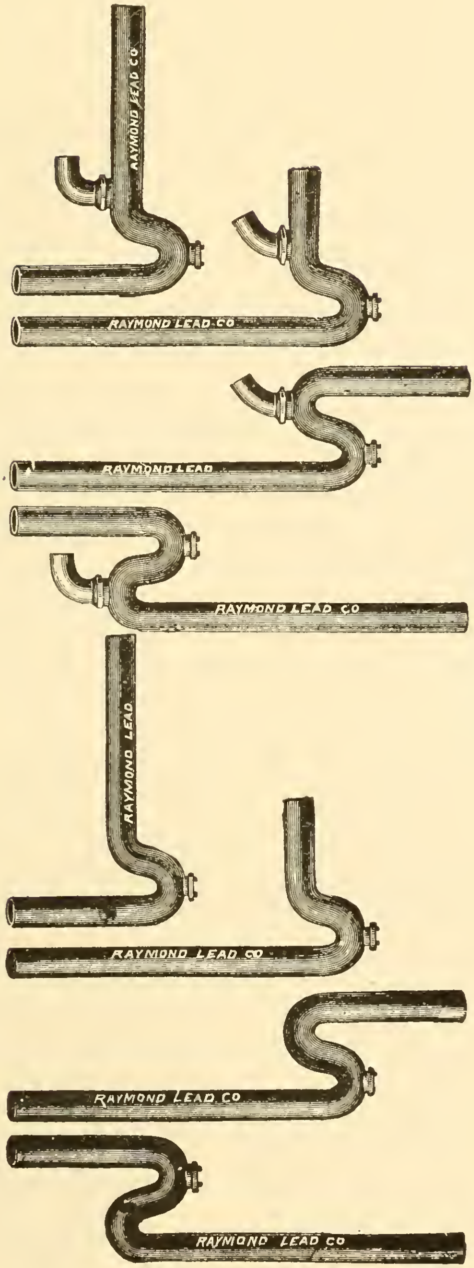


Fig. 88.

EXTRA LONG—Vented

EXTRA LONG—Plain



FULL S TRAPS
Fig. 89.

Extra long plain and vented S-traps are also shown in Fig. 89.

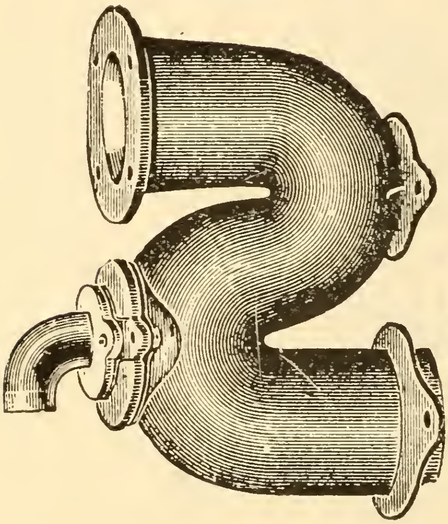


Fig. 90.

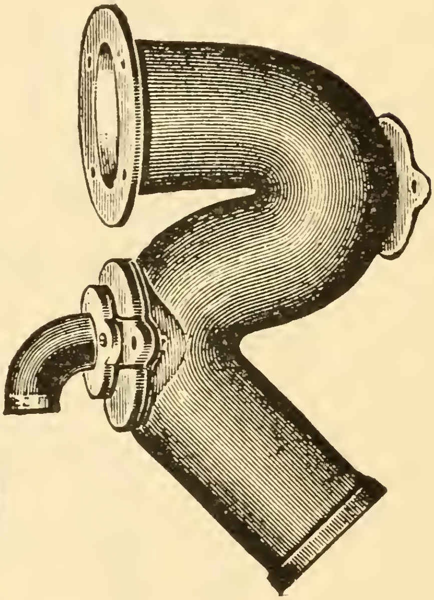


Fig. 91.

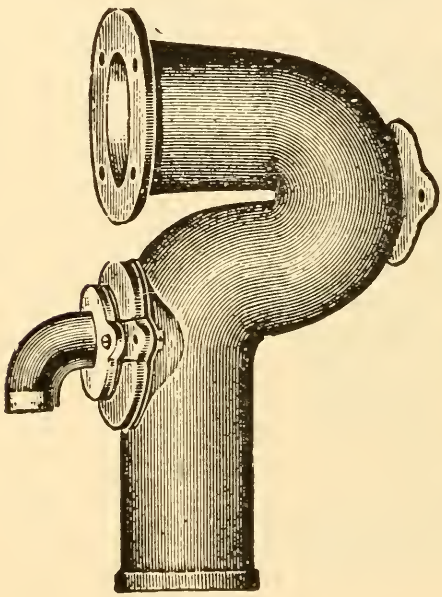


Fig 92.

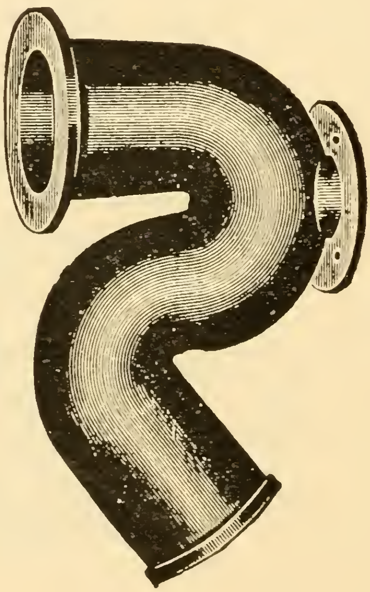


Fig. 93.

Hopper Traps. A high pattern S-trap for lead pipe connections is shown in Fig. 90, and a high pattern three-quarter and half S-trap for iron pipe connections in Figs. 91 and 92.

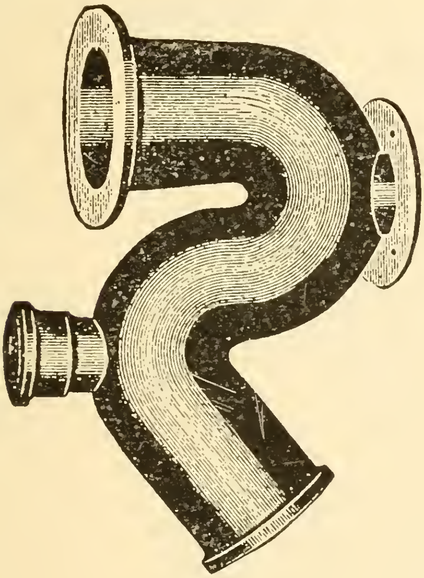


Fig. 94.

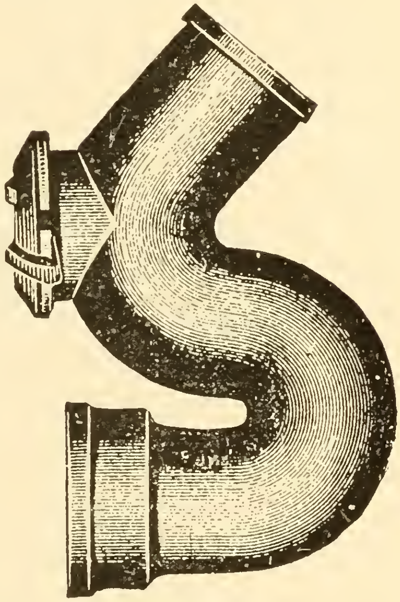


Fig. 95.

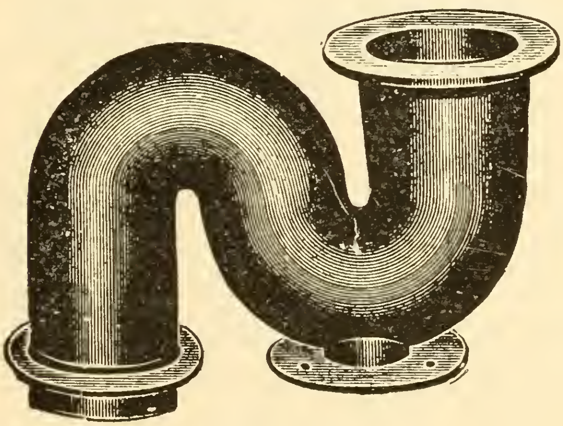


Fig. 96.

A plain three-quarter S high pattern hopper trap, a three-quarter S high pattern hopper trap with hub-vent and three-quarter S high pattern

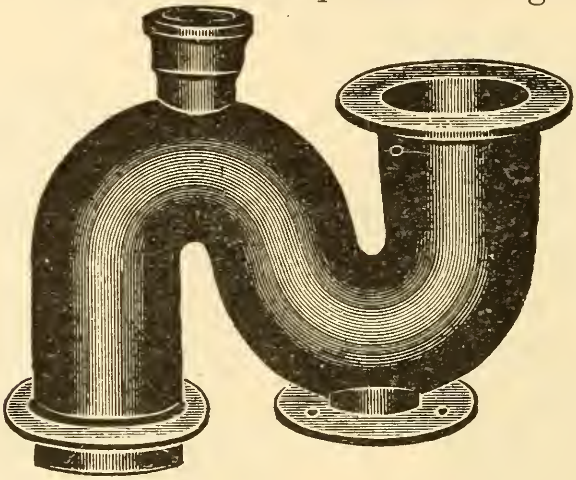


Fig. 97.

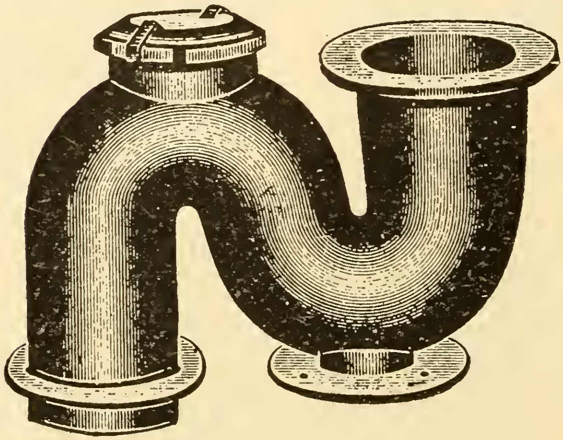


Fig. 98.

hopper trap with hand hole and cover, are shown in Figs. 93, 94 and 95.

A high pattern plain S-trap, a high pattern S-trap with hub-vent and a high pattern S-trap with hand hole and cover, all for lead pipe connections, are shown in Figs. 96, 97 and 98.

The same style of S-traps only for iron pipe connections are shown in Figs. 99, 100 and 101.

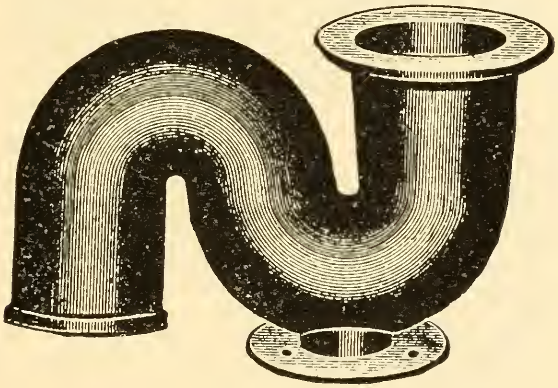


Fig. 99.

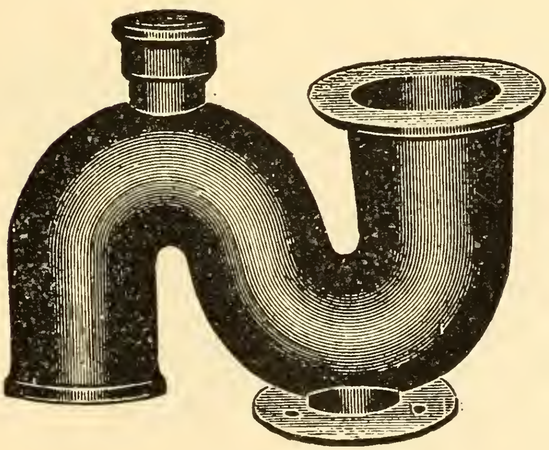


Fig. 100.

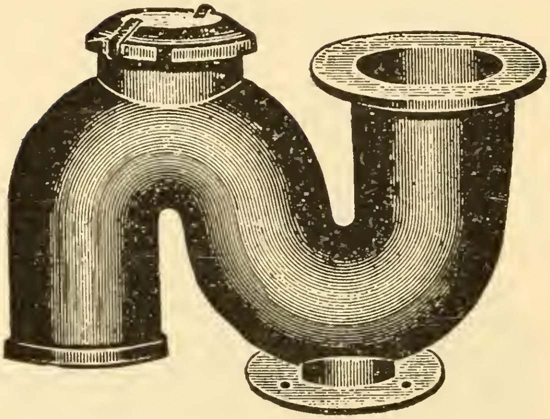


Fig. 101.

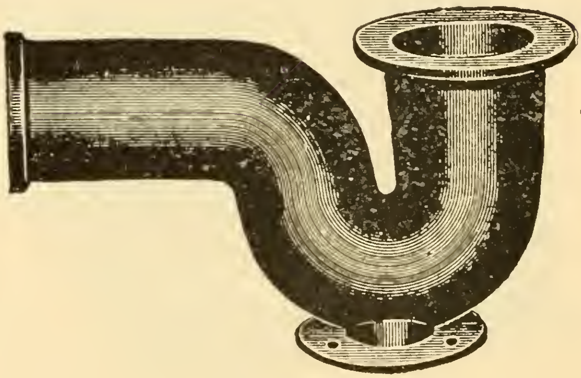


Fig. 102.

A half S-trap plain, a half S-trap with hub-vent and a half S-trap with hand hole and cover are shown in Figs. 102, 103 and 104.

Sewer gas and back water traps are shown in Fig. 105. They have hand holes and covers and

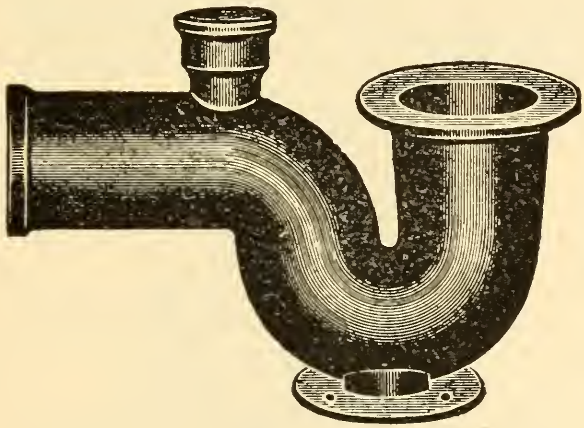


Fig. 103.

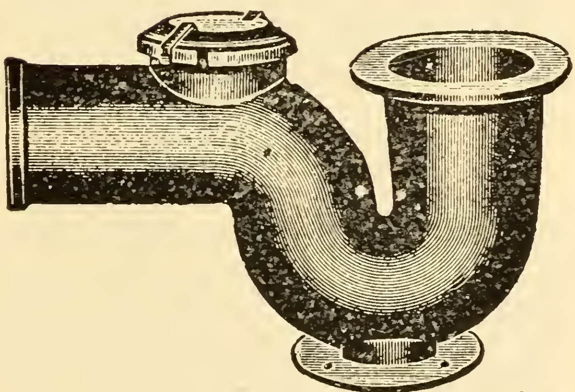


Fig. 104.

swing check valves to prevent any back flow of water.

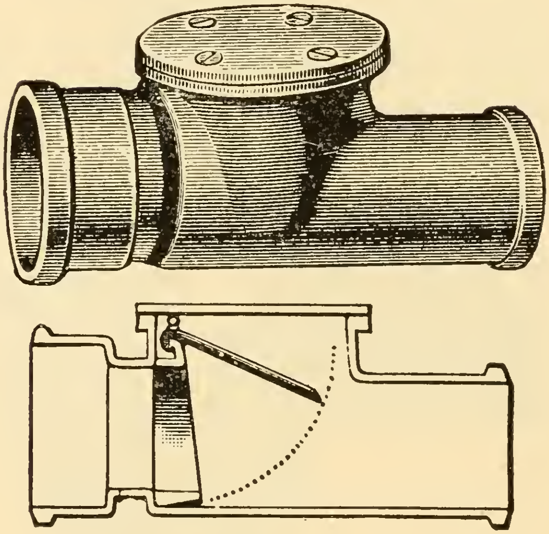


Fig. 105.

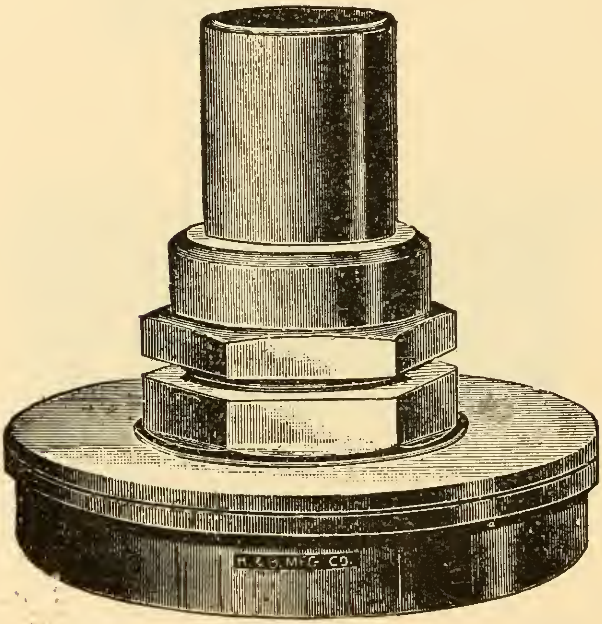


Fig. 106.

Brass trap caps with straight and bent couplings are shown in Figs. 106 and 107.

Cleanouts. Cleanouts with hand-hole and swivel cover, with hand-hole and bolted cover

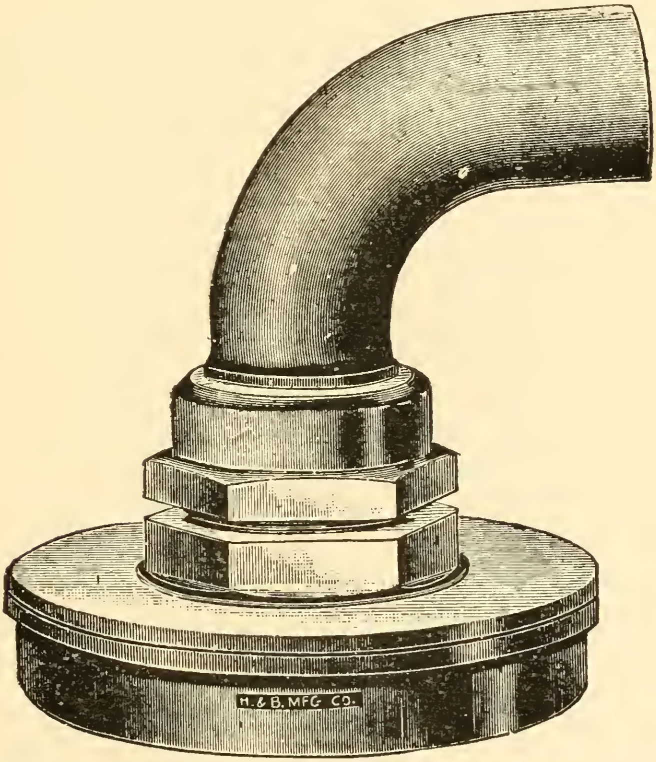


Fig. 107.

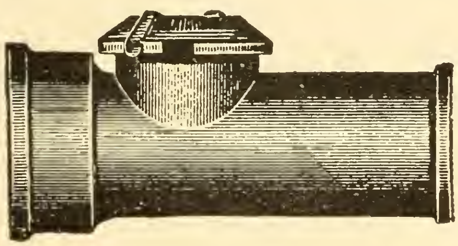


Fig. 108.

and with brass trap-screw are shown in Figs. 108, 109 and 110.

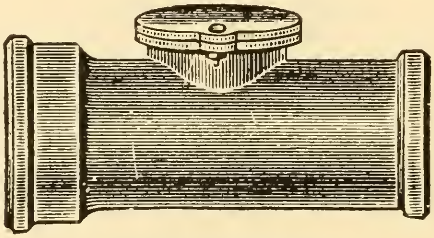


Fig. 109.

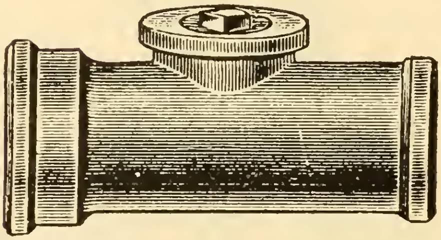


Fig. 110.

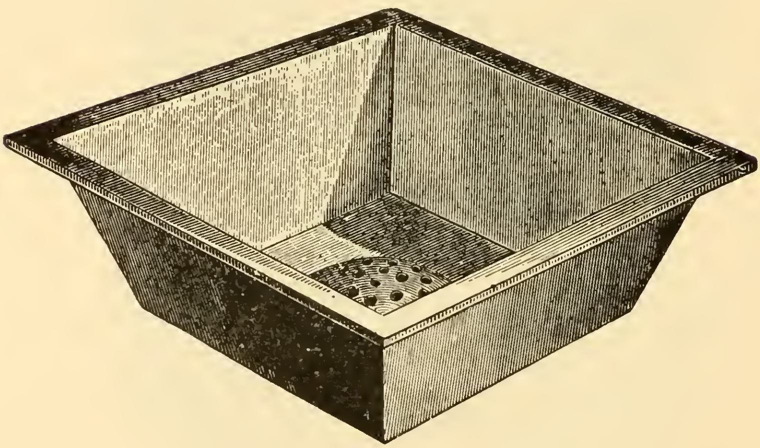


Fig. 111.

Cesspools. A hydrant cesspool for use with cellar or outdoor hydrants is shown in Fig. 111. A stable cesspool with bell-trap and grating is

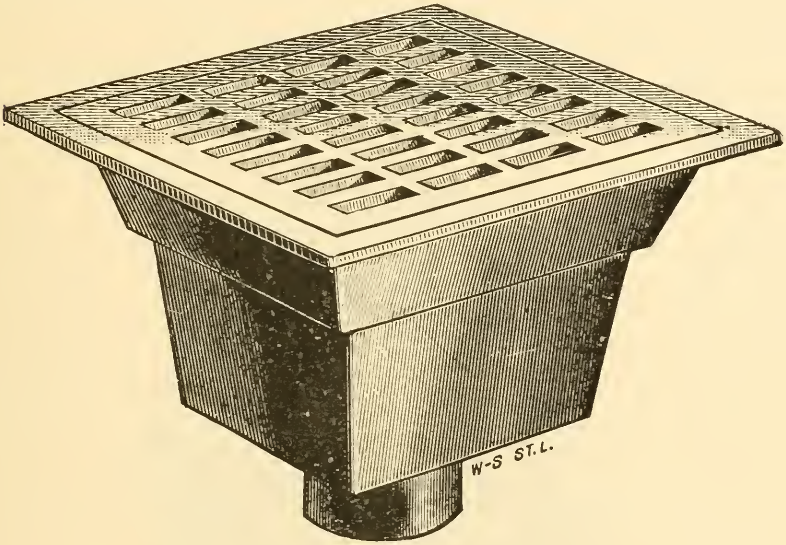


Fig. 112.

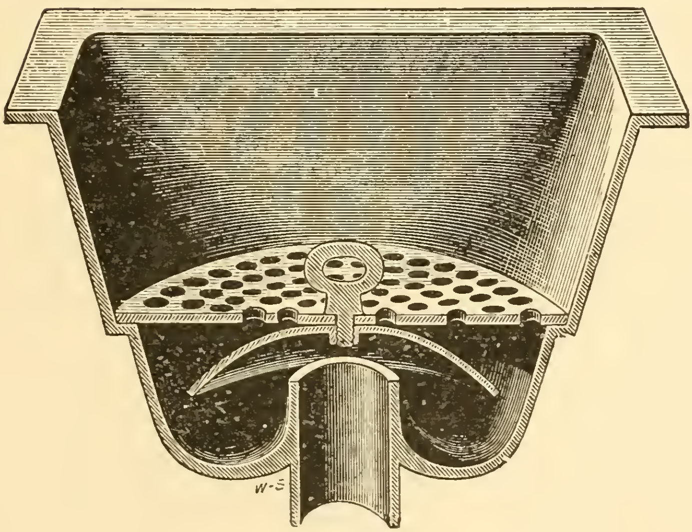


Fig. 113.

illustrated in Fig. 112, while Fig. 113 shows a slop sink with bell-trap and strainer. A cellar cesspool with bell-trap and grating of rectangular shape is shown in Fig. 114, while one of circular shape is illustrated in Fig. 115.

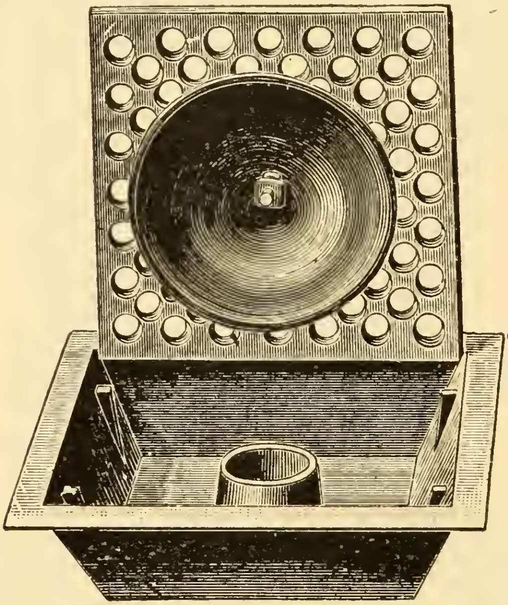


Fig. 114.

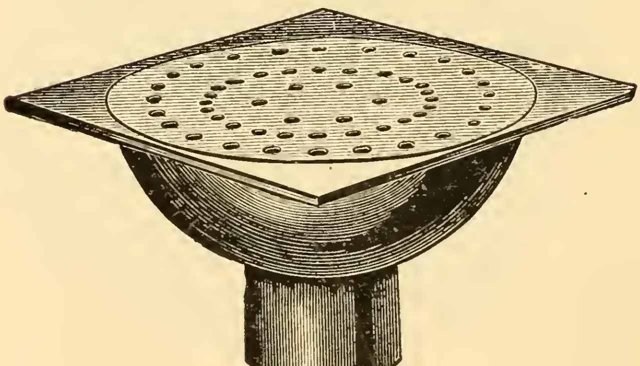


Fig. 115.

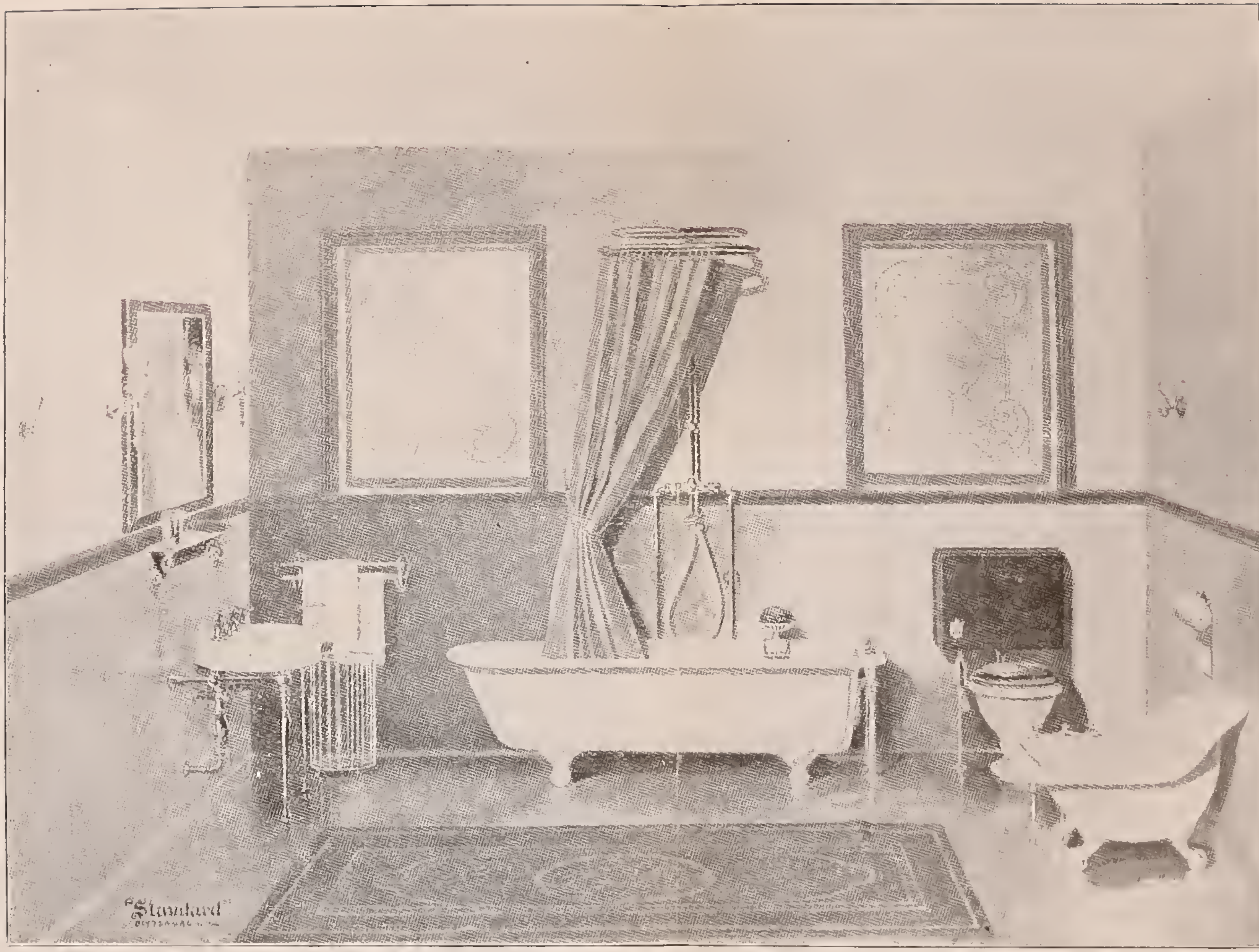


FIG 116. BATHROOM

SANITARY PLUMBING.

The Bathroom. There are good reasons why a bathroom should be finished in the best manner in preference to any other room in the house. As a rule, the bathroom is more used than any other room in the house except the kitchen. It requires the best material to stand such constant use, and it is always economy to have the best material for purposes where hard usage or work is to be performed. Without a good finish, with the proper materials for this purpose, the bathroom cannot be kept in a sanitary condition. From the sanitary condition of the bathroom the sanitary condition of the entire house may be judged. Any person who pays attention to the sanitary condition of a house, can also tell the nature of the people who occupy it. Where the bathroom is neglected, scarcely any other part of the house will be in a proper sanitary condition.

A bathroom should be well lighted with windows, so that the sunlight may come in. It should be heated to a much higher temperature than any other room in the house, and should be thoroughly ventilated. The walls, doors, and casings should be of such material that they will be proof against water and steam. The floors should never be covered with carpet, as it is a very unsanitary thing in any bathroom. Hard wood makes a good floor for a bathroom.

The bathroom of the modern house is often the most expensive room in the house, as today people who have both taste and means are spending large sums of money in securing the most sanitary fixtures for the bathroom and the highest degree of art in everything pertaining to the bathroom. Fig. 116 shows a bathroom in which all the fixtures are open work, a roll-rimmed porcelain lined bathtub with carved brass feet, and also screen shower attachment, a sitz bath of the same material and finish as the bathtub, a syphon closet with low down flush tank, a washbowl with nickel-plated legs and brackets as supports, also nickel-plated supply and waste fixtures.

Bathtubs. In Fig. 117 is shown a porcelain roll rim bathtub. This is a sanitary article in every manner, as it requires no woodwork about it, and as this bathtub is made entirely of one piece, there is no chance for dirt to lodge in any part of it. This bathtub will last a life-time; once properly set there will be no further expense for repairs. The porcelain bathtub is not without some fault or disadvantage; it is very heavy to handle. It is no easy matter to carry a bathtub of this kind up one or two

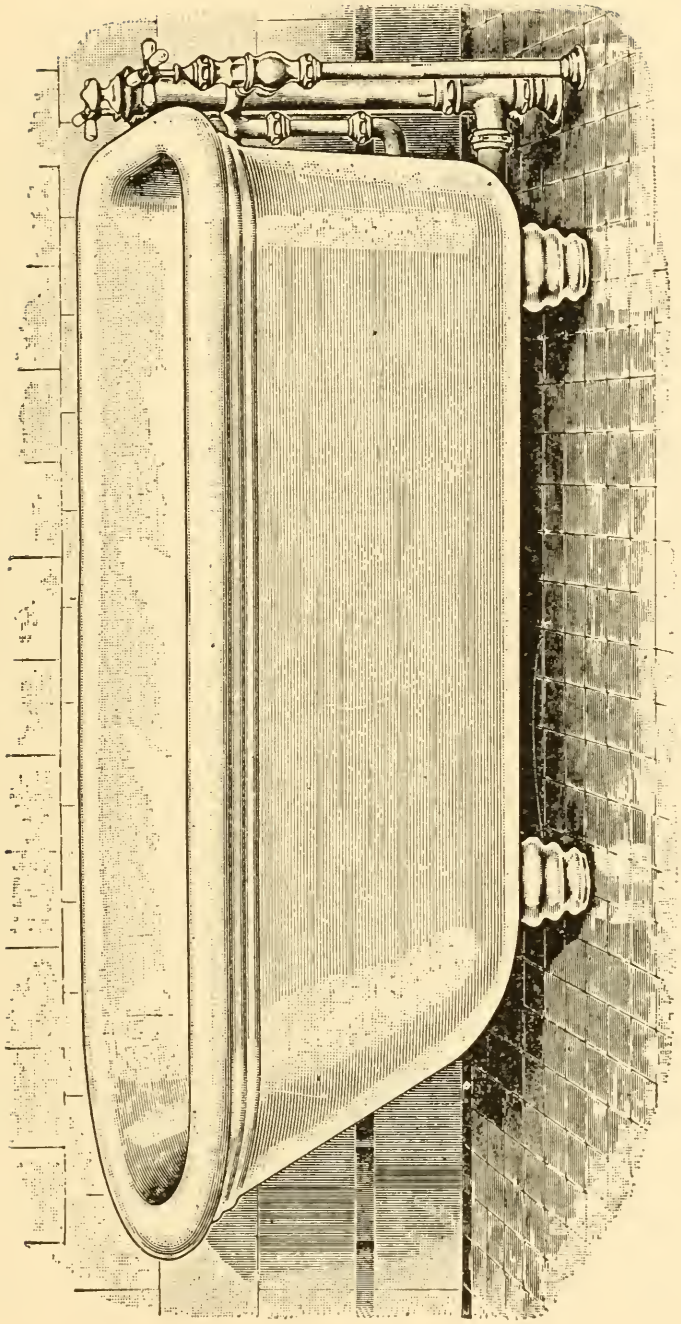


Fig. 117.

flights of stairs and land it safely to where it is to be set. It requires the greatest care in handling. In using the porcelain bathtub it has another bad point in being very cold to the touch until it has become entirely warm from the hot water.

What is styled a corner porcelain bathtub is illustrated in Fig. 118, the back and end of the tub are to be built into the wall, and the base sets into the floor. It is fitted with nickel-plated combination bell supply and waste fittings, which are connected directly to the bathtub itself.

Three styles of porcelain enameled bathtubs are shown in Figs. 119, 120 and 121, the supply and waste are connected directly to the bathtubs shown in Figs. 119 and 120, while the bathtub shown in Fig. 121 has only the waste and overflow connections on the tub.

A solid porcelain roll rim sitz bath is illustrated in Fig. 122. It is fitted with nickel-plated combination bell supply and waste fittings.

A porcelain enameled footbath is shown in Fig. 123, it is also fitted with nickel-plated combination bell supply and waste fittings.

Fig. 124 illustrates a combination spray and shower bath with rubber curtain and porcelain enameled roll rim receptor.

The proper sanitary plumbing connections for a bathtub are shown in Fig. 125. The cast iron soil pipe is 4 inches in diameter, the main air

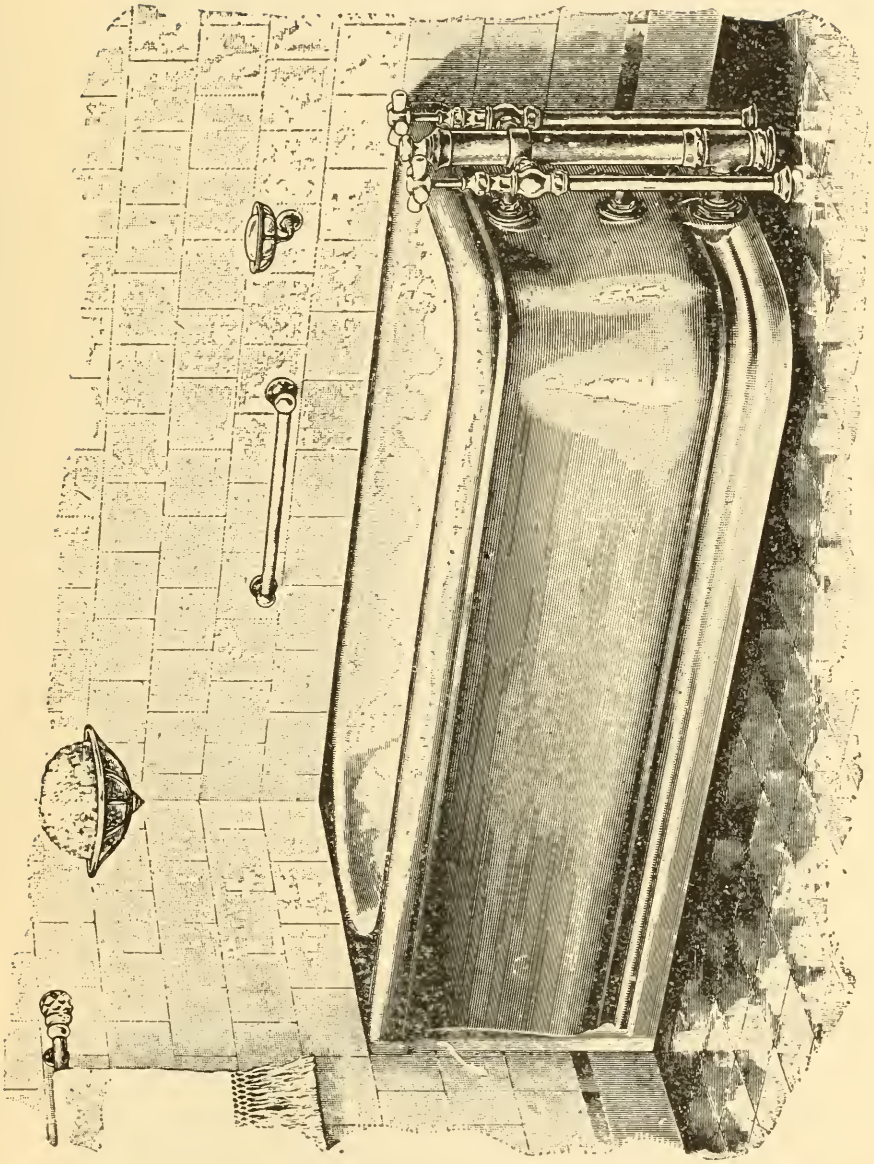


Fig. 118.

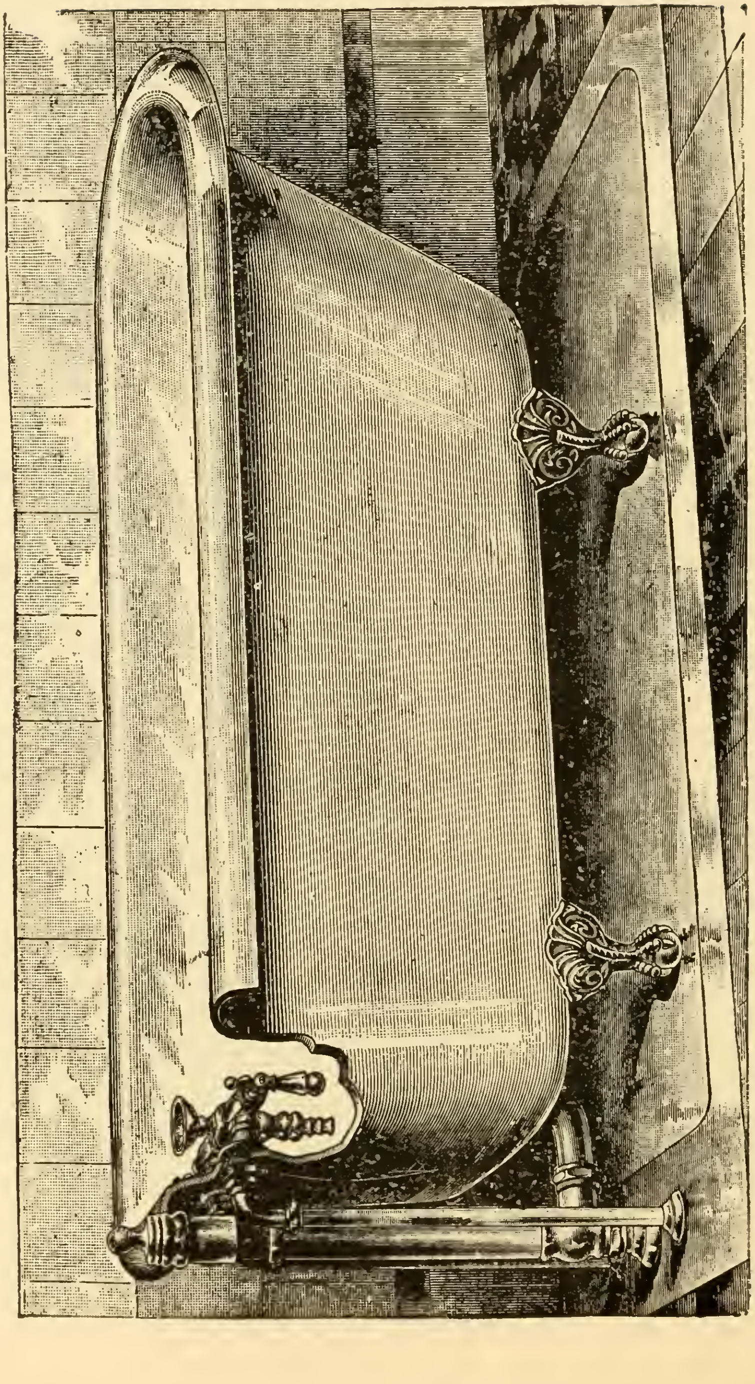


Fig. 119.

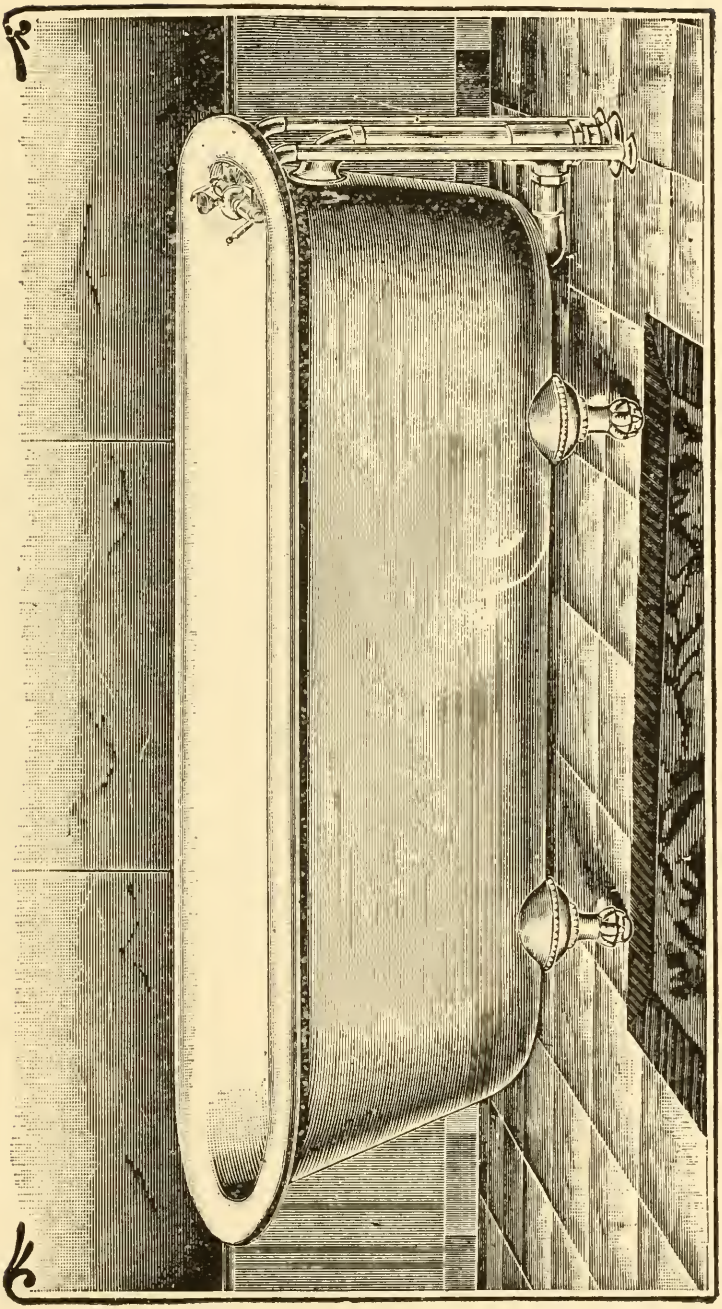


Fig. 120.

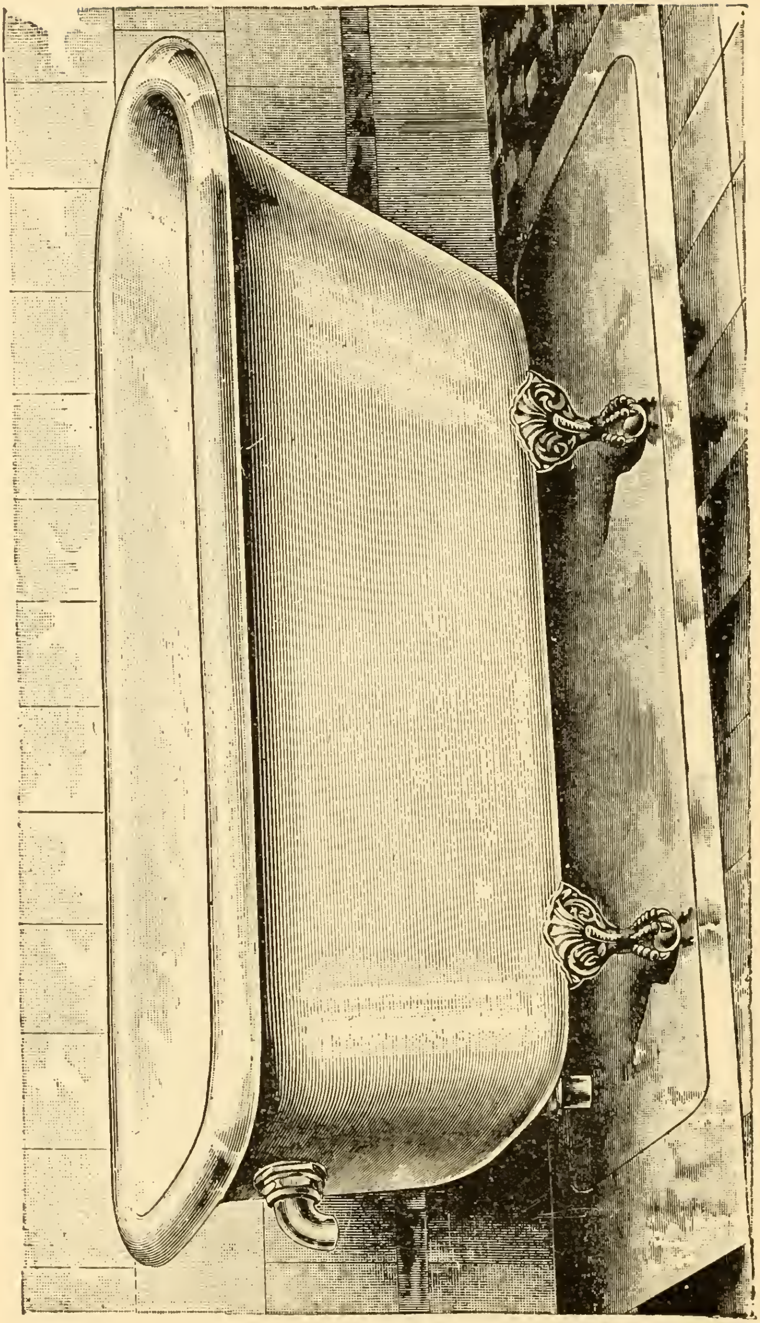


Fig. 121.

pipe 2 inches, and the air-vent pipe on the connection leading from the trap 1½ inches; the waste and overflow from the tub are also 1½ inches in diameter.

Water Closets. The washout closet is, perhaps, the best sanitary water closet, and they

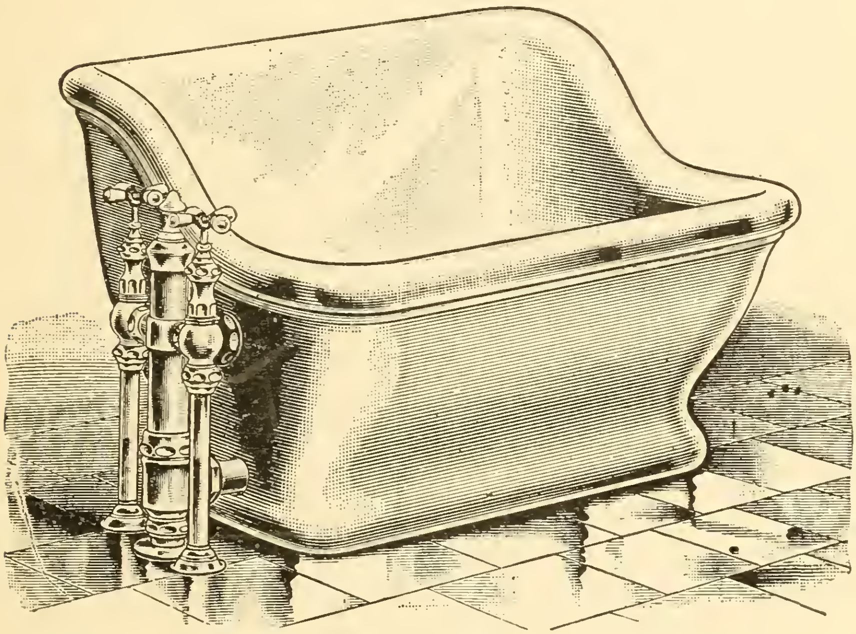


Fig. 122.

are made by nearly all manufacturers of sanitary fixtures. This closet is made with the bowl and trap combined in one single piece. The washout closet would be almost perfect if it were set up and connected as intended to be, and with a good local vent connected. The local vent is the best possible thing that could be attached to a water closet, but, like all other arrangements, it must be made in such a way so that it will operate at all times and during every condition of the atmosphere. The local vent is

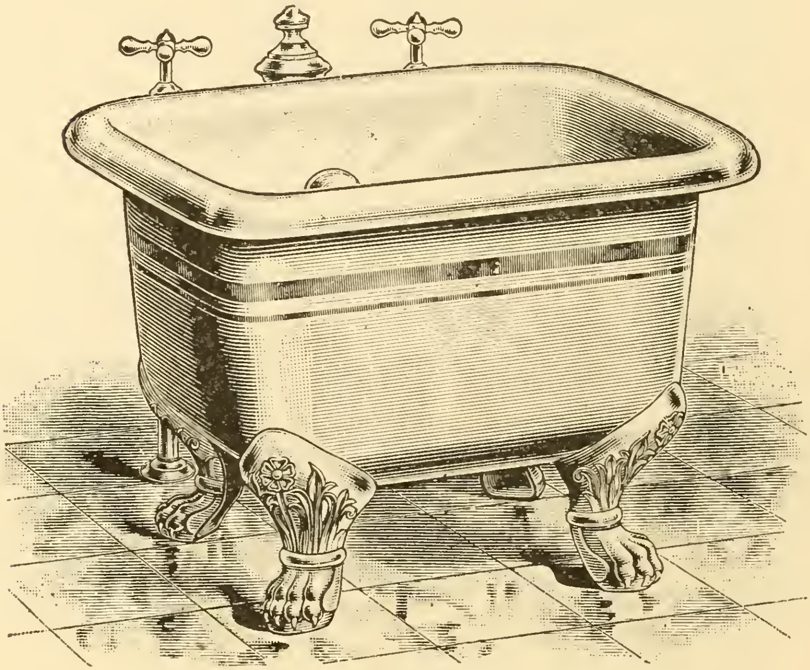


Fig. 123.

connected to the bowl of the closet for the purpose of taking away the air from the bowl of the closet in the room where it may be located, so that no foul odors while being used will pass from the closet to the room.

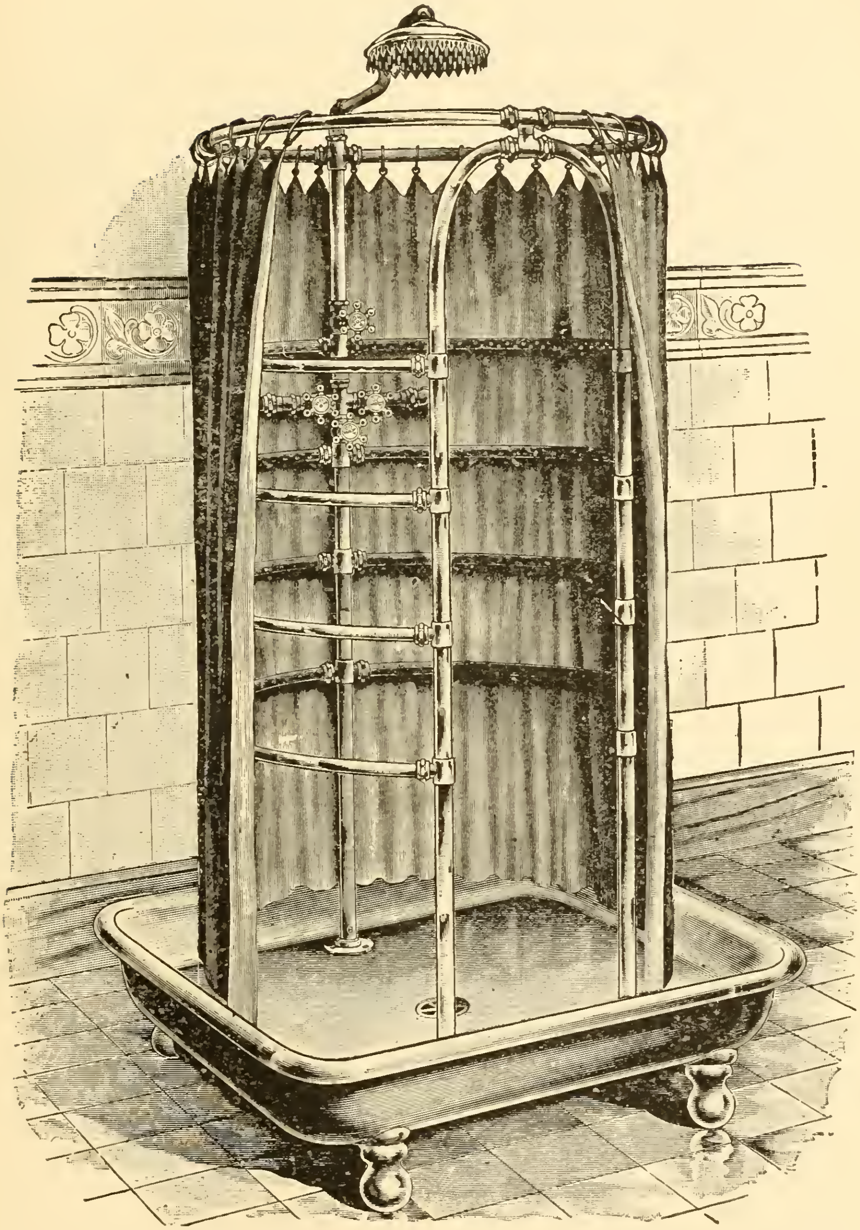


Fig. 124.

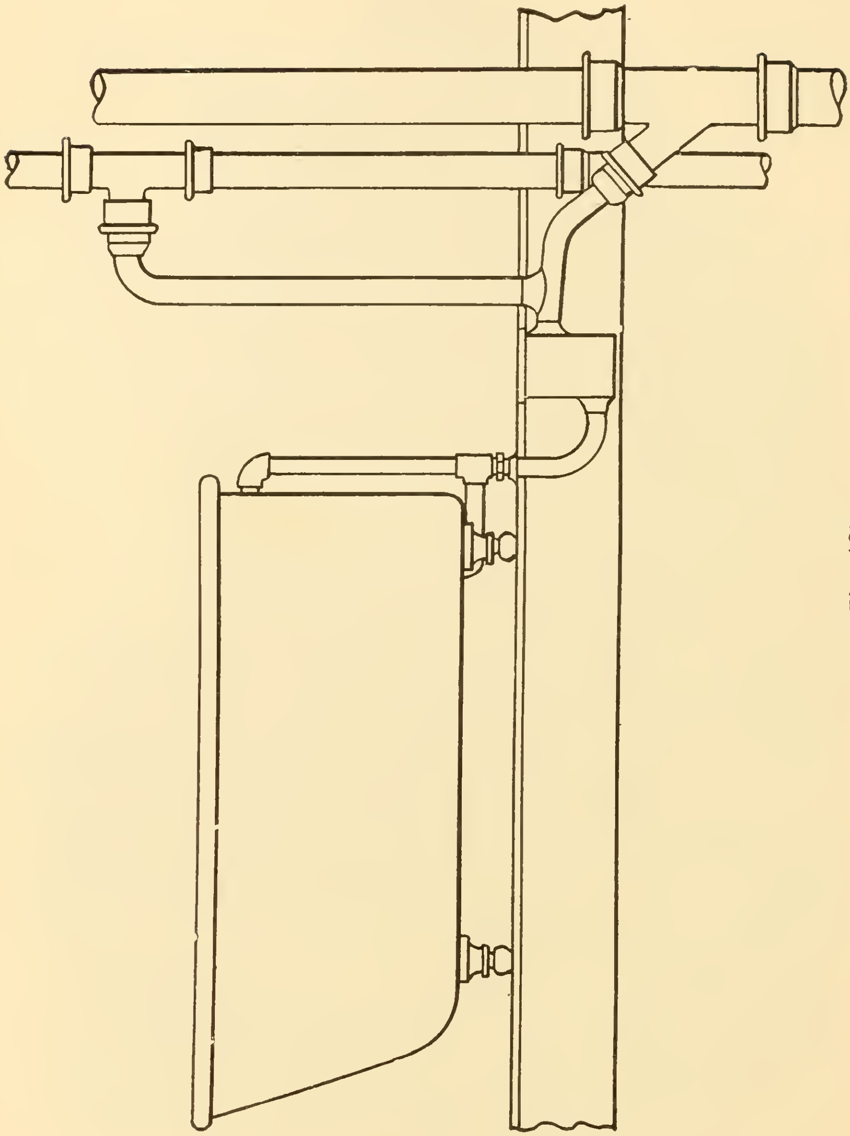


Fig. 125.

To make the local vent work satisfactorily at all times it will be necessary to arrange the pipes so that there would always be a suction in the pipe drawing from the point which is connected with the water closet bowl. This pipe can never be connected with the main ventilating shaft of the soil pipe, but must escape from the house by some other channel. In order to cause this local current of air to pass up and out of the house from the water closet bowl, it will be necessary to provide some artificial heat for this purpose. And where it is possible to connect to a chimney flue that is always warm when the house is occupied, the desired result may be had without any additional expense.

The washout closet is far from being an ideal sanitary fixture. It is an improvement over the hopper style of closet, yet its principle is not correct because it does not wash out. The objection to the washout closet is, that its bowl becomes filthy in a short time, and without having attached to it a local vent the bad odors from the bowl become unbearable. In the bowl of the washout closet there is too much dry surface, and the soil clings to it and cannot be washed off with the flow of water as it falls from the tank. The appearance of the inside of this closet is also very bad, especially the style of washout with the back outlet as shown in Fig. 126.

Fig. 127 shows a washout closet with front outlet.

A short oval flushing rim hopper water closet, with trap and air vent on the top of syphon is shown in Fig. 128.

Two styles of seat operated water closets are shown in Figs. 129 and 130, one with long hop-

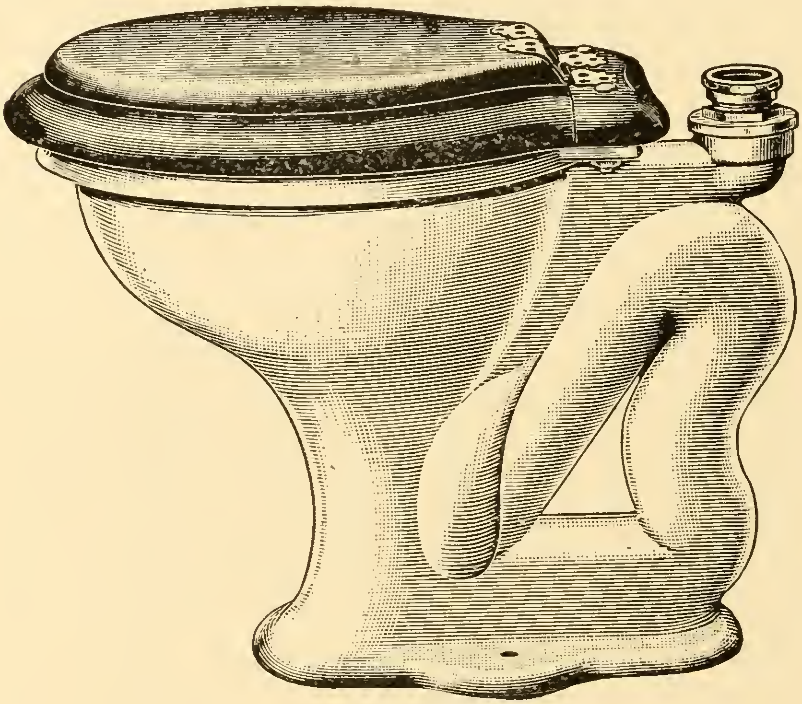


Fig. 126.

per without trap and the other with short hopper and trap. The seat is normally kept open by the weight shown to the right, when depressed by the act of a person sitting upon the closet, the small arm or lever attached to the

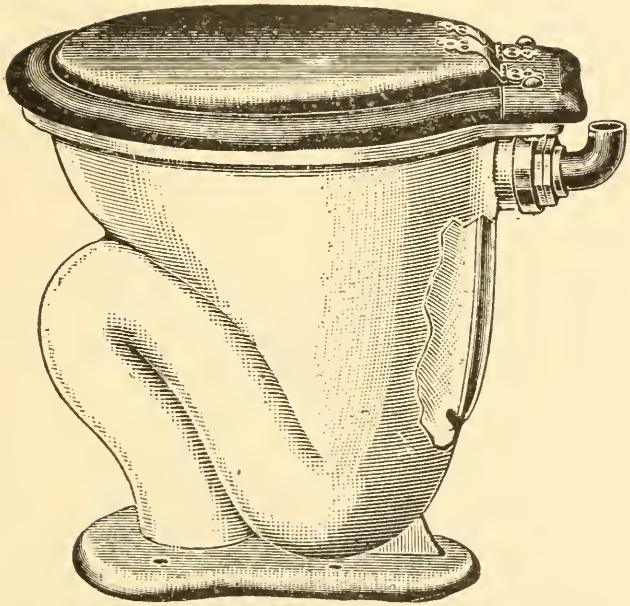


Fig. 127.

Fig. 128.

seat comes into contact with the plunger valve, causing the water to flow as long as the seat is down.

A syphon jet water closet with low down tank

Fig. 129.

is shown in Fig. 131. It is necessary with this style of tank to increase the diameter of the flush pipe in order to induce syphonage in the closet. With this increased opening a large quantity of water is thrown into the closet, which is sufficient to make the syphon operate.

A prison water closet with short hopper and trap to wall connection is shown in Fig. 132. A

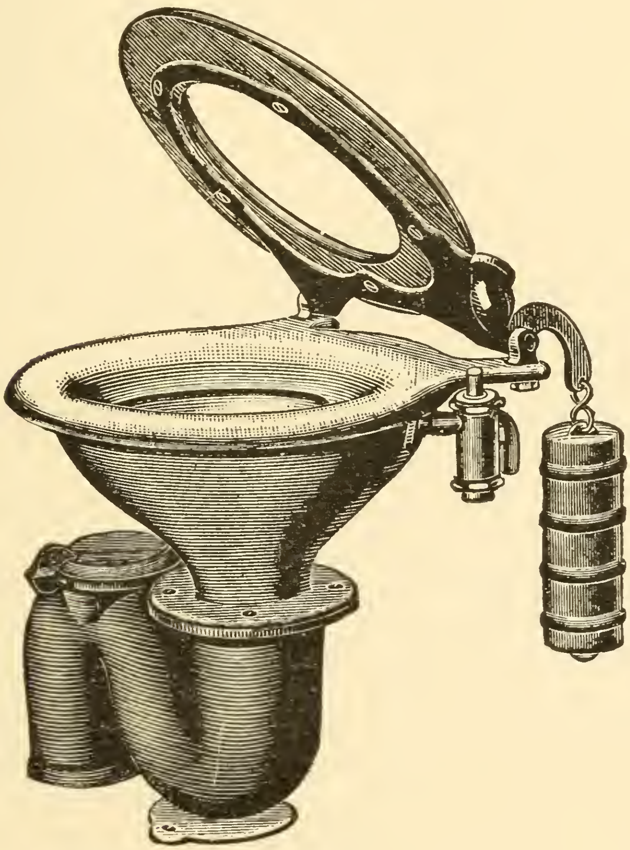


Fig. 130.

self-closing faucet is connected to the flushing rim.

A syphon jet closet set up complete with hard-

Fig. 131.

wood, copper-lined syphon tank and concealed water supply pipe is shown in Fig. 133.

Water closet seats with legs and with or without lid are shown in Figs. 134 and 135.

The proper sanitary plumbing connections for a washout water closet are shown in Fig. 136.

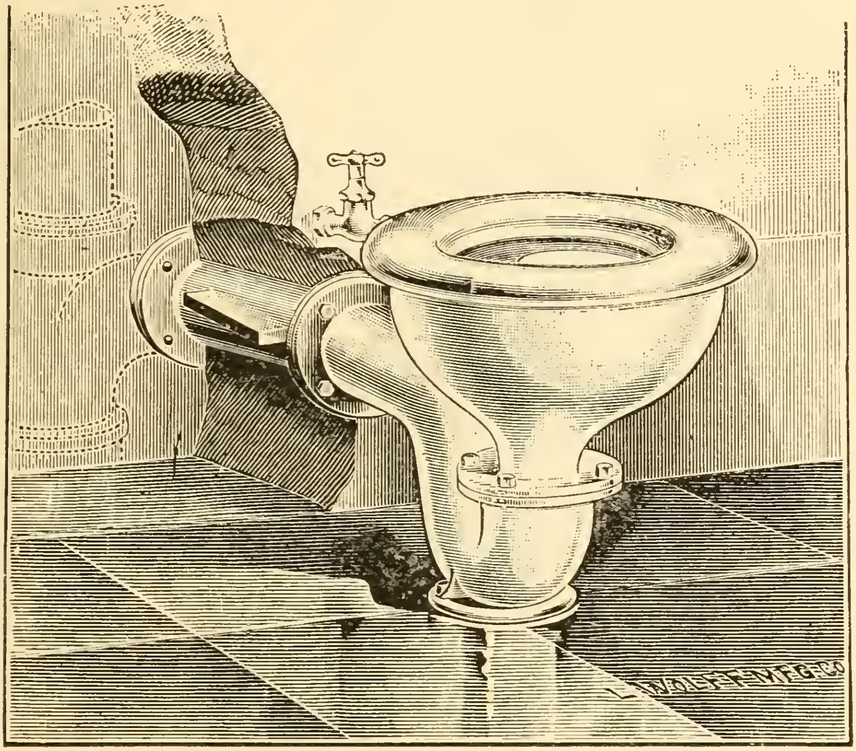


Fig. 132.

The cast iron soil pipe and the lead elbow which connects the trap of the closet with the soil pipe are both 4 inches inside diameter while the air-vent from the lead elbow and the main

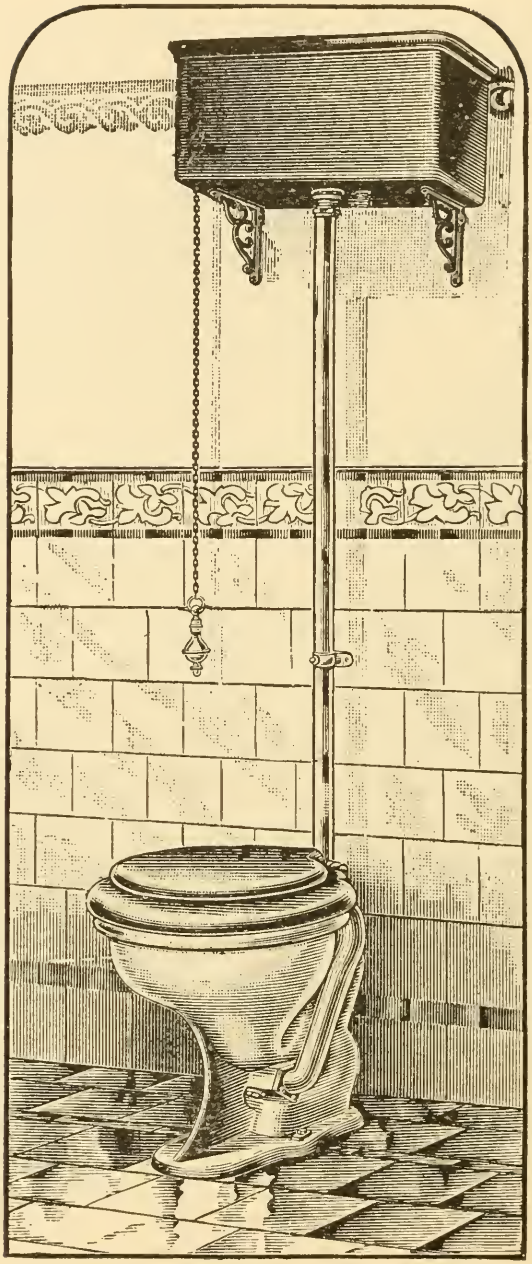


Fig. 133.

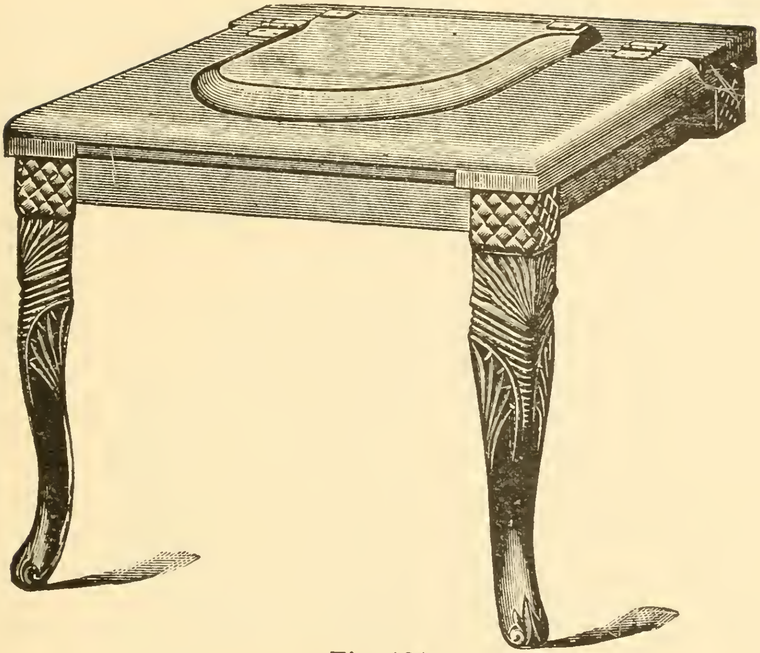


Fig. 134.

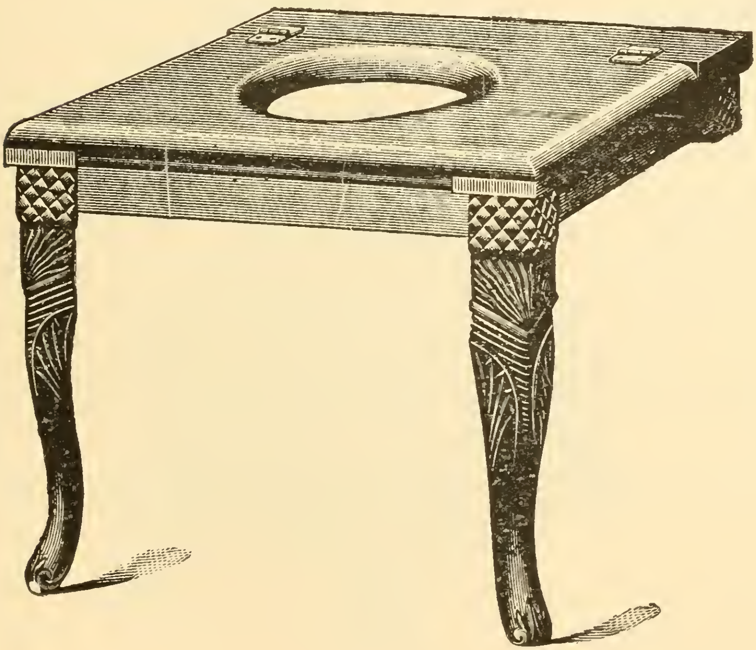


Fig. 135.

air pipe are 2 inches inside diameter. The air-vent pipe is of lead and the main air pipe of cast iron.

Urinals. A flat back porcelain urinal is illus-

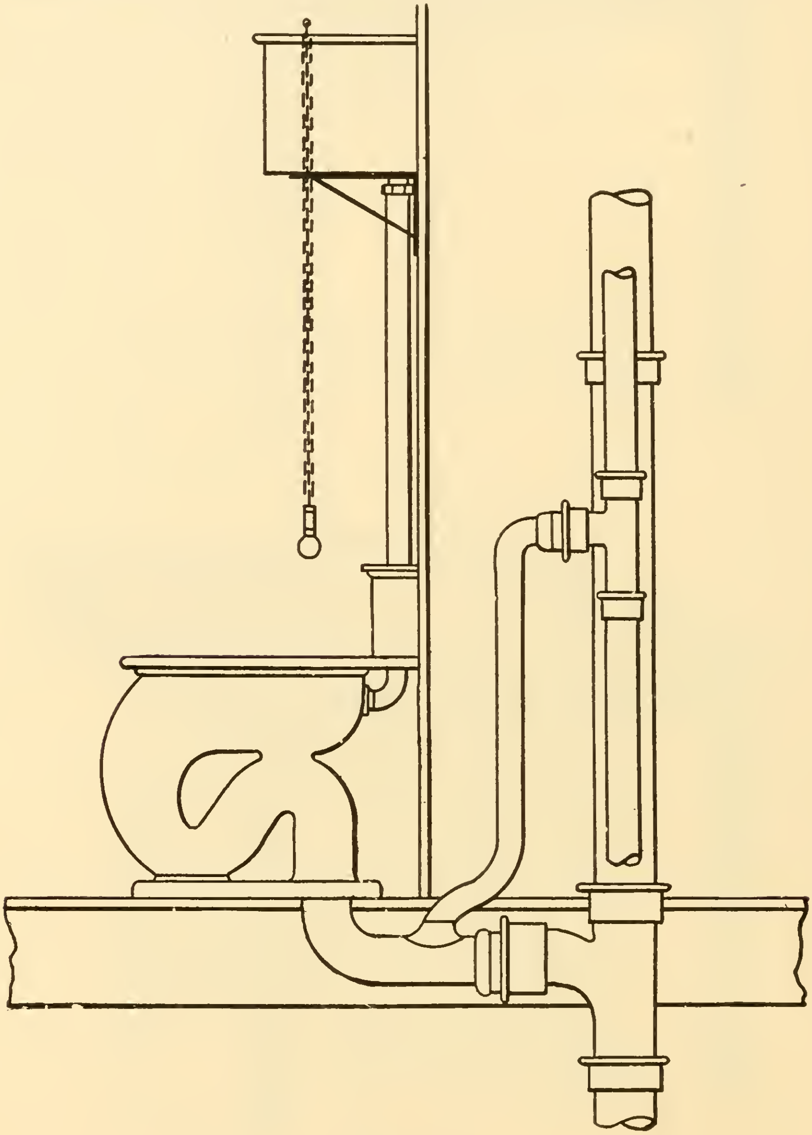


Fig. 136.

trated in Fig. 137, and corner porcelain urinals in Figs. 138 and 139. These are adapted for use in hotels and office buildings.

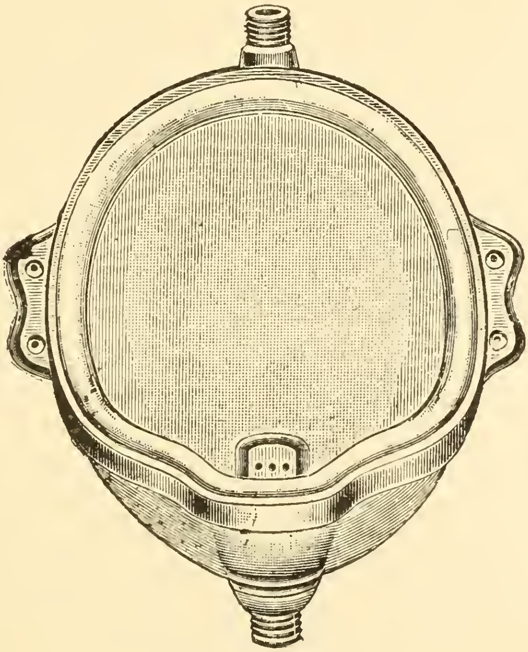


Fig. 137.

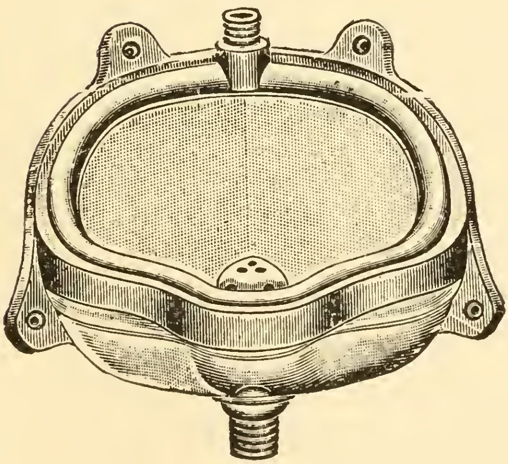


Fig. 138.

Individual stall urinals are shown in Figs. 140 and 141. The one shown in Fig. 140 has a plain stall with floor trough and spray pipe, while the one shown in Fig. 141 has urinal bowls or hoppers attached to the back wall. A complete toilet room containing closets, urinals and washbowls is shown in Fig. 142. This represents the interior of a toilet room in a hotel or office building.

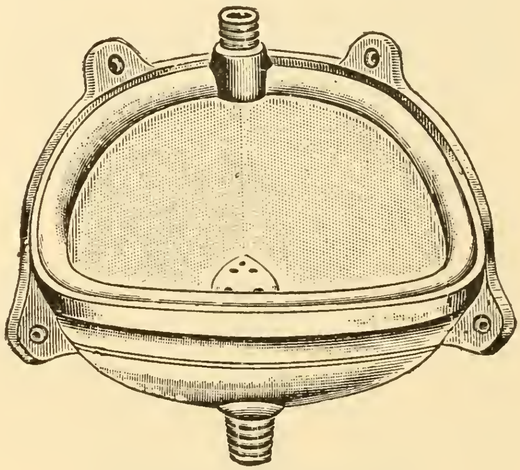


Fig. 139.

Washbowls. A job which requires experience and good judgment is the setting of porcelain washbowls to marble slabs. Although it may look like an easy job, no one can do this work well unless having had considerable experience. In setting washbowls to marble slabs there are some things to be considered, and to accomplish these things in a satisfactory manner there must be some calculations made. To have a wash-bowl properly fitted to a marble slab it is necessary to grind the flange of the bowl so that it

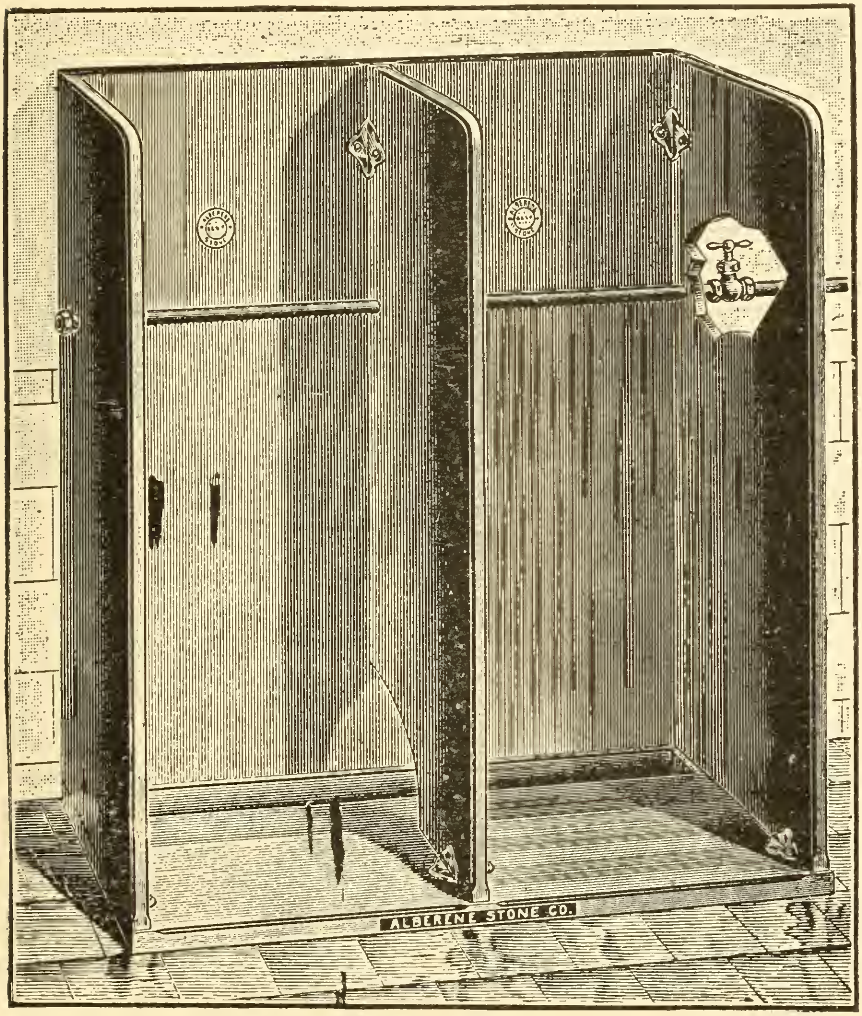


Fig. 140.

will lay level on the slab. This has to be done by rubbing the upper surface of the flange of the bowl on the marble, using sand and water on the marble, until the top edge of the bowl is perfectly flat and level. This grinding action

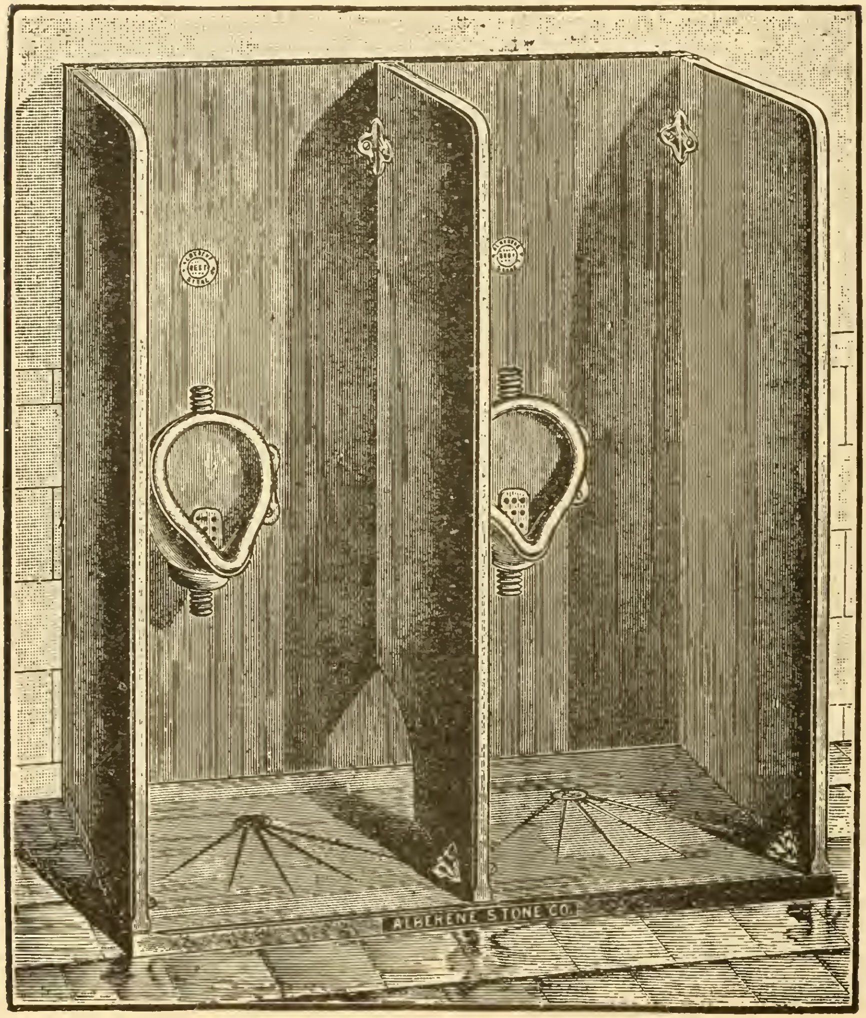


Fig. 141.

also takes off the glazed surface and allows the plaster-of-Paris to take hold of the procelain

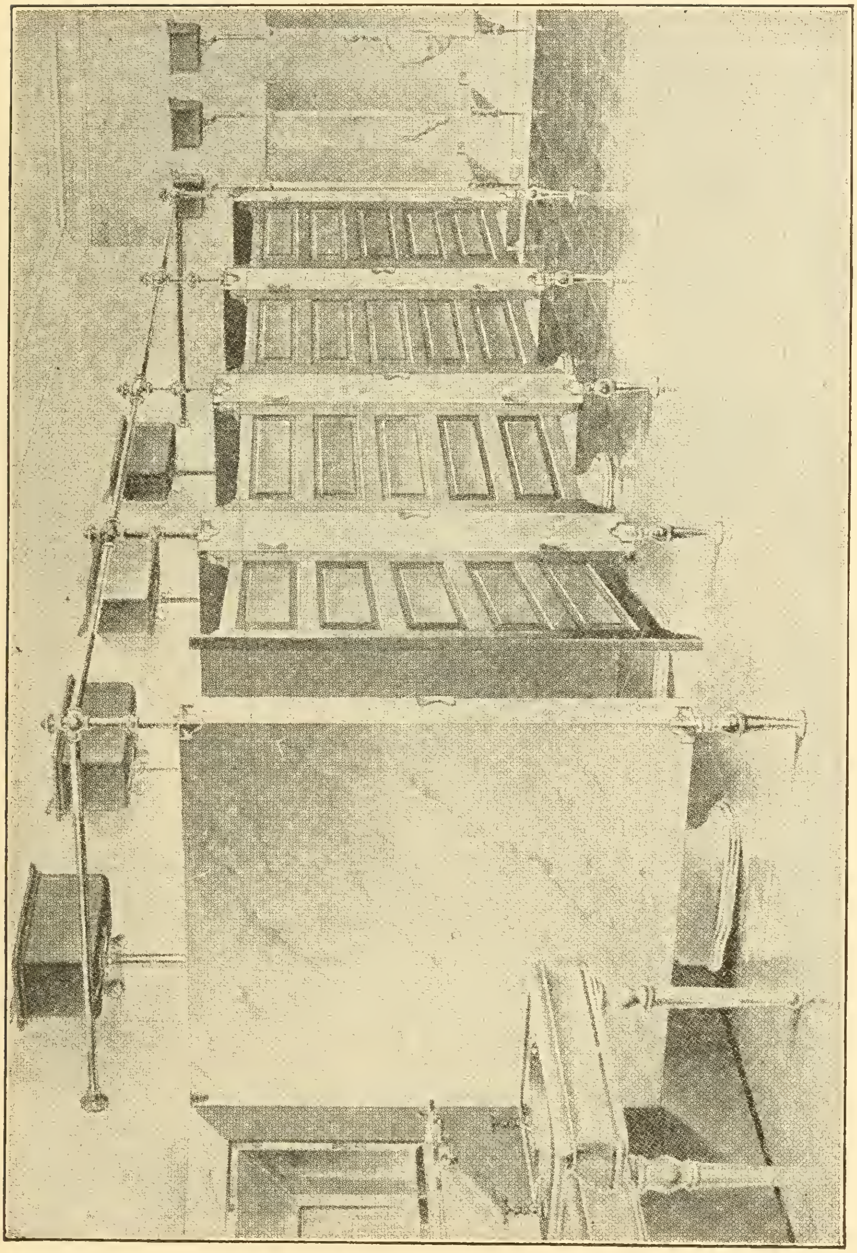


Fig. 142.

and make a perfect joint. The bowl must be set perfectly even all around with the hole in the slab. The less plaster used in setting bowls the better. It is a poor job that has to be filled up with a large amount of plaster. To get the position of the holes for the bowl clamps, it will be necessary to mark on the back of the slab the exact position of the edge of the bowl, then

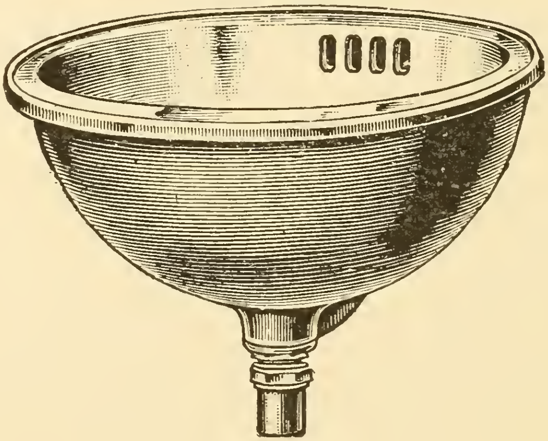


Fig. 143.

space off the distance and drill the slab for at least four clamps. In drilling the slab for the clamp holes the polished surface of the slab must rest on the floor, and in order not to scratch or injure it the slab should have under it a bed of some soft and clean material. The clamps should be well calked into the slab with melted lead, and made so that they will not shake nor pull out.

Independent bowls for attaching to marble slabs are shown in Figs. 143 and 144. They are provided with brass plugs and coupling and rubber stopper for the waste.

A roll-edge washbowl with removable strainer at the overflow, nickel-plated plug and coupling and rubber stopper, and bronzed brackets is shown in Fig. 145.

A half-circle roll edge washbowl with high

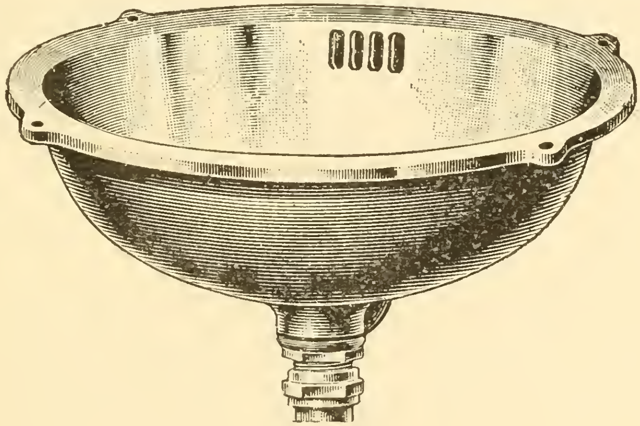


Fig. 144.

back and apron, cast in one piece, is shown in Fig. 146.

Fig. 147 shows a roll-edge oval washbowl with overflow with removable strainer, bronzed brackets, nickel-plated plug and coupling and rubber stopper.

A roll-edge corner washbowl with oval bowl, removable nickel-plated strainer, nickel-plated plug and coupling and rubber stopper is shown in Fig. 148.

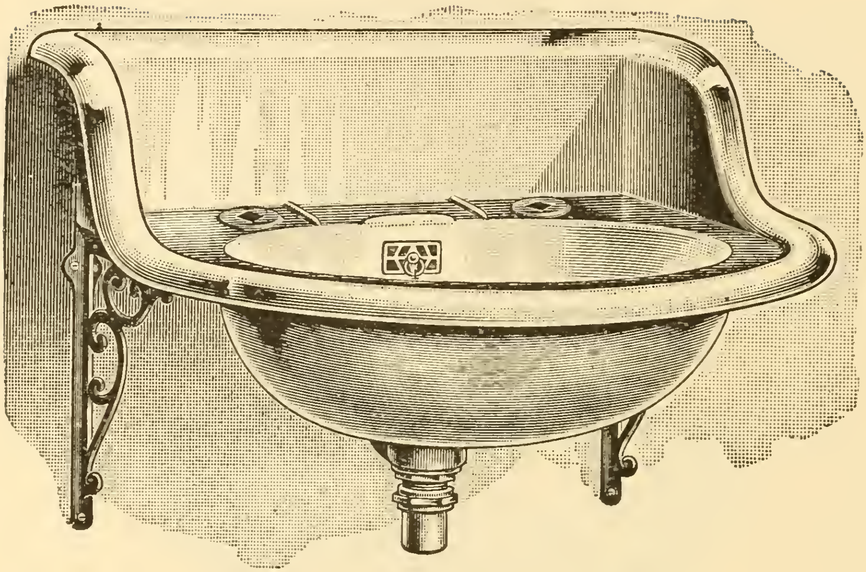


Fig. 145.

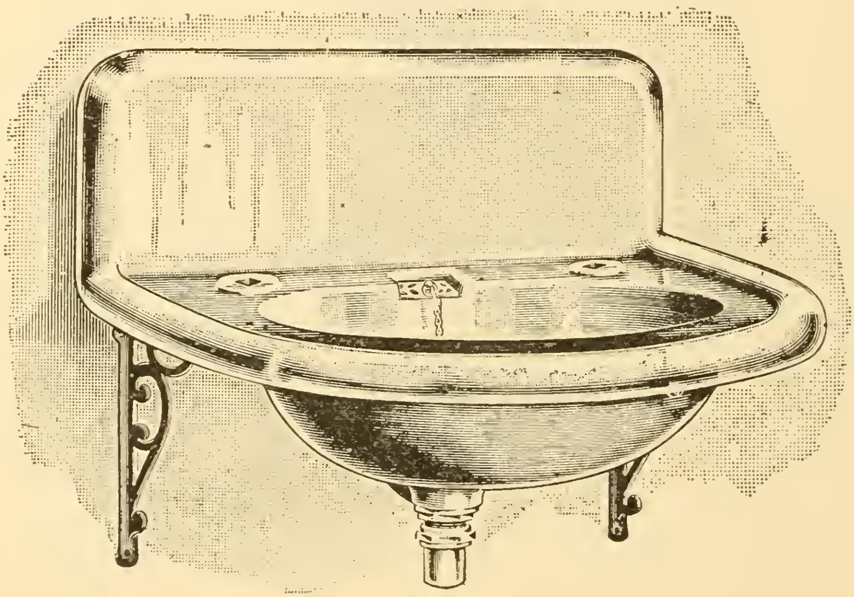


Fig. 146.

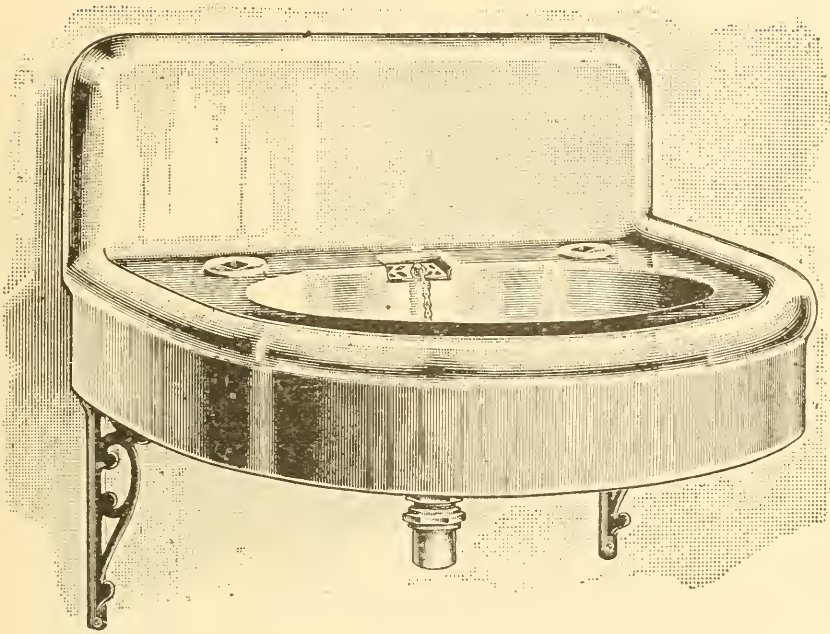


Fig. 147.

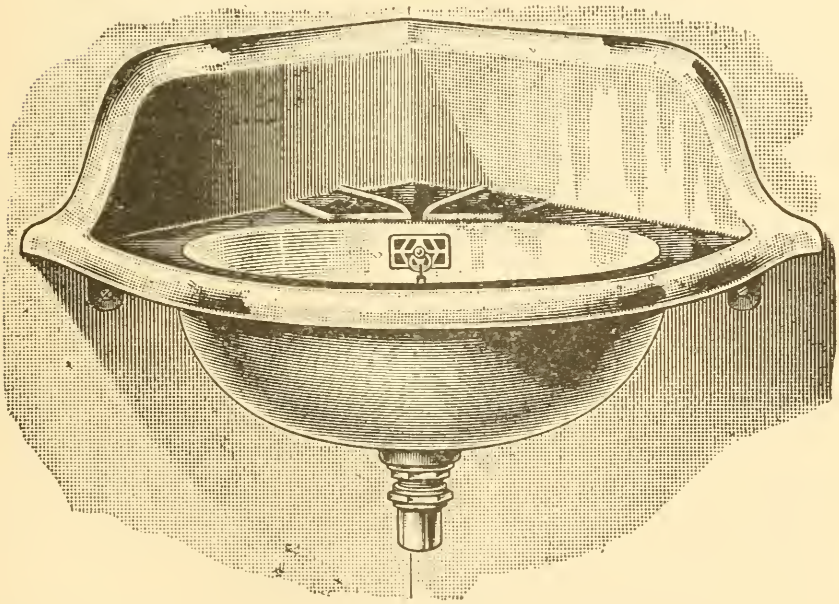


Fig. 148.

A roll-edge slab and bowl with ideal waste is shown in Fig. 149. It has a round bowl and high back.

A vertical cross section of the above bowl showing the ideal waste is given in Fig. 150.

The proper sanitary plumbing connections

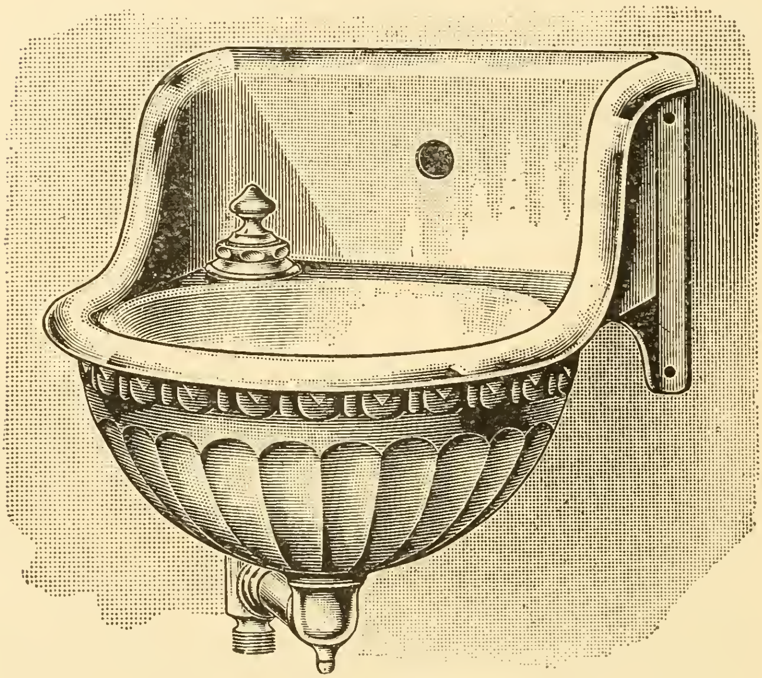


Fig. 149.

for a washbowl are shown in Fig. 151. The cast iron soil pipe is 4 inches in diameter. The waste pipe from the bowl and the air-vent pipe from the top of the syphon are 1½ inches and the main air pipe 2 inches in diameter.

Drinking Fountains. A solid porcelain double roll edge drinking fountain with back and bowl in one piece is shown in Fig. 152. It has a self-closing faucet and nickel-plated drip-cup with strainer. A one-piece solid porcelain drinking fountain with roll-edge bowl is shown in Fig.

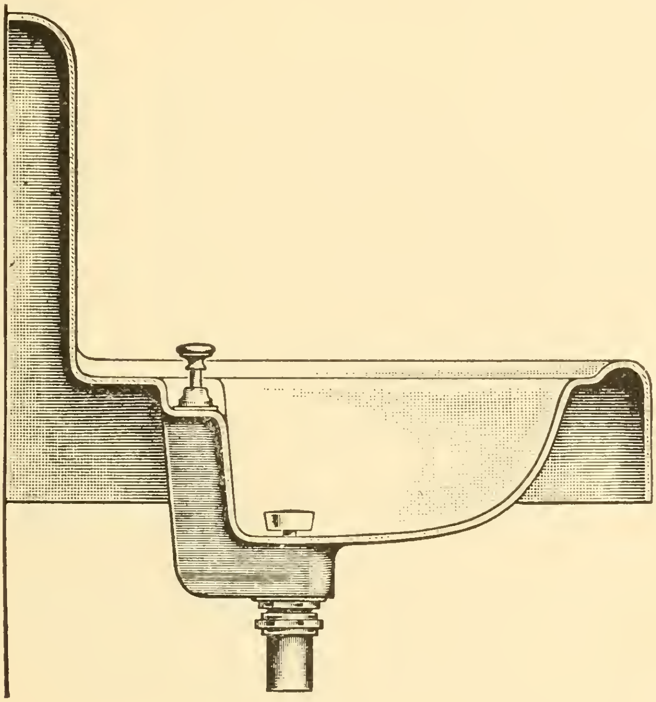


Fig. 150.

153. It has a self-closing faucet and nickel-plated half S-trap.

A marble drinking fountain is shown in Fig. 154, which has a counter sunk slab and high back, nickel-plated Fuller pantry cock, drip-cock with shield, nickel-plated supply pipe, and trap with vent and waste to wall.

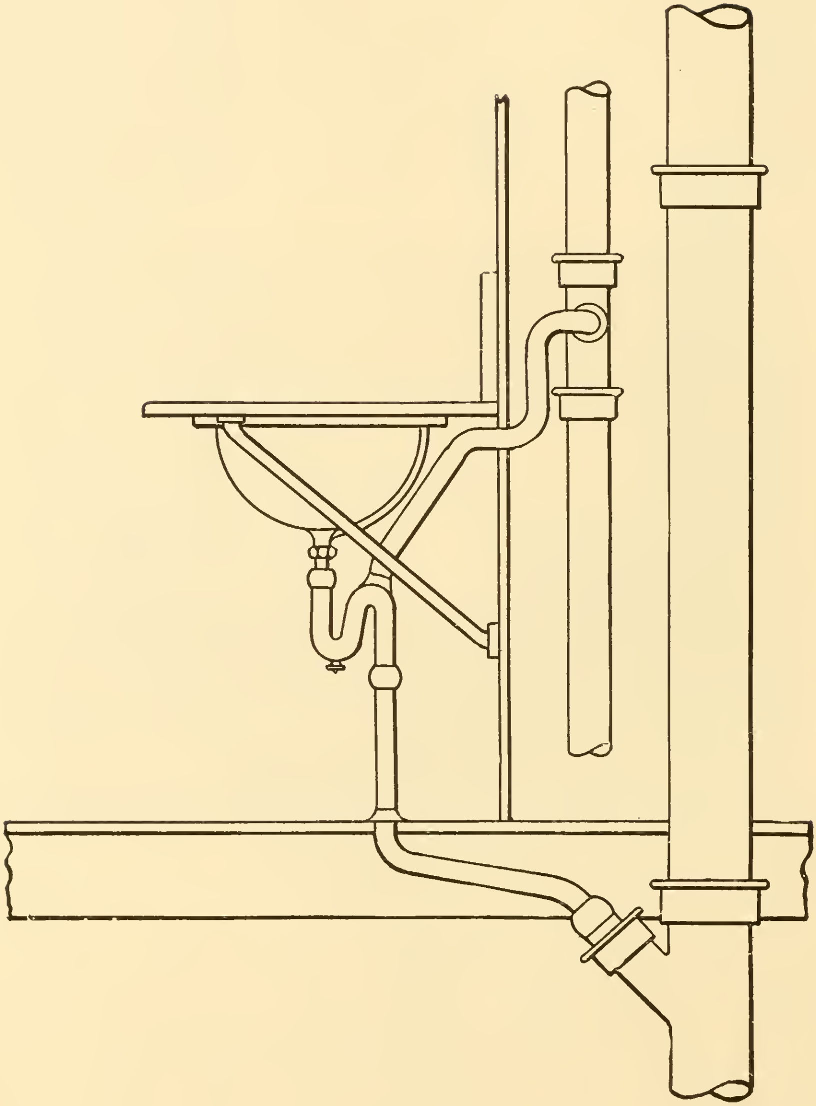


Fig. 151.

A drinking fountain with marble slab, back and side-pieces, nickel-plated Fuller pantry cock, drip cup with shield and nickel-plated brackets is shown in Fig. 155.

Sinks. The enameled iron sink is a great advancement in sanitary improvements. When

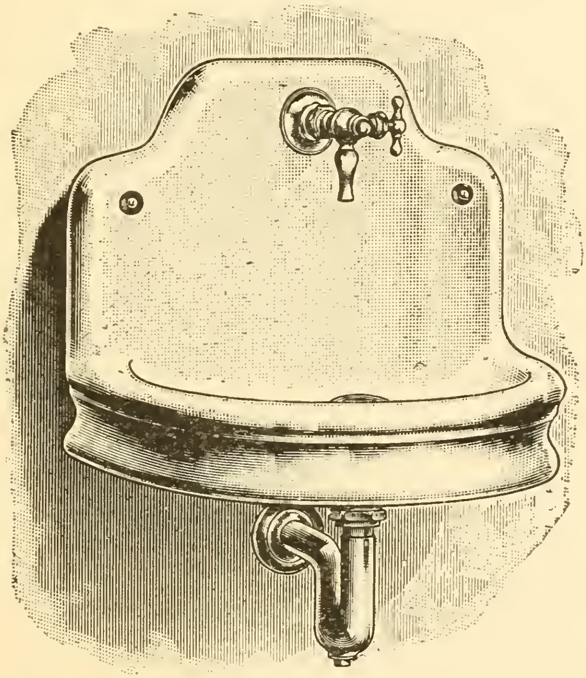


Fig. 152.

made properly and used for light work it is all that could be desired, because it is coated with a material which wears well, and is also proof against the action of gases or acids. It has a smooth finish and is easily kept clean, but it is not suitable for heavy or rough work. In the larger sinks this enameled coating cracks off easily when heavy utensils are placed in it, which causes the sink to bend, and the enamel,

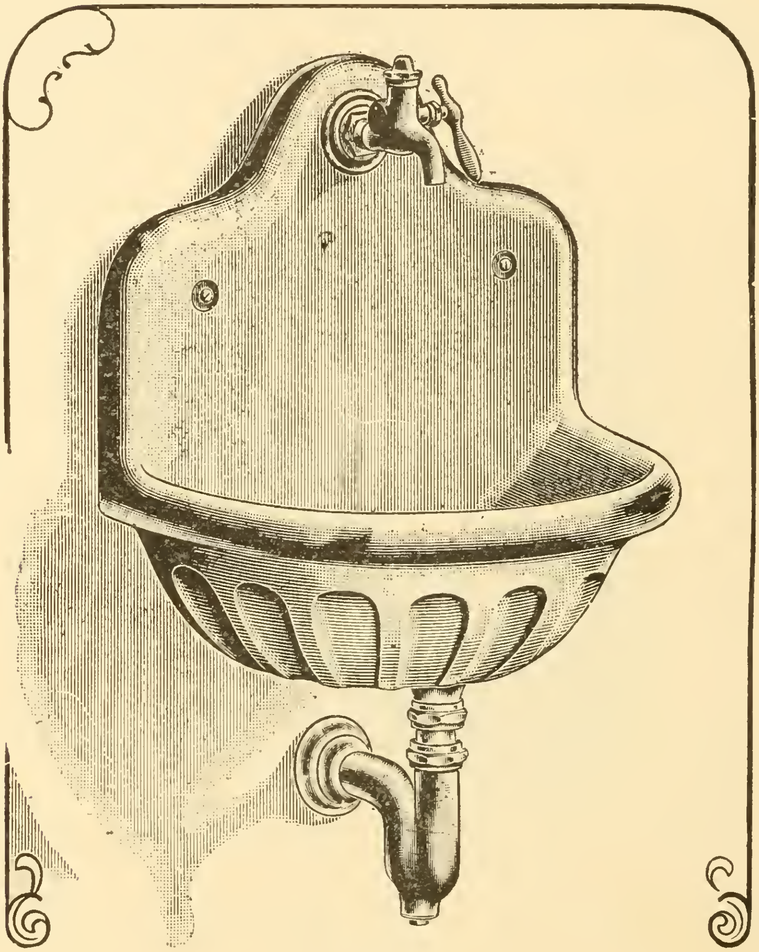


Fig. 153.

having very little elasticity, must naturally crack. It sometimes cracks by the uneven or sudden expansion and contraction of the iron, and as soon as the coating is partly cracked off the sink becomes sanitarily bad.

A roll rim enameled iron sink is shown in Fig. 156. It has a high back, concealed air cham-

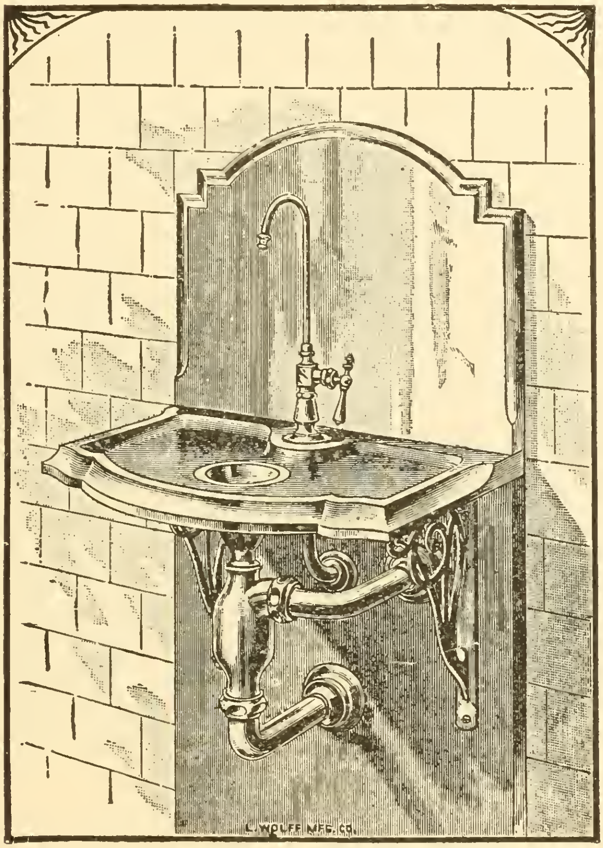


Fig. 154.

bers and nickel-plated faucets. A corner enameled iron sink with roll rim, high back, concealed air chambers and nickel-plated faucets is shown in Fig. 157. Instead of having brackets for support, it is carried by the walls and one leg.

A plain enameled iron sink is shown in Fig. 158.

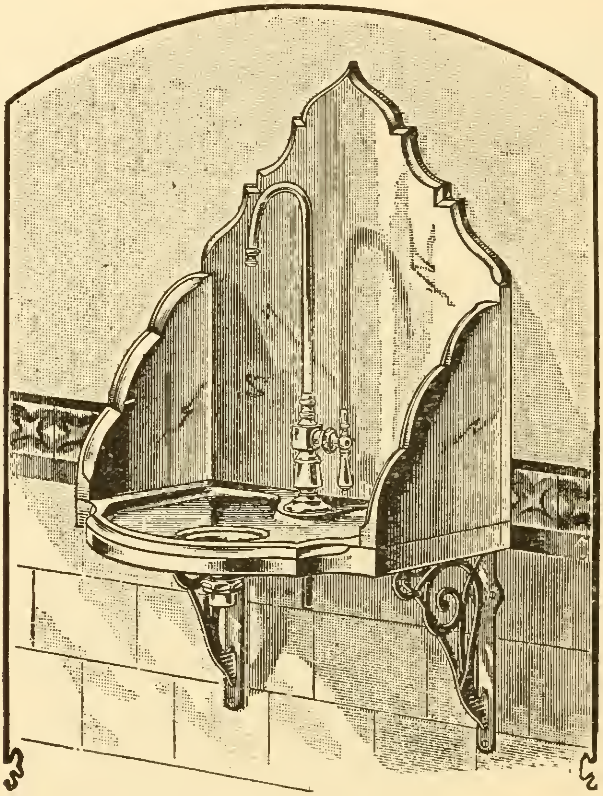


Fig. 155.

A roll rim drawn steel sink with high back is illustrated in Fig. 159.

Grease Trap. Grease from the kitchen sink not only stops up the sink waste pipe, but it will often stop up the main sewer. When a pipe becomes choked with grease it cannot be forced out by pressure, or the use of potash or lye for the purpose of dissolving it. The only remedy in such a case is to cut the pipe and take out the grease. This is very expensive, and costs a great deal more than a grease trap

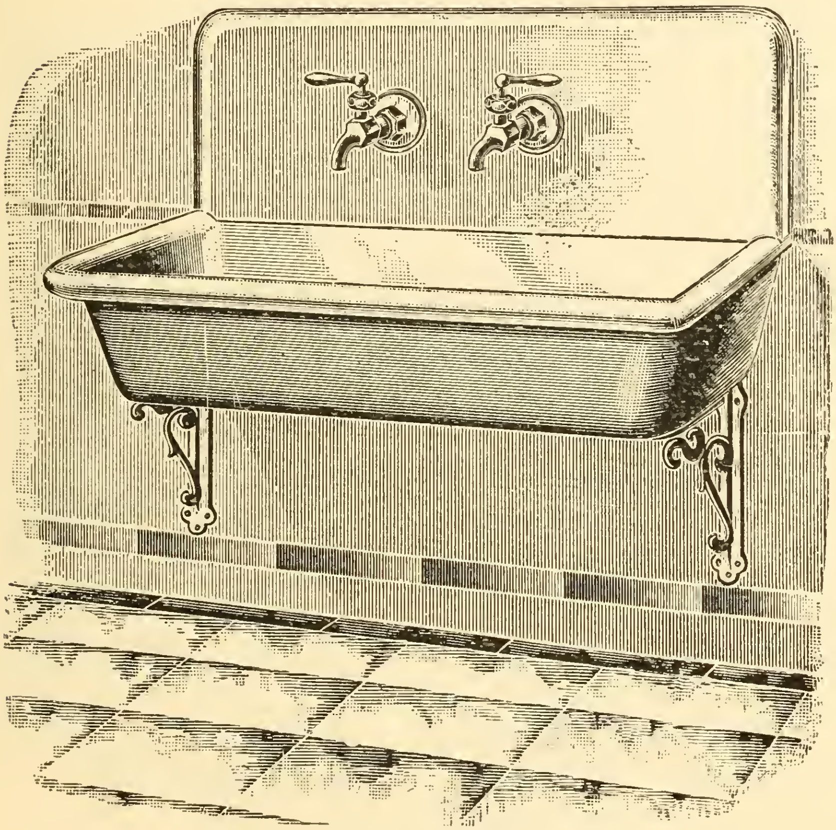


Fig. 156.

that could have been placed on the sink when new, and would have prevented such trouble. Fig. 160 shows a device made specially for kitchen sinks in hotels and restaurants to prevent grease from getting into the waste pipes. It traps the pipe against air or sewer gas coming into the house, and is called a grease trap.

In places where the grease trap is used it is a

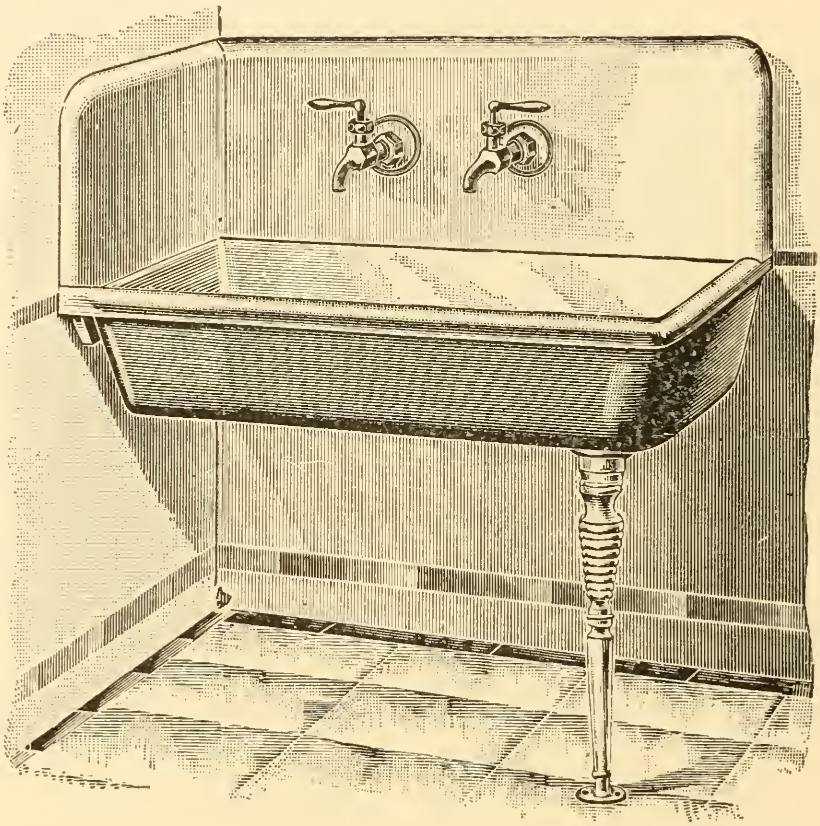


Fig. 157.

source of revenue as well as a prevention against the stopping of pipes by saving the grease, which is caught in the trap, and selling it for soft soap.

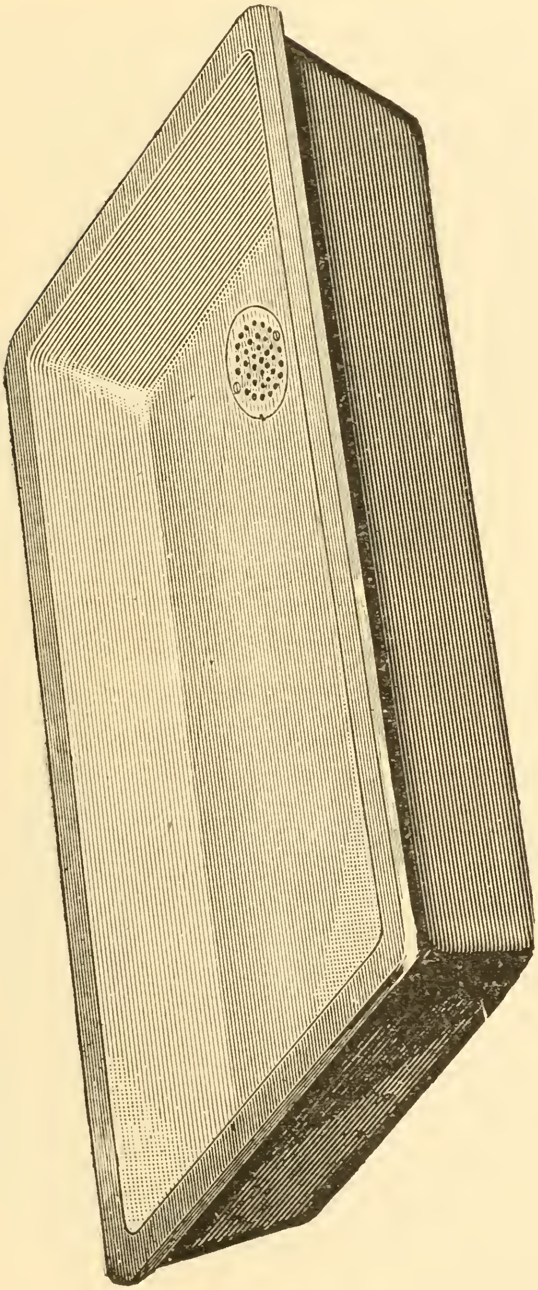


Fig. 158.

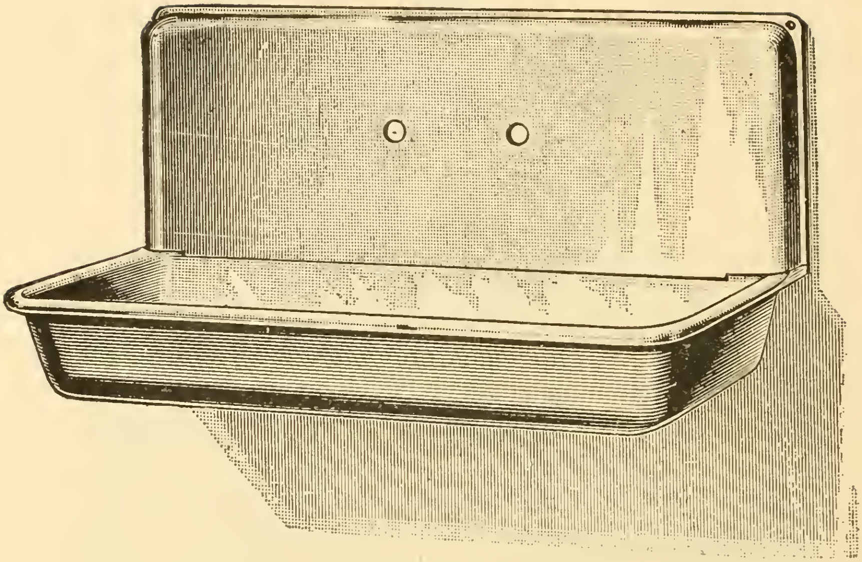


Fig. 159.

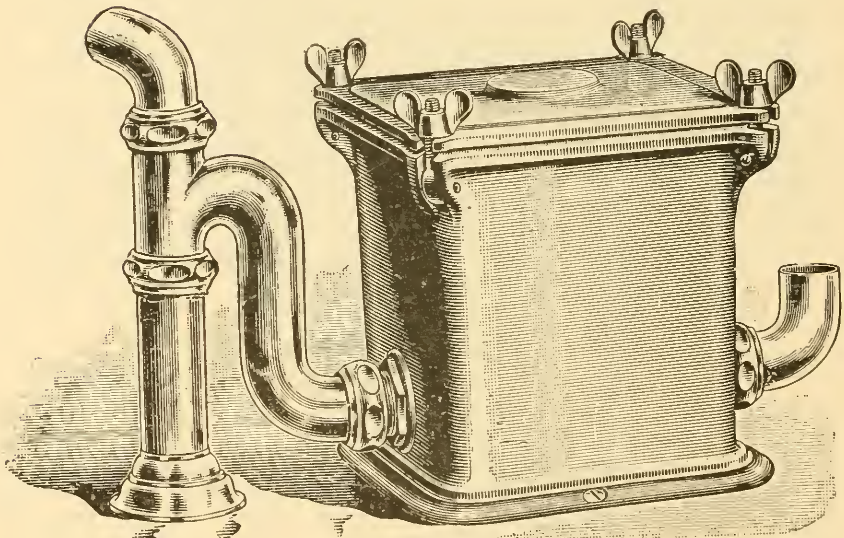


Fig. 160.

Laundry Tubs. Stoneware makes the best kind of laundry tub from every point of view, and they are almost as cheap as enameled iron tubs. The stoneware is non-absorbent. It is very smooth, and will not crack by the variations of heat and cold. This style of laundry tub should be set on a solid foundation of either brick piers or good strong cast iron legs; there should be no woodwork around it, and even a wooden cover is very bad on a laundry tub. Some persons cover over the laundry tub for the purpose of making it answer as an ironing board, but it is not intended for this purpose. To close up the top of the laundry tubs prevents the air from circulating through them, and what little particles of soap or other matter that remain even after cleaning the tubs soon form into a gas which makes a very unpleasant smell when the cover is raised.

A stoneware laundry tub with metal rim, brass plugs, strainers, overflow and waste connections is shown in Fig. 161.

A somewhat similar stoneware laundry tub is shown in Fig. 162, only without the metal rim on the edges of the tub. It has a high back and the faucets are above the level of the tub proper.

The proper sanitary plumbing connections for a laundry tub are shown in Fig. 163. The waste pipes from the tubs and the connection from the trap to the main waste are 1½ inches diameter;

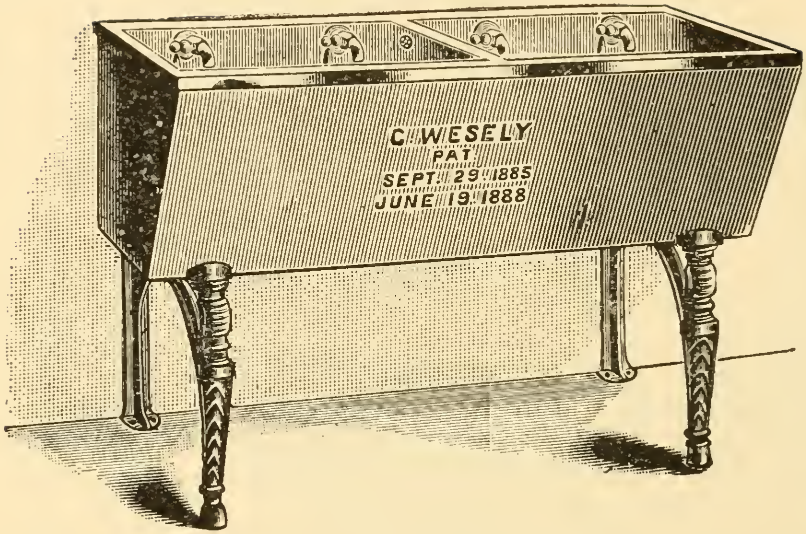


Fig. 161.

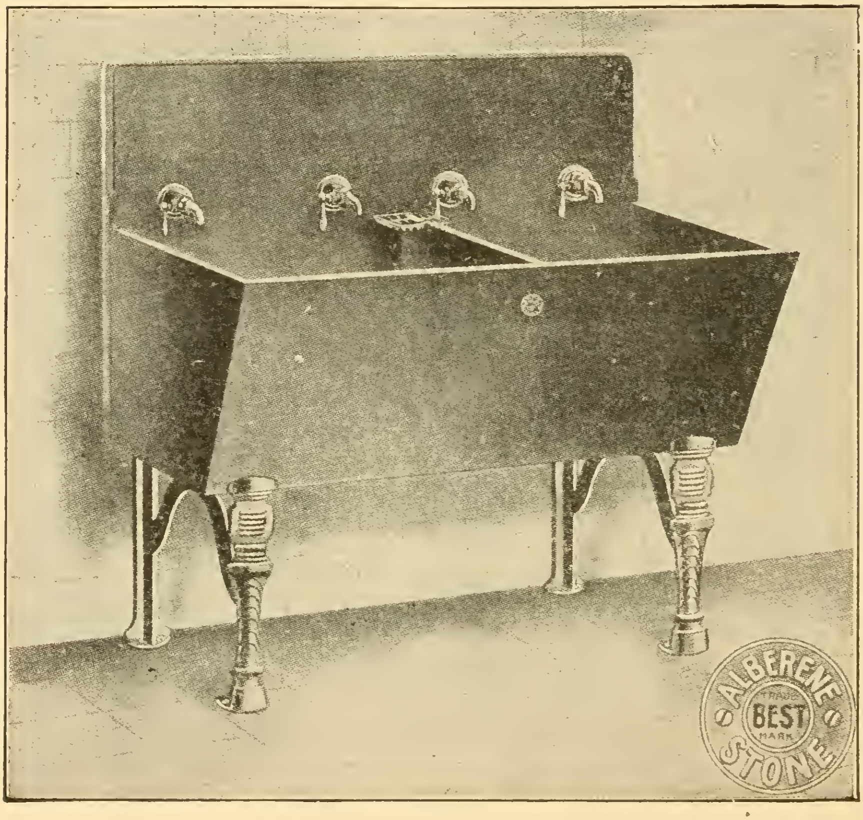


Fig. 162.

the air-vent pipe from the outlet of the trap is also $1\frac{1}{2}$ inches. The main waste and main air pipes are 2 inches in diameter. The waste pipes from the tubs, the connection from the trap to

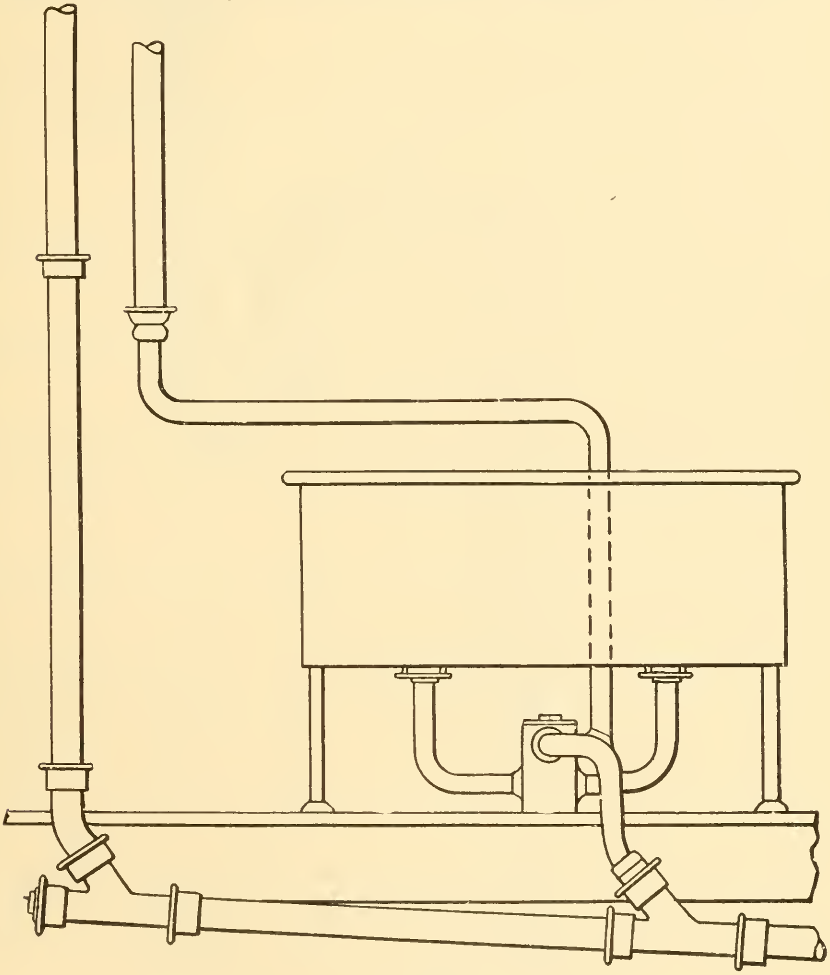


Fig. 163.

the main waste and the air-vent pipe are of lead. The main air and the main waste pipes are of cast iron.

BATHROOM AND KITCHEN FITTINGS.

Washbowl Traps. A nickel-plated brass washbowl floor-trap without vent is shown in Fig. 164, and a similar washbowl floor-trap with wall-vent in Fig. 165.

A nickel-plated brass washbowl wall trap, with or without the coupling plug and stopper is shown in Figs. 166 and 167.

A nickel-plated brass washbowl floor trap with wall-vent is shown in Fig. 168.

Washbowl Plugs. Washbowl plugs with thimble, coupling and rubber stoppers are shown in Figs. 169 and 170.

A washbowl plug with thimble, coupling and brass stopper is shown in Fig. 171.

Laundry or Bathtub Plugs. A tub plug with flange drilled for countersunk screws or bolts is shown in Fig. 172 and the rubber stopper for the same in Fig. 173.

Another form of tub plug is shown in Fig. 174. This style of plug is to be either cemented or soldered in place. A tub plug with extra wide flange drilled for countersunk bolts and with brass stopper is illustrated in Fig. 175.

Sink Strainers. A sink strainer with flange drilled with holes for countersunk bolts is shown

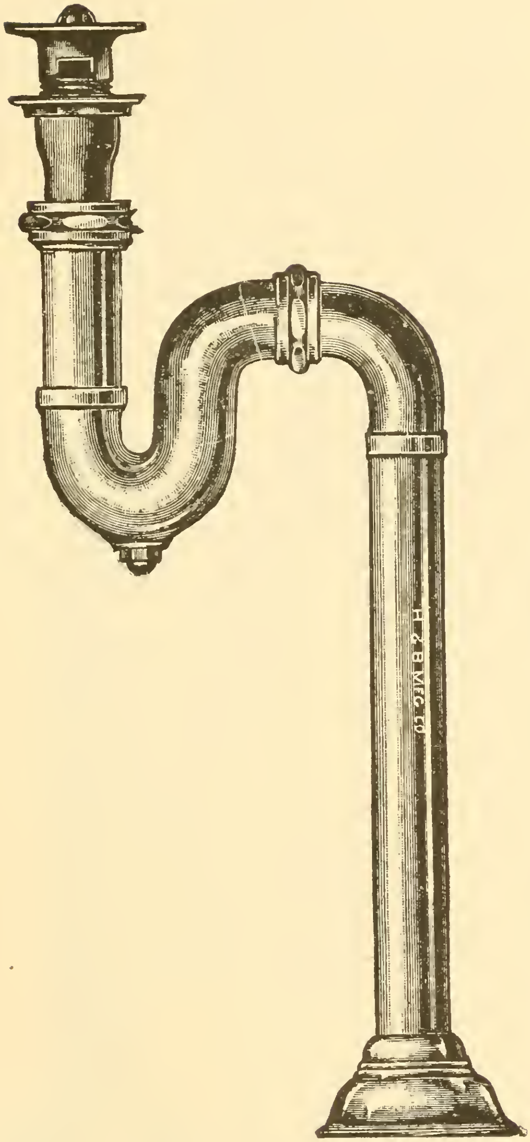


Fig. 164.

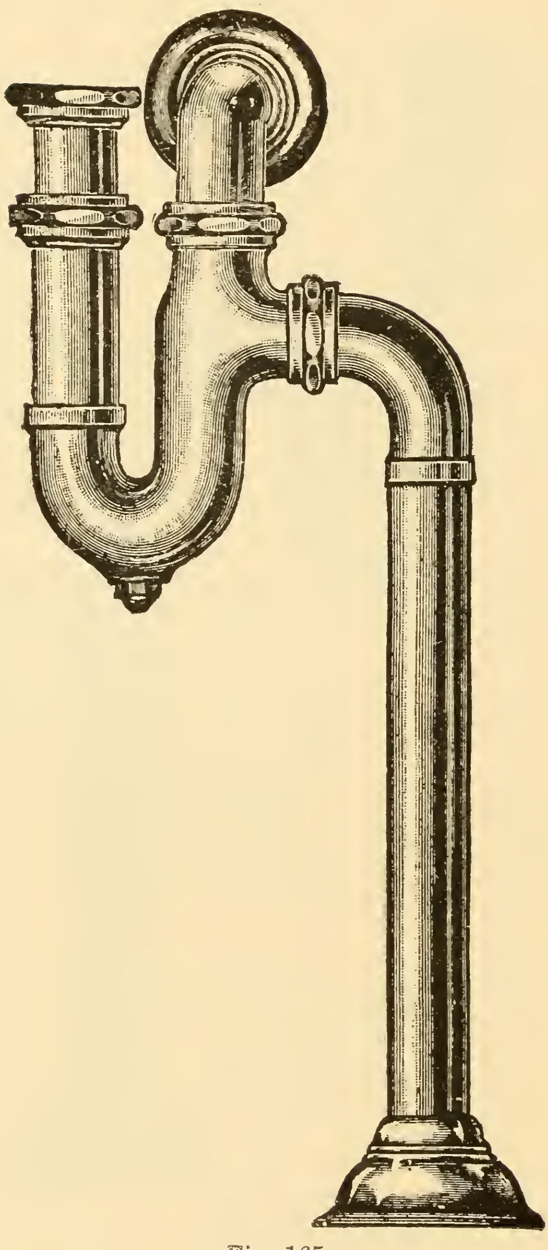


Fig. 165.

in Fig. 176, and a sink-strainer with lock-nut and coupling in Fig. 177; plug and open strainers are shown in Figs. 178 and 179.

Bathtub Fittings. Figures 180 and 181 illus-

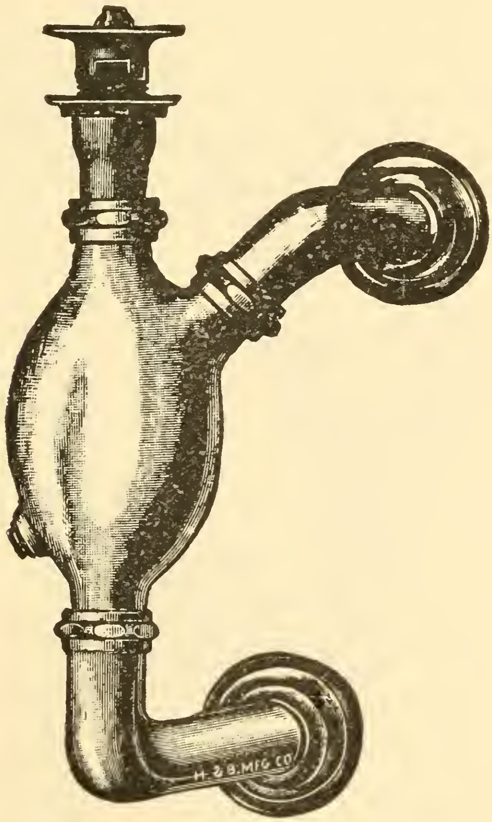


Fig. 166.

trate two forms of compression combination bath-cocks. The one shown in Fig. 180 has the handles horizontal and the combination fitting in sight, while the fitting shown in Fig. 181 has only the cock-handles and the supply nozzle exposed.

Urinal Fittings. A compression urinal cock with union and adjustable flanges is shown in Fig. 182. and a self-closing urinal cock with

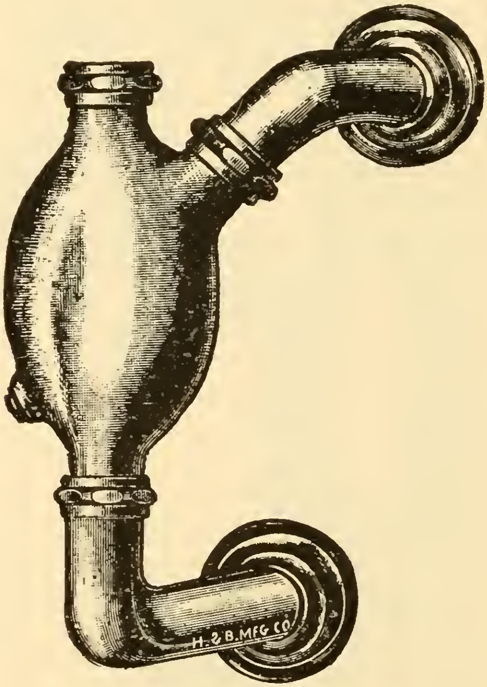


Fig. 167.

flanges and thimble for soldering in Fig. 183.

A urinal inlet connection with union and adjustable flange is shown in Fig. 184, and a urinal outlet connection of similar construction in Fig. 185.

A nickel-plated brass urinal trap with union and adjustable flanges is illustrated in Fig. 186.

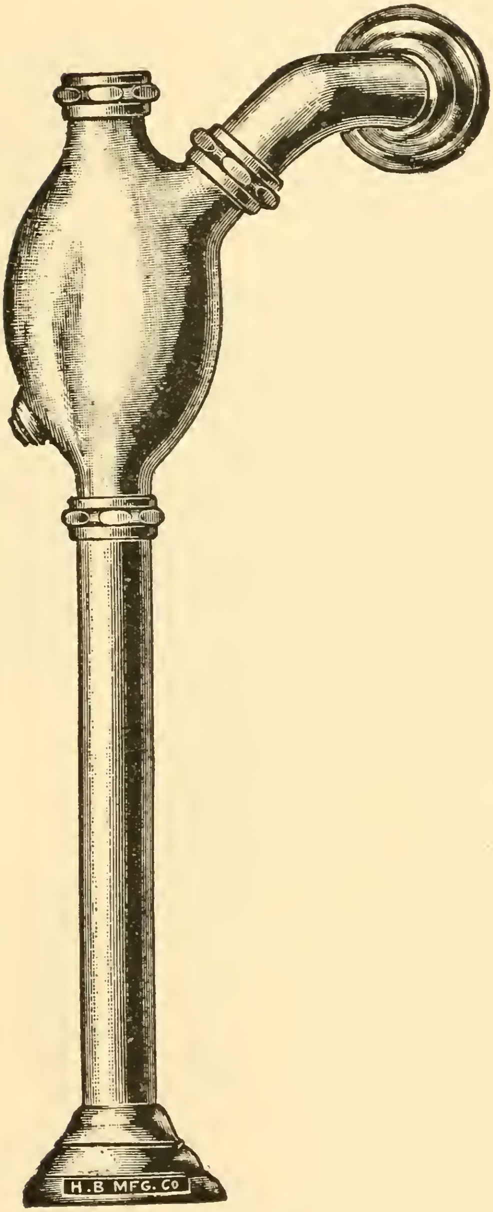


Fig. 168.

Faucets. A plain bibb compression faucet for lead pipe, with flange and thimble is shown in Fig. 187, and a hose-bibb compression faucet with flange and thimble in Fig. 188.

A plain-bibb compression faucet with shoulder for iron pipe is shown in Fig. 189, and a hose-

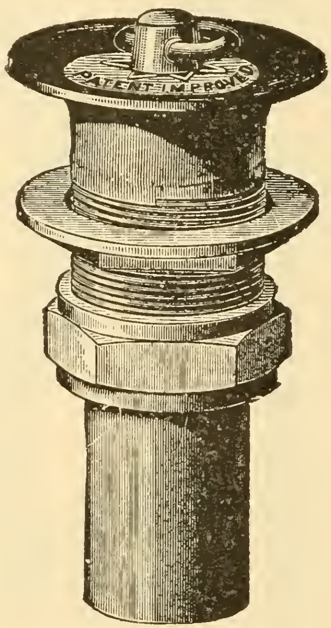


Fig. 169.

bibb compression faucet with shoulder for iron pipe in Fig. 190.

Fig. 191 shows a plain bibb compression faucet with flange and inside thread for iron pipe and Fig. 192 a hose-bibb compression faucet with flange and inside thread for iron pipe.

A plain bibb L-handle ground faucet with

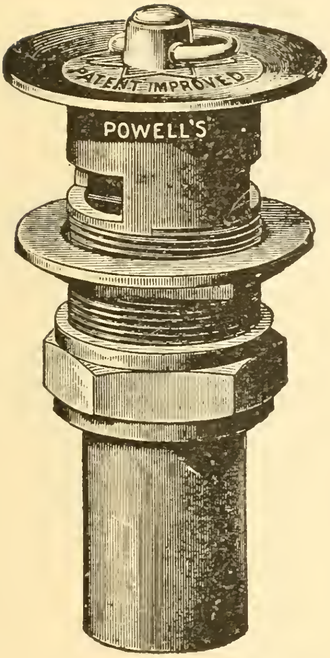


Fig. 170.

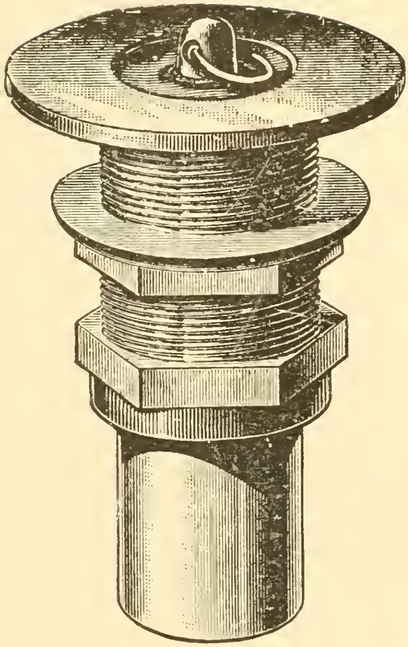


Fig. 171.

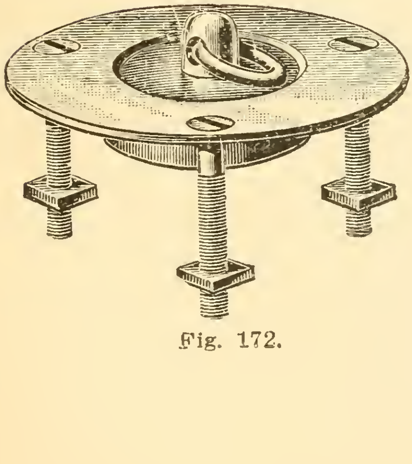


Fig. 172.

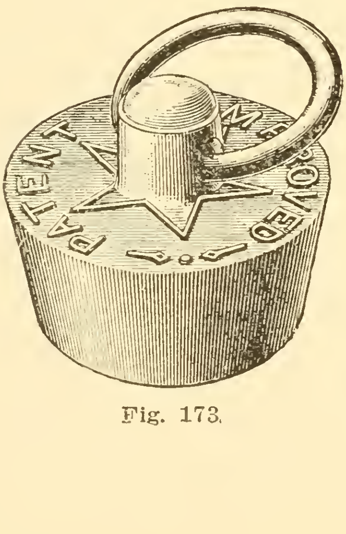


Fig. 173.

Fig. 174.

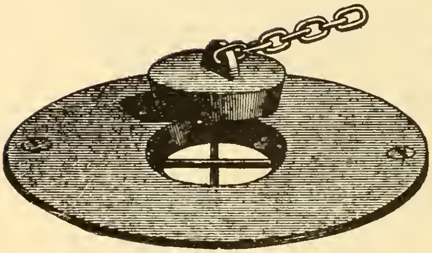


Fig. 175.

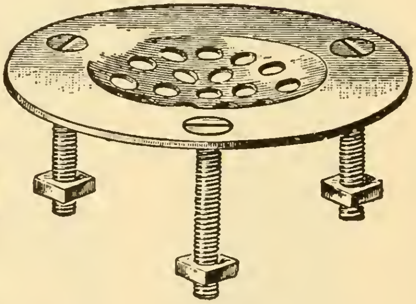


Fig. 176.

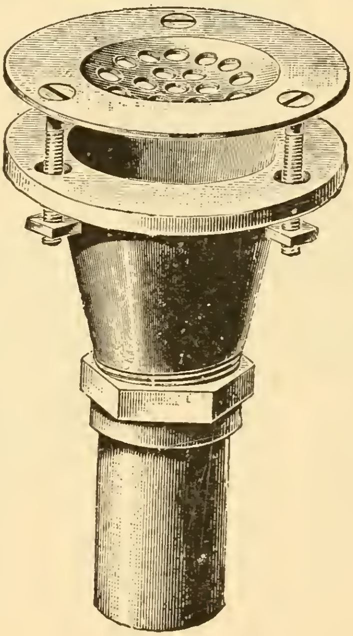


Fig. 177.

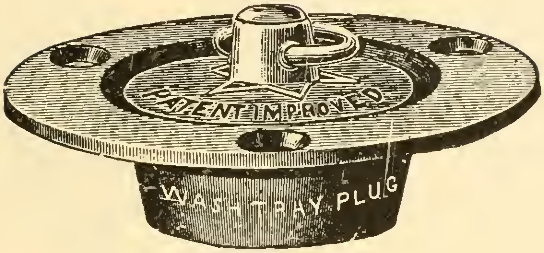


Fig. 178.

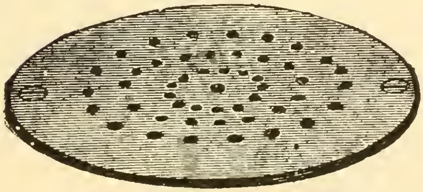


Fig. 179.

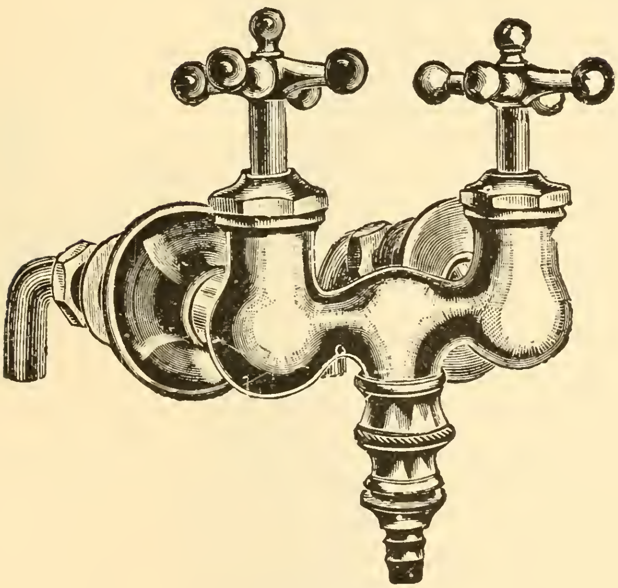


Fig. 180.

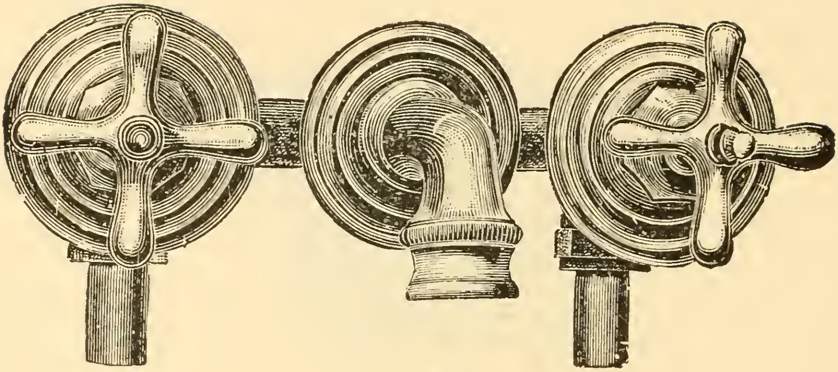


Fig. 181.

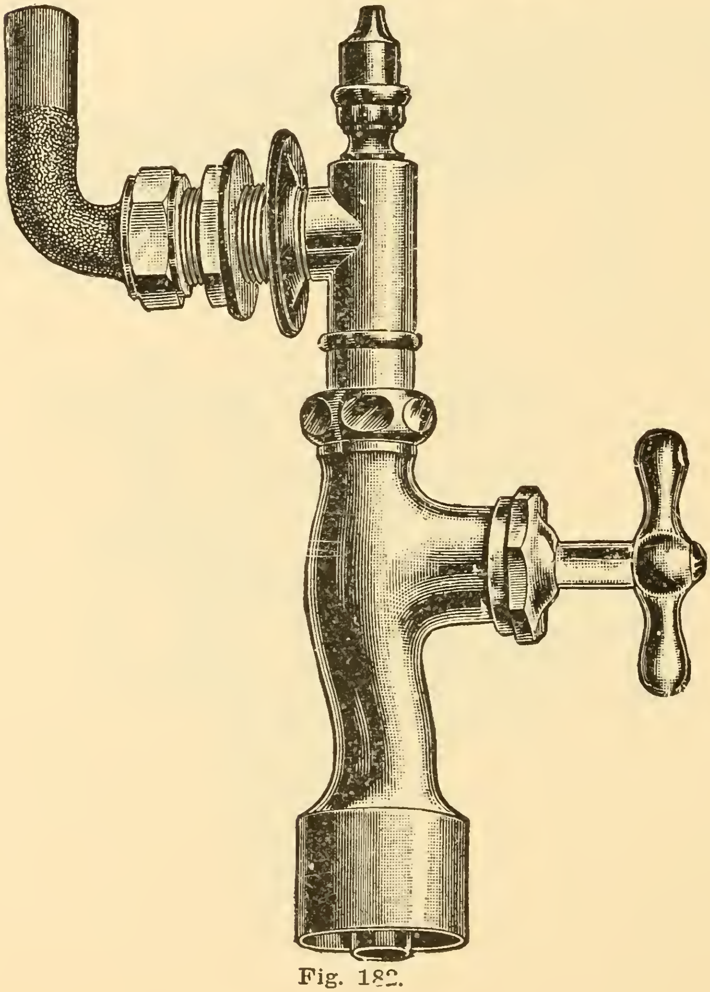


Fig. 182.

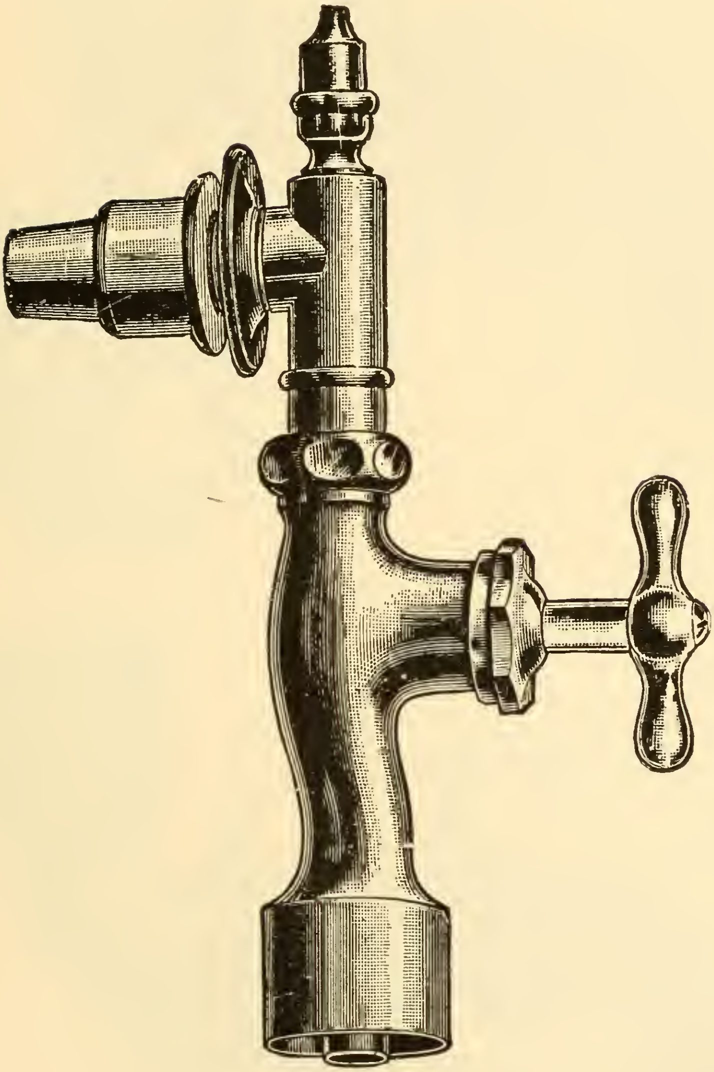


Fig. 183.

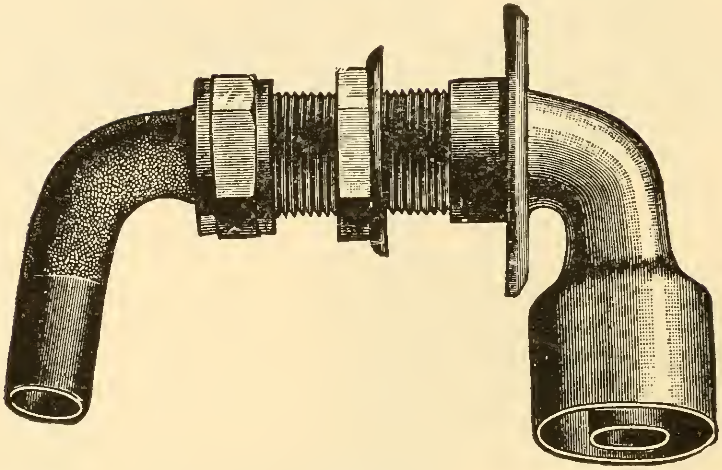


Fig. 184.

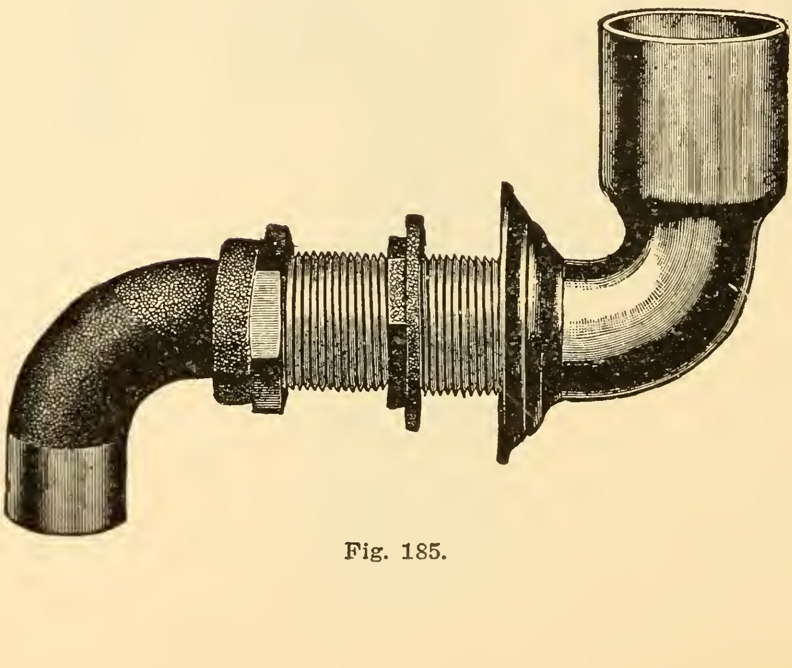


Fig. 185.

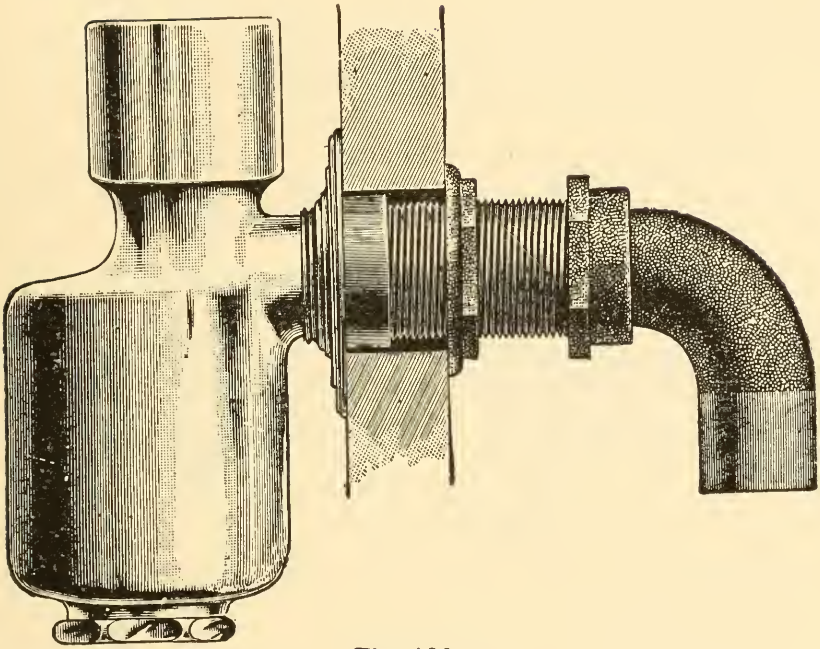


Fig. 186.

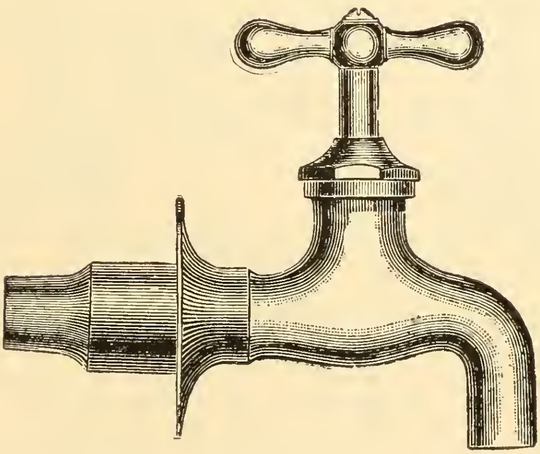


Fig. 187.

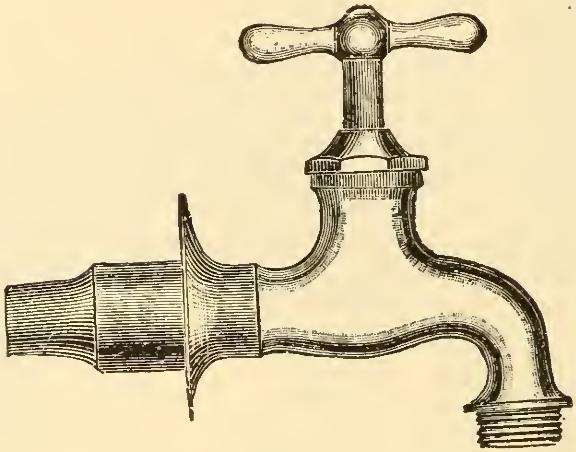


Fig. 188.

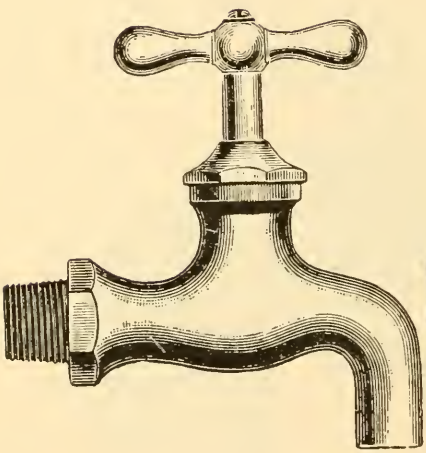


Fig. 189.

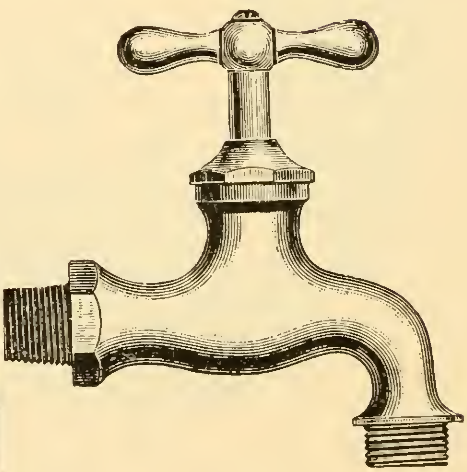


Fig. 190.

shoulder for iron pipe is illustrated in Fig. 193, and a hose-bibb L-handle ground faucet with shoulder for iron pipe in Fig. 194.

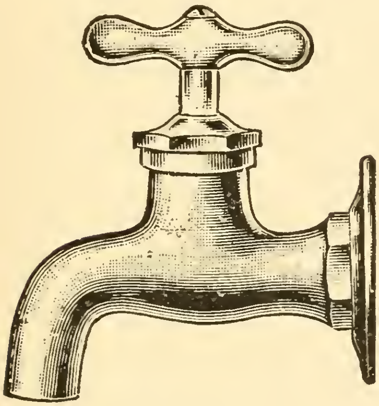


Fig. 191.

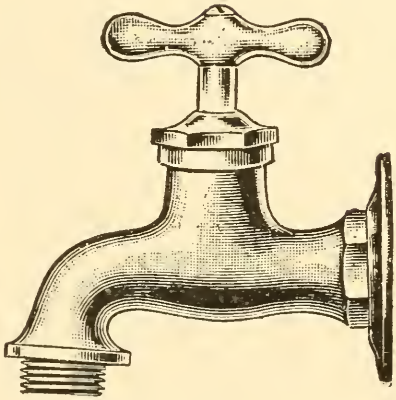


Fig. 192.

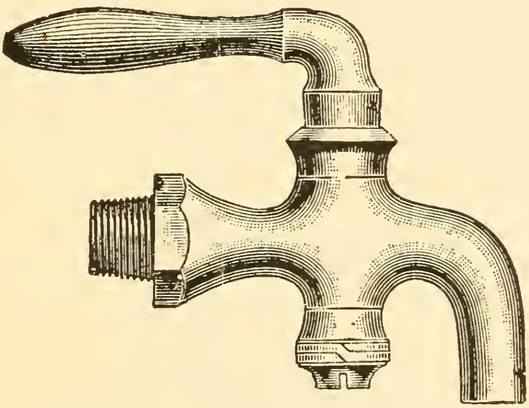


Fig. 193.

A plain bibb L-handle ground faucet for lead pipe is shown in Fig. 195, and a hose-bibb L-handle ground faucet for lead pipe in Fig. 196.

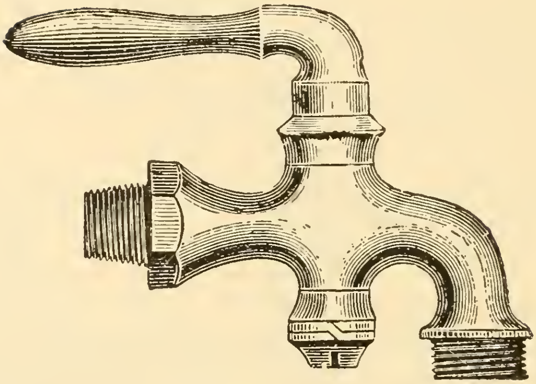


Fig. 194.

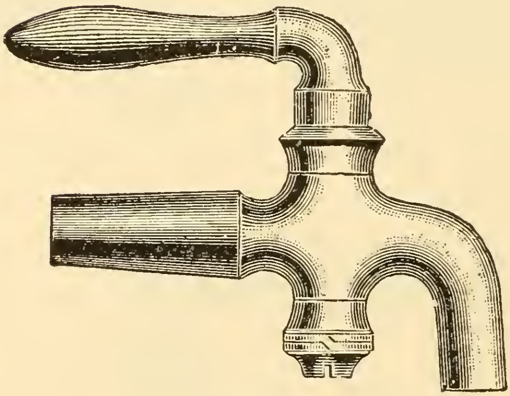


Fig. 195.

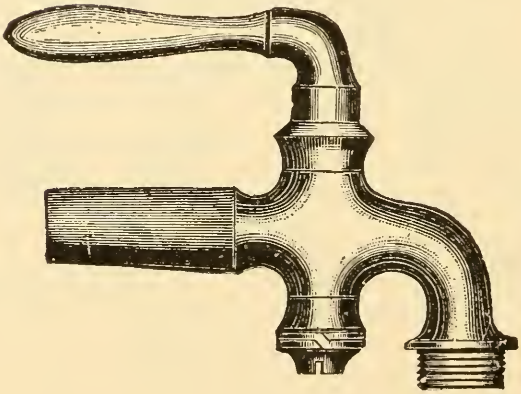


Fig. 196.

Self-closing Faucet. Self-closing faucets are fitted with either a torsion or a compression form of spring, which always holds the valve on its seat, except when in use, and then it must be held up by the hand which acts against the spring through a T or L-handled lever, and when released the spring by its own pressure closes the valve against the flow of the water. The advantages of a self-closing faucet are to prevent the overflowing of washbowls, bathtubs, sinks and other fixtures. The water cannot be left running when the self-closing style is used, as when they are released by the hand, the pressure of the spring immediately closes the valve and shuts off the water. One style of self-closing bibb cock is shown in Fig. 197. The details of construction are very clearly shown in the drawing. The valve has a square thread of very quick pitch upon its stem, which is surrounded by a torsion spring, one end of which is attached to the head of the valve and the other to the under side of the threaded cap or cover of the faucet. Upon turning the valve by means of the T-handle on its outer and upper end the valve is raised from its seat by the action of the screw. At the same time the spring is compressed, upon releasing the handle the spring brings the valve back upon its seat.

Bibb and Stop-Cocks. A Fuller plain bibb cock with shoulder for iron pipe is shown in Fig.

198, and a Fuller hose-bibb cock with shoulder for iron pipe is shown in Fig. 199.

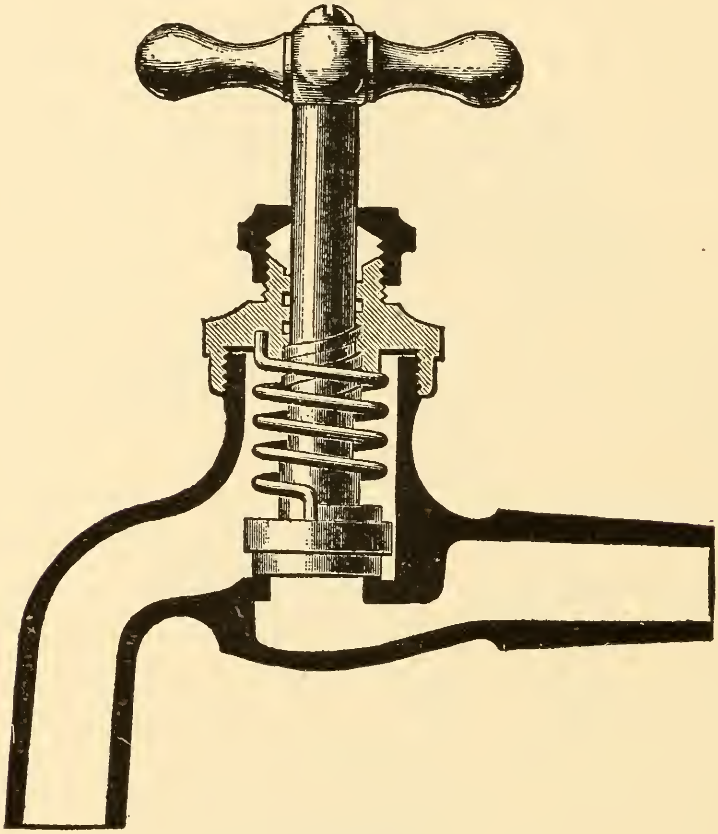


Fig. 197.

Fig. 200 illustrates a Fuller plain bibb cock with flange and iron pipe thread, and Fig. 201 a Fuller hose-bibb with flange and iron pipe thread.

A Fuller plain bibb cock with flange and inside thread for iron pipe is shown in Fig. 202, and a Fuller hose-bibb with flange and inside thread for iron pipe in Fig. 203.

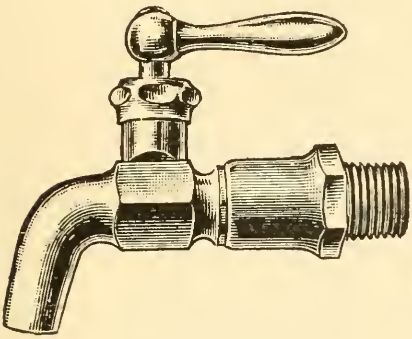


Fig. 198.

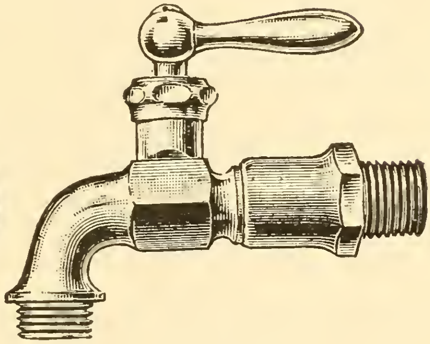


Fig. 199.

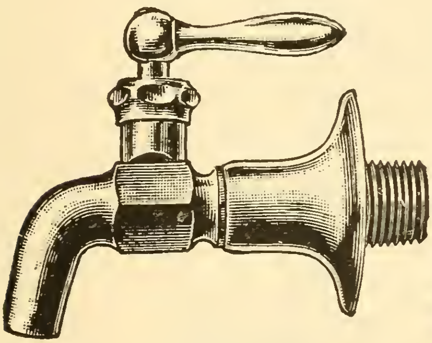


Fig. 200.

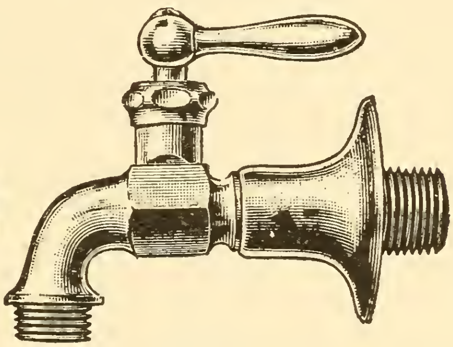


Fig. 201.

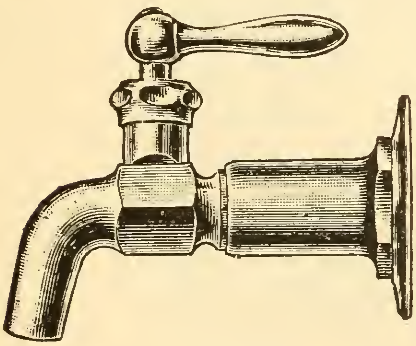


Fig. 202.

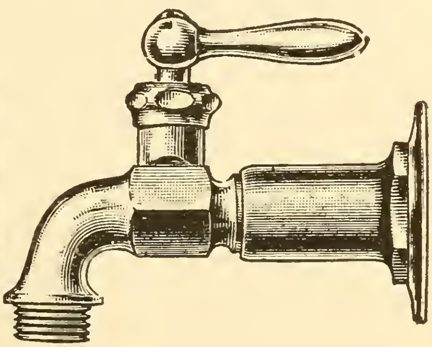


Fig. 203.

Different styles of Fuller basin cocks are shown in Figs. 204, 205, 206 and 207. Self-clos-

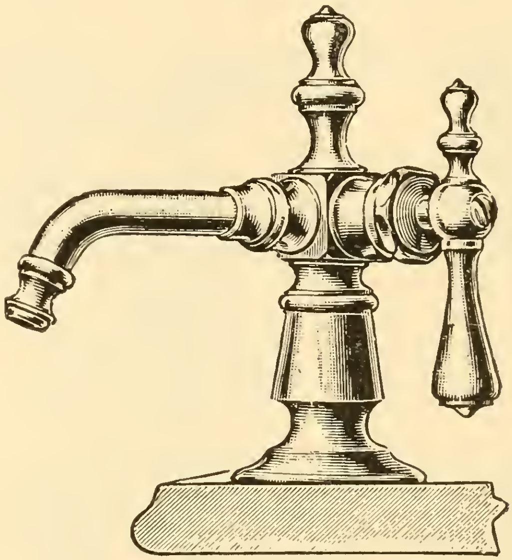


Fig. 204.

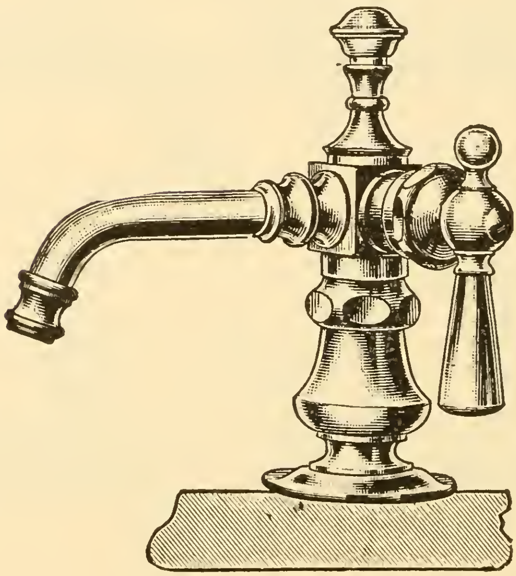


Fig. 205.

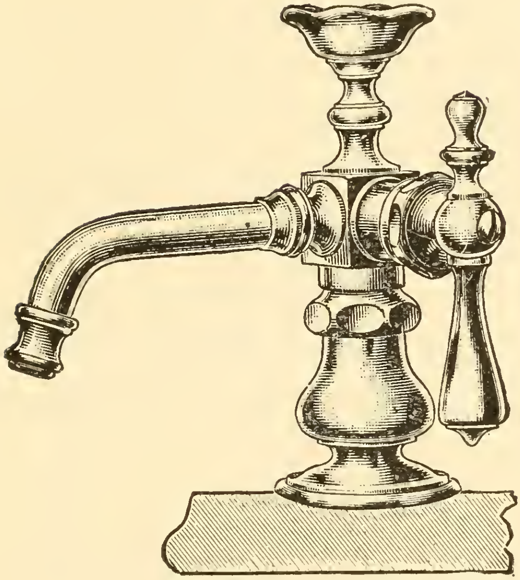


Fig. 206.

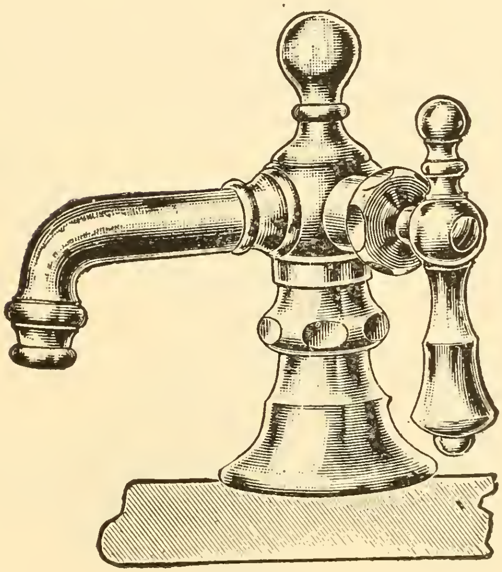


Fig. 207.

ing basin cocks are shown in Figs. 208 and 209, the one shown in Fig. 208 is to be connected to the slab and the one in Fig. 209 to the back of the wash basin.

An L-handle stop-cock for lead pipe is shown

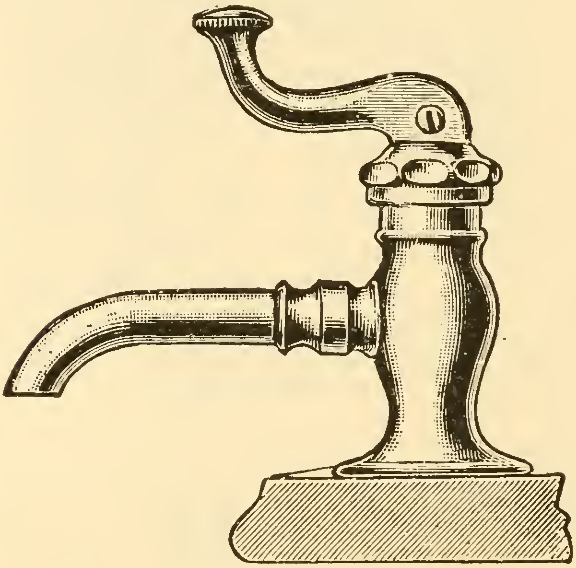


Fig. 208.

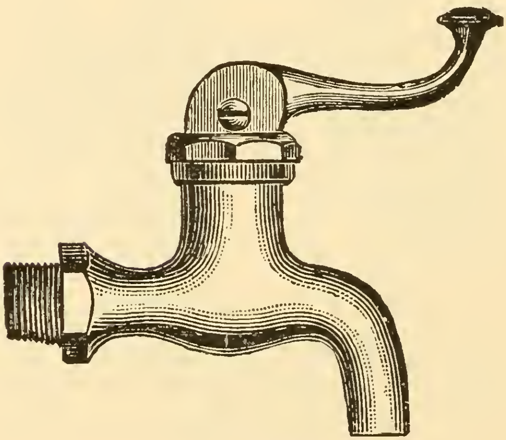


Fig. 209.

in Fig. 210, and an L-handle stop-cock for lead pipe with check and waste in Fig. 211.

A T-handle straight-way stop-cock for lead pipe is shown in Fig. 212, and also an L-handle

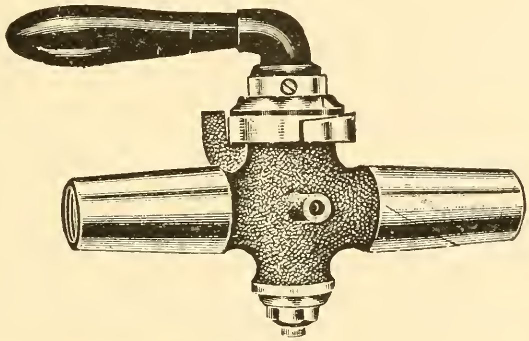


Fig. 210.

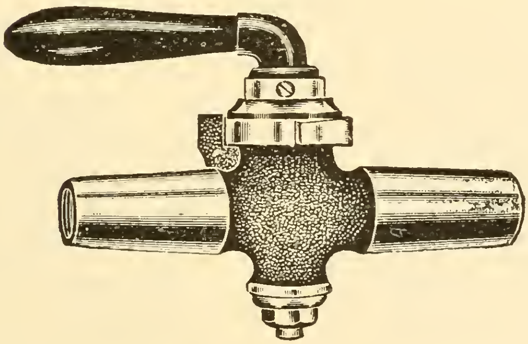


Fig. 211.

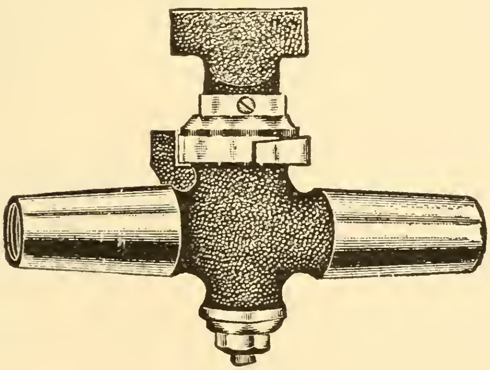


Fig. 212.

straight-way stop-cock for lead pipe with check and waste in Fig. 213.

A T-handle round-way stop-cock for iron pipe is shown in Fig. 214, and also a T-handle round-way stop-cock with check and waste.

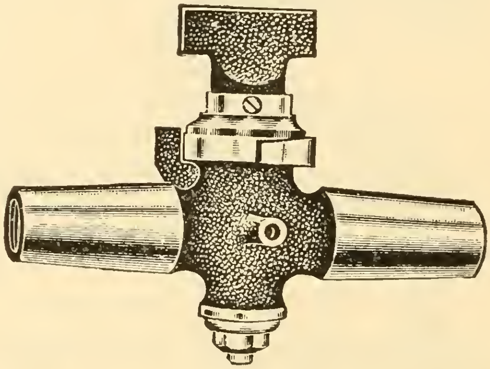


Fig. 213.

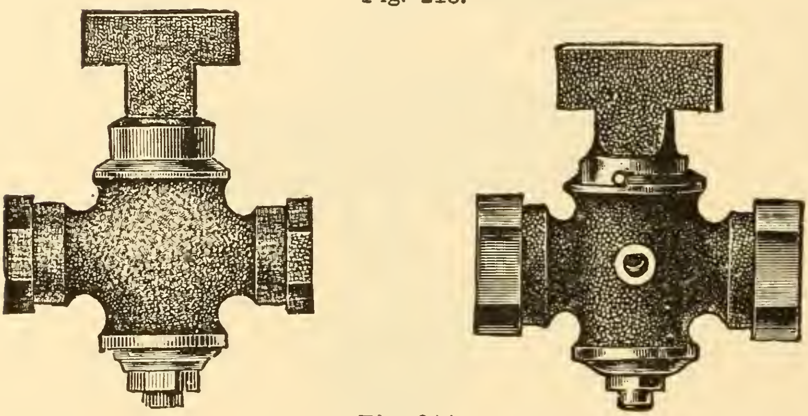


Fig. 214.

An L-handle straight-way stop-cock for iron pipe is shown in Fig. 215, and also an L-handle straight-way cock with check and waste for iron pipe.

An L-handle round-way stop-cock for iron pipe is illustrated in Fig. 216, and also an L-handle round-way stop-cock with check and waste.

A semi-finished T-handle stop-cock for iron pipe is shown in Fig. 217, also a semi-finished

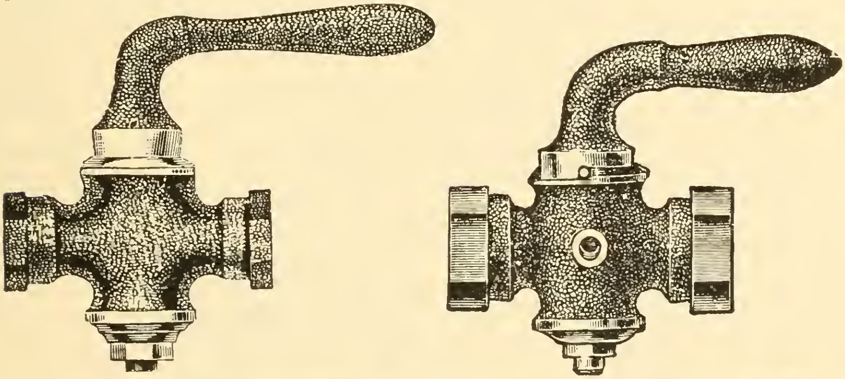


Fig. 215.

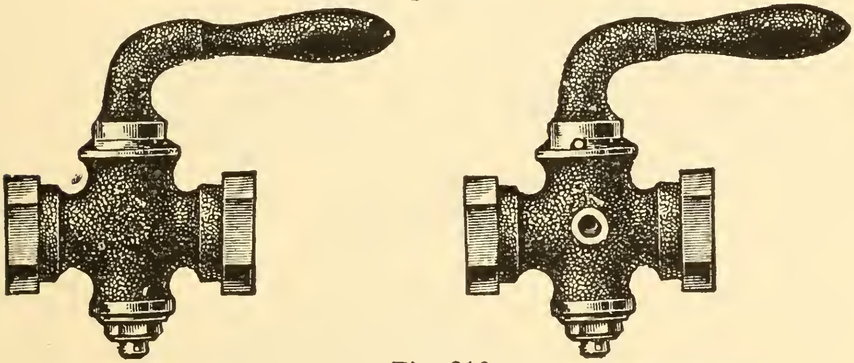


Fig. 216.

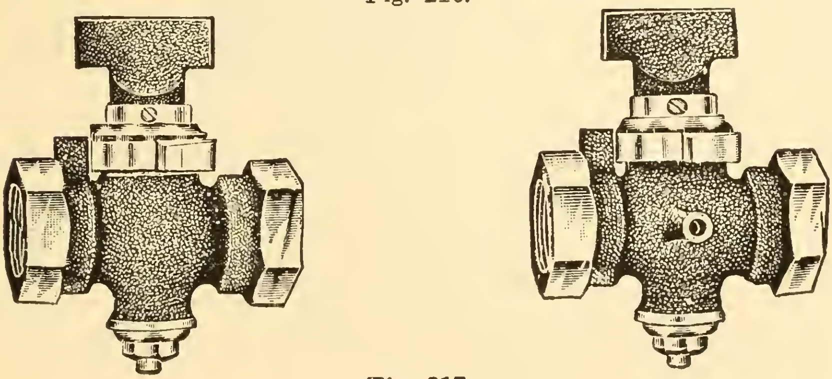


Fig. 217.

T-handle stop-cock for iron pipe with check and waste.

A semi-finished L-handle stop-cock for iron pipe is shown in Fig. 218, and a semi-finished L-handled stop-cock with check and waste in Fig. 219.

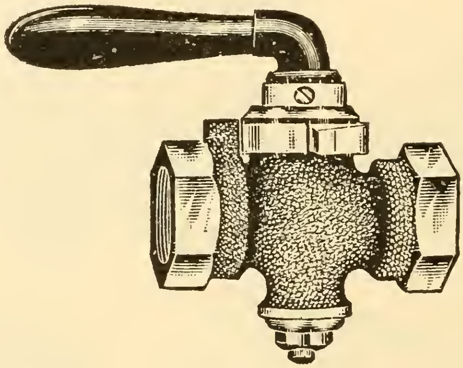


Fig. 218.

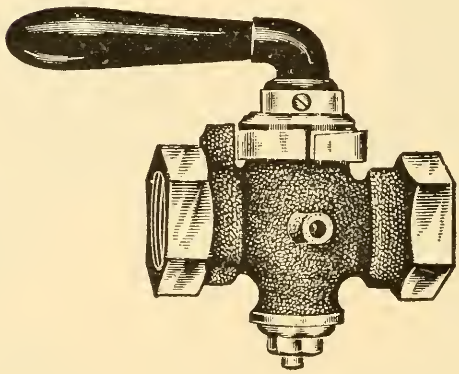


Fig. 219.

A T-handle straight-way stop-cock for iron pipe is shown in Fig. 220; also a T-handle straight-way stop-cock with check and waste.

Boiler and Water-back Fittings. The best pipe to use for boiler and water-back connections is brass, with fittings of the same material having threaded joints. A soldered joint should not be used in these connections, and where unions are to be used they should be ground-joint unions, that is, without packing. Lead pipe is too soft for this purpose; and further will not stand the high temperature which the water in these con-

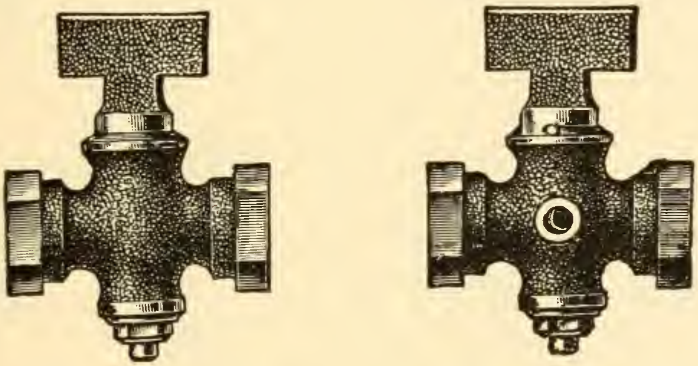


Fig. 220.

nections sometimes attains. Wrought-iron pipe will either rust solidly, or be honey-combed and cut to pieces by the action of the water in a very little while.

Boiler fittings are shown in Figs. 221 and 222, and water-back connections in Figs. 223 and 224.

Combination Soldering Fittings. For connecting lead to wrought iron pipe the soldering nipples shown in Figs. 225 and 226 are very suitable, they have male or female pipe thread on one end and can be soldered directly to lead pipe at the other end.

Combination Lead Pipe Coupling. Many methods are in use for coupling lead pipe to pipes made of other material such as wrought

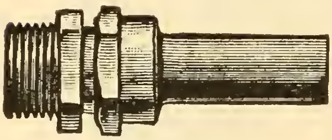


Fig. 221.

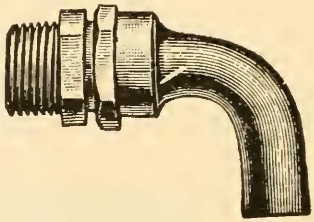


Fig. 222.

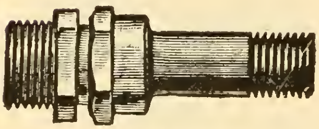


Fig. 223.

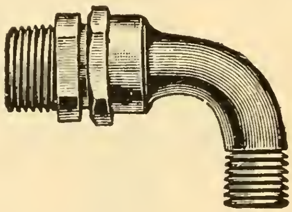


Fig. 224.

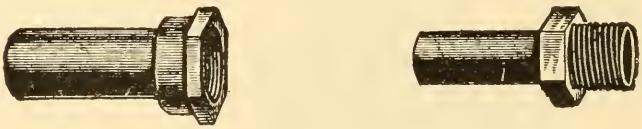


Fig. 225.

Fig. 226.

iron or brass, but all these methods have certain features which are common to all, an example of such a coupling is shown in Fig. 227.

The casting A is threaded on the outside and provided with a female threaded coupling part C. A flanged bushing D is placed over the pipe

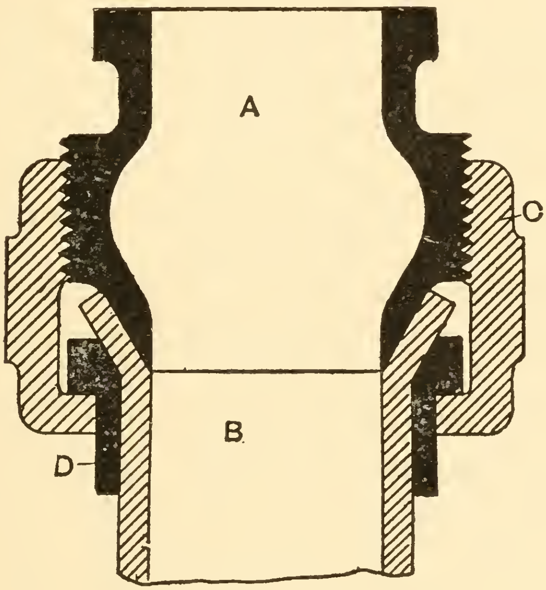


Fig. 227.

B and inside the shouldered opening of C. The lower portion of the casting is of cone shape to fit the inside of the pipe B, so that when the coupling C is tightened the lead pipe is expanded as shown in the drawing and a tight joint thereby made.

Traps. A trap is a vessel which contains water, its purpose is to prevent the passage of sewer gas and other foul odors from the sewer into the house, or to prevent the entrance through the house fixtures of gas and noxious odors that may be formed between the main trap and the house fixtures. The water seal of a trap should not be less than 1½ to 2 inches.

The seal of a trap may be broken in different ways, viz: by syphonage, evaporation, back pressurage and momentum or the action of the waste itself as it may pass off with considerable force.

A good trap should have a good seal, it should be non-syphonable, self-cleaning and have as few corners or places where dirt or refuse may collect as possible.

The S-trap and the drum or cylinder trap are two forms most used.

The back pressure or gas from the sewer will saturate the water in a trap with sewer gas, therefore all traps should be back-vented from the sewer side of the siphon and at the highest point of the same.

Traps should always be counter-vented, principally to prevent syphonage, to ventilate the plumbing system and to relieve back pressure.

Counter-venting. A counter-vent is a pipe by means of which a trap is supplied with air, to prevent the partial or total syphonage of the trap and also ventilate the plumbing system of the house.

Counter-vents from fixture traps should always be carried into the main air-pipe and higher than the top of the fixture or else directly through the roof.

The counter-vent from a water closet should always be vented from the highest point of the syphon and never from a lower point where the flushing action of the closet would throw waste matter into the entrance of the counter-vent or at any point where the waste would be liable to settle in the vent-pipe.

Calking Joints. A ring of oakum is first forced into the joint, and then set with a calking tool until hard. After the oakum is firmly calked, an asbestos rope is placed around the top of the joint, leaving a small opening at the top for pouring the melted lead. The melted lead is then poured, and after cooling, firmly set down with the calking tool, care being taken to thoroughly calk the inner and outer edges of the lead circle. The lead in a 4-inch soil pipe should be about 1 inch deep.

SOLDER.

The composition and properties of solders are a matter of considerable interest to all metal workers, but the subject is of especial importance to plumbers, because on the quality and purity of solder depend in a large measure the reliability and good appearance of their work. Nothing is more annoying, nor is there anything so productive of bad work, waste of time, and consequent irritability and bad temper, as the trying to do good work with bad material, particularly if that material is wiping or plumbers' solder. Until recent years it was invariably the practice for plumbers to make their own solders, either from the pure lead and tin, or, old joints and solders were melted down, and tin added in proportion. Of late years it is becoming quite unusual for plumbers to know anything about solder-making. Plumbers consider it more economical to buy it, already made, from firms who make solder-making a branch of their manufacturing trade. Another advantage is, that if supplied by a firm of good standing it can generally be depended upon for purity and uniform quality.

Good plumbers' solder should consist of two parts of lead to one of tin, but the proportions, of course, vary according to the quality of the constituent parts. Tin, for instance, varies very much in quality, and no fluxing or a superabundance of the tin will make good solder if this metal is of an inferior kind. It is, therefore, far the most economical in the long run to use tin of the very best quality.

As the exact proportions, as they are generally given, depend to a very great extent upon the condition of the two metals, it follows that the mere mixing of certain quantities of tin and lead does not necessarily make a composition that will serve the purpose that it is intended for, but a plumber with an experienced eye can detect at a glance the inferiority and usefulness of such solders when required for the execution of good work.

Although it is not absolutely necessary that a good solder-maker should be a plumber, it is important that he should have a considerable knowledge of the appearance of solder in proper condition. In the absence of a practical test, there are certain indications by which the solder may be judged, whether it is good or bad. The most common practice is to run out a strip of solder on a smooth level stone. As soon as the strip is nearly cold, the quality of the solder or the proper proportion of tin and lead can be determined by the appearance of both surfaces. It is important, before running the solder out on the stone, that it should be at such a heat as to allow the solder to run freely. A temperature just below red heat is the most suitable for this purpose, if the solder is not hot enough, it will have a dull white look, whether it is good or bad.

If it is in good condition, it should have a clean, silvery appearance, bright spots should also form on the surface from an eighth to a quarter of an inch in diameter. As a rule, the larger the spots the finer is the solder, although some kinds of tin will not show large spots, however much is used. In such cases they should appear more numerous.

If the strip has a dull, dirty appearance and a mottled surface, it is evident the solder is not as pure as it should be. It probably contains some mineral impurities, which can generally be removed by well heating the solder in the pot, and stirring into it a quantity of resin and tallow. These substances have but very little, if any, chemical effects, either upon the solder or the foreign matters it may contain, but the action that seems to take place is that they combine with the lighter mineral matters by what may be called adhesive attraction, and cause them to rise to the surface, where they can be skimmed off. There are some earthy impurities that get into the solder, the specific gravities of which are probably much lighter than the solder itself, but which will not rise to the surface until assisted by means of fluxes. It must be remembered that although tin has a specific gravity of 7.3 and lead 11.445, it is therefore, necessary to well stir the solder while it is being poured into the moulds, as the tin will continually rise to the top, yet if it were not stirred at all after it was once mixed, the lower portion would not be wholly deprived of tin, showing that the greater specific gravity of the one does not wholly displace the other. The same is true of certain impurities, which are not removed until they are washed out, as it were, by means of fluxes such as resin and tallow.

The greatest enemy to plumbers' solder is zinc. If the slightest trace of this metal gets into a pot of solder, it is almost a matter of impossibility to wipe joints with it, especially underhand joints.

When zinc is present, the strip of solder has a dull, crystallized appearance on the surface. The tin spots are also very dull and rough, and not at all bright and clean. When solder of this kind is being used for wiping, the first thing noticed is that a thick, dirty dross forms on the surface directly after it is skimmed. It is impossible to keep the surface clean for even a second. When it is poured on a joint, it sets almost instantly, and it matters not at what heat it is used. As soon as one attempts to move it with the cloth, it breaks to pieces, and falls off the joint.

In the case of branch joints when an iron is used, the solder cools in hard lumps, and breaks away like portions of wet sand. There are two or three ways of extracting zinc from solder, one is to partly fuse it, and when it is nearly set to pulverize it until the particles are separated as much as possible. The whole is then placed in a pot or earthenware vessel and saturated with hydrochloric acid, commonly called muriatic acid. The acid dissolves the zinc and produces chloride of zinc; the latter can be washed out with clean water and the solder returned to the pot in a comparatively pure state. This method cannot be recommended as a certain cure, because of the difficulty there exists in dividing the particles to such an extent as to expose the whole of the zinc that may be contained in it, and considering the small amount of zinc that is sufficient to poison a pot of solder it is doubtful if the acid process is radical enough in its action to thoroughly eradicate the zinc without repeated applications.

Sulphur is the best thing to use for this purpose.

When a pot of solder has been found to be poisoned with zinc, it is heated to just below a red heat. Lump sulphur is broken up and granulated, it is then screwed up tight in three or four thicknesses of paper, and in this form is thrown into the pot and held below the solder with a ladle. As the paper burns the sulphur rises through the solder, combines with the zinc, and floats on the surface. The solder is well stirred so as to thoroughly mix the sulphur with the whole of the contents of the pot, the dross which is formed by this process is then skimmed off with a ladle and thrown away as useless.

In the case of the sulphur, although it is generally called a flux, the action that takes place is altogether different to that of resin and tallow. It may safely be inferred by reference to the results of chemical combinations that the zinc, having a great affinity for sulphur, as soon as it comes in contact, forms sulphide of zinc, this is really a substance similar to zinc blende, a common form of zinc ore. In this condition, the specific gravity being considerably reduced, it readily rises to the surface of the solder, where it can be skimmed off with a ladle.

The question naturally arises—why is it the sulphur does not combine with the lead to which it also has an affinity, and thus form sulphide of lead? If lead is heated only just above its melting point and then some sulphur is mixed with it, a substance would be formed similar to galena, or sulphide of lead. But if the temperature is raised several degrees higher the sulphide gives up the lead, and either floats to the top or passes off in the form of gaseous vapor, chemically termed sulphurous anhydride. Therefore, by heating the solder containing zinc to a temperature just below redness, it is hot enough to prevent the sulphur combining with the lead and tin, but not sufficiently heated to cause the sulphur to give up the zinc, which fuses at a temperature of 773 degrees Fahrenheit, whereas lead fuses at 612 degrees Fahrenheit, and in combination with tin as solder at 441 degrees Fahrenheit. The difference in the melting points is in all probability the principal cause of the sulphur attracting the zinc and leaving the lead and tin comparatively unaffected.

Another method of extracting the zinc from solder is to raise the temperature to a very bright red heat, if this is continued long enough the zinc vaporizes and passes off in a gaseous state.

The latter is a very wasteful process because it cannot be done without a large proportion of the tin becoming oxidized. The oxide gathers in the form of a powder on the surface, and is what is commonly known as putty powder. One of the most common means of spoiling solder is the last mentioned.

The flowing of solder, especially that used with the copper-bit, depends to a large extent upon the fluxes that are used for tinning purposes. For soldering lead only a very simple flux is necessary, namely, a little tallow and powdered resin. The same kind of flux is also very often used for tinning and soldering brass and copper, and there are many plumbers who use nothing else but a piece of common tallow candle, which seems to answer the purpose very well. For soldering iron, zinc, and tin goods, chloride of zinc, or what is commonly called killed spirit of salt, is generally used, although it is not necessary to kill the hydrochloric acid when zinc has to be soldered. Soldering fluids and preparations have been invented which have, to a very large extent, superseded the common fluxes. The disadvantage of spirit of salt is owing to the tendency it has to produce oxidation on iron, and chlorides on zinc, after the soldering is done.

It would be interesting to try and find out the reason why a combination of metals fuses at such a low temperature when compared with the fusing points of the component parts of the alloys. It is necessary to bear in mind the fact that all metals, and indeed all matter, are composed of minute particles or molecules, and that there is nothing existing that is a strictly solid uniform mass. It is also acknowledged that the molecules of different substances always assume a distinctive shape, and when metallic matter is crystallized, as it is said to be when it becomes solid by the action of cold, these particles are attracted to each other by a force of more or less power according to the nature of the metal, whether it is said to be hard or soft.

Now the force by which these aggregations of minute particles are held together is what is called cohesive attraction, and the power of this force to hold the particles together depends to a very great extent upon the particular shape which these extremely small particles assume, and the amount of surface which they present to each other. It is very easy to conceive that if a number of bodies have mutual attraction for each other, the larger the surface that comes in contact the more force is there exerted one with the other. If, for instance, the particles take the form of spheres like a number of marbles, the surface in actual contact is comparatively very small indeed, the same would be the case if they were very irregular in form. But if each particle took the form of a cube, or some other regular body, the attraction would be greatly increased, as each of the particles approached and fitted into its proper place. It is not contended that the molecules are actually attracted into absolutely close contact, because, as a matter of fact, they are not. In every substance, however hard and solid it might appear to be, there are certain interstices between the particles which are called pores, the capacities of which vary according to peculiar conformation of the particles, and the degree of affinity which one set of particles may have for others in the same mass. It follows then that as a rule the hardness or softness of any substance depends, according to the theory of cohesive attraction, upon the close and compact nature of the molecules, and the large or small spaces or interstices between them, that is, so far as the action of heat is concerned. If it is required to make a hard substance soft and pliable, some power is necessary to exert a reactionary influence upon the attractive force which causes the particles to cohere. Now the only powers that will effectually produce this result is heat, when heat is applied to nearly all metallic substances, the first thing it does is to enlarge the bulk by the almost irresistible force of expansion. The effect that heat has on a solid is to cause the particles to be thrown farther apart from each other by a repulsive force, overcoming to a certain extent the force of cohesive attraction. This repulsive action continues to increase as the temperature is raised, until the attractive force has to give way to the force of gravity.

The result is the particles will no longer cohere in a mass, but fall away from each other and become in a state of fluid, and if they are not kept together in a vessel of some kind during their high temperature they will run in any direction by the influence of gravity like ordinary liquids. When a metal is in such a condition it is said to be melted or fused. There are some metals, zinc for instance, the particles of which are separated to a much greater extent than is the case with fusion only. For if the heat is applied so that the temperature is raised above fusing point, evaporation takes place, and the molecules are driven off in the form of vapor.

When two distinct metals are mixed together, such as tin and lead, the cohesive attraction is modified to a large extent, because the molecules of one have a comparatively small affinity for the other. Of course tin has a certain amount of affinity for lead, in fact, if there were no affinity between the two, solders would be useless on lead, because tinning could not be effected if such were the case. But what seems certain is, when the two metals are alloyed, the molecules are not held together by the same attractive force that is exerted when a metal is not alloyed, that is, the particles of one metal do not, by reason of their difference of construction or conformation, have the same affinity for each other as they do when they are not intermixed with other particles of a different nature.

Consequently, when such combinations of metals are subjected to the action of heat, the particles mutually assist each other to separate, and gravitate like liquids to a level surface, with a much lower degree of temperature than is required to obtain the same effect when the metals are melted separately.

Then with regard to wiping solder, it retains its fluid and plastic state for a much longer time than lead or tin would before they are mixed, showing that the particles, probably for the same reason, do not solidify so quickly as they would in a separate state. If they did, joint-wiping would, of course, be impossible, for on the peculiar power that solder has to retain its heat, or rather the effects of heat, depends the success of the most important parts of plumbing work. An alloy of lead and tin contracts considerably in cooling, the result of this can be seen when a solder pot is placed on the fire. Before the bulk of the solder melts, but as soon as that part which is near the hottest part of the fire begins to fuse, the molten metal forces its way up to the top, between the sides of the mass of solder and the sides of the pot, this often continues until the top of the unmelted mass is covered with a melted layer which has forced its way there, showing that when the solder cooled it contracted into a smaller space than it occupied when it was in a fluid state. Consequently, when the lower part of the solder is melted first, the expansion that takes place forces it of necessity to the top, because there is not room for the increased bulk in the space it was reduced to during the process of cooling. But if antimony, the fusing point of which is 840 degrees Fahrenheit, is added to lead and tin, the result is just the reverse, for on cooling this alloy expands. The latter alloy is generally used for casting types for printing, the proportions of which are two of lead, one of antimony, and one of tin, although a more expansive alloy is made of nine of lead, two of antimony, and one of bismuth. Then with regard to the hardness of metals, it is not always that the hardest metals require the highest temperature to fuse them. Tin, for instance, is much harder than lead, yet it fuses at a temperature nearly 200 degrees Fahrenheit lower than lead.

HOW TO MAKE SOLDER.

Plumber's wiping solder, for use with the ladle and the soldering cloth, is made up by melting together pure lead and block tin in the proportion of 2 pounds of lead to 1 pound of tin. Plumber's fine solder is made of about equal parts of those two metals. Strip solder—used with the copper-bit—is made in the proportion of 2 pounds of tin to 3 pounds of lead. Gas-fitter's solder may be made in the proportion of 8 pounds of tin to 9 pounds of lead, tinsmith's copper-bit solder is 1 pound of lead to 1 pound of tin. The proportion of lead and tin may vary within certain limits without apparent effort on the solder.

Plumber's wiping solder, when in a bar, should have a clean grey appearance, and not be dirty-looking. The ends of the bar should be bright, and show several tin spots mottled over their surfaces. In use, the solder should work smooth, and not granular. The tin should not separate from the lead on the lower part of the joints. One test for the quality of solder is to melt it and then pour on to a cold but dry stone about the size of a dollar, and take note of the color and size and also the number and sizes of the spots that appear, but the only reliable test is to make a joint and note the ease with which it can be worked. For making joints on lead pipes copper-bit solder made in thin strips is generally used. This is the kind used also for soldering zinc. Some plumbers prefer solder finer, others coarser than the usual average which is given above.

The usual method of making solder is as follows: An iron pot is suspended over a coke fire, to which enough broken coke is added to bank up all round the pot. Sheet-lead cuttings and scraps of clean pipe are put into the pot until it is rather more than half full. Preference is given to pig-lead over sheet, and to new cuttings over pipe, because the lead rolled into sheets is generally purer than that used for pipe. Some pipe is made of old metals which contain lead, tin, antimony, arsenic, and zinc, it is inadvisable to put such material in the solder-pot. The effect would be to raise the melting point of the solder, and in applying it to the joint to be soldered it would in all probability partially melt the lead. Moreover, the metals named do not alloy perfectly, but partake more of the nature of a mixture which partially separates when making a joint, some metals, especially zinc, show as small bright lumps on the surface. Joints made with such solder, which usually is called poisoned metal, are difficult to form, and they usually leak when in water pipes. The appearance of such joints is a dirty grey, instead of bright and clean as when pure solder is used. From this it is clear that in making solder great care must be taken to exclude zinc from the pot. Zinc, lead, and tin do not alloy well, lead will unite with only 1.6 per cent of zinc, and above that proportion the metals are only mixed when melted, and on cooling partially separate.

Sufficient lead having been melted in the pot, about ½ pound of lump sulphur, broken into pieces about the size of hickory nuts, is added, and the whole well stirred with a ladle, the sulphur unites with zinc and other impurities. The resultant sulphides are skimmed off in the form of a cake, more sulphur being added so long as sulphides continue to form. The bowl of the ladle, in the intervals of stirring, should be laid on the fire, to burn off any adherent sulphur. When sulphide ceases to be formed, a handful of resin is thrown into the pot, and the lead stirred. When the resin has burned, the lead is again skimmed, and a piece of tallow about the size of a hen's egg is put into the pot, the lead being again stirred and skimmed. In stirring the lead it is lifted up and poured back by the ladleful, a larger amount of lead being thus exposed to the action of the cleaning material.

Best block tin is now added in the required proportion, and after the molten mass has been well stirred a little of the mixture should be run on to a stone to test its fineness. If it appears too coarse more tin is added, if too fine, more sheet-lead. Finally, a little resin and tallow having been added, the solder is skimmed and is then ready for use or for pouring into moulds. When plumber's solder is heated in an open pot, the surface exposed to the air combines with oxygen, and on heating to redness, the combination takes place more readily. The tin melts at a lower temperature than lead, and so its specific gravity is lighter, floats when melted, and so the solder becomes poorer when too highly heated, owing to the tin's oxidation. If the dross is melted with a flux, or with powdered charcoal, which will combine with the oxygen, the solder will again become fit for use, but it is sometimes necessary to add a little more tin.

Burning the solder must be carefully avoided. A pot of solder after it has been red-hot has always a quantity of dross or dirt collected on the top. This is principally oxide of tin and oxide of lead, the tin and lead having united with the oxygen in the atmosphere to form oxides of these metals. Lead being roughly 50 per cent heavier than tin, the tendency is for the tin in the molten mixture to form the upper layer of the solder—the part most exposed to the action of the atmosphere. When the solder becomes red-hot, there is therefore more tin burned than lead. Hence the solder becomes too coarse, and more tin must be added. Zinc is the greatest trouble to the solder pot. Great care has to be taken to exclude it, or to get it out. It may get into the solder from a piece of zinc, having been put into the pot by mistake for lead, but more commonly brass, which is an alloy of copper and zinc, is the source of the zinc that poisons the pot, into which brass filings find their way whilst brass is being prepared for tinning. If the filing is done at the same bench as the wiping, splashes of metal may fall on the filings, which will adhere, and thus get into the pot. Solder that is poisoned by arsenic or antimony is beyond the plumber's skill to clean, but zinc can be extracted by stirring in powdered sulphur when the solder is in a semi-molten condition, and then melting the whole, when the combined sulphur and zinc will rise to the surface, and can be taken off in the form of a cake, the solder being left in good condition for use.

SOLDERING FLUXES.

The flux ordinarily used for plumber's wiping solder is tallow, generally in the form of a candle. No other fluxes answer this purpose so well, as they all spoil the wiping cloths, but different kinds of fluxes are required for different kinds of work. For a wiped joint, a tallow candle is rubbed over the parts. This is often used in making copper-bit joints, though for this latter purpose many plumbers prefer to use black rosin. Muriatic acid is employed as a flux for use when soldering, the acid—which is a powerful poison—being used for zinc or galvanized iron, and the killed acid for other metals, such as brass, tinplate, copper, wrought-iron, etc.

After tinning brass with fine solder, the copper-bit should be wiped quite clean, as the copper, uniting with some of the zinc in the brass, may affect the wiping solder. Some plumbers tin brass by holding it over the metal pot and pouring the solder on to it. This is bad practice, as the surplus solder, and any zinc with which it may have combined, fall into the pot. In cleaning solder, the sulphur must be used with more care than when cleaning lead, or the tin will be burnt out as well as the zinc.

The method ordinarily adopted by plumbers for tinning iron is to file it bright and then coat the part with killed acid or chloride of zinc, or muriatic acid in which zinc has been dissolved, and then dip it into molten plumber's solder. Sometimes sal-ammoniac is used for the flux, or a mixture of sal-ammoniac and chloride of zinc. When wrought-iron pipes have been thus tinned, and then soldered joints made, they have been found to come apart after a few years, the pipe ends, when pulled from the solder, being found to be rusty. Although more difficult to accomplish, iron pipe ends filed and covered with resin, and then plunged into molten solder, from the surface of which all dross has been skimmed, and afterwards soldered together, have been known to last a considerable time. When tinning the pipes or making the joints, the solder must not be overheated, or failure will result.

PREPARING WIPED JOINTS.

One objection that is often raised to wiped joints is that they are too expensive, and require a large quantity of solder. Another is that they take up too much time, and when they are made they are said to be ugly, and have been described as a "ball of solder round a pipe." It seems very unfortunate that plumbers' work should be judged by its worst specimens, but, probably, this course of action is justified by the principle that the strength of the chain is limited to its weakest link. There is no doubt that if joints are carefully prepared and properly wiped the above objections would be groundless, and that for good substantial work there is no other kind of joint that is more suitable for the purpose.

In the process of making wiped joints no part is no important as the preparation. A joint may be wiped as nicely and as regularly as possible, but if the ends are not properly prepared and fitted, it will very often happen that the joint will leak by sweating, as it is called, the solder is generally supposed to be the cause, but more often it is the fault of the imperfect preparation of the ends of the pipe. We will suppose, for instance, an upright joint on an inch service pipe. Fig. 229 is a sketch showing the way a joint of this kind is usually prepared. Very often one end barely enters the other, no care is taken to see that the ends fit properly together, and any space that may be left between the two ends is closed up with a hammer. As to shaving inside the socket end, this is thought quite unnecessary, if not a fault, for some think if the socket end is shaved inside, it will induce the solder to run through and partly fill up the pipe. There is no doubt it would do so if the ends do not fit; but that is just the thing that is most important, not only as regards the solder getting inside the pipe, but on it depends, to a very large extent, the soundness of the joint.

The general idea is that if the two ends of a pipe are shaved and placed together, and a piece of solder stuck round them, that is all that is required to make a joint. If the solder is not so fine as it ought to be, it is the cause of most of the leaky joints, and very often the joints are found broken right across the center, more especially in the case of joint on hot-water, service, and waste pipes. It has been remarked that the solder is generally blamed for all the failures. It is either too coarse or too cold, or else it must have got a piece of zinc in it. Otherwise, if the joint is made to brasswork, it is that which has poisoned the solder. In short, everything gets blamed except the right cause.

It must not be supposed that joint-wiping can be taught by books. This can only be accomplished in the workshop or on a plumbing job. But as practice is very often greatly assisted by precept, probably a few hints on the matter of joint-wiping will be helpful to many who have not the opportunities to gain a very large or varied experience. In preparing a joint similar to the one mentioned, after the two ends are carefully straightened, the spigot, or what is generally called the male end, should be first rasped square, and then tapered with a fine rasp quite half an inch back from the end. A fine rasp is mentioned because the rasps that are used by many plumbers are far too coarse to properly rasp the ends of pipes. Generally the very coarse rasps are used, it is difficult to say why, except it is that they are cheaper than the fine rasps, but if the advantages of a fine rasp be taken into account, the extra cost would not be considered.

When preparing the ends of the pipe, great care should be taken to avoid the raspings getting into the pipes, these cause no end of time and trouble when they get into valves and other fittings, after the pipes are filled with water.

As a rule, it is the back stroke of the rasp that throws the raspings inside the pipe, especially when the pipe is being rasped horizontally, or with the end of the pipe pointing upwards. If possible, when the ends are being rasped, they should either be pointing in a downward direction, or else the rasp should not be allowed to touch the pipe in its backward stroke. Some plumbers place a wad or stopper in the end of a pipe when it is being rasped; this is a very good precaution to take, providing it is not forgotten and left in the pipe. After the spigot end has been rasped, it should be soiled about six inches long, but no farther towards the end than an inch from the rasped edge. Sometimes the soiling is taken right up to the end, but this is not a good plan, because, if it is soiled over the rasped edge, the shave-hook does not always take the soil out of the rasp marks, a point which is most important; and as it is quite unnecessary to soil farther than the line of shaving, the soil at the end is quite superfluous. Many plumbers soil the ends before they rasp them with the same object in view, but this is not a good plan, because very often in rasping the ends, the end of the rasp is likely to scratch the soiling, making it necessary to touch up the soiling again.

If the soil is good it is an advantage to rub it, after it is dry, with a piece of carpet or a hard brush, a dry felt will do. This makes the surface of the soil smooth and more durable, and not so likely to flake off when the joint is wiped. The best soil is made from vegetable black and diluted glue with a little sugar, and finely ground chalk added. The proportion of the ingredients depends to a large extent on their quality. Lamp black and size are generally used, but if the black is not very good it is very difficult to make soil fit for use, it will rub or peel off and become a nuisance. Good soil, and a properly made soil pot and tool, are indispensable to a plumber who wishes to turn out a good quality of work. Any makeshift does for a soil pot with a great many plumbers. Some use an old milk-can or a saucepan. It is much better to have a good copper pot, with a handle. Most plumbers should be able to make a soil pot with a piece of sheet copper, otherwise a coppersmith would make one for a small sum. Before soiling the end of the pipe, it is always a good plan to chalk it well. This will counteract the effects of the grease that is nearly always found on the surface of new lead pipes. If the pipe is very greasy, it is still better to scour it well with a piece of card-wire before it is chalked and soiled. The scouring is not always necessary, but it is always best to carry a piece of card-wire in case of need.

When the end of the pipe has been properly soiled, it should be shaved the length required, that is, about half an inch longer than half the length of the joint, thus allowing half an inch for socketing into the other end. Grease, or "touch," as it is called by plumbers, should immediately be rubbed over the shaved part to prevent oxidation. The socket end of the pipe should now be rasped square and opened with a long tapered turnpin—a short stumpy turnpin is not a proper tool for this purpose, although many of this kind are used. After rasping the edge of the pipe, the rasped part should be parallel with the side of the pipe, as shown at Fig. 228. It is not at all necessary for the edge of the socket end to project, nor to reduce the bore of the pipe in the joint; but if the ends are prepared, as shown at Figs. 229 and 230, it would be necessary to open the socket end an extraordinary width to get the same depth of socket, and then a much larger quantity of solder would be required to cover the edge, which would make the shape of the joint look ugly, and not make such a reliable joint either.

When the socket end is properly fitted, it should be soiled and shaved half the length of the intended joint. The inside of the socket should also be shaved about half an inch down and touched.

If the solder is used at a proper heat and splashed on quickly, so as to well sweat the solder in between the two surfaces where the ends are socketed, the joint is made, so far as the soundness is concerned, independent of the wiping or the form and shape of the solder when it is finished. In fact, if a joint is prepared in a proper manner, it would be sound in most instances if the solder was wiped bare to the edge of the socket end. Of course, it would not

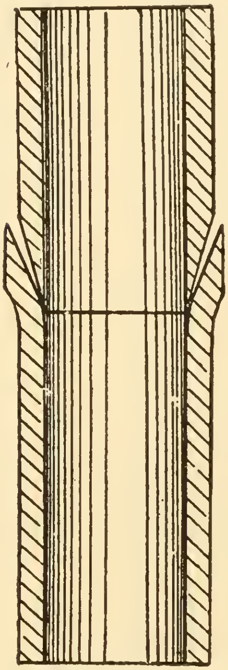


Fig. 228.

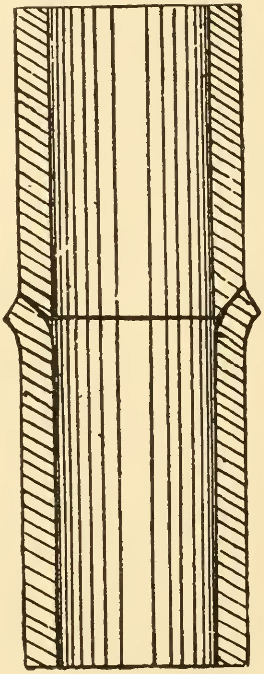


Fig. 229.

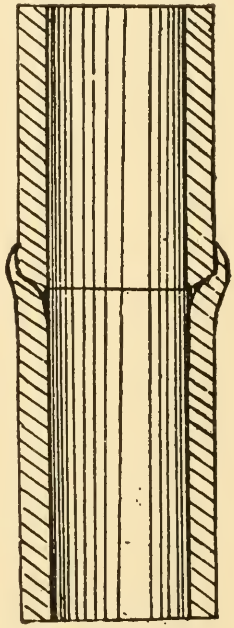


Fig. 230.

be advisable to do this, but still, a joint should and could be quite independent of the very large quantity of solder that is frequently used. But when a large amount of solder is seen on a joint, it can generally be taken for granted that the plumber that made it, when he prepared the ends, took great pains to close up the edge of the socket end to the spigot end so that it fitted tight, so tight was this edge, that it prevented the slightest particle of solder getting in between. The consequence very often is, that if the plumber is not quick at wiping the joint, and keeps the solder moving until it is nearly cold, or at least cold enough to set, the whole of the solder on the joint will be in a state of porousness, or, in other words, instead of the solder cooling into a compact mass, the continual moving of it by the act of wiping causes the particles, as they become crystallized by cooling, to be disturbed and partially disintegrated. The result is, that under a moderate pressure the water will percolate through the joint and cause what is generally termed "sweating." Very often it is rather more than sweating, it can more correctly be compared to water running through a sieve. Under some conditions it is not a very easy matter to prevent this sweating, especially if the solder is very coarse, or is poisoned by zinc or other deleterious matters. The great advantage of leaving the socket end open is, that if the solder is used at a good heat, as it always should be when it is splashed on, it runs into the socket at such a heat that, when it cools, it sets much firmer than that part of the solder which has been disturbed by the forming of the joint.

JOINT-WIPING.

Joint-wiping forms an important branch in the art of plumbing. It is a part of the work which requires more care, skill and practice than any of the other branches, and on it depends the success or failure of some of the most particular jobs in sanitary plumbing. Many serious cases of disease have been traced to bad joint-wiping. It is not expected that a joint can under all conditions, be as perfectly symmetrical and well proportioned as if it had been turned in a lathe. The best workmen have to leave joints that they would be ashamed of, as far as the appearance is concerned, if they were made on the bench or in some convenient place. There are too many who seem to think that sound work is good work, and therefore never try to make their work look as creditable as it should. The different styles of joint-wiping are so numerous, that one could go to any length describing the many eccentricities and peculiarities that are displayed in this particular branch of the trade. Of course every one has his own peculiar ideas in most matters, and no person does a thing exactly like another.

After a helper has been at the trade for a short time, his one great ambition is to wipe a joint. He seems to think that if he can only manage to get a small portion of solder to adhere to a piece of pipe, and then so manipulate it as to induce it to take the form of an egg or a turnip, as the case may be, he has done something to be proud of, and soon begins to think he ought to be a full-blown plumber. Another question with regard to joints is the proper lengths to make them. Some like long joints, others prefer short ones. The advocates of long joints say that short joints are ugly, and are not proportionate. They are often compared to turnips, and other things not quite so regular in shape. Those who are in favor of short joints say the long ones are not so sound, that they will not stand a great pressure, and are liable to sweat. It is ridiculous to make joints of enormous lengths, when a joint made more in proportion to the diameter of the pipe would not only be much stronger, but would look far neater, and generally require less solder. Then there is the question of wiping-cloths. A great many plumbers like a very thick cloth for wiping joints, but, on the other hand, as many more say they cannot wipe joints with thick cloths. Many plumbers who are used to thick cloths and can wipe joints as easily as possible, are quite beaten if they try to use thin cloths. The difference in the thickness of cloths is very great in some cases. Very thin cloths are not suitable for making joints a nice shape. When a plumber gets used to a reasonably thick cloth he can make joints far better and easier than if he used thin ones. Generally, plumbers who use thin cloths make joints very short and lumpy, and bare at the ends, so that the shaving is shown about an eighth to three-eights from the ends. But when thicker cloths are used it is much easier to make joints more like the proper shape. This is very important in all joint-wiping, because wherever the shaving is left bare, the pipe is weaker here than any other part, whereas, if a joint is properly made, this part of it should be the strongest. In a large number of instances, when a pipe is subject to much expansion and contraction, it will break at this weak point very soon after it is fixed. It would be difficult to say generally what should be a proper thickness for cloths, excepting that they should be in proportion to the width and length. Cloths for large joints should be much thicker than those used for small ones, because the larger the cloth is, the more difficult it is to keep it in the shape required for wiping the joint. If a cloth used for making a four-inch joint were made of only about six thicknesses of moleskin, it would be no more, or at least but little more, use than one generally used for three-quarter or one-inch joints, because when a small amount of solder falls on it, the cloth would bend down and let the solder fall, so that the solder would not remain in the cloth except that caught in the middle, where the hand is under it. Consequently, there is much difficulty in getting up the great heat necessary to make a large joint. Then supposing it were possible to get up the heat sufficient to wipe the joint, it is useless to try to make the point as regular as would be the case if moderately thick cloth were used. The reason is, that when the cloth is hot it gives too much to the pressure of each finger, and therefore presses unequally on the surface of the joint, making it either bare at the edges and showing the tinning, or causing the body of the joint to be irregular and bad in shape, more especially at the bottom where it is nearly bare.

A cloth should be just thick enough to prevent the impression of the fingers having any influence on the body of the joint, but at the same time it should be thin enough to allow it to be bent the shape required without any great exertion. A cloth cannot be employed like a mould used by a plasterer to mould a cornice, if it could, it would not be so difficult, and require so much practice to make a joint as it does. Although there can be no doubt that suitable tools are indispensable to the workman, yet it must be remembered, by plumbers especially, that the cloth, however well made both in size and shape, will not make a joint without it is manipulated by an intelligent and experienced hand.

Wiping Horizontal Joints. In the making of wiped joints one of the greatest mistakes that is generally made is that of using too thin cloths. It is very difficult, if not altogether impossible, to make a good shaped joint with a thin cloth. The joints shown at A and B in Fig. 231 are

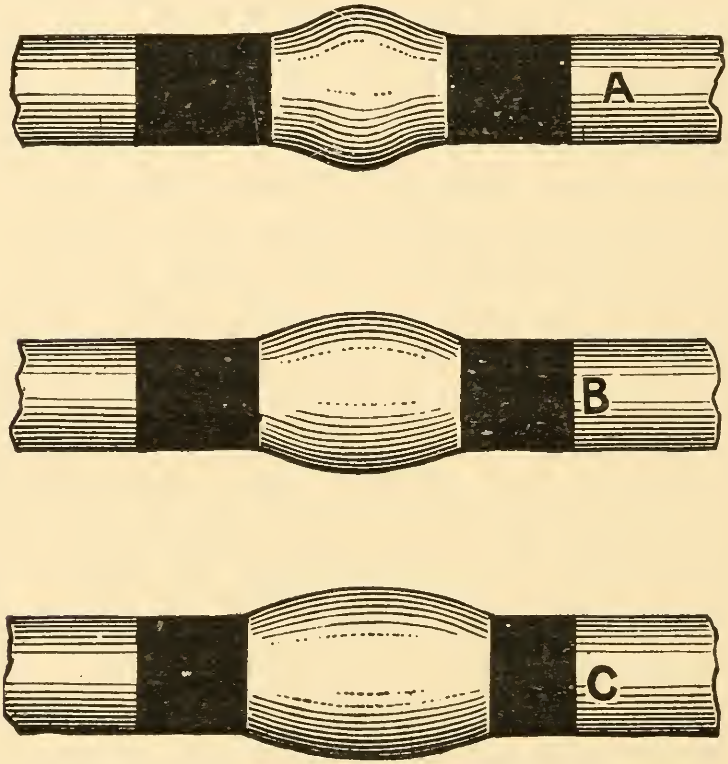


Fig. 231.

the kind of joint generally made with a thin cloth. By thin cloths are meant about five thicknesses of moleskin or ticking. Ticking, however, is not nearly so suitable for the purpose as moleskin. Another objection to the use of thin cloths is their liability to get hot too quickly. Before the joint is finished it is almost impossible to hold the cloth on account of the intense heat. A cloth suitable to make a good wiped joint should consist of about eight thicknesses of moleskin. The width of a good cloth should be about an inch longer than the joint, and the length about the same or perhaps a little longer.

It will not be found a good plan to fold up the cloth out of one piece of material, as when the folds are at the sides, it is difficult to make the cloth bend as is required when in use. The better plan is to cut the cloth into pieces, of twice the length and exactly the same width as the cloth is required to be when finished. These should be folded once and then sewn together at the edge as shown in Fig. 232. To those who are in the habit of using thin cloths it will no doubt be found rather awkward at first to use thick ones, but a little practice will show that they are much more convenient to use and will turn out a better shaped joint as shown at C in Fig. 231. Thin cloths after they are hot get out of shape and give too much, with the result that the edges of the joint are often wiped bare. Another and very important advantage of thick cloths is that the joints may be made much lighter, as it does not necessarily follow that because a large amount of solder is used on a joint it is any more sound or stronger than a lighter one.

When the solder on the joint is at such a heat as to make it difficult to keep it on the pipe, it should be patted round with the cloth, and the

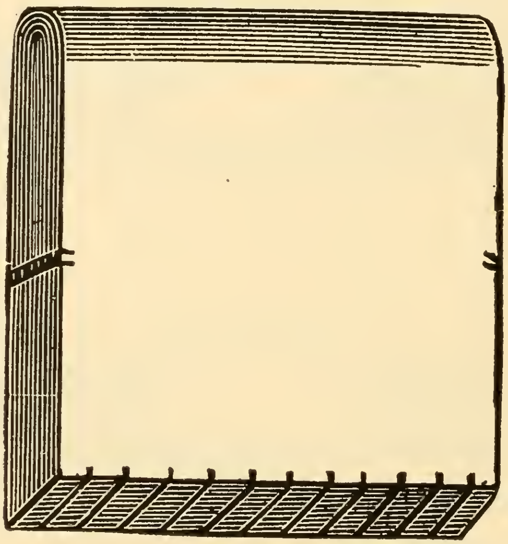


Fig. 232.

surplus solder on the edges wiped off. The cloth should now be taken in the right hand, as shown in Fig. 233, and the wiping commenced at the back of the joint. While drawing the cloth upwards, the forefinger should be used to clean the edge nearest to it, after which the little finger should be used to clean the other edge. As soon as the edges are clean, the body of the joint can be formed with the middle of the cloth. Then take the cloth in the left hand, and pushing the surplus solder downwards, clean the outside edges of the joint with the fore and little fingers. Now take the cloth in the middle of the right hand, pressing equally with each finger so that the cloth touches the whole length of the joint, wipe round as far as is convenient with the right hand, then change quickly to the

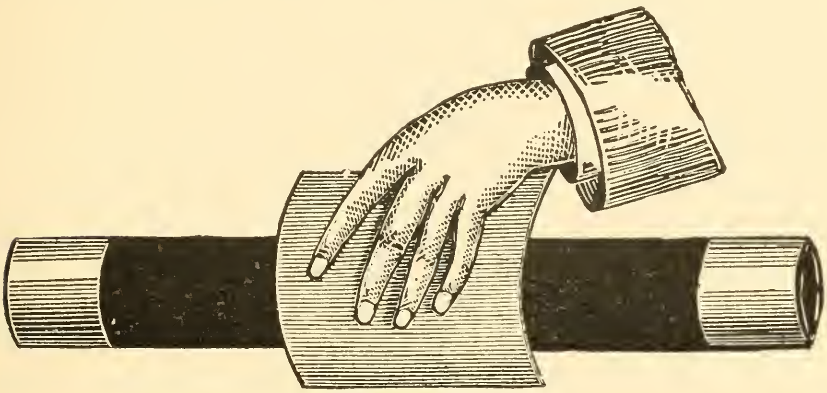


Fig. 233.

left hand and continue the wiping under the joint to the other side. It may be sometimes necessary to wipe the joint round this way two or even three times before it is smooth and clean, but it is much the better way to avoid wiping the surface more than is necessary. The sooner a joint is left alone after it is formed, the better it will be, both for looks and reliability.

Wiping Upright Joints. When wiping an upright joint as shown in Fig. 234, it is better to proceed by stages than to try to wipe the joint all at once. The first stage is to pour on the metal and tin the joint, that is, cause a film of solder to alloy with the surface of the pipe.

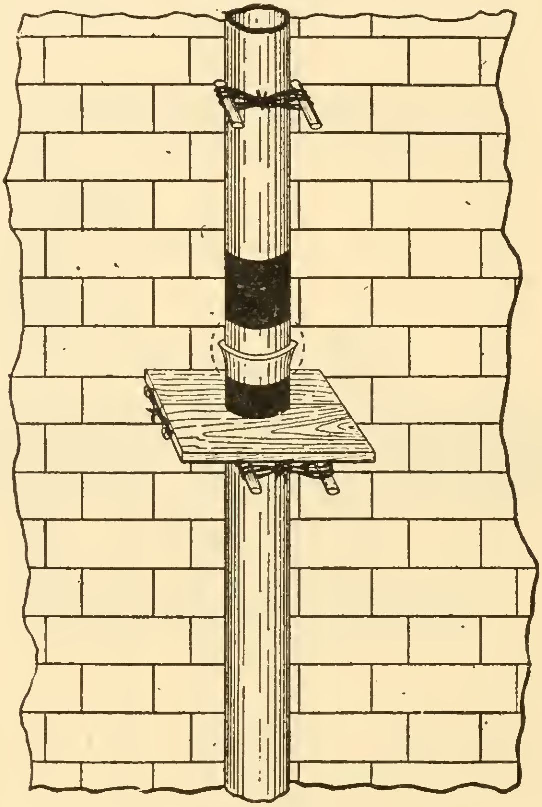


Fig. 234.

When the above described operation has been performed, the iron should be made hot, and the joint should be splashed by means of the splash-stick, until the pipe is hot enough and sufficient solder is on it to allow of the wiping cloth to be used. Great care should be used in melting the solder, if allowed to get red-hot the solder deteriorates. The soldering-iron should be heated to the right temperature and the bit filed clean and bright. The solder should first be splashed on the shaved portion of the pipe and then on about two inches of the soiled part at each end of the pipe. The cloth should always be held under the place where the solder is being splashed on, to catch the surplus solder. As the solder runs down the sides of the pipe and is caught in the cloth, it is pressed up against the pipe to keep up the heat and also to tin the pipe.

As soon as the pipe has been well tinned, the solder should be formed into the shape of a joint. Begin at the top of the joint, and with the hot iron in one hand and the cloth in the other, rub the iron over the solder on the joint and wipe round with the cloth quickly and lightly, working downwards until the joint is finished. When the joint has partially cooled, it may be cleansed and brightened by rubbing it over with tallow and wiping off with a clean soft rag.

Wiping Branch Joints. Fig. 235 shows a badly shaped joint that is often made by the use of a thin cloth, while Fig. 236 shows a joint that may be much more readily made by the use of a thick cloth. When everything is ready and the solder is at a suitable heat, it should be splashed on very carefully while at the same time the pipe should be warmed for a few inches

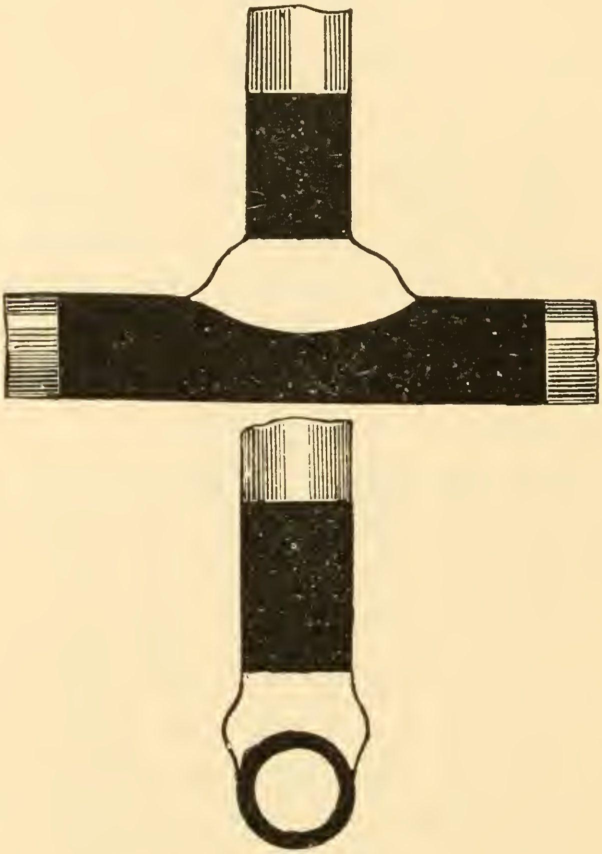


Fig. 235.

each side of the joint with the solder. When the solder on the joint is at such a heat as to make it difficult to keep it on the pipe with continually drawing it up, take a small clean iron at a dull red heat, and start wiping at one end of the joint. Carefully form the sides of the joint and wipe the solder as hot as possible by the continual application of the iron before each

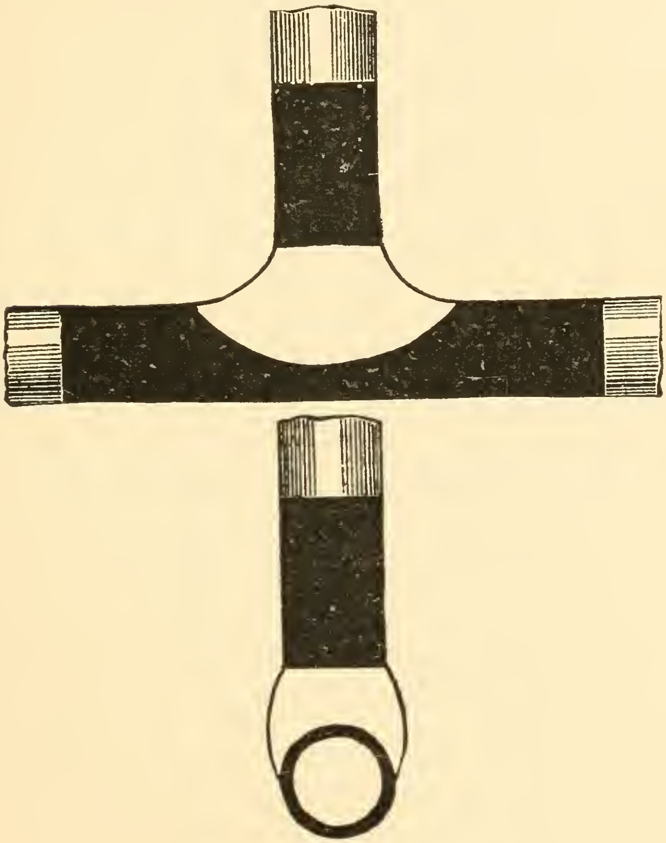


Fig. 236.

part of the joint is wiped. Finish the joint at the same end as it was started by drawing the wipe-off to the outside edge of the joint.

A lead pipe can be wiped to a cast iron pipe with a fair amount of ease, but the joint will not stand satisfactorily. The best way is to file clean the end of the cast-iron pipe and then coat it with pure tin, using sal-ammoniac as a flux. The pipe is then washed to remove the sal-ammoniac, and afterwards re-tinned, using resin and grease as a flux. A plumber's joint, 3½ inches long for 4-inch pipes, is then wiped in the usual way. Great pains will have to be taken to make a good, sound, strong joint between the two metals. Nevertheless, in the course of time, it may be only a few years, the cast iron will come out of the solder. The first sign of decay will be a red ring of iron rust showing at the end of the joint. This rust will swell a little and cause the end of the soldering to curl slightly outwards. Eventually the rust will creep between the solder and the iron and destroy the adhesion of the one to the other. Only those metals that alloy together can be satisfactorily joined by soft soldering, and the solder should contain as great a proportion as possible of the metals that are to be united. The joint would, if out of doors, be subjected to temperatures ranging over 90° Fahrenheit, under such conditions the solder would expand .001251 inch, and the iron would expand .000549 inch, or less than half as much as the solder. The joint would therefore eventually become a loose ring on the iron pipe, but not on the lead pipe, as the expansion of lead and solder do not differ materially.

Numerous experiments have been tried for overcoming the difficulty of wiping joints on ordinary tin-lined pipes, but the only method which has been found to approach success has been to insert a long nipple of tinned sheet iron, this method, however, has not been wholly successful with the ordinary make of tinned pipe. However, on a new kind of tin-lined pipe, wiped joints can be made very easily, without the tin lining melting.

It would often be a convenience if copper pipes could be united satisfactorily by wiping, but plumbers' wiped joints are of no use with copper tube, for the expansion and contraction will not permit them to remain sound, as many hot-water engineers know to their cost, brazed joints would be satisfactory, though troublesome to make. If copper pipe is thick enough to be threaded, have the fittings threaded also, and screw them together the same as with iron pipe, except that with long runs there must be expansion joints or other provision made for expansion. Even when a wiped joint on copper pipes is strongly made by sweating on a sleeve and then wiping a joint over the whole, it is doubtful if it would be permanent. It is very probable that electrolysis would set in, if the pipe is in damp ground. However, should circumstances suggest that a wiped joint might answer, the work is done as described below.

Wiped joints on copper pipes are longer than wiped joints on lead pipes. Copper pipes 2 inches or more in diameter have joints from 3½ to 4 inches long, 4-inch pipes have joints about 5 inches long, but it must be remembered that whilst reasonable length and thickness of joint are necessary to enable the copper pipe to withstand pressure and strain, the maximum time of service does not depend on the length or thickness of the joint as in lead pipe work. That which determines practically the life of the joint is the extent of pipe which is carefully tinned before making the wiped joint. If the interiors of the two pipe ends are tinned, say, for 6 to 8 inches, if the joint is cut open, in a few years' time, it is found that the tinning has diminished to 2 or 3 inches, a corroding action having taken place at the end of the tinning, for this reason it is advisable that the tinning be fairly thick, so as to retard the separation and ultimate failure of the joint. In tinning copper, first thoroughly clean it with dilute sulphuric acid or scour with sand and water, and then rinse it with chloride of zinc, known as killed spirits. Melt some pure tin, throw in sal-ammoniac as a flux, and dip the copper in the tin, or pour or rub the latter over the copper. In pipes forming a portion of a distillery plant it is especially important that untinned spots are not left on the interiors of the pipe ends, as at such spots the destruction of the tinning commences at once. The pipe is strengthened by putting one pipe within the other, and the corrosion of the tinning is arrested when it reaches the lap. If sufficient lap is given, the pipe may be handled before the joint is wiped—a great convenience. The pipe ends are placed together, when practicable, over the iron pot containing the molten solder, which is then poured continuously over the joint until a heat is got up. This practice is not possible with lead or brass pipes, because in the one case the lead would melt, and in the other the molten zinc would leave the brass and ruin the solder. When the pipes cannot be moved, a shovel is placed beneath the joint and the solder poured on rapidly. When a thorough heat has been obtained, the joint can be wiped, with the aid of a cloth and of the mushy solder from the shovel, in much the same way as a joint on a lead pipe is wiped.

AUTOGENOUS SOLDERING OR LEAD BURNING.

The art of lead burning has for many years been kept quite distinct from plumbing generally, it is nevertheless a branch of the trade, and one in which large numbers of plumbers are becoming very proficient. There is not required a large amount of skill or ingenuity in the execution of lead burning, because, as a matter of fact, when it is compared with first-class plumbing, it is not nearly so difficult to acquire. In most cases where lead burning was considered necessary, such for instance as lining large tanks in chemical factories especially for the manufacture of sulphuric acid, the lead was simply used in large sheets fixed with tacks to wooden framework and the edges burned together. Of late years, however, this method of burning the edges of lead together has been adopted for numerous other purposes, such as the lining of sinks for chemical laboratories, and lining cisterns in cases where the water attacks the solder.

The modern term for lead burning is "autogenous soldering." The word "autogenous" is rather an ugly one, and somewhat difficult to define, it pertains to the word "autogeneal," which means "self-begotten or generating itself," neither of which is very appropriate to the process of lead burning. In fact the latter term is not strictly applicable, because the lead is not burnt, it is only fused. The most suitable term would be "fusing process." Instead of saying "the seams are burned," it would be better to say "the seams are fused," as this would correctly describe the action that takes place.

The simplest kind of lead burning is that known as flat seams, and which as a rule is the only kind that plumbers are likely to make use of. Professional lead burners of course are required to burn seams in many different ways, even horizontal seams overhead are sometimes necessary. When the seams of sinks and cisterns have to be burned, the joints should always be arranged about 6 inches from the angles. Because if the seams are arranged in the angles the flame of the blow-pipe is likely to catch the surface of the lead at the side and burn them through before the seam is formed. It is best also to butt the edges of the lead and not to lap them. Then when each edge has been shaved about a quarter of an inch wide, take a strip of shaved lead about half an inch wide and direct the flame on the end until a drop is melted and falls on the seam, at the same time the flame should be directed towards the part of the seam to be burned, for the purpose of heating it. Then cause the flame to play upon the small drop of lead until that and the lead upon which it rests are fused, then draw up the flame quickly. This operation, owing to the intense heat of the airo-hydrogen flame, occupies much less time than it takes to describe it. So that the operator has to be quick in manipulating the blast if he wishes to avoid burning the lead over a much larger space than is desirable. It must not be supposed that a flowing seam like that produced by a copper-bit and fine solder can be formed by the burning process, this, under the circumstances, is not possible. Each wave has to be formed separately by a distinct application of the flame. The regularity of these waves will depend partly upon the skill of the operator, partly upon the quality of the blast and on the purity of the lead upon which it is being used. But like most other mechanical operations proficiency has to be attained by practice and experience. When it is found necessary to burn seams on the vertical side of a cistern, the lap is generally arranged in a slanting direction for the purpose of forming a ledge for the drops of molten lead to rest upon until they are fused into the seam, which is formed of a series of drops, instead of waves. A similar appearance is obtained when seams are burned on an upright side of a cistern in a horizontal line.

Another very convenient way to produce a good flame for lead burning is to use compressed oxygen and coal gas. The oxygen can be obtained in steel bottles, this, being discharged under great pressure, is used for the blast instead of air, a bellows is therefore unnecessary.

When it is stated that a small sized blow-pipe of this kind with a supply of oxygen at the rate of 7 cubic feet per hour, and a gas supply through a quarter-inch pipe, will fuse a quarter-inch wrought-iron rod easily, the intense heat of the flame can be somewhat realized. Probably the oxygen method of burning would be rather costly where only small jobs of lead burning are occasionally required, but where there is a considerable amount to do the compressed oxygen would be far more preferable to the cumbersome and often troublesome hydrogen machine.

There is yet another method which has been adopted to a very large extent for lead burning, namely the use of a red-hot hatchet copper-bit.

The seam is placed, in the case of a pipe, on an iron mandrel, or if a flat seam, on an iron plate, and the hot copper-bit is drawn through, slowly fusing the lead together as it goes. A core or bed of sand will also answer the purpose.

It is, of course, a rough and ready way of doing the work, and it involves a large amount of time and labor in cleaning off the seams. But it is nevertheless effectual, and, where more skilful means are not at hand, it often serves the purpose in a rough way. It would not, however, do for general application, in fact, in numerous instances where lead burning is required, it would not be at all practicable.

In conclusion, it may be well to point out that the idea of substituting the burning system for soldering generally in plumbers' work is not at all likely to be an accomplished fact. It is all very well for special purposes, but the art of soldering in the modern style is too well established to be ever superseded by the comparatively inartistic methods of lead fusing. Not only is lead burning not so attractive or so substantial in appearance as soldering, but it is not nearly so well adapted to general plumbers' work, and there does not at present seem any probability of it ever becoming a successful competitor.

PROPERTIES OF WATER.

A tasteless, transparent, inodorous, liquid, almost incompressible, its absolute diminution being about one twenty-thousandth of its bulk, possesses the liquid form only, at temperatures between thirty-two degrees and two hundred and twelve Fahrenheit. Chemically considered, it is a compound substance of hydrogen and oxygen, two volumes of hydrogen to one volume of oxygen. Water is the most powerful and universal solvent known.

The gallon is the unit of measure for water. The unit of water pressure is the pound per square inch, one gallon of water measures .134 cubic feet and contains 231 cubic inches and weighs about eight and one-third pounds, or sixty-two and one-third pounds per cubic foot.

The above is figured at sixty-two degrees Fahrenheit, which is taken as a standard temperature.

The weight of a column of water of one inch area and twelve inches high, at sixty-two degrees Fahrenheit is .433 pounds, on

$$.433 \times 144 = 62.35 \text{ pounds per cubic foot.}$$

The pressure of still water, in pounds, per square inch, against the side of any pipe or vessel, of any shape whatever, is equal in all directions, downwards, upwards or sideways. To find the pressure in pounds, per square inch, of a column of water, multiply the height of the column in feet, by .433, approximately one foot of elevation, is equal to one half-pound pressure per square inch.

The head is the vertical distance between the level surface of still water and the height in the pipe, unless caused by pressure such as by a pump, etc. Water pressure is measured in pounds per square inch, above atmospheric pressure, by means of a pressure gauge. To ascertain the height water will rise, at any given pressure, divide the gauge pressure by .433; the result is the height in feet.

Example: The pressure gauge on a supply pipe in a basement shows 25 pounds pressure. To what height will water rise in the piping throughout the building?

Answer: $25 \div .433 = 57\frac{1}{2}$ feet.

While water will rise to this height, sufficient head should be provided to furnish a surplus head of about ten feet above the highest point of delivery, to insure a respectable velocity of discharge.

It is frequently desired to know what number of pipes of a given size is equal in carrying capacity to one pipe of a larger size. At the same velocity of flow, the volume delivered by two pipes of a different size is proportionate to the square of their diameters, thus: A four-inch pipe will deliver the same volume as four two-inch pipes.

Example:

2 inches $\times$ 2 inches = 4 square inches.
4 inches $\times$ 4 inches = 16 square inches.
16 inches $\div$ 4 inches = 4 2-inch pipes.

With the same head, however, the velocity being less in a two-inch pipe, the volume delivered varies about as the square root of the fifth power. Thus one four-inch pipe is actually equal to 5.7 two-inch pipes.

Example: With the same head, how many two-inch pipes will it take to equal one four-inch pipe?

Solution:

$2^5 = 2 \times 2 \times 2 \times 2 \times 2 = 32$ and the $\sqrt{32} = 5.7$ nearly.

In other words, the decrease in loss by friction in the four-inch pipe, in comparison with the two-inch pipes, is equal to 1.7 two-inch pipes over the actual square of their respective areas.

Water boils or takes the form of vapor or steam at 212 degrees Fahrenheit, at a mean pressure of the sea level, or 14.696 pounds per square inch. Water freezes, or assumes a solid form, that of ice, at 32 degrees Fahrenheit, at the ordinary atmospheric pressure, and ice melts at the same temperature. The point of maximum density is reached at 39.2 Fahrenheit, that is, water at that temperature occupies its smallest possible volume. If cooled further, it expands until it solidifies, and if heated, it expands.

Hardness of water is indicated by the easy manner with which it will form a lather with soap, the degree of hardness being based on the presence and amount of lime and magnesia. The more lime and magnesia in a sample of water, the more soap a given volume of water will decompose. The standard soap measurement is the quantity required to precipitate or neutralize one grain of carbonate of lime. It is commonly recommended that one gallon of pure, distilled water takes one soap measure to produce a lather, and, therefore, one is deducted from the total amount of soap measurements found to be necessary to produce a lather in a gallon of water, and in reporting the number of soap measurements or degrees of hardness of the water sample.

The impurities which occur in waters are of two kinds, mechanical and physical, dirt, leaves, insects, etc., are mechanical and can be removed by filtration. It is said that these impurities are held in suspension.

Solutions of minerals, poisons and the like are physical and are designated as those held in solution.

Freshening water to render it palatable is accomplished by aeration, that is, by exposing water to the action of the air, by passing air through it or raising it to an elevation built for that purpose, protected from dust and other impurities of the air, if the water is to be used for drinking purposes, and allowing it to run down an incline, which is slatted or barred, so as to break it up into small particles, and allow it to become saturated with air.

This process, however, is of no practical use for actual purification.

USEFUL INFORMATION.

One heaped bushel of anthracite coal weighs from 75 to 80 lbs.

One heaped bushel of bituminous coal weighs from 70 to 75 lbs.

One bushel of coke weighs 32 lbs.

Water, gas and steam pipes are measured on the inside.

One cubic inch of water evaporated at atmospheric pressure makes 1 cubic foot of steam.

A heat unit known as a British Thermal Unit raises the temperature of 1 pound of water 1 degree Fahrenheit.

For low pressure heating purposes, from 3 to 8 pounds of coal per hour is considered economical consumption, for each square foot of grate surface in a boiler, dependent upon conditions.

A horse power is estimated equal to 75 to 100 square feet of direct radiation. A horse power is also estimated as 15 square feet of heating surface in a standard tubular boiler.

Water boils in a vacuum at 98 degrees Fahrenheit.

A cubic foot of water weighs 62½ pounds, it contains 1,728 cubic inches or 7½ gallons. Water expands in boiling about one-twentieth of its bulk.

In turning into steam water expands 1,700 its bulk, approximately 1 cubic inch of water will produce 1 cubic foot of steam.

One pound of air contains 13.82 cubic feet.

It requires 1½ British Thermal Units to raise one cubic foot of air from zero to 70 degrees Fahrenheit.

At atmospheric pressure 966 heat units are required to evaporate one pound of water into steam.

A pound of anthracite coal contains 14,500 heat uits.

One horsepower is equivalent to 42.75 heat units per minute.

One horsepower is required to raise 33,000 pounds one foot high in one minute.

To produce one horsepower requires the evaporation of 2.66 pounds of water.

One ton of anthracite coal contains about 40 cubic feet.

One bushel of anthracite coal weighs about 86 pounds.

Heated air and water rise because their particles are more expanded, and therefore lighter than the colder particles.

A vacuum is a portion of space from which the air has been entirely exhausted.

Evaporation is the slow passage of a liquid into the form of vapor.

Increase of temperature, increased exposure of surface, and the passage of air currents over the surface, cause increased evaporation.

Condensation is the passage of a vapor into the liquid state, and is the reverse of evaporation.

Pressure exerted upon a liquid is transmitted undiminished in all directions, and acts with the same force on all surfaces, and at right angles to those surfaces.

The pressure at each level of a liquid is proportional to its depth.

With different liquids and the same depth, pressure is proportional to the density of the liquid.

The pressure is the same at all points on any given level of a liquid.

The pressure of the upper layers of a body of liquid on the lower layers causes the latter to exert an equal reactive upward force. This force is called buoyancy.

Friction does not depend in the least on the pressure of the liquid upon the surface over which it is flowing.

Friction is proportional to the area of the surface.

At a low velocity friction increases with the velocity of the liquid.

Friction increases with the roughness of the surface.

Friction increases with the density of the liquid.

Friction is greater comparatively, in small pipes, for a greater proportion of the water comes in contact with the sides of the pipe than in the case of the large pipe. For this reason mains on heating apparatus should be generous in size.

Air is extremely compressible, while water is almost incompressible.

Water is composed of two parts of hydrogen, and one part of oxygen.

Water will absorb gases, and to the greatest extent when the pressure of the gas upon the water is greatest, and when the temperature is the lowest, for the elastic force of gas is then less.

Air is composed of about one-fifth oxygen and four-fifths nitrogen, with a small amount of carbonic acid gas.

To reduce Centigrade temperatures to Fahrenheit, multiply the Centigrade degrees by 9, divide the result by 5, and add 32.

To reduce Fahrenheit temperature to Centigrade, subtract 32 from the Fahrenheit degrees, multiply by 5 and divide by 9.

To find the area of a required pipe, when the volume and velocity of the water are given, multiply the number of cubic feet of water by 144 and divide this amount by the velocity in feet per minute.

Water boils in an open vessel (atmospheric pressure at sea level) at 212 degrees Fahrenheit.

Water expands in heating from 39 to 212 degrees Fahrenheit, about 4 per cent.

Water expands about one-tenth its bulk by freezing solid.

Rule for finding the size of a pipe necessary to fill a number of smaller pipes. Suppose it is desired to fill from one pipe, a 2, 2½ and 4-inch pipe. Draw a right angle, one arm 2 inches in length, the other 2½ inches in length. From the extreme ends of the two arms draw a line. The length of this line in inches will give the size of pipe necessary to fill the two smaller pipes—about 3¼ inches. From one end of this last line, draw another line at right angles to it, 4 inches in length. Now, from the end of the 2-inch line to the end of the last line draw another line. Its length will represent the size of pipe necessary to fill a 2-, 2½- and 4-inch pipe. This may be continued as long as desired.

Discharge of water. The amount of water discharged through a given orifice during a given length of time and under different heads, is as the square roots of the corresponding heights of the water in the reservoir above the surface of the orifice.

Water is at its greatest density and occupies the least space at 39 degrees Fahrenheit.

Water is the best known absorbent of heat, consequently a good vehicle for conveying and transmitting heat.

A U. S. gallon of water contains 231 cubic inches and weighs 8 1/3 pounds.

A column of water 27.67 inches high has a pressure of 1 pound to the square inch at the bottom.

Doubling the diameter of a pipe increases its capacity four times.

A hot water boiler will consume from 3 to 8 pounds of coal per hour per square foot of grate, the difference depending upon conditions of draft, fuel, system and management.

A cubic foot of anthracite coal averages 50 pounds. A cubic foot of bituminous coal weighs 40 pounds.

Weights.

One cubic inch of water weighs	0.036	pounds
One U. S. gallon weighs	8.33	"
One Imperial gallon "	10.00	"
One U. S. gallon equals	231.00	cubic inches
One Imperial gallon "	277.274	" "
One cubic foot of water equals	7.48	U. S. gallons

Liquid Measure.

4 Gills make 1 Pint	4 Quarts make 1 Gallon
2 Pints make 1 Quart	31½ Gals. make 1 Barrel

To find the area of a rectangle, multiply the length by the breadth.

To find the area of triangle, multiply the base by one-half the perpendicular height.

To find the circumference of a circle, multiply the diameter by 3.1416.

To find the area of a circle, multiply the diameter by itself, and the result by .7854.

To find the diameter of a circle of a given area, divide the area by .7854, and find the square root of the result.

To find the diameter of a circle which shall have the same area as a given square, multiply one side of the square by 1.128.

To find the number of gallons in a cylindrical tank, multiply the diameter in inches by itself, this by the height in inches, and the result by .34. To find the number of gallons in a rectangular tank, multiply together the length, breadth and height in feet, and this result by 7.4. If the dimensions are in inches, multiply the product by .004329. To find the pressure in pounds per square inch, of a column of water, multiply the height of the column in feet by .434.

To find the head which will produce a given velocity of water through a pipe of a given diameter and length: Multiply the square of the velocity, expressed in feet per second, by the length of pipe multiplied by the quotient obtained by dividing 13.9 by the diameter of the pipe in inches, and divide the result obtained by 2,500. The final amount will give the head in feet.

Example.—The horizontal length of pipe is

1,200 feet, and the diameter is 4 inches. What head must be secured to produce a flow of 3 feet per second?

3×3=9; 13.9÷4=3.475.
9×1,200×3.475=37,530.
37,530÷2,500=15 ft.

To find the velocity of water flowing through a horizontal straight pipe of given length and diameter, the head of water above the center of the pipe being known: Multiply the head in feet by 2,500, and divide the result by the length of pipe in feet multiplied by 13.9, divided by the inner diameter of the pipe in inches. The square root of the quotient gives the velocity in feet per second.

To find the head in feet, the pressure being known, multiply the pressure per square inch by 2.31.

To find the contents of a barrel. To twice the square of the largest diameter, add the square of the smallest diameter and multiply this by the height, and the result by 2,618. This will give the cubic inches in the barrel, and this divided by 231 will give the number of gallons.

To find the head in feet, the pressure being known, multiply the pressure per square inch by 2.31.

To find the lateral pressure of water upon the side of a tank, multiply in inches, the area of the submerged side, by the pressure due to one-half the depth.

Example—Suppose a tank to be 12 feet long and 12 feet deep. Find the pressure on the side of the tank.

144 x 144=20,736 square inches area of side.

12 x .43=5.16, pressure at bottom of tank. Pressure at the top of tank is 0. Average pressure will then be 2.6. Therefore 20,736 x 2.6=53,914 pounds pressure on side of tank.

To find the number of gallons in a foot of pipe of any given diameter, multiply the square of diameter of the pipe in inches, by .0408.

To find the diameter of pipe to discharge a given volume of water per minute in cubic feet, multiply the square of the quantity in cubic feet per minute by 96. This will give the diameter in inches.

To find the weight of any length of lead pipe, when the diameter and thickness of the lead are known: Multiply the square of the outer diameter in inches, by the weight of 12 cylindrical inches, then multiply the square of the inner diameter in inches by the same amount, subtracting the product of the latter from that of the former. The remainder multiplied by the length gives the desired result.

Example. Find the weight of 1,200 feet of lead pipe, the outer diameter being ⅞ inch, and the inner diameter 9-16 inch.

The weight of 12 cylindrical inches, 1 foot long, 1 inch in diameter, is 3.8697 lbs.

$7/8 \times 7/8 = 49\text{-}64 = .765625$.

$9\text{-}16 \times 9\text{-}16 = 81\text{-}256 = .316406$.

$.765625 - .316406 = .449219 \times 3.8697 \times 1{,}200 = 2{,}086$ lbs.

Cleaning Rusted Iron. Place the articles to be cleaned in a saturated solution of chloride of tin and allow them to stand for a half day or more.

When removed, wash the articles in water, then in ammonia. Dry quickly, rubbing them hard.

Removing Boiler Scale. Kerosene oil will accomplish this purpose, often better than specially prepared compounds.

Cleaning Brass. Mix in a stone jar one part of nitric acid, one-half part of sulphuric acid. Dip the brass work into this mixture, wash it off with water, and dry with sawdust. If greasy, dip the work into a strong mixture of potash, soda, and water, to remove the grease. and wash it off with water.

Removing Grease Stains from Marble. Mix 1½ parts of soft soap, 3 parts of Fuller's earth and 1½ parts of potash, with boiling water. Cover the grease spots with this mixture, and allow it to stand a few hours.

Strong Cement. Melt over a slow fire, equal parts of rubber and pitch. When wishing to apply the cement, melt and spread it on a strip of strong cotton cloth.

Cementing Iron and Stone. Mix 10 parts of fine iron filings, 30 parts of plaster of Paris, and one-half parts of sal ammoniac, with weak vinegar. Work this mixture into a paste, and apply quickly.

Cement for Steam Boilers. Four parts of red or white lead mixed in oil, and 3 parts of iron borings, make a good soft cement for this purpose.

Cement for Leaky Boilers. Mix 1 part of powdered litharge, 1 part of fine sand, and one-half part of slacked lime with linseed oil, and apply quickly as possible.

To keep plaster of Paris from setting too quickly. Sift the plaster into the water, allowing it to soak up the water without stirring, which would admit the air, and cause the plaster to set very quickly. If it is desired to keep the plaster soft for a much longer period, as is necessary for some kinds of work, add to every quart of water one-half teaspoonful of common cooking soda. This will gain all the time that is needed.

To keep paste from spoiling. Add a few drops of oil of clove.

To make a cement that will hold when all others fail. Melt over a slow fire equal parts of rubber and pitch. When wishing to use it, melt and spread it on a strip of strong cotton cloth.

Bath for cleaning sheet copper that is to be

tinned. Pour into water sulphuric acid, until the temperature rises to about blood heat, when it will be about right for pickling purposes.

Making Tight Steam Joints. With white lead ground in oil mix as much manganese as possible, with a small amount of litharge. Dust the board with red lead, and knead this mass by hand into a small roll, which is then laid on the plate, oiled with linseed oil. It can then be screwed into place.

Substitute for Fire Clay. Mix common earth with weak salt water.

Rust Joint Cement. Mix 5 pounds of iron filings, 1 ounce of sal ammoniac, and 1 ounce of sulphur, and thin the mixture with water.

To tin sheet copper after it has been well cleaned. Take it from the bath. If there are any spots which the acid has failed to remove, scour with salt and sand. Then over a light charcoal fire heat it, touching it with tin or solder, and wipe from one end of the sheet to the other with a handful of flax, only going so fast as it is thoroughly tinned. If the tinning shows a yellowish color, it shows there is too much heat, which is the greatest danger, as tinning should be done with as little heat as is necessary to make the metal flow. When this is done, rinse off in clean water and dry in sawdust.

To give copper a red appearance as seen on bath boilers. After the copper has been cleaned, rub on red chalk and hammer it in with a planishing hammer.

To tin soldering copper with sal-ammoniac. It will be found very handy to have a stick of sal-ammoniac in the kit for tinning purposes. After filing the heated copper bright, touch the copper with the sal-ammoniac and afterward with a stick of solder. The solder will at once flow over the entire surface. In this there is but one danger, the too great heating of the copper, in which case the burned sal-ammoniac will form a hard crust over the surface. Tin with as little heat as possible. Sal-ammoniac will be found of great value in keeping the soldering copper in shape by frequently rubbing the tinned point with it.

To Keep Soldering Coppers in Order While Soldering with Acid. In a pint of water dissolve a piece of sal-ammoniac about the size of a walnut. Whenever the copper is taken from the fire, dip the point into the liquid, and the zinc taken from the acid will run to the point of the copper and can then be shaken off, leaving the copper bright.

TESTS FOR PURE WATER.

Color. Fill a long clean bottle of colorless glass with the water. Look through it at some blank object. It should look colorless and free from suspended matter. A muddy or turbid appearance indicates soluble organic matter or solid matter in suspension.

Odor. Fill the bottle half full, cork it and leave it in a warm place for a few hours. If, when uncorked, it has a smell the least repulsive, it should be rejected for domestic use.

Taste. If water at any time, even after heating, has a repulsive or disagreeable taste, it should be rejected. A simple, semi-chemical test is to fill a clean pint bottle three-fourths full of water, add a half teaspoonful of clean granulated or crushed loaf sugar, stop the bottle with glass or a clean cork, and let it stand in the light, in a moderately warm room, for forty-eight hours. If the water becomes cloudy, or milky, it is unfit for domestic use.

Table Showing Pressure of Water at Different Elevations.

Feet Head.	Equals Pressure per Square Inch.	Feet Head.	Equals Pressure per Square Inch.	Feet Head.	Equals Pressure per Square Inch.
1	.43	130	56.31	255	110.46
5	2.16	135	58.48	260	112.62
10	4.33	140	60.64	265	114.79
15	6.49	145	62.81	270	116.96
20	8.66	150	64.97	275	119.12
25	10.82	155	67.14	280	121.29
30	12.99	160	69.31	285	123.45
35	15.16	165	71.47	290	125.62
40	17.32	170	73.64	295	127.78
45	19.49	175	75.80	300	129.95
50	21.65	180	77.97	310	134.28
55	23.82	185	80.14	320	138.62
60	25.99	190	82.30	330	142.95
65	28.15	195	84.47	340	147.28
70	30.32	200	86.63	350	151.61
75	32.48	205	88.80	360	155.94
80	34.65	210	90.96	370	160.27
85	36.82	215	93.14	380	164.61
90	38.98	220	95.30	390	168.94
95	41.15	225	97.49	400	173.27
100	43.31	230	99.63	500	216.58
105	45.48	235	101.79	600	259.90
110	47.64	240	103.96	700	303.22
115	49.81	245	106.13	800	346.54
120	51.98	250	108.29	900	389.86
125	54.15			1000	433.18

WEIGHT OF PIPE PER FOOT FOR A GIVEN HEAD OR FALL OF WATER.

Head, or Number of Feet Fall.	Pressure per Square Inch.	Diameter and Weight per Foot of Lead Pipe Required.													
		3-8 Inch.		1-2 Inch.		5-8 Inch.		3-4 Inch.		1 Inch.		1 1-4 Inch.		1 1-2 Inch.	
	Pounds.	lbs.	oz.	lbs.	oz.	lbs.	oz.	lbs.	oz.	lbs.	oz.	lbs.	oz.	lbs.	oz.
30	15	0	8	0	12	1 1	4 8	1 1	4 8	1 2	12 0	2	8	3	8
40	20	0 0	10 12	0 1	14 0	1	12	1 2	12 0	2	8	3	0	4	0
50	25	0	12	1	4	1 2	12 0	2 2	4 8	3	0	4	0	4 5	8 0
75	38	1	0	1 1	8 12	2 2	4 8	3 3	0 8	4	0	4 5	8 0	6	0
100	50	1	4	2	0	2 3	12 0	4	0	5	0	7	0	10	0
150	75	1 1	4 8	2	8	3 3	4 8	4	8	6	0	9	0	12	0
200	100	1	8	3	0	4	0	5	0	7	0	12	0	15	0

TABLE OF QUANTITITY OF WATER DELIVERED BY SERVICE PIPES OF VARIOUS SIZES UNDER VARIOUS PRESSURES.

Proportion of Head of Water (H) to Length of Pipe (L).

Gallons Per Minute.

Diameter of Pipe Inches.	H = 10 L.	H = 9 L.	H = 8 L.	H = 7 L.	H = 6 L.	H = 5 L.	H = 4 L.	H = 3 L.
½	19.8	18.7	17.7	16.5	15.3	14.0	12.5	10.8
⅝	34.5	32.7	30.1	28.9	26.5	24.4	21.5	18.9
¾	54.4	51.7	48.7	45.6	42.2	38.5	34.4	29.8
1	111.8	106.0	100.0	93.5	86.6	79.0	70.7	61.2
1¼	195.2	185.2	174.6	163.3	151.2	138.0	123.4	106.9
1½	308.0	292.1	275.4	257.6	238.5	217.7	194.8	168.7
2	632.2	599.7	566.4	538.9	488.1	447.0	399.8	346.3
2½	1104.0	1048.0	987.8	924.0	855.4	780.9	698.5	604.9
3	1745.0	1651.0	1560.0	1460.0	1351.0	1234.0	1103.0	955.5
4	3581.0	3397.0	3203.0	2996.0	2774.0	2532.0	2265.0	1962.0
5	6247.0	5928.0	5588.0	5227.0	4839.0	4417.0	3951.0	3406.0
6	9855.0	9349.0	8814.0	8245.0	7633.0	6968.0	6233.0	5391.0

Diameter of Pipe Inches.	H = 2 L.	H = 1¾ L.	H = 1½ L.	H = 1¼ L.	H = 1 L.	H = ¾ L.	H = ½ L.	H = ¼ L.
½	8.8	8.3	7.7	7.0	6.3	5.4	4.4	3.1
⅝	15.4	14.4	13.4	12.2	10.9	9.5	7.7	5.5
¾	24.3	22.8	21.1	19.3	17.2	14.9	12.2	8.6
1	50.0	46.8	43.2	39.5	35.3	30.6	25.0	17.7
1¼	87.3	81.6	75.6	69.0	61.7	53.5	43.7	30.9
1½	137.7	128.8	119.3	108.9	97.4	84.3	68.7	48.7
2	282.7	264.4	248.8	223.5	199.9	173.1	141.4	100.0
2½	493.9	482.0	427.7	390.4	349.2	302.4	246.9	174.6
3	780.2	728.8	674.8	615.9	555.5	477.1	390.1	275.8
4	1602.0	1496.0	1385.0	1264.0	1133.0	979.3	800.8	566.2
5	2791.0	2613.0	2420.0	2209.0	1976.0	1711.0	1394.0	987.7
6	4407.0	4122.0	3817.0	3484.0	3116.0	2693.0	2204.0	1558.0

CAPACITY OF DRAIN PIPE UNDER DIFFERENT AMOUNTS OF FALL.

Gallons per Minute.

Size of Pipe.	1-2 inch fall per 100 feet.	3 inch fall per 100 feet.	6 inch fall per 100 feet.	9 inch fall per 100 feet.
3 In.	21	30	42	52
4 "	36	52	76	92
6 "	84	120	169	206
9 "	232	330	470	570
12 "	470	680	960	1160
15 "	830	1180	1680	2040
18 "	1300	1850	2630	3200
20 "	1760	2450	3450	4180

Size of Pipe.	12 inch fall per 100 feet.	18 inch fall per 100 feet.	24 inch fall per 100 feet.	36 inch fall per 100 feet.
3 In.	60	74	85	104
4 "	108	132	148	184
6 "	240	294	338	414
9 "	660	810	930	1140
12 "	1360	1670	1920	2350
15 "	2370	2920	3340	4100
18 "	3740	4600	5270	6470
20 "	4860	5980	6850	8410

DIMENSIONS OF WROUGHT-IRON PIPE.

Nominal Inside Diameter.	Actual Outside Diameter in Inches.	Actual Inside Diameter in Inches.	Thickness of Metal in Inches.	Threads per Inch.	Length of Full Thread in Inches.
1/8	.405	.270	.068	27	.19
1/4	.540	.364	.085	18	.29
3/8	.675	.493	.091	18	.30
1/2	.840	.622	.109	14	.39
3/4	1.050	.824	.113	14	.40
1	1.315	1.048	.134	11 1/2	.51
1 1/4	1.660	1.380	.140	11 1/2	.54
1 1/2	1.900	1.610	.145	11 1/2	.55
2	2.375	2.067	.154	11 1/2	.58
2 1/2	2.875	2.468	.204	8	.89
3	3.500	3.067	.217	8	.95
3 1/2	4.000	3.548	.226	8	1.00
4	4.500	4.026	.237	8	1.05
4 1/2	5.000	4.508	.246	8	1.10
5	5.563	5.045	.259	8	1.16
6	6.625	6.065	.280	8	1.26
7	7.625	7.023	.301	8	1.36
8	8.625	7.981	.322	8	1.46
9	9.625	8.937	.344	8	1.57
10	10.750	10.018	.366	8	1.68
11	11.75	11.000	.375	8	1.78
12	12.75	12.000	.375	8	1.88
13	14.	13.25	.375	8	2.09
14	15.	14.25	.375	8	2.10
15	16.	15.25	.375	8	2.20

Taper of the thread is 3/4 inch to one foot.

Pipe from 1/8 inch to 1 inch inclusive is butt welded and tested to 300 pounds per square inch.

Pipe 1 1/4 inch and larger is lap welded and tested to 500 pounds per square inch.

DECIMAL PARTS OF AN INCH.

1-64	.01563	11-32	.34375	43-64	.67188
1-32	.03125	23-64	.35938	11-16	.6875
3-64	.04688	3-8	.375		
1-16	.0625			45-64	.70313
		25-64	.39063	23-32	.71875
5-64	.07813	13-32	.40625	47-64	.73438
3-32	.09375	27-64	.42188	3-4	.75
7-64	.10938	7-16	.4375		
1-8	.125			49-64	.76563
		29-64	.45313	25-32	.78125
9-64	.14063	15-32	.46875	51-64	.79688
5-32	.15625	31-64	.48438	13-16	.8125
11-64	.17188	1-2	.5		
3-16	.1875			53-64	.82813
		33-64	.51563	27-32	.84375
13-64	.20313	17-32	.53125	55-64	.85938
7-32	.21875	35-64	.54688	7-8	.875
15-64	.23438	9-16	.5625		
1-4	.25			57-64	.89063
		37-64	.57813	29-32	.90625
17-64	.26563	19-32	.59375	59-64	.92188
9-32	.28125	39-64	.60938	15-16	.9375
19-64	.29688	5-8	.625		
5-16	.3125			61-64	.95313
		41-64	.64063	31-32	.96875
21-64	.32813	21-32	.65625	63-64	.97438

MELTING POINTS OF ALLOYS OF TIN, LEAD, AND BISMUTH.

Tin.	Lead.	Bismuth.	Melting Point in Degrees Fahrenheit.	Tin.	Lead.	Bismuth.	Melting Point in Degrees Fahrenheit,
2	3	5	199	4	1		372
1	1	4	201	5	1		381
3	2	5	212	2	1		385
4	1	5	246	3		1	392
1		1	286	1	1		466
2		1	334	1	3		552
3	1		367				

Weight of Twelve Inches Square of Various Metals.

Thickness.	Wrought Iron.	Cast Iron.	Steel.	Gun Metal.	Brass.	Copper.	Tin.	Zinc.	Lead.
1/16	2.50	2.34	2.56	2.75	2.69	2.87	2.37	2.25	3.68
1/8	5.00	4.69	5.12	5.50	5.38	5.75	4.75	4.50	7.37
3/16	7.50	7.03	7.68	8.25	8.07	8.62	7.12	6.75	11.05
1/4	10.00	9.38	10.25	11.00	10.75	11.50	9.50	9.00	14.75
5/16	12.50	11.72	12.81	13.75	13.45	14.37	11.87	11.25	18.42
3/8	15.00	14.06	15.36	16.50	16.14	17.24	14.24	13.50	22.10
7/16	17.50	16.41	17.93	19.25	18.82	20.12	16.17	15.75	25.80
1/2	20.90	18.75	20.50	22.00	21.50	23.00	19.00	18.00	29.50
9/16	22.50	21.10	23.06	24.75	24.20	25.87	21.37	20.25	33.17
5/8	25.00	23.44	25.62	27.50	26.90	28.74	23.74	22.50	36.84
11/16	27.50	25.79	28.18	30.25	29.58	31.62	26.12	24.75	40.54
3/4	30.00	28.12	30.72	33.00	32.28	34.48	28.48	27.00	44.20
13/16	32.50	30.48	33.28	35.75	34.95	37.37	30.87	29.25	47.92
7/8	35.00	32.82	35.86	38.50	37.64	40.24	32.34	31.50	51.60
15/16	37.50	35.16	38.43	41.25	40.32	43.12	35.61	33.75	55.36
1	40.00	37.50	41.00	44.00	43.00	46.00	38.00	36.00	59.00

Weight of Metals. To Find Weight in Pounds.

Aluminium	cubic inches	× 0.094
Brass	" "	× 0.31
Copper	" "	× 0.32
Cast-Iron	" "	× 0.26
Wrought-Iron	" "	× 0.28
Lead	" "	× 0.41
Mercury	" "	× 0.49
Nickel	" "	× 0.31
Tin	" "	× 0.26
Zinc	" "	× 0.26

WEIGHT OF COPPER PIPES PER FOOT.

Bore in Inches.	Thickness of Metal in Parts of an Inch.					
	1/16	1/8	3/16	1/4	5/16	3/8
	pounds.	pounds.	pounds.	pounds.	pounds.	pounds.
1/2	0.426	0.946	1.561	2.270	3.075	3.973
5/8	0.520	1.185	1.845	2.649	3.547	4.540
3/4	0.615	1.324	2.129	3.027	4.020	5.108
7/8	0.709	1.514	2.412	3.425	4.493	5.676
1	0.804	1.703	2.696	3.784	4.966	6.243
1 1/4	0.993	2.081	3.263	4.540	5.712	7.378
1 1/2	1.182	2.459	3.831	5.297	6.857	8.514
1 3/4	1.372	2.838	4.388	6.055	7.805	9.646
2	1.560	3.217	4.967	6.808	8.748	10.783
2 1/4	1.750	3.591	5.531	7.566	9.694	11.918
2 1/2	1.940	3.975	6.103	8.327	10.643	13.066
2 3/4	2.128	4.352	6.668	9.081	11.590	14.190
3	2.316	4.729	7.238	9.737	12.534	15.325

WEIGHT OF BRASS PIPES PER FOOT.

Bore in Inches.	Thickness in Parts of an Inch.						
	1/16	1/8	3/16	1/4	5/16	3/8	7/16
	pounds	pounds	pounds.	pounds.	pounds	pounds.	pounds.
1/4	0.22	0.53	0.94	1.43	2.01	2.68	3.44
1/2	0.40	0.89	1.47	2.15	2.91	3.75	4.70
3/4	0.58	1.25	2.01	2.86	3.80	4.83	5.95
1	0.76	1.61	2.55	3.58	4.70	5.92	7.25
1 1/4	0.94	1.96	3.09	4.31	5.64	6.98	9.46
1 1/2	1.12	2.34	3.67	5.01	6.49	8.05	9.71
1 3/4	1.33	2.66	4.14	5.70	7.36	9.11	10.94
2	1.48	3.04	4.69	6.44	8.27	10.20	12.21
2 1/4	1.65	3.40	5.23	7.16	9.17	11.27	13.46
2 1/2	1.83	3.75	5.77	7.87	10.06	12.35	14.72
2 3/4	2.01	4.11	6.31	8.59	10.96	13.42	15.97
3	2.19	4.47	6.84	9.31	11.85	14.69	17.42

Diameters, Circumferences, Areas, Squares, and Cubes.

Diameter in Inches.	Circumference in Inches.	Area in Square Inches.	Area in Square Feet.	Square, in Inches.	Cube, in Inches.
1/8	.3927	.0122	....	.0156	.00195
1/4	.7854	.0490	....	.0625	.01563
3/8	1.1781	.1104	....	.1406	.05273
1/2	1.5708	1963	....	.25	.125
5/8	1.9635	.3068	....	.3906	.24414
3/4	2.3562	.4417	....	.5625	.42138
7/8	2.7489	.6013	....	.7656	.66992
1	3.1416	.7854	....	1.	1.
1 1/8	3.5343	.9940	.0069	1.2656	1.42383
1 1/4	3.9270	1.2271	.0084	1.5625	1.95313
1 3/8	4.3197	1.4848	.0102	1.8906	2.59961
1 1/2	4.7124	1.7671	.0122	2.25	3.375
1 5/8	5.1051	2.0739	.0143	2.6406	4.291
1 3/4	5.4978	2.4052	.0166	3.0265	5.3593
1 7/8	5.8905	2.7611	.0191	3.5156	6.5918
2	6.2832	3.1416	.0225	4.	8.
2 1/8	6.6759	3.5465	.0245	4.5156	9.5957
2 1/4	7.0686	3.9760	.0275	5.0625	11.3906
2 3/8	7.4613	4.4302	.0307	5.6406	13.3965
2 1/2	7.8540	4.9087	.0340	6.25	15.625
2 5/8	8.2467	5.4119	.0375	6.8906	18.0879
2 3/4	8.6394	5.9395	.0411	7.5625	20.7969
2 7/8	9.0321	6.4918	.0450	8.2656	23.7637
3	9.4248	7.0686	.0490	9.	27.
3 1/8	9.8175	7.6699	.0531	9.7656	30.5176
3 1/4	10.210	8.2957	.0575	10.5625	34.3281
3 3/8	10.602	8.9462	.0620	11.3906	38.4434
3 1/2	10.995	9.6211	.0668	12.25	42.875
3 5/8	11.388	10.320	.0730	13.1406	47.634
3 3/4	11.781	11.044	.0767	14.0625	52.734
3 7/8	12.173	11.793	.0818	15.0156	58.185
4	12.566	12.566	.0879	16.	64.

Diameters, Circumferences, Areas, Squares, and Cubes.

Diameter in Inches.	Circumference in Inches.	Area in Square Inches.	Area in Square Feet.	Square, in Inches.	Cube, in Inches.
4⅛	12.959	13.364	.0935	17.0156	70.1895
4¼	13.351	14.186	.0993	18.0625	76.7656
4⅜	13.744	15.033	.1052	19.1406	83.7402
4½	14.137	15.904	.1113	20.25	91.125
4⅝	14.529	16.800	.1176	21.3906	98.9316
4¾	14.922	17.720	.1240	22.5625	107.1719
4⅞	15.315	18.665	.1306	23.7656	115.8574
5	15.708	19.635	.1374	25.	125.
5⅛	16.100	20.629	.1444	26.2656	134.6113
5¼	16.493	21.647	.1515	27.5625	144.7031
5⅜	16.886	22.690	.1588	28.8906	155.2871
5½	17.278	23.758	.1663	30.25	166.375
5⅝	17.671	24.850	.1739	31.6406	177.9785
5¾	18.064	25.967	.1817	33.0625	190.1094
5⅞	18.457	27.108	.1897	34.5186	202.7793
6.	18.849	28.274	.1979	36.	216.
6⅛	19.242	29.464	.2062	37.5156	229.7832
6¼	19.635	30.679	.2147	39.0625	244.1406
6⅜	20.027	31.919	.2234	40.6406	259.084
6½	20.420	33.183	.2322	42.25	274.625
6⅝	20.813	34.471	.2412	43.8906	290.7754
6¾	21.205	35.784	.2504	45.5625	307.5469
6⅞	21.598	37.122	.2598	47.2656	324.9512
7	21.991	38.484	.2693	49.	343.
7⅛	22.383	39.871	.2791	50.7656	361.7051
7¼	22.776	41.282	.2889	52.5625	381.0781
7⅜	23.169	42.718	.2990	54.3906	401.1309
7½	23.562	44.178	.3092	56.25	421.879
7⅝	23.954	45.663	.3196	58.1406	443.3223
7¾	24.347	47.173	.3299	60.0625	465.4844
7⅞	24.740	48.707	.3409	62.0156	488.3730
8	25.132	50.265	.3518	64.	512.

DIAMETERS, CIRCUMFERENCES, AREAS, SQUARES, AND CUBES.

Diameter in Inches.	Circumference in Inches.	Area in Square Inches.	Area in Square Feet.	Square, in Inches.	Cube, in Inches.
8⅛	25.515	51.848	.3629	66.0156	536.3770
8¼	25.918	53.456	.3741	68.0625	561.5156
8⅜	26.310	55.088	.3856	70.1406	587.4277
8½	26.703	56.745	.3972	72.25	614.125
8⅝	27.096	58.426	.4089	74.3906	641.6191
8¾	27.489	60.132	.4209	76.5625	669.9219
8⅞	27.881	61.862	.4330	78.7656	699.0449
9	28.274	63.617	.4453	81.	729.
9⅛	28.667	65.396	.4577	83.2656	759.7988
9¼	29.059	67.200	.4704	85.5625	791.4531
9⅜	29.452	69.029	.4832	87.8906	823.9746
9½	29.845	70.882	.4961	90.25	857.375
9⅝	30.237	72.759	.5093	92.6406	891.666
9¾	30.630	74.662	.5226	95.0625	926.8594
9⅞	31.023	76.588	.5361	97.5156	962.0968
10	31.416	78.540	.5497	100.	1000.
10⅛	31.808	80.515	.5636	102.5156	1037.9707
10¼	32.201	82.516	.5776	105.0625	1076.8906
10⅜	32.594	84.540	.5917	107.6406	1116.7715
10½	32.986	86.590	.6061	110.25	1157.625
10⅝	33.379	88.664	.6206	112.8906	1199.4629
10¾	33.772	90.762	.6353	115.5625	1242.2969
10⅞	34.164	92.885	.6499	118.2656	1286.1387
11	34.557	95.033	.6652	121.	1331.
11⅛	34.950	97.205	.6804	123.7656	1376.8926
11¼	35.343	99.402	.6958	126.5625	1423.8281
11⅜	35.735	101.623	.7143	129.3906	1471.8184
11½	36.128	103.869	.7270	132.25	1520.875
11⅝	36.521	106.139	.7429	135.1406	1571.0098
11¾	36.913	108.434	.7590	138.0625	1622.234
11⅞	37.306	110.753	.7752	141.0155	1674.5605
12	37.699	113.097	.7916	144.	1728.

Weight and Thickness of Sheet Lead.

Weight in Lbs. per Sup. Foot.	Thickness in Inches.	Weight in Lbs. per Sup. Foot.	Thickness in Inches.
1	0.017	7	0.118
2	0.034	8	0.135
3	0.051	9	0.152
4	0.068	10	0.169
5	0.085	11	0.186
6	0.101	12	0.203

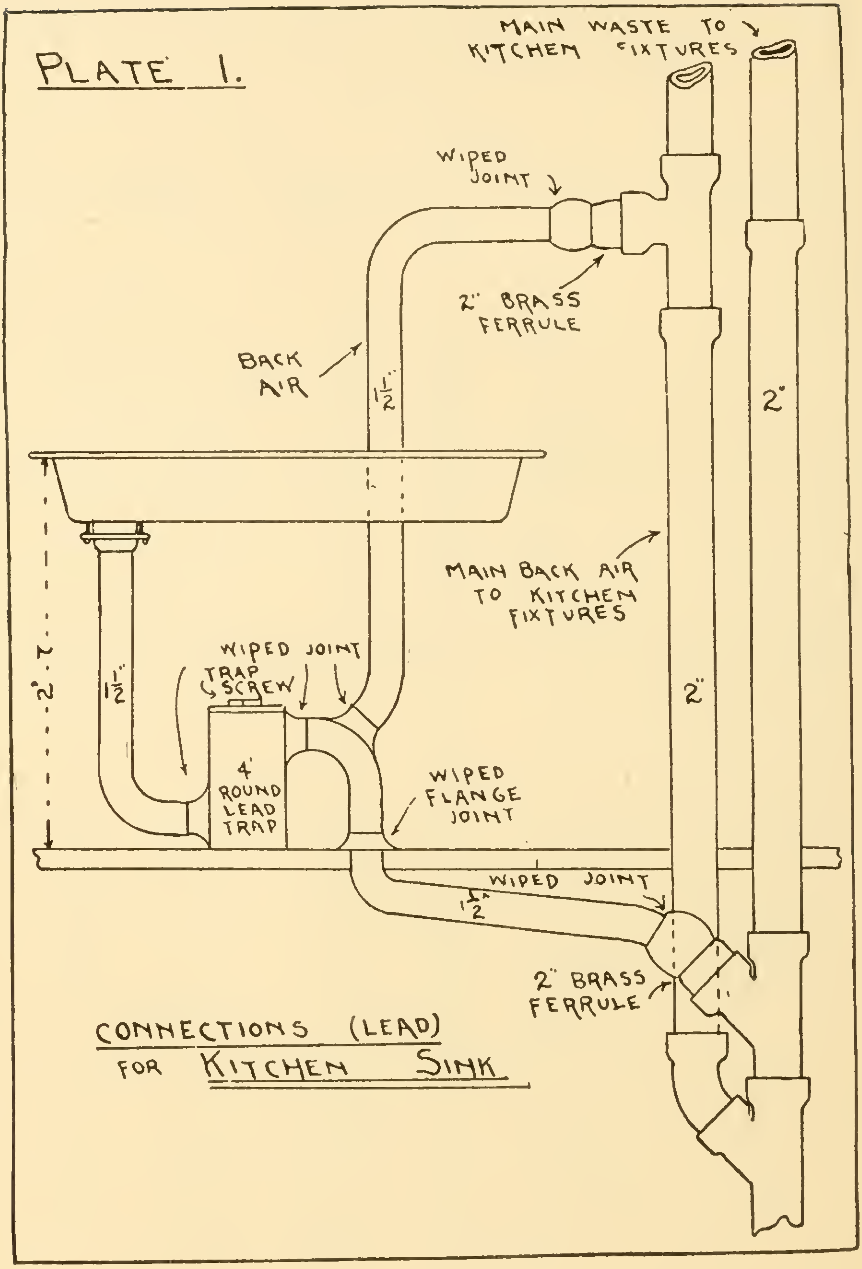


PLATE 1.
MAIN WASTE TO KITCHEN FIXTURES
WIPED JOINT
2" BRASS FERRULE
BACK AIR
1½"
2"
MAIN BACK AIR TO KITCHEN FIXTURES
WIPED JOINT
TRAP SCREW
1½"
2' 2"
4' ROUND LEAD TRAP
WIPED FLANGE JOINT
WIPED JOINT
1½"
2" BRASS FERRULE
2"
CONNECTIONS (LEAD) FOR KITCHEN SINK

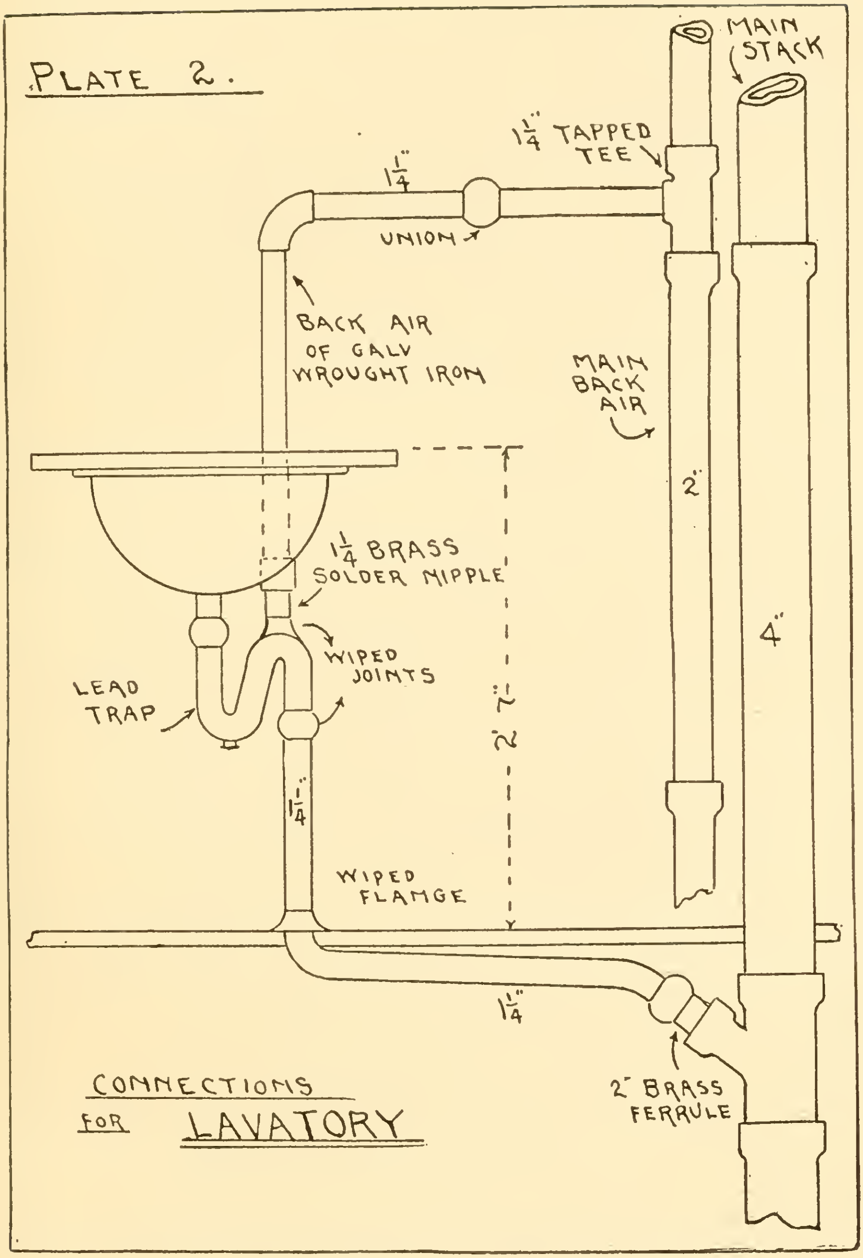
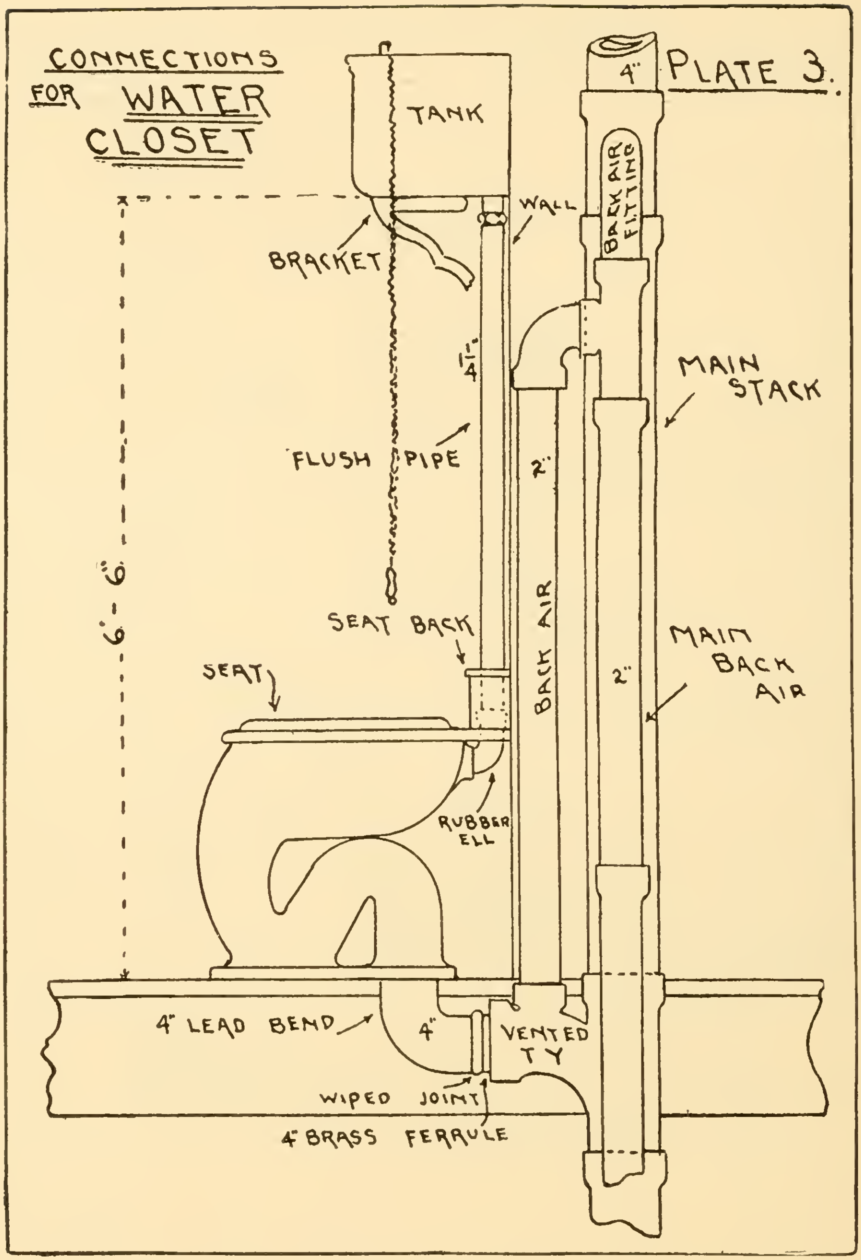


PLATE 2.

CONNECTIONS FOR LAVATORY


CONNECTIONS
FOR WATER
CLOSET
PLATE 3.
TANK
4"
BACK AIR FITTING
WALL
BRACKET
$1\frac{1}{4}$"
MAIN
STACK
FLUSH PIPE
2"
6'-6"
SEAT BACK
BACK AIR
2"
MAIN
BACK
AIR
SEAT
RUBBER
ELL
4" LEAD BEND
4"
VENTED
T Y
WIPED JOINT
4" BRASS FERRULE

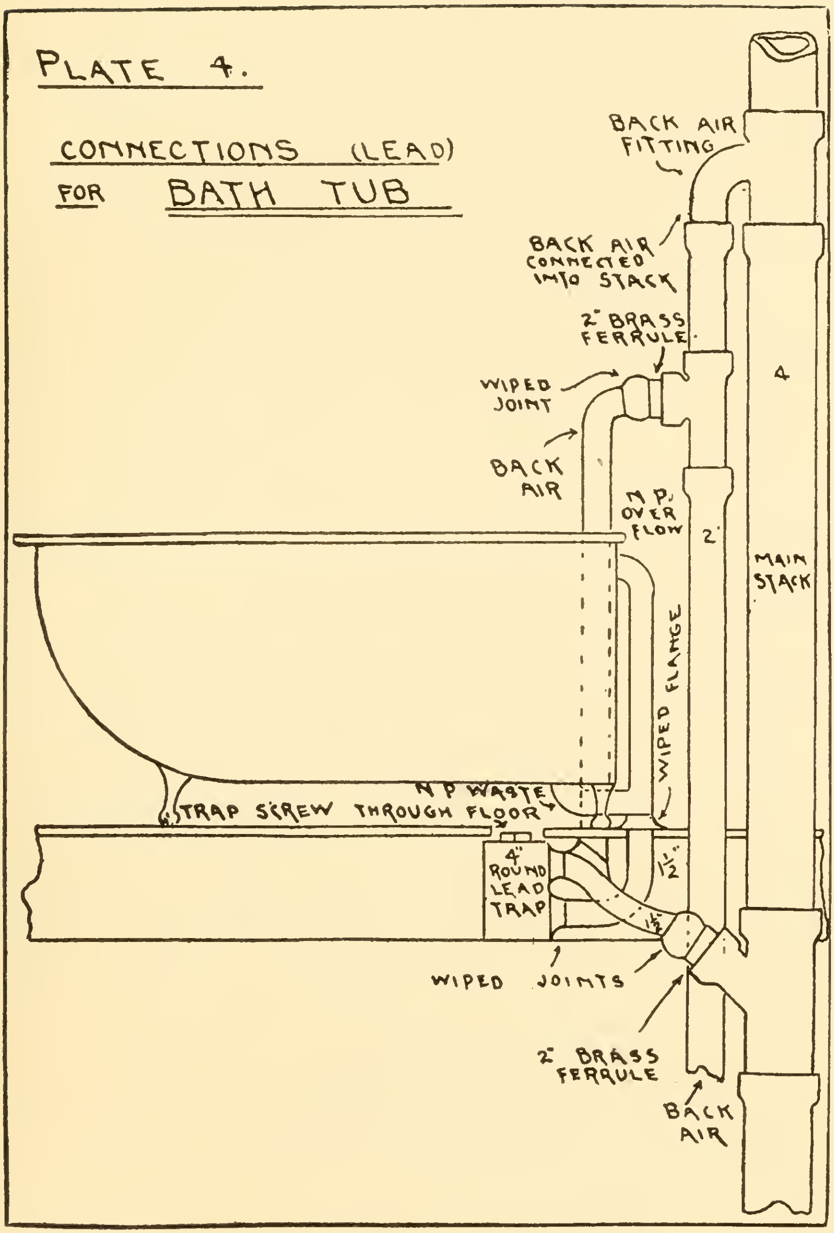
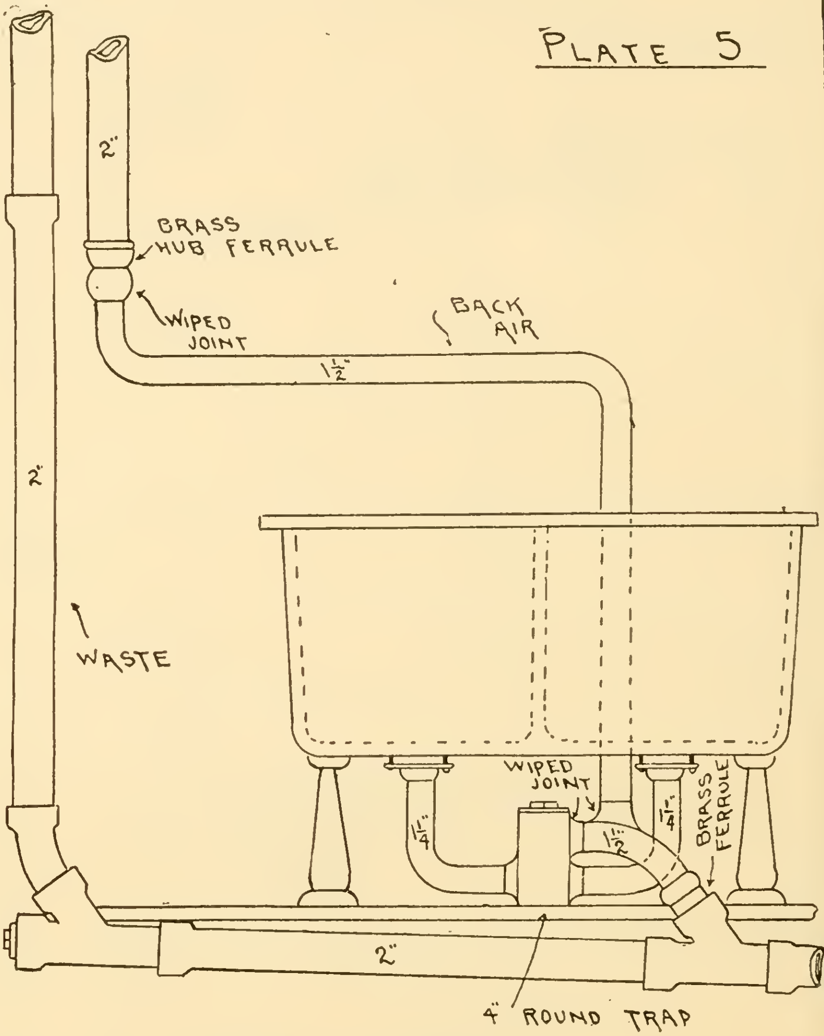


PLATE 4.
CONNECTIONS (LEAD)
FOR BATH TUB
BACK AIR FITTING
BACK AIR CONNECTED INTO STACK
2" BRASS FERRULE
WIPED JOINT
BACK AIR
N. P. OVER FLOW
2"
4
MAIN STACK
WIPED FLANGE
N P WASTE
TRAP SCREW THROUGH FLOOR
4" ROUND LEAD TRAP
1½"
WIPED JOINTS
2" BRASS FERRULE
BACK AIR

PLATE 5



CONNECTIONS FOR WASH TRAYS

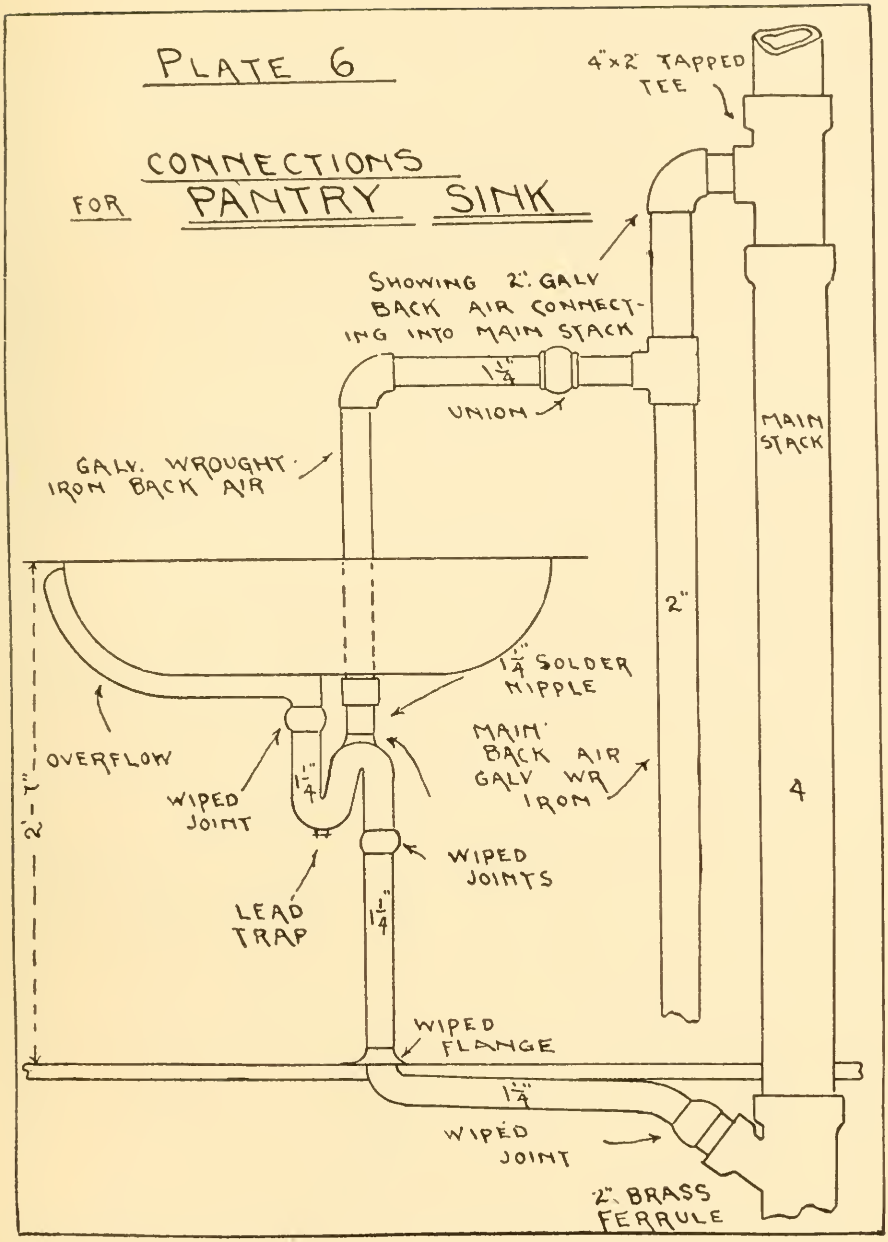


PLATE 6
CONNECTIONS
FOR PANTRY SINK
4"x2" TAPPED TEE
SHOWING 2". GALV BACK AIR CONNECT-ING INTO MAIN STACK
1¼"
UNION
MAIN STACK
GALV. WROUGHT IRON BACK AIR
2"
1¼" SOLDER NIPPLE
MAIN BACK AIR GALV WR IRON
OVERFLOW
WIPED JOINT
1¼"
2'-1"
4
LEAD TRAP
WIPED JOINTS
1¼
WIPED FLANGE
1¼"
WIPED JOINT
2" BRASS FERRULE

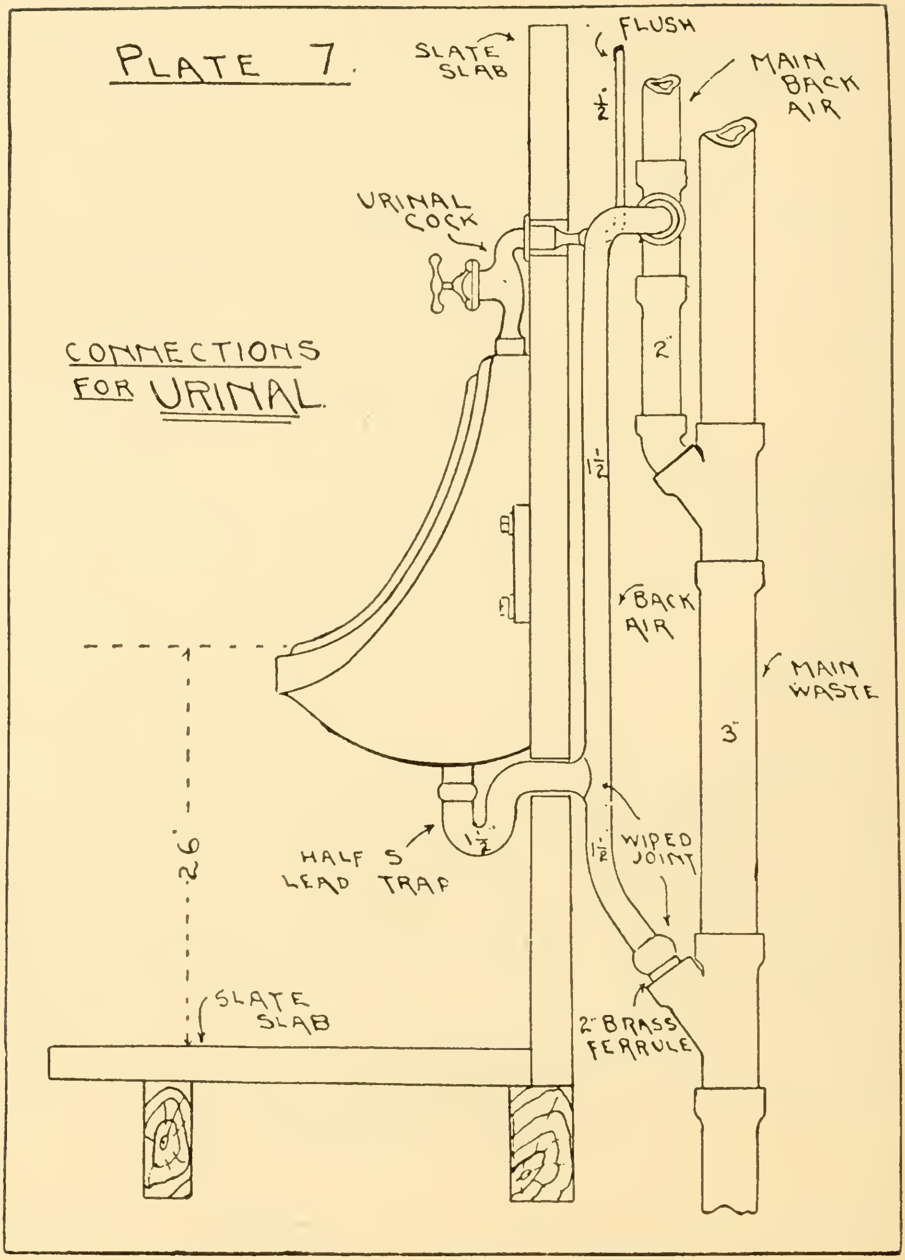


PLATE 7.
CONNECTIONS FOR URINAL.
SLATE SLAB
FLUSH
½"
MAIN BACK AIR
URINAL COCK
2"
1½
BACK AIR
MAIN WASTE
3"
HALF S LEAD TRAP
1½
1½
WIPED JOINT
26"
SLATE SLAB
2" BRASS FERRULE

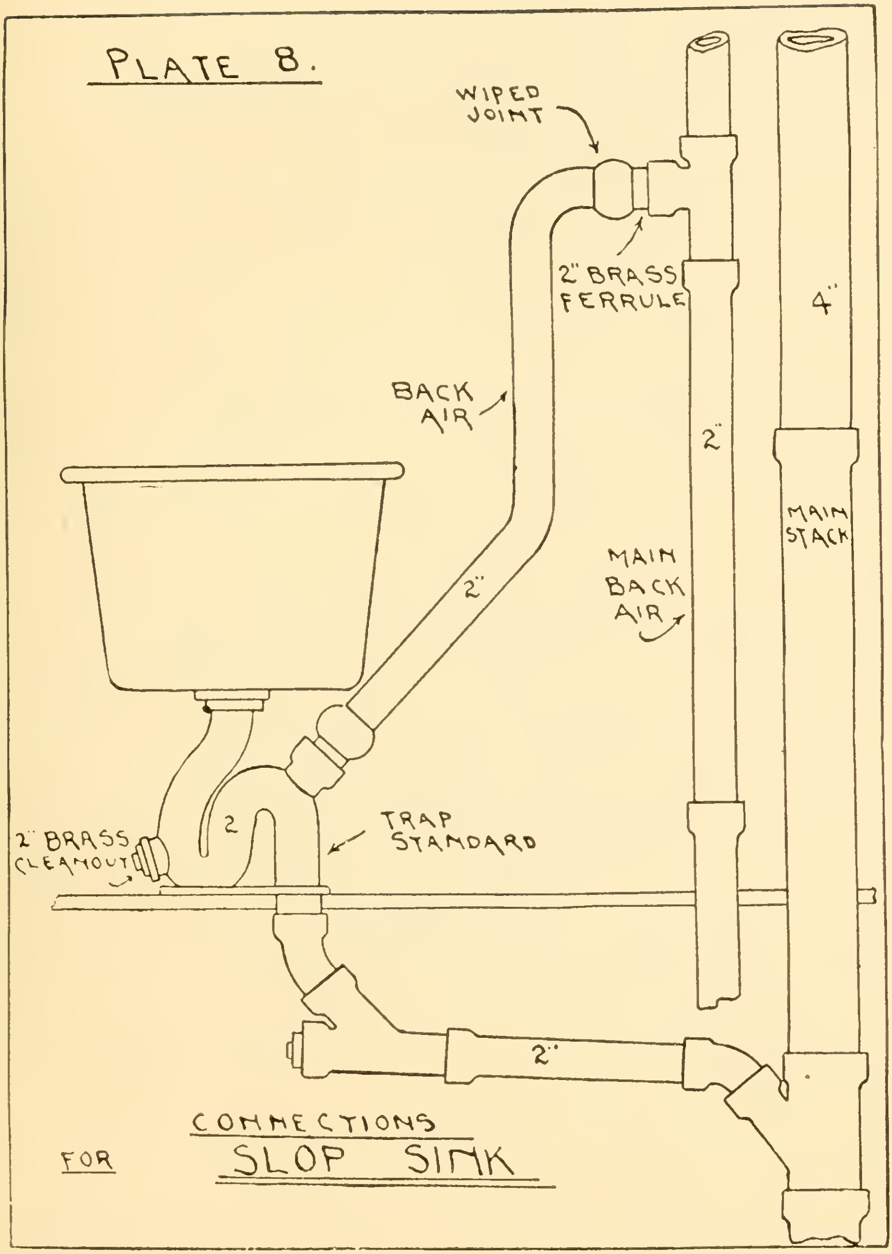


PLATE 8.
WIPED JOINT
2" BRASS FERRULE
4"
BACK AIR
2"
2"
MAIN STACK
MAIN BACK AIR
2
2" BRASS CLEANOUT
TRAP STANDARD
2"
CONNECTIONS
FOR
SLOP SINK

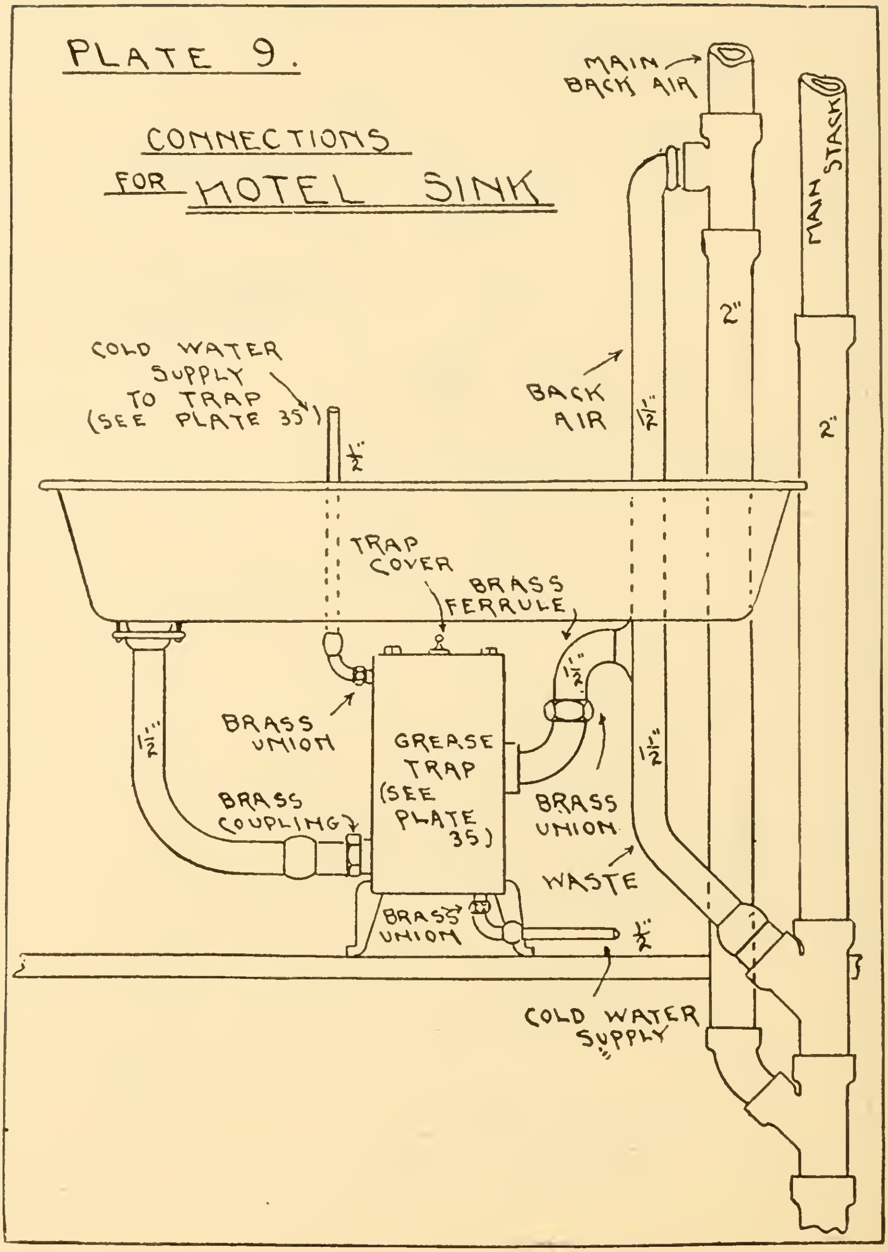


PLATE 9.
CONNECTIONS FOR HOTEL SINK
MAIN BACK AIR
MAIN STACK
2"
2"
COLD WATER SUPPLY TO TRAP (SEE PLATE 35)
1/2"
BACK AIR
1 1/2"
TRAP COVER
BRASS FERRULE
1 1/2"
BRASS UNION
1 1/2"
GREASE TRAP (SEE PLATE 35)
1 1/2"
BRASS COUPLING
BRASS UNION
WASTE
BRASS UNION
1/2"
COLD WATER SUPPLY

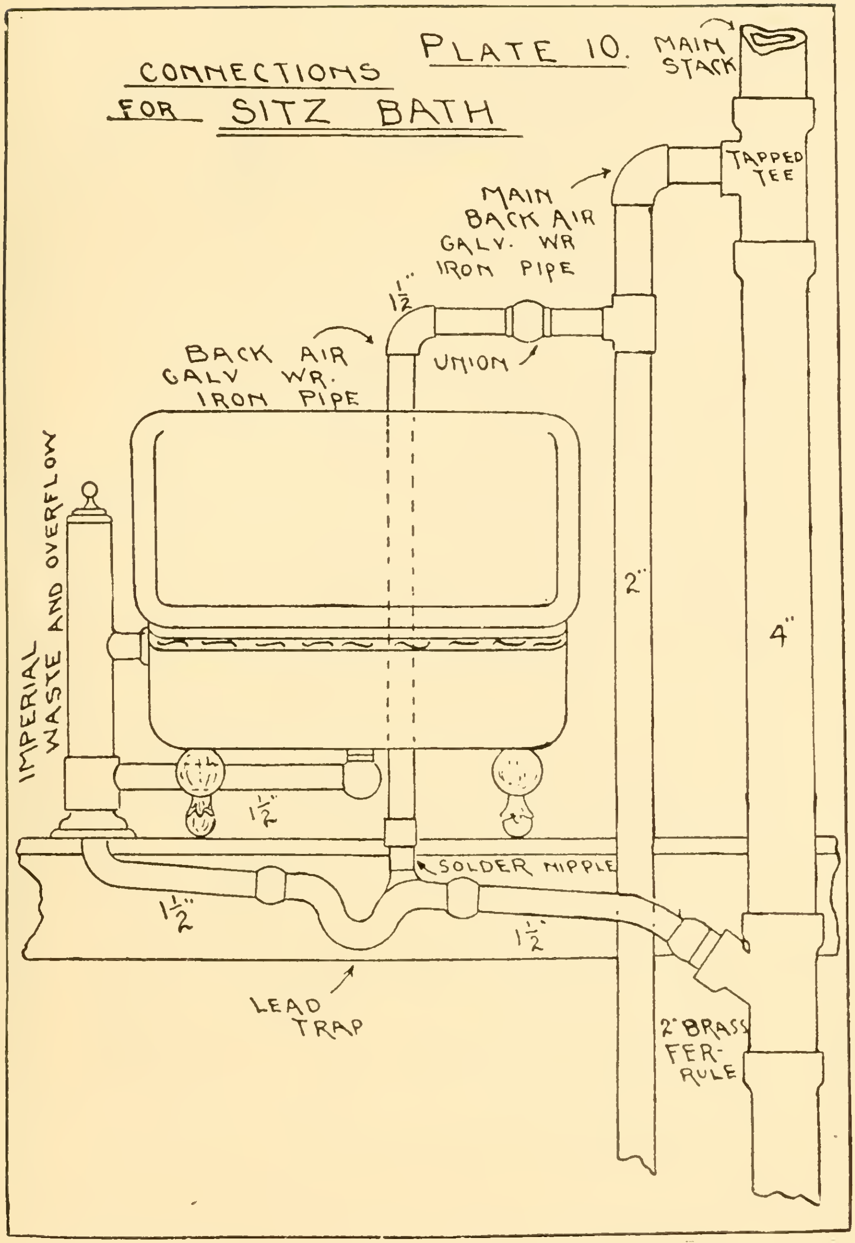
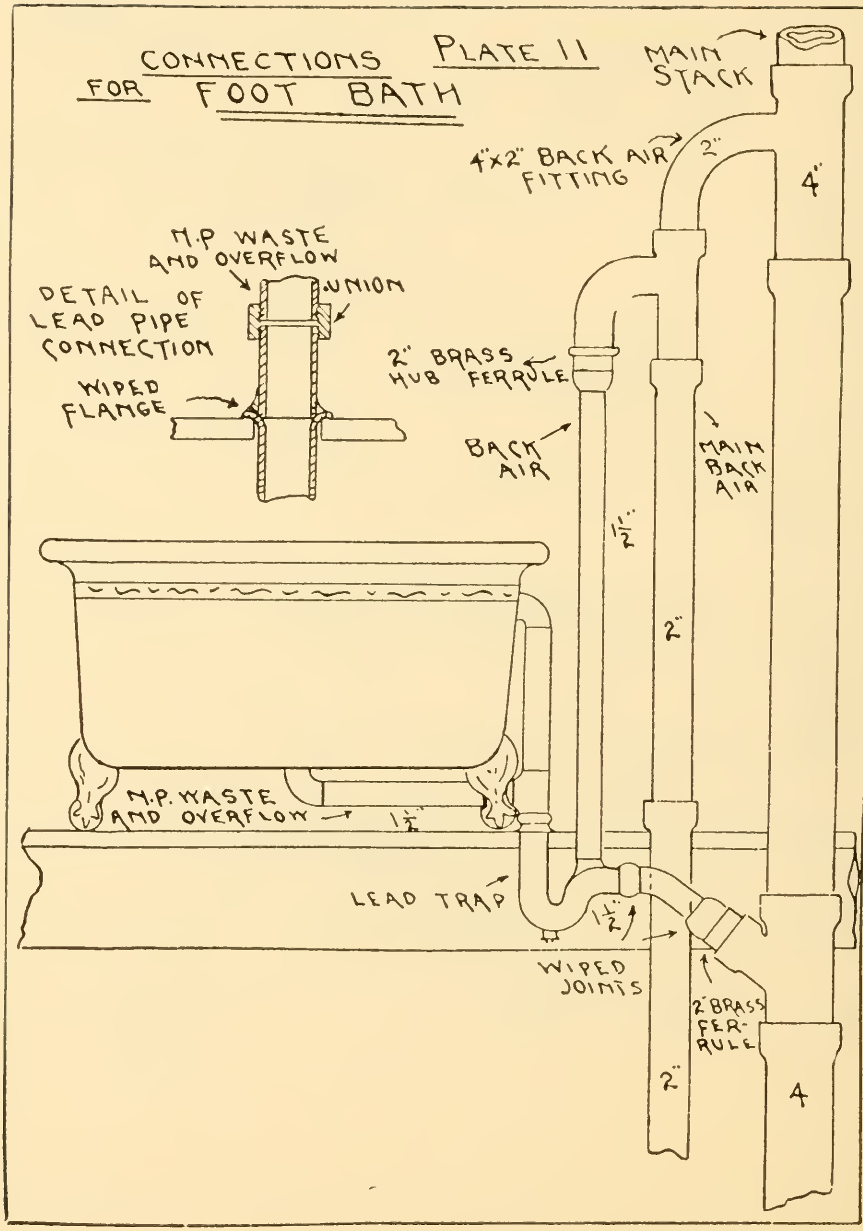
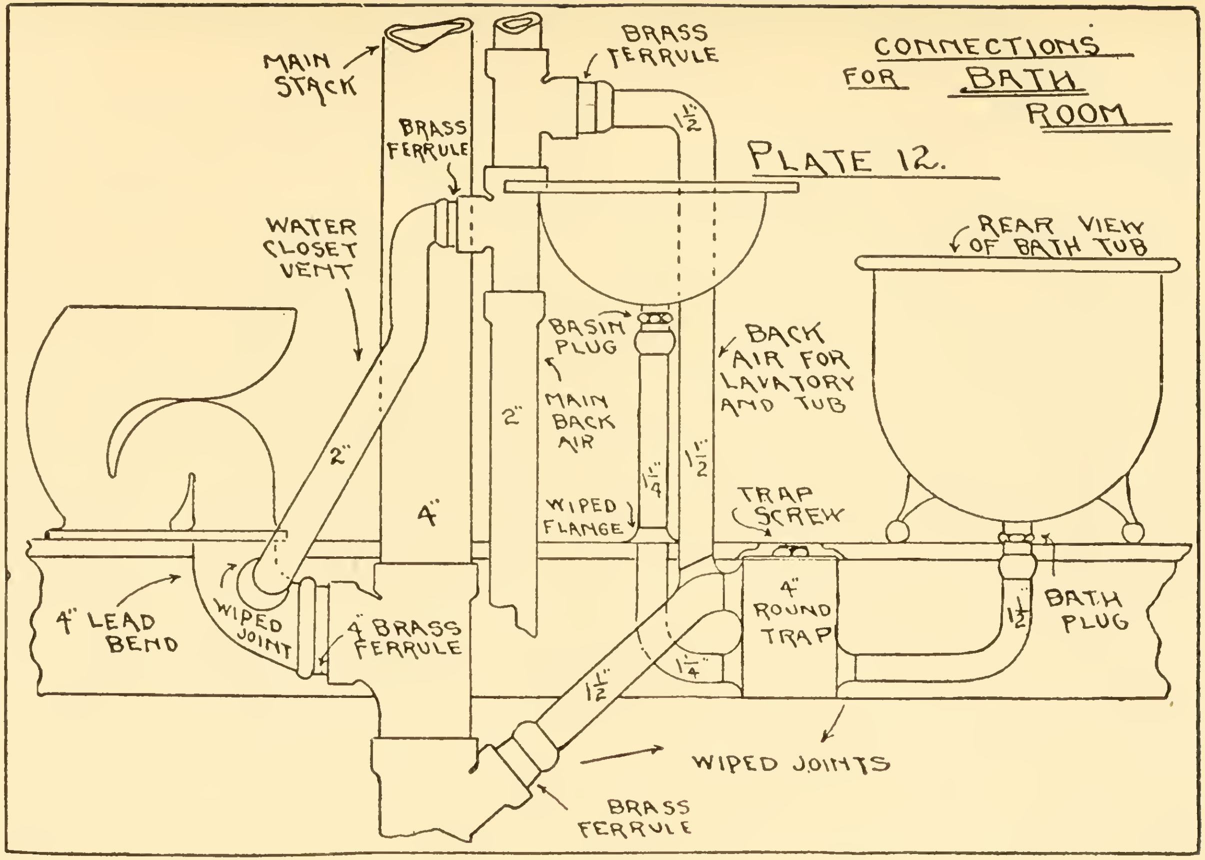


PLATE 10.
CONNECTIONS
FOR SITZ BATH
MAIN STACK
TAPPED TEE
MAIN BACK AIR GALV. WR IRON PIPE
1 1/2"
BACK AIR GALV WR. IRON PIPE
UNION
IMPERIAL WASTE AND OVERFLOW
2"
4"
1 1/2"
SOLDER NIPPLE
1 1/2"
1 1/2"
LEAD TRAP
2" BRASS FER-RULE


CONNECTIONS FOR FOOT BATH
PLATE 11
MAIN STACK
4"x2" BACK AIR FITTING
2"
4"
M.P WASTE AND OVERFLOW
UNION
DETAIL OF LEAD PIPE CONNECTION
WIPED FLANGE
2" BRASS HUB FERRULE
BACK AIR
MAIN BACK AIR
1½"
2"
M.P. WASTE AND OVERFLOW
1½"
LEAD TRAP
1½"
WIPED JOINTS
2" BRASS FERRULE
2"
4


CONNECTIONS FOR BATH ROOM
PLATE 12.
MAIN STACK
BRASS FERRULE
BRASS FERRULE
1½"
WATER CLOSET VENT
REAR VIEW OF BATH TUB
BASIN PLUG
BACK AIR FOR LAVATORY AND TUB
MAIN BACK AIR
2"
2"
4"
1½"
1¼"
WIPED FLANGE
TRAP SCREW
4" ROUND TRAP
BATH PLUG
1½"
4" LEAD BEND
WIPED JOINT
4" BRASS FERRULE
1¼"
1½"
WIPED JOINTS
BRASS FERRULE

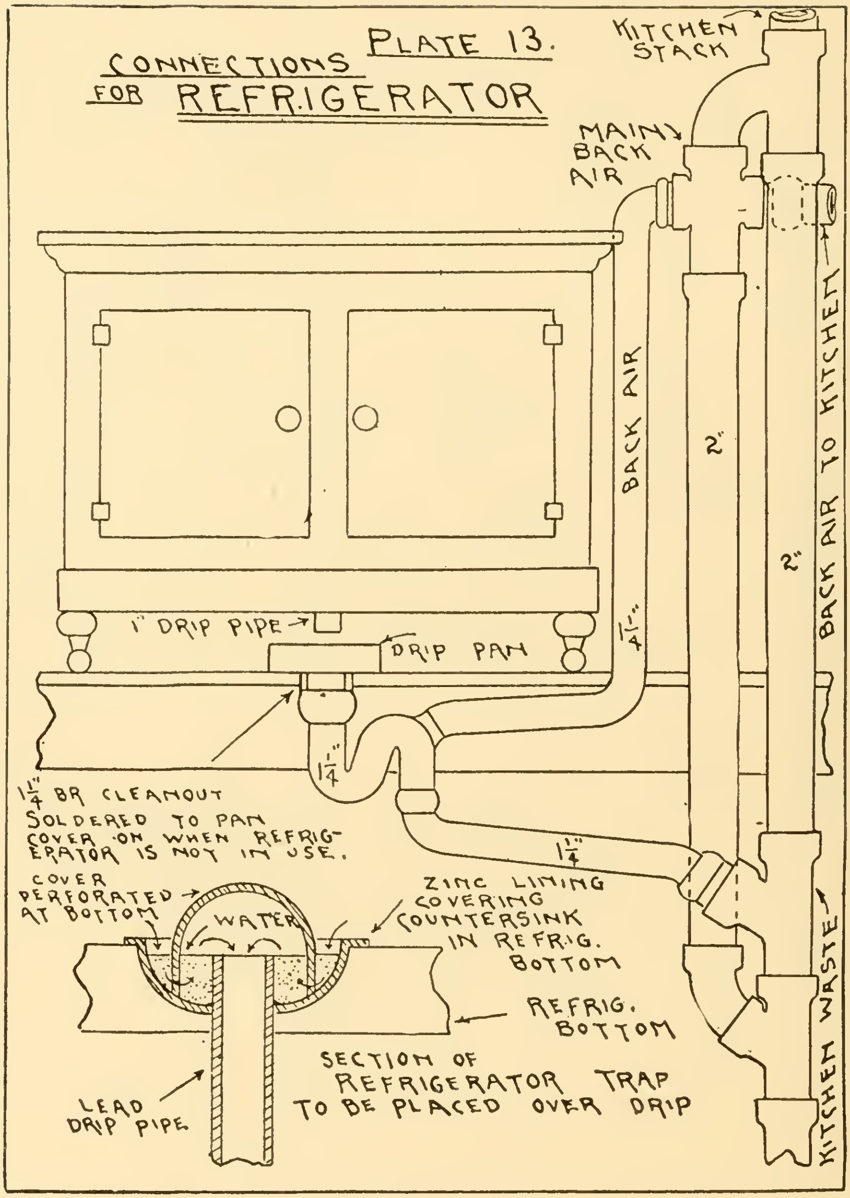
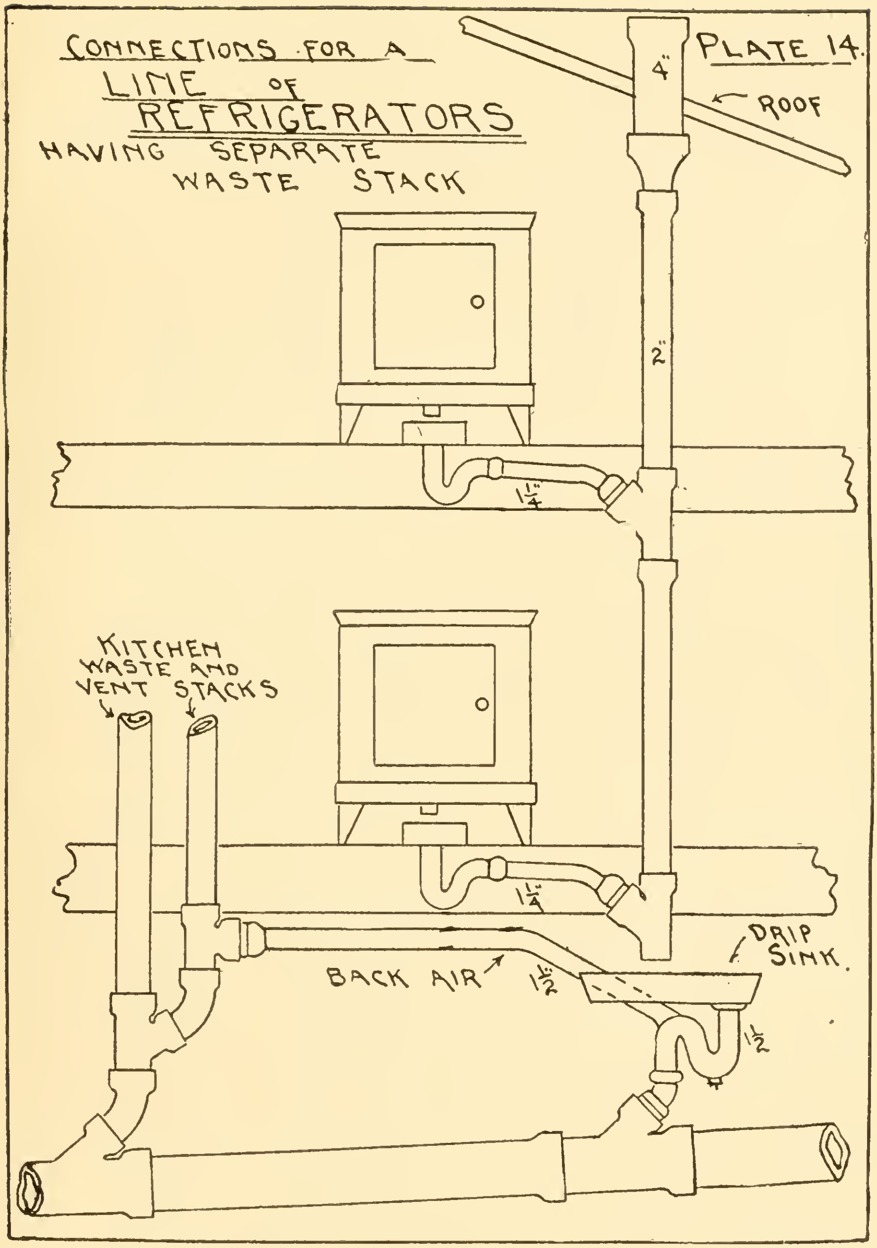


PLATE 13.
CONNECTIONS FOR REFRIGERATOR
KITCHEN STACK
MAIN BACK AIR
BACK AIR
2"
BACK AIR TO KITCHEN
2"
1¼"
1" DRIP PIPE
DRIP PAN
1¼"
1¼ BR CLEANOUT SOLDERED TO PAN COVER ON WHEN REFRIGERATOR IS NOT IN USE.
1¼"
COVER PERFORATED AT BOTTOM
WATER
ZINC LINING COVERING COUNTERSINK IN REFRIG. BOTTOM
REFRIG. BOTTOM
SECTION OF REFRIGERATOR TRAP TO BE PLACED OVER DRIP
LEAD DRIP PIPE
KITCHEN WASTE



CONNECTIONS FOR A
LINE OF
REFRIGERATORS
HAVING SEPARATE
WASTE STACK
PLATE 14.
4"
ROOF
2"
1¼"
KITCHEN
WASTE AND
VENT STACKS
1¼"
DRIP
SINK.
BACK AIR
1½"
1½"

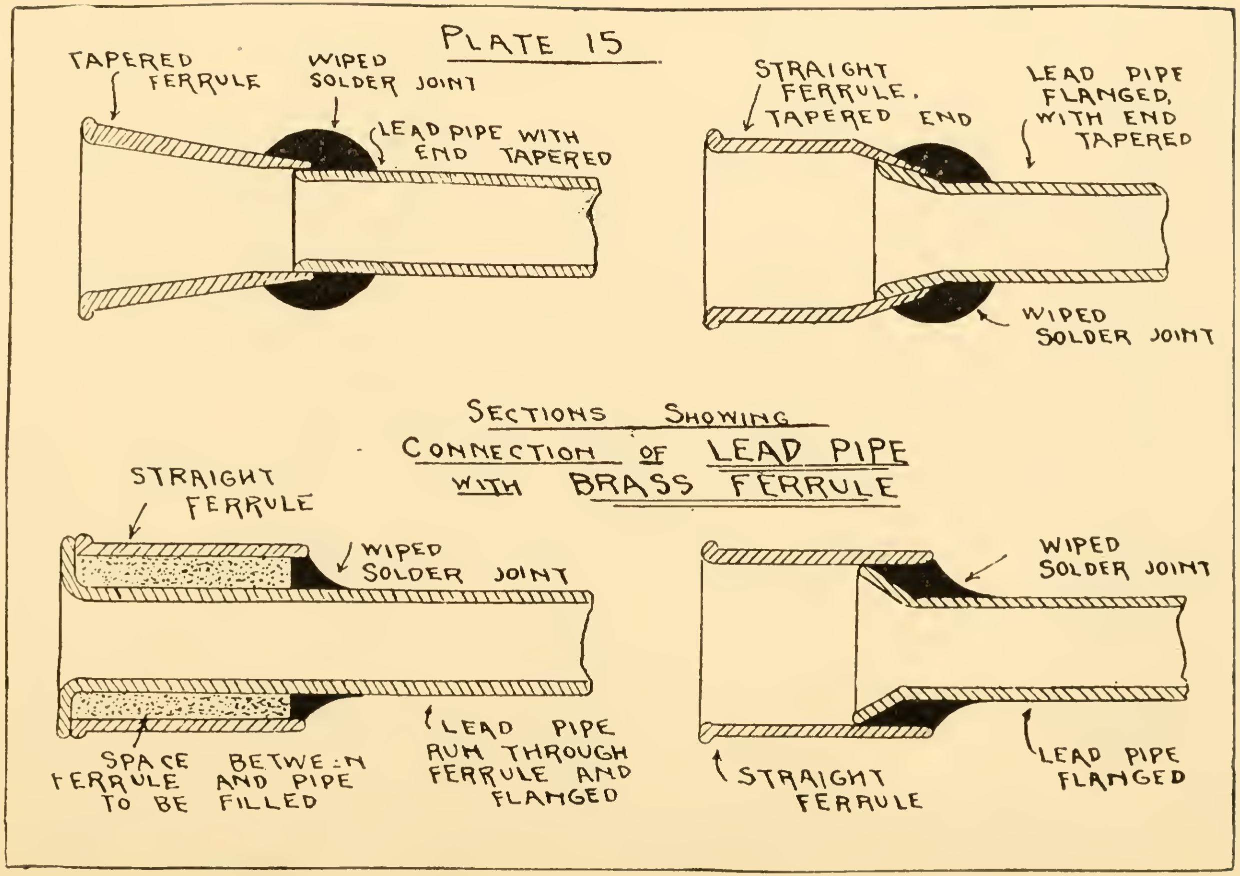
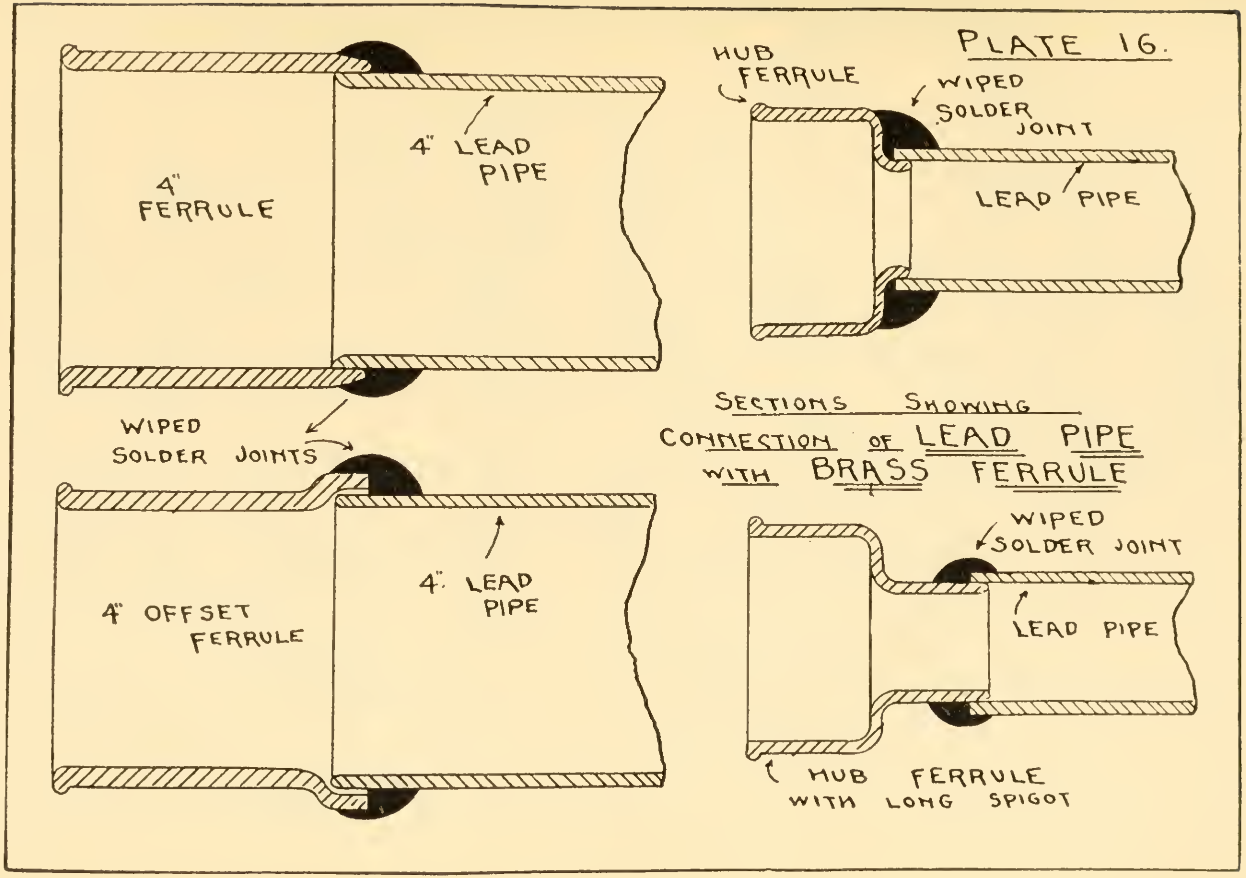


PLATE 15
TAPERED FERRULE
WIPED SOLDER JOINT
LEAD PIPE WITH END TAPERED
STRAIGHT FERRULE, TAPERED END
LEAD PIPE FLANGED, WITH END TAPERED
WIPED SOLDER JOINT
SECTIONS SHOWING
CONNECTION OF LEAD PIPE
WITH BRASS FERRULE
STRAIGHT FERRULE
WIPED SOLDER JOINT
SPACE BETWEEN FERRULE AND PIPE TO BE FILLED
LEAD PIPE RUN THROUGH FERRULE AND FLANGED
WIPED SOLDER JOINT
STRAIGHT FERRULE
LEAD PIPE FLANGED

PLATE 16.



SECTIONS SHOWING CONNECTION OF LEAD PIPE WITH BRASS FERRULE

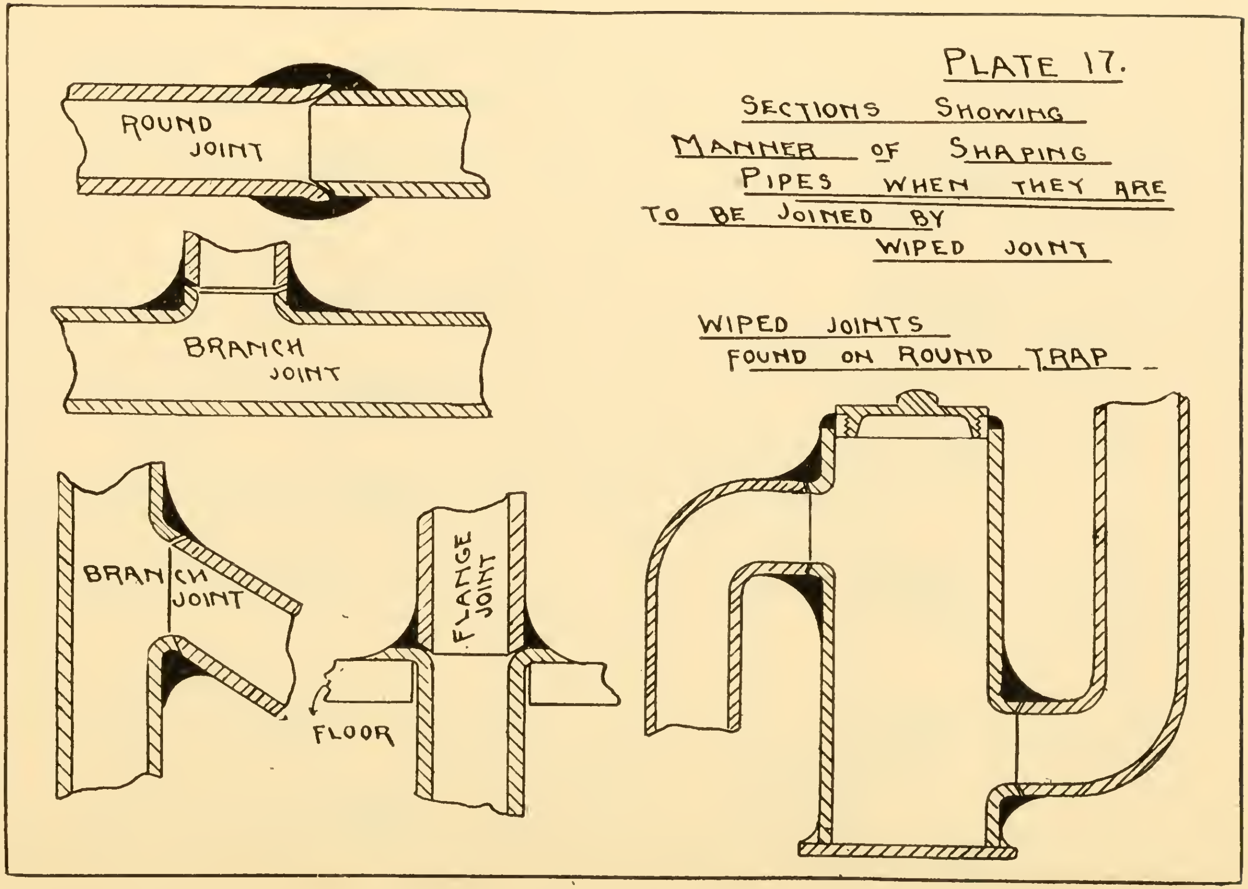


PLATE 17.
SECTIONS SHOWING
MANNER OF SHAPING
PIPES WHEN THEY ARE
TO BE JOINED BY
WIPED JOINT
WIPED JOINTS
FOUND ON ROUND TRAP
ROUND JOINT
BRANCH JOINT
BRANCH JOINT
FLANGE JOINT
FLOOR

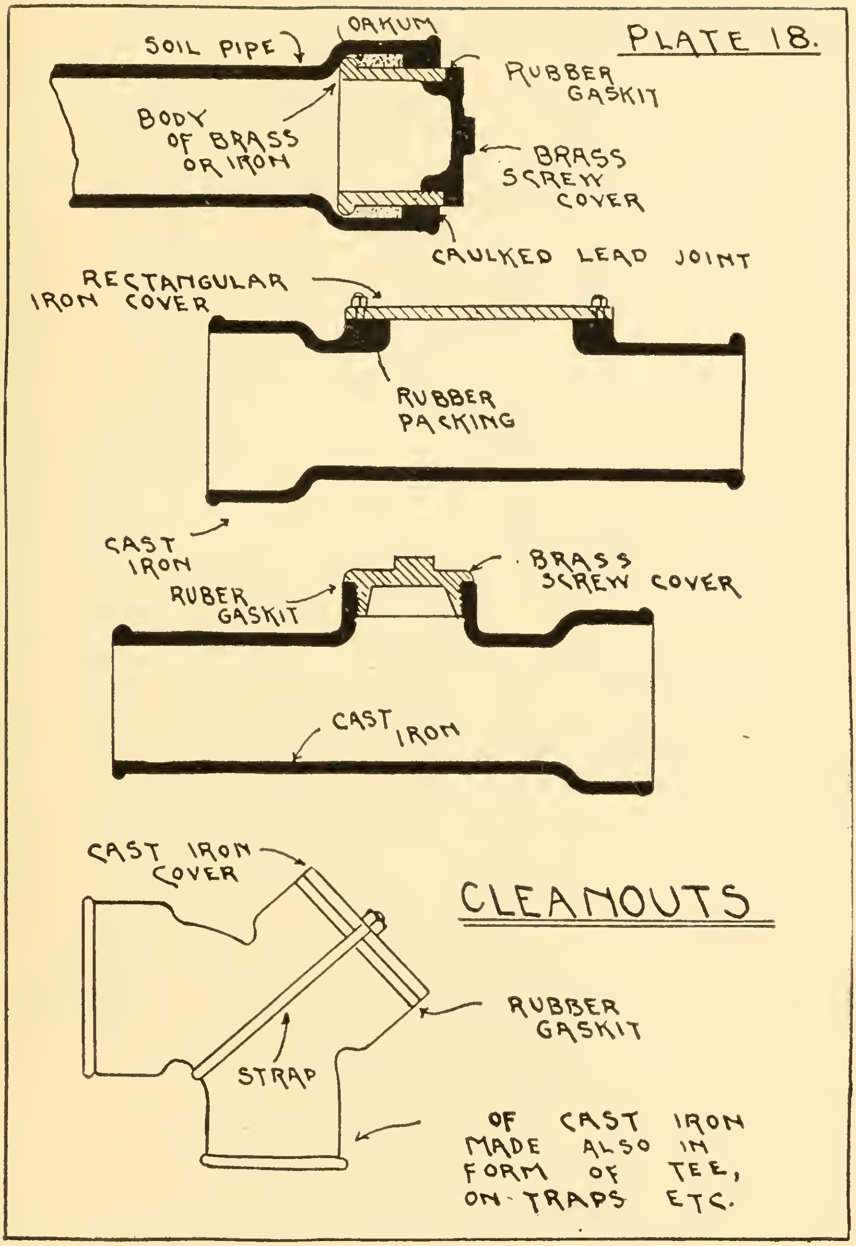


PLATE 18.
SOIL PIPE
ORKUM
RUBBER GASKIT
BODY OF BRASS OR IRON
BRASS SCREW COVER
CAULKED LEAD JOINT
RECTANGULAR IRON COVER
RUBBER PACKING
CAST IRON
RUBER GASKIT
BRASS SCREW COVER
CAST IRON
CAST IRON COVER
CLEANOUTS
RUBBER GASKIT
STRAP
OF CAST IRON MADE ALSO IN FORM OF TEE, ON TRAPS ETC.

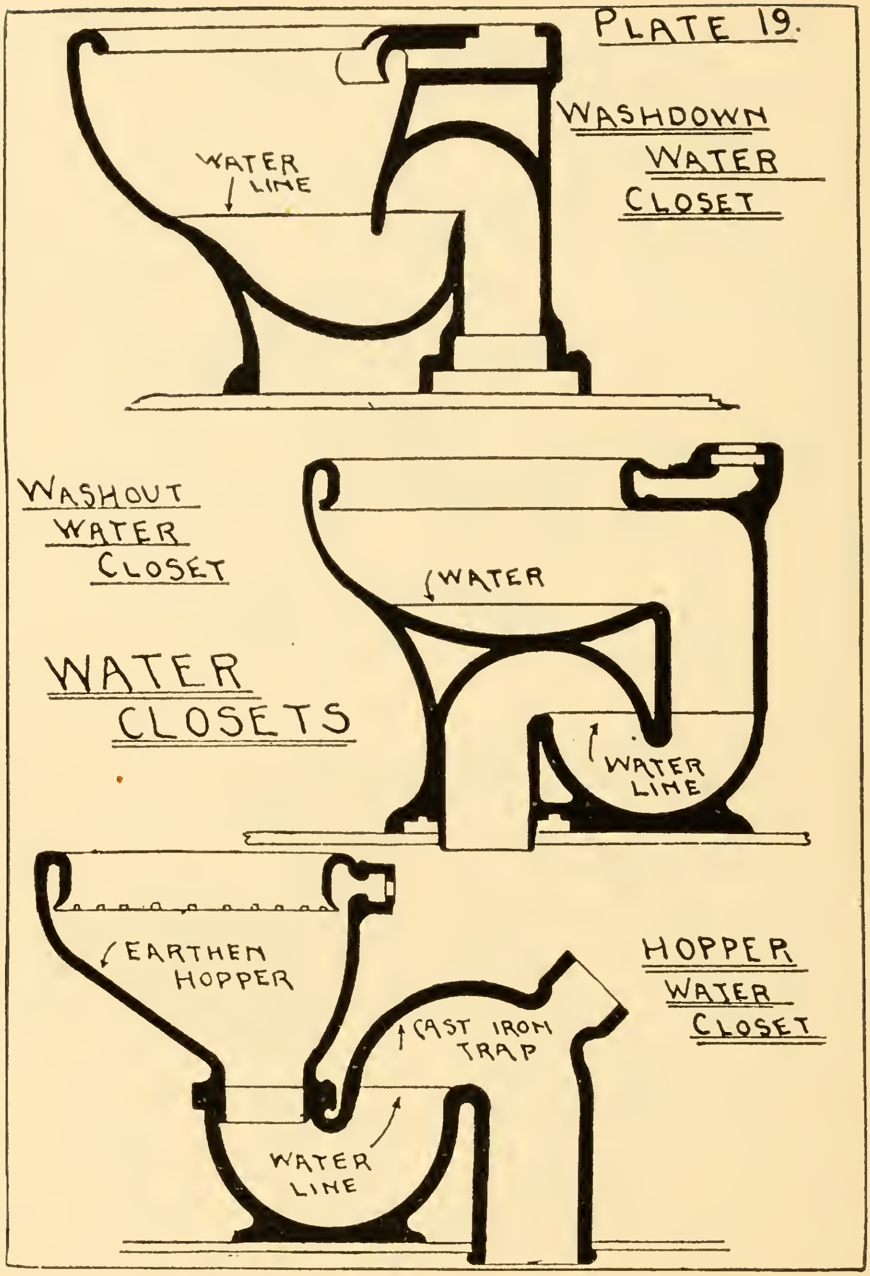
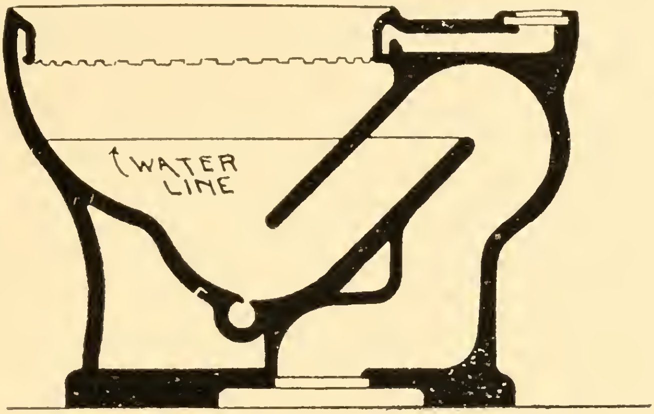


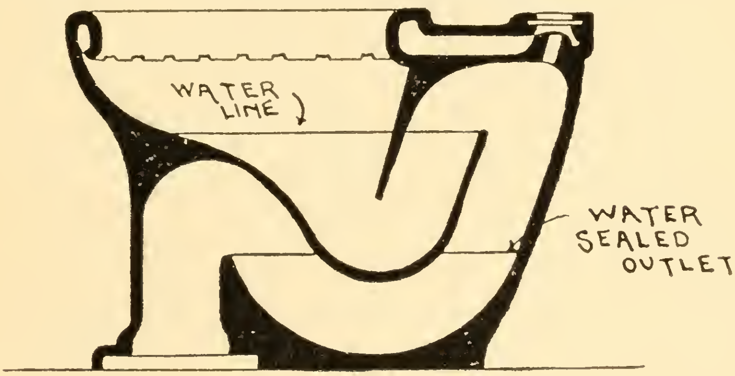
PLATE 19.
WASHDOWN WATER CLOSET
WATER LINE
WASHOUT WATER CLOSET
WATER
WATER LINE
WATER CLOSETS
EARTHEN HOPPER
CAST IRON TRAP
WATER LINE
HOPPER WATER CLOSET

PLATE 20

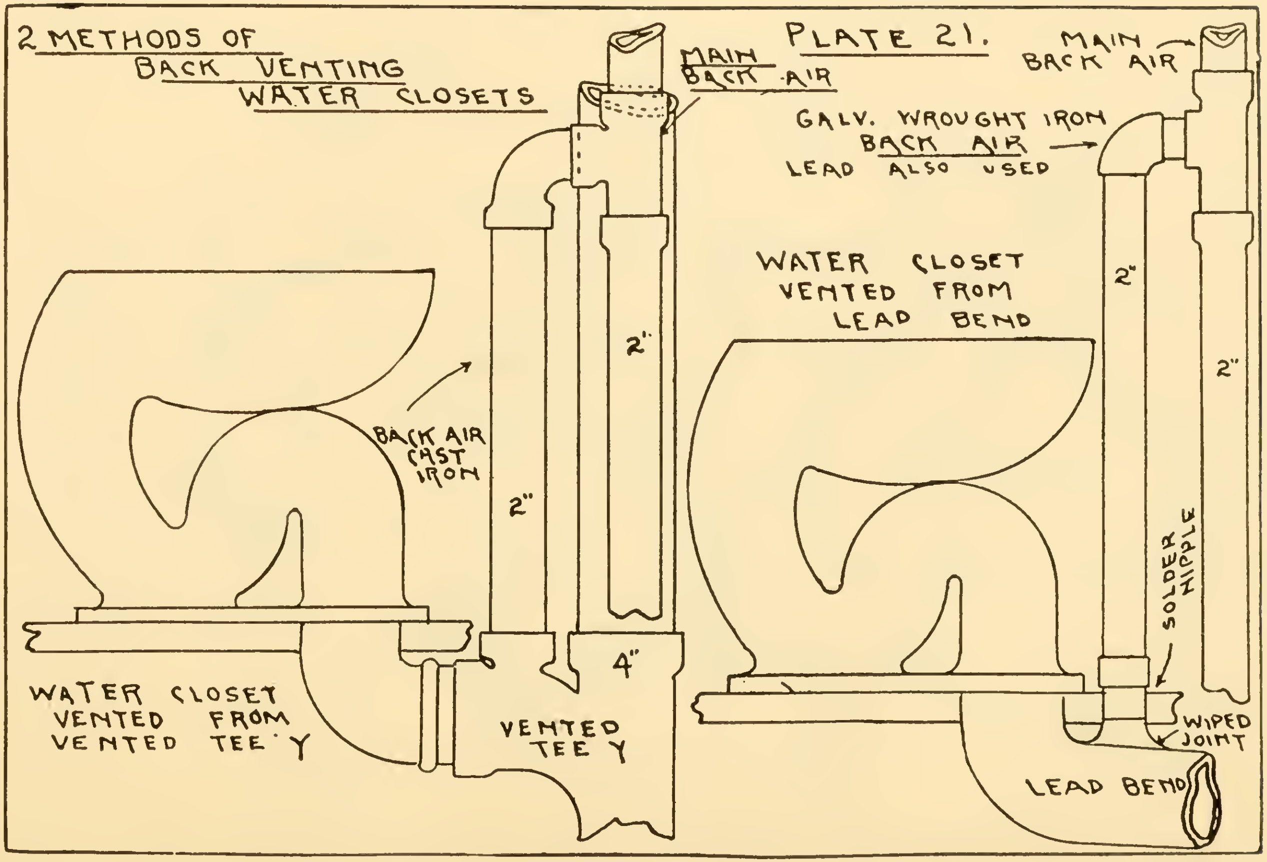
SYPHON JET WATER CLOSET



WASHDOWN-SYPHONIC ACTION WATER CLOSET



WATER CLOSETS


2 METHODS OF
BACK VENTING
WATER CLOSETS
PLATE 21.
MAIN
BACK AIR
MAIN
BACK AIR
GALV. WROUGHT IRON
BACK AIR
LEAD ALSO USED
BACK AIR
CAST
IRON
2"
2"
2"
2"
4"
WATER CLOSET
VENTED FROM
LEAD BEND
SOLDER
NIPPLE
WIPED
JOINT
LEAD BEND
WATER CLOSET
VENTED FROM
VENTED TEE Y
VENTED
TEE Y

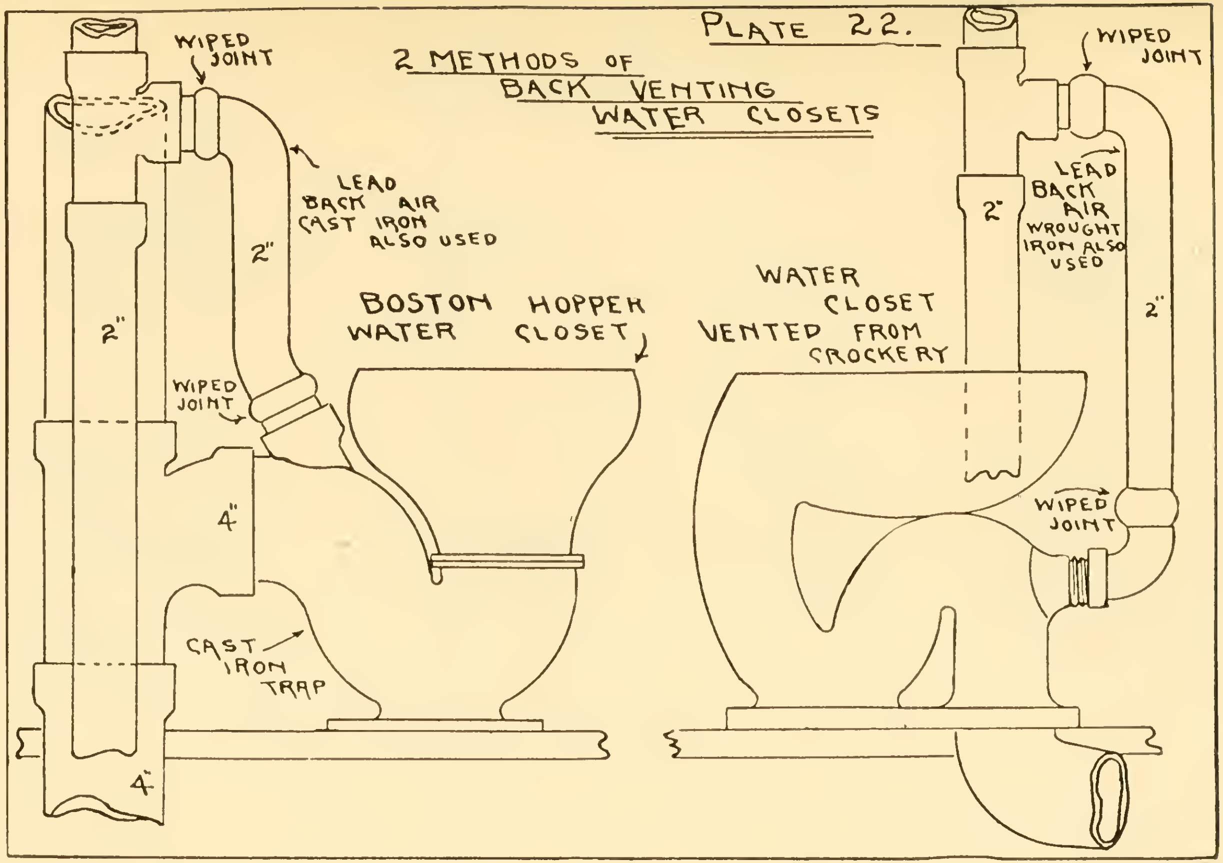
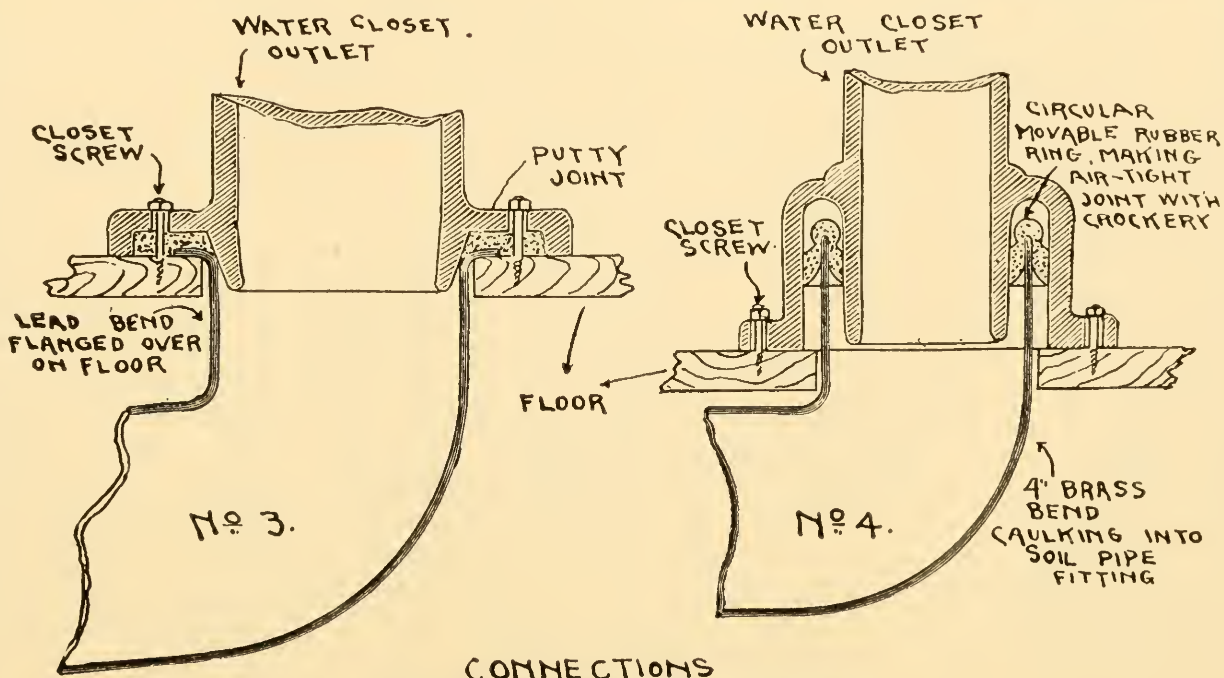


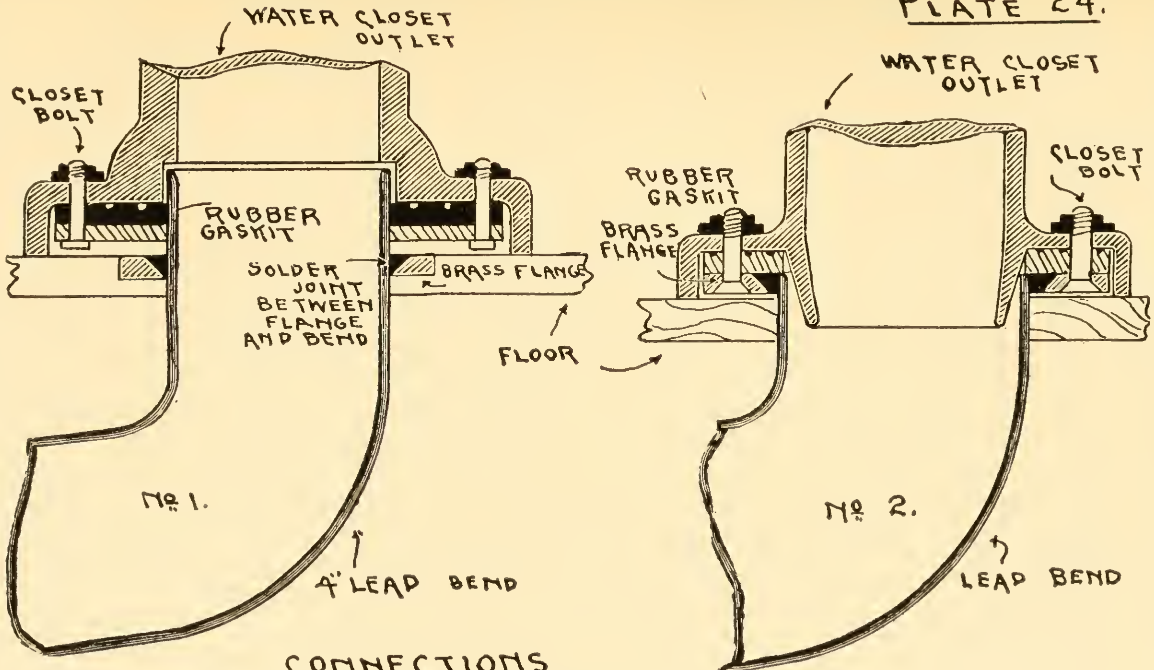
PLATE 22.
2 METHODS OF
BACK VENTING
WATER CLOSETS
WIPED JOINT
LEAD BACK AIR CAST IRON ALSO USED
2"
2"
WIPED JOINT
4"
CAST IRON TRAP
4"
BOSTON HOPPER WATER CLOSET
WATER CLOSET VENTED FROM CROCKERY
WIPED JOINT
LEAD BACK AIR WROUGHT IRON ALSO USED
2"
2"
WIPED JOINT

PLATE 23.

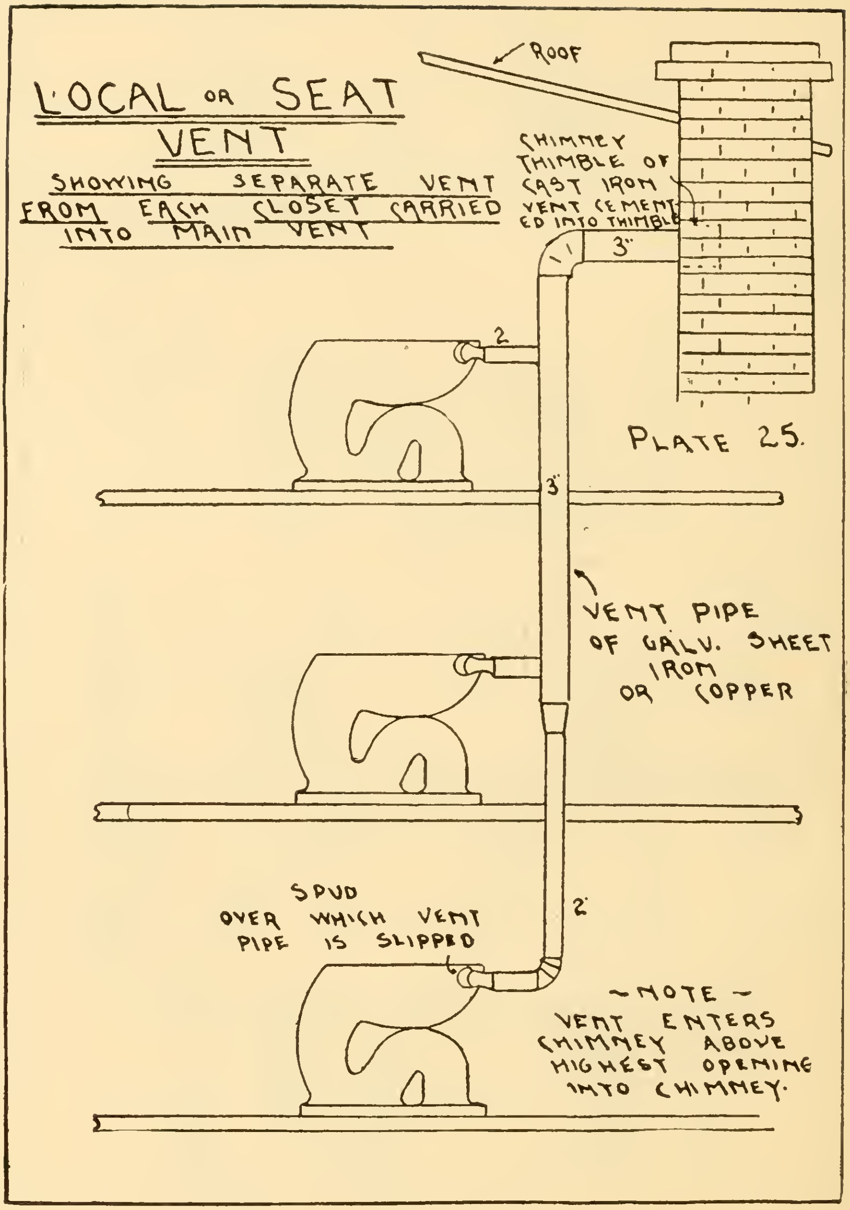


CONNECTIONS BETWEEN WATER CLOSET AND BEND

Plate 24.



CONNECTIONS
BETWEEN WATER CLOSET
AND LEAD BEND


LOCAL OR SEAT VENT
SHOWING SEPARATE VENT FROM EACH CLOSET CARRIED INTO MAIN VENT
ROOF
CHIMNEY THIMBLE OF CAST IRON VENT CEMENTED INTO THIMBLE
3"
2
PLATE 25.
3"
VENT PIPE OF GALV. SHEET IRON OR COPPER
SPUD OVER WHICH VENT PIPE IS SLIPPED
2"
~ NOTE ~
VENT ENTERS CHIMNEY ABOVE HIGHEST OPENING INTO CHIMNEY.

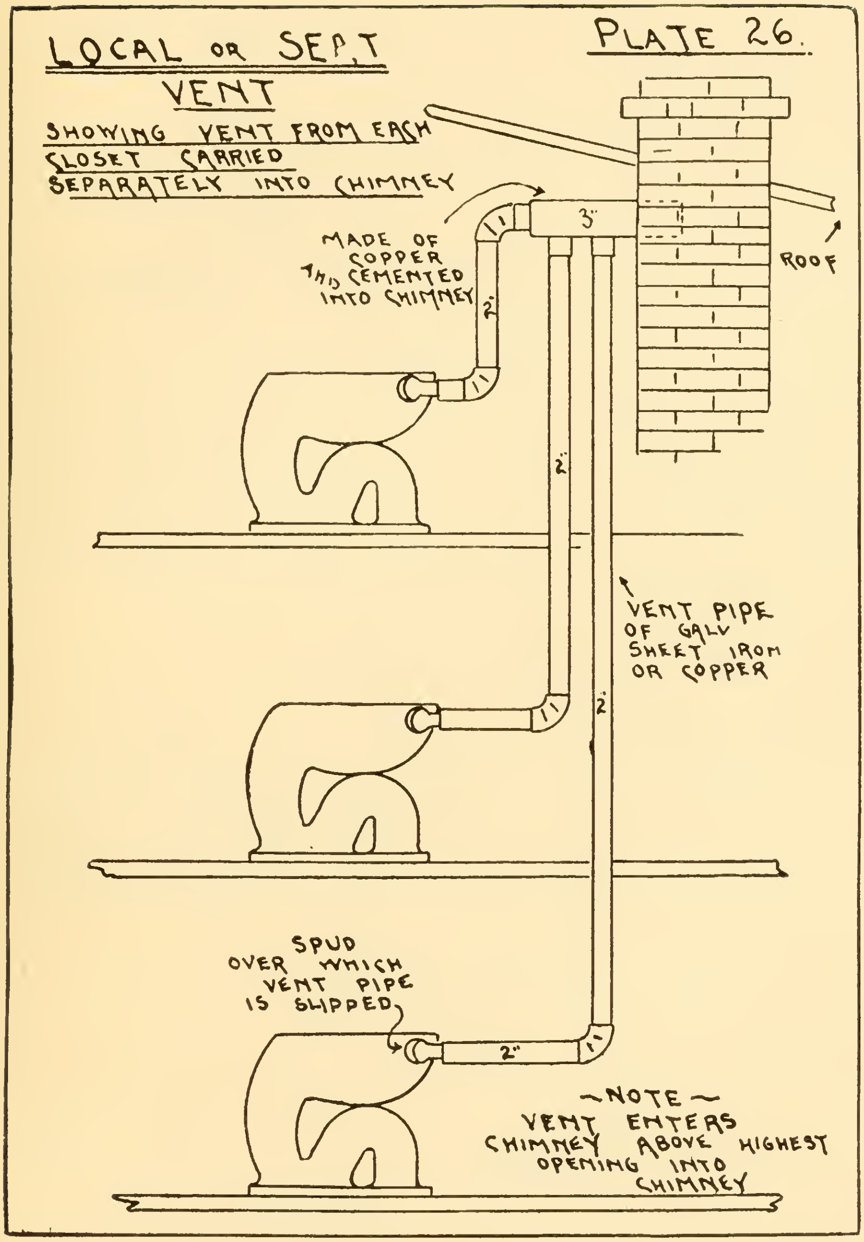


PLATE 26.
LOCAL OR SEP.T VENT
SHOWING VENT FROM EACH CLOSET CARRIED SEPARATELY INTO CHIMNEY
MADE OF COPPER AND CEMENTED INTO CHIMNEY
3"
2"
ROOF
VENT PIPE OF GALV SHEET IRON OR COPPER
SPUD OVER WHICH VENT PIPE IS SLIPPED
~NOTE~
VENT ENTERS CHIMNEY ABOVE HIGHEST OPENING INTO CHIMNEY

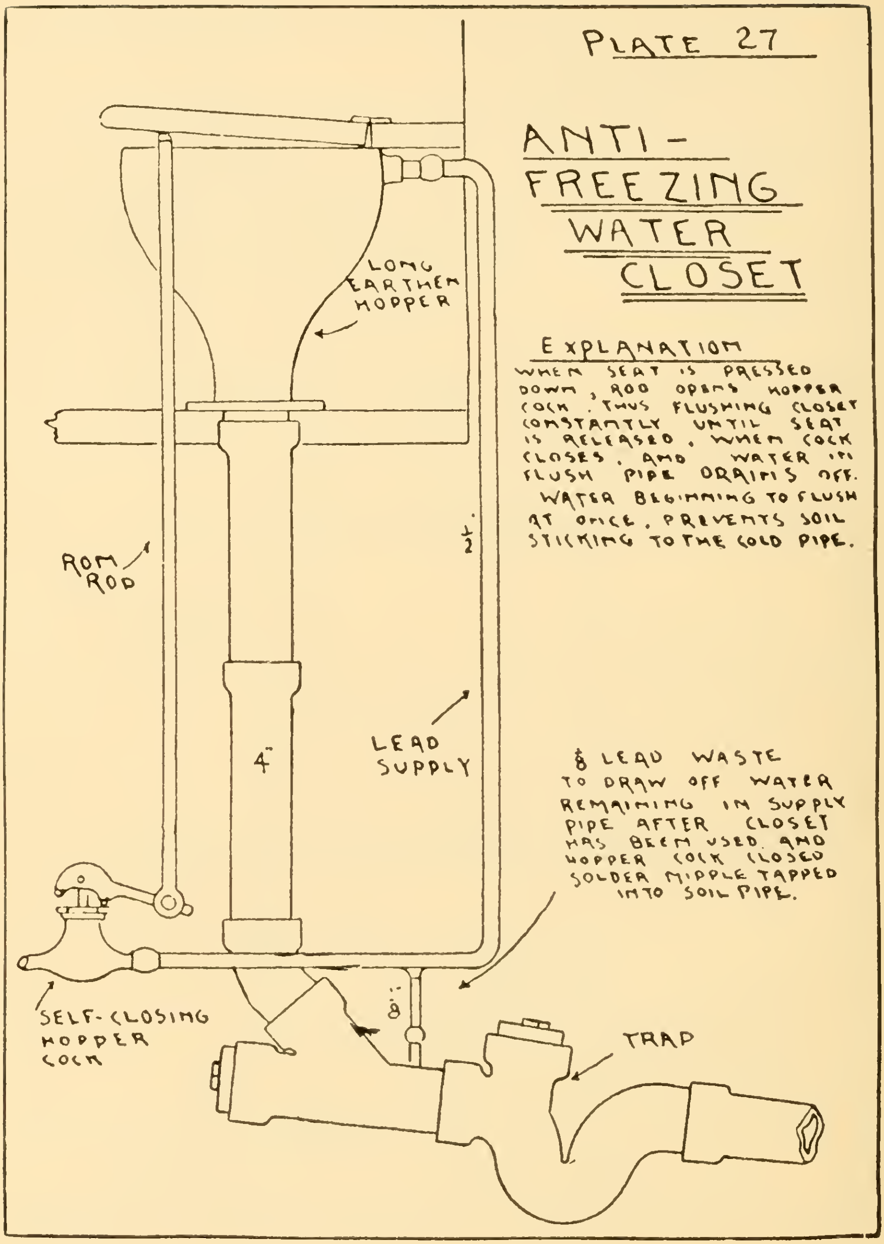


PLATE 27
ANTI-FREEZING WATER CLOSET
EXPLANATION
WHEN SEAT IS PRESSED DOWN, ROD OPENS HOPPER COCK. THUS FLUSHING CLOSET CONSTANTLY UNTIL SEAT IS RELEASED, WHEN COCK CLOSES, AND WATER IN FLUSH PIPE DRAINS OFF.
WATER BEGINNING TO FLUSH AT ONCE, PREVENTS SOIL STICKING TO THE COLD PIPE.
LONG EARTHEN HOPPER
IRON ROD
1/2
4"
LEAD SUPPLY
8 LEAD WASTE TO DRAW OFF WATER REMAINING IN SUPPLY PIPE AFTER CLOSET HAS BEEN USED AND HOPPER COCK CLOSED SOLDER NIPPLE TAPPED INTO SOIL PIPE.
SELF-CLOSING HOPPER COCK
TRAP

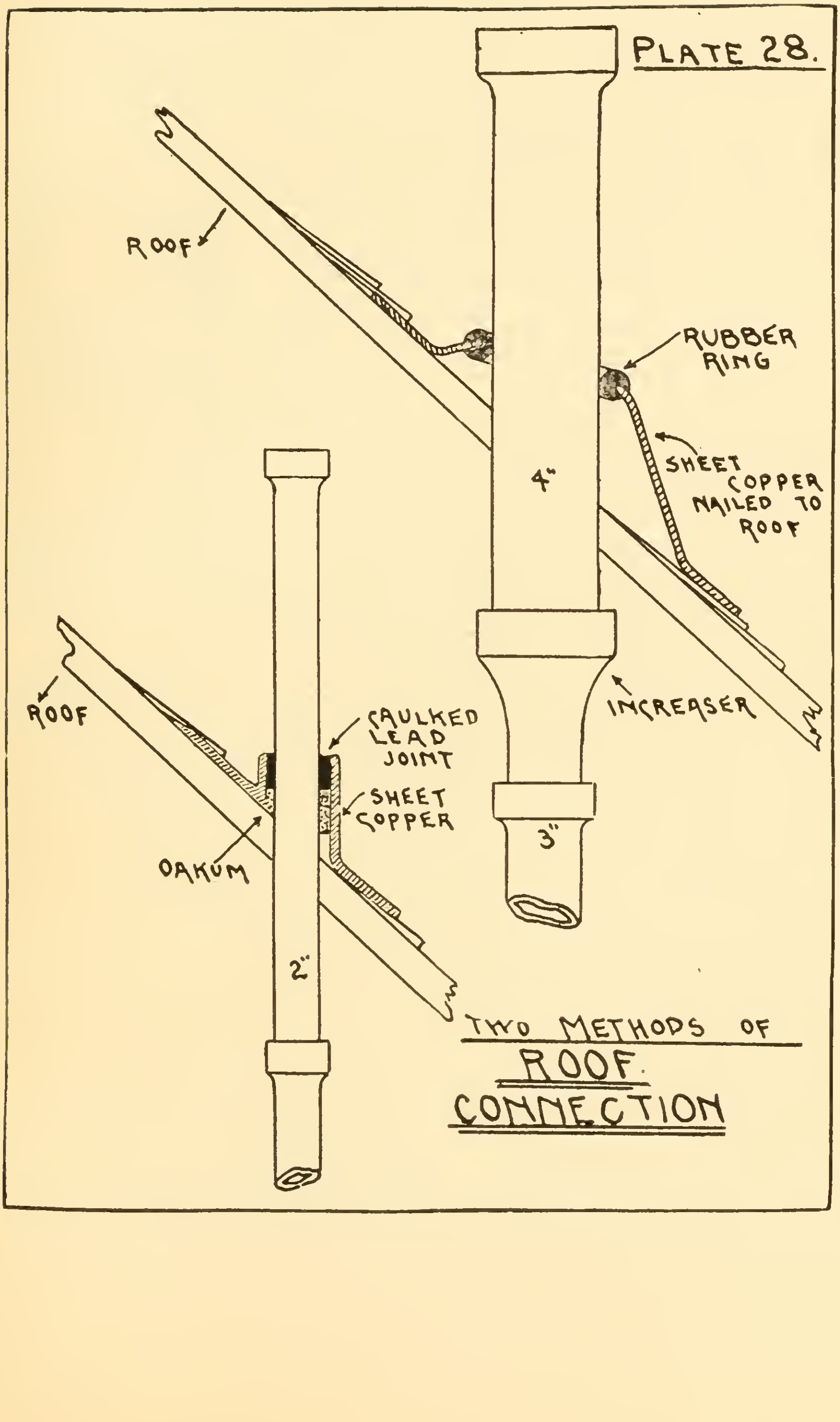


PLATE 28.
ROOF
RUBBER RING
SHEET COPPER NAILED TO ROOF
4"
INCREASER
3"
ROOF
CAULKED LEAD JOINT
SHEET COPPER
OAKUM
2"
TWO METHODS OF
ROOF
CONNECTION

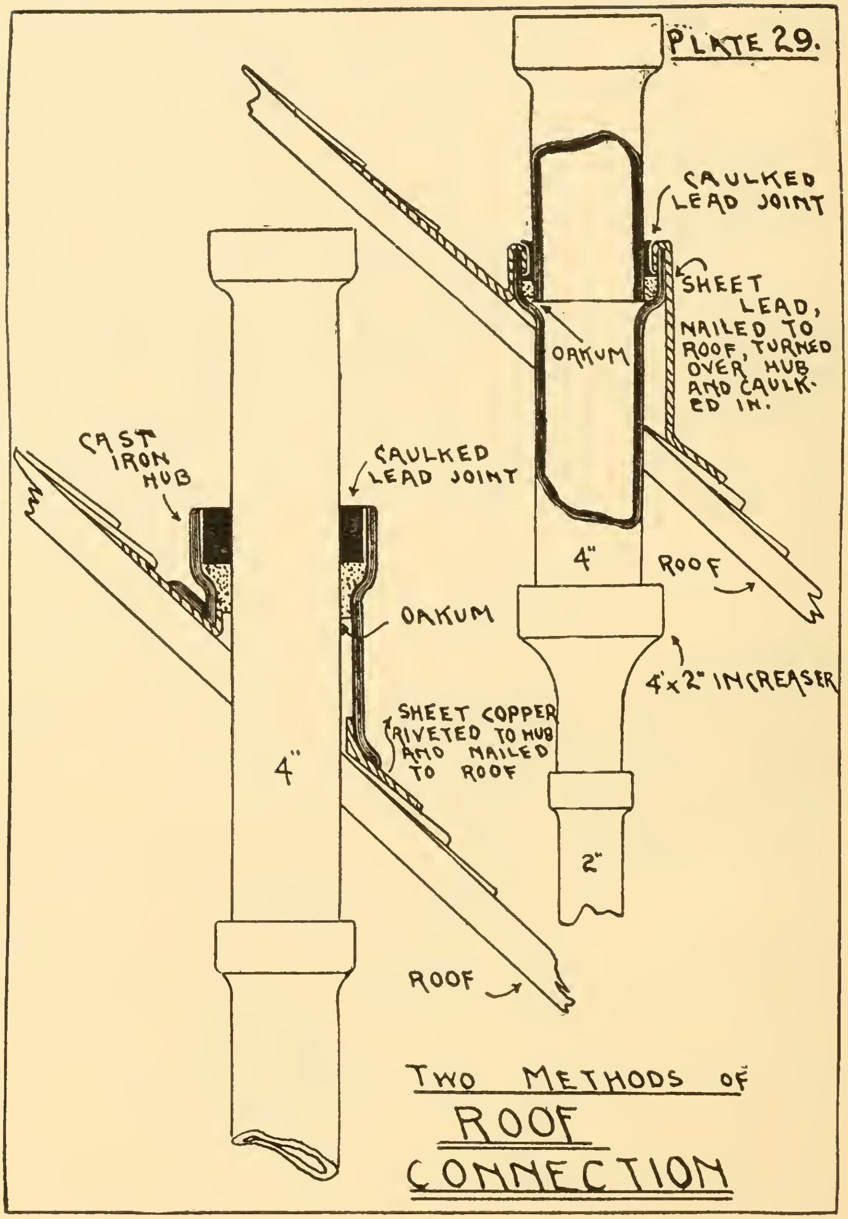


PLATE 29.
CAULKED LEAD JOINT
SHEET LEAD, NAILED TO ROOF, TURNED OVER HUB AND CAULKED IN.
OAKUM
4"
ROOF
4"x2" INCREASER
2"
CAST IRON HUB
CAULKED LEAD JOINT
OAKUM
SHEET COPPER RIVETED TO HUB AND NAILED TO ROOF
4"
ROOF
TWO METHODS OF
ROOF
CONNECTION

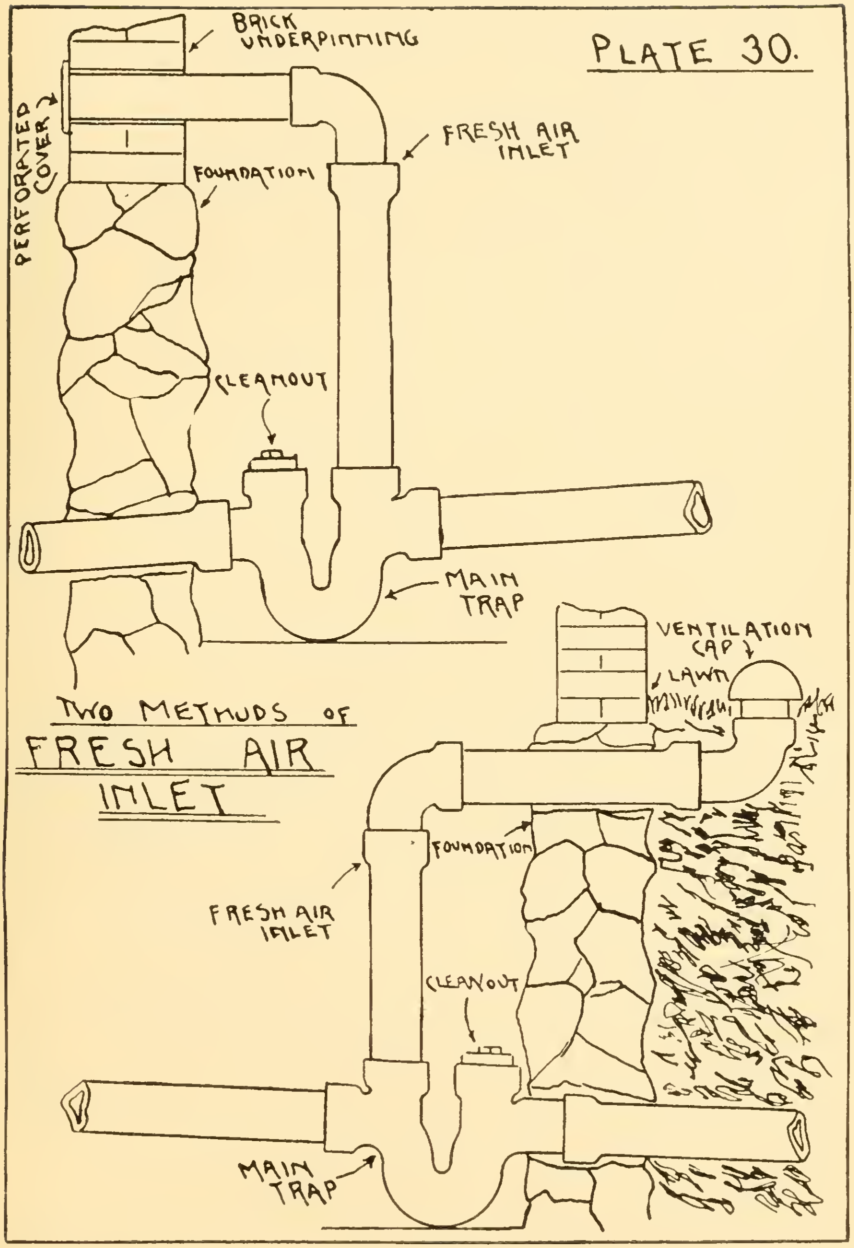


PLATE 30.
BRICK UNDERPINNING
PERFORATED COVER
FRESH AIR INLET
FOUNDATION
CLEANOUT
MAIN TRAP
TWO METHODS OF
FRESH AIR INLET
VENTILATION CAP
LAWN
FOUNDATION
FRESH AIR INLET
CLEANOUT
MAIN TRAP

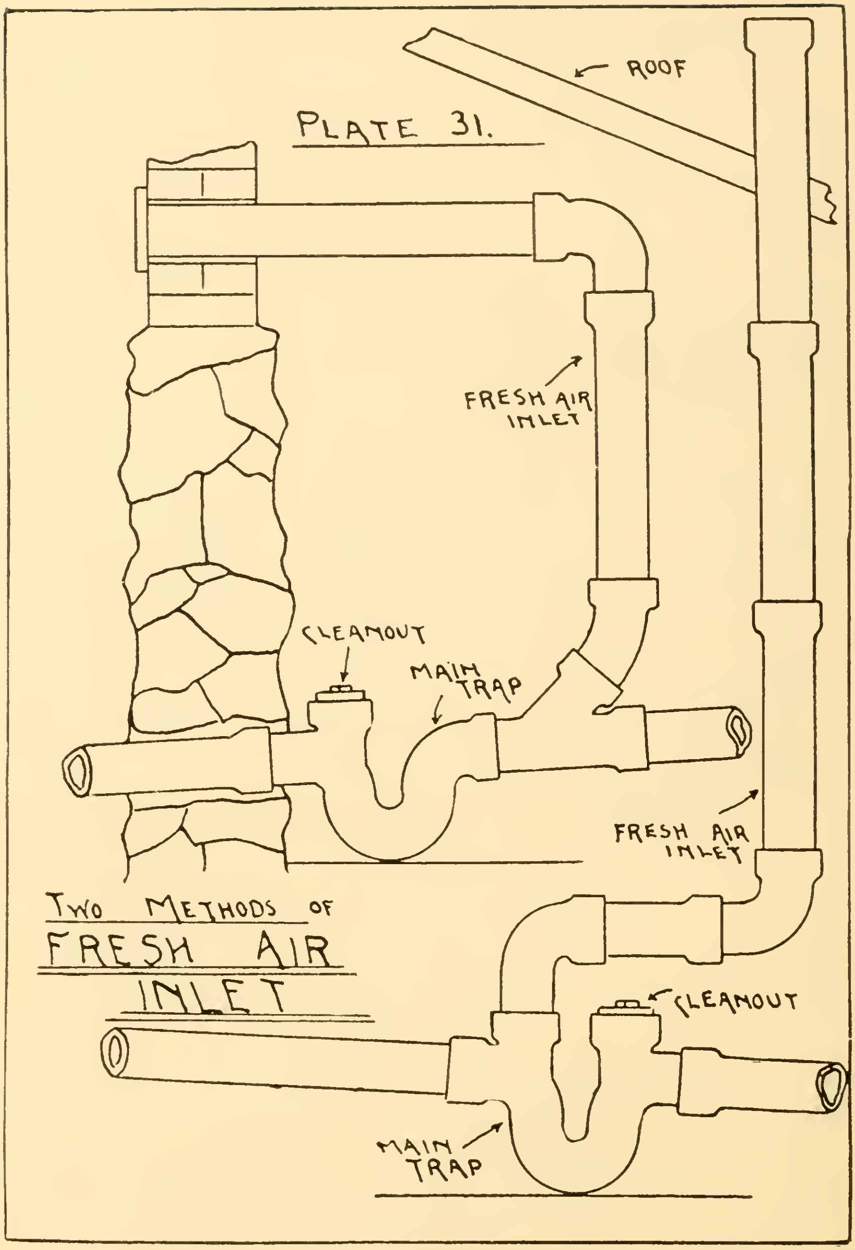
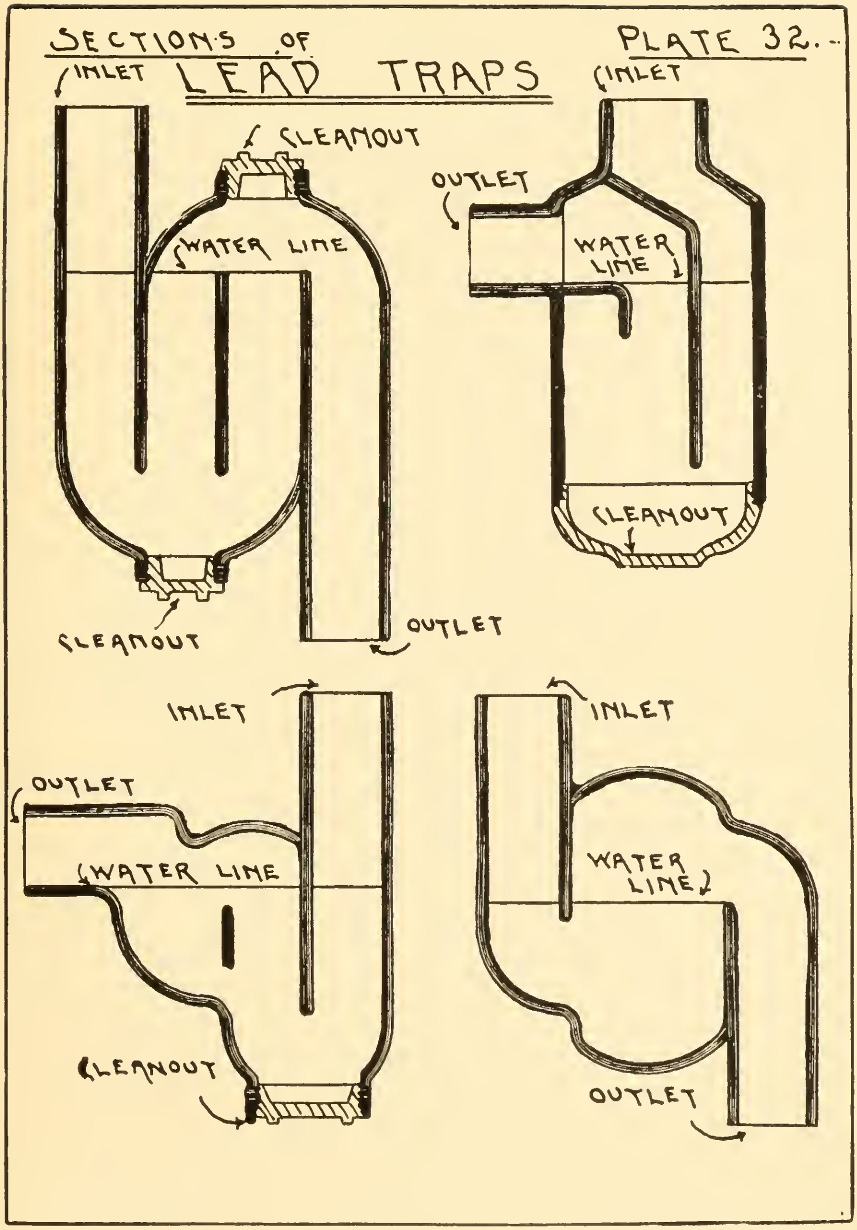


PLATE 31.
ROOF
FRESH AIR INLET
CLEANOUT
MAIN TRAP
FRESH AIR INLET
TWO METHODS OF FRESH AIR INLET
CLEANOUT
MAIN TRAP


SECTIONS OF
LEAD TRAPS
PLATE 32.
INLET
CLEANOUT
WATER LINE
CLEANOUT
OUTLET
INLET
OUTLET
WATER LINE
CLEANOUT
INLET
OUTLET
WATER LINE
CLEANOUT
INLET
WATER LINE
OUTLET

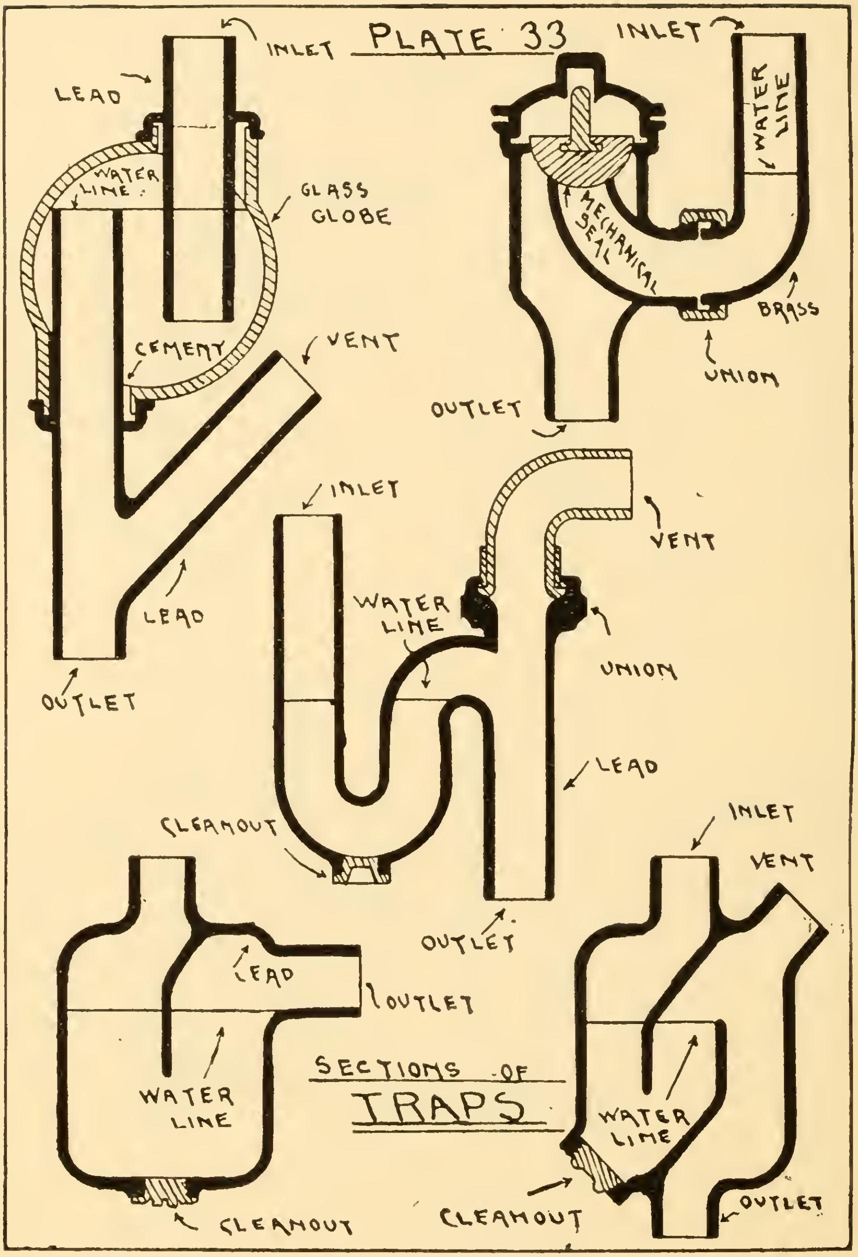


PLATE 33
INLET
LEAD
WATER LINE
GLASS GLOBE
CEMENT
VENT
LEAD
OUTLET
INLET
WATER LINE
MECHANICAL SEAL
BRASS
UNION
OUTLET
INLET
VENT
WATER LINE
UNION
LEAD
CLEANOUT
OUTLET
LEAD
OUTLET
WATER LINE
CLEANOUT
SECTIONS OF
TRAPS
INLET
VENT
WATER LINE
CLEANOUT
OUTLET

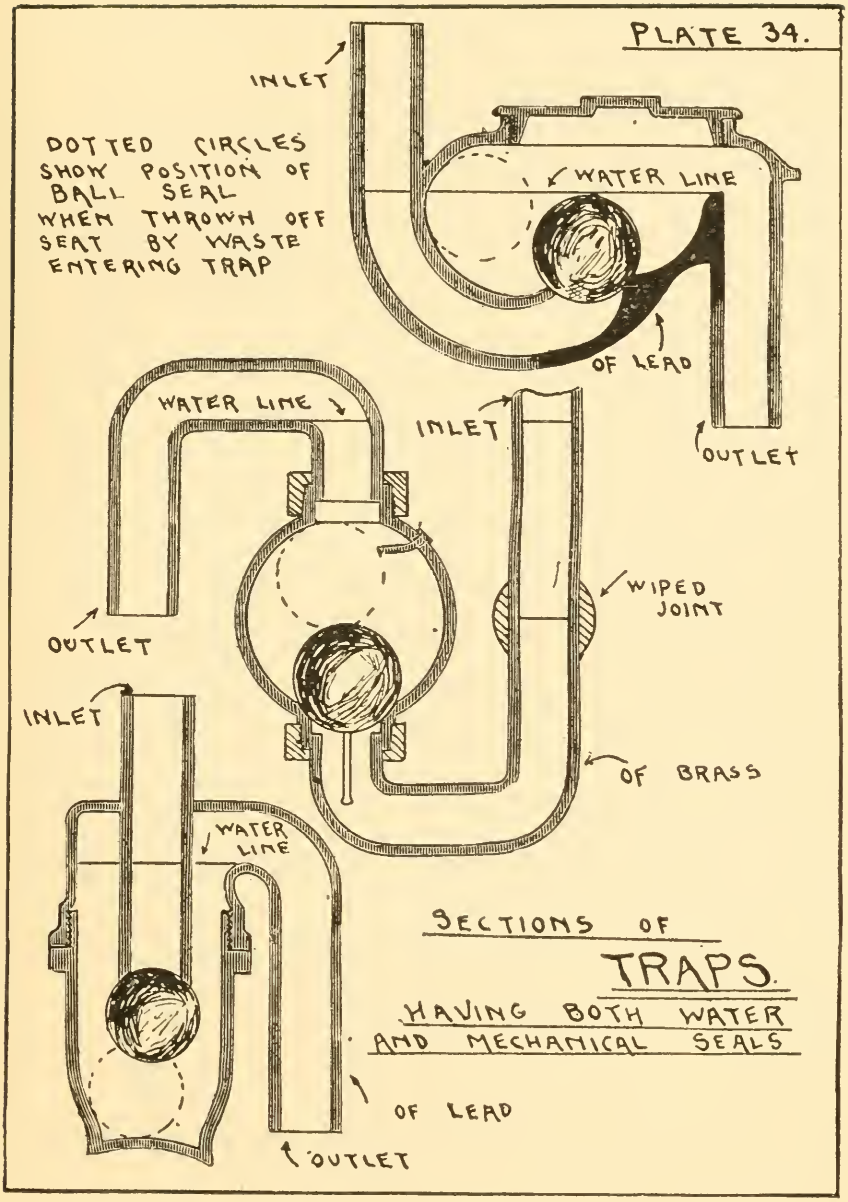


PLATE 34.
INLET
DOTTED CIRCLES SHOW POSITION OF BALL SEAL WHEN THROWN OFF SEAT BY WASTE ENTERING TRAP
WATER LINE
OF LEAD
OUTLET
WATER LINE
INLET
WIPED JOINT
OUTLET
INLET
OF BRASS
WATER LINE
SECTIONS OF TRAPS. HAVING BOTH WATER AND MECHANICAL SEALS
OF LEAD
OUTLET

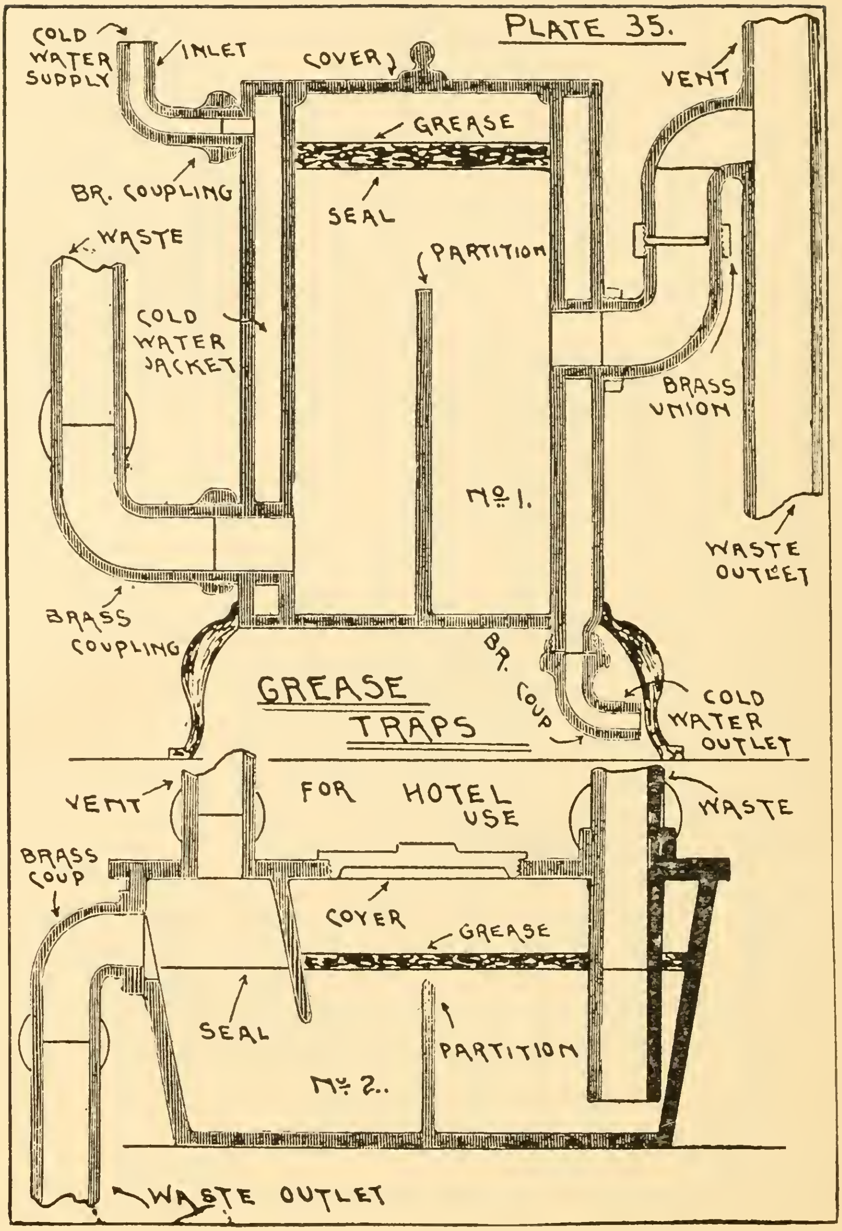
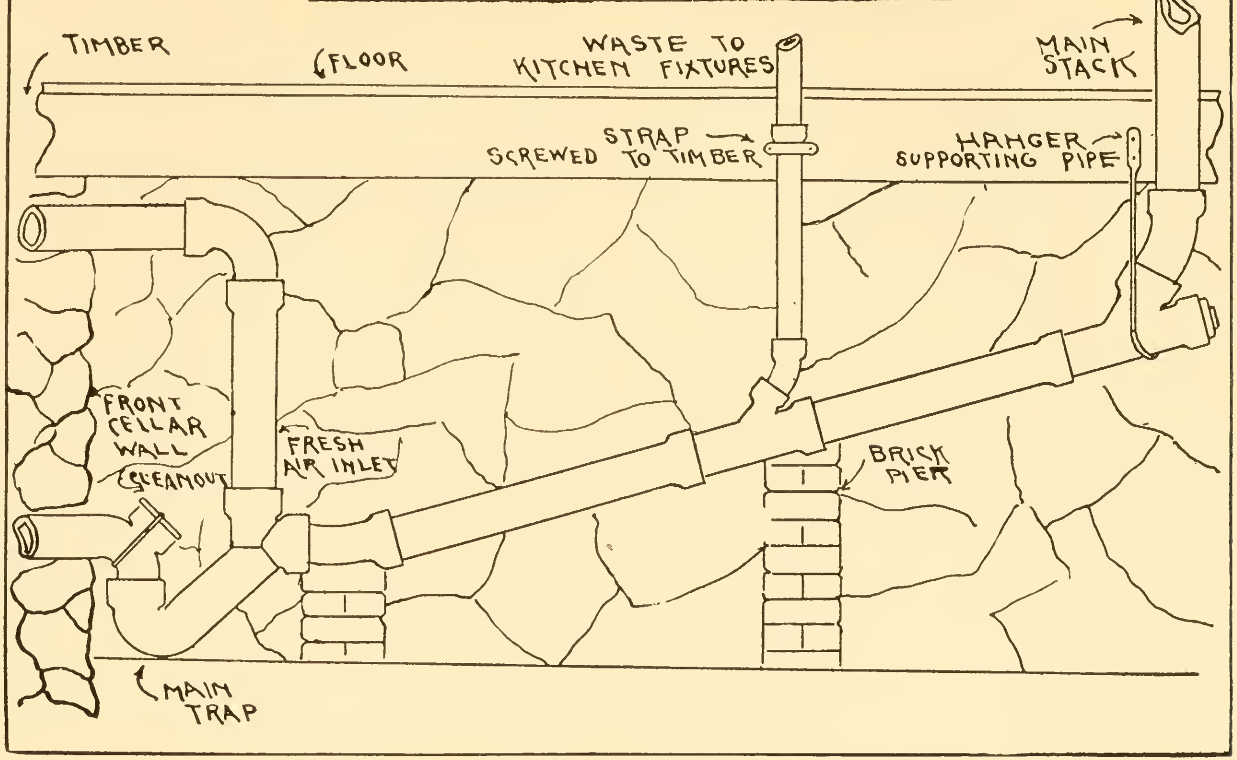


PLATE 35.
COLD WATER SUPPLY
INLET
COVER
GREASE
SEAL
BR. COUPLING
VENT
WASTE
PARTITION
COLD WATER JACKET
BRASS UNION
No. 1.
WASTE OUTLET
BRASS COUPLING
BR. COUP
COLD WATER OUTLET
GREASE TRAPS
FOR HOTEL USE
VENT
WASTE
BRASS COUP
COVER
GREASE
SEAL
PARTITION
No. 2..
WASTE OUTLET

PLATE 36.

METHOD OF RUNNING LONG LINE OF SOIL PIPE ON CELLAR WALL.



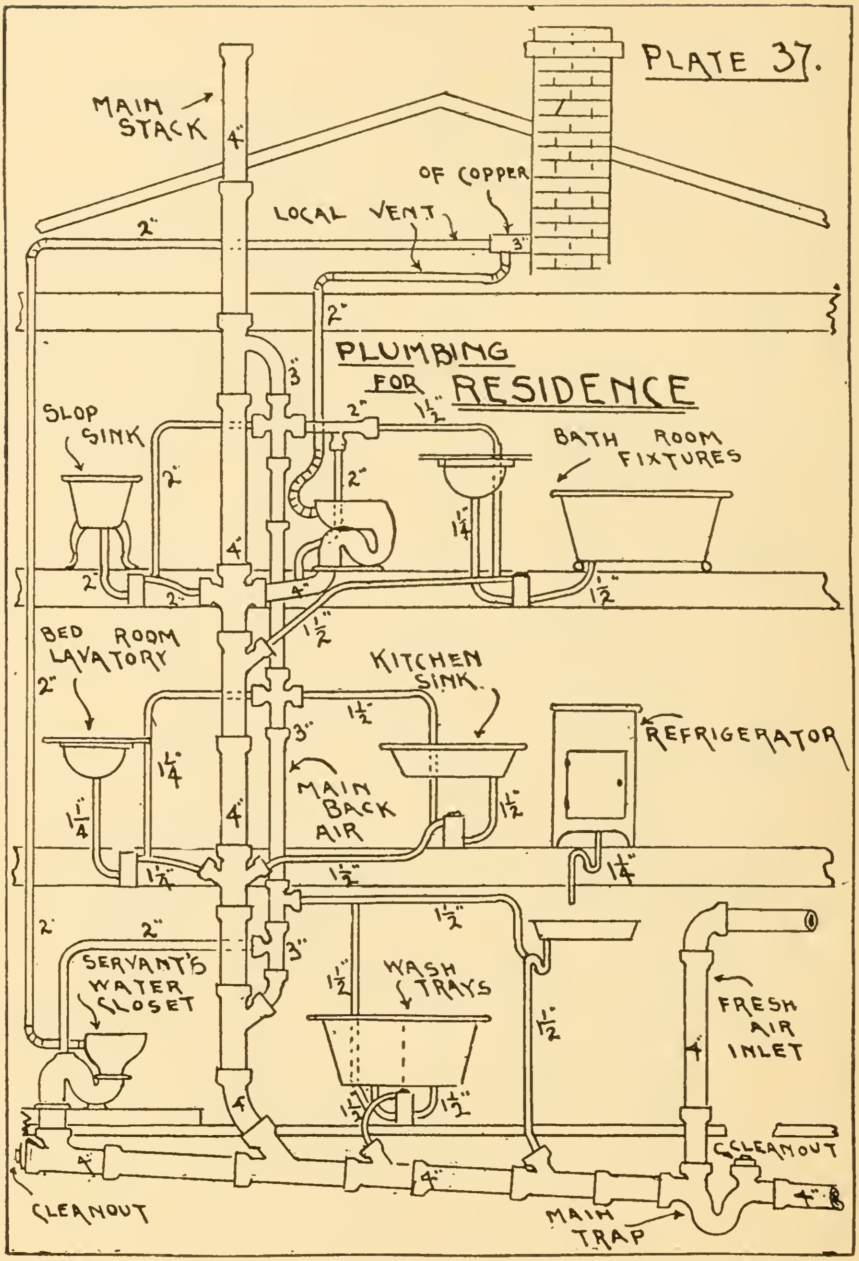


PLATE 37.
PLUMBING FOR RESIDENCE
MAIN STACK
4"
OF COPPER
LOCAL VENT
2"
3"
SLOP SINK
BATH ROOM FIXTURES
BED ROOM LAVATORY
KITCHEN SINK
REFRIGERATOR
MAIN BACK AIR
SERVANT'S WATER CLOSET
WASH TRAYS
FRESH AIR INLET
CLEANOUT
CLEANOUT
MAIN TRAP

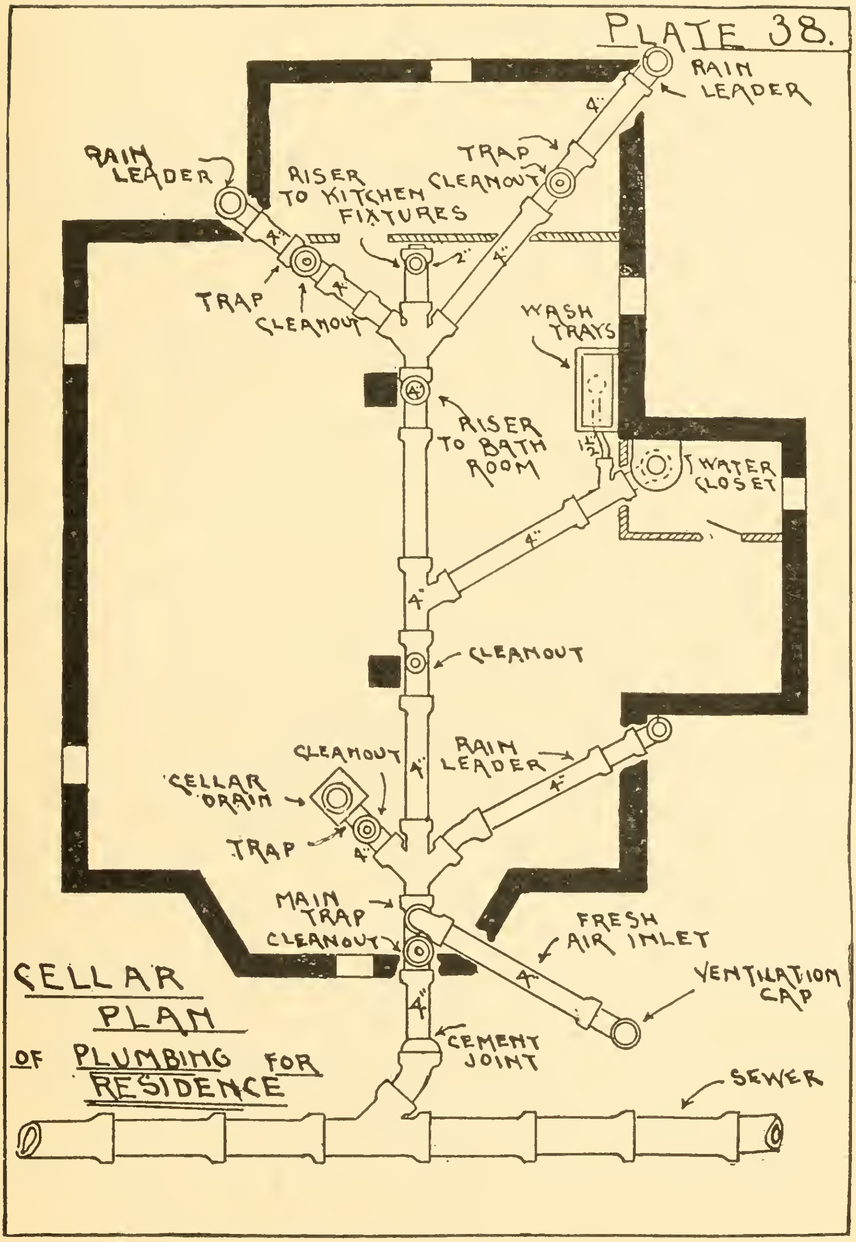


PLATE 38.
RAIN LEADER
4"
TRAP
CLEANOUT
RAIN LEADER
RISER TO KITCHEN FIXTURES
2"
TRAP
CLEANOUT
WASH TRAYS
RISER TO BATH ROOM
1½"
WATER CLOSET
CLEANOUT
RAIN LEADER
CLEANOUT
CELLAR DRAIN
TRAP
MAIN TRAP
CLEANOUT
FRESH AIR INLET
VENTILATION CAP
CEMENT JOINT
SEWER
CELLAR PLAN OF PLUMBING FOR RESIDENCE

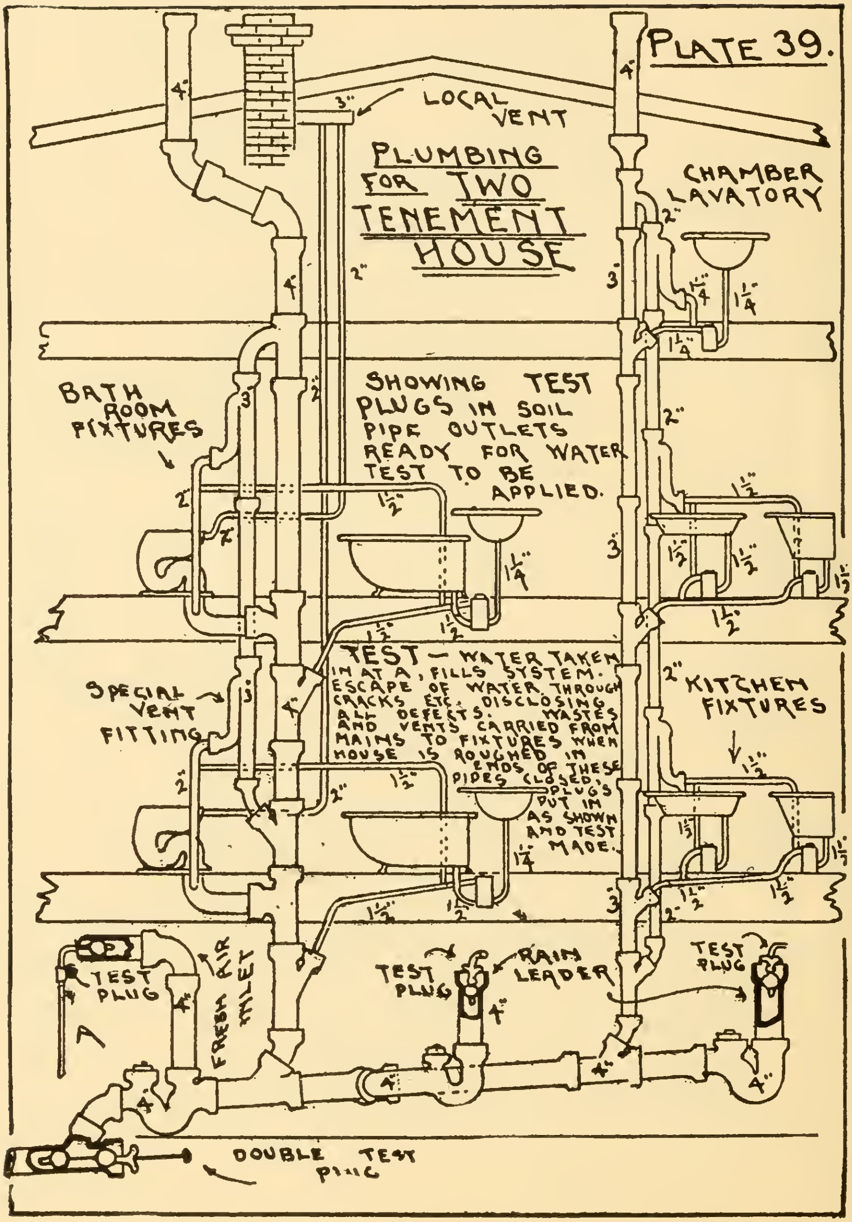


PLATE 39.
PLUMBING FOR TWO TENEMENT HOUSE
LOCAL VENT
CHAMBER LAVATORY
BATH ROOM FIXTURES
SHOWING TEST PLUGS IN SOIL PIPE OUTLETS READY FOR WATER TEST TO BE APPLIED.
SPECIAL VENT FITTING
TEST — WATER TAKEN IN AT A, FILLS SYSTEM. ESCAPE OF WATER THROUGH CRACKS ETC. DISCLOSING ALL DEFECTS. WASTES AND VENTS CARRIED FROM MAINS TO FIXTURES WHEN HOUSE IS ROUGHED IN ENDS OF THESE PIPES CLOSED, PLUGS PUT IN AS SHOWN AND TEST MADE.
KITCHEN FIXTURES
TEST PLUG
FRESH AIR INLET
A
TEST PLUG
RAIN LEADER
TEST PLUG
DOUBLE TEST PLUG

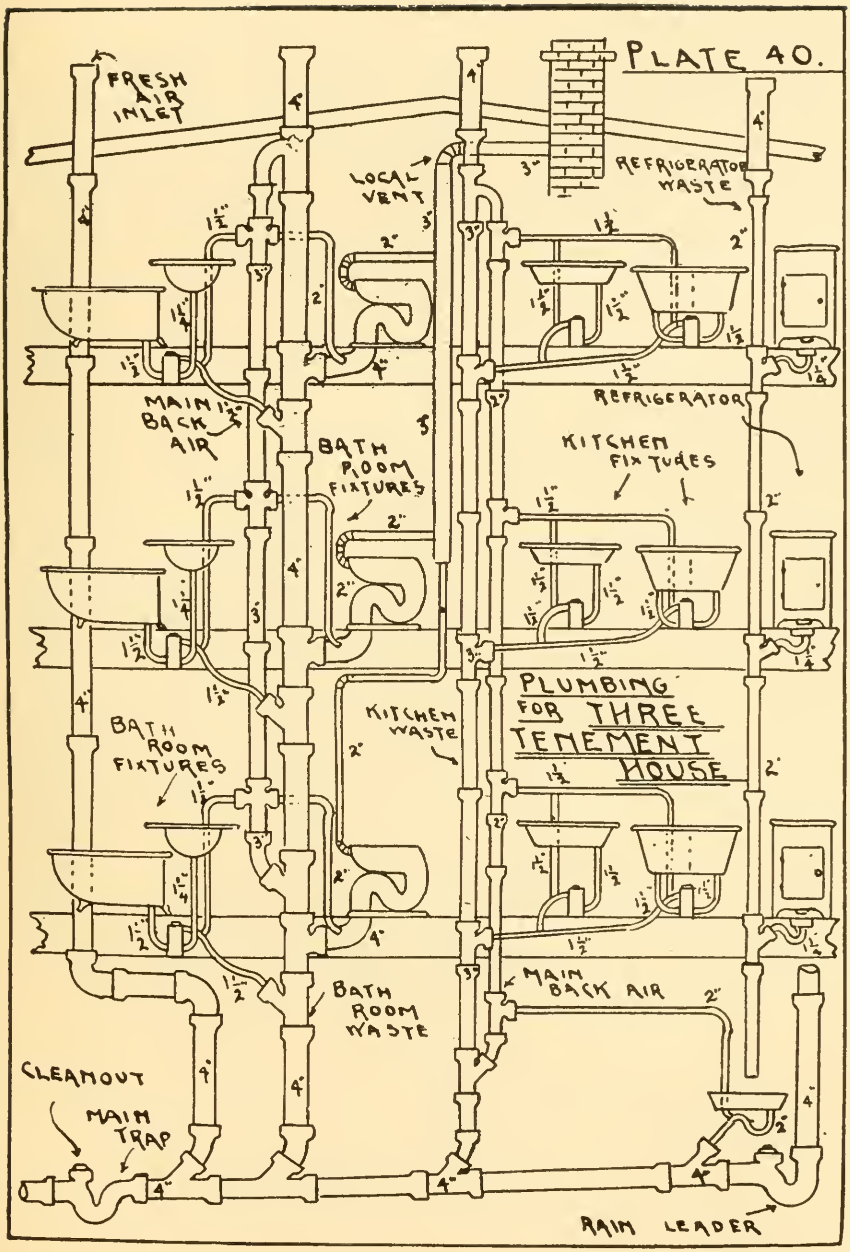
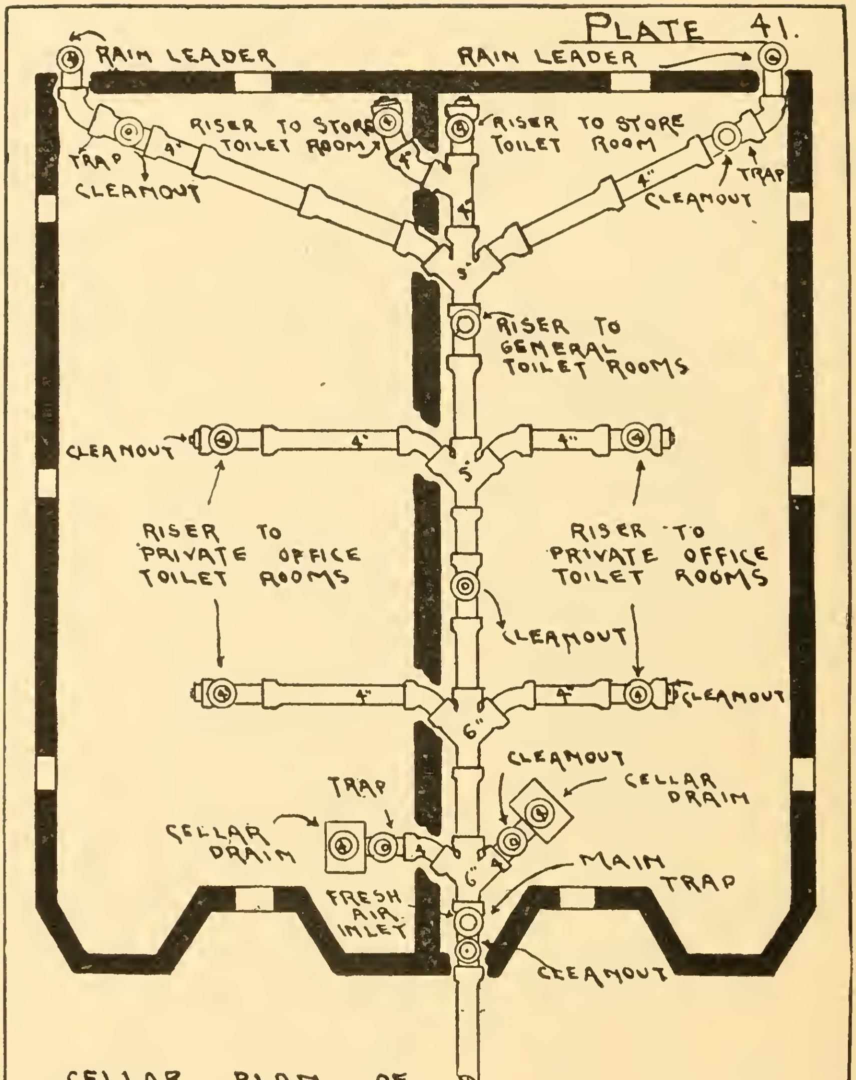
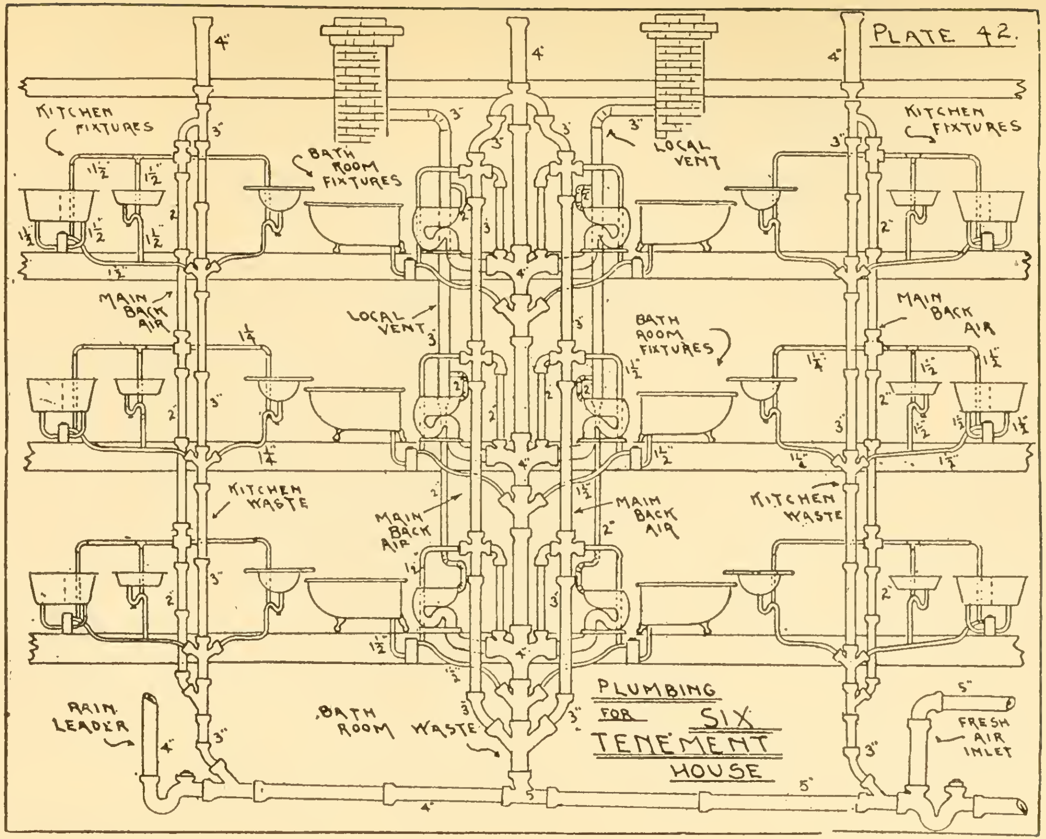


PLATE 40.
PLUMBING FOR THREE TENEMENT HOUSE
FRESH AIR INLET
LOCAL VENT
REFRIGERATOR WASTE
REFRIGERATOR
KITCHEN FIXTURES
MAIN BACK AIR
BATH ROOM FIXTURES
KITCHEN WASTE
BATH ROOM FIXTURES
MAIN BACK AIR
BATH ROOM WASTE
CLEANOUT
MAIN TRAP
RAIN LEADER



CELLAR PLAN OF BLOCK OF STORES AND OFFICES

PLATE 42.


PLUMBING FOR SIX TENEMENT HOUSE
KITCHEN FIXTURES
BATH ROOM FIXTURES
LOCAL VENT
MAIN BACK AIR
KITCHEN WASTE
BATH ROOM WASTE
RAIN LEADER
FRESH AIR INLET

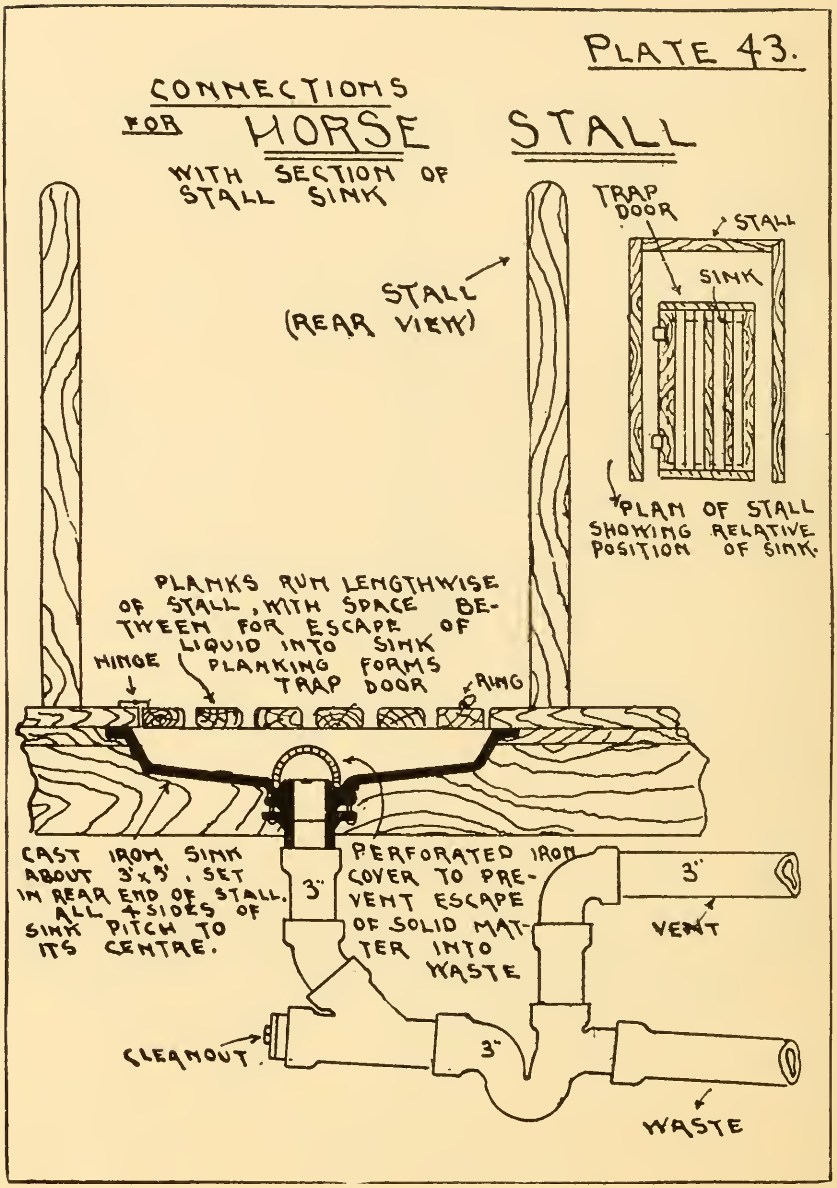


PLATE 43.
CONNECTIONS FOR HORSE STALL
WITH SECTION OF STALL SINK
STALL (REAR VIEW)
TRAP DOOR
STALL
SINK
PLAN OF STALL SHOWING RELATIVE POSITION OF SINK.
PLANKS RUN LENGTHWISE OF STALL, WITH SPACE BETWEEN FOR ESCAPE OF LIQUID INTO SINK
HINGE
PLANKING FORMS TRAP DOOR
RING
CAST IRON SINK ABOUT 3'x5', SET IN REAR END OF STALL. ALL 4 SIDES OF SINK PITCH TO ITS CENTRE.
PERFORATED IRON COVER TO PREVENT ESCAPE OF SOLID MATTER INTO WASTE
3"
3"
VENT
CLEANOUT
3"
WASTE

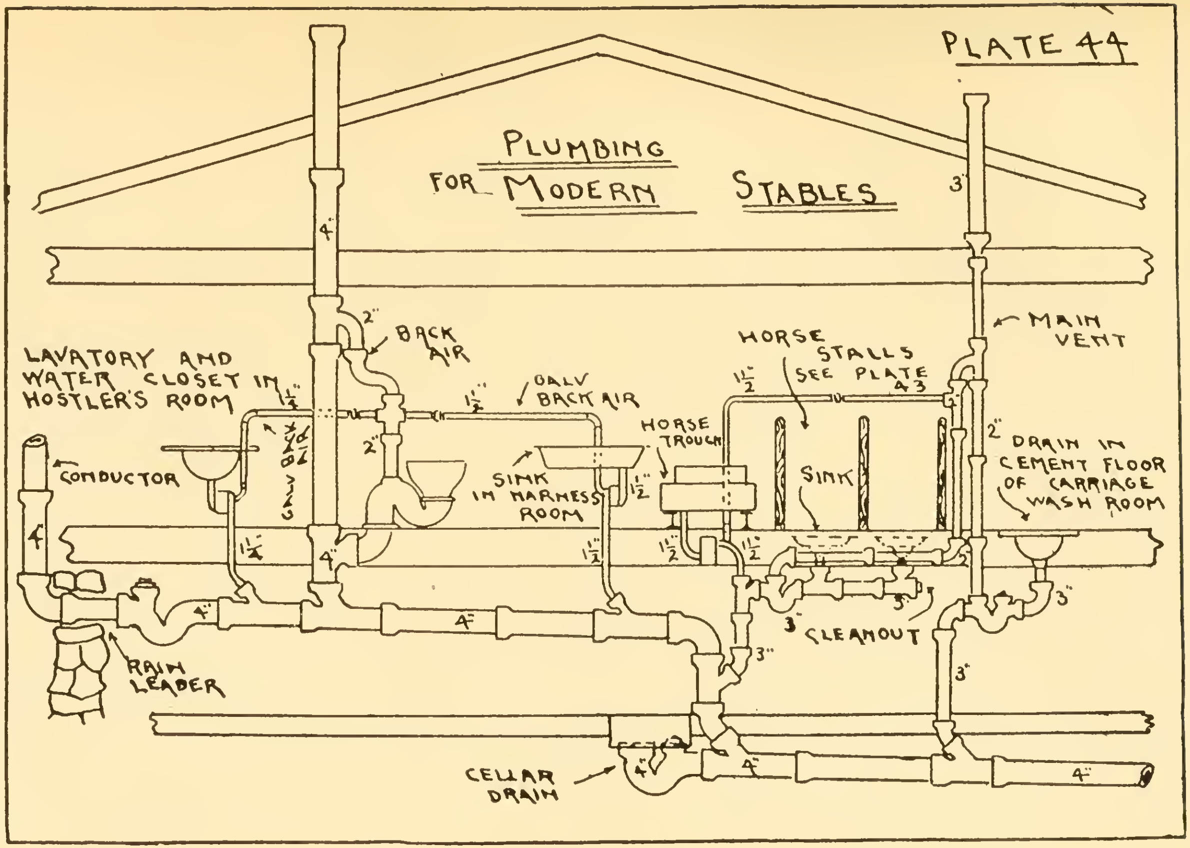


PLATE 44
PLUMBING FOR MODERN STABLES
MAIN VENT
BACK AIR
GALV BACK AIR
LAVATORY AND WATER CLOSET IN HOSTLER'S ROOM
CONDUCTOR
SINK IN HARNESS ROOM
HORSE TROUGH
HORSE STALLS SEE PLATE 43
SINK
DRAIN IN CEMENT FLOOR OF CARRIAGE WASH ROOM
3" CLEANOUT
RAIN LEADER
CELLAR DRAIN

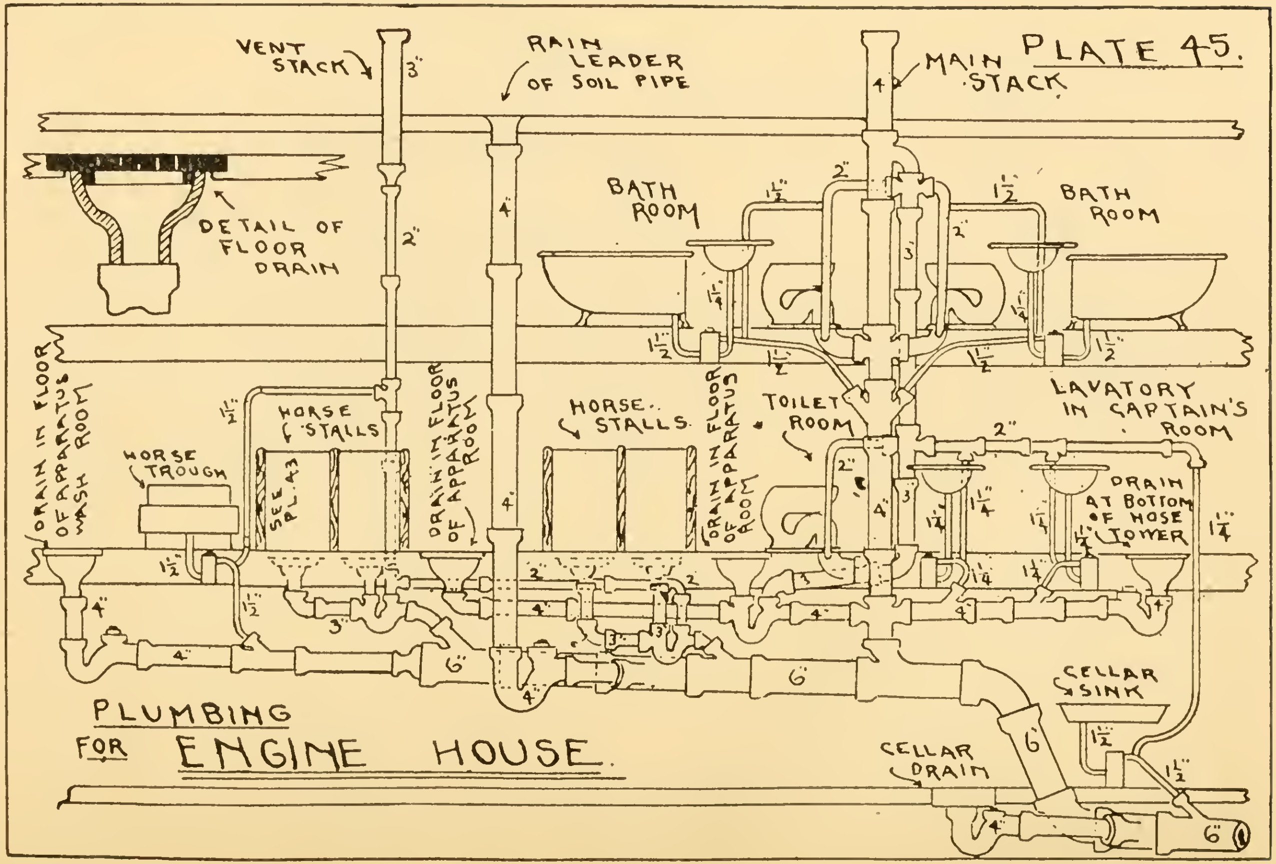
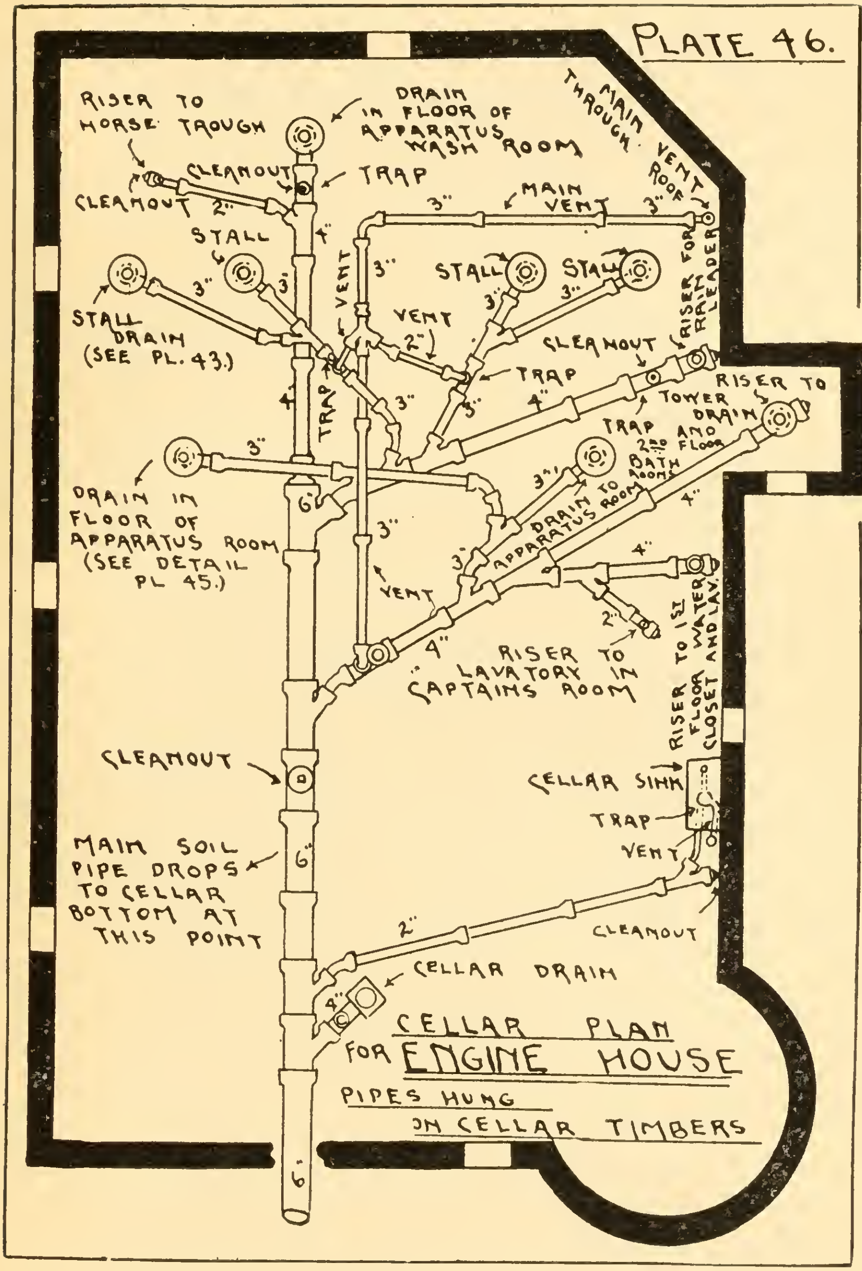


PLATE 45.
VENT STACK
RAIN LEADER OF SOIL PIPE
MAIN STACK
DETAIL OF FLOOR DRAIN
BATH ROOM
BATH ROOM
HORSE STALLS
SEE PL. 43
HORSE STALLS
TOILET ROOM
LAVATORY IN CAPTAIN'S ROOM
HORSE TROUGH
DRAIN IN FLOOR OF APPARATUS WASH ROOM
DRAIN IN FLOOR OF APPARATUS ROOM
DRAIN IN FLOOR OF APPARATUS ROOM
DRAIN AT BOTTOM OF HOSE TOWER
CELLAR SINK
CELLAR DRAIN
PLUMBING FOR ENGINE HOUSE.

PLATE 46.



RISER TO HORSE TROUGH
DRAIN IN FLOOR OF APPARATUS WASH ROOM
MAIN VENT THROUGH ROOF
CLEANOUT
TRAP
CLEANOUT
2"
3"
MAIN VENT
3"
STALL
STALL
STALL
STALL
RISER FOR RAIN LEADER
STALL DRAIN (SEE PL. 43.)
VENT
VENT
TRAP
CLEANOUT
TRAP
RISER TO TOWER DRAIN
TRAP
2ND FLOOR BATH ROOMS
DRAIN IN FLOOR OF APPARATUS ROOM (SEE DETAIL PL 45.)
DRAIN TO APPARATUS ROOM
VENT
RISER TO LAVATORY IN CAPTAINS ROOM
RISER TO 1ST FLOOR WATER CLOSET AND LAV.
CLEANOUT
CELLAR SINK
TRAP
VENT
MAIN SOIL PIPE DROPS TO CELLAR BOTTOM AT THIS POINT
CLEANOUT
CELLAR DRAIN
CELLAR PLAN
FOR ENGINE HOUSE
PIPES HUNG ON CELLAR TIMBERS

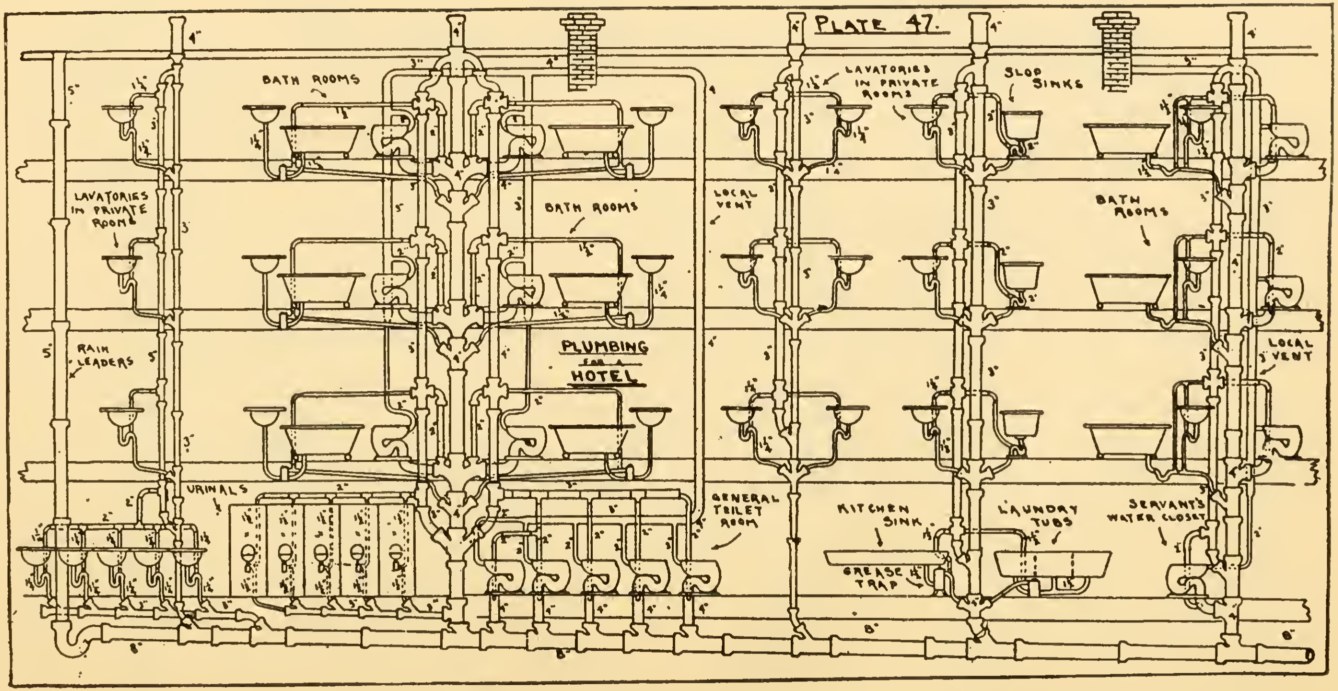


PLATE 47.
PLUMBING FOR A HOTEL
BATH ROOMS
LAVATORIES IN PRIVATE ROOMS
SLOP SINKS
LOCAL VENT
RAIN LEADERS
URINALS
GENERAL TOILET ROOM
KITCHEN SINK
GREASE TRAP
LAUNDRY TUBS
SERVANTS WATER CLOSET

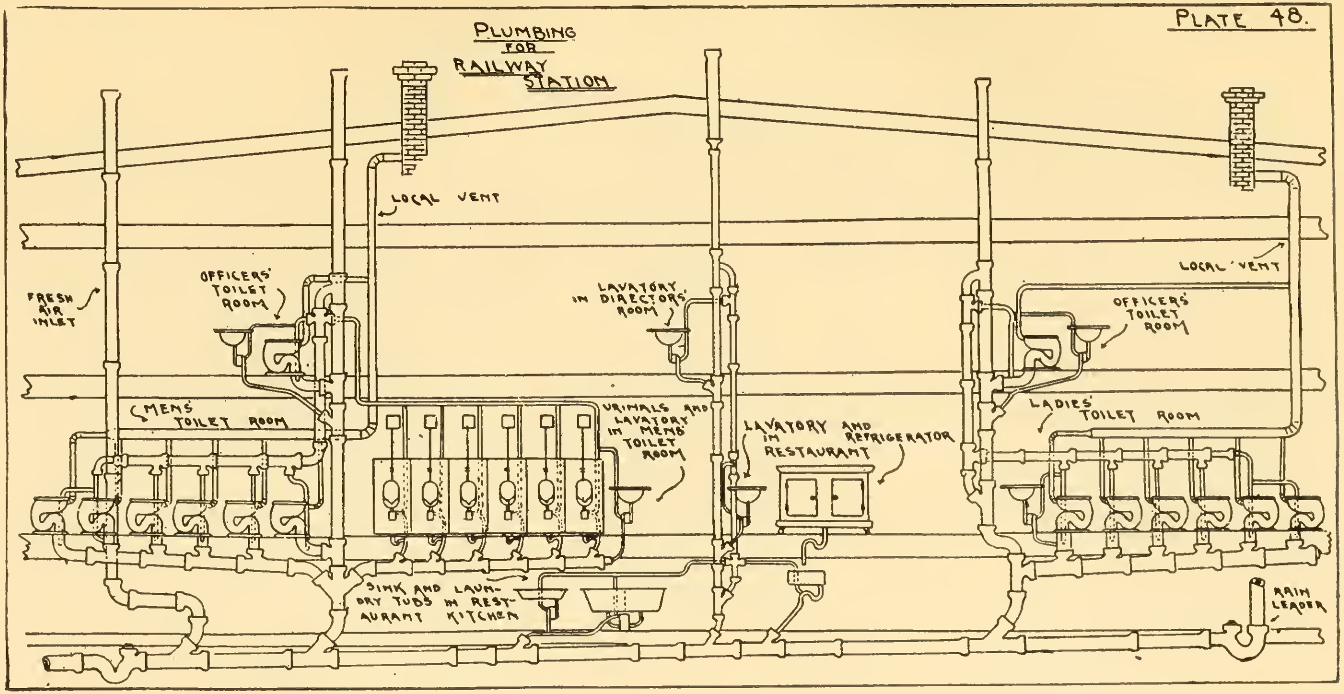


PLATE 48.
PLUMBING FOR RAILWAY STATION
LOCAL VENT
LOCAL VENT
FRESH AIR INLET
OFFICERS' TOILET ROOM
OFFICERS' TOILET ROOM
LAVATORY IN DIRECTORS' ROOM
MENS' TOILET ROOM
URINALS AND LAVATORY IN MENS' TOILET ROOM
LAVATORY AND REFRIGERATOR IN RESTAURANT
LADIES' TOILET ROOM
SINK AND LAUNDRY TUBS IN RESTAURANT KITCHEN
RAIN LEADER

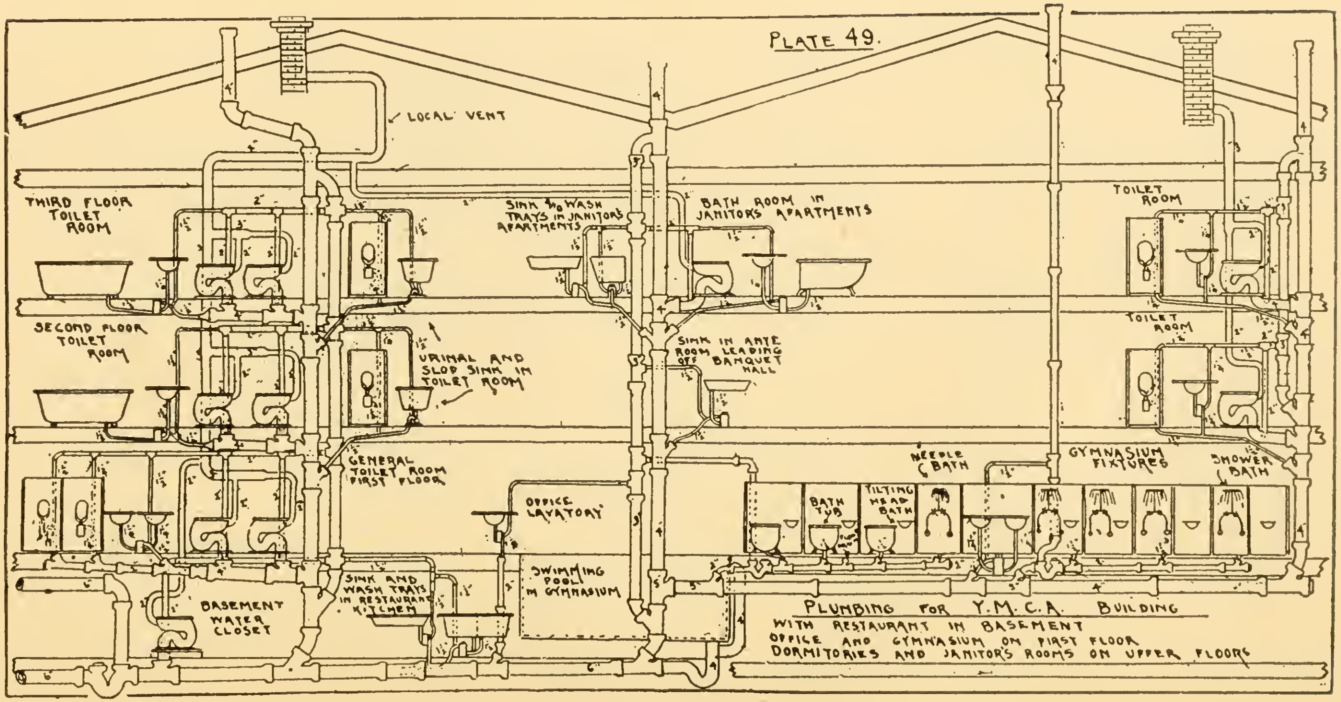


PLATE 49.
LOCAL VENT
THIRD FLOOR TOILET ROOM
SECOND FLOOR TOILET ROOM
URINAL AND SLOP SINK IN TOILET ROOM
GENERAL TOILET ROOM FIRST FLOOR
BASEMENT WATER CLOSET
SINK AND WASH TRAYS IN RESTAURANT KITCHEN
OFFICE LAVATORY
SWIMMING POOL IN GYMNASIUM
SINK AND WASH TRAYS IN JANITOR'S APARTMENTS
BATH ROOM IN JANITOR'S APARTMENTS
SINK IN ANTE ROOM LEADING OFF BANQUET HALL
NEEDLE BATH
BATH TUB
TILTING HEAD BATH
GYMNASIUM FIXTURES
SHOWER BATH
TOILET ROOM
TOILET ROOM
PLUMBING FOR Y.M.C.A. BUILDING
WITH RESTAURANT IN BASEMENT
OFFICE AND GYMNASIUM ON FIRST FLOOR
DORMITORIES AND JANITOR'S ROOMS ON UPPER FLOORS

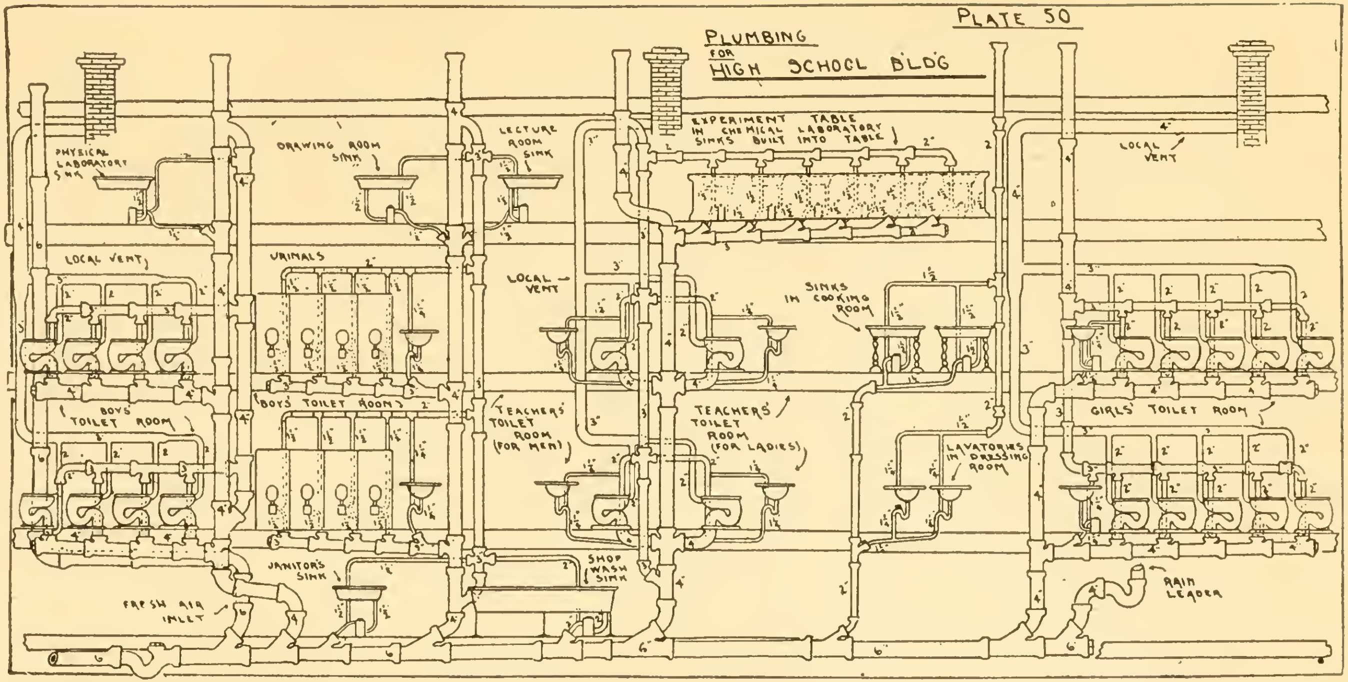


PLATE 50
PLUMBING FOR HIGH SCHOOL BLDG
EXPERIMENT TABLE IN CHEMICAL LABORATORY SINKS BUILT INTO TABLE
LOCAL VENT
PHYSICAL LABORATORY SINK
DRAWING ROOM SINK
LECTURE ROOM SINK
URINALS
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SINKS IN COOKING ROOM
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TEACHERS' TOILET ROOM (FOR LADIES)
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JANITOR'S SINK
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FRESH AIR INLET
RAIN LEADER

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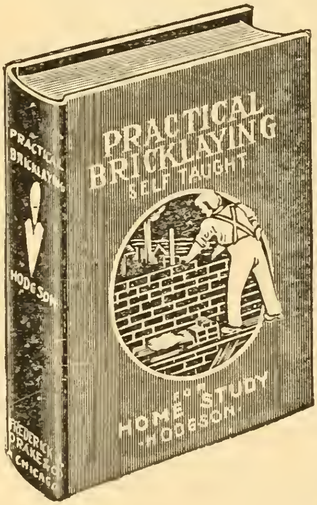
Practical Bricklaying Self-Taught

FOR HOME STUDY

By FRED T. HODGSON



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