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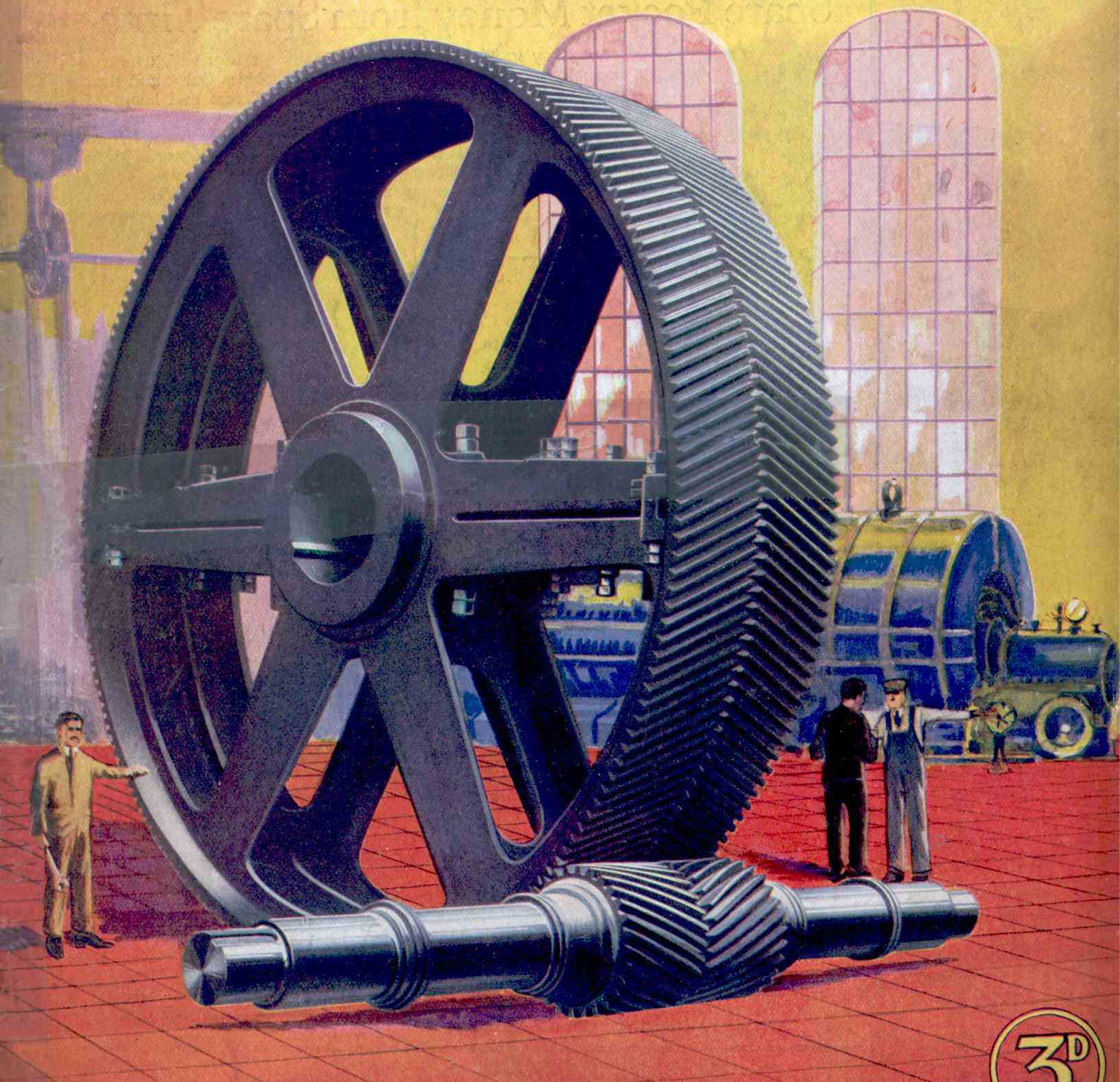
MECCANO MAGAZINE



The Largest Gear Wheel in the World. (See page 554)

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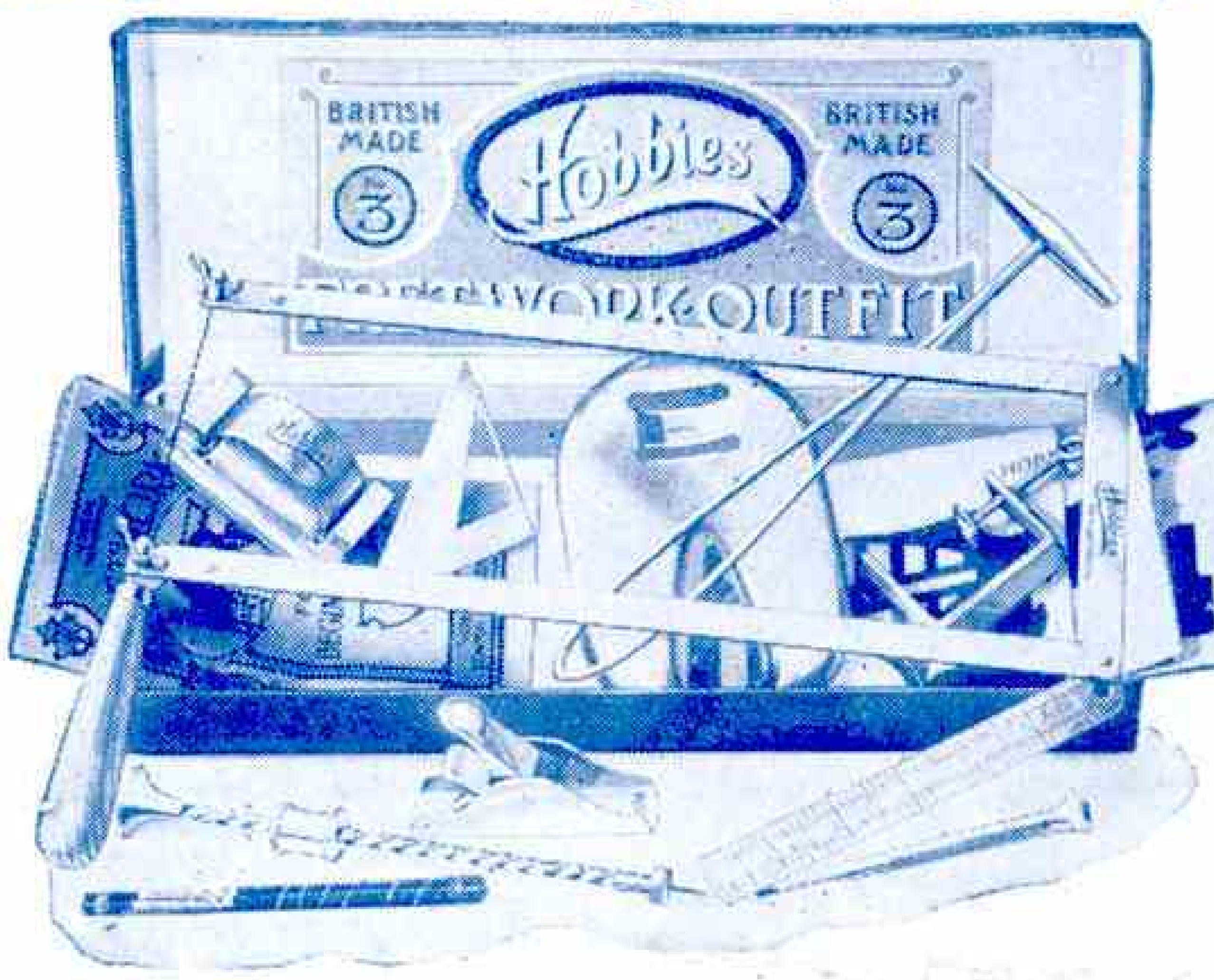

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MECCANO MAGAZINE

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OF BOYS

Vol. X, No. 11

November 1925

With the Editor

Sound Engineering Practice

In modern engineering the inventor of a new machine must base his design upon economy of working, simplicity, and reliability, if his work is to be successful. These qualities are necessary in every type of machinery, for they represent the tendency of all modern engineering. They are to be found behind every successful machine, whether it be an intricate piece of textile machinery or a Ford car—which latter, incidentally, is surely a working testimonial to economy, simplicity and reliability, in spite of the many jokes at its expense!

The necessity for these sound practices was evident to James Nasmyth, whose life story we commence this month. I hope all my readers will closely follow this series, for I am sure they will be interested to read how this young man rose to fame. If Nasmyth had ever been asked to what particular qualities he owed his success in life, I feel sure he would have said that hard work, earnestness of purpose and attention to detail were the main attributes that made him what he was.

It is impossible to say exactly how much the world in general—and this country in particular—owes to such men as Nasmyth, and to Maudslay and the other engineers whose life stories have already been told in these pages. They were fine types of the many men, found in all walks of life, who did so much to build up the British Empire during the past century. To them our debt is great, and the least we can do is to read their lives and tell others of their deeds, for—regrettable to say—their works are too often forgotten and liable to be overshadowed by events of a more spectacular, but less enduring, nature.

Special Christmas Number

Next month's magazine will be published on the 9th December. It will contain 96 pages and the price will be 6d. Readers are advised to order now to prevent disappointment, for the demand will be very great.

PUBLICATION DATE: 9th DECEMBER.

Our December Issue

We have in active preparation a Special Christmas Number of pages and containing more good things than usual. We are now hard at work getting together material for articles on our regular subjects of engineering, railways and aeroplanes, and other matters of general interest. In addition to these features, the special Christmas issue will include articles on Edward Lear, the writer of wonderful nonsense poetry; The Story of Railway Signalling; The Adventure of Living, by Theodore Roosevelt, at one time President of the United States; The Wonders and Beauty of Snow; A New Feed Pump for L.M.S. Locos; the performances of British locomotives overseas during the great war; The Travelling Post Office, describing how mails are handled on the railway, and a very interesting article on a concrete house that was built over 60 years ago.

Anticipating a greatly-increased demand, we are printing at least 80,000 copies of the special issue. Notwithstanding this, readers will be well advised to make sure that their order for a copy is placed at once with their Meccano dealer or newsagent. The demand will be so great that unless ordered well in advance, many readers will be disappointed to find supplies are unobtainable for we fully expect to sell out—as we did with our last Christmas number.

It is important to note that owing to the increased number of pages we find it impossible to publish the December Magazine before Wednesday, the 9th December, so that I hope my readers will bear this in mind and not cause troublesome scenes at their dealers on the 1st December because the Magazine is not to hand!

Will Electricity Supersede Steam?

Electricity has developed so considerably in recent years that it now plays one of the most important parts in everybody's life. With it we light our houses and shops, cook our meals, warm our rooms, sweep our carpets and do a thousand-and-one other things. Although its introduction into everyday life has been gradual, there would be a considerable blank in the world's affairs if the electric current were eliminated. In this issue is printed the first part of a special article on the Story of the Electric Train. I feel sure that the facts dealt with in this article will interest all my readers, whether or not they are railway enthusiasts.

It is very satisfactory to learn of the adoption of electricity for railway working if only from the fact that the development gives great scope to engineers. Not only does the building of dams and artificial lakes, the laying down of pipe-lines, and the establishment of hydro-electric stations, make work for engineers, but in nearly every direction the general development provides almost unlimited scope for the inventor.

No doubt my readers have often wished that they lived a hundred years ago at the commencement of the era of the steam train. If Meccano had been in existence at that time there would have been daily improvements made to Stephenson's "*Locomotion*," and with such a large body of bright boys thinking and working on the problems presented by the steam engine there is no doubt that the development of the steam locomotive would have been considerably hastened.

Although the pioneer work of the steam locomotive and of steam railways was done a hundred years ago, I would remind my readers that they are living in the pioneer days of electrical traction. Undoubtedly in years to come there will be a call for more engineers for work in connection with the electrification of the railways, and future development should offer satisfactory scope for the energies and inventiveness of Meccano boys—the engineers of the future.

Meccanoland in Pantomime

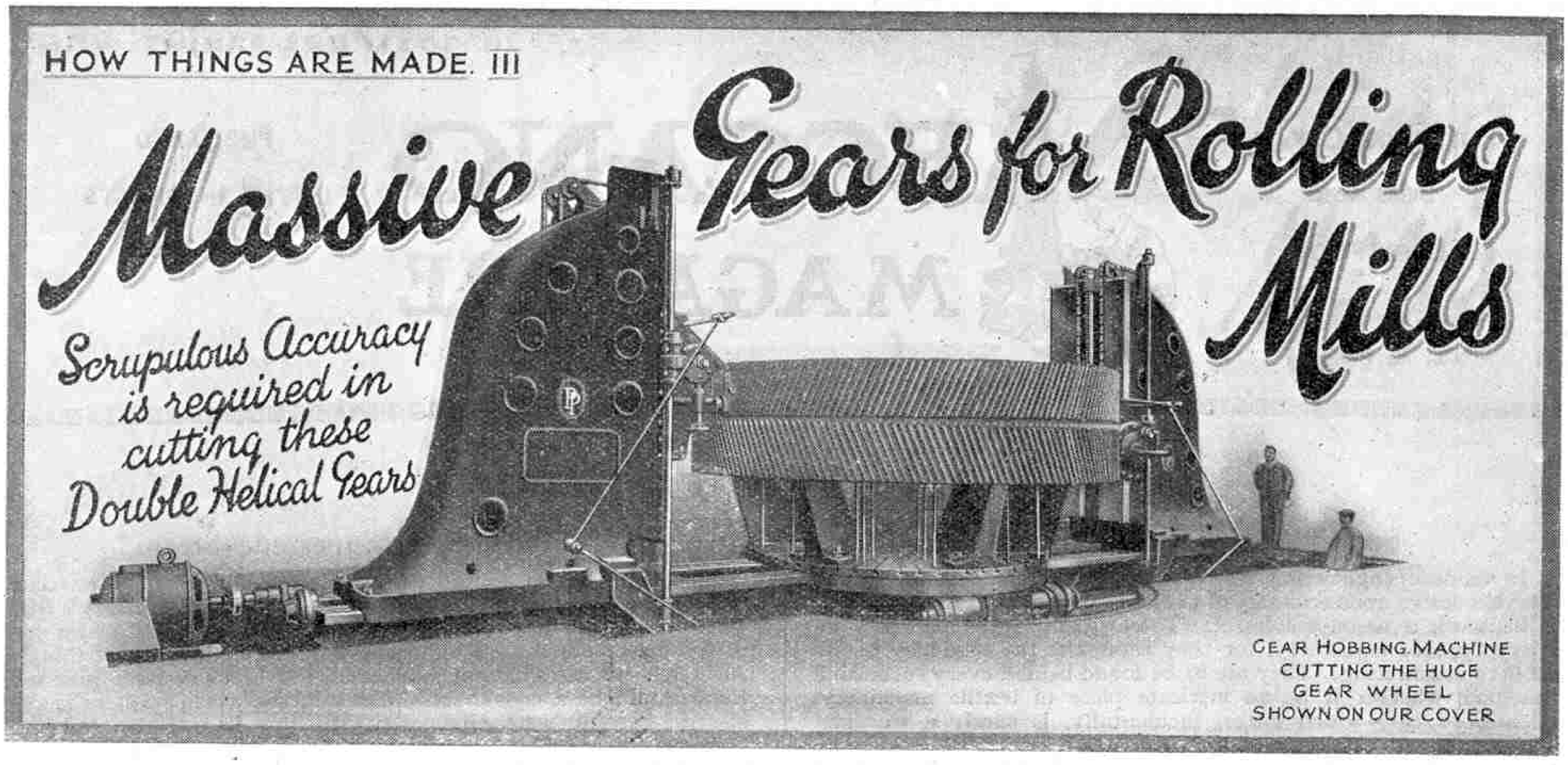
I expect that after a day of Meccano model-building many of my readers have had wonderful dreams in which they have seen their models magnified a hundred times. Those boys who are fortunate enough to live in or near Liverpool will see this dream realised in real life this Christmas, for there is to be a real Meccanoland scene in Julian Wylie's pantomime "The Sleeping Beauty" at the Empire Theatre, Liverpool. Aeroplanes, Cranes, Flip-Flap and Big Wheel will be represented on the stage with huge Meccano parts. There will be real Meccano boys, wearing the regular Meccano jerseys, to play with these gigantic models—George Robey, Dan Leno (the son of the famous Dan Leno you have all heard your fathers talk about) and Marie Blanche, who, as the handsome, dashing "Prince Charming" will be the "principal boy" in this wonderful pantomime. Dozens of Meccano boys, will to all intents and purposes be in Meccanoland, for they will actually operate these gigantic Meccano models about which they have so often dreamed.

I am sure that every Meccano boy within a radius of many miles of Liverpool will ask his father to take him to see this wonderful Meccanoland scene and I hope to announce further particulars next month.

HOW THINGS ARE MADE. III

Massive Gears for Rolling Mills

Scrupulous Accuracy is required in cutting these Double Helical Gears



GEAR HOBBING MACHINE CUTTING THE HUGE GEAR WHEEL SHOWN ON OUR COVER

WE feel sure that our model-building readers, familiar with gear wheels in many forms and sizes, will be particularly interested in our cover this month. It shows one of the largest Double Helical Gears ever made. The larger wheel, measuring approximately 17 ft. in diameter and its face 4 ft. in breadth, is made from Siemens Martin cast steel. It consists of two pieces bolted together, the weight of each half of the wheel in the rough casting state being 15 tons. The pinion, made from a high carbon steel forging, is 18 ft. 6 in. in length and weighs 8 tons 12 cwts. The pitch of the teeth is 3·14 ins. and the pair of gears is capable of transmitting up to 15,000 h.p. when reducing from 245 to 34.5 r.p.m.

These gigantic gears were cut by Messrs. The Power Plant Co. Ltd., to whom we are indebted for the accompanying photographs. The gears were made to drive a number of steel rolling mills employed in rolling corrugated sheets. A rolling mill resembles a huge mangle with the two rollers connected together by gearing and driven by an electric motor working through a totally-enclosed reduction gear. The mill rollers are of cast steel and may be raised or lowered, according to the desired thickness of the metal to be rolled. One reduction gear, similar to that illustrated, drives twelve rolling mills.

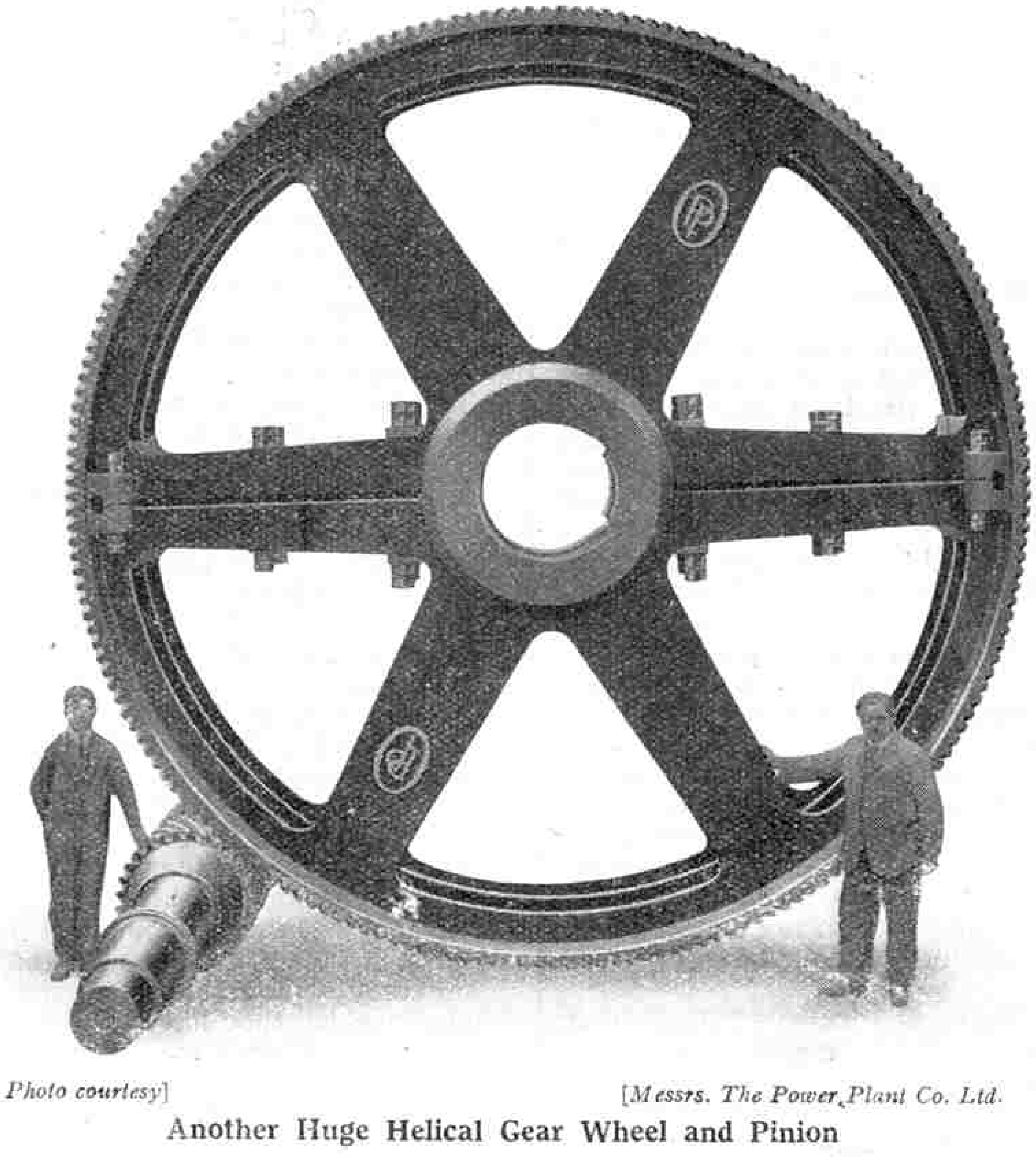


Photo courtesy] *[Messrs. The Power Plant Co. Ltd.*

Another Huge Helical Gear Wheel and Pinion

Introduction of Helical Gears

Of recent years the question of power transmission has received considerable attention, for it has been realised that an efficient system of transmission is essential if any given source of power is to be utilised to the full. This question of power transmission is one of the most difficult problems that engineers are called on to solve, and wherever power is generated or used the problem has to be faced. The overall efficiency of the power plant depends to a very large extent upon the solution of the problem of efficient transmission.

From the very beginning of the age of machinery, gearing of one sort or another has been used. Generally this has been in the form of straight-toothed spur gears. In the early days when power was both generated and applied at comparatively slow speeds, the disadvantages of inefficient transmission were perhaps not very serious, and certainly they were not obvious. More recently, however, the development of such high-speed prime movers as the steam turbine and the electric motor, and their employment for driving slow speed machinery, has placed an entirely different complexion upon the question of power transmission.

Although the introduction of the electric motor greatly influenced the production of accurately cut gears, the greatest influence in this connection was undoubtedly that of the steam turbine. Its development called for highly efficient and reliable machine-cut Double Helical Gears, for they made possible the necessary high peripheral velocity that was quite impracticable with the older straight-toothed gears.

Disadvantages of Spur-Gearing

With the ordinary straight-cut spur-gearing the engagement of the wheels commences across the point of the driving tooth, and it moves over the tooth surface until it ceases near the root. Theoretically, if the teeth are perfectly formed and the gears so designed that not less than two teeth are in engagement, the velocity ratio remains constant.

The different stages of the engagement of the wheels are cyclic, however, and the stresses on the lines of contact are constantly alternating. This causes unequal wear on the teeth and also unequal deflection, the consequence being that noise and vibration quickly develop in the gears. It is found, indeed, that this noise and vibration make it impossible to use straight-toothed gears wherever speeds are required greater than 2,500 ft. per minute, even when the gear wheels are cut with the greatest care and with a high degree of accuracy.

Noise and vibration is always present in straight-toothed gearing, even when used for low ratios. In the case of high ratios the defects are so apparent and serious that this form of gearing is never considered as a practical proposition.

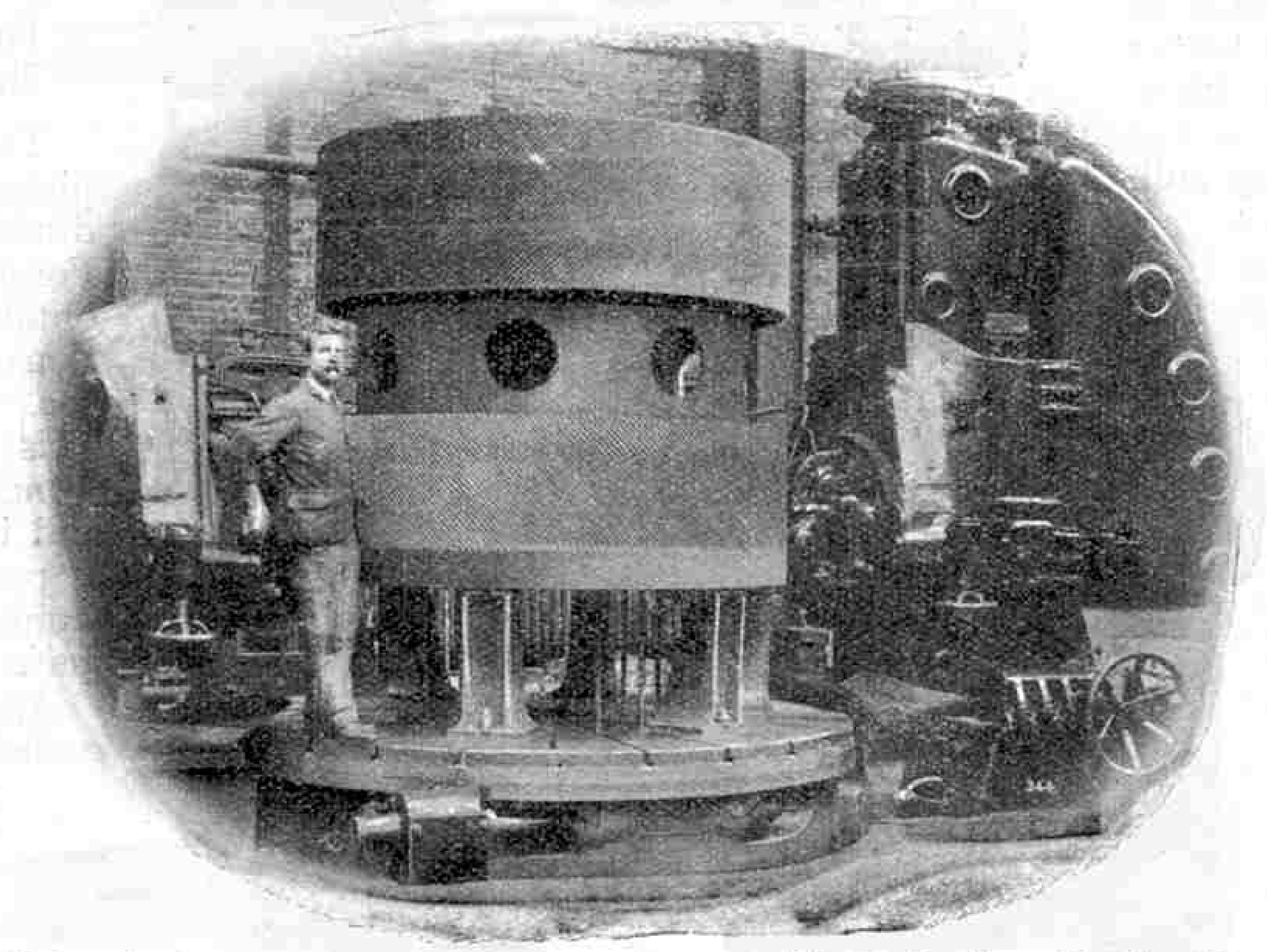


Photo courtesy] *[Messrs. The Power Plant Co. Ltd.*

Cutting a 23,000 h.p. Double Helical Gear
32/60/251 Teeth, 1·052 in. pitch, 54 in. Active Face width

Double Helical Gears are Smooth and Vibrationless

For high ratios and speeds greater than those that can be dealt with by straight-toothed gears, the machine-cut Double Helical Gearing has been introduced. The earliest examples of this form of gearing were comparatively crude and inaccurate, as judged by modern standards. They have constantly been improved and developed, however, until Helical Gears are now the only form of gear transmission to be considered by engineers when dealing with the transmission of high speeds.

To be satisfactory, Helical Gears must be correctly designed, the cutting must be meticulously accurate, and the lines of contact must have a path diagonally across the teeth at an angle with the axis in all planes. When these conditions are fulfilled Helical Gearing is the only type of gearing that has unvarying engagement and which gives a constant load carrying area.

Determining Gear Sizes

When a plant, such as a steel rolling mill, is being erected, the first thing the engineers have to consider is the exact amount of power required to roll the red hot metal from one thickness to another. Data for this is obtained from accurate records made on existing mills, and these figures are carefully tabulated. The engineer determines the power required and the speed at which the rollers are to be run, and this enables him to calculate the sizes of the gears, shafts, bearings, and framework necessary in the circumstances. Additional strength is given to the various parts to make allowance for the sudden and frequent shocks that occur in this class of work.

The sizes of the gears, shafts, etc., having been fixed, the job is passed to the Drawing Office where each component part is drawn out separately, and an arrangement drawing of the whole of the gearing is made. When this is completed, the drawings of all those parts requiring castings are sent to the Pattern Shop, where wooden patterns and core boxes are made, so that the necessary moulds can be made in sand or loam.

The moulds are made in the foundry and after they have dried they are set out in relation one to another, and everything is ready for the cast. We have already dealt in the "*M.M.*" with the casting of iron and steel, and the casting of these gear wheels is but a specialised branch of the ordinary foundry work such as has been already fully described. Ore is obtained from the mine, smelted, and treated so as to produce a steel having chemical and mechanical characteristics peculiar to the purpose for which the metal is ultimately required.

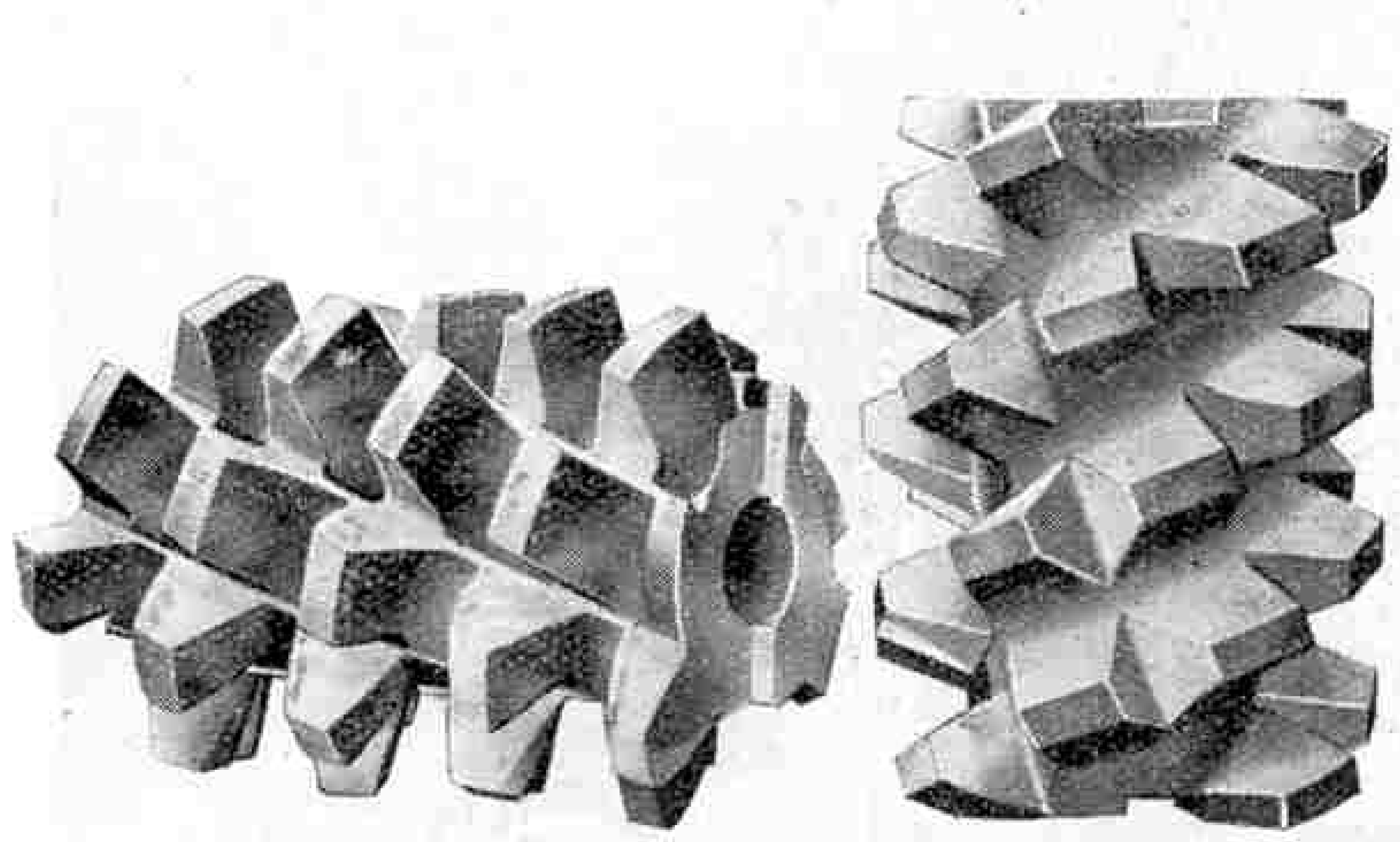


Photo courtesy] *[Messrs. The Power Plant Co. Ltd.*

The Cutting Hobs

Taken to the foundry, the metal is heated in the cupola until it becomes molten, and when at a white heat and sufficiently fluid, the cupola is tapped and the metal run into large ladles. These are then conveyed by means of overhead cranes to the moulds, the metal is poured in and is allowed to cool. Then the sand is removed, leaving the complete casting, which, after being trimmed up, or "fettled," by the foundry men, is ready to be taken to the Machine Shop.

Up to this point the treatment of the casting has been similar to the procedure in any engineering works, but it is in the Machine Shop that the treatment differs, for here the real work of gear-cutting begins.

Drilling the Casting

In the Machine Shop the first job is to plane across the joint of each casting, so that the two halves will fit accurately together. The casting is then drilled to enable bolts to be fitted so that the two halves may be secured one to the other.

When this has been done the casting is placed on a Boring Mill, where a rough cut is taken over the outside and the edges and across and through the boss. The wheel is then removed from the machine and allowed to stand for a little time so as to give the metal a rest, for the making of the rough cut may have liberated certain internal stresses that, if disregarded, might cause the wheel to become distorted.

After standing for a little while, the casting is again placed on a Boring Mill where it is finished, turned and bored, before being passed to the gear-cutting machine, which is a special machine tool designed for the particular purpose.

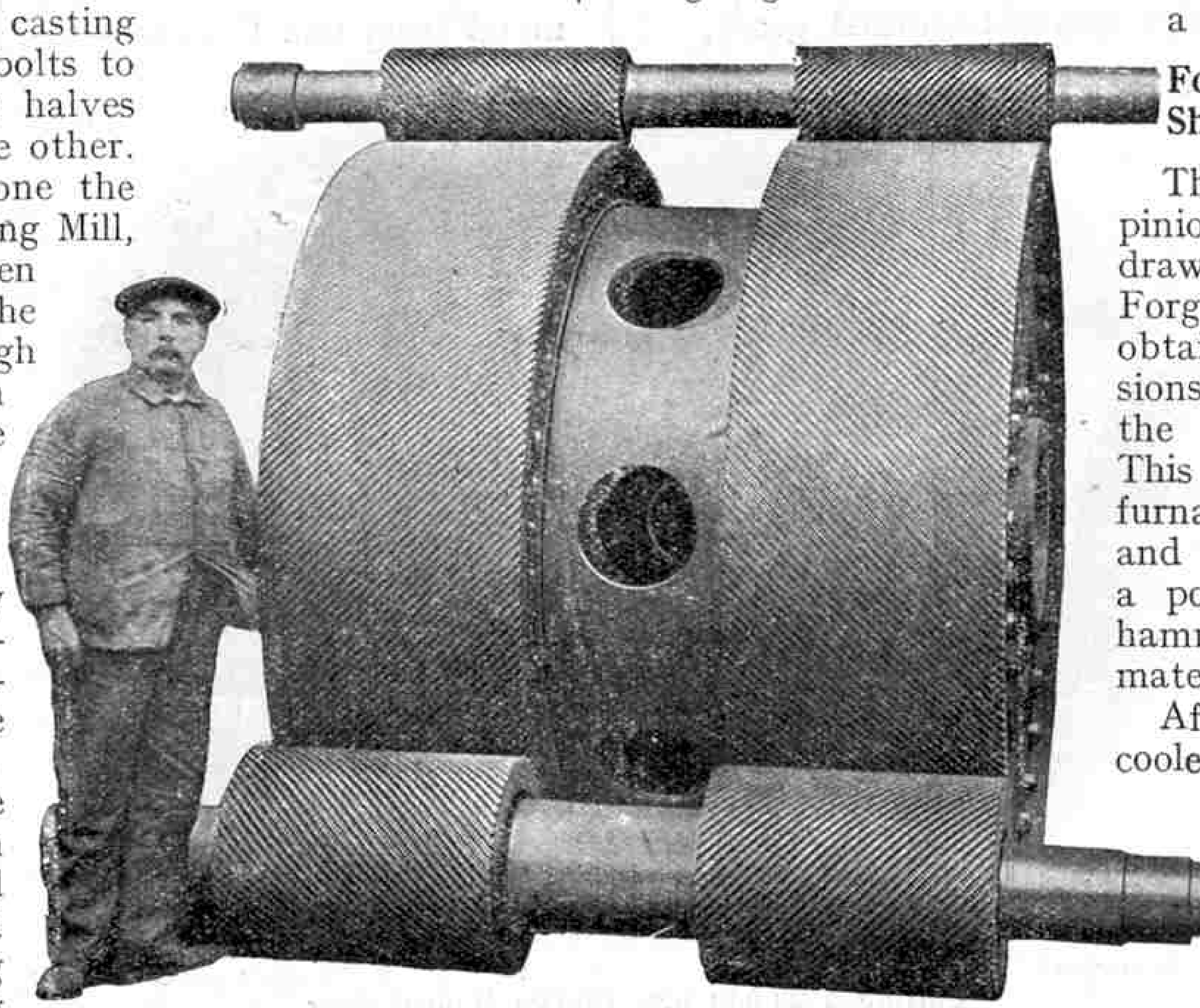


Photo courtesy] [*Messrs. The Power Plant Co.*

23,000 h.p. Gears for Battle-Cruisers

8,500 h.p. Pinion 2,660 r.p.m. 14,500 h.p. Pinion 1,420 r.p.m. Wheel 340 r.p.m.

A Wonderful Machine

The particular gear-cutting machine that cut the huge wheel illustrated on our cover was built by The Power Plant Co. Ltd., under their patents, and it is fitted at their works at West Drayton. It has a large circular bed-plate on which the casting is mounted. On each side there are heads, carrying cutters, which may be moved nearer together or further apart according to the different diameter of the work in hand. This machine has a maximum capacity of 20 ft. diameter and 12 ft. width.

The cutters used on this machine, known as "hobs," resemble a worm gear with a number of cuts at right angles to the thread, which cuts produce the cutting edges. The hobs are made of special steel, and are hardened and ground to correct shapes. Each operates at the same time, one cutting from the top downwards towards the centre of the face, and the other cutting from the bottom upwards.

Both the hobs and the casting revolve at pre-determined speeds that have a definite relation to each other. Meantime, the hobs are slowly moving across the face of the casting, removing metal from the face and so cutting into it that they form teeth of the correct shapes and at an angle that is dead accurate. It requires more than one cut to make a tooth. One or more roughing cuts are taken and the tooth is finished with a fine finishing cut.

Forging the Pinions and Shafts

The manufacture of the pinion commences with a drawing being sent to the Forge, where a billet is obtained of suitable dimensions and of metal possessing the necessary properties. This billet is heated in the furnace until it is red hot and it is then placed under a powerful hammer to be hammered into the approximate shape required.

After the forging has cooled, a roughing cut is taken all over, after which the pinion is turned up in a lathe and passed to the gear-cutting machines for the cutting of the teeth.

In the meantime, the shafts have been specially forged. The shaft for the large wheel is hydraulically pressed into position and further secured by shrink rings which, after heating, are placed in position on the wheel boss and there allowed to cool, thus causing contraction and enabling the boss to grip tightly on the shaft.

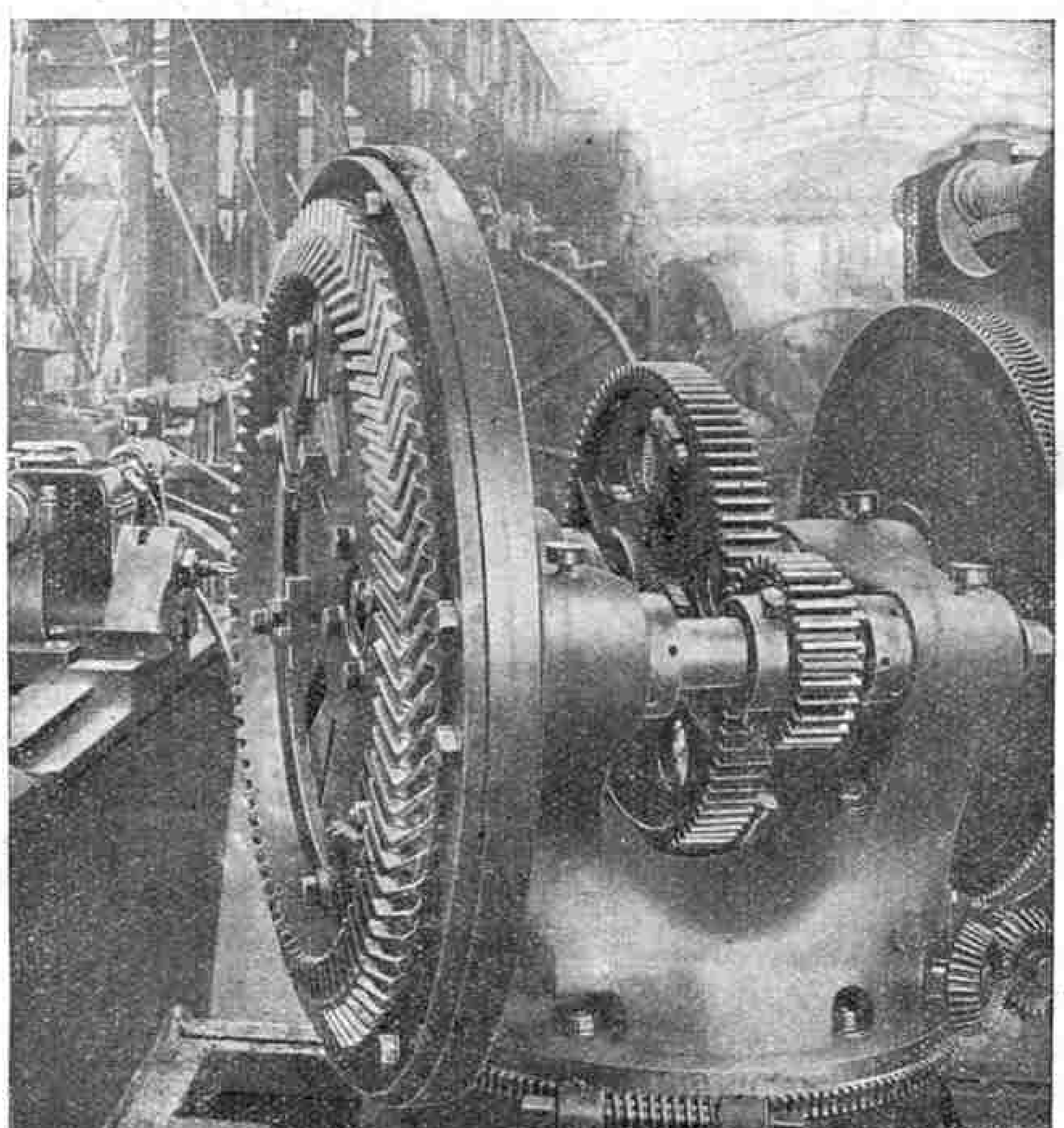


Photo courtesy] [*Messrs. The Power Plant Co.*

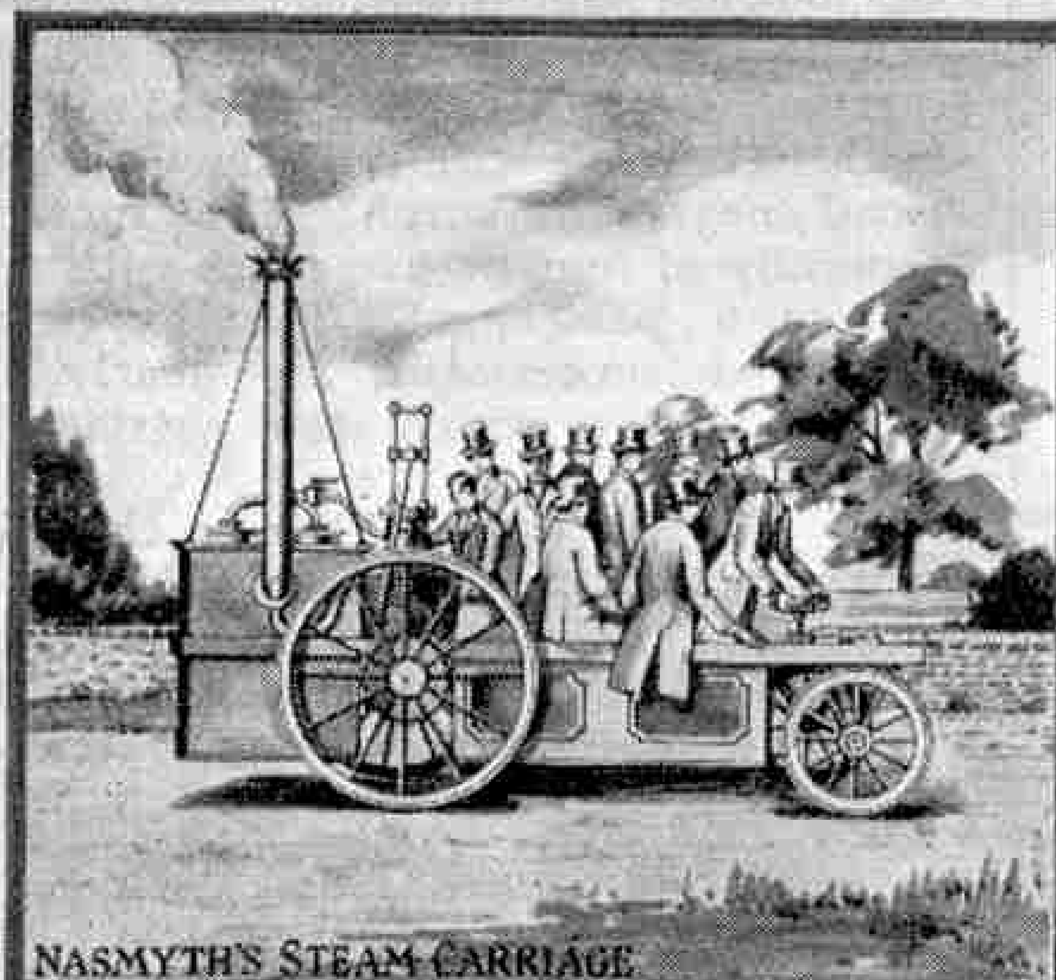
End Milling of Chevron type of Double Helical Bevel Gear Wheels

Value of Accuracy

The whole gearing, produced by the most scientific and accurate machinery, and the exercise of the greatest care, can be guaranteed to run with perfect smoothness and with a complete absence of noise and vibration even when used for the reduction of the highest speeds. Great accuracy also enables relatively fine pitches to be employed, thus making possible the use of the maximum number of teeth in simultaneous engagement. This is a point of great importance because it allows a uniform distribution of the load over the greatest possible tooth surfaces, thus reducing wear and tear to a minimum.

Double Helical Gears are used in collieries, mines, ships, power-stations, and in connection with industrial machinery of all kinds, each

(*Continued on page 603*


NASMYTH'S STEAM CARRIAGE

Lives of Famous Engineers

XXII
James Nasmyth and the STEAM HAMMER

JAMES NASMYTH, the inventor of the steam hammer, was born at Edinburgh on 19th August 1808. His father, Alexander Nasmyth, was an eminent landscape and portrait painter. He has been referred to as the founder of the Scottish school of landscape painting, and the one authentic portrait of Robert Burns, now in the Scottish National Gallery, is by him.

Origin of the Name

The traditional origin of the name Nasmyth is very interesting and the story as told by James Nasmyth himself in his autobiography is as follows :—

" In the troublous times which prevailed in Scotland before the union of the Crowns, the feuds between the King and the Barons were almost constant. In the reign of James III., the House of Douglas was the most prominent and ambitious. The Earl not only resisted his liege lord, but entered into a combination with the King of England, from whom he received a pension. He was declared a rebel, and his estates were confiscated.

" He determined to resist the royal power, and crossed the Border with his followers. He was met by the Earl of Angus, the Maxwells, the Johnstons, and the Scotts. In one of the engagements which ensued the Douglases appeared to have gained the day, when an ancestor of the Naesmyths, who fought under the royal standard, took refuge in the smithy of a neighbouring village. The smith offered him protection, disguised him as a hammerman, with a leather apron in front, and asked him to lend a hand at his work.

" While thus engaged a party of the Douglas partisans entered the smithy. They looked with suspicion on the disguised hammerman, who, in his agitation, struck a false blow with the sledge hammer. Upon this, one of the pursuers rushed at him, calling out ' Ye're nae smyth ! ' The stalwart hammerman turned upon his assailant, and, wrenching a dagger from him, speedily overpowered him. The smith himself, armed with a big hammer, effectually aided in overpowering and driving out the Douglas men. A party of the royal forces made their appearance, when Naesmyth rallied them, led them against the rebels, and converted what had been a temporary defeat into a victory.

" A grant of lands was bestowed upon him for his service. His armorial bearings consisted of a hand dexter with a dagger, between two broken hammer-shafts, and there they remain to this day. The motto was, *Non arte sed marte*, ' Not by art but by war.' In my time I have reversed the motto (*Non marte sed arte*) ; and instead of the broken hammer-shafts, I have adopted, not as my ' arms ' but as a device, the most potent form of mechanical art—the Steam Hammer."


James Nasmyth

Ancestor Burned as a Witch

It is interesting to learn that a member of the Nasmyth family, Elspeth Naesmyth, who lived at Hamilton in the " good old times," was burned as a witch, the evidence against her being that she kept four black cats and read her Bible with two pairs of spectacles !

James Nasmyth undoubtedly inherited mechanical ability from his father. It was one of Alexander Nasmyth's greatest joys, as a relief from his work at the easel, to retire to his little workroom, which was fitted up with tools and mechanical appliances of all kinds. It was in this room that the boy James first learned to handle mechanical tools.

Tree-Planting by Artillery

An instance of Alexander Nasmyth's ingenuity is worth recalling. On one occasion the Duke of Athol consulted him regarding a rocky crag called Craigybarns, which he desired should be planted with trees to relieve the barrenness of its appearance. The difficulty lay in the fact that the crag was so precipitous that it was impossible for any man to climb it in order to set seeds or plants in the clefts of the rocks.

Alexander Nasmyth pondered over the problem for a while and then a happy idea struck him. He had observed in front of the Duke's castle a pair of small cannon used for firing salutes, and he saw a method of turning these to account. The village tinsmith was ordered to make a number of canisters fitted with covers, and these were filled with the seeds of suitable trees. By means of the cannon the canisters were fired against the face of the rock, where they burst and scattered the seed in all directions.

Many years afterwards, when Alexander Nasmyth re-visited the place, he was delighted to find that trees, planted as it were by artillery, were flourishing in recesses of the rock.

James Nasmyth was fortunate in meeting many famous men during his boyhood days. One of his earliest hobbies was that of collecting old coins. One day while he was busily engaged in making a drawing of a particularly fine Roman coin, Sir Walter Scott came into the room, noticed what the boy was doing and asked to see his collection. James proudly exhibited his little store, and afterwards Sir Walter took from his pocket a beautiful silver coin of the reign of Mary Queen of

Scots and presented it to him as a "young brother antiquary."

On another memorable occasion he saw James Watt, then over 80 years of age. Watt was on a visit to Edinburgh and during his stay he called upon Alexander Nasmyth. James only saw him as he was leaving the house, but the great man's benevolent countenance and tall but bent figure made a lasting impression upon his mind.

Early Mechanical Enthusiasm

As in the case of most great engineers and inventors, James Nasmyth showed a strong leaning towards mechanical matters at an early age. While he was attending the Edinburgh High School he had the good fortune to have for a companion the son of an ironfounder.

"Every spare hour I could command," he tells us, "was devoted to visits to his father's iron foundry, where I delighted to watch the various processes of moulding, iron-melting, casting, forging, pattern-making, and other smith and metal work; and although I was only about twelve years old at the time, I used to lend a hand, in which hearty zeal did a good deal to make up for want of strength. I look back to the Saturday afternoons spent in the workshops of that small foundry as an important part of my education. I did not trust to reading about such and such things; I saw and handled them; and all the ideas in connection with them became permanent in my mind. I also obtained there—what was of much value to me in after life—a considerable acquaintance with the nature and characters of workmen.

Bribing the Monitors

"By the time I was fifteen, I could work and turn out really respectable jobs in wood, brass, iron and steel, indeed, in the working of the latter inestimable material I had at a very early age (eleven or twelve) acquired considerable proficiency. As that was the pre-lucifer match period, the possession of a steel and tinder box was quite a patent of nobility among boys. So I used to forge old files into 'steels' in my father's little workshop, and harden them and produce such first-rate, neat little articles in that line that I became quite famous amongst my school companions; and many a task have I had excused me by bribing the monitor, whose grim sense of duty never could withstand the glimpse of a steel."

Nasmyth left the High School at the end of 1820 and continued his studies at private classes, at the same time working regularly in his father's workroom. About this time he had an opportunity of visiting the celebrated Carron Ironworks, which made a great impression upon him. Of this visit he wrote:—"The Carron Ironworks are classic ground to engineers. They are associated with the memory of Roebuck, Watt and Miller of Dalswinton. For there Roebuck and Watt began the first working steam-engine; Miller applied the steam-engine to the purposes of navigation, and invented the Carronade gun. The works existed at an early period in the history of British iron manufacture. Much of the machinery continued to be of wood. Although effective in a general way it was monstrously cumbrous. It gave the idea of vast power and capability of resistance, while it was far from being so in reality.

"It was, however, truly imposing and impressive in its effect upon strangers. When seen partially lit up by the glowing masses of white-hot iron, with only the rays of bright sunshine gleaming through a few holes in the roof, and the dark, black smoky vaults in which the cumbrous machinery was heard rumbling away in the distance—while the moving parts were dimly seen through the murky atmosphere, mixed with the sounds of escaping steam and rushes of water; with the half-naked men darting about with masses of red-hot iron and ladles full of molten cast-iron—it made a powerful impression upon the mind."

The Fight in the Smithy
From a drawing made by Nasmyth

Constructs a Steam Carriage

Nasmyth now began to occupy himself with building working models of steam engines and other mechanical apparatus, to serve as illustrations for lectures on engineering and mechanics. He worked very hard during this period, rising early to work at his father's lathe, attending university classes during the day and sitting up late at night to make brass castings in his bedroom!

About the year 1827 the subject of steam carriages to run upon the ordinary roads was attracting a great deal of attention. Many engineers had produced vehicles of sorts and Nasmyth thought that he, too, would try his hand. He made a small working model of a steam carriage and exhibited it before the members of the Scottish Society of Arts. The performance of this model was so satisfactory that the Society requested him to construct a full-sized carriage capable of conveying four or six persons, and towards the cost of this vehicle the Society subscribed £50. The carriage was duly completed and successful trials were made with it on the Queensferry Road near Edinburgh. The runs were generally of four or five miles with a load of eight passengers. The experiments continued successfully for nearly three months, after which the carriage was broken up.

While on the subject of road vehicles it may be mentioned that the first coach started from Edinburgh to Newcastle from an inn in the Grassmarket, Edinburgh, opposite the house where Nasmyth's father was born. The public notice exhibited there was decidedly cryptic. It stated that: "The Coach would set out from the Grass market ilka Tuesday at Twa o'clock in the day God Wullin; but whether or no on Wednesday!"

Voyage to London

The chief ambition of Nasmyth at this time was to go to London and obtain employment at the famous works of Henry Maudslay. He knew that his father was unable to pay the large premium required for placing an apprentice at Maudslay's works, but he thought that by showing specimens of his work and drawings he might be able to satisfy Maudslay of his ability, and so possibly be taken on. With this object in view he constructed a working model of a high-pressure engine and prepared several drawings in his very best style. Model and drawings were carefully packed up and on 19th May 1829 Nasmyth and his father set sail by the Leith smack "*Edinburgh Castle*," and reached their destination after a pleasant voyage.

At the first opportunity they set out for Maudslay's house adjoining the works in Westminster Road, Lambeth. Maudslay was at home and received them in his usual friendly manner. After a short general conversation the object of the visit was stated and, to the acute disappointment of the boy, Maudslay replied that his experience of pupil apprentices had been so unsatisfactory that he had decided to take no more.

Assistant to Maudslay

The boy did not give up hope, however, and before leaving he ventured to ask Maudslay if he would examine the model and drawings he had brought from Edinburgh. Maudslay agreed and they were duly brought round to his house the next morning. Maudslay and his partner, Joshua Field, examined the work in detail for twenty minutes and Maudslay then informed Nasmyth that he had decided to take him, not as an apprentice, but as his assistant workman to work beside him in his private workshop.

This was an honour of which Nasmyth had never even dreamed, and his delight was unbounded! He continued to work alongside Maudslay until the latter's death in February 1831, from a chill contracted while crossing the Channel when returning from a visit to a friend at Boulogne.

This event was a severe blow to Nasmyth, but he was greatly consoled by the kindness of Maudslay's partner Field, for whom he acted as draughtsman for some months. During this period Field gave him many valuable hints in regard to the designing of machinery and in particular he impressed upon him the importance of bearing in mind the importance of the "*get-at-ability*" of parts, so that when any part of a machine was out of order it could be repaired without taking the whole machine to pieces.

Commences business in Manchester

Nasmyth was now in his 23rd year and was desirous of commencing business for himself. He therefore bade farewell to his good friends in London and returned to Edinburgh, where he set to work to equip himself with a stock of engineering parts.

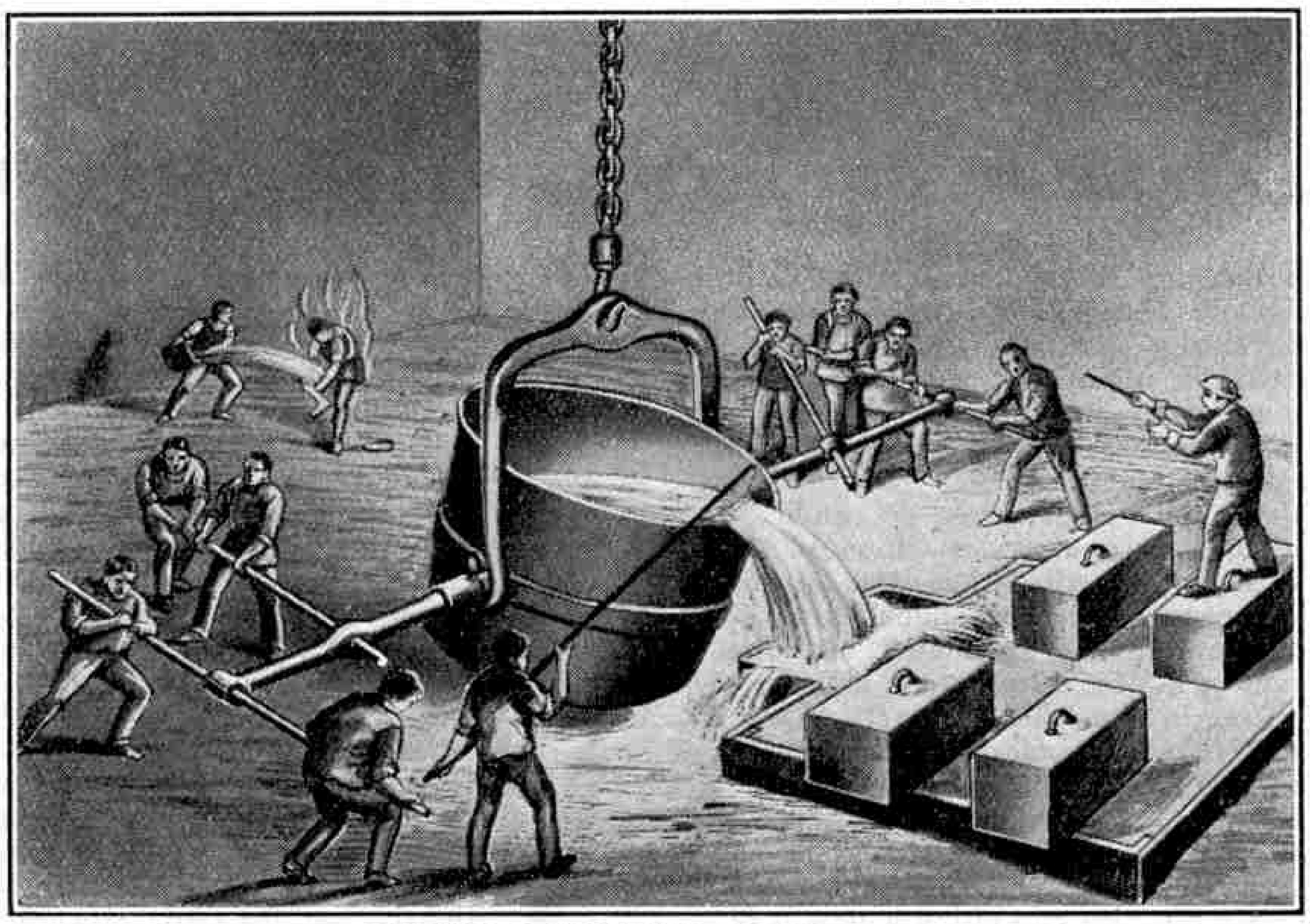
He now had to decide where he would set up in business and his choice ultimately fell upon Manchester. In June 1834 he took a flat in an old mill in Dale Street in that city and began business in a very small way. He soon obtained small orders and these he executed so well and so promptly that repeat orders came in and gradually his business grew and prospered. By degrees he took on more employees and introduced new and bigger machinery, and finally there came a time when the flat was no longer adequate to his needs.

The actual move came about in a somewhat startling manner. The tenant of the flat below Nasmyth was a glass cutter, who was always somewhat nervous regarding the weight of Nasmyth's machinery above his head. From time to time he noticed with alarm that bits of plaster were dropping down among his cut glasses and decanters and he greatly feared that some day the floor and its weighty contents would tumble down and involve him in ruin. His fears were only too well justified!

A Shock for the Glass Cutter

Nasmyth obtained an order for a high-pressure steam engine of 20 h.p. to drive the machinery of a distillery at Londonderry in Ireland. He was very doubtful at first about undertaking the job, on account of the size of the engine and the limited space available in his already over-crowded workshop. He was anxious not to let such an order pass, however, and finally undertook to execute it. Instead of building the engine perpendicularly, he constructed it lying upon its side and managed to complete it. The next step was to take it to pieces to be packed for conveyance to Londonderry, and then disaster occurred, for his men had the misfortune to allow the end of the engine beam to fall. Through the floor it crashed with a terrible scattering of lath, plaster and dust, and descended upon the glass-cutter's stock below!

The glass-cutter was in a dreadful state of panic and rage and he rushed off to find the landlord and bring him to judge for himself. The landlord came and was not long in judging. He looked in at the glass-worker's flat and saw the damage that had been done among the tumblers and decanters. In addition to this there was the hole in the floor through which the end of the engine beam had crashed. The landlord next visited Nasmyth and gently but firmly begged him to remove himself and his machinery at the earliest possible moment before he brought the whole building to the ground!



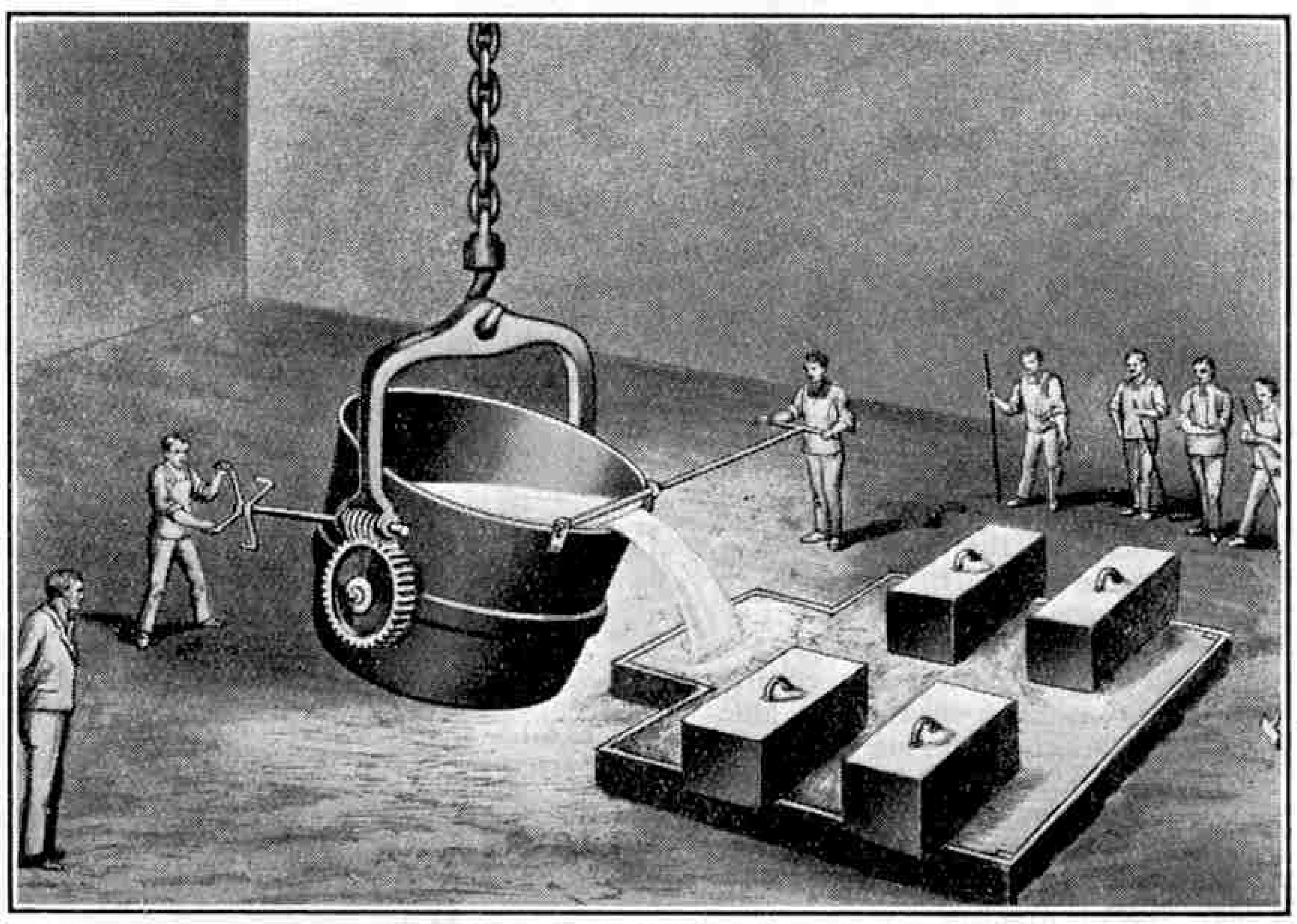
Old Type of Foundry Ladle

Bridgewater Foundry

On a previous visit to Manchester Nasmyth had sat down to rest on the parapet of the bridge overlooking the Bridgewater Canal near Patricroft, and had gazed longingly upon a plot of land along the canal side. After the disaster just described he went out again to look at the plot and found it was still unoccupied. It consisted of about six acres and was bounded on one side by the Bridgewater Canal; on another side by the Liverpool and Manchester Railway and on a third side by a good road. Nasmyth lost no time in calling upon the owner of this land and was fortunate in securing it at a very low annual rental on a lease for 999 years.

The erection of workshops proceeded rapidly and by August 1836 the foundry, which Nasmyth named the Bridgewater Foundry, was in full swing. Work increased, more and more workmen were taken on, cottages for their accommodation sprang up, and where there had been quiet fields became the centre of a busy population.

Shortly afterwards Nasmyth took in a partner named Holbrook Gaskell, who had had considerable commercial experience and who also possessed a fair amount of capital. This partnership continued successfully for sixteen years, at the end of which Gaskell had to leave the firm on account of ill-health.



Nasmyth's Improved Safety Foundry Ladle

Invention of Safety Ladle

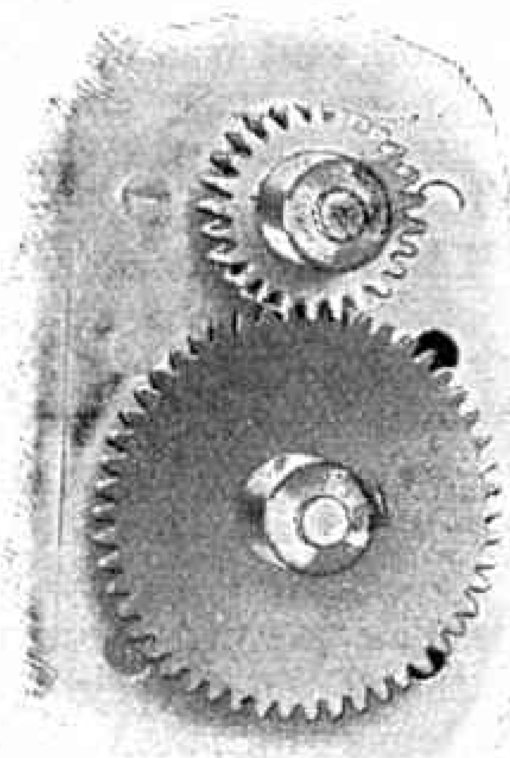
In 1838 Nasmyth invented his safety foundry ladle. He had observed the danger caused to workmen by the method of pouring the molten iron into the casting moulds. The white-hot metal was drawn off from the melting furnace into a large ladle fitted with handles and levers manipulated by 12 or 15 men. The ladle contained several tons of metal and was transferred by a crane to the moulds. The whole operation required the utmost care and steadiness, for if a stumble occurred and the ladle was in the slightest

Continued on page 584)

MECCANO STANDARD MECHANISMS

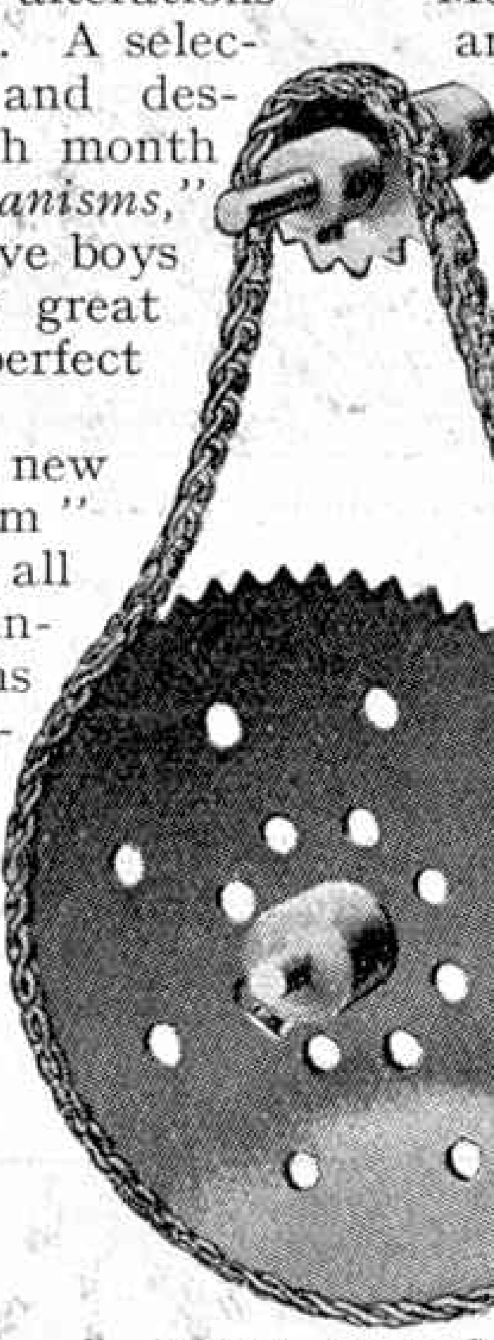
GEAR RATIOS AND BELT AND ROPE MECHANISM

NO Meccano boy is content to build only the models illustrated in the Meccano Manuals, for every boy who thinks is keen on inventing and likes to build models from his own ideas. With this in mind, and to assist boys to embody correct engineering practices in their new models, we have collected and classified a number of Meccano movements that have to a certain extent become standardised. That is to say, these movements may be applied to more than one model—in most cases without any alteration, but in some few cases with only slight alterations to the standard movement. A selection will be illustrated and described in the *"M.M."* each month as *"Meccano Standard Mechanisms,"* and we believe that inventive boys will find these articles of great assistance in helping to perfect their Meccano models.



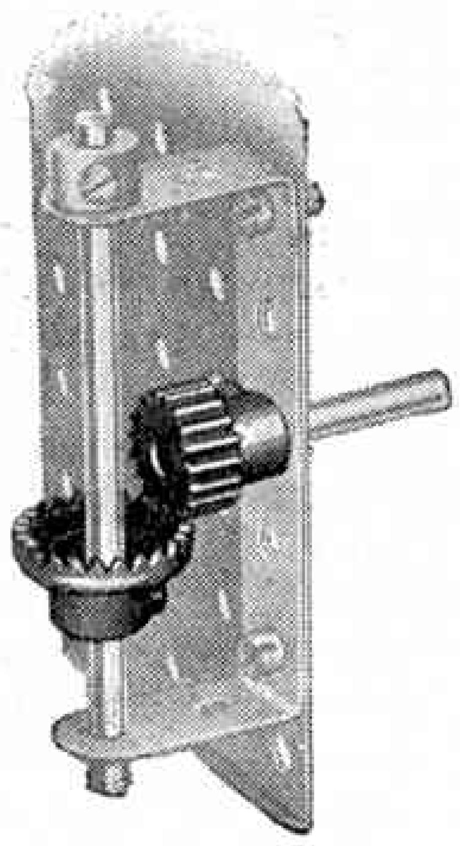
S.M. 1
¾" Pinion and 50-tooth Gear Wheel

We are also compiling a new "Standard Mechanism" manual which will comprise all these movements, divided into thirteen different Sections and indexed so that immediate reference may be made to any particular motion that it is desired to incorporate in a model. The sections dealing with "Pulleys" and "Levers" will be amplified by the description of several interesting experiments carried out with Meccano.



S.M. 7 Chain Gear

Other features will include Clutches, Reversing and Drive-changing Mechanism, Brakes and Retarding Appliances, Bearings, Screw Gear, Steering Gear, Traversing Mechanism, etc. The principles involved in these details will well repay the study of any boy interested in engineering.

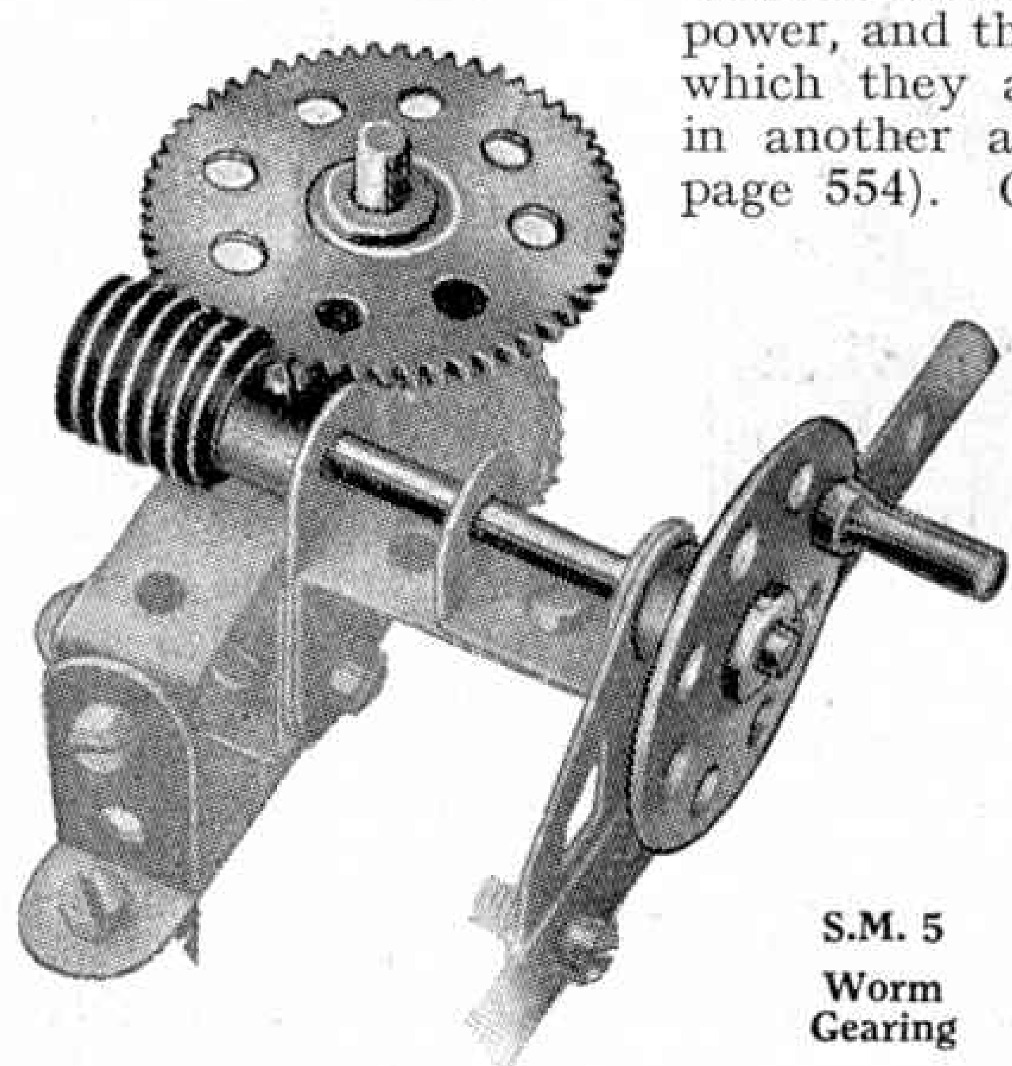


S.M. 3
Contrate Gear (for shafts at right angles)

Cutting Meccano Gears

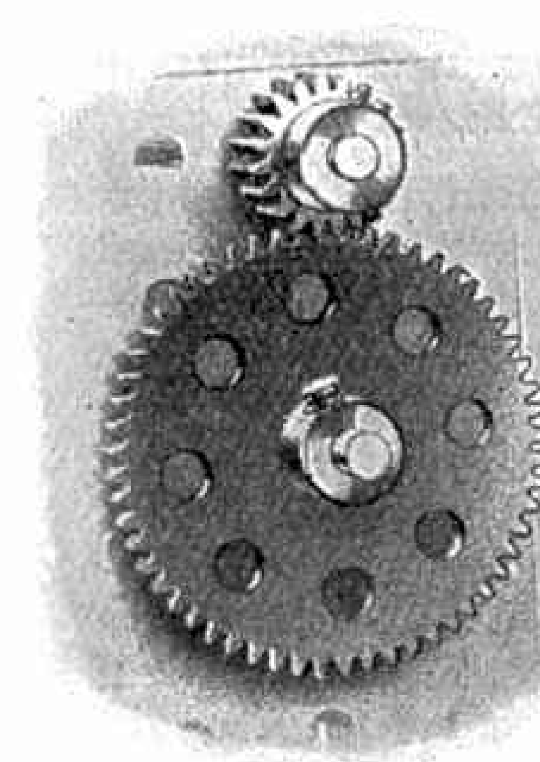
The important part played by toothed wheels in the transmission of power, and the wonderful processes by which they are made, are described in another article in this issue (see page 554). Gear Wheels are equally indispensable in Meccano engineering, and Meccano Gear Wheels are made in much the same manner as are the gears used in actual practice.

We believe all Meccano boys would like to watch a "No. 26" or "27" as it passes through the various stages of manufacture. It is certainly very interesting to observe solid pieces of brass being transformed with amazing rapidity into beautifully finished Gear Wheels, destined, in all probability, to provide many years of hard service in hoisting loads or working hammers, drills, lathes, engines, clocks, and motor cars, at the bidding of some happy Meccano boy!



S.M. 5
Worm Gearing

The first process is the cutting and shaping of the wheel from the bars of solid brass, boring out the centres, and cutting the thread to receive the set-screws. Next a number of these blanks—still quite unfamiliar in appearance to the Meccano boy—are placed face to face and inserted on a mandril in a wonderful machine-tool. Here a circular cutting tool, revolving at a high speed, passes along the row of brass discs, and in doing so cuts out a single tooth in each wheel. When the tool has reached the end of its stroke, the blanks are rotated slightly, and the tool, returning, cuts out the next tooth. This process is repeated until all the teeth are shaped.

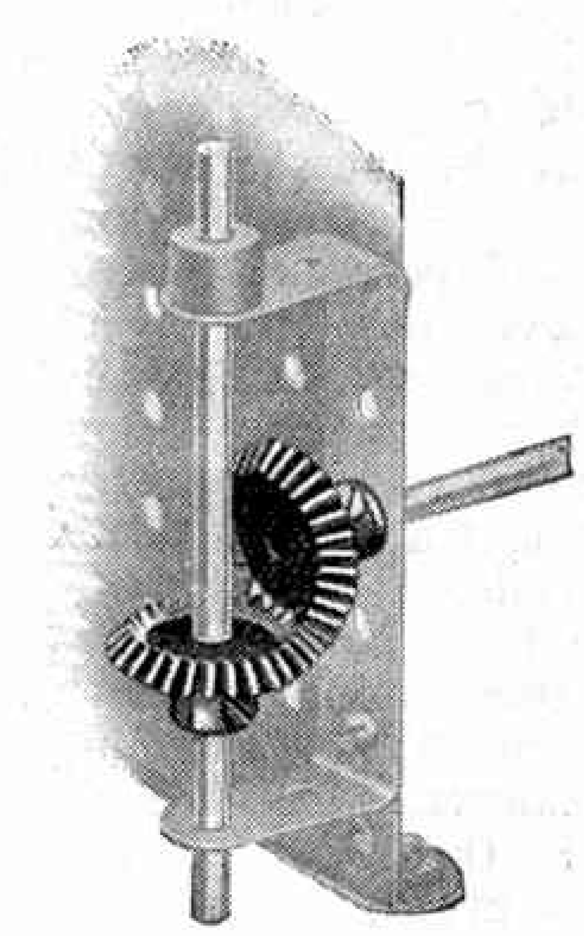


S.M. 2
½" Pinion and 57-tooth Gear Wheel

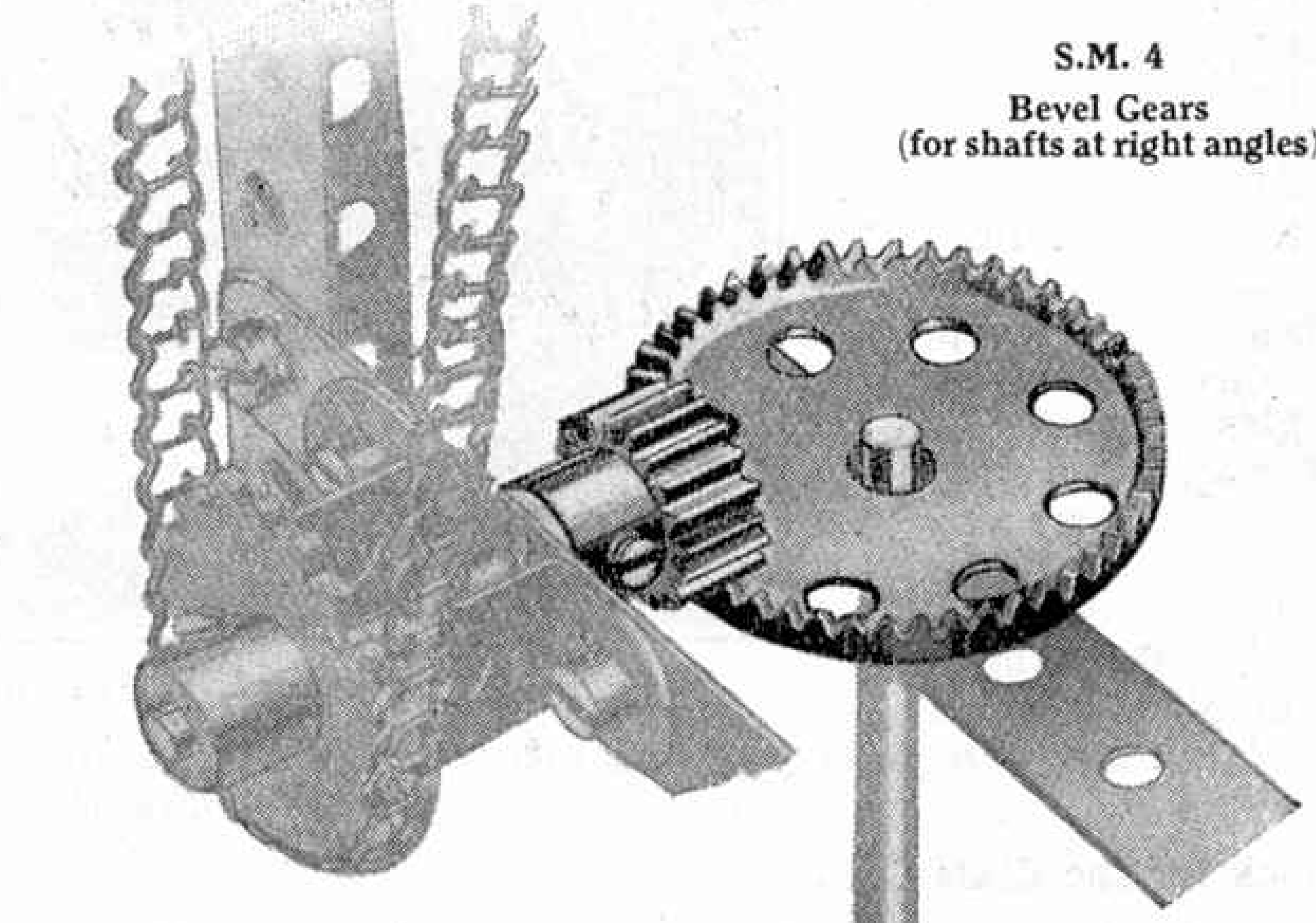
Section I. Gear Ratios

Standard Mechanism No. 1 shows the Meccano ¾" Pinion in mesh with a 50-tooth Gear Wheel. Since the Pinion possesses 25 teeth, it is obvious that it must rotate twice to every one revolution of the Gear Wheel. Thus the speed ratio of this gear is 2 to 1.

S.M. 2 illustrates the ½" Pinion (19 teeth) and 57-tooth Gear Wheel, giving a ratio of 3 to 1. A larger ratio is obtained from the use of a ½" Pinion and 3½" Gear Wheel (133 teeth), in which the Pinion must revolve seven times as fast as the Gear Wheel.



S.M. 4
Bevel Gears (for shafts at right angles)



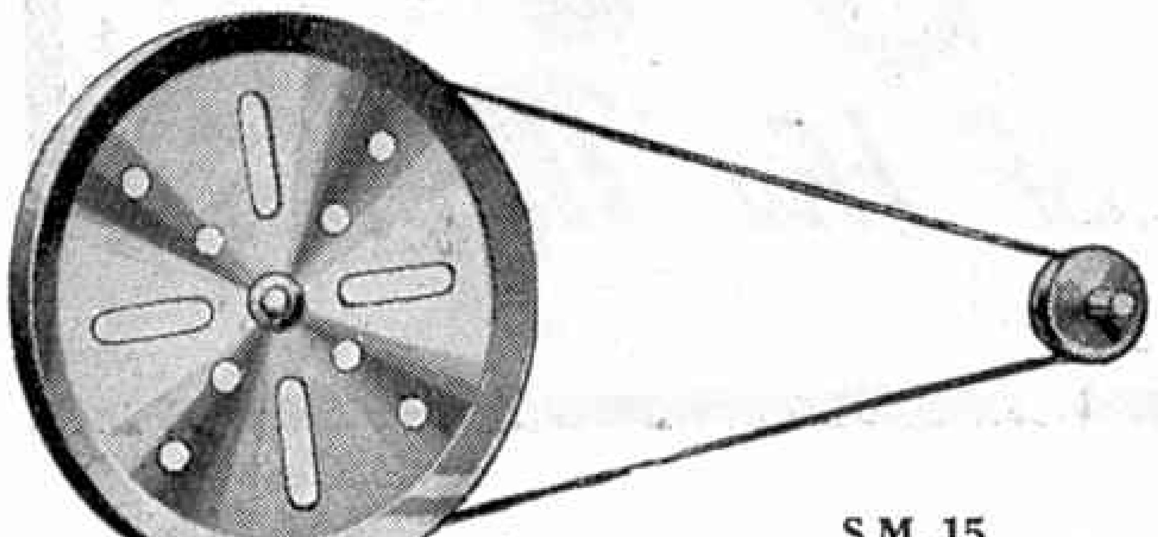
S.M. 6
½" Pinion and 1½" Contrate Wheel (for shafts at right angles)

Meccano Standard Mechanisms—(*continued*)

One to one ratios may be obtained by connecting two shafts by means of 1″ Gear Wheels or two ½″ Pinions.

Either Bevel Wheels or Contrate Wheels may be employed to drive shafts placed at right-angles to one another.

The Bevel drive (S.M. 4) provides for a 1 to 1 ratio only, but varying speeds can be produced with contrate gears. S.M. 3 illustrates a ½″ Pinion and ¾″ Contrate Wheel, giving an approximate ratio of 1⅓ to 1, while S.M. 6 shows the 1½″ Contrate Wheel driven by a ½″ Pinion, in which the ratio is roughly 2⅔ to 1. A 2 to 1 gear is provided by a ¾″ Pinion and 1½″ Contrate Wheel.

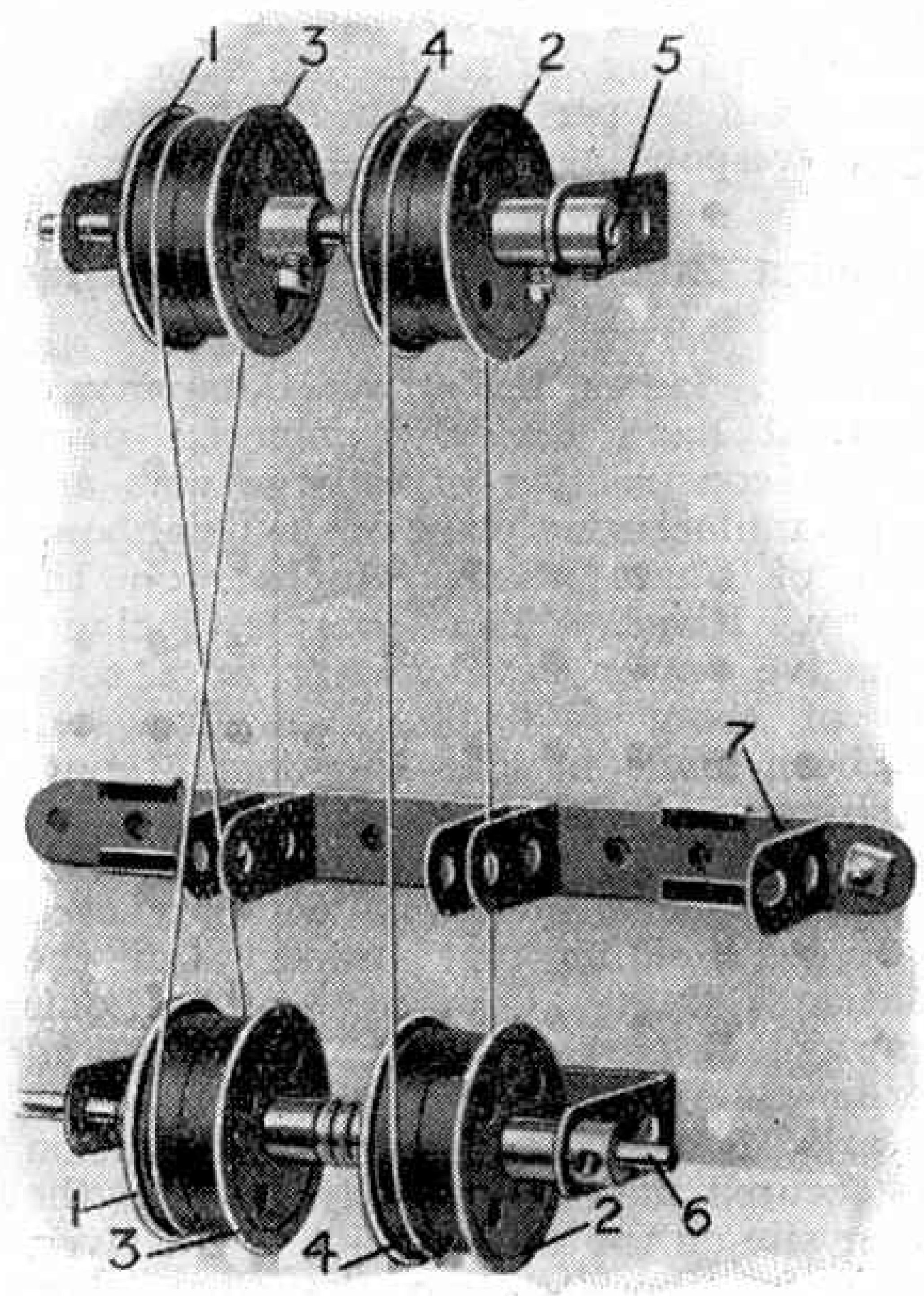


S.M. 15
Open Belt Gear

S.M. 5 is a typical Worm drive, providing for the big speed reduction of 57 to 1. To find the speed ratio in Worm gears, it may be assumed that the number of revolutions of a Gear Wheel (or Pinion) to one revolution of the Worm correspond with the number of the teeth in the Gear Wheel. For example, ½″ Pinion and Worm gear gives a ratio of 19 to 1.

The Meccano Sprocket Chain gear is unique in model engineering. It provides a positive and smooth-running drive which lends itself to an unlimited number of applications, and the wide range of sizes to which the Sprocket Wheels are made provide a number of varying speed ratios. The illustration (S.M. 7) shows a chain drive between ¾″ and 3″ Sprocket Wheels, giving a speed reduction of four revs. to one. Two to one drives may be obtained by employing one 1″ and one 2″ Sprocket Wheel, or one ¾″ and one 1½″ Sprocket Wheel, while ratios of 1 to 1 may be obtained by running the Chain over any two Sprocket Wheels of like diameter.

Reduction gearing becomes of special importance in models driven by Meccano Electric Motors, for it should be remembered that the Motors prove most efficient when running at maximum speed, no matter at what rate the model itself is required to move.



S.M. 18
Belt Reversing Gear and Belt Clutch

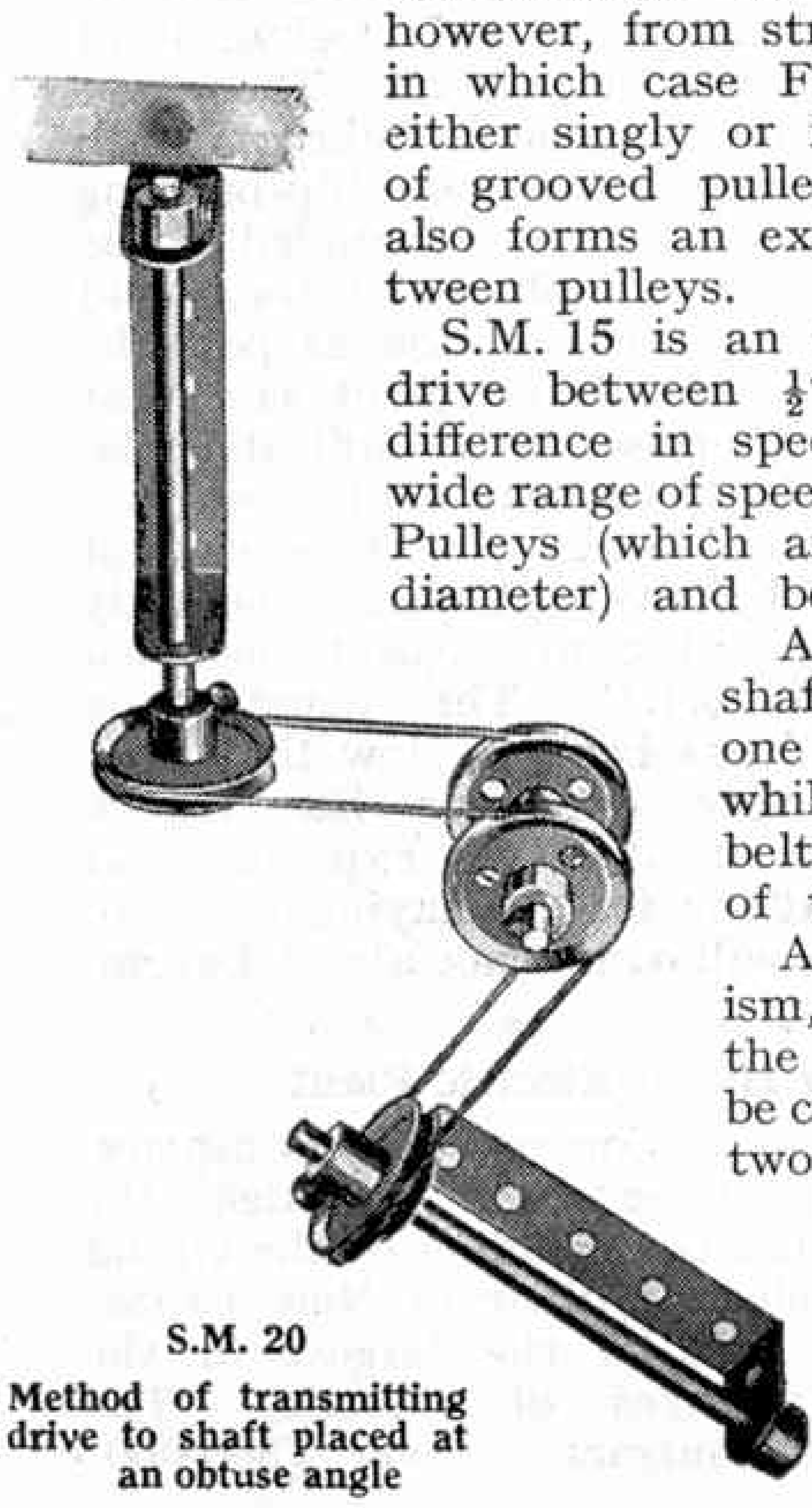
Section II. Belt & Rope Mechanism

In Meccano models, cords usually take the place of belts for this method of power transmission. Miniature belting may be made, however, from strips of canvas, indiarubber, etc., in which case Flanged Wheels should be used, either singly or in pairs (as in S.M. 18) instead of grooved pulleys. The Meccano Spring Cord also forms an excellent means of connection between pulleys.

S.M. 15 is an example of ordinary open belt drive between ½″ and 3″ Pulleys, giving great difference in speed between the two shafts. A wide range of speeds may be procured with Meccano Pulleys (which are made in sizes from ½″ to 6″ diameter) and belt gear.

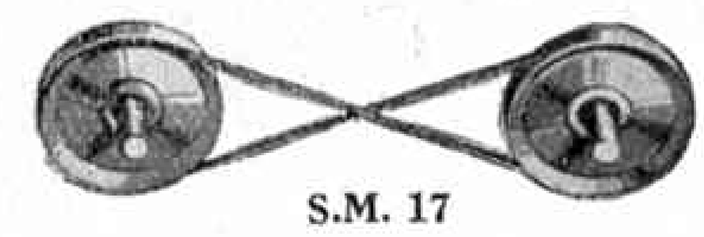
A method of connecting two shafts placed at right angles to one another is shown in S.M. 16, whilst S.M. 17 illustrates a crossed belt drive, which reverses the motion of the driven shaft.

A practical belt reversing mechanism, suitable for most drives where the load is not too heavy, may be constructed as follows (see S.M. 18); two pairs of Flanged Wheels, 1 and 2, are fixed, and two pairs 3 and 4 are loose, on a driving shaft 5 and a driven shaft 6. The wheels 1 are connected by a crossed belt, thereby reversing the motion of the driven shaft 6 (as in S.M. 17), while the wheels 4 are connected by an open belt. The operation of a lever 7 moves one of the belts on to a pair of fixed pulleys, at the same time throwing the other on to a loose pair, and vice versa, thereby reversing the action of the driven shaft 6.

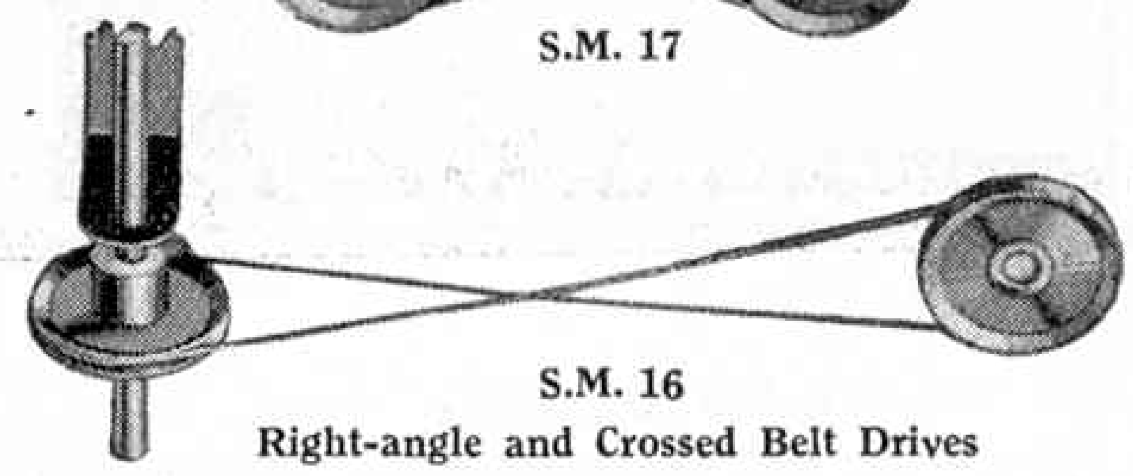


S.M. 20
Method of transmitting drive to shaft placed at an obtuse angle

The pulleys 4 and 2, in the same illustration, also serve to demonstrate the principle of a belt clutch. The driven shaft 6 may be thrown into gear with the driving shaft 5 by moving the belt on to the fixed pair of wheels 2. By reversing the operation the shaft 6 is thrown out of gear again without stopping the driving shaft 5.



S.M. 17



S.M. 16
Right-angle and Crossed Belt Drives

S.M. 19 is an arrangement adopted when the pulleys are not in line with one another, and forms an alternative method to direct gearing. The guide pulleys 1 ride freely upon the axle 2. It will be seen that this is a useful means of avoiding an obstruction—such as a moving lever or wheel—that may lie between the two Pulleys.

The final example in this section shows a method of transmitting power to a shaft placed at an obtuse angle. The belt is led round the 1″ loose guide pulleys.

Non-Slip Device

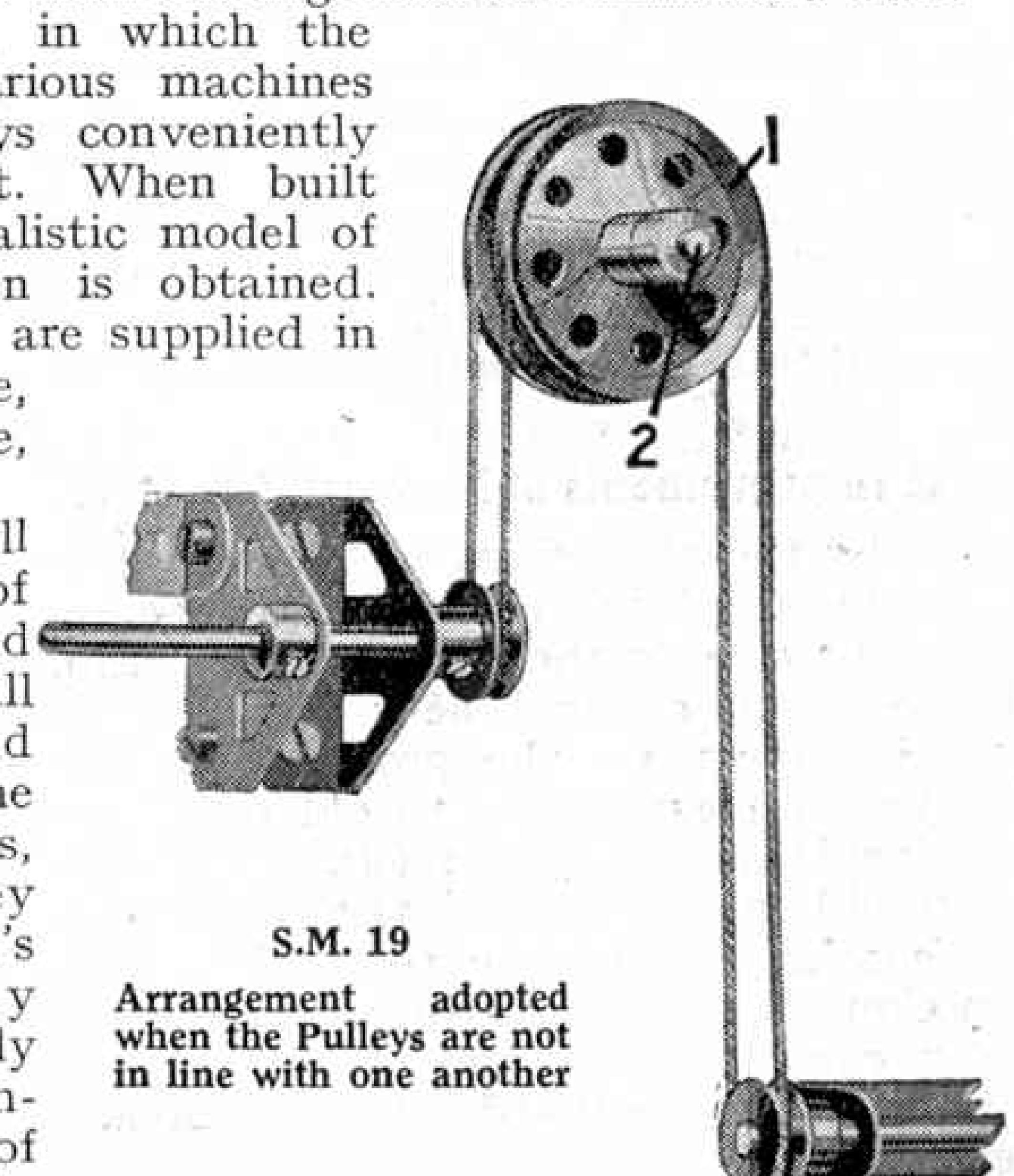
In order to ensure a positive drive with rope mechanism, and to guard against the possibility of slipping, it is advisable sometimes to give the cord or rope an additional turn round each of the pulleys. A still more efficient drive may be obtained by using ropes in duplicate, or even triplicate. In this arrangement each loop of rope engages between a separate pair of pulleys; thus, supposing an ordinary open belt gear (such as S.M. 15) is required to withstand an exceptionally heavy load; all that is necessary is to repeat the existing gear—by adding further ½″ Pulleys and 3″ Pulleys alongside those already shown—until the requisite "grip" is obtained to rotate the shafts.

Jockey-Pulley Device

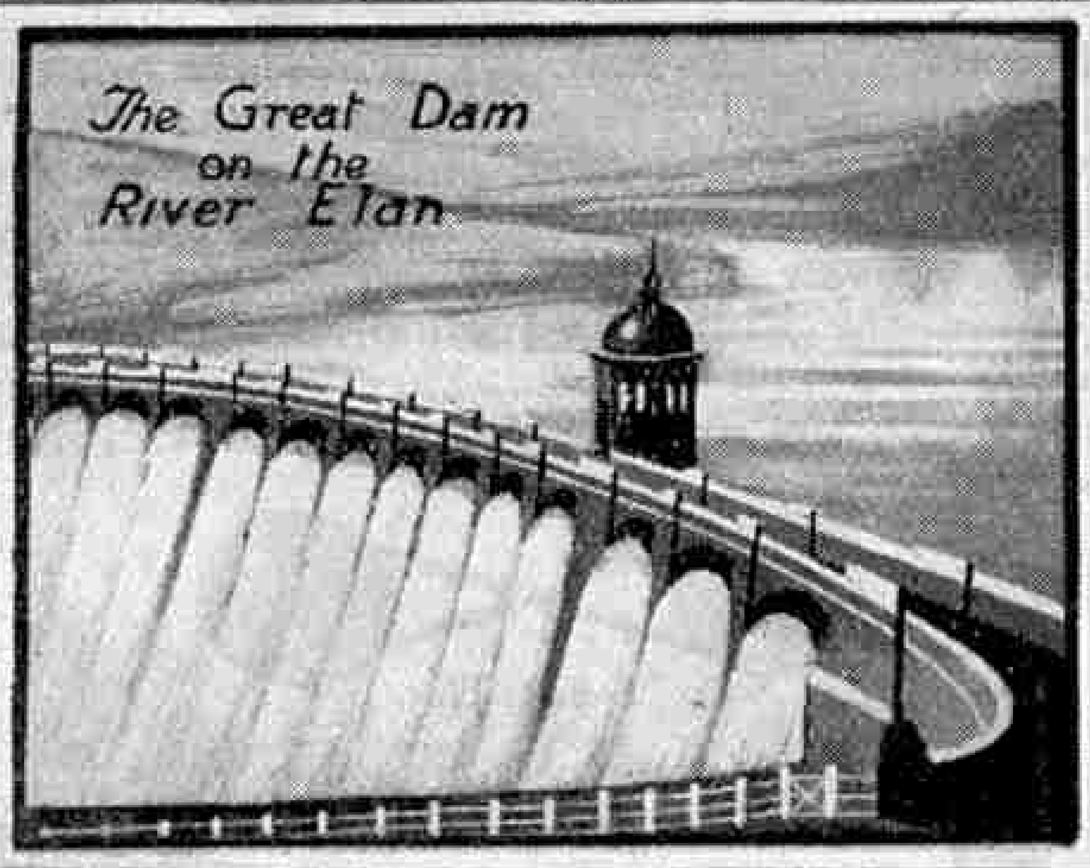
A method frequently adopted in order to keep a belt always at a certain degree of tightness consists of an additional "idle" wheel known as the "jockey" pulley. This pulley is arranged to ride upon the belt, and is caused to exert a slight pressure upon it by means of a spring or a weight, etc. In this way, the jockey-pulley takes up any "slack" due to expansion of the belt in running.

Meccano Shafting Standards have been specially designed for use in connection with belt driving, etc.; they may be used, for example, to carry the main driving shaft of a miniature workshop or similar model, in which the belts operating the various machines are driven from pulleys conveniently mounted on the shaft. When built in this way a most realistic model of belt power transmission is obtained. The Shafting Standards are supplied in two sizes; large size, price 1/- each, small size, price 8d. each.

Next month we shall publish Section III. of "Meccano Standard Mechanisms." This will deal with "Pulleys and Pulley Blocks," and the various kinds of pulleys, fixed and moveable pulley blocks, as well as Weston's "Differential Pulley Block, will be simply explained and demonstrated with a number of ingenious Meccano models.



S.M. 19
Arrangement adopted when the Pulleys are not in line with one another



Engineering News of the Month

World's Largest Single Span

Up to now the tremendous undertaking of bridging the Hudson River from Manhattan to New Jersey has daunted the engineers, but the bridge has become so necessary, in view of the growing congestion of motor traffic in and out of New York, that preliminary surveys are now being made. At 178th Street, the point where it is proposed to erect the bridge, the river is approximately 3,300 ft. in width, but it will be necessary for the span of the bridge to be several hundred feet longer. This will, therefore, be the largest single span in the world.

It has not yet been definitely decided what type of bridge will be constructed, but it will probably be a suspension bridge. As the bank of the Palisades of New Jersey is some 300 ft. in height and that on the New York side only 220 ft. in height, it may be necessary to cut away the land on the New Jersey side so as to make both ends of the bridge le el.

The relief for cross river traffic at the bottom end of Manhattan Island, expected from the construction of the roadway tunnels from Hoboken to Grand Street, will be supplemented at the upper end by the new bridge. The tunnels will probably be completed next year and so eliminate the use of the ferries which up to now have had to carry all vehicles across the Hudson.

Although the new bridge will be twice as long as the one at present being erected between Philadelphia and Camden, over the Delaware River, the centre span of which will be 1,686 ft. in length, the engineers do not expect any insuperable engineering difficulties in the construction of the Hudson Bridge.

* * * *

New Bridge on the Rio Apey

The Government of Uruguay has made arrangements for the construction of a new steel bridge over the Rio Apey, at Paso de Tacuabe. The bridge will be set on cement foundations and will be completed and ready for public use next year. The total cost will be approximately £8,000.

* * * *

Port Improvements at Newcastle, N.S.W.

Among the alterations now being made at Newcastle N.S.W., are the deepening of the entrance to the harbour, the closing of the south channel near Hexham for widening purposes, the provision of new wharves and extensions to old ones, and additional loading apparatus. The new works will greatly enhance the importance and convenience of the port. The construction of a large floating dock is also under consideration, and it is proposed to build this at the Walsh Island Dockyard, Newcastle.

Concrete Roads in America

The total length of concrete roads in the United States exceeds 32,000 miles, whereas Britain has only about 250 miles. During January to May of this year contracts were placed in America for the laying of over 51,000 square yards of concrete paving for roads and streets, an increase of 25 per cent. on the figures for the corresponding period of 1924.

* * * *

Canadian Zinc and Lead Manufacturing Plant

Messrs. James Robertson Company of Montreal have recently prepared plans for the construction of a large zinc and lead manufacturing plant in the neighbourhood of Chats Falls, Quebec, on the Ottawa River. The scheme includes extensive power development at a total cost of about £400,000. The first step has been made by the Kingdom Mining, Smelting and Manufacturing Company, which is controlled by the James Robertson Company. This company has purchased the power rights and property of the Pontiac Mining Company and Louis Simpson, of Ottawa, in the locality, and work will shortly be commenced. The Ontario Hydro-electric Power Commission has secured and will shortly develop the power site on the Ontario side of the river, and it is suggested that the power dam should be built as a joint undertaking by the Kingdom Company and the Ontario Commission.

* * * *

Wireless Without Valves

An apparatus which, it is claimed, will revolutionise the present system of wireless transmission has recently been produced.

The claims made for this new apparatus are long-distance wireless transmission without valves or coils, continuous short-wave communication between any two points in the world with apparatus costing less than £50 ; perfect reproduction of broadcast music and speech without rectification ; satisfactory reception in England of programmes of any station in Europe with extremely simple and cheap apparatus ; a directional ray of transmission which can be aimed at a given point, regardless of distance, with a degree of accuracy that will give almost perfect secrecy, and the entire elimination of fading and atmospherics.

According to the theory put forward by the inventor, Mr. Chapman, the "Heaviside layer" in the upper atmosphere, which is supposed to deflect wireless waves, is non-existent. Instead, he says, there is a dense electronic field enveloping the earth the density of which varies with the density and temperature of the atmosphere and with its distance from the earth's surface. By concentrating the output of a transmitter into a ray or beam, and aiming it at a given angle into the electronic and magnetic fields, the beam may be directed to a receiver in any part of the world so accurately that it cannot be picked up anywhere else except in the close vicinity of the receiver.

In order that they may prove in actual practice the claim that continuous communication can be maintained at a fraction of the cost entailed by any other method, Messrs. Autoveyors have applied to the authorities in this country and in the United States for a licence to accept messages for transmission between Great Britain and America.

* * * *

9,000 Horse Power Motor

A 9,000 h.p. motor, probably the largest ever built for a steel mill, is to be installed at the plant of the McKinney Steel Company, Cleveland, to drive the company's new 21 in. continuous billet mill and 18 in continuous sheet bar and billet mill. The motor will be a 6,600-volt, three-phase, 25 cycle machine, running at a speed of 107 r.p.m. Automatic starting and compensator arranged for plugging and reversing will be fitted and the motor will be provided with its own generator set exciter.

* * * *

New Cruisers

It is officially announced by the Secretary of the Admiralty that two new cruisers will be built at the Royal Dockyards of Portsmouth and Devonport. The other two, to be laid down next February, will be built by contract in private ship-building yards. The four gunboats included in the programme will be built by contract, and orders will be placed as soon as possible. Although the official statement says that the keel of the cruiser to be built at Portsmouth was to have been laid down last month it is felt locally that this will not be possible before next year, the only building slip being at present occupied by the "*Suffolk*." The construction of this vessel has been so slow that even an approximate date for her launch cannot yet be fixed. It is expected that first preparations for the laying down of the new ship will commence about December next.

* * * *

New Hydro-Electric Plant

The Dominion Construction Company, of Montreal, have been awarded the contract for the construction of the Grand Falls hydro-electric plant in New Brunswick, which will be the largest in the Maritime Provinces of Canada. The value of the contract is over £300,000

Wider Bridges at Carlisle

Important bridge widening schemes are being considered at Carlisle. These are necessitated by demands of modern traffic, and the Ministry of Transport are making substantial grants. In this connection the Highways Committee of the City Council have accepted the £57,000 tender of Messrs. John Laing and Son, Carlisle, for the re-erection of St. Nicholas bridge, leading to a rapidly developing suburb.

* * *

A £65,000,000 Channel Bridge

Proposals for connecting Calais and Deal by a railway road and canal, have been before the engineering world in France for the past three months. Although at first sight the idea sounds fantastic, there are engineers who consider it practicable to build across the Channel two breakwaters on which two lines of railway might be laid thus connecting up the railway systems of the Continent with this country.

Experience with submarine nets during the war showed how comparatively shallow the Channel is at this point. It is proposed that the smooth waters between the breakwaters should be used as a canal, along which might pass barges from Central Europe to London.

Compared with the cost of the Channel tunnel, the estimate of £65,000,000 is not excessive and from an engineering point of view the scheme is arousing much interest.

* * * *

New Thames Pier

It is proposed to construct below London Bridge a new Thames Pier to relieve London Bridge of the extra passengers resulting from the loading of the river passenger traffic at Old Swan Pier, which is immediately above the bridge. The suggestion has been made that the new pier should be erected on the City bank, near the Tower of London, but it is probable that the War Office will oppose this proposal.

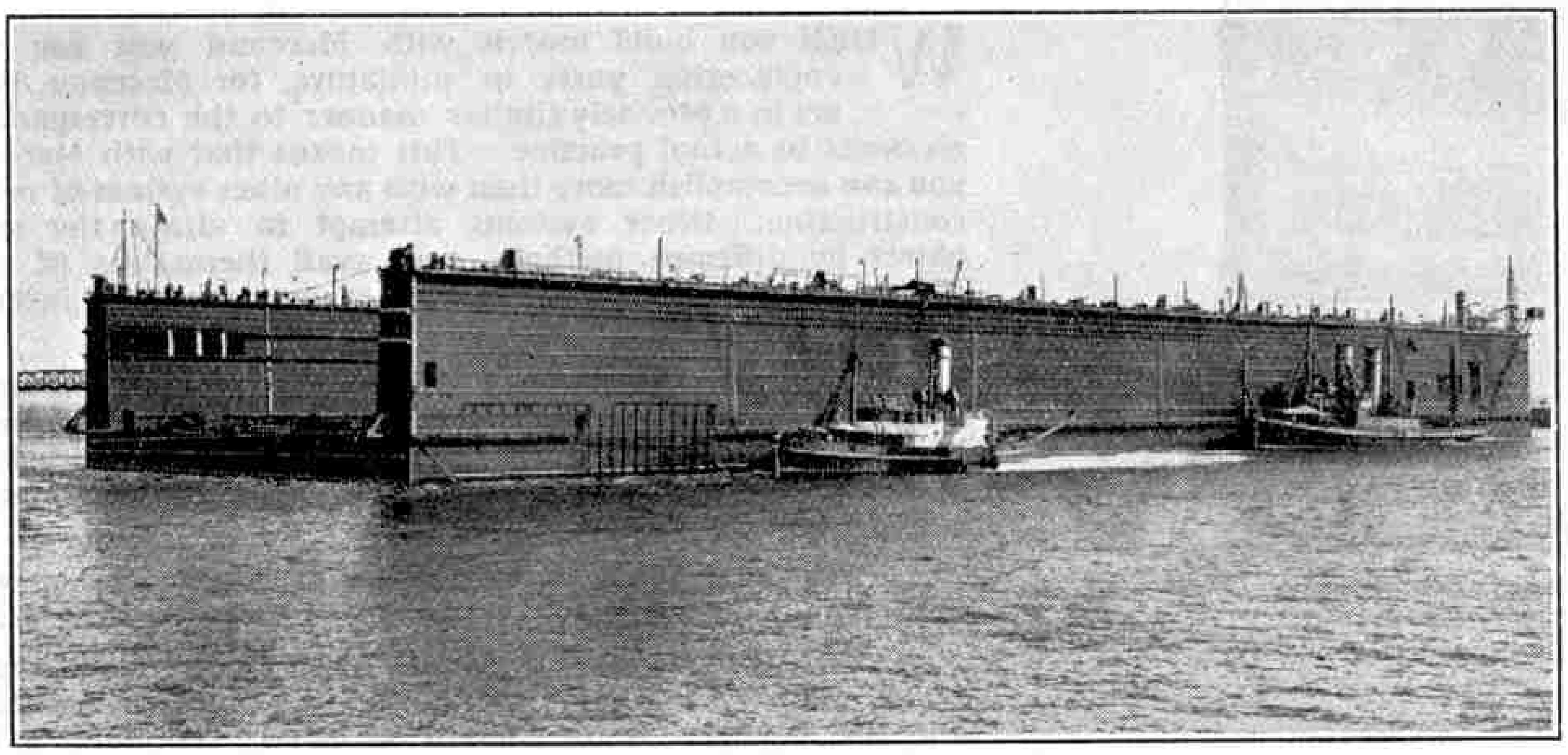
* * * *

A Huge Condenser

An exceptionally large single steam condenser has been built by the Westinghouse Electric Co. for the new station at Philadelphia. It weighs 1,000,000 lb. and stands 30 ft. in height. It has a cooling surface of 70,000 sq. ft. and when operating at maximum capacity it will require approximately 150,000,000 gallons of circulating water per day. Provision has been made for the ultimate installation of 12 condensers of this type.

Exeter Ship Canal Lock Gates

The Old Lock Gates on the Exeter Ship Canal, which have been in use for nearly sixty years, are now being replaced by oak gates. Each of the new gates weighs 12 tons. A "stank" has been erected, 26 ft. in height, to keep out the sea while the new gates are being placed in position.



The New Floating Dock at Malta

The above photograph (sent us by Mr. T. Milne, Broughton Ferry, Scotland) shows the ex-German floating dry dock which was towed from Sheerness to Malta, where it is to be used for docking the capital ships of the Mediterranean Fleet.

The dock was mentioned in our August and September Magazines and the extra section, built in this country, has now safely arrived at its destination and has been placed in position.

The dock is now 1,000 ft. in length and is capable of lifting 60,000 tons. The new section cost £400,000.

New Yorkshire Waterworks

One of the most important extensions of water supply that have been carried out in the West Riding of recent years, namely, the Sladen Valley waterworks of the Keighley Corporation, have been opened by the Marquis of Hartington. The Valley of the Sladen beck has been dammed for the construction of the Lower Laithe Reservoir, about five miles from Keighley, and filter beds have been provided, together with a pipe line, to carry the supply to Keighley. The new reservoir when full has a surface area of 31½ acres, with a maximum depth of 60 ft., and a total capacity of 281¼ million gallons. The height of the embankment above the stream is 84½ ft., and its length 1,010 ft., while the reservoir will yield daily a supply of a million gallons.

The constructional work has been carried out by Messrs. Sir William Arrol & Co. Ltd., of Glasgow, and includes a circular tank of concrete, with an internal facing of white-glazed bricks. This forms the clear water basin, into which the water passes from the filter beds. It is 100 ft. in diameter, with a depth of 15 ft., and it holds a fourteen hours' water supply. The pipe line to Keighley is 15 in. in diameter. The original estimated cost of the scheme was £208,750, but owing to the war this has actually worked out at about £570,000.

* * * *

New Bridge over St. Lawrence

Work is to be started immediately on a new bridge at Montreal crossing the St. Lawrence river to the South shore. The total cost of the bridge is estimated at over £2,000,000.

A Sixty-mile-an-hour Motor Boat

There has recently been constructed what is probably the fastest motor boat in the world. This is "*Oma II.*," 40 ft. in length and built to the order of the Hon. A. E. Guinness. She weighs 3½ tons, and her 450 h.p. Napier "Lion" aero-engine is capable of driving her at a 50 knot speed, or a shade over 60 miles per hour. Tested soon after her launch in the broken waters of the Solent, she made 50 m.p.h. She is no mere racing machine, however, for she has seating for eight to ten people.

"*Oma II.*" is not the first marine craft "of any kind" to attain a 50 knot speed. That was first achieved by the Forlanini hydroplane on Lake Maggiore some years ago. Rising on her palettes or underwater planes, this extraordinary craft lifted her hull wholly clear of the water, while her submerged gear-driven shafting kept the propellers down.

* * * *

New C.P.R. Pier at Vancouver

The new Canadian Pacific Railway deep-water pier at Vancouver harbour front is nearing completion. The pier will be 1,100 ft. in length and the largest of its particular type in the world. Berthing facilities will be provided for four liners at once, with accommodation for coasting steamers. The pier will be equipped with the most modern freight-handling facilities and the total cost is estimated at over £1,000,000. Over 5,000 concrete piles from 50 to 90 ft. in length have been used in the construction of the pier. Some of these piles weighed 25 tons and to handle them the largest floating pile driver in the world was built.

* * * *

Tube Railways for Manchester ?

The proposal for a mammoth system of underground railways for Manchester to link up various parts of the city has been before the City Council for some time. A Corporation Committee is now investigating the possibility of introducing the tube system. It is proposed to include in the scheme all the adjacent areas, including Salford and such places as Stretford and Prestwich. The population within twelve miles of the centre of Manchester is three million, equal to that for which the first tubes in London catered. There would be less difficulty, from an engineering point of view, in constructing tubes in Manchester than in most centres. The basis of three-quarters of the proposed area is red sandstone, which can easily be worked, there being no need for propping. The cost of the tubes, it is estimated, would be from £250,000 to £300,000 per mile, fully equipped.

MECCANO

REAL ENGINEERING IN MINIATURE

The No. 2 Outfit costs 15/– and builds 163 models.

WHEN you build models with Meccano you use real engineering parts in miniature, for Meccano parts act in a precisely similar manner to the corresponding elements in actual practice. This means that with Meccano you can accomplish more than with any other system of model construction. Other systems attempt to attain the same object by different methods, and avail themselves of constructive elements that are not based on correct engineering principles.

It is important to realise this, for if you commence with badly-designed parts you can only build a limited number of models. Even these will necessarily be constructed incorrectly and will give you faulty ideas of the laws of engineering.

There is no limit to the number of models that may be built with Meccano, and all are real working structures.

The Meccano Clock keeps accurate time ; the Meccano Loom weaves beautiful material for hat-bands or neckties ; and the Meccano Motor Chassis so closely resembles a real motor-car that it is used for teaching students at numerous Schools of Motoring.

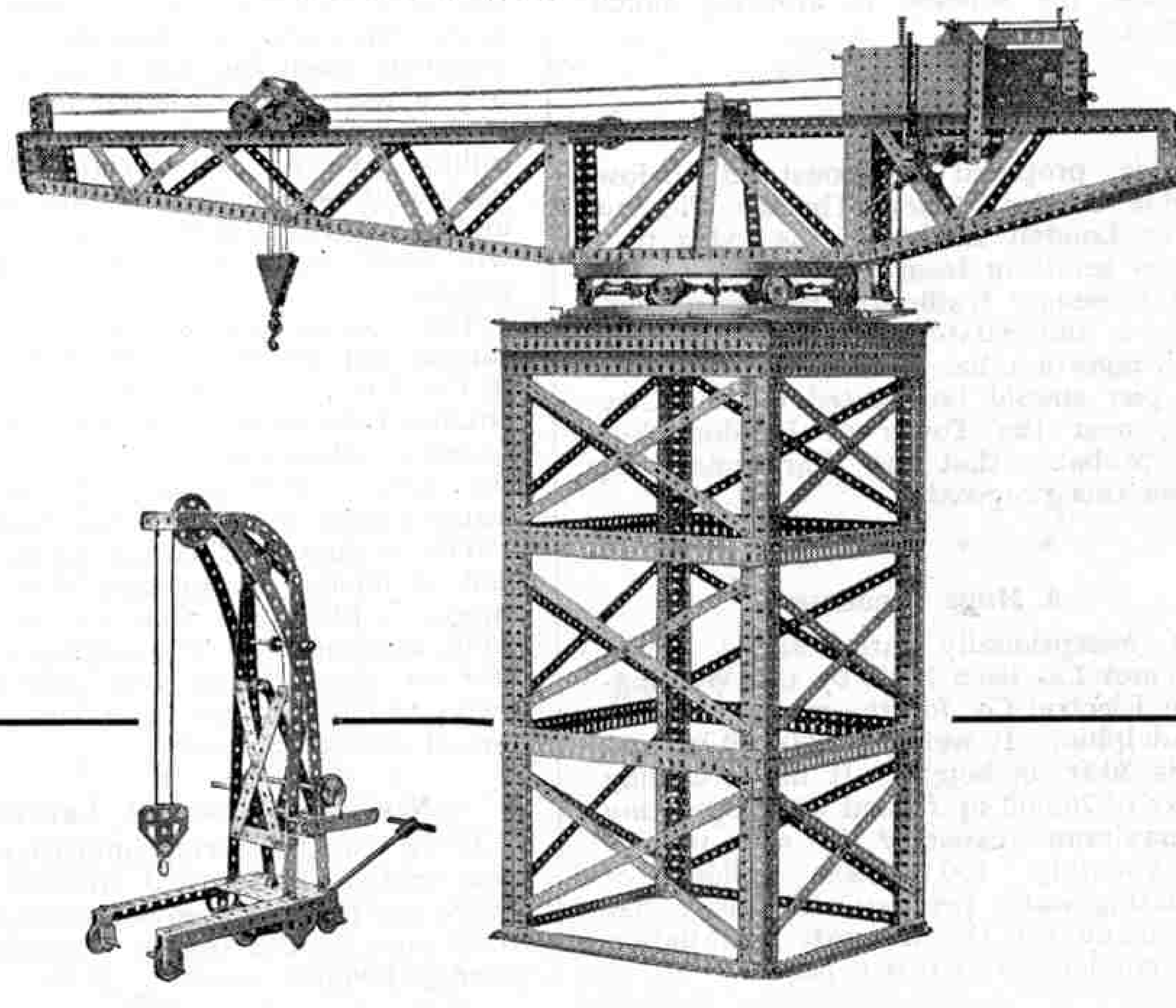
It is the same with all other Meccano models—they are all accurate reproductions of the real thing, and they all work because they are based on correct engineering principles.

MECCANO PRICES

COMPLETE OUTFITS		ACCESSORY OUTFITS	
No. 00 ...	3/6	No. 00a ...	1/6
No. 0 ...	5/–	No. 0a ...	4/–
No. 1 ...	8/6	No. 1a ...	7/6
No. 2 ...	15/–	No. 2a ...	8/6
No. 3 ...	22/6	No. 3a ...	18/6
No. 4 ...	40/–	No. 4a ...	15/–
No. 5 (in well-made carton) ...	55/–	No. 5a (in well-made carton)	50/–
No. 5 (in superior oak cabinet with lock and key)	85/–	No. 5a (in superior oak cabinet with lock and key)	80/–
No. 6 (in well-made carton) ...	105/–	No. 6a (in superior oak cabinet with lock and key)	210/–
No. 6 (in superior oak cabinet with lock and key)	140/–		
No. 7 (in superior oak cabinet) with lock and key)	370/–		

Meccano Outfits may be obtained from all leading toy stores.

Compare these two fine models of cranes—one, a small hand-operated portable hoist, and the other, a giant "hammer-head" crane. Both are constructed on the same principles, and work in a most realistic manner. Any Meccano boy may build the big crane just as easily as he builds the small one.



The Improved Meccano Platform Scales

A Model that will Accurately Register ½ oz. to 4½ lbs.

We described the Meccano Platform Scales in our issue for May last, and asked readers to assist us in improving the model in such a way that it should weigh small amounts, such as two or three ounces, accurately. This meant reducing the friction present in the model to an absolute minimum. We find that this has proved a severe test on the resourcefulness of our readers, as we had expected, and unfortunately many of the suggestions we have received do not justify their claims when put into actual practice, although they were well thought-out and showed much originality.

As hinted in our first article, however, we had already effected important modifications in this model, and we describe these below. The chief improvements will be found in the knife-edge bearing which forms the fulcrum of the steelyard, and in the new arrangement of levers in the base, providing for a free lateral movement, as well as vertical, of the platform.

This improved construction of the model enables amounts varying from half an ounce to 4½ lbs. to be weighed with remarkable accuracy.

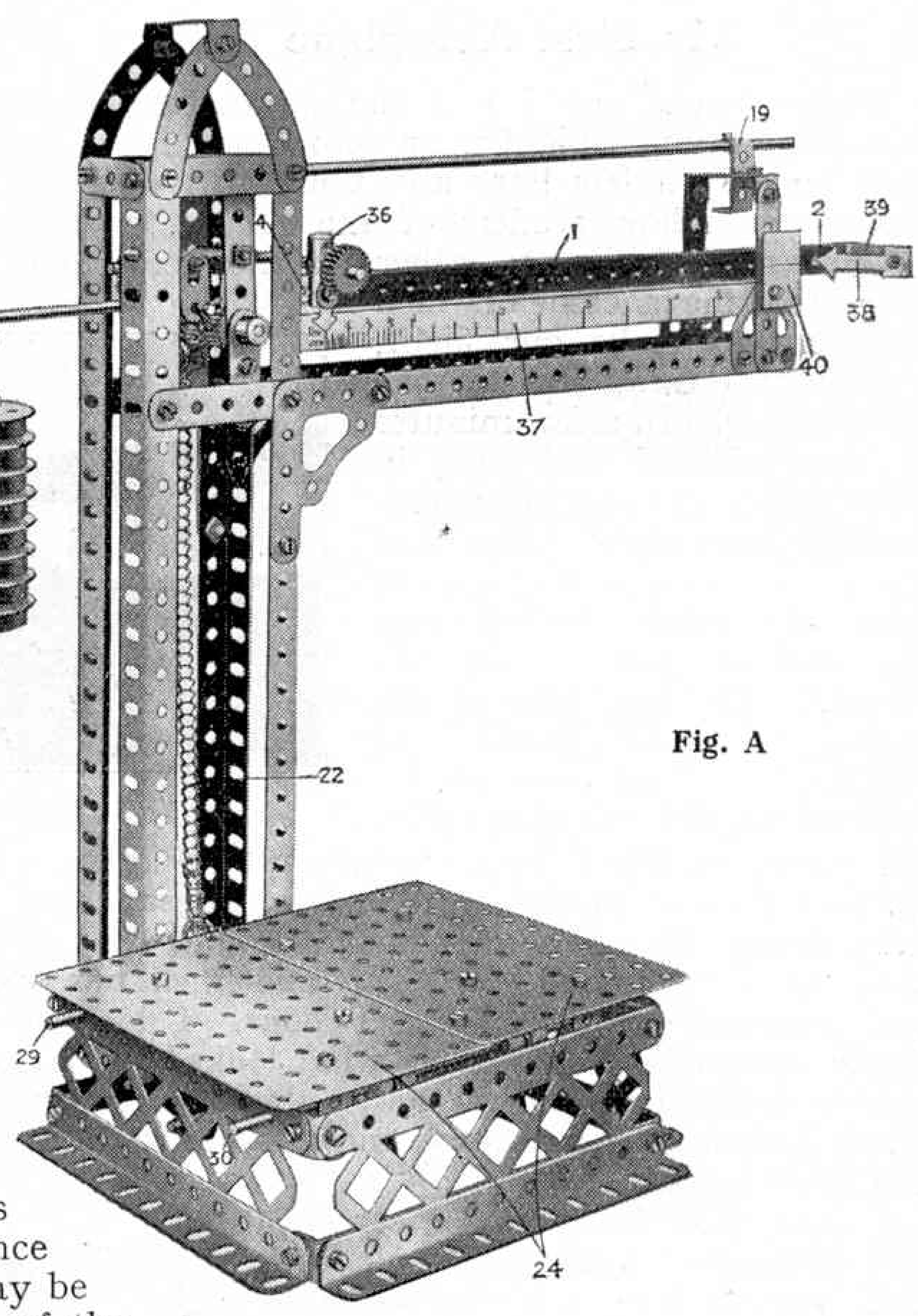


Fig. A

Building the New Model

The steelyard 1, consisting of a 12½″ Strip, is bolted at its extreme end at 2 to a Coupling mounted on an 11½″ Rod 3, Fig. B, and at its other end 4 to a second Coupling 5 (Fig. B). This Coupling is carried on a short Rod 6 which passes through two further Couplings 7 and 8 and enters another Coupling 9 in which a further Axle Rod 10 is mounted. This Rod 10 carries the balance weights 11 which may be secured by means of the Coupling 12 in any position on the Rod 10. The latter is also extended at its end by the Coupling 13 and Threaded Rod 14 carrying a Threaded Boss 15, by which very accurate balance adjustment may be made. When the steelyard is exactly balanced the Threaded Boss is secured in its position by the bolt 16.

The fulcrum rests upon a knife-edge bearing 17 consisting of two Centre Forks secured in the Coupling 7, with their points resting between the teeth of two ½″ Pinions. These Pinions are bolted to a short Rod rigidly held in two Cranks, which are attached to 3½″ Strips suspended from a Coupling mounted on the end of an 11½″ Rod 18. The steelyard is lifted into weighing position by placing the 11½″ Rod 18 under the stop 19. A Sprocket Chain 22,

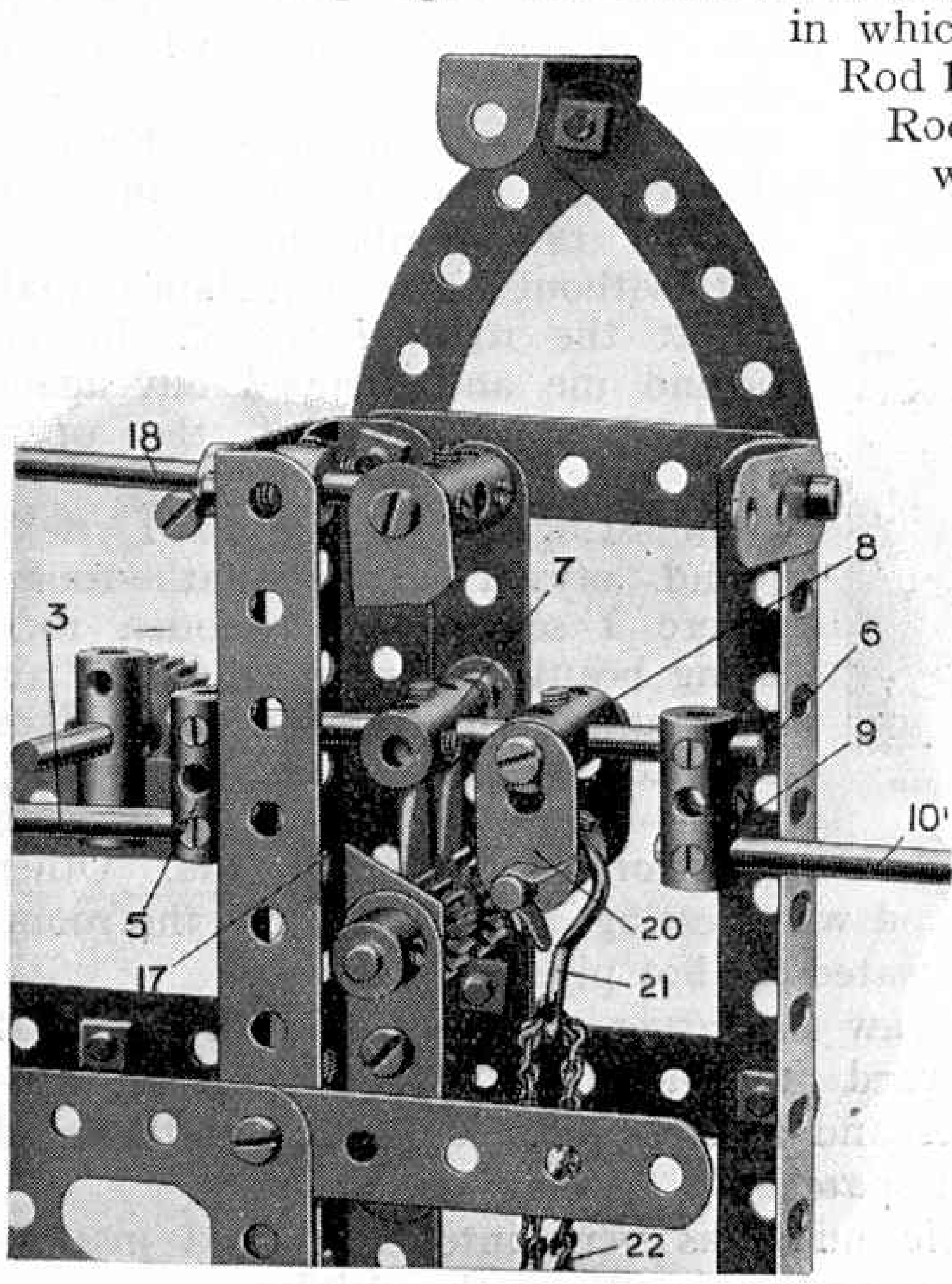


Fig. B

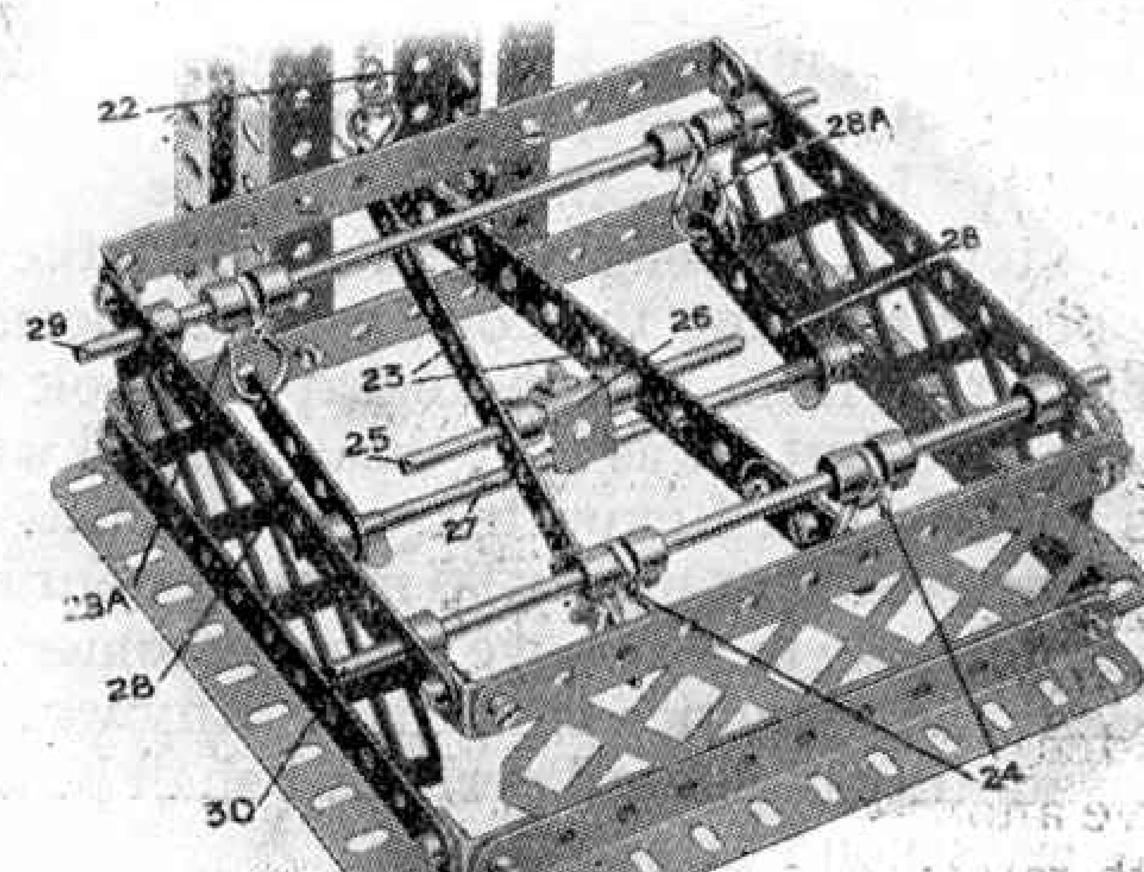


Fig. C

(Continued on page 584)

This page is reserved for articles from our readers. Contributions not exceeding 500 words in length are invited on any subject of general interest. These should be written neatly on one side of the paper only, and they may be accompanied by photographs or sketches for use as illustrations. Articles that are published will be paid for at our usual rates. Statements contained in articles submitted for this page are accepted as being sent in good faith, but the Editor takes no responsibility for their accuracy.

My First Aeroplane Trip

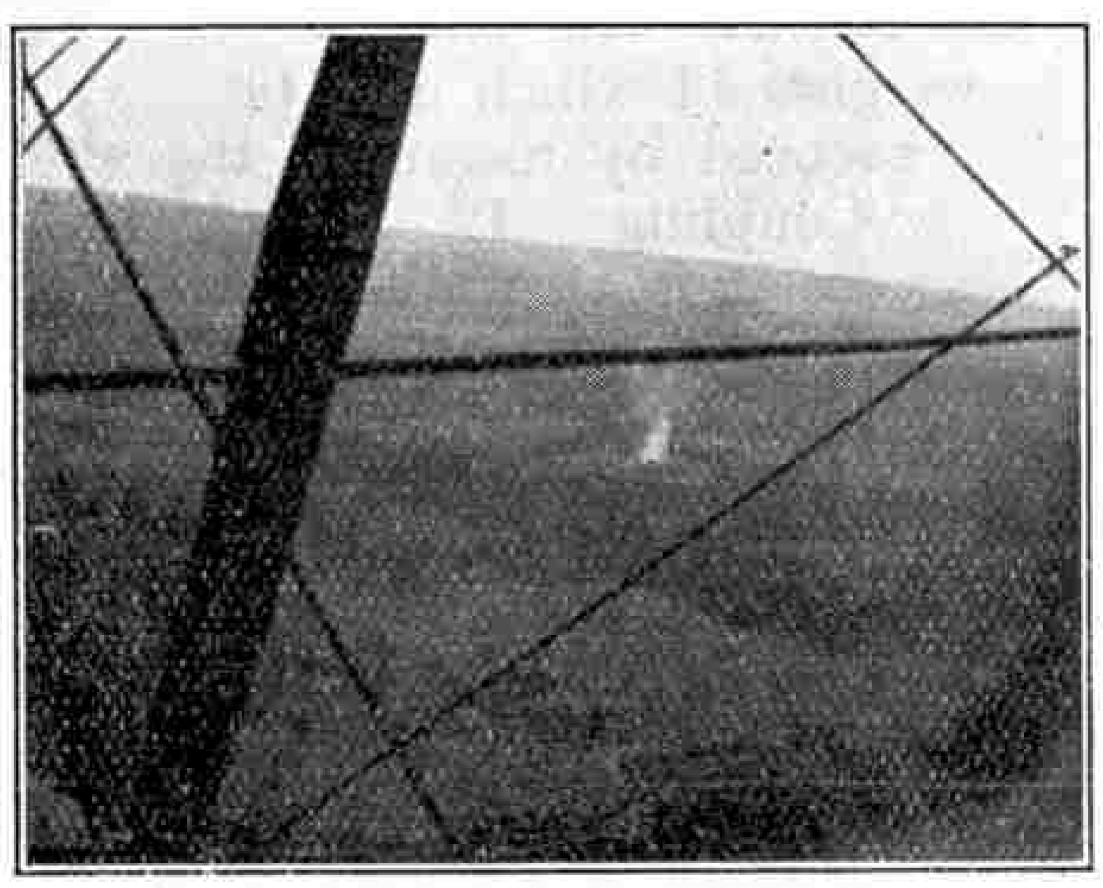
A few weeks ago I had the wonderful experience of making my first flight in an aeroplane, and I thought that possibly a few lines about my trip would be of interest to fellow readers of the "*M.M.*"

On arrival with my father at the aerodrome we found that the machine in which we were to make our flight, a Sopwith "*Gnu*," was in one of the sheds. In a few minutes it was wheeled out and in we climbed. It was very comfortable inside and there was plenty of room. A moment later the pilot climbed into his cockpit and closed our "roof." He then started the engine, a "*Le Rhone*" of 110 h.p., and we were off.

100 h.p. Le Rhone-engined Sopwith "Gnu" Aeroplane

When we had travelled about 100 yards we lifted from the ground. Shortly afterwards I glanced at the speedometer and saw that we were doing 79 miles per hour. Round we circled until we were over 1,000 ft. up and then our speed had increased to 87 miles per hour. I looked out of the window and saw below what looked like a huge garden, dotted here and there with dolls' houses, among which I recognised our house and close to it the Castle and the Church.

I then took hold of my camera and pointed it out of the window and pressed the trigger, without looking to see what I was taking. I drew in the camera, intending to wind on the film, but immediately found myself gripping the seat for we were banking over and almost vertical!



A snap from the air by our reader, C. Harman

After that we started to drop. Ugh! I felt as if my stomach had taken a journey to my mouth! Quickly we dropped to 400 ft. and then—bumpity, bump, bump—we were down again and running smoothly back to the shed. The pilot stopped his engine and opened the roof, and we stepped out feeling that our trip had been all too short.

The print from the photograph I took while flying is shown here, but I was very disappointed with it. The job was harder than I expected. The conditions in an aeroplane travelling at nearly 90 miles an hour are very different from those to which we are accustomed, and it is quite evident that practice is needed. Anyway I am going to have another flight and perhaps I shall be more successful with my second attempt.

C. Harman, Lympne, Kent.

A Visit to a Saw Mill

The other day I had the good fortune to be shown round a large sawmill, and I was very interested in all that was going on there.

Entering first the large timber yard, I saw on one side a large pile of tree trunks from which a couple of men were stripping the bark so as to prepare them for cutting up. Close by, a man was busily engaged in preparing round logs of wood for wheel hubs, while two others were sawing through a giant tree trunk, measuring some five feet in diameter, which was as yet too large for the mechanical saws to cut. Another feature of interest in the yard was a large crane used for moving tree trunks from one place to another.

I then entered the actual mill. There timber of all sizes and shapes was being cut up, some into planks and some into square poles, while odd pieces of wood were being sawn up into firewood. In the constant hum of the machinery, with sawdust flying around, I stood fascinated for some time, watching the wood being cut as easily as if it were cardboard!

Next I visited the engine room, and to me this was the most interesting place of all. A gigantic fly-wheel was revolving at a tremendous speed, driven by a gas engine, about which there were too many points of interest to describe here. It was not without some reluctance that I left the roar of the machinery behind me and stepped out again into the quietness of the open air.

Mounting some steps, I next found myself in the lathe-room, where I saw square wooden rods being beautifully rounded into chair legs and supports. Another place of interest visited was the drying room, where strips of wood were being curved in a rack for the backs of chairs. Other pieces of wood were resting on racks around the room, which was heated by hot pipes.

Finally I saw the larger planks of wood being piled up in the yard and the sheds, and also chairs, five-barred gates and fencing poles assembled and packed ready for despatch.

The whole mill was very interesting and instructive, and altogether well worth visiting.

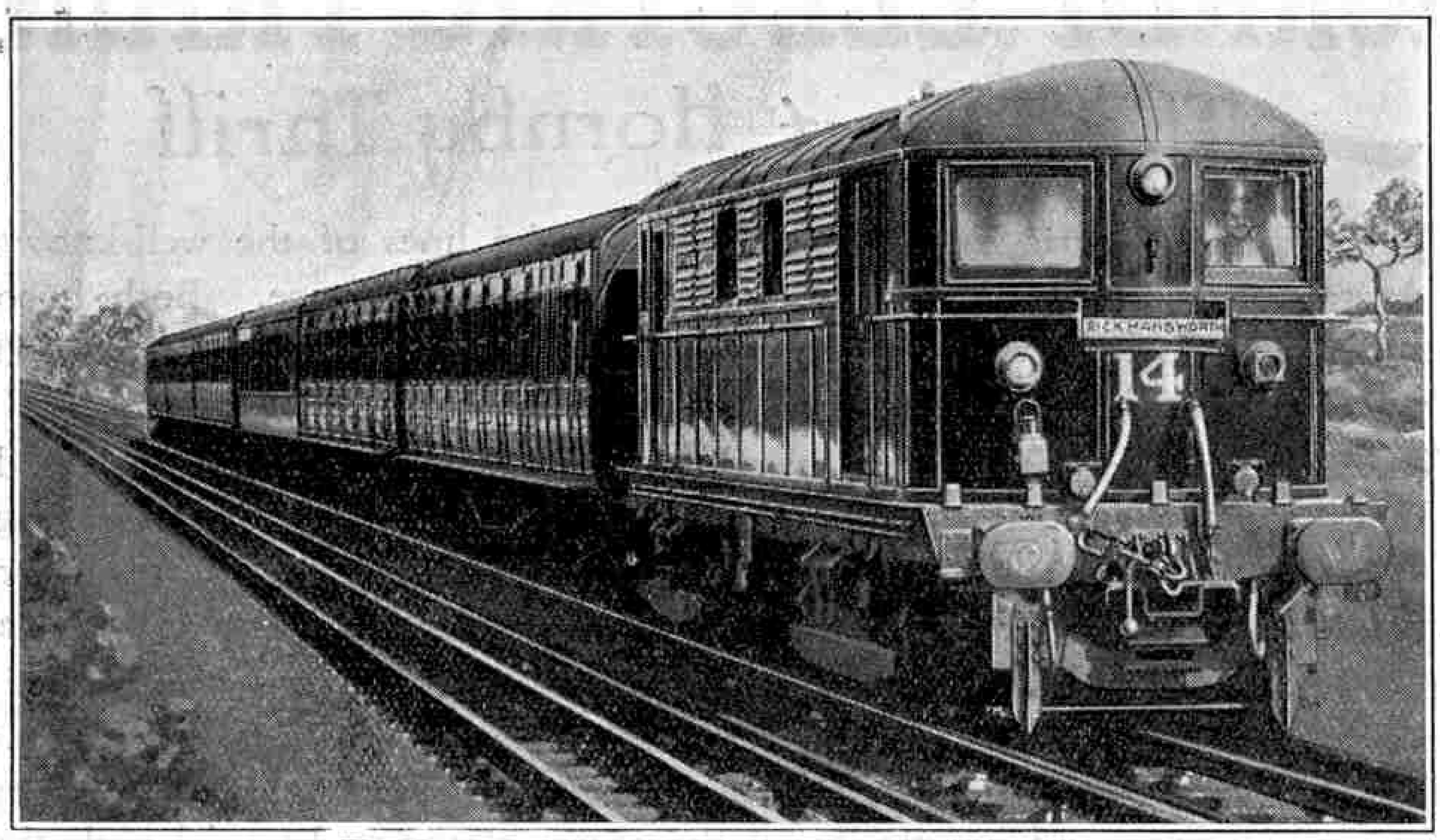
F. Colquhoun, Leamington Spa.

Electric Trains and Their Story

The Development of Electric Traction from 1885 to the Present Day

Although for many years the steam locomotive must continue to be the prime mover for main-line railway working, recent developments seem to indicate that for practically every form of railway haulage, electric traction will ultimately displace steam. There is little doubt that the general use of electricity will be a great advantage to the railways.

It is difficult to say which of the many attributes of electrical traction are the most important. Economy in working should certainly take a leading place for, apart from the heavy initial outlay for track and power equipment, electric railways are more economical to operate than steam railways. Another favourable factor is the greater cleanliness and consequent increased pleasure in travelling by electric trains, which are capable of sustained high speed working and smooth and noiseless running.



The Latest Type of Metropolitan Electric Train

Up to the present time, electric trains have been used chiefly for suburban services, because of their quick acceleration from the numerous stops, and general convenience on such services, for the multiple-unit system of electric trains has solved the problems of high-pressure work at busy terminal stations. The use of automatic signalling in conjunction with electric trains represents the high water mark of railway efficiency, and enables a set of metals to carry the utmost number of passengers, with complete safety, in a given time and at the highest speed.

Express working by electric trains over long distances has not yet been attempted in this country, although interesting developments undoubtedly lie ahead. Abroad the experiment has in many instances developed into a successful and permanent arrangement, however, whilst the handling of goods traffic by electric locos is said to show a saving of 40% in working expenses.

The Four Systems in General Use

There are four systems of electric traction in ordinary use (1) Direct Current (low tension) (2) Direct Current (high tension) (3) the Three-phase (4) the Single-phase.

The first on the list was the earliest system to be developed and is the one in most general use for short railways. In its simplest form the D.C. system does not require much apparatus. Current is supplied direct to an insulated overhead wire or conductor rail, from which it is collected by the locomotive or electric train by means of some form of sliding contact. It then passes through a suitable regulating apparatus to the motors, and returns either through the wheels and running rails, or through a specially-insulated conductor rail back through a short cable to the generator.

The Largest Power Station in Europe

Where high pressure current is generated at a power station, special sub-stations must be arranged in order to reduce it to low-pressure current suitable for direct use on the train motors.

A most interesting example of this system is to be found in the supply of power from Lots Road Power Station in Chelsea—one of the largest in Europe. Electric power is there generated on the three-phase system at a pressure of 11,000-volts, and supplied to the Metropolitan District Railway and its extensions, also to the most recently constructed Tube Railways. Current is transmitted through the tunnels to the sub-stations, where by means of rotary converters it is transformed into direct current at 600-volts ready for use by the trains.

Transformers Eliminate Sub-stations

The Single-phase system is the latest development, and although its possibilities have been known for many years, difficulties of construction and equipment have prevented its use until comparatively recently. In this system, high tension current at pressures up to 15,000-volts is collected directly by the train, no stationary sub-stations with rotating machinery being necessary. Although the train motors are only suitable for low pressure, each electric train carries its own sub-station in the form of a static transformer. The current is generally collected from an overhead wire and is then passed through a main switch, circulated through the high-tension coils of the main transformer and returned by way of the wheels to the rails, and thus back to the power house. All the current used for the propulsion, brake-operating and lighting of the train is taken from the low-tension side of the transformer.

(*Continued on page* 569

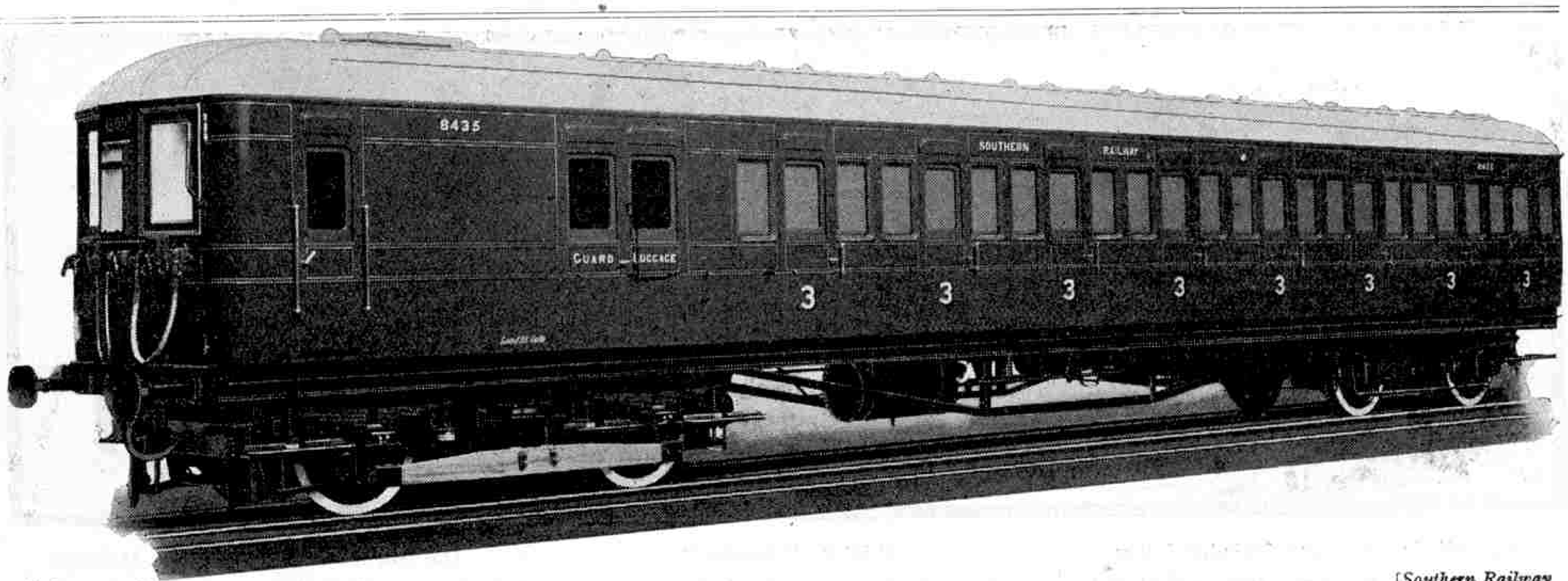


Photo courtesy] [*Southern Railway*

One of the New Motor Coaches built by the Metropolitan Carriage, Wagon, and Finance Co., Birmingham, for the South Eastern Suburban Services of the Southern Railway

Electric Trains and Their Story—(*continued from page* 567)

An interesting example of the three-phase current system is found in the haulage of heavy trains through the Simplon Tunnel. The high-tension direct current system is being adopted with great success in the United States and on the Continent.

The First Electric Tramway

The pioneer applications of electricity to traction purposes were made in Ireland in 1885, tramways at Newry and Portrush being run off a 250-volt third rail. In 1890 the City and South London Railway adopted electricity and in 1893 the Liverpool Overhead Railway installed electrically driven trains, whilst at the close of the century, several other lines were being equipped. Greater progress was made in the United States, and several short lines had been electrified at this time, the usual system being the D.C. third rail.

In 1900 a great impetus was given to electricity for railways by the opening of the Central London Railway and by the conversion in 1904-5 of the Metropolitan and District Railway after a long enquiry at which the respective merits of three-phase and direct current were hotly debated.

The next five years saw the electrification of the Mersey Railway, the Liverpool and Southport (L.&Y.R.), North Eastern Tyneside lines, and Great Western and Metropolitan Joint. Across the Atlantic a law was passed to minimise the smoke nuisance in New York, and several of the great trunk railways abandoned the use of steam locomotives for their approach lines to that city.

The direct current system with two conductor rails was favoured in this country, but two lines in 1908 and 1909 tried the alternating current method with overhead collection. These were the Midland, who had an experimental section between Lancaster and Heysham, and the Brighton Railway with their suburban lines in the London area.

Electric Railway across the Rockies

In 1913 a further advance was made, a section of the Lancashire and Yorkshire Railway between Bury and Holcombe Brook being electrified at 3,500-volts direct current. This was an immediate success, although overhead equipment problems in the congested Manchester area caused a reversion to a 1,300-volt third rail system when other lines were brought up-to-date in 1916. The rolling-stock, constructed entirely of steel and aluminium, was the first all-metal stock to be built in Britain.

In 1915 the Chicago, Milwaukee, and St. Paul Railway commenced to electrify some 650 miles of their main line across the Rocky Mountains on a 3,000-volt D.C. system with a 100,000-volt A.C. transmission to the sub-stations, which contained motor-generators in place of rotary converters.

Further developments in this country of the D.C. system were the electrification during the years of the War of the L. & N.W.R. North London and Watford suburban lines, and the change-over of 47 miles of track on the old London and South Western.

In 1915 the only section of goods railway so far to be electrified in this country was commenced between Newport and Shildon, on the North Eastern Railway, and proved to be a very advantageous turn-over from steam. The first mineral line in the world to be worked entirely by electric locomotives was the Butte, Anaconda, and Pacific Railroad in America. It was twenty-five miles in length and was worked by D.C. at 2,400-volts.

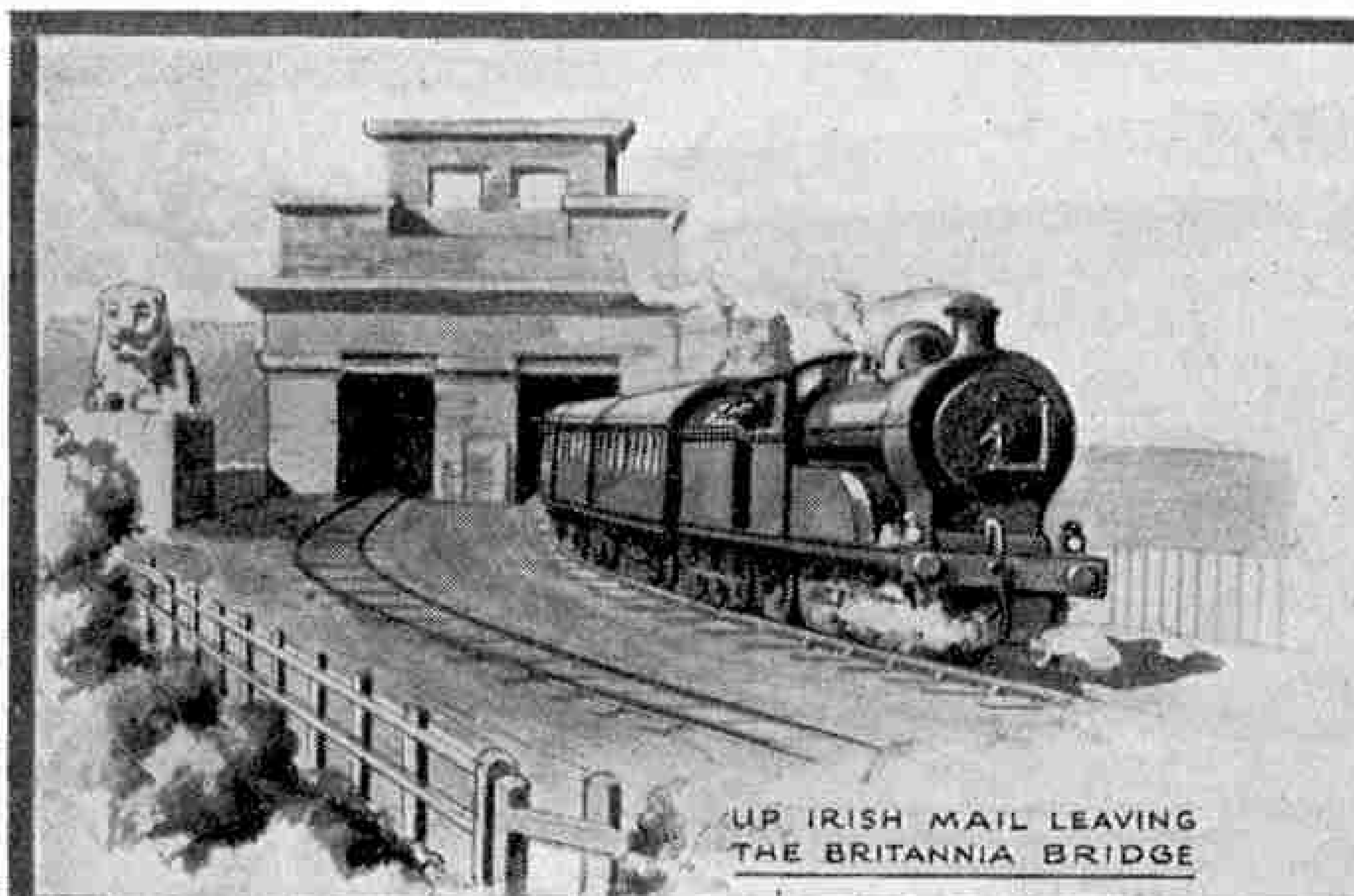
Since the War, the electrification of suburban lines has proceeded apace, and the new suburban services of the Southern Railway probably represents its highest standard, although there is nowhere to be found an electric railway that can be criticised adversely.

The First Electric Locomotive

Of the various systems of electric traction that most closely akin to steam working is, of course, the employment of an electric locomotive. The comparatively short history of this steed is a story of almost incredible advancement and increase in power and size.

The earliest electric locomotive of which any record remains was designed by a Mr. Davidson, an eminent Scots scientist, and was tried on the Edinburgh and Glasgow Railway as long ago as December 1842. It was self-contained, of course, the current being derived from primary batteries consisting of zinc and iron corrugated plates immersed in acid. The motor was of the simplest type, working on the principle of the attraction of iron bars on a revolving cylinder to fixed electro-magnets. These bars were energised and de-energised at correct intervals by brush and commutator.

(*To be continued*)



UP IRISH MAIL LEAVING THE BRITANNIA BRIDGE

Railway News of the Month

Two-Cylinder v. Three-Cylinder Locos

Extensive tests have been carried out recently on the L.N.E.R. main line with a view to ascertaining the respective merits of the 2-cylinder and 3-cylinder types of modern locos. On the Edinburgh-Newcastle section of 122 miles with some heavy gradients, locos of the "Atlantic" type were compared. Each loco made five double trips with trains weighing some 360 tons, including the dynamometer car.

The details of water and coal consumption, average speed, average boiler pressure, and draw-bar pull were carefully registered and the figures afterwards published. The points that will interest our readers are as follows :—

	Both 4–4–2 N.E. type 2-cyl. No. 701	3-cyl. No. 729
Weight of Train (tons) ...	362.5	364.8
Average speeds (M.P.H.) ...	46.26	45.75
Average Draw-Bar Horse Power Tons	422.1	454.5
Average Steam Pressure ...	169.7 lb.	168.7 lb.
Average Water per mile ...	41.24 gall.	37.03 gall.
Average Coal per mile ...	56.1 lb.	45.6 lb.

During the runs No. 701 made four unbooked stops and suffered from 11 signal checks, while the 3-cylinder loco made three unbooked stops and had 18 signal checks. Weather conditions favoured the latter loco.

Locomotives of the "Consolidation" (2–8–0) type with two and three cylinders respectively were tested with coal trains over the 74-mile course between London and Peterborough. In this case the journeys up to London were with full loads and in the opposite direction with trains of empties. For the following table only the "up" runs are considered. The up run includes some long banks of 1 in 200, and a stop for water near Hitchin involves restarting on a rising gradient. As in the tests on the Northern section between "Atlantics," the same drivers and firemen were employed throughout. The weather on the coal-train runs was all in favour of the 2-cylinder loco.

	Doncaster (G.N.R.) Type 2–8–0 2-cyl. No. 3466	3-cyl. No. 3479
Weight of Train (tons) ...	1310.5	1315
Average Speed (M.P.H.) ...	13.24	13.67
Average Draw-Bar Horse Power Tons	356	394
Average Steam Pressure ...	163.5 lb.	162.5 lb.
Average Water per mile ...	86.05 gall.	81.1 gall.
Average Coal per mile ...	141.25 lb.	137.65 lb.

The result of these tests and the fact that 3-cylinder locos need less repair and cause less wear and tear to the permanent way indicate that the policy of Mr. H. N. Gresley, C.B.E., Chief Mechanical Engineer of the L.N.E.R., in building this type is sound.

G.W.R. "Castles"

In response to a number of requests we give a complete list of the new "Castle" type 4–6–0 express locos :—

4073–4082—*Caerphilly, Caldicot, Cardiff, Carmarthen, Chepstow, Pembroke, Pendennis, Powderham, Warwick, Windsor.*

4083–4089—*Abbotsbury, Aberystwyth, Berkeley, Builth, Cardigan, Dartmouth, Donnington.*

4090–4099—*Dorchester, Dudley, Dunraven, Dunster, Dynevor, Harlech, Highclere, Kenilworth, Kidwelly, Kilgerran.*

Railway Mileage in Australia

Canberra Federal District ...	5
New South Wales	5,444
New Zealand	3,011
Northern Territory	198
Queensland	7,203
South Australia	3,467
Tasmania	867
Victoria	4,349
Western Australia	4,839
Total	29,203

5000–5012—*Launceston, Llandovery, Ludlow, Lulworth, Manorbier, Newport, Nunney, Oystermouth, Raglan, Shrewsbury, Swansea, Tintagel, Wallingford.*

The class is completed by No. 111, "*Viscount Churchill*" (formerly "*The Great Bear*,") and 4009, "*Shooting Star*," which was rebuilt to conform with the "Castles."

* * * *

An Ingenious Device

Most of our readers are familiar with the various schemes for preventing the wind screen on a motor car becoming covered with rain drops or snow to such an extent as to make it difficult for the driver to see ahead. An extremely interesting device to serve a similar purpose on locos has been adopted in the United States. In order that the enginemen may obtain a clear view of the line ahead in all weather conditions, the usual footplate spectacle is superseded by a polished glass disc fitted into a spectacle frame and carried on a central bearing so that it can be rotated by a small electric motor. The result is that, with a fairly rapid rotation, averaging 1,600 r.p.m., rain or snow is instantly thrown off, while the revolution is so fast that an unimpeded view is given.

Old North Eastern Locos for Museum

Two of the old locos that took part in the Centenary Procession last July are to be placed in the Railway Museum at York. The veterans on whom this honour is to be conferred are Nos. 901 and 1275 of the former N.E.R. No. 901 is a 2–4–0 passenger loco built to Fletcher's design in 1875, and until the main line expresses became too heavy was well known as a "Flyer" on the Scottish trains. The other loco is of the 0–6–0 mineral type and was built at Glasgow in 1870.

* * * *

The Value of Catch-Points

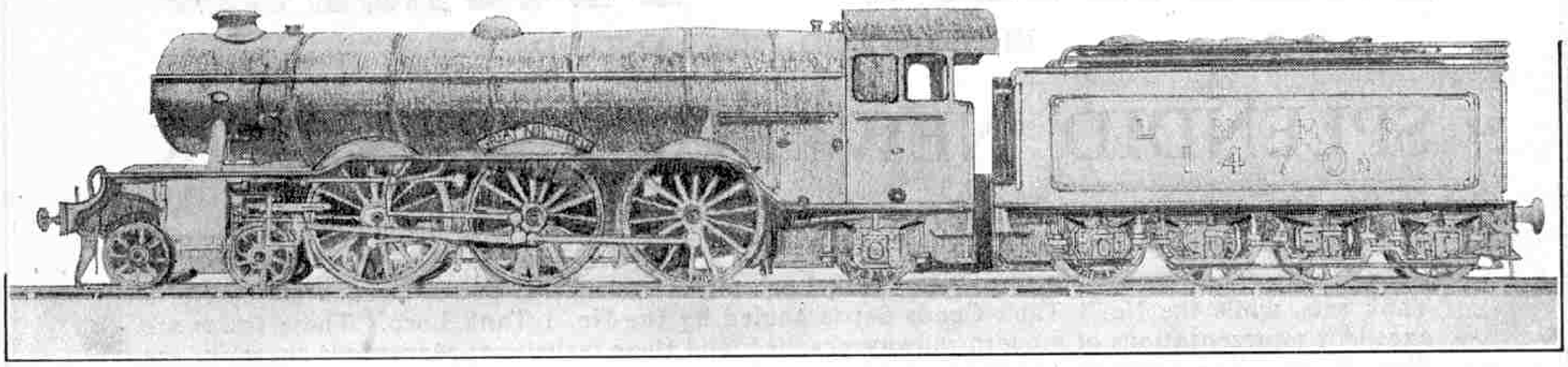
Safety points, variously labelled "catch-points," "runaway points," and "switch," will often have been noticed by readers of the "*M.M.*" on almost any main or important branch line. Catch points are nearly always to be found on gradients steeper than 1 in 200, their function being to derail or divert from the main line any vehicles out of control and running back down the gradient on the up or wrong line. The tongue of the points is actuated by a spring, enabling up trains to pass in the "trailing" direction, but in the opposite direction the points come into operation and runaways are either derailed clear of the main line or led into a sand-drag which effectually overcomes their momentum.

During the last week of August a heavy goods train on the L.M.S. was climbing the inclines across the Pennine Range between Lancashire and Yorkshire when a coupling in the front portion of the train broke. The loco and front trucks continued their journey while the rear section of the train, heavily laden with coal and building materials, ran back down the bank. Pluckily keeping his post, the brakesman in the van applied his hand-brake, but it was insufficient to do more than check the onrush momentarily, so he jumped clear and fortunately landed on a grassy bank unhurt.

The heavy wagons continued their mad career until they reached the catch-points, which diverted them into an embankment. Considerable damage was done, several wagons being broken to matchwood, but had the runaway freight train continued down the gradient it probably would have collided with a following train and the consequences would have been disastrous.

On some lines the distance and direction of catch-points from the top of a gradient is indicated by a special board.

"The Great Northern"



L.N.E.R. 3-Cylinder Express Loco No. 1470 (4-6-2)

Drawn by P. Duxbury of Margate (age 11¾ years) and awarded First Prize (Class B) in our Second Drawing Competition.

Another Railway Centenary Pageant

The centenary of the opening of the Stockton and Darlington Railway on 27th September 1825, was celebrated on the actual anniversary by a pageant at Belle Vue, Manchester. The event was organised entirely by railway employees and the President was Mr. J. H. Hayes, M.P. for the Edge Hill division of Liverpool, which was a notable centre of early railway activities. More than 50,000 railwaymen and their relatives were present. The pageant opened with the crowning as "Centenary Queen of the Railways" of Miss H. M. Wotton, the sixteen-year old daughter of a Great Western employee at Kingswear. Afterwards came a pageant illustrating the development of transport from the camel and the elephant to the great locos of to-day.

Previous to the pageant the "*Centenary Queen*" made a tour of the places of historical railway interest in the Liverpool and Manchester districts, and laid a wreath on the railside memorial at Parkside which marks the spot where Mr. Huskisson, M.P., the first victim of a railway accident, was run over on the day of the opening of the Liverpool and Manchester Railway.

* * * *

Exhibition Trains

Four trains, each consisting of three specially-adapted 50-ft. carriages, are to tour the chief railway systems of Great Britain for about a year. Each train will provide space for about 100 exhibitors, the intention of the scheme being to bring to the notice of the public the superiority of British and Colonial manufactured goods. A programme has been drawn up allowing stays of from two to six days in the districts to be visited. Demonstrators and representatives of the interested firms are to travel with the trains. The rolling-stock to be used consists of former ambulance trains used during the War.

* * * *

Long Working Hours for Locos

The tendency of locomotive departments now is to keep locos in steam for very long spells, thus adding tremendously to the mileage that has generally been considered to represent a good day's work. Thus, on the L.N.E.R. East Coast expresses, it is customary for the "Pacifics" to work from Newcastle to Edinburgh, back to York and thence to Newcastle, the distance covered since leaving shed being 410 miles. Recently No. 2572 of this class, after completing this full duty, added a further trip to York and back, returning to "rest" only after running 571 miles!

On the G.W.R. there are examples of a loco starting from Paddington in the morning and being found at Penzance later in the day, or working on express turns between such widely-distant points as Chester and Newton Abbot. Similarly, the L.M.S. have locos in steam most of the 24 hours, and working through from Euston to Holyhead.

The world's record in long continuous running is claimed by the Union of South Africa Railways (3 ft. 6 in. gauge). A mail train consisting of 11 bogie carriages, including sleeping and restaurant cars, was worked through from Johannesburg to Capetown, a distance of 956 miles, in 27 hours 33 minutes. The loco was one of the new American-built express type, and before the new arrangements the train concerned made no fewer than six stops to change engines.

* * * *

L.N.E.R. Notes

The new "Mikado" loco, No. 2393, recently underwent a special test. This powerful loco, which is fitted with an auxiliary "Booster" engine, was set to haul a loaded coal train of 103 wagons, a 20-ton brake, and the North Eastern dynamometer car, between Peterborough and London. The total load behind the tender exceeded 1,700 tons, but it was hauled with great ease by the new loco.

* * * *

A train recently joined the L.N.E.R. system at Harwich, en route to London from Milan! This was a goods train of specially constructed vehicles conveying Italian motor cars via the train-ferry without transhipment.

* * * *

The London-Edinburgh Pullman has for some time been worked between King's Cross and Leeds by the former Great Central 4-6-0 locos, 6164, "*Earl Beatty*" and 6165, "*Valour*" (The War Memorial loco). The "Pacific" No. 4477 has been named "*Gay Crusader,*" and a new 4-4-0 "Director" type loco running in Scotland is 6390 "*Hobbie Elliot.*"

* * * *

G.C. 4-2-2 (single) loco, No. 5972, which took part in the Centenary Procession this Summer, is again working first class expresses between Liverpool and Manchester.

* * * *

G.W.R. Notes

Mixed traffic locos of the 4700 (2-8-0) type now work over the Northern Section of the main line via Wolverhampton and Shrewsbury. These locos have 5 ft. 8 in. driving-wheels and particularly large boilers. The difficulty seems to be to find trains heavy enough for them, as the smaller 2-6-0's of the 4300 class are not afraid of any load or of fast running.

* * * *

A new type of tender, larger than the usual pattern, is attached to one of the new 4-6-0's, No. 4088, "*Dartmouth Castle.*" The only double bogie tender on the line is that originally built for the "Pacific" engine (now rebuilt as a "Castle.") This tender has been seen in company with a 4-4-0 "County" loco on express duty between Birmingham and the West of England.

* * * *

The Speedy "King Arthurs"

The up-to-date 4-6-0 express locos of the "King Arthur" class are acquiring a good reputation in the matter of speed on the various sections of the Southern Railway. In working the fast Continental Boat Trains over the South Eastern section these handsome locos cover the long straight line between Ashford and Tonbridge (26½ miles) in 25½ minutes with trains of 425 tons. Prior to the introduction of the 4-6-0's it was unusual for trains to load above 300 tons. Severe speed restrictions for curves at Tonbridge and elsewhere prevent the "King Arthurs" attaining higher speeds at present.

No. 454 "*Queen Guinevere*" of the same class, has set up a record in hauling a West of England express from Exeter to Waterloo over the 76 miles from Sidmouth Junction to Salisbury in 78 minutes. The train consisted of 14 main-line coaches, but this did not prevent maximum speeds varying from 75 to 80 m.p.h. The line is severely graded.

HORNBY TRAINS

BRITISH AND GUARANTEED

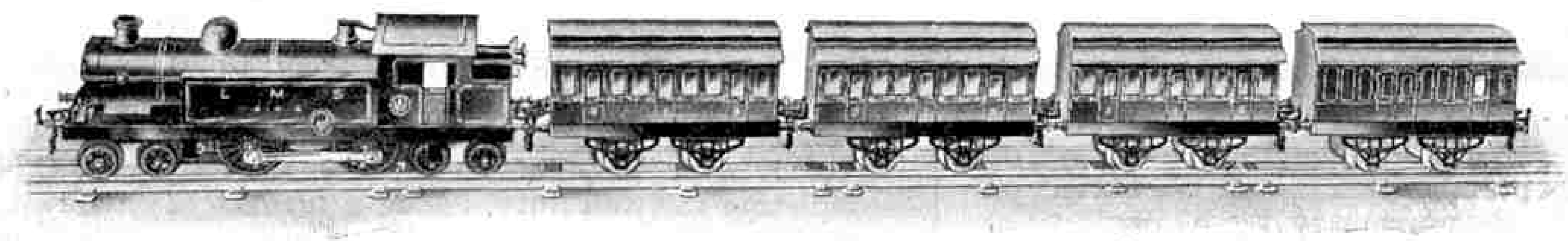
SPLENDID NEW ROLLING STOCK

We are now able to announce the addition of three new Train sets to the Hornby Series.

The new rolling-stock consists of the Hornby No. 2 Tank Passenger Set and Nos. 1 and 2 Tank Goods Sets. The famous Hornby 4-4-4 Tank Loco forms the motive power in each of the No. 2 Tank sets, while the No. 1 Tank Goods Set is hauled by the No. 1 Tank Loco. These trains are excellent representations of modern railway practice, and their realistic appearance is shown in the illustrations. The Locos and component Wagons, etc., of the sets may be also obtained separately.

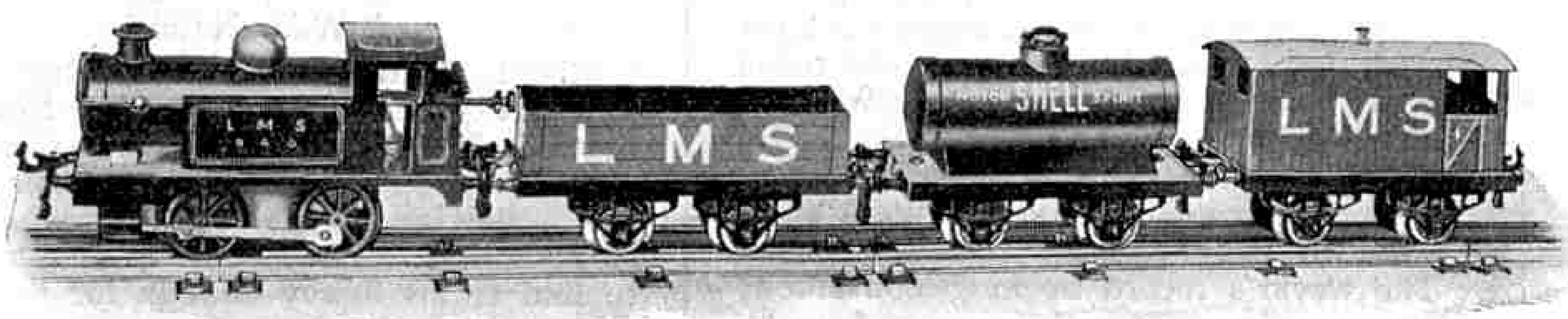
Hornby Tank Locos are already well known for reliability and strength, for they have been long tried under exhaustive tests. The new trains are fully covered by our guarantee.

HORNBY No. 2 TANK PASSENGER SET



This set contains a No. 2 Hornby Tank Loco, three Passenger Coaches, Guard's Van, and set of Rails to form a circle 4ft. in diameter. One of the Rails is fitted with levers by means of which the Loco may be both braked and reversed from the track. Gauge 0, in colours to represent the L.M.S. or L.N.E. Railway Companies' rolling-stock.

Complete Set, well boxed ... Price **45/-**

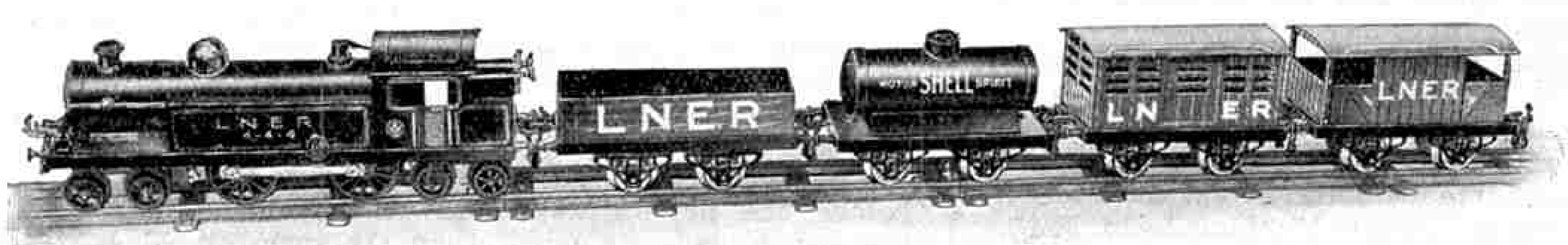


HORNBY No. 1 TANK GOODS SET

This Set contains a No. 1 Hornby Tank Loco, Hornby Wagon, Petrol Tank Wagon, Brake Van and set of Rails to form a circle 2ft. in diameter, and two Straight Rails. The Loco is fitted with brake, which may be operated by a lever in the cab or from the track, reversing-gear and governor.

Gauge 0, in colours to represent the L.M.S. or L.N.E. Railway rolling stock. Complete Set, well boxed ... Price **25/-**

HORNBY No. 2 TANK GOODS SET



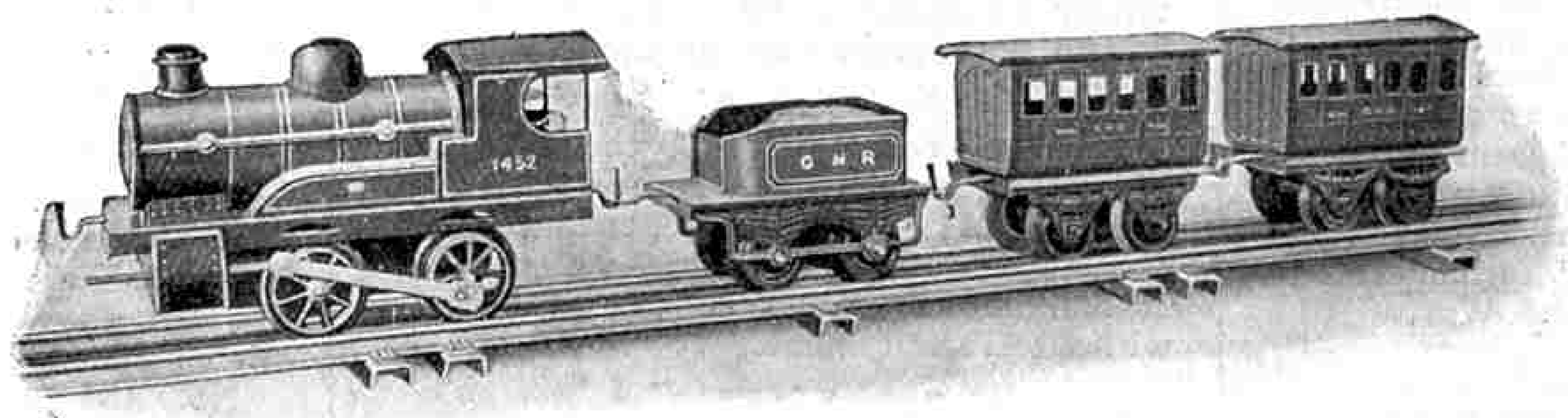
The rolling-stock of this realistic goods train consists of a No. 2 Tank Loco, Hornby Wagon, Petrol Tank Wagon, No. 1 Cattle Truck, and Brake Van. The Loco may be braked and reversed from the track—which forms a circle 4 ft. in diameter—or from levers in the cab. The No. 2 Hornby Tank Loco is 11¾" in length and is fitted with leading and trailing four wheeled bogies.

Gauge 0, in colours to represent the L.M.S. or L.N.E. Railway Companies' rolling stock. Hornby No. 2 Tank Goods Set, complete, well boxed ... Price **45/-**

No. 00 CLOCKWORK TRAINS

(GAUGE 0)

Each No. 00 Clockwork Train Set is now supplied complete with set of Curved Rails to form a circle 2 ft. in diameter, and two Straight Rails. They form ideal commencing sets for the boy who wishes to build up a model railway gradually, and those fortunate boys who already possess more elaborate railways will find them admirably suitable for use as additional "suburban" rolling stock, etc. They are strongly built and fitted with reliable clockwork mechanism.



Each set contains Loco, Tender, and two Passenger Coaches, with set of Rails as described above. The Loco is fitted with brake and regulator, non-reversing. In colours to represent G.N., Midland, or L.N.W. Railway rolling stock.

No. 00 Clockwork Train, complete set, well boxed, Price **10/6.** Loco, Price **6/6.** Coach, Price **1/-.** Tender, Price **9d.**

ASK YOUR DEALER TO SHOW YOU SAMPLES

"Super-Sentinel" Shunting Loco

To Reduce Fuel Cost and Running Repairs by Half

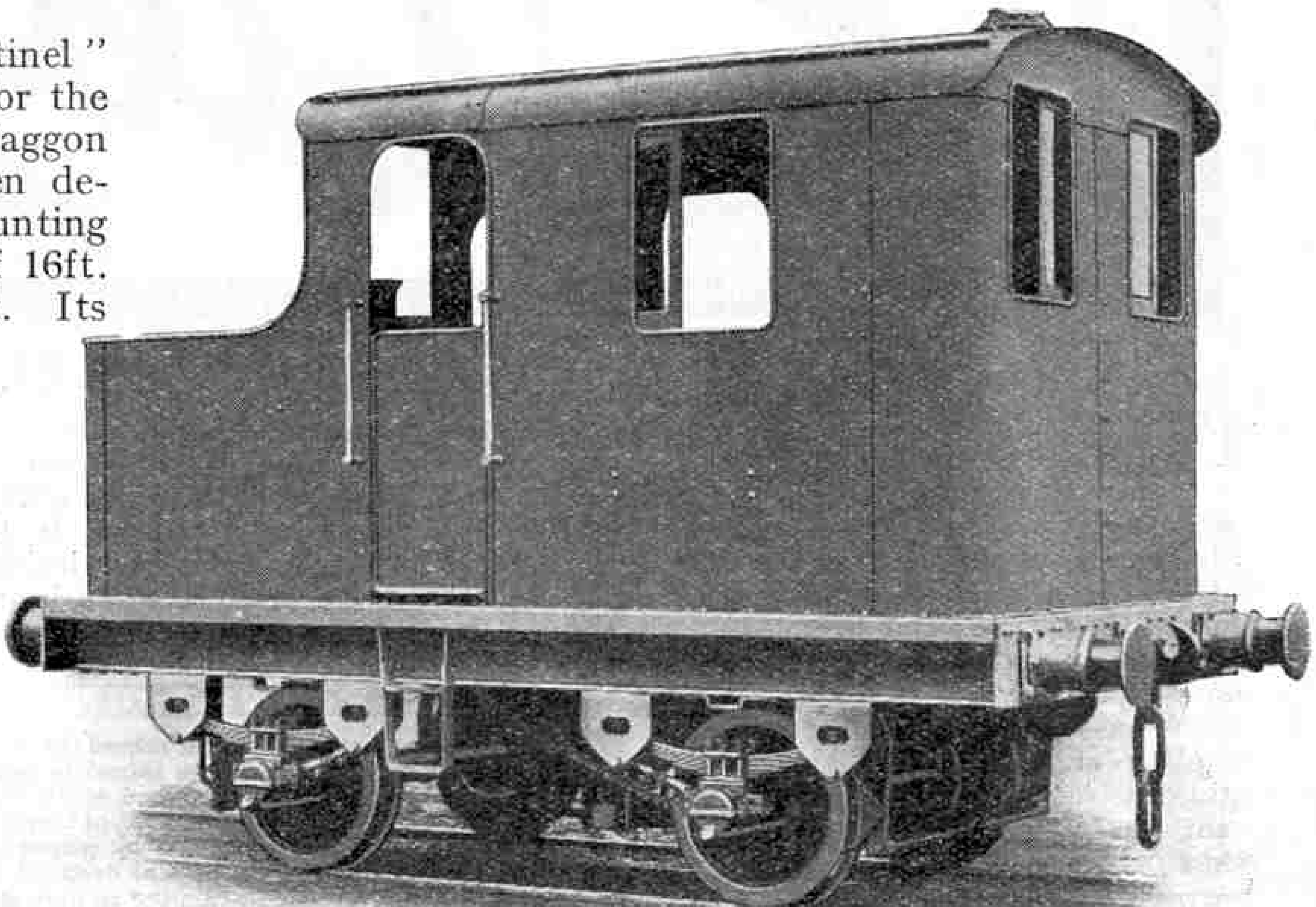


Photo courtesy] [Messrs. "Sentinel" Wagon Works, Ltd.

The New "Sentinel" Locomotive, Front View

AN interesting vertical-engined "Super-Sentinel" steam locomotive has recently been built for the L.M.S. Railway by the "Sentinel" Waggon Works (1920) Ltd. This engine, which has been designed for experimental work in connection with shunting operations at Crewe, has a length over buffers of 16ft. $10\frac{1}{4}$ in., a width of 8 ft. and a wheel base of 7 ft. Its total weight is 17 tons.

The engine has two double-acting high-pressure cylinders, with poppet valves of stainless steel and adjustable tappets. There are double piston rod glands and the two cam-shafts are enclosed in a crank case.

The cylinders are $6\frac{3}{4}$ in. diameter and the piston stroke is 9 in. The feed-pump is geared down to run at half engine speed.

All the working parts are self-oiling and are entirely protected from dust and grit, while the cylinders are lubricated by a mechanical oil pump driven from the engine.

The boiler is of the water-tube pattern, is without stay tubes or stays, and has a working pressure of 275 lbs. per sq. in. It is cylindrical in shape and has a firebox $\frac{5}{8}$ in. thick and a shell 17/32 in. thick. The boiler contains thirty plain, short weldless steel tubes, inclined at an angle to facilitate circulation.

The mountings comprise two safety valves, a stop valve, and a special hot water injector. There are also injector and blower steam valves, blow-down cock, filling and cleaning plugs, and a hand-hole door for cleaning inside the boiler and replacing the fusible plug. The tubes contribute 29.1 sq. ft. and the firebox 29.4 sq. ft. heating surface.

The firebox is easily accessible for cleaning purposes. The fire-grate area is 3.97 sq. ft.

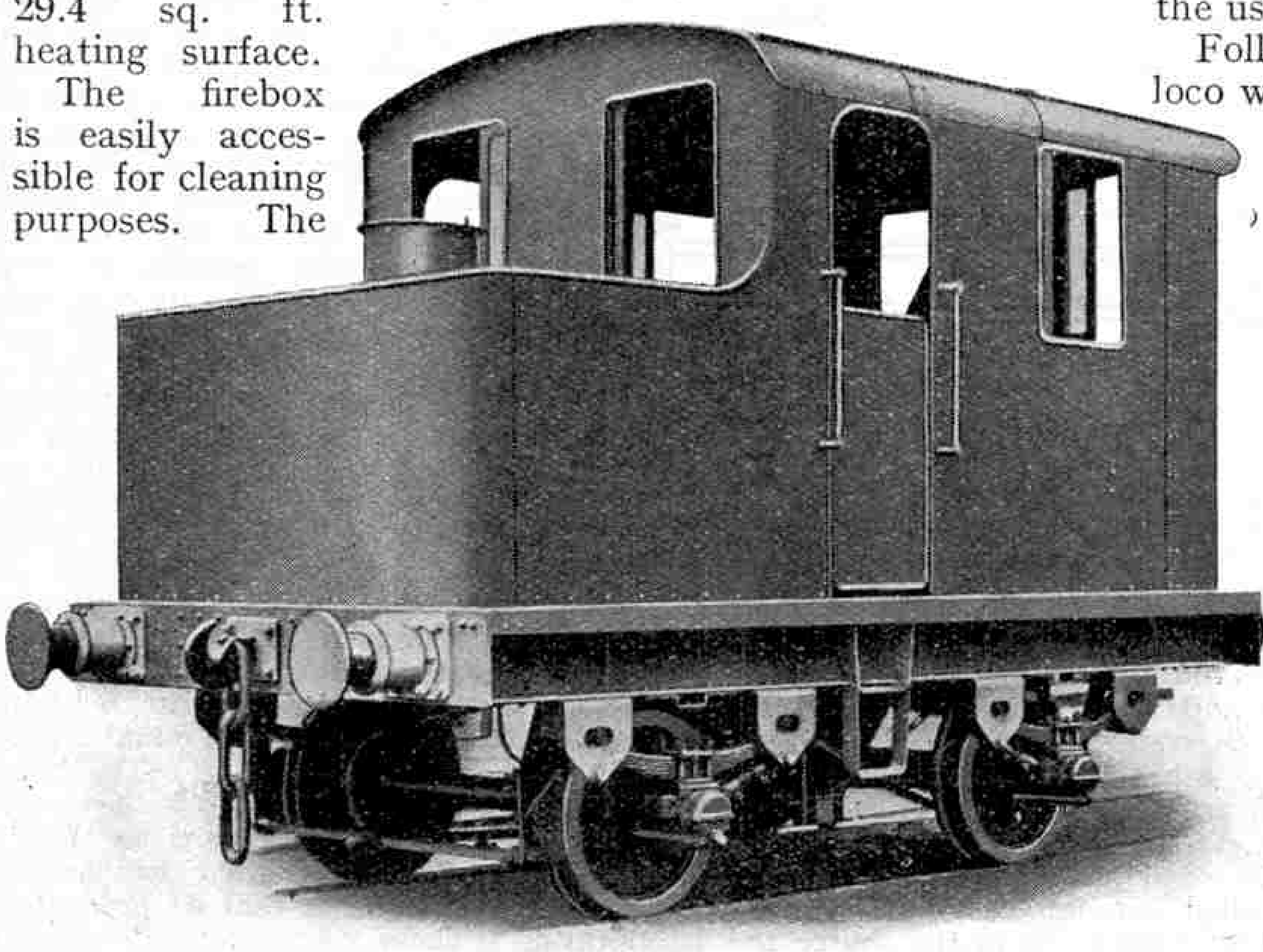


Photo courtesy] [Messrs. "Sentinel" Wagon Works, Ltd.

Rear View of the New Vertical-engined Locomotive

Steam is superheated to approximately 600 deg. and the boiler will evaporate 1,600 lb. of water per hour, when Welsh steam coal is being used.

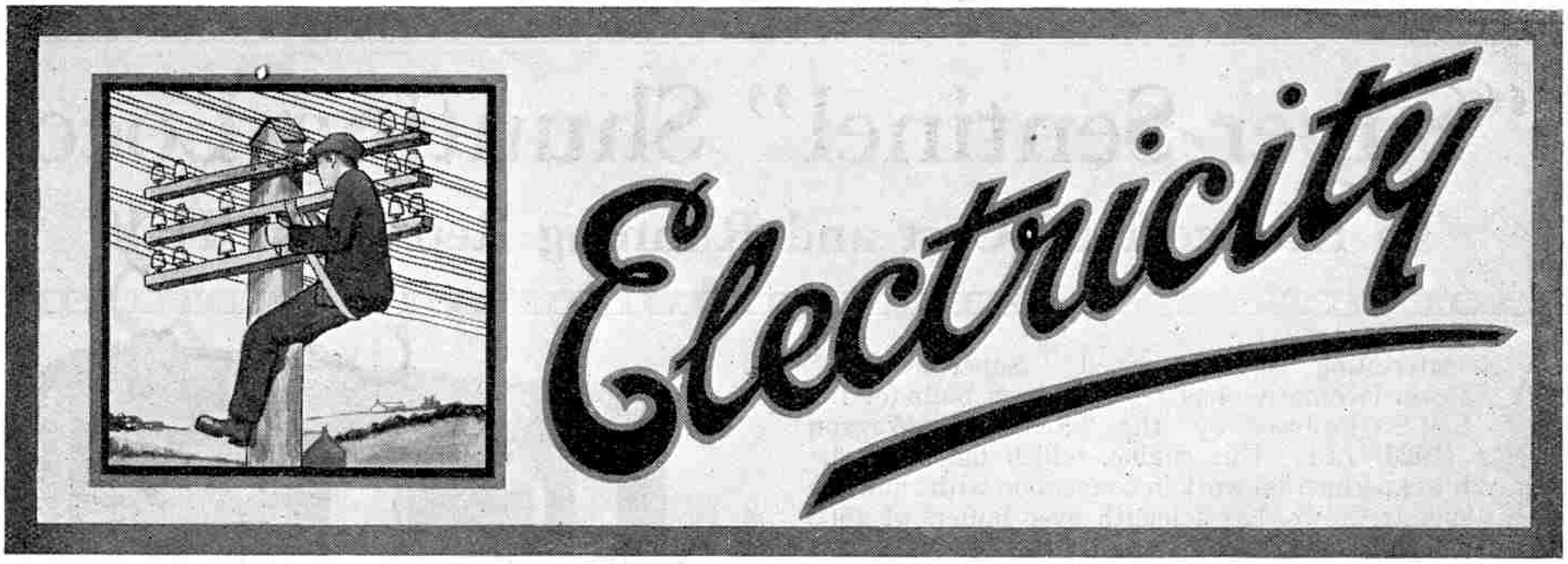
It is claimed for this new type of locomotive that it exerts a drawbar pull of 9,200 lb.

The makers affirm that fuel and repair costs are reduced by more than 50 per cent. in comparison with the usual types of locomotives built for similar service.

Following upon its arrival at Crewe, the new shunting loco was subjected to several tests with a dynamometer car and various weights of train. On the first trip the train weighed just over 100 tons. At 1,000 yards the speed had risen to 15 m.p.h. but it dropped to 8 m.p.h. in climbing a stiff gradient. The second and third tests were made over the same route with loads of $200\frac{1}{2}$ tons and the fourth test with $156\frac{1}{2}$ tons, the summit being passed at 7 miles per hour.

On the last two runs the dynamometer car, weighing 36 tons, alone formed the load, but the haulage was up a bank of 1 in 45. The speed attained in 150 yards was 16 m.p.h. and on restarting on the 1 in 45 a speed of 7 m.p.h. was attained in 40 yards.

A remarkable feature of the tests was the little loco's ability to start from rest without slipping. There was no need for the driver to juggle with the regulator to overcome this common bad habit, and the makers claim that the tendency towards slipping is reduced to 1/27 of the normal.



XX. THE TELEPHONE

There is a tremendous organisation behind the simplest telephone communication and in this and subsequent articles we intend to describe some of the methods by which the present remarkably high standard of efficiency is obtained.

By courtesy of Messrs. Adam Hilger Ltd., of London, we are able to reproduce three interesting sound wave records obtained by means of the Low-Hilger Audiometer, which is an extremely sensitive instrument designed to record the pressure variation caused by sound waves. These fascinating records enable one, as it were, to see the invisible.

IGNORING for the moment the mechanism of the exchanges, whereby any subscriber may be connected to any other subscriber, the process of telephoning is briefly as follows. The voice of the speaker causes sound waves to be formed in the air, and these act upon the transmitter and control the flow of an electric current that passes between the sending and the receiving stations. This electric current operates mechanism that produces similar sound waves in the air at the receiving end, and these sound waves act upon the ear of the listener, who interprets them as words and sentences.

Thus the object of the telephone mechanism is to convert the sound into electricity at the transmitting end and then to convert this back into sound at the other end. Since sound waves are concerned with the process at both ends it is necessary for us to understand something of their nature.

How Sound Travels

We may soon satisfy ourselves that sound must have some medium through which to travel. This may be demonstrated by taking an electric bell and suspending it in a large jar from which the air may be removed by means of an air pump. Under normal conditions we hear the sound of the bell quite clearly, but when we operate the air pump and withdraw the air the sound grows fainter and fainter until at last it practically ceases, yet we know that the bell is still ringing for we can see the hammer striking the gong as energetically as ever. The sound does not cease absolutely, but this is because we are unable to exhaust all the air from the jar, and also because there is still a material medium connecting the bell with the outer air, namely, the suspending wires.

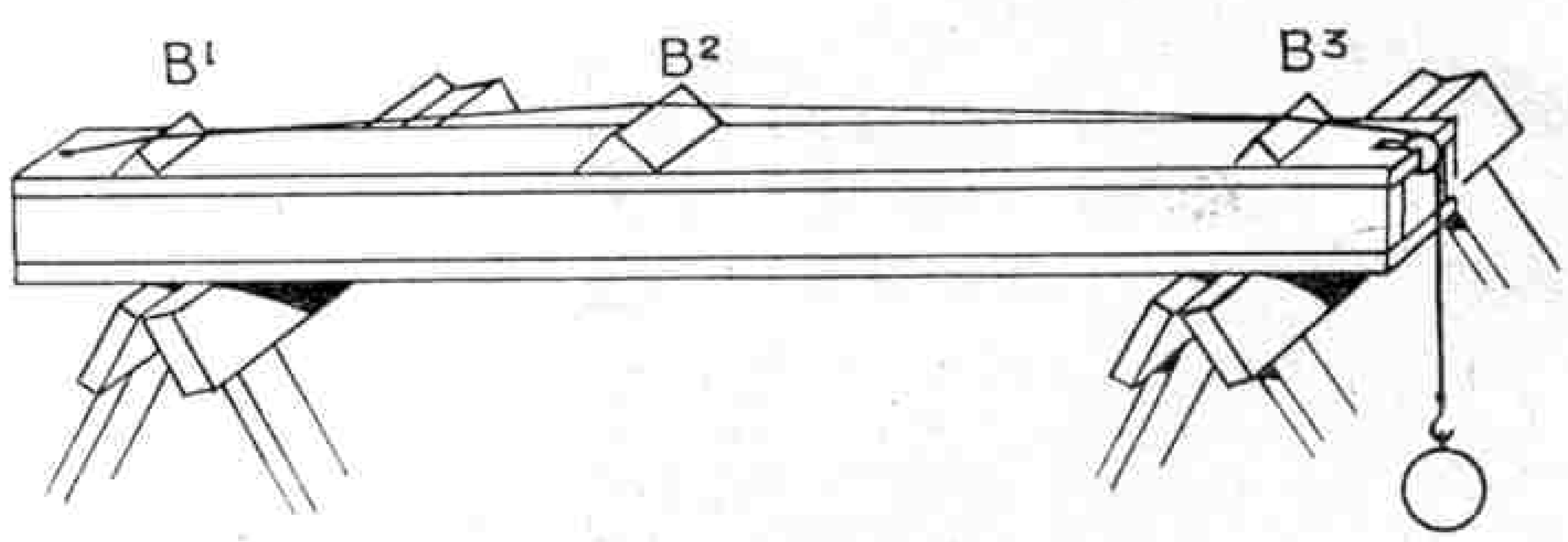
A Simple Experiment

This experiment may be performed in a much simpler manner with considerable success. All that is required is a glass flask with a tightly fitting cork. A piece of wire is pushed through the cork and its lower end is turned up to make a little hook to which is fastened a small bell of the kind sold for reins for children. Place a small amount of water in the flask and cork it tightly. The bell is now, of course, inside, and if we shake the flask we shall hear the ringing quite distinctly. Now remove the cork and place the flask over a Bunsen flame until the water boils. Allow the boiling to continue for a little while in order to drive out the air and then remove the flame and cork the flask as quickly as possible. Allow the flask to cool and again shake it and it will be noticed that the sound of the bell can scarcely be heard.

These experiments are sufficient to enable us to say that sound requires a material medium through which to travel, and that it cannot pass through a vacuum.

Transmission through Liquids and Solids

The air is the usual medium through which sound travels, but it may be transmitted also through liquids and solids. When swimming under water we are able to hear sounds made on the bank surrounding the water, or in a boat above, and on the other hand above the water we can hear the sound of two stones struck together under water. In both cases it is clear that the sound must have travelled through the water for a portion of its journey from the source to the ear of the listener.



The Monochord

It is easy to show that sound can travel through solids. If you press your ear against a telegraph post when the wind is making the overhead wires "sing," the sounds are heard much more distinctly than when you listen to them as transmitted through the air. Another simple experiment consists of placing the ear at the end of a long wooden rod or lath and noticing how plainly we can hear a slight scratching made at the other end.

The Speed of Sound

If we watch a roadside stonebreaker at work at a distance we cannot fail to notice that we see the stroke of his hammer before the sound of the blow reaches us. This shows that sound takes time to travel, and also that it travels much slower than light. The difference between the two speeds is enormous. Light, which of course travels through the ether, not through the air like sound, has the tremendous speed of 186,000 miles per second, whereas the air-borne sound has a speed of only about 1,100 ft. per second.

A more striking proof of the difference between the speeds of light and sound is afforded by every thunderstorm. We know that the flash and the thunder take place at the same instant, but we always see the flash before we hear the thunder. If the lightning discharge occurs immediately overhead, the interval is very small, but the further away the discharge the greater becomes the interval. The speed of light is so enormous that we may assume that we see the flash at the instant at which it occurs and, knowing the speed of sound in air, 1,100 ft. per second, we are able to calculate roughly the distance at which the discharge took place. If, for instance, the sound of the thunder reaches us 5 seconds after the flash, we know that the electrical discharge took place just over a mile away, for $5 \times 1{,}100$ equals 5,500 ft. and 5,280 ft. equal 1 mile.

Sound Produced by Vibrations

If we strike a tuning fork so that it sounds its note and then examine it carefully, we shall see that its prongs are vibrating. These vibrations may be very plainly felt by placing one of the prongs gently against a tooth. If we experiment with other familiar sources of sound—a piano string, a 'cello string, etc.—we find that they also are vibrating while they are producing sound. From experiments of this nature we learn that sound is produced by vibration.

When a tuning fork is vibrating, the forward movement of a prong compresses the air in front of it, and this compression is transmitted as a wave. The succeeding backward movement of the prong causes a rarefaction, which also is carried forward as a wave. These alternate movements of the prong continue to produce other similar waves which travel outward in all directions in ever-widening spheres. These waves may be regarded as being similar to waves on the surface of water except that whereas the water waves can only travel horizontally, the air waves travel in every direction, horizontally and vertically alike. In considering this difference it must be remembered that water waves are transmitted on the surface of the medium in which they have their origin, whereas air waves have their source inside the medium in which they travel and therefore are not limited in direction.

When sound waves strike the drum of a listener's ear they set it vibrating very slightly at the same rate and in the same way as the original vibrating body. These movements of the ear drum set in motion the delicate mechanism of the internal ear and cause us to experience the sensation of sound. The actual process by which this is brought about is complex and is beyond the scope of this article.

Loudness, Pitch and Quality

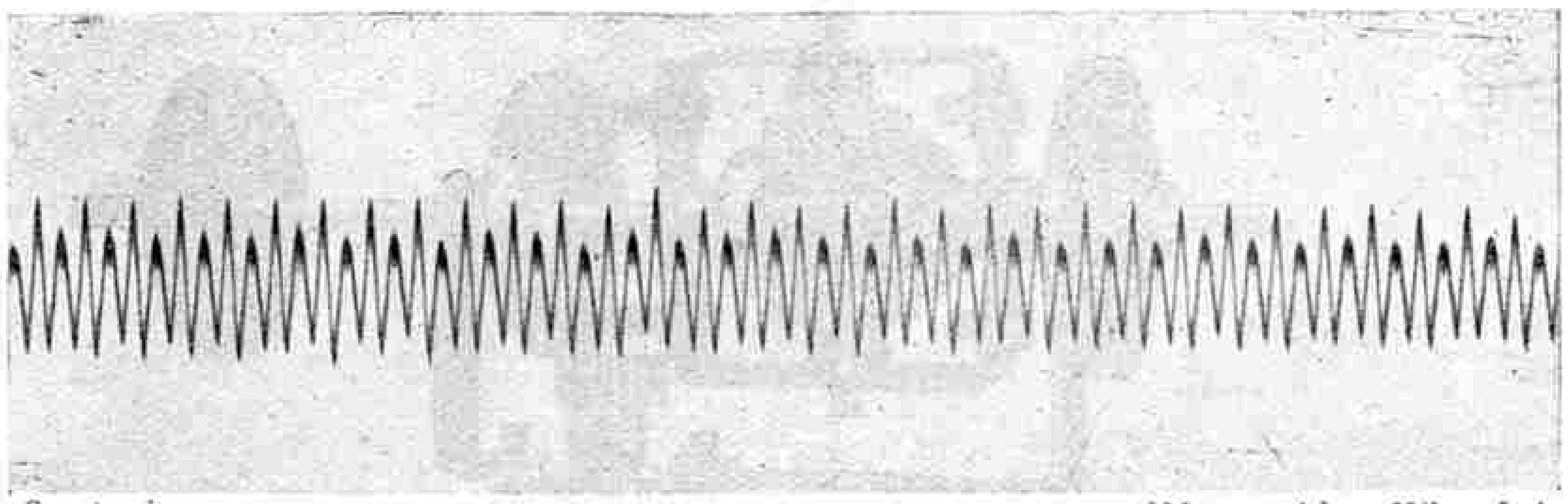
If we examine the different musical notes produced by the various instruments of an orchestra we find that there are only three ways in which they differ—in loudness, in pitch and in quality. There are also three ways in which air waves differ—in amplitude or size ; in wavelength or distance between two successive wave crests moving in the same direction, and in shape.

The loudness of the sound depends entirely upon the amplitude of the air wave, this, of course, being controlled by the amplitude of the vibrations of the source. The pitch depends entirely upon the wavelength, which is controlled by the frequency of the vibrations of the source ; and the quality, which enables us to distinguish the difference between the same note played on different musical instruments, depends entirely upon the shape of the wave, this being controlled by the form of the vibrations of the source.

It is not possible by means of simple experiments to demonstrate the different shapes of waves by which the sound quality is varied, but it is a simple matter to experiment with the causes of loudness and pitch. This is best accomplished by means of a piece of apparatus called a monochord.

Experiments with the Monochord

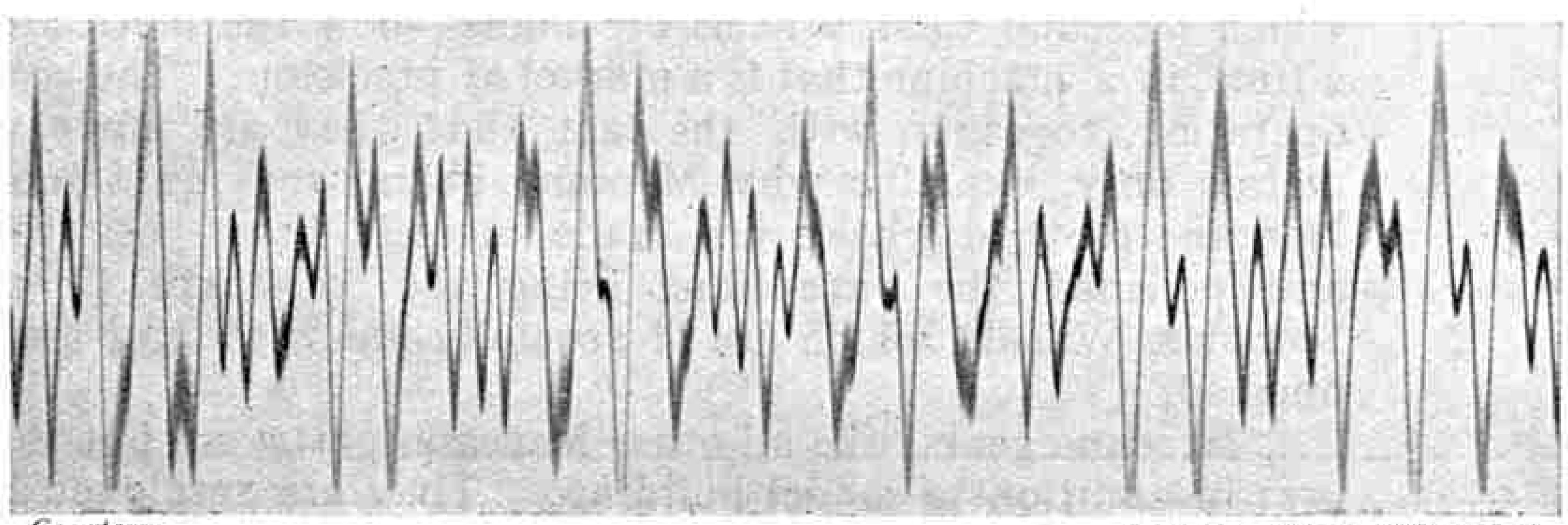
An easily made monochord is shown on the previous page. It consists of a wooden



Courtesy] [Messrs. Adam Hilger Ltd.

Violin, E, open string : frequency 689 per second

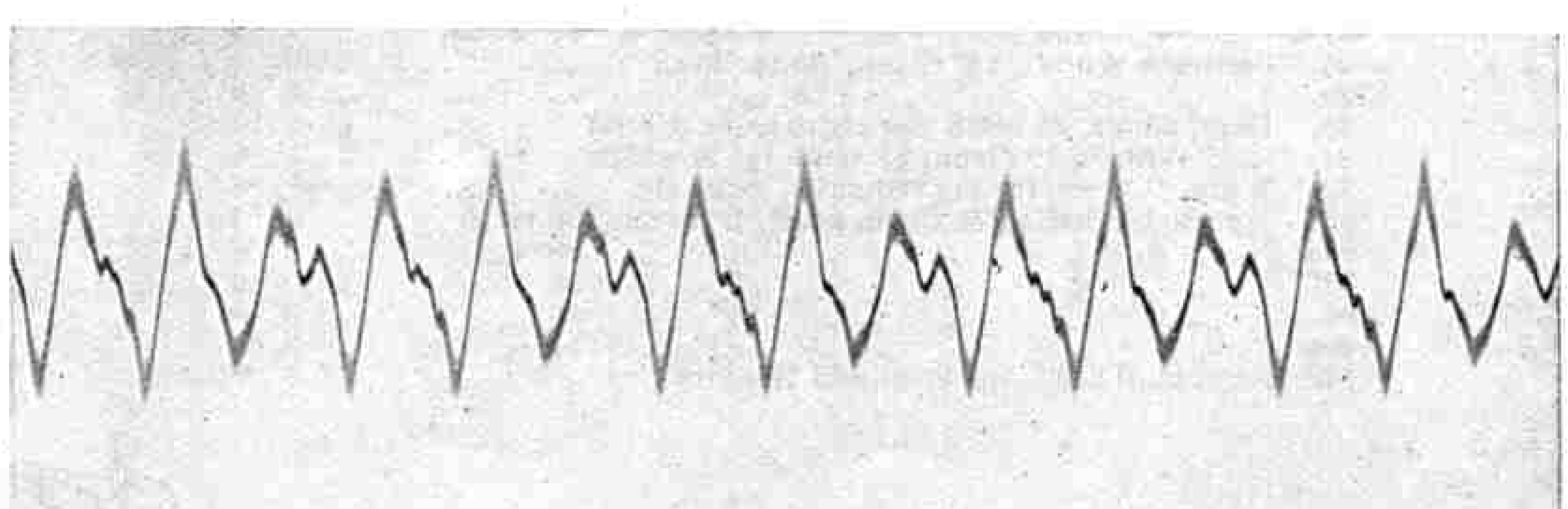
box about 40 in. in length, 4 in. in width and 3 in. in depth. The top board should be of thin hard wood. Three triangular wooden bridges are required, two of these being about $\frac{3}{4}$ in. high and the third about $\frac{1}{8}$ in. higher. The smaller bridges are glued near the ends of the box as shown at B1 and B3 in the figure. A screw should be driven in at one end of the box, and a small Meccano pulley wheel fixed at the other. A piece of steel



Courtesy] [Messrs. Adam Hilger Ltd.

Violin, pizzicato, G, D, A and E sounded simultaneously

wire is now required. This has a loop made at one end to attach it to the screw and the wire is then led over the two fixed bridges and the pulley wheel and down over the end of the box, where it is attached to a weight of, say, 7 lb. as shown. The remaining bridge is not fixed, but placed under the wire to move about as required. The monochord is now complete and if the wire is plucked with the finger a musical note will be



Courtesy] [Messrs. Adam Hilger Ltd.

'Cello, G, open string : frequency 102 per second

given out.

First let us investigate the cause of loudness. Remove the bridge B2 altogether, pluck the wire gently with the finger and notice the loudness of the sound. Repeat the process, but this time with a more powerful pluck, and notice that the note is now considerably louder, although still of the same quality and pitch. We are thus entitled to assume that loudness depends upon the amplitude, or size, of the vibrations, which in turn control the amplitude of the air waves.

We know that any wire vibrates in accordance with certain laws and that for any particular wire at a fixed tension the rate of vibration will depend entirely on the free length, which on our monochord—bridge B2 having been replaced—is the distance between B1 and B2. If we halve the distance B1 and B2 we double the rate of vibration ; if we double the distance we halve the rate, and so on.

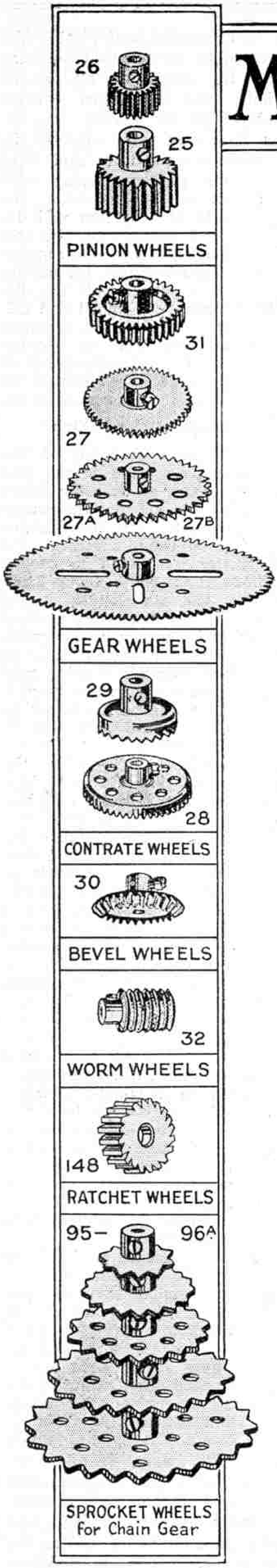
Frequency and Pitch

Each vibration of the wire sends out one air wave at the rate of 1,100 ft. per second, so that the faster the wire vibrates the shorter the wavelength. For example, if it vibrates at the rate of 1,100 times a second, the wavelength of the air waves so caused will be one foot ; if the frequency is 2,200 times a second the wavelength is six inches, and so on. In discussing musical notes, however, it is more usual to speak of the frequency of the waves, that is, the number passing any fixed point in one second. This number is equal to the rate of vibration of the string.

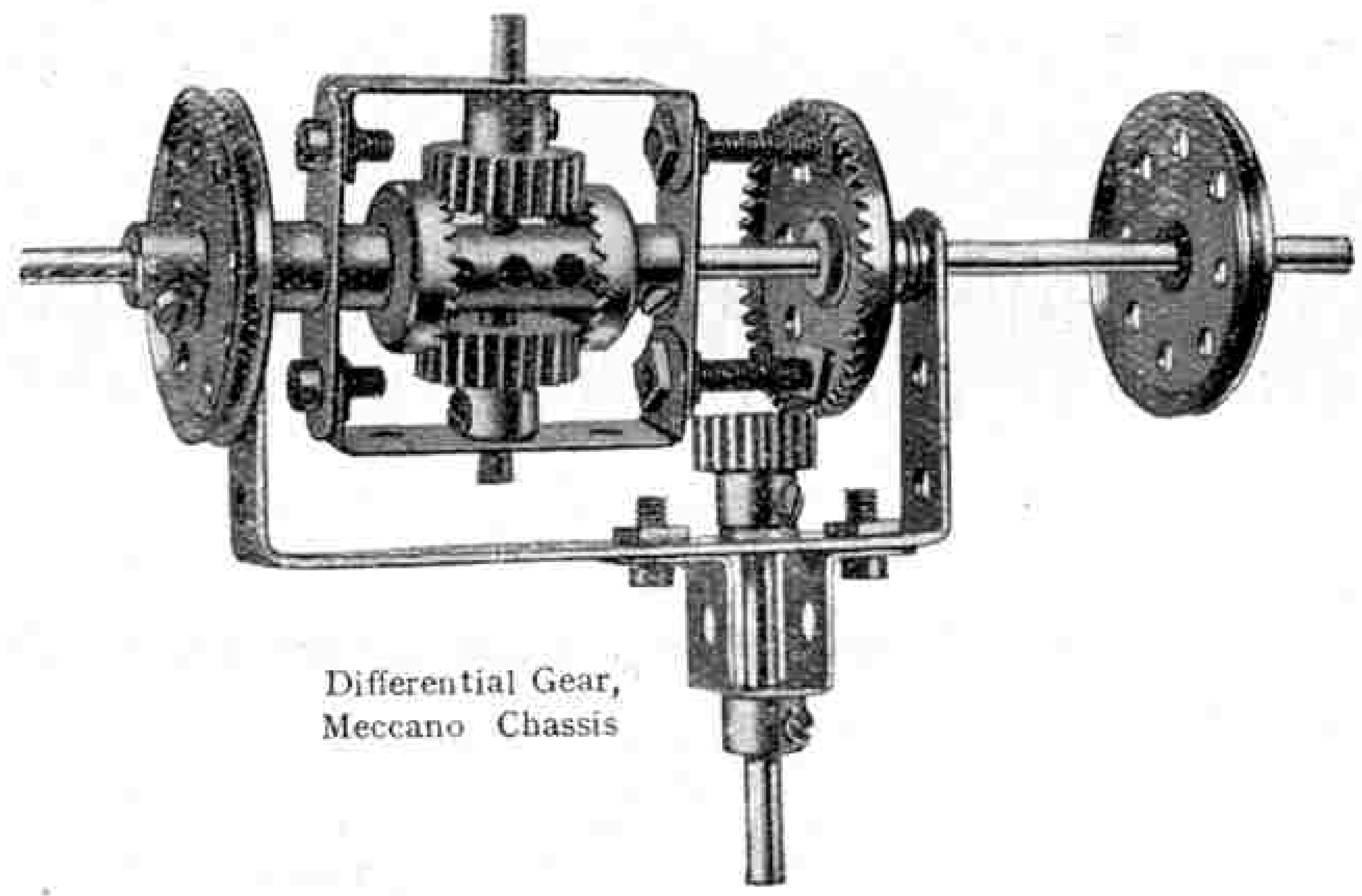
Place B2 under the string near B3 and pluck the wire, noticing the pitch of the note so produced. Measure the distance between B1 and B2 and then move B2 so that it is only half its previous distance from B1. Now pluck the wire again and it will be found that the octave of the previous note will sound. The greater the frequency of the vibrations the higher the pitch, and doubling the frequency always produces the octave.

An interesting lesson in regard to the pitch of sounds may be learned by standing on a railway embankment while an express train rushes past with its whistle blowing. It will be noticed that the pitch of the whistle rises as the train approaches us, becoming a high-pitched shriek when the loco is at its nearest point. Then, after the loco has passed us, the pitch of the whistle falls considerably.

The actual pitch of the whistle does not alter and the explanation of this effect is interesting. When the train is approaching the listener, the successive air waves are brought nearer to each other owing to the movement of the train, and when the train is receding they are taken further apart. The result is that the frequency of the waves, that is the number received per second by the listener, alters with reference to himself, and consequently to him the pitch rises as the train approaches and falls as it passes away from him.



MECCANO ACCESSORY PARTS



Differential Gear,
Meccano Chassis

GEAR WHEELS

Elsewhere in these pages we have briefly described the method by which Meccano Gear Wheels are made—how the teeth are cut, one at a time, in a machine that is a marvel of precision. The accuracy of this operation, together with the fact that they are made of the finest metals only, explains why Meccano gears work so smoothly. Most Meccano toothed wheels are made of solid brass, beautifully finished and polished, the exceptions being the 133-teeth Gear Wheel and Sprocket Wheels, which are of specially-fine steel and are equally well finished.

Meccano gears, like all other Meccano parts, are put to innumerable uses in addition to model-building. They are employed by engineers, students and professors of engineering, inventors, builders, and mechanics. Big engineering firms use them to demonstrate the working of the various machines they manufacture, as well as to try out new ideas, new movements, etc. They may be used with advantage in the construction of radio sets and hundreds of similar devices.

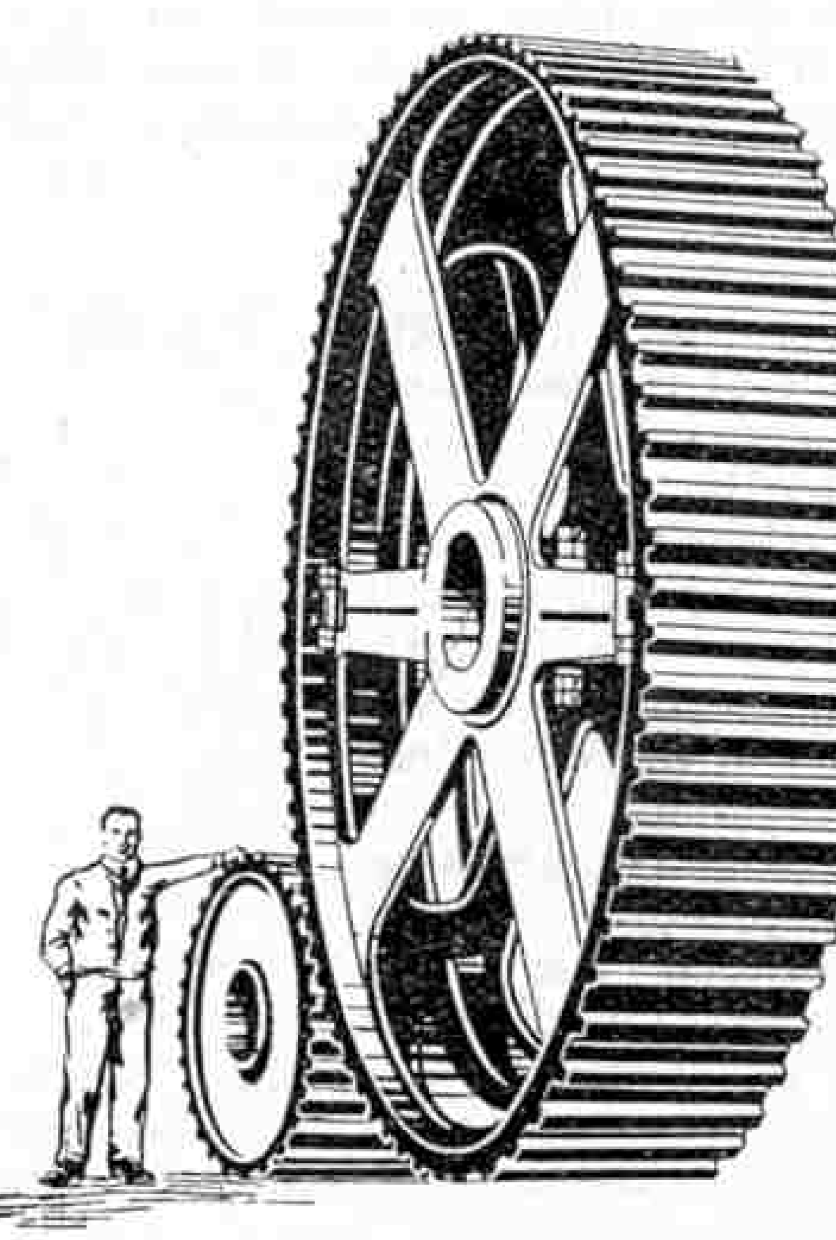
PRICE LIST

No.			s.	d.
25.	Pinion Wheels, ¾" diam., 25 teeth, to gear with No. 27	each	0	6
26.	" " ½" " 19 teeth, " " 27A	"	0	4
27.	Gear Wheel, 50 teeth, to gear with ¾" pinion ...	"	0	9
27a.	" " 57 " " " ½" " ...	"	0	9
27b.	" " 133 " " " ½" " 3½" diam.	"	1	6
28.	Contrate Wheels, 1½" diam., 50 teeth	"	0	9
29.	" " ¾" " 25 "	"	0	6
30.	Bevel Gears, 26 teeth (for right-angle drives) ...	"	0	10
31.	Gear Wheels, 1" diam., 38 teeth (¼" in width) ...	"	1	0
32.	Worm Wheels, for big reduction gear, etc.	"	0	6
95.	Sprocket Wheels (for Chain gear), 2" diam., 36 teeth	"	0	5
95a.	" " " " 1½" " 28 "	"	0	4
95b.	" " " " 3" " 56 "	"	0	6
96.	" " " " 1" " 18 "	"	0	3
96a.	" " " " ¾" " 14 "	"	0	3
148.	Ratchet Wheels, for Pawl and Ratchet Gear ...	"	0	9

Ask your dealer for a complete list of Accessory Parts or write for one to

MECCANO LTD.

BINNS ROAD LIVERPOOL



"WHEELS OF INDUSTRY"

Suggestions Page

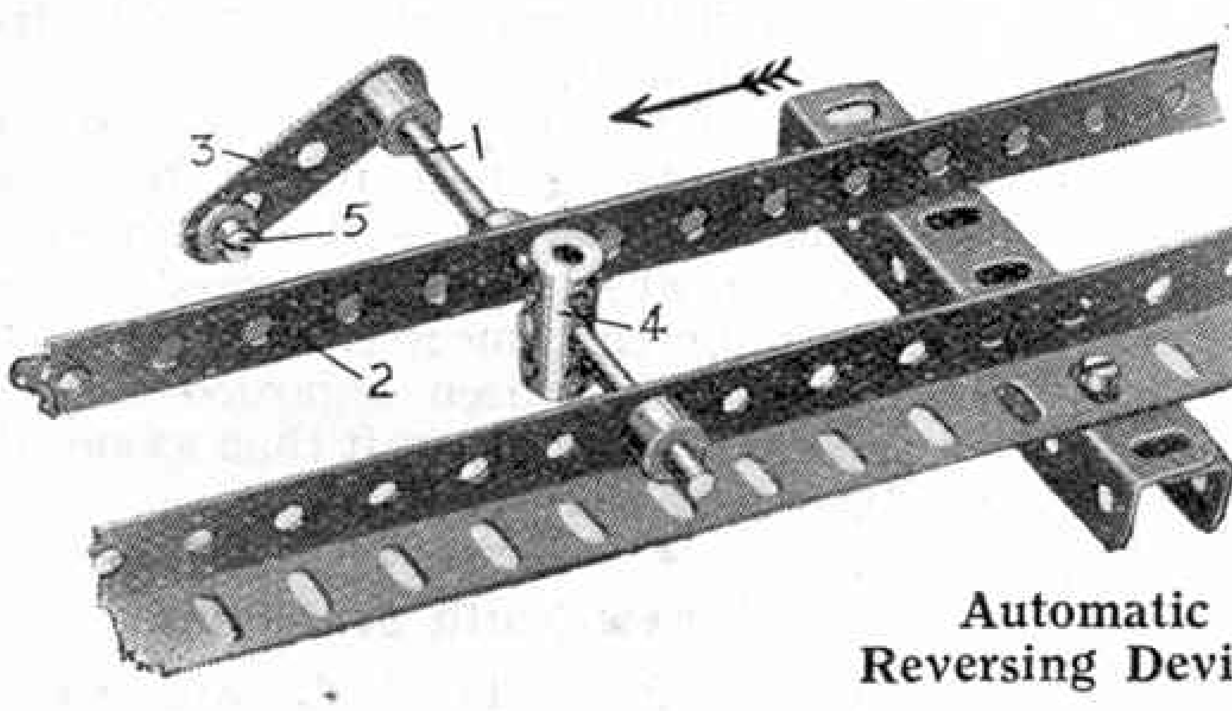
Automatic Reversing Device

By Eric Body, Broad Green, Liverpool.

This gear is designed for use with Hornby Locos, although it will serve admirably as a means of controlling many Meccano models that are required to travel to and fro upon rails. Master Body hit upon the idea whilst trying out his No. 2 Hornby Loco upon a length of Meccano track, built up from Angle Girders. The apparatus consists of a Rod 1, passed through the rails 2, and carrying a Crank 3 and Coupling 4. The web of the Crank rests upon the floor or table, etc., over which the rails are laid, and carries a nut, bolt and Washer 5 as additional weight. The Rod 1 is so adjusted in the rails that the Coupling 4 is caused to engage with the small projecting levers beneath the Loco, which operate the reversing or brake mechanisms, according to the direction in which the engine is running.

Supposing, for example, the Loco is travelling in the direction of the arrow shown; the Coupling 4, which is prevented from turning by the Crank 3, strikes the projecting lug beneath the engine and reverses the mechanism. The Loco, carried on by its momentum, passes some distance down the line, beyond the lever 2, before it begins to run back. On its return it strikes the Coupling 4 on the opposite side, and the Coupling, falling into a horizontal position between the rails, allows the Loco to pass unaffected, and is then returned to its former position by the weighted arm of the Crank 3.

It will now be seen that if a lever of this type is mounted at either end of a single length of track, a Hornby Loco may be allowed to travel to and fro for a considerable period—until the spring is exhausted—without outside supervision or aid, or fear of its over-reaching the ends of the track. The Cranks, or balance arms of the two levers should be set, of course, in opposite positions.

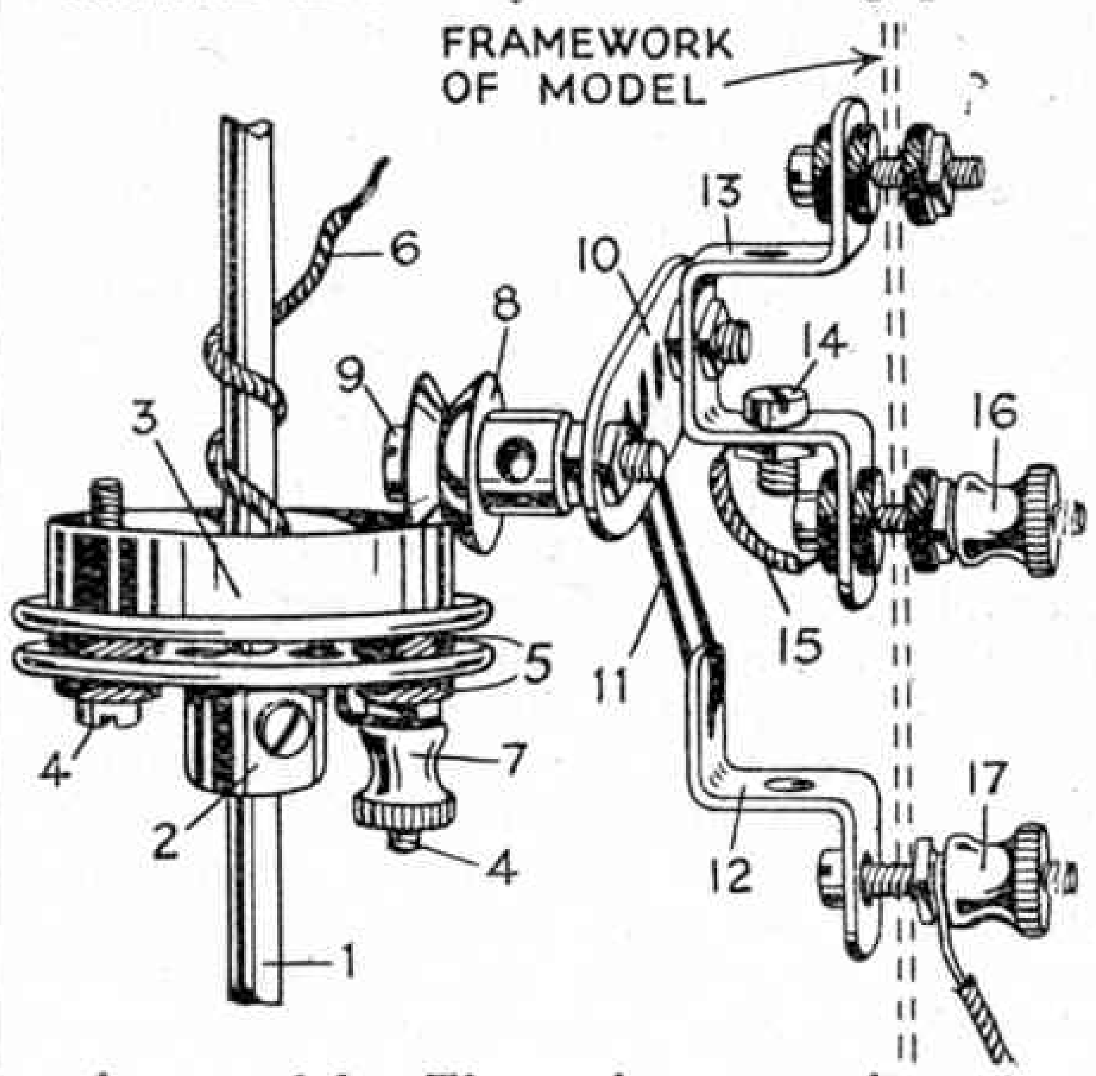


Automatic Reversing Device

Current Collector for Rotating Models

By Carl. W. Beese, Hamilton, Ont.

This is an ingenious arrangement by which electrical contact may be made between stationary and rotating portions of a model. The only unusual part required for its construction is a Flange Wheel (3) which has been separated from its boss; this may be effected with little difficulty by drilling. Our contributor suggests, however, that this special unit should be introduced as a new Meccano part, and although we are not certain as yet whether the demand will warrant its manufacture, we shall give the idea further consideration.



The Bush Wheel 2 is nipped on the Rod 1 and carries the special Flange Wheel 3, which is bolted to it with 6—B.A. Bolts 4, passed through Insulating Bushes 5. The wire 6 to the Motor or lamp is fastened under the Terminal 7, and is led through holes in the wheels 2 and 3. This must be an insulated wire. The ½″ fast Pulley 8 rotates freely on the Pivot Bolt 9 which is bolted to the collector wheel arm (10). Firm contact is obtained between the wheels 3 and 8 by the rubber band (11) which acts as a spring, and is attached to the framework of the model by means of a ½″ Reversed Angle Bracket 12. The collector arm 10 is lock-nutted to the Double Bent Strip 13 which is insulated from the model; a short wire 15 carries the current from a Terminal 16 to the Double Bent Strip at 14. The other Terminal 17 is connected to the frame of the model, and the source of current is connected to these two Terminals 16 and 17.

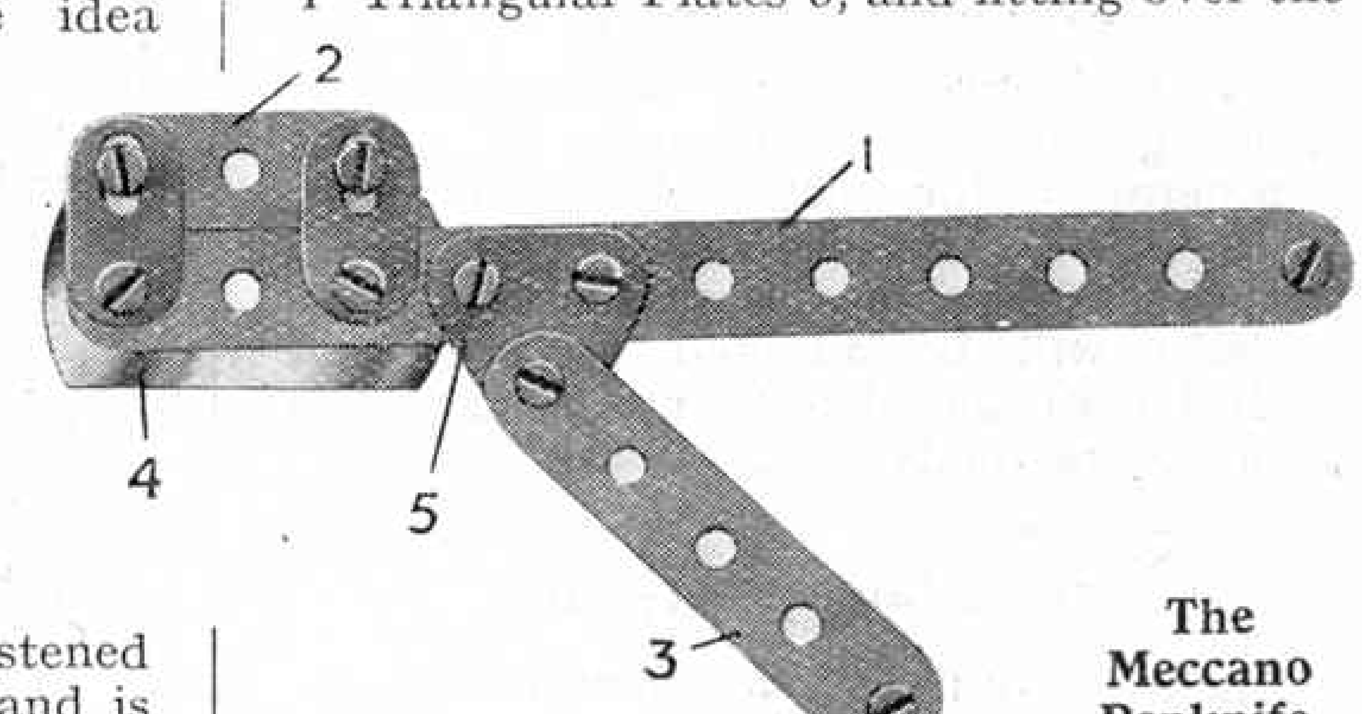
The Rod 1 carries the rotating portion of the model, whether it be a roundabout, a crane jib, or any other similar structure. The collector will be found useful in Models 322, 422, 423, 602, 606, etc. (for lighting purposes); 445 (red and green shades for signal light may be made of coloured tissue paper); 630 (mount Motor in revolving top of crane); 639 (Electric Motor), etc. The model numbers are taken from the new complete Manual.

A Meccano Penknife

By N. J. Creasey, Raynes Park, S.W.20.

Another excellent example of the resourcefulness of Meccano boys. Master Creasey tells us that he was induced to construct this novel penknife to meet the demand created by the Meccano Cross-Word Puzzles for nicely pointed pencils! Although we believe the situation is now somewhat eased, since the last Cross-Words have appeared, yet we can still endorse the practicability of this model. In fact, we are using one on our desk at this very moment!

The "business end" of the knife consists of an old safety-razor blade, and it is unnecessary, we hope, to warn our readers that this should be handled carefully during construction! The blade is bolted between two 5½″ Strips 1 and two 1½″ Strips 2 connected at either side by two Flat Brackets. A safety cover 3, constructed from two 2½″ Strips spaced apart by a Washer, pivots about a bolt mounted in 1″ Triangular Plates 5, and fitting over the protruding portion of the blade 4, safeguards one against accidental cuts.



The Meccano Penknife

Photographers will find this knife very useful in trimming their prints, etc. Indeed, there must be many purposes for which it will be found specially suitable, although Meccano boys should *not* attempt to shave with it!

Two further suggestions for using old safety razor blades will be found in Models 720 and 721 in the complete Manual.

Contributions for this page should be accompanied by drawings or photographs if possible. Do not hesitate to send rough sketches, for if the idea is suitable for publication, we will have new drawings made by our artists. Five shillings will be paid for each suggestion published.

"First Come—First Served"

A Warminster doctor recently advertised for an experienced chauffeur and on the day his advertisement appeared, was surprised to see an aeroplane circle round his house and land in a near-by field, but his surprise gave place to astonishment when the airman applied for the post of chauffeur. His story, briefly told, was that he had purchased the 'plane on demobilisation from the Royal Air Force, in which he had served as a Non-Commissioned Officer, with the object of giving flying exhibitions and training pilots. The venture was not a financial success and noting Dr. Brookes' advertisement he flew from Scarborough and secured the post!

* * * *

An Aerial Beacon

A great aerial lighthouse has been established recently on Mont Affrique, near Dijon, which lies close to the course taken by aeroplanes en route from Paris to Switzerland, Italy and the Mediterranean. The light is now working regularly, and, after dusk, a great beam is radiated every ten seconds. In normal weather the light, which by the way is of 874 million candle power, can be seen from a distance of nearly one hundred miles.

* * * *

Map Making by Aeroplane

The Ordnance Survey Authorities are carrying out experiments in aerial photography for map-making purposes. If the results are satisfactory it is highly probable that the air method of map revision will be adopted to the total exclusion of the slower and perhaps less accurate methods of the past.

* * * *

The Gloster Napier III.

The hopes of the Gloucestershire Aircraft Co. are centred in their Schneider Cup entry, the Gloster Napier III., and it is anticipated that all speed records will go by the board if this little seaplane lives up to its designers' faith.

This entry is a new departure for the builders have not previously attempted to capture seaplane honours, but have contented themselves with winning the Aerial Derby in three successive years. A press view was given recently at Felistowe and the engine, a Napier "*Lion*" with direct drive, was started up, the machine being lashed to an iron ring set in concrete. The quiet hum developed into a deafening roar as the engine was opened out. It was stated that at the period of greatest noise, the propeller was rotating at a speed rather greater than that at which sound travels.

For obvious reasons, the Gloster Company has not disclosed the intimate details of constructon but it is interesting to learn that the wings of the machine are built up of spruce ribs and spars. The fabric has been fixed up by a new process which it is hoped, will do much to overcome the suction produced at racing speed. The propeller is of solid duralumin and the same metal is used in the construction of the streamline floats.

* * * *

302 Miles Per Hour

Lieut. A. J. Williams, the American airman who won the world's speed championship—266.59 miles per hour—at Long Island in 1923, claims to have attained the speed of 302.3 miles per hour while flying over the Curtis Aerodrome recently. The engine of his machine was fitted with a new V400 motor, developing 619 h.p., and the terrific speed was achieved by piloting the machine in a downward course for nearly three-quarters of a mile.

* * * *

Restaurant in Aeroplane

The largest air liner in the world, and a restaurant car at that, was delivered last month to Croydon Aerodrome. It is a Rolls-Royce Vanguard and is driven by two Rolls-Royce engines, the total horse-power being 1,300. The machine can carry twenty-two people at 115 miles per hour and provision is made for serving meals during flight. Each passenger is provided with an arm chair and in front of these is a small collapsible table.

* * * *

World's Record Broken

As we go to press we learn that the Pulitzer Trophy was won by a Curtiss racer, piloted by Lieut. C. Bettis, which attained 248.9 m.p.h. This speed is a world's record for closed circuit courses.

* * * *

Helicopter Comes to Grief

The veil of mystery which has surrounded the helicopter was temporarily lifted last month when a private test was attempted at Farnborough in the presence of Air Ministry officials. After rising only a few feet in its vertical flight, however, the machine appeared to swerve and crashed to the ground. Fortunately the pilot escaped injury and was able to retain partial control long enough to preserve the 'plane from complete destruction, but the propellors were broken, a wing smashed and the body strained. Mr. Louis Brennan, the inventor, states that the damage can be made good in a few weeks.

Mr. Brennan was also the inventor of the famous "Brennan" torpedo for which he received £110,000 from the British Government.

* * * *

French Seaplane Trials

The urgent necessity for seaplane communication between France and her Algerian and Tunisian interests would appear to have awakened her to the necessity for encouragement to be given to designers and constructors of that type of machine. Hitherto the French have paid main attention to the aeroplane but the recent trials for seaplanes held at St. Raphael would indicate a determination to forge ahead in this branch of aviation. In the trials to which we refer the planes had to make the double journey from St. Raphael to Antibes and Ajaccio and back four times, the total distance covered being approximately 1,250 miles. Five machines, out of seven entrants, were successful in completing the course and it is of interest that only one machine, the Camps, had two engines, these being of 260 h.p. each. The remaining machines, three Schrecks and a Villiers, had single Hispano-Suiza or Lorraine 450 horse-power engines.

* * * *

The Hydro-Glider

It is reported from Berlin that a German Company proposes to put a gliding boat into service between Dresden and Saxon, Switzerland. Driven by a large aeroplane propeller, the vessel, despite its size, is expected to attain a maximum speed of 38 to 45 miles per hour and will draw only 7 or 8 inches of water.

Vessels of this type might be described as hybrids, being half motor boat half aero machine and it will be interesting to discover whether the proposed venture is a commercial success. Hitherto the gliding boat has been regarded more as an expensive sporting craft than as suitable for transport purposes.

* * * *

A New North Sea Route

Imperial Aircrafts Ltd. are experimenting prior to the introduction of a regular seaplane service across the North Sea. The first trip was made in the early days of October between Gothenburg (Sweden) and Southampton. The machine employed was a Dornier Wal, an all metal flying-boat of German design, propelled by two Rolls-Royce engines and the distance travelled approximately 600 miles. Important developments are anticipated and it is possible that Denmark will be included in the scheme.

Experiments are to be made with twin-engine air-boats of British design and construction throughout and a giant sea-going boat, capable of accommodating thirty passengers is projected.

Safer Flying

In our last issue mention was made of a device by which airmen could be sure of making a safe landing even though their machines were enveloped in fog. Another scheme has been brought forward by Mr. F. J. Courteney, the famous pilot, and for his suggestion it is claimed that its adoption would overcome climatic conditions and make possible the running of regular day and night services in any weather. The suggestion introduces what might be termed "blindfold flying" and would permit huge three-engined passenger 'planes to fly through fog at over 100 miles per hour with perfect safety. The new system requires pilots to fly entirely by instruments controlled from a powerful central signal station on the lines of the Croydon Control Tower, but possessing an even more complete method of communication. The speed and height of the machine, together with the type of weather being encountered, would be known to the control station, which would issue instructions by wireless. Special instruments on the 'plane dashboard would include height and turn indicators and a course-setting device.

This suggested new system is the outcome of practical experiments made during the past few years, and, coming from a pilot of Mr. Courteney's experience, may be regarded as being well past the experimental stage.

* * * *

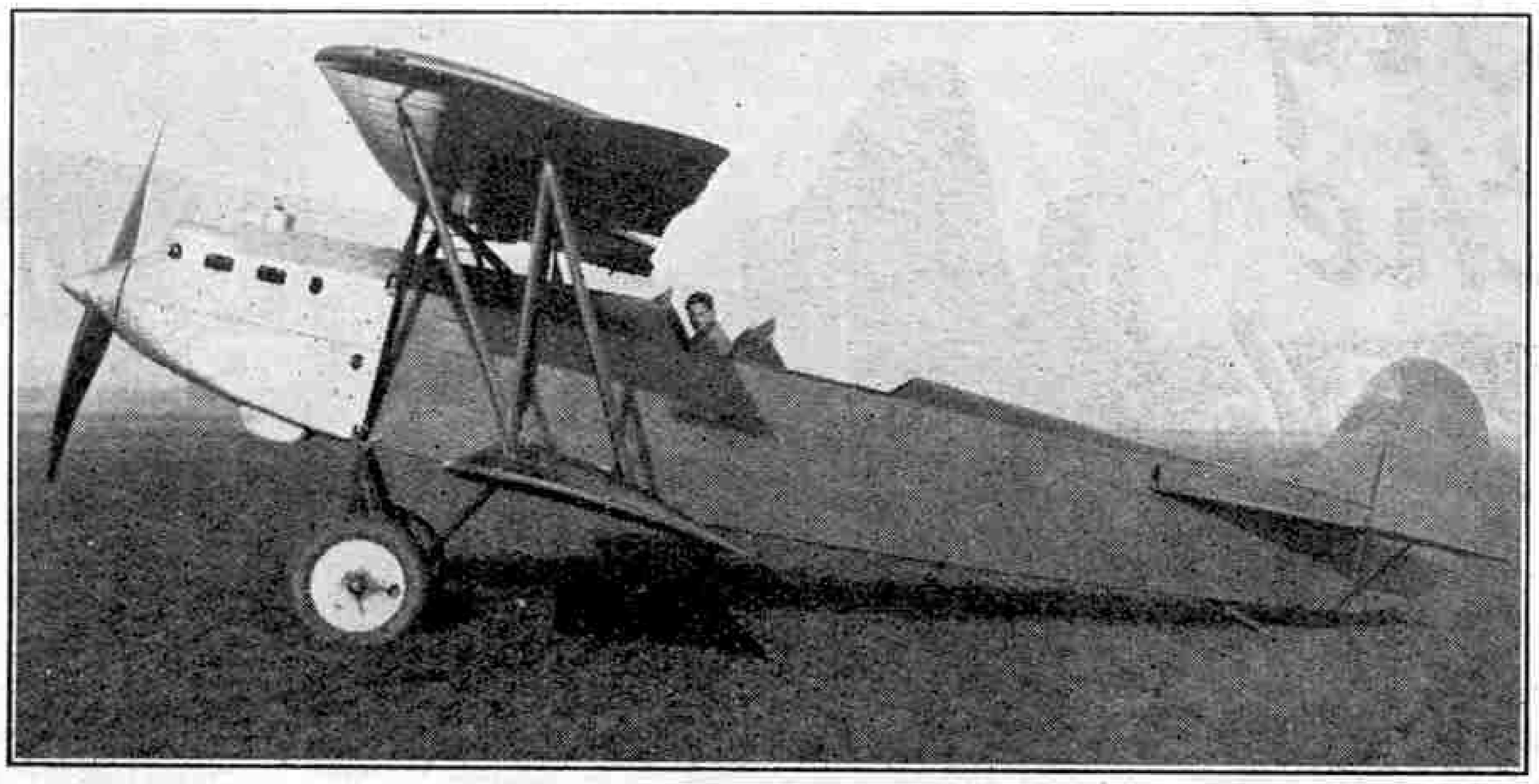
Re-conditioning of R33

The story of R33's great fight against storm elements in April last is too fresh in our readers' minds to need repetition, but the skilful airmanship and courageous endurance displayed by her crew on that occasion, have earned for the ship a warm spot in the hearts of all interested in aeronautics. For that reason the news that the re-conditioning of R33 is complete and the ship in the air once more is very welcome.

At the time of her accident R33 was engaged on research work, from the results of which it was hoped to obtain important information to assist in the design of two larger airships that it is intended to construct. After further tests, upon which she embarked during the evening of 5th October, she will recommence this work.

A number of improvements and alterations have been effected, among these being, of course, the fitting of a new nose cap. For this it is claimed that the fiercest gale will be unable to tear the ship from its mooring mast.

The most interesting addition to the equipment consists of an apparatus by which a light aeroplane is able to attach itself to the ship and break away during flight. Briefly this device is a two-pronged fork—fitted prongs downward—attached to the under side of the airship between the control cabin and the engine cars amidships. On each side of the prongs are heavily padded buffers.



The Fokker C.V Fighting Scout, fitted with 450 h.p. Hispano-Suiza engines

(See article on page 585).

The method of attachment is as follows. As the aeroplane approaches the airship, a metal tube, in appearance somewhat similar to a trapeze, is lowered with the aid of a steel cable. At an opportune moment the aeroplane darts at the tube and grips it by means of a spring clip fixed above the pilot's seat. This accomplished, the 'plane soon loses speed and commences to swing to and fro, just as an acrobat at a circus does, below the airship. The cable is then hauled in until the prongs of the fork grip the fuselage, one on each side, the buffers having the effect of steadying the wings.

Previously, similar attempts have been made in this country and in America with a two-point attachment, but one experiment here, during the war, resulted in a fatal accident owing to the failure of the rear release.

It will be seen that in the event of the device proving a success, great strides will have been made toward enabling airships to carry aeroplanes on long cruises. Commercially the possibilities are considerable, for an airship would be able to land passengers, mails and merchandise without the necessity of landing or "tying up" to a mooring mast. Its affect on aerial warfare would also be great and the range of small fighting craft limited only by the range of the parent ship.

* * * *

Commemoration Day

A proposal has been brought forward by the National Aeronautical Association of America to celebrate each year the anniversary of "man's conquest of the air by American genius" and the President of the United States is being asked to fix 17th December as "Aviation Day." This date is the anniversary of Wilbur Wright's original flight and the Association suggests that the celebration of the date each year would emphasise the importance to national well-being of aeronautical development.

The First Wright Aeroplane

The famous aeroplane with its tiny home-constructed four-cylinder engine on which the brothers, Wilbur and Orville Wright, made their first power-driven flight at Kitty Hawk, South Carolina, in the later part of 1903, is lying at Wayton, Ohio, packed in cases waiting for shipment to London, where its eventual home will be the Science Museum at South Kensington. Mr. Orville Wright has stated that he greatly regrets the necessity for sending the machine to a museum outside his own country, but that he bases his decision on the action of the Washington Smithsonian Institute, which in 1914 permitted the Langley "*Aerodrome*" to be taken from its charge, modernised, modified and altered to make it fly for the sole purpose of proving that Samuel Langley had anticipated the Wright's invention, and of procuring sufficient evidence to commence a law suit to render invalid a number of the original Wright patents. Mr. Wright has refused to give any authority permission to alter his machine and states that if half the changes made in the Langley machine were permitted in his "Kitty Hawk" 'plane, it would be a simple matter to prove his machine incapable of sustained free flight.

* * * *

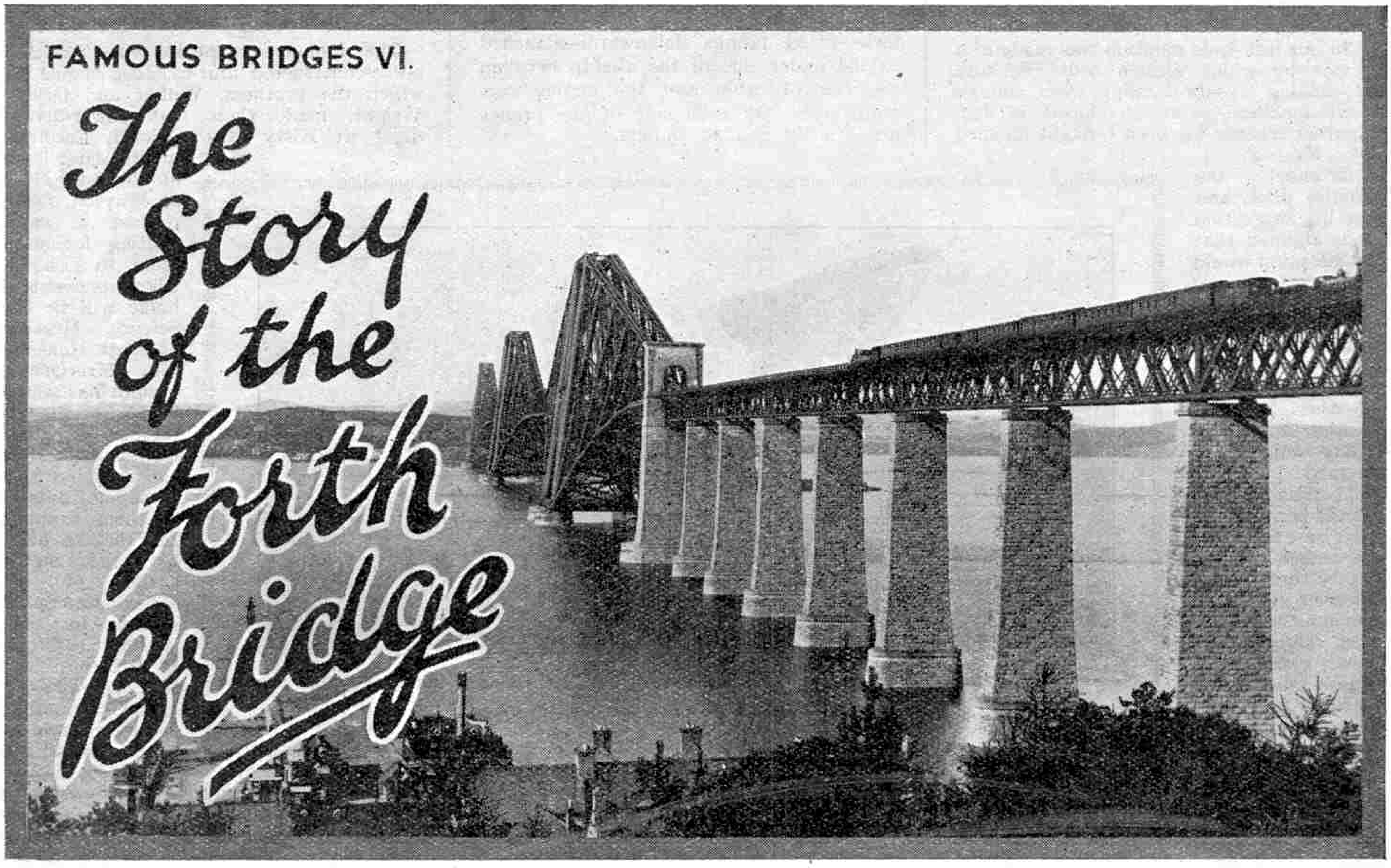
Arrested for Flying!

In this connection it is learnt that the first triplane constructed by Mr. A. V. Roe also has been presented to the South Kensington Museum. Mr. Roe was one of the pioneers of British aviation, and his first flight resulted in his being dubbed "Roe the Hopper." This flight was accomplished on 8th June 1908, and the distance travelled was sixty yards at an average height of two feet. Hence the nick-name. Strangely enough Mr. Roe was not allowed to conduct his early experiments without interference, for the local Council engaged a "watchman" to prevent Mr. Roe from flying. Fortunately for British aviation the pioneer carried on but eventually the sleuth was able to catch him at work, and Mr. Roe was called before the magistrates. Nothing came of his arrest and, indeed, one is rather at a loss to explain the local authorities' attitude for it was just at that time that Bleriot made his successful Channel flight, demonstrating that aviation as a practical means of transport had come to stay.

* * * *

Doctors by Air

If experiments in Wireless Telegraphy, at present being carried out in Central Australia, are successful, it is proposed to establish a scheme whereby doctors will be sent by aeroplane to settlers in the more remote areas.



FAMOUS BRIDGES VI.

The Story of the Forth Bridge

Part II.

LAST month we outlined the history of the great cantilever bridge across the Forth and gave a description of the completed bridge. In the following article we deal with an even more interesting topic—the actual building of the bridge.

Preliminary Operations

Work was commenced in January 1883, and on the rising ground at the south side several acres of land were secured and here offices, workshops and stores were erected. Lines were laid down throughout the various yards and workshops and by means of a siding the whole was brought into direct communication with the North British Railway.

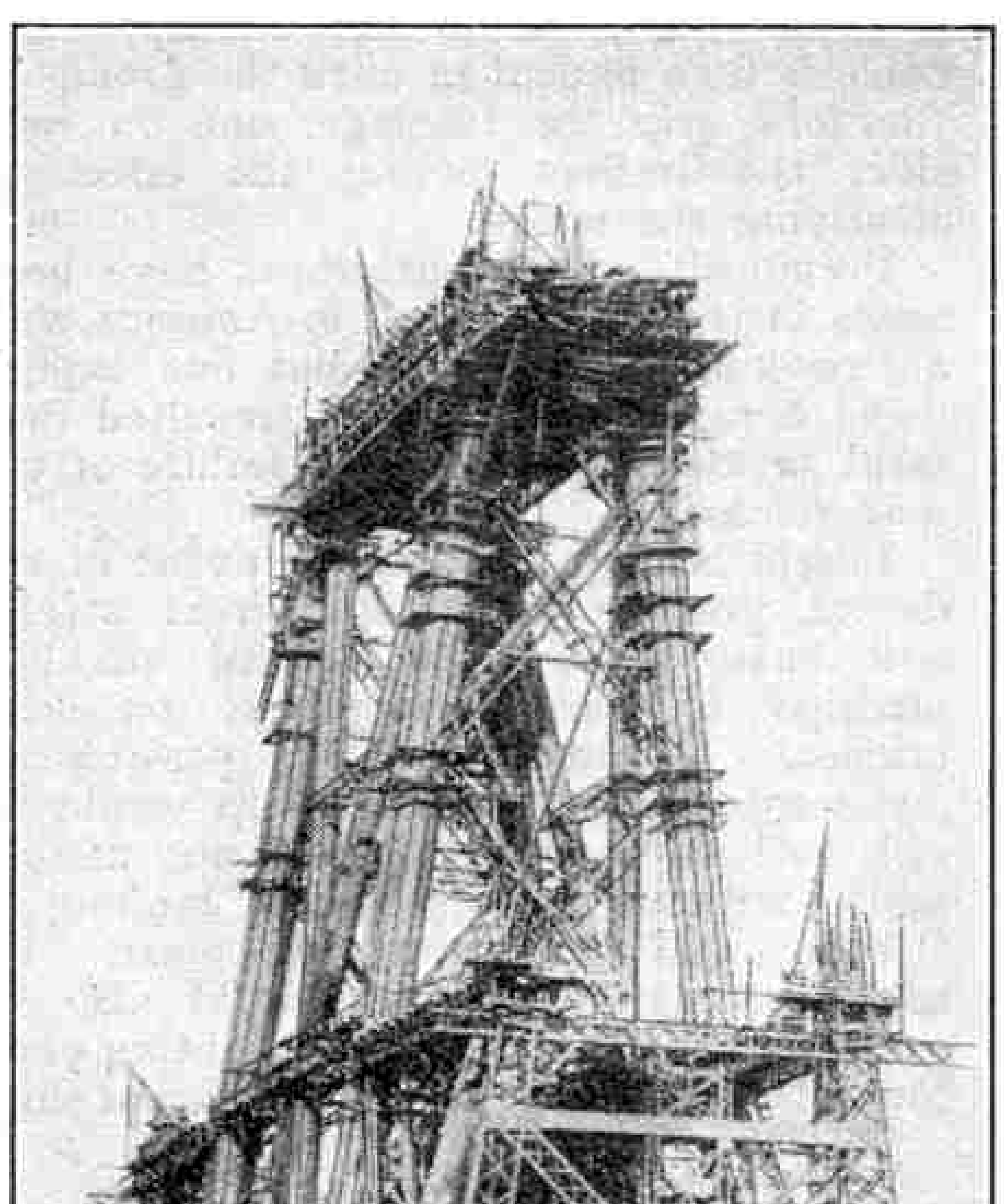
In addition to all this, steamers, barges and boats of all kinds ; cranes, steam and hydraulic, and a bewildering amount of machinery for drilling, lighting, pumping, riveting, etc., had to be provided. Many of these machines were specially designed for the work by the contractors. Temporary cottages had to be built for the workmen, as the accommodation afforded by the local villages of Dalmeny and Kirkliston was insufficient.

Foundation of the Piers

The first task was to secure the foundation of the piers, which were fixed into bed-rock and boulder clay. The masonry work necessarily had to be very substantial and was carried out in cofferdams.

The engineers drove into the ground a circle of heavy piles, filled up the space between the piles with clay, and inside the palisade thus formed erected a framework of timber to strengthen it and to resist the pressure of the water. The water inside was then pumped out and the workmen were able to dig the foundations.

Many difficulties were encountered in this work owing to the sloping nature of some of the foundations on which the piers had to rest, and also because the tides had to be waited for, as much of the work in the centre of the river could only be carried out at low-water of big tides.



The Platforms, after building out the first strut

The cofferdams were about 70 ft. in length and 40 ft. in width, and averaged in depth between 30 ft. and 40 ft. below high water. The whole area of the bottom of the cofferdams was covered with concrete a few feet thick, upon which the masonry was constructed.

The foundations of the Fife piers, which stood on the mainland, demanded nothing further than straightforward excavation and rock levelling.

Constructing the Caissons

The two southern piers on the island and the four southern or Queensferry piers were constructed by the aid of caissons, huge cylindrical structures closely resembling an ordinary gasometer. They were built in a small bay to the east of the bridge. The structural material was mainly wrought iron, with the exception of the lower or cutting edge which was made of steel.

Each caisson had a floor which formed the roof of the air chamber and was supported from above by a series of girders. Upon this floor and about 7 ft. from the outer skin was an internal skin, the two being braced together in such a manner that the space between them was converted into a series of chambers which, when filled with concrete, were utilised for weighting the caisson at any given point. The caissons were built to a certain height and were then towed into position, where they sank into the boulder clay by pressure.

With one exception all the caissons were built, launched and sunk without any serious mishap, which was a great tribute to the skill and care of all concerned in the operations. This will be realised when it is learned that the average weight of each caisson was about 400 tons, and

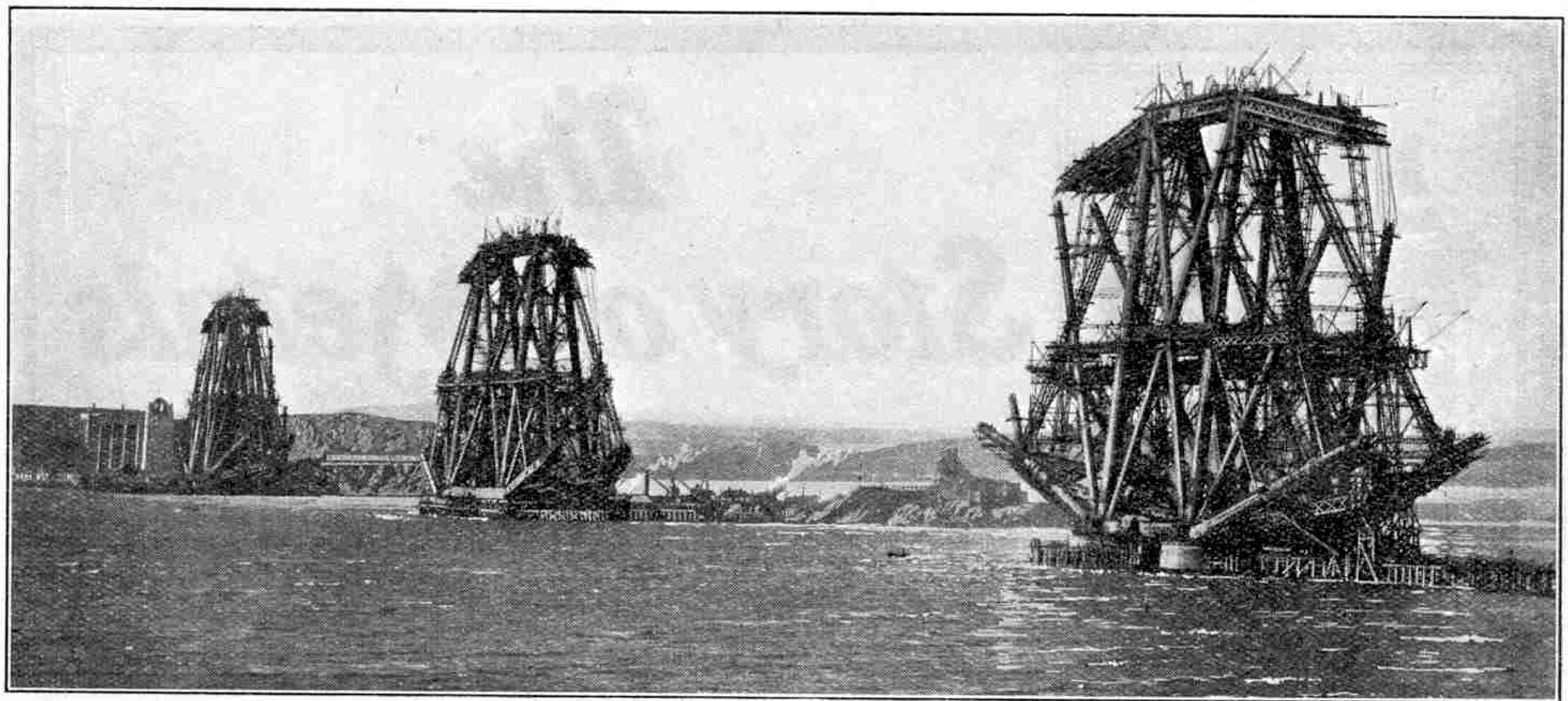


Photo by permission of] **The Forth Bridge from the south-west before the cantilevers were built out** *[Messrs. Baker and Hurtzig, Westminster*

when loaded with concrete this weight was increased to about 15,000 tons.

Working by Compressed Air

The height of the permanent caissons was not sufficient to keep out the water at high tide and to serve this purpose temporary iron segments were bolted on. On a level with the top of these segments a platform was erected from which most of the operations were carried out. From the floor of the caisson to this platform three shafts were constructed. Two of these were for the purpose of handling materials and the third provided the means by which the men entered and left the air chamber.

The lower chamber had no bottom, and therefore as the shafts by which it was connected with the air were open, it is obvious that, until steps were taken to prevent it, water would rise in them to the level at which it stood outside. Before the men could descend to work, this water had to be expelled, and this was carried out by compressed air.

When the compressors had provided the pressure necessary to drive out and keep out the water from the air chamber, the men descended into an air lock and found themselves in a chamber containing an inner door leading directly to the compressed air. This inner door was held fast by a pressure of many tons from within, and before it could be opened the pressure in the two chambers had to be equalised. This was effected by closing the outer door and admitting compressed air through a valve until the outer door was held fast by the increased pressure. At this stage the pressure in the two chambers was the same, the inner door swung open and the workmen were able to continue their descent by means of iron ladders.

Photo by permission of] *[Messrs. Baker and Hurtzig, Westminster*

The main pier at Fife

Caisson Disease

Working in compressed air has certain decided disadvantages. The large supply of oxygen enables the men to work with unusual energy, but the strain is severe and only men of thoroughly strong physique are able to withstand it for long. The density of the air produces many curious effects, such as exaggerating noises to an almost alarming extent. Voices too, sound harsh and quite different from their normal tones. The worst feature of all, however, is the trouble known as "Caisson Disease." The symptoms of this disease, usually intensely severe pains in the joints, are felt when the air pressure is reduced to normal, and the mischief is caused by an excessive amount of nitrogen being absorbed by the blood. If the transition from high pressure to normal pressure is performed very slowly and gradually there is little inconvenience, but if the process is hurried the results are extremely unpleasant.

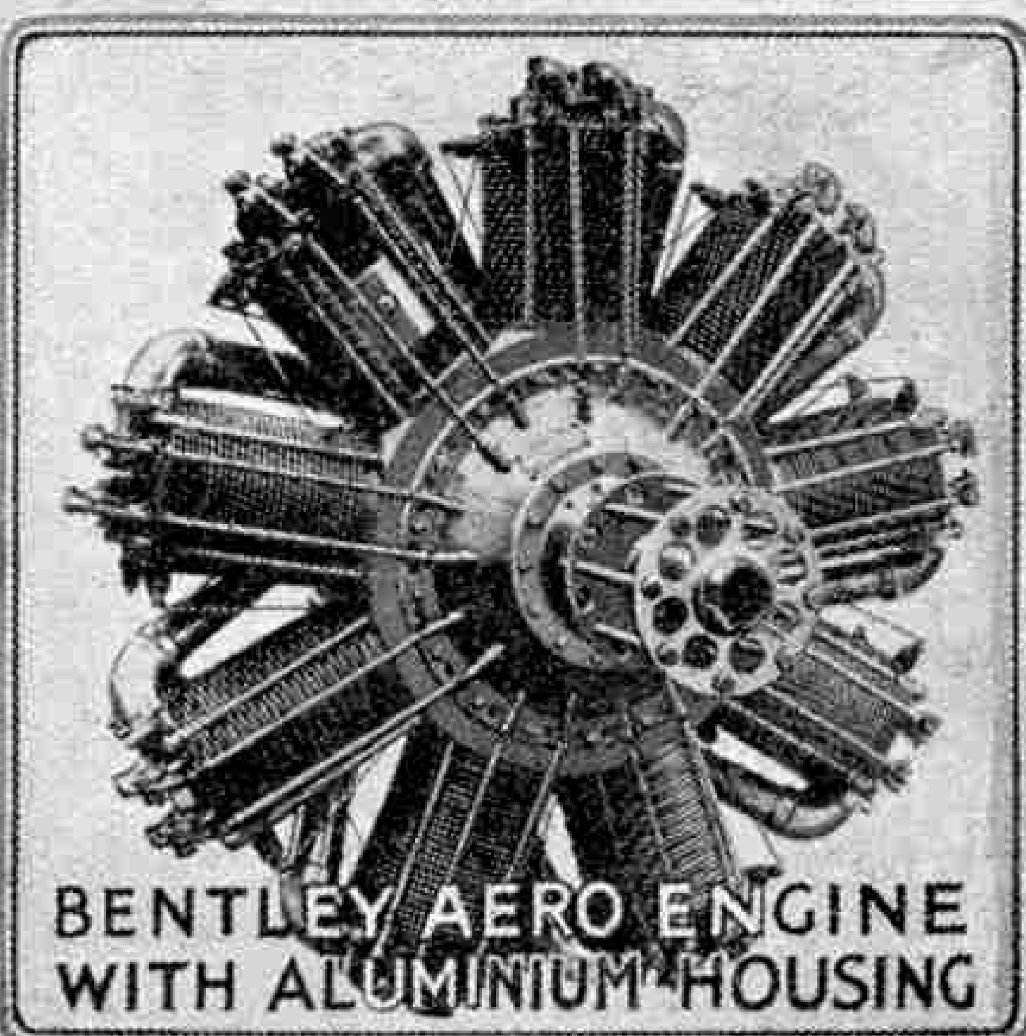
The main difficulty experienced was to make the men stay in the air locks while the pressure was gradually reduced and the unwanted nitrogen expelled by means of the lungs. When a man had neglected the necessary precautions and on reaching the open air was attacked by caisson disease, the only method of affording him relief was to carry him back into one of the air locks and increase the pressure again, subsequently reducing it very slowly and gradually. It is stated, whether truly or not, that some of the men employed in the Forth Bridge caissons suffered so much from caisson disease that they were only too glad to spend their Sundays in the air locks in order to obtain relief!

The one exception to the successful sinking of the caissons was due mainly to the slope of the river bed at that particular point. This particular caisson was watched with anxiety from the first, and although every possible care was taken it heeled over so far as to permit the rising tide to create an amount of damage that took some months to repair.

Viaduct Piers

The rail level of the bridge having been fixed at 150 ft. above high water, it was necessary that the viaducts connecting the cantilevers with the two shores should also be at a considerable height. The piers were built up to a certain level and the girders were put together on a sort of stage a few feet above each pier. The steelwork was then raised by hydraulic jacks, each capable of lifting some 200 tons if necessary. Each jack was connected with pumping engines in such a manner that all worked together. When pressure was applied to the jacks the girders were raised, and packings of

(*Continued on page 584*)



The Story of Metals

V. ALUMINIUM.

LAST month we gave a brief outline of the history of the metal Aluminium and of the method employed for its production from Bauxite. In the following article we shall deal with a few of the many applications of this interesting metal and its alloys.

Pure aluminium is naturally a soft and weak metal. Its most remarkable feature is that of lightness, and during recent years a great deal of research has been carried out with the object of discovering alloys of the metal which, while preserving to a great extent its quality of lightness, have in addition the valuable quality of high tensile strength.

Copper and Zinc Alloys

Copper and zinc are the metals mostly used along with aluminium. Alloys of zinc are cheaper to produce than copper alloys, but they are inferior in many important respects. The well-known alloy Duralumin, which was discovered in 1910 by a German named Wilm, possesses lightness together with great tensile strength. This alloy consists of a little over 94 per cent. aluminium and about 4 per cent. copper, with small quantities of iron, manganese, magnesium and silicon. Duralumin is an alloy of very great value, but alloys of copper, magnesium and aluminium have been prepared in England which possess even greater tensile strength.

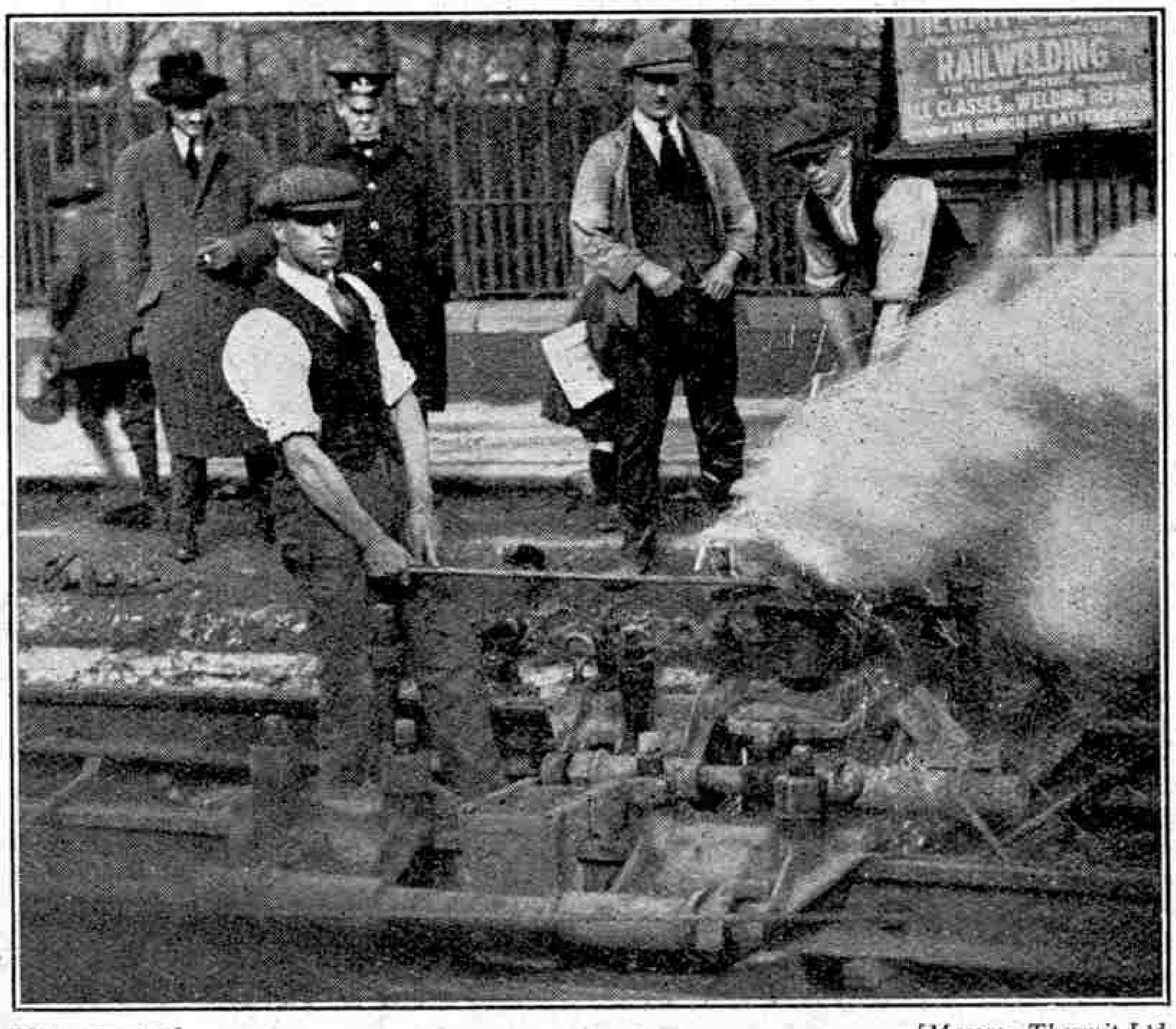


Photo courtesy] [*Messrs. Thermit Ltd.*

Welding Tram Rails

Aircraft and Automobiles

Aluminium alloys to-day occupy a very important place in the construction of aircraft and automobiles. During the war the application of such alloys to aeroplanes was pushed forward with great rapidity, mainly in order to obtain strength with lightness, but also to make it possible to produce an all-metal machine and thus fire-proof. The successful development of airships has been made possible largely by the use of aluminium alloys, notably Duralumin. These are used for the construction of almost the whole of the framework and the cars to carry the crew, and they also enter largely into construction of the power units.

The use of aluminium alloys in the engines of aircraft and automobiles has developed in a very remarkable manner. There are few parts of the modern car engine for which aluminium cannot be used and in most cases with distinct advantage. To-day we find aluminium cylinder blocks, crank cases, pistons and connecting rods. One result has been the attainment of an extraordinarily low weight-power ratio, and also the high thermal conductivity of aluminium has proved of great advantage. A steel piston may be made even lighter than an aluminium piston, but the heat generated in the combustion chamber is not so rapidly conducted to the walls of the cylinder as is the case with aluminium. This advantage becomes even more marked at very high temperatures because the thermal conductivity of aluminium alloys increases with temperature, whereas that of cast iron and steel decreases.

The saving in weight resulting from the introduction of aluminium is well-illustrated by the fact that a rear axle made of this metal will weigh something like 33 per cent. less than a similar axle made in steel, and this including the parts that of necessity are made in steel. The remarkable results obtainable by the substitution of aluminium alloys for steel is well demonstrated by such engines as the Napier "*Lion*," which not only possess the advantage of a low weight-power ratio but also have remarkable flexibility.

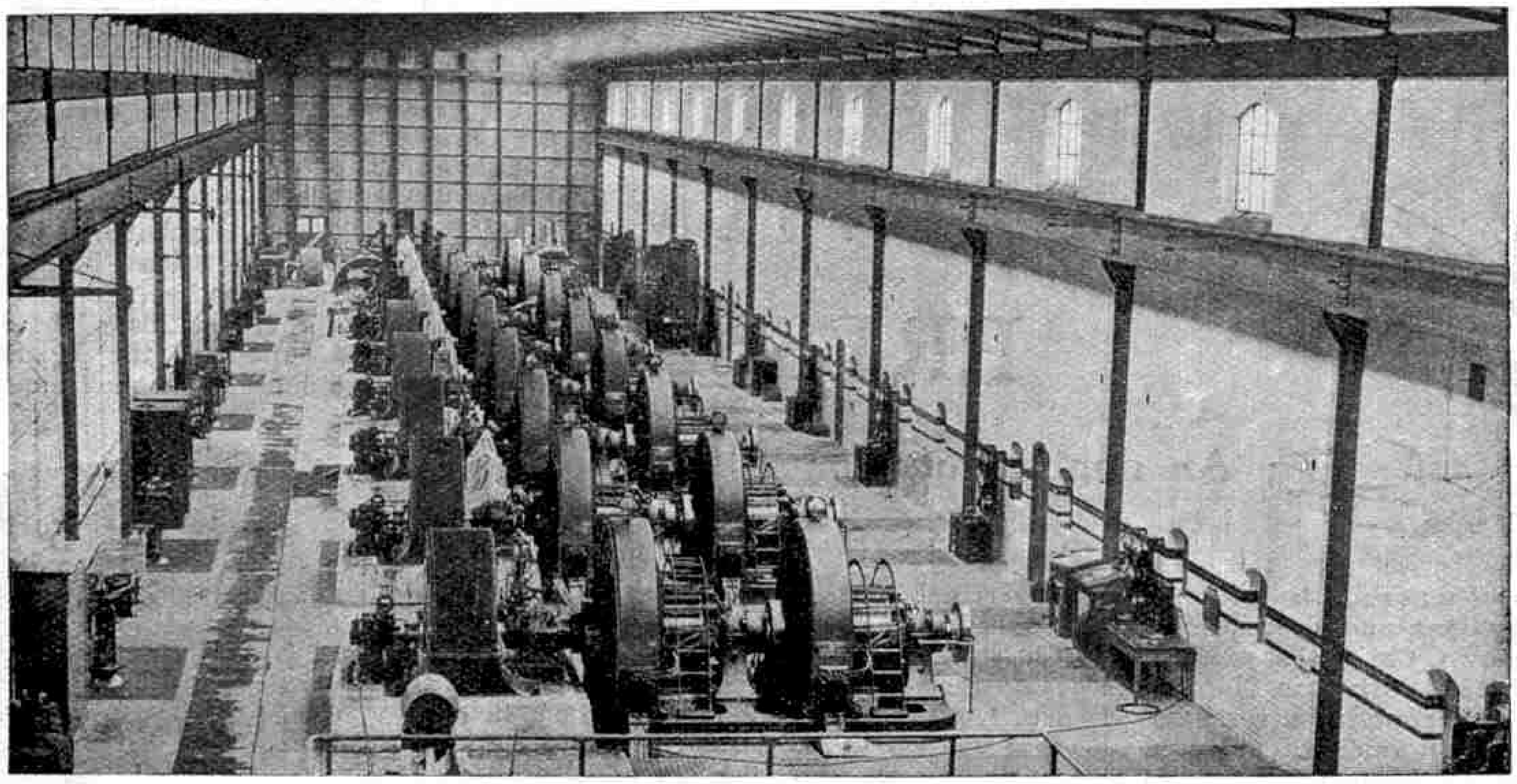


Photo courtesy] [*Messrs. British Aluminium Co. Ltd.*

The Power Plant at Kinlochleven

Aluminium in Railway Rolling Stock

The modern tendency towards reduction in weight per horse power has produced great changes in railway rolling stock. Any saving in weight involves a smaller consumption of energy or alternatively enables more passengers to be carried for the same consumption. Aluminium and its alloys are greatly in evidence on the London underground railways. For the panelling and roofing of the coaches and for many of the internal fittings the use of aluminium is well established.

The advantages thus gained are strikingly illustrated by the fact that on a 60 ft. railway car the use of an aluminium roof instead of a steel one results in a saving in weight of about half-a-ton, while another half-ton may be saved by using aluminium for the outside panels. Aluminium sheet is more expensive than steel in first cost, but in the long run the advantage certainly lies with aluminium.

Wheels for Motor Buses

An aluminium casting is only about one-third the weight of a casting of similar size in iron, steel or brass, and for most purposes ample strength may be obtained by the use of an alloy suitable for the particular purpose. An interesting example of the great strength of these alloys is provided by their use for the wheels of motor lorries and other heavy commercial vehicles, in place of cast steel. Aluminium wheels have been tested over extremely bad roads and have emerged from their trials with perfect success. Large numbers of London buses are now fitted with this class of wheel, the principal advantage of which lies in its reduction of unsprung weight, which reduces wear on tyres and also contributes to the general advantage in weight-saving from a power consumption standpoint. Another point of considerable importance is that the reduced unsprung weight means reduced wear on road surfaces.

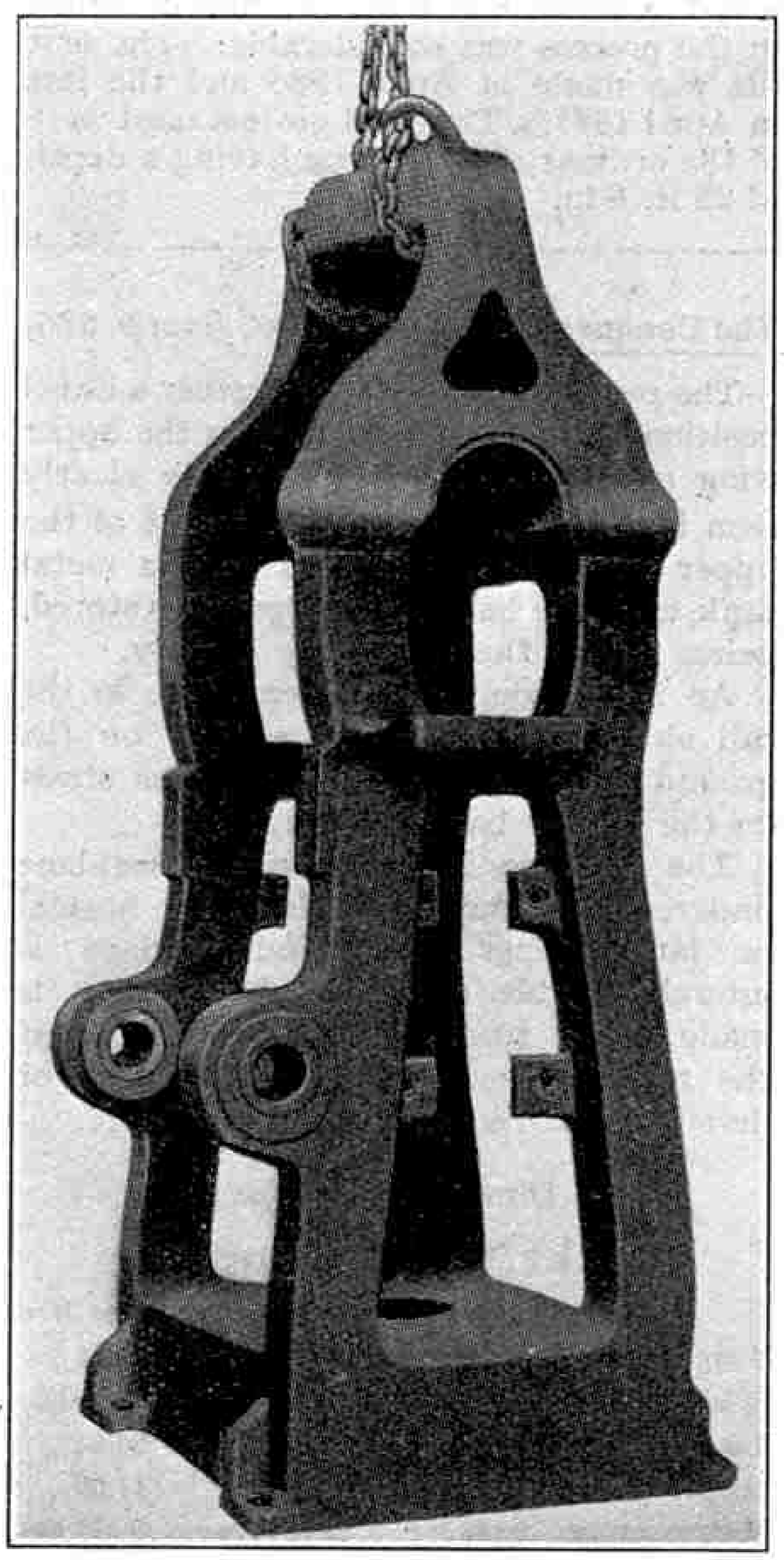


Photo courtesy] [*Messrs. Thermit Ltd.*

A Welded Steel Frame for 1,000 Ton Press. Welds (at shoulders) appear lighter in shade

The use of aluminium for kitchen utensils is familiar to everybody. Such utensils have the advantage of lightness, and besides being chemically clean they look clean, which adds greatly to their popularity with users.

Aluminium is largely used in various chemical processes owing to its resistance to chemical action. The metal is of particular value in processes involving the production of foodstuffs, and it has come more and more into use in this direction.

Where food is cooked or manufactured in aluminium vessels the great heat conductivity of the metal is a further very important advantage. Heat is transferred through any thickness of aluminium more than five times as quickly as through an equal thickness of cast iron. If, as an experiment, you take a vessel of water, dip an iron rod into it and heat the free end of the rod, the water in the vessel will boil in time, the heat being conveyed to it directly through the rod. If now you repeat the experiment with an aluminium rod of the same size, the water will boil in a far shorter time.

Although nobody would dream of boiling water in such an inefficient manner, these experiments reproduce in an exaggerated form the conditions occurring when water is boiled in a metal saucepan in the ordinary way, and provide a scientific explanation of the economy in fuel obtained by using aluminium vessels instead of iron ones.

Importance in Electrical Industry

Just as aluminium is a good conductor of heat, so it is also a very good conductor of electricity. It is not quite so good as copper in this respect, and an aluminium wire

(*Continued on page* 603)

CHOOSE YOUR OWN CHRISTMAS PRESENT

An opportunity for "*M.M.*" readers

It is a wonderful sensation to sit down and study illustrations and descriptions, and select your own Christmas present. Try it! The Special Christmas Number of the "*M.M.*" will contain advertisers' announcements of all kinds of splendid toys, books, and all manner of articles for giving pleasure to boys at Christmas. We are going to make at least one boy happy by giving him the very thing he wants, from amongst the articles advertised in our columns.

Let us know what you want—

On a Postcard

Obtain a copy of the Christmas number of the *Meccano Magazine*, which will be ready on 9th December, look at *all* the articles advertised and then decide which you would like the postman to hand to you on Christmas morning. Write the name of it on the top of your postcard, marking it No. 1. Then write the name of the article that you would like second best and mark it No. 2. Do this with six articles altogether, write your name and address at the bottom in very plain letters, and send the postcard to "Christmas Presents, *Meccano Magazine*, Binns Road, Liverpool."

To the boy whose list corresponds most nearly in order of merit with the total voting we will post the article that heads his list, to reach him on Christmas morning.

"Christmas Presents" postcards must reach us not later than 18th December.

Lives of Famous Engineers—

(*Continued from page* 559)

degree upset there was always the danger of a splash of hot metal, which frequently set the men's clothes on fire or caused terrible scalds and burns.

Nasmyth's safety ladle was designed to prevent these accidents. He applied a screw wheel keyed to the trunnions of the ladle, which was acted upon by an endless screw attached to the sling of the ladle. By this arrangement one man could move on its axis the largest ladle and pour out its contents with perfect safety, at the same time securing better castings by means of the increased steadiness of the flow of metal into the mould.

Another improvement brought about by Nasmyth was the fixing of a skimmer to the edge of the ladle to keep back the dross or slag floating on the surface of the molten metal. This process also was previously done by hand and many accidents occurred in consequence. Nasmyth did not patent these inventions, but preferred to make them over to the public.

The Story of the Forth Bridge—

(*Continued from page* 581)

hard wood were placed beneath them to hold them in position while the jacks were moved to a new bearing, when a second lift was made. By repeating this process the lifting of the girders and the building of the masonry proceeded until the required height was attained. The building of the masonry between each lift, including the time required for setting of the work on one half of the pier before the other was commenced, was carried upward at the rate of about 9 ft. on each pier per month. As the girders were ultimately raised to 150 ft. above high water, and as each lift was only about 3 ft. 6 in., the time occupied in the process was considerable. The first lift was made in April 1886 and the last in April 1887. The steel girders used were of the ordinary lattice type having a depth of 22 ft. 6 in.

The Conquest of the Air—(*cont. from p.* 585)

The petrol tank is fitted in rather a novel position, it being incorporated in the upper wing of the machine. It will be clearly seen from our illustration that part of the upper wing above the fuselage is a metal tank, and it is here that the petrol is stored, being fed to the engine by gravity.

An improvement has been made in the tail skid, so that better control on the ground is obtained, and any sudden stress on the rudder bar prevented.

The machine is fitted with a seaplane undercarriage for use with either normal or large wings. The undercarriage is interchangeable and special provision is made in the fuselage for hoisting so that the machine may be lifted by crane or derrick from the sea without damage.

Dimensions of the

Fokker C.V Aeroplane

	Normal	*Small*	*Large Wings*
Wing Area ...	48.68 sq. yds.	43.65 sq. yds.	55 sq. yds.
Span ...	42.04 ft.	40.55 ft.	48.25 ft.
Length ...	30.35 ,,	30.35 ,,	30.64 ,,
Height ...	10.86 ,,	10.77 ,,	11.09 ,,
Weight empty	3,160 lbs.	3.050 lbs.	3.271 lbs.
,, laden	4,928 ,,	4,376 ,,	5,481 ,,
,, per h.p.	10.0 ,,	9.72 ,,	12.16 ,,
Speed (max.)	137.4 m.p.h.	143.7 m.p.h.	131.2 m.p.h.

Meccano Platform Scales—

(*Continued from page* 565)

suspended by means of Flat Brackets 20 and Hook 21, connects with the levers 23 in the base of the model (Fig. C, page 565). These levers are pivoted on Hooks 24 and carry a central 3″ Rod 25 from which hangs a link 26 consisting of a Double Bracket and ¾″ Bolt. This link supports a further Rod 27 carried in the ends of another pair of levers 28 pivoted to the Hooks 28A. The 6½″ Rods 29 and 30, on which the Hooks are mounted, are journalled in the framework of the base.

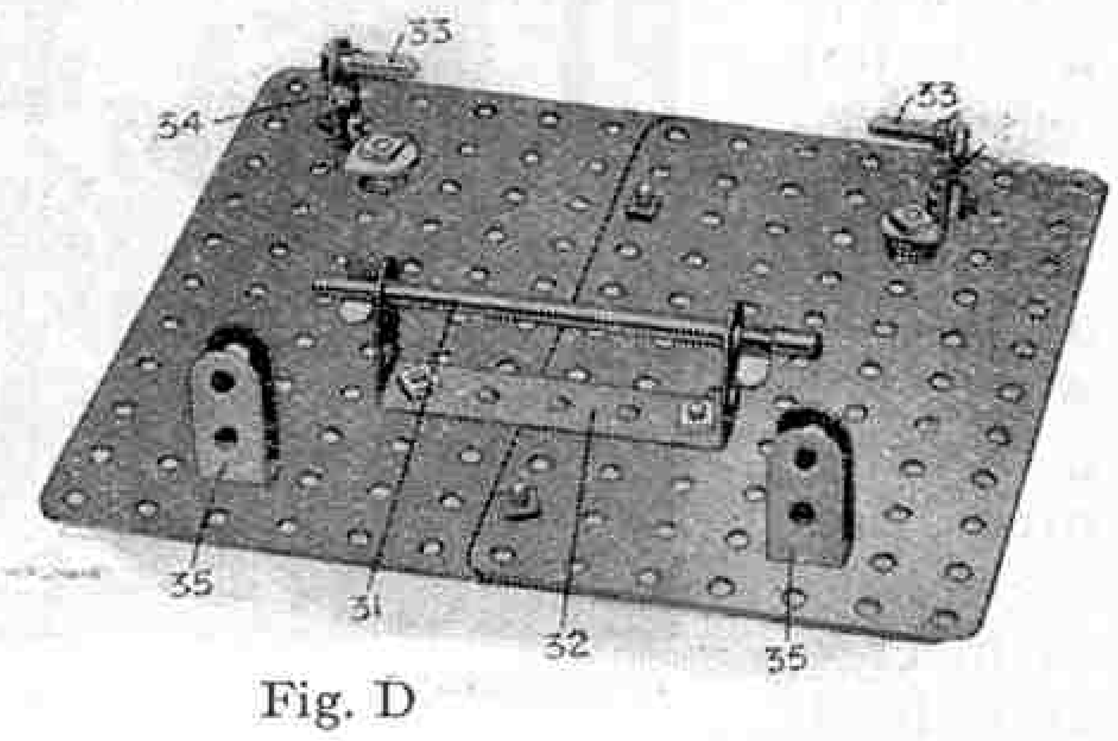


Fig. D

The platform, shown inverted in Fig. D, is composed of two large Flat Plates overlapped one hole and secured together; the Axle Rod 31 carried in a Double Angle Strip 32 rests upon the levers 23, while the Threaded Pins 33 bolted in 1″ by ½″ Angle Brackets 34 rest upon the levers 28. Two Washers are placed on the bolts underneath each end of the Double Angle Strip 32 and four Washers are placed beneath each of the brackets 34. Single Bent Strips 35 form guides for the platform and fit over the Rod 30 in the base.

A weight 36 consisting of a Strip Coupling, short Rod, and ¾″ Pinion slides along the steelyard 1 and carries a small pointer, cut from cardboard, which indicates the load being weighed by means of the graduated rule 37. A piece of cardboard 38 cut in the form of an arrow may be bolted to a 1″ Reversed Angle Bracket 39 and arranged to rest against the cardboard indicator 40 when the scales are exactly balanced.

When the model is complete, and before commencing to weigh, care should be taken in balancing the steelyard by means of the weight 11 and adjustment 15, so that the arrow 38 rests on the line at 40 when the sliding weight 36 is at the "O" mark in the rule 37.

The graduated scale may be prepared by placing known weights on the platform, and accurately marking the position at which the sliding weight 36 must point in order to maintain the arrow 38 dead on the line at 40.

The model should be oiled at frequent intervals, and all working parts must be perfectly free to move. The fulcrum 7, especially, should not be allowed to make contact with the suspended 3½″ Strips.

Parts required:

(Revised List)

3 of No. 1	1 of No. 15	6 of No. 57
2 ,, ,, 2	3 ,, ,, 16	20 ,, ,, 59
2 ,, ,, 3	2 ,, ,, 16B	2 ,, ,, 62
2 ,, ,, 4	1 ,, ,, 17	8 ,, ,, 63
3 ,, ,, 5	2 ,, ,, 18A	1 ,, ,, 63B
2 ,, ,, 6	1 ,, ,, 18B	1 ,, ,, 64
6 ,, ,, 6A	8 ,, ,, 20	2 ,, ,, 65
4 ,, ,, 8	1 ,, ,, 25	1 ,, ,, 81
2 ,, ,, 9	2 ,, ,, 26	4 ,, ,, 90
4 ,, ,, 10	8 ,, ,, 35	3 ,, ,, 100
1 ,, ,, 11	78 ,, ,, 37	2 ,, ,, 102
2 ,, ,, 12	14 ,, ,, 38	2 ,, ,, 108
1 ,, ,, 12A	1 ,, ,, 46	1 ,, ,, 111
3 ,, ,, 12B	3 ,, ,, 48	1 ,, ,, 111A
2 ,, ,, 13	4 ,, ,, 48D	2 ,, ,, 115
2 ,, ,, 14	2 ,, ,, 52A	2 ,, ,, 126A

The Conquest of the Air

VIII. A Dutch Aeroplane with Interchangeable Parts

Fokker C.V. Scout, fitted with 400 h.p. Liberty engine (See also illustration on page 579)

WE feel sure that our readers will be specially interested in the latest "Fokker" aeroplane illustrated above, because it is to a certain extent based on a Meccano idea—that of interchangeable parts.

The aeroplane in question is a two-seater biplane, designed with all the experience, both theoretical and practical, accumulated during the past eighteen months, by the world-wide use of the "Fokker C.IV."

The new type of aeroplane is known as the "C.V.," and it will incorporate several important new details.

Interchangeable Wings

In the first place, it is fitted with three alternative wing sizes. These wings may be changed at will, so that the machine may be used as a two-seater fighter with the small wings, as a scouting-machine with normal wings, and as a long-distance bomber with large wings.

Two fixed machine-guns are mounted ahead of the pilot and the observer's seat is equipped with a gun-ring for two Lewis guns. When used as a long-distance bomber or reconnaissance machine, another gun may be fitted to a mounting arranged to fire down and under the tail.

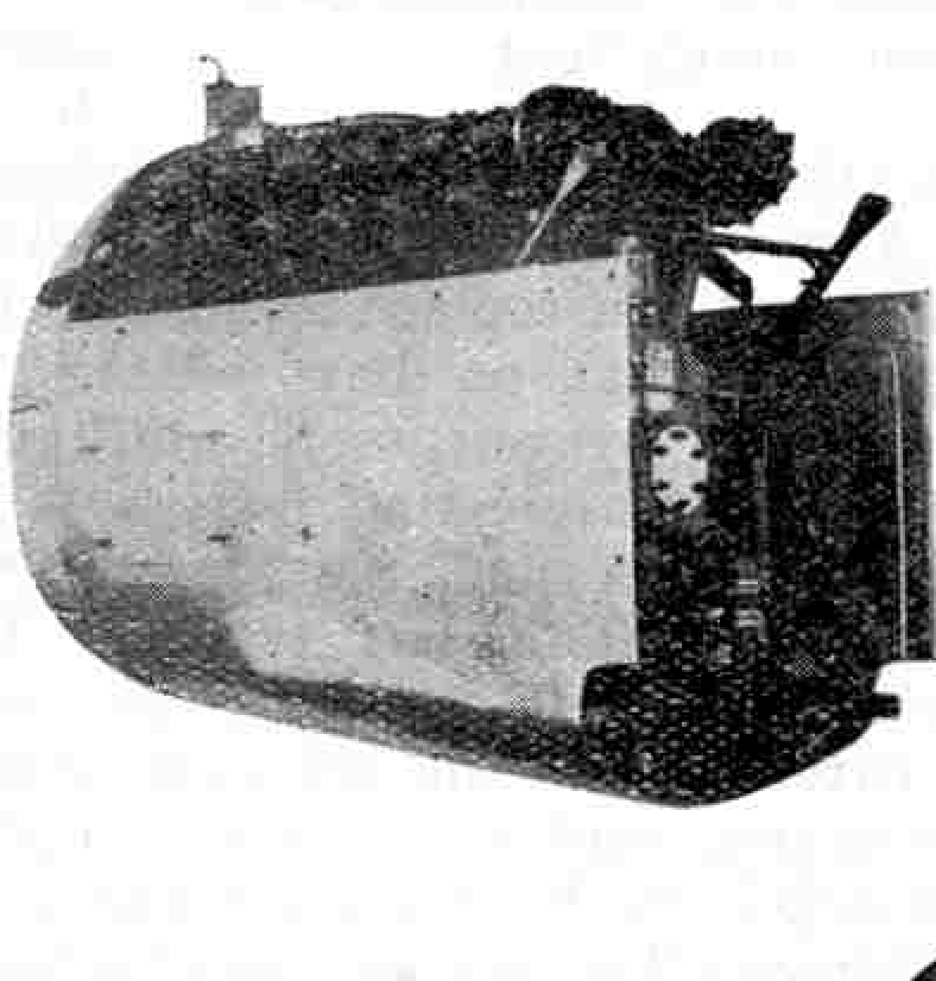
Another remarkable constructional development is that the machine has been designed so that the front portion of the fuselage may be entirely removed when so desired. The engine-bed and power plant is therefore completely detachable, enabling another engine of greater or less power to be fitted to the fuselage, without any alteration to the machine itself.

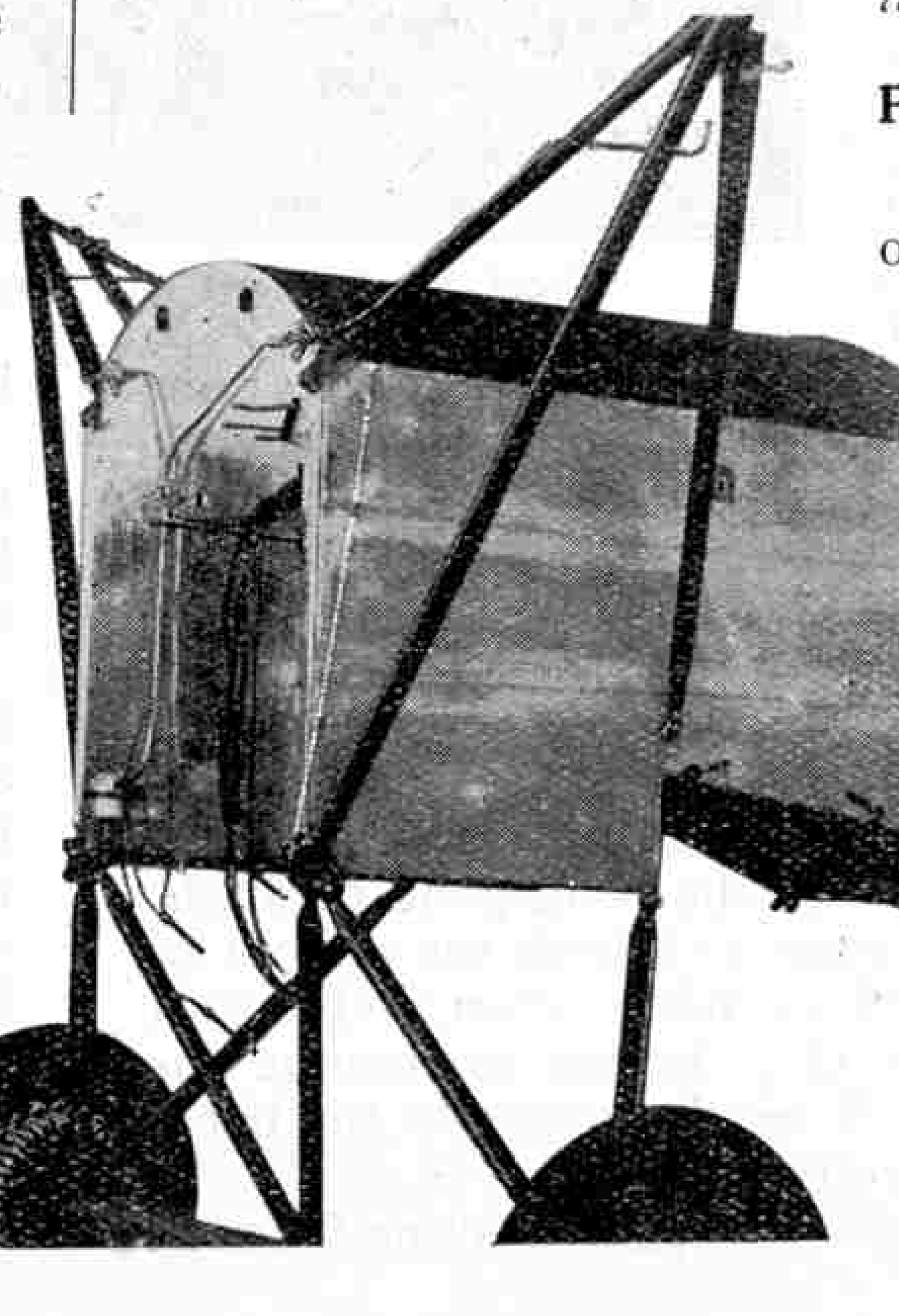
Here again the machine is available for different purposes. Fitted with an engine of low power it is suitable for use in flying schools or for training purposes, whilst more powerful engines are fitted for service conditions.

The engines that are supplied as standard by the makers are 160 h.p. Beardmore; 230 h.p. Siddeley "Puma;" 360 h.p. Rolls-Royce "Eagle;" 400 h.p. Lorraine-Dietrich; 400 h.p. Liberty; 450 h.p. Hispano-Suiza; 450 h.p. Napier "Lion;" and 650 h.p. Wright "Tornado."

Petrol Tank in Upper Wing

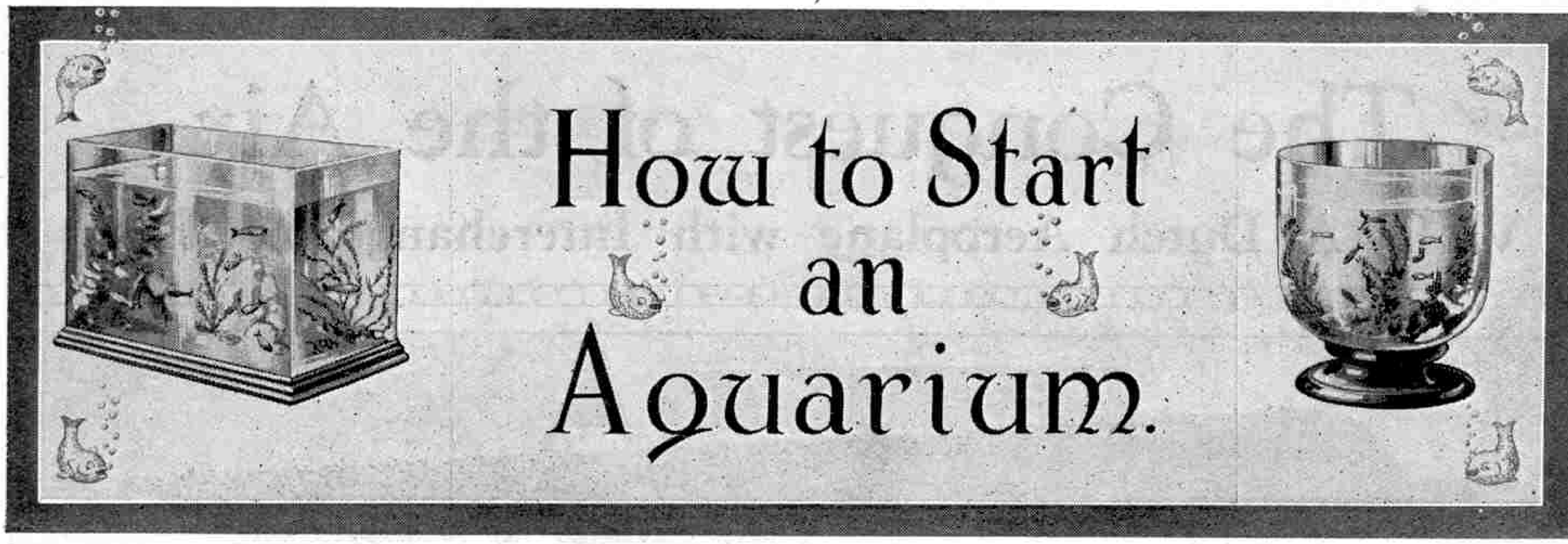
In design the fuselage of the C.V. is narrower than that of the standard machine, thus enabling the pilot to have a greater field of fire were the areoplane used in wartime. The ailerons are interchangeable with all sizes of wings, and Meccano boys who know the value of interchangeable parts will understand something of what this means in the aerodrome.





Showing how, by withdrawing four bolts, the whole of the power unit comes away from the fuselage

(*Continued on page 594*)



How to Start an Aquarium.

By W. COLES-FINCH
(Resident Engineer, Chatham etc. Water Co.)

V. POND LIFE—NEWTS

AMONG all the creatures suitable for study in the home aquarium, Newts are general favourites, and they possess the advantage of being able to share the tank with the pugnacious Stickleback.

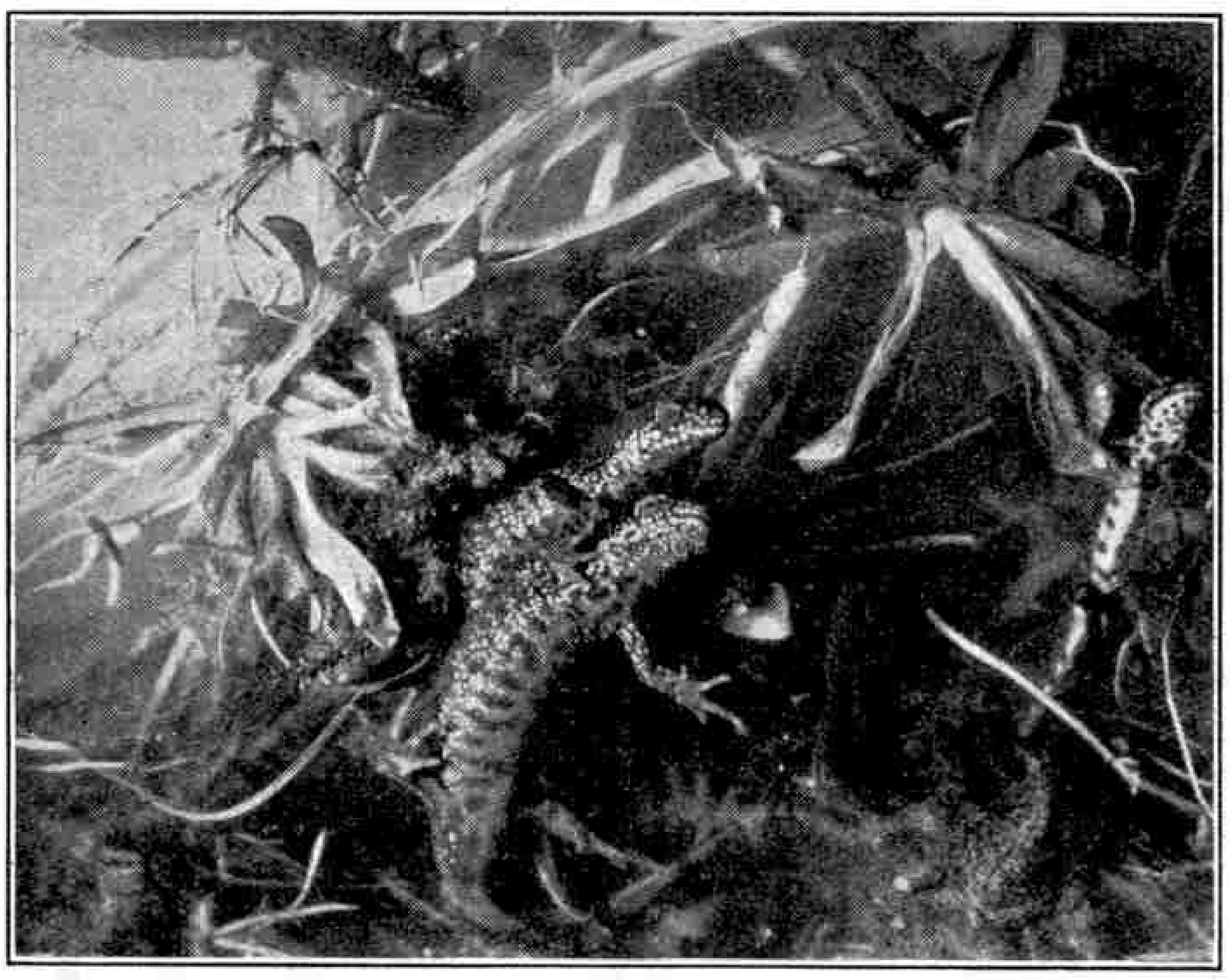
Every boy knows how to capture a Newt by means of a bent pin, a length of thread, a stick and a garden worm. An alternative is the dexterous use of a hand net when the creature comes to the surface of the water to breathe. This it does periodically and frequently, taking in a mouthful of air with a popping noise and then returning to rest awhile among the water-plants below.

Newt-Tadpoles

Our ponds and ditches generally provide the two common British species of the "*Salamandridæ*" family. These are the Great Warty Newt, *Triton cristatus*, and the Common Smooth Newt, *Triton punctatus*. The former may be readily recognised, for it is larger than the Common Newt, its back is nearly black and its under parts are of dull orange colour, spotted with black. The Common Newt is seldom more than four inches in length and its skin is quite smooth. The male is of light-brownish grey above, spotted irregularly with black. Beneath it is light yellow, changing to brilliant orange, also spotted black, in the breeding season. The female is more soberly coloured and is thus not so attractive a creature as the male.

At the approach of Winter, Newts leave the water and hide away in little groups in any place offering protection near the margins of the pool, pond or ditch. They sleep through the winter and with the advent of Spring awaken from their long hibernation and return to the water. The male then begins to assume his indented crest which runs down the centre of the back, but the female remains crestless.

In May the female deposits her eggs, selecting for each egg a single leaf of a water plant, preferably the Starwort or Canadian Water-weed. She carefully envelopes the egg in the leaf, drawing the edges of the leaf together and glueing them firmly by means of a sticky substance that exudes from her body. Then she leaves the egg to hatch out. When the tiny creatures appear they wriggle their way out of the imprisoning leaves and commence their wonderful metamorphosis, passing from the tadpole state with its fringed gills to the perfect creature.



Great Warty Newt and Common Smooth Newt

Replacing Lost Limbs

It is owing to the Newt's peculiarity of spending only a portion of its existence in the water that these creatures, in common with the Frog and Toad, are classed as *Amphibia*. This word is derived from the Greek *Amphis*, meaning both ways, and signifying a "double life," partly in the water and partly out of it. In early life—the tadpole stage—such creatures breathe by gills or branchiae the air that is dissolved in the water. Afterwards, in the adult stage, they throw off these organs and breathe atmospheric air by direct lung respiration.

As in the case of the lobster and certain other creatures, the Newt can replace its lost limbs. The writer trusts, however, that no boy will test the accuracy of the statement by purposely mutilating his little pets.

Another interesting feature is the manner in which, from time to time, the Newt first becomes sluggish and then proceeds to shed its skin. The thin filmy skin will be readily seen, and it is an interesting task to float it carefully, by the aid of a camel-hair brush, on to a clean post-card and spread it out, even to the toe-tips, leaving it to dry for further inspection. It will readily adhere to the card and will be found to resemble a thin water-colour drawing of the creature.

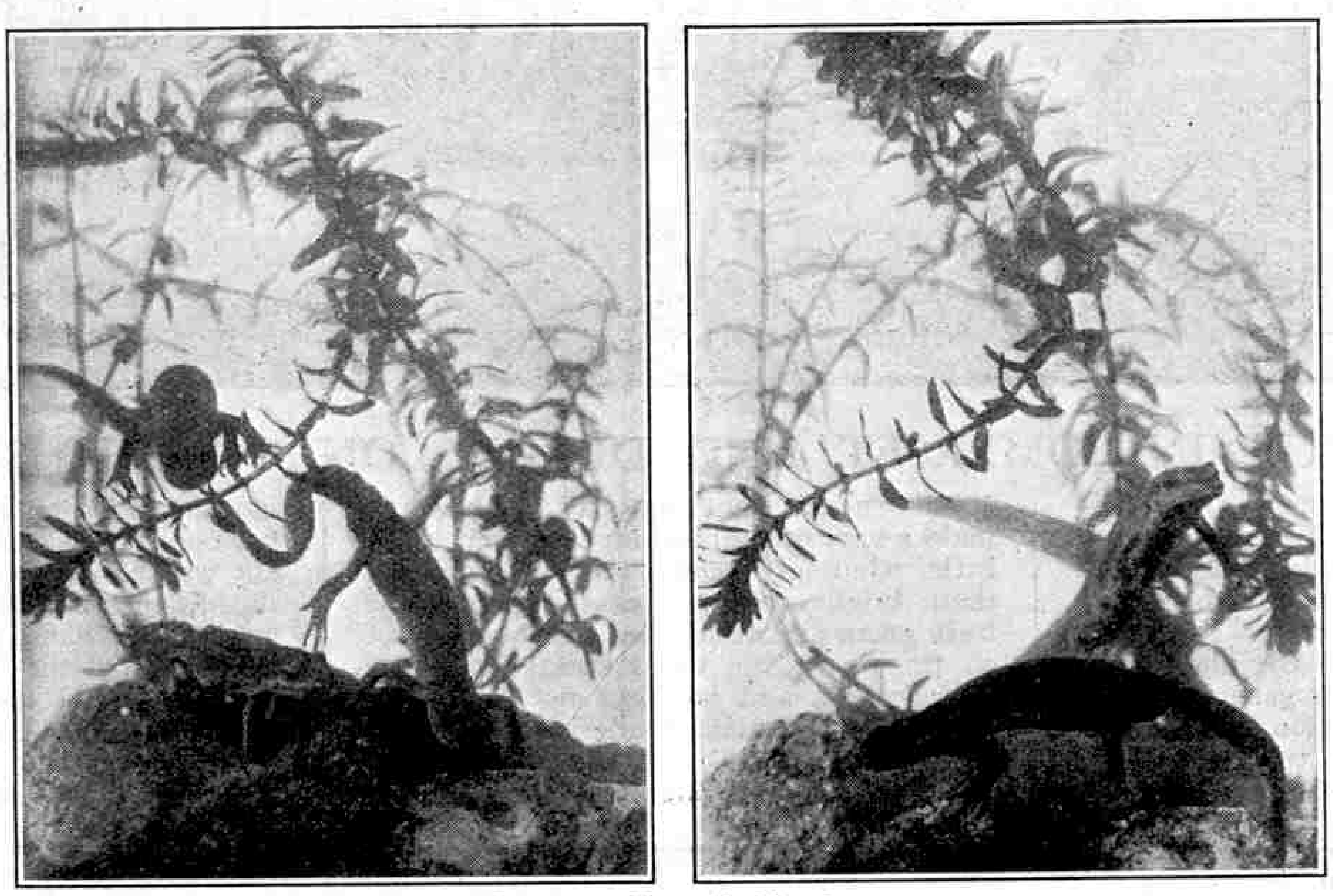
Newts are voracious creatures and will devour small newts, tadpoles, worms, and shreds of raw meat.

They will fight over a large worm, each contestant pulling in a different direction until either one annexes the complete morsel or the worm parts in two and each is satisfied!

A Roman Proverb

The amateur photographer will find that Newts provide excellent subjects. They rest in graceful attitudes for considerable periods upon plants or rockery and thus give every opportunity to obtain excellent negatives of them, as if in their native haunts.

The Newt is also known as the Salamander, and the Romans appear to have regarded this harmless creature with considerable alarm, for they had a proverb: "He who was bitten by a Salamander had need of as many physicians as the reptile bore spots." As a matter of fact the creature is as inoffensive as it is interesting.



Common Smooth Newts

A rockery or floating water plants should be provided in order that the Newts may recline thereon out of the water when they so desire, but care should be taken that they do not escape, for they never fail to take an opportunity to do so.

At this stage I would strongly impress upon the reader the fact that the aquarium containing the fishes we have already described must in no way be considered as a receptacle for the creatures dredged and netted in the ponds and ditches. The fishes offer a special delight of their own, not to be confounded with the closer study of pond life, for which purpose the tank is absolutely unsuitable. Of all the pond creatures the Tritons alone should find a temporary place there for just a month or two in the summer, and then should be given their freedom.

Studying Pond Life

The student of pond life should provide a series of ordinary glass and earthenware jars and dishes and furnish them with plant life, if only a spray or two. These should be placed on a shelf in a position where a good light is available, but where they can be screened from the direct rays of the sun, and where they will be readily available for immediate use when returning from a "ditch foray." In this manner the creatures may be watched more readily and much will be learned of their wonderful life.

Before proceeding further with pond life I would remind the reader that if he should contemplate obtaining fishes for his aquarium from a distant agent, this should be done in the approaching cold weather. As was explained last month, fishes prefer cold to heat and therefore at this time of the year they may be sent with practically no loss in transit. On the other hand a journey in hot weather is very trying to the fishes and frequently causes many casualties.

I understand from several correspondents that their fishes have developed the greenish-white fungoid growth on their scales; that is a sign of the presence of a vegetable parasite known as *saprolegnia ferox.* I have read with interest the various unsuccessful attempts that have been made by readers to cure this contagious disease. My advice is to clean out the tank, destroy its contents, and begin again, changing the source from which the stock was obtained. My reason for the last proviso is obvious, for the disease is the outcome of neglect and want of light, coupled with unwholesome water.

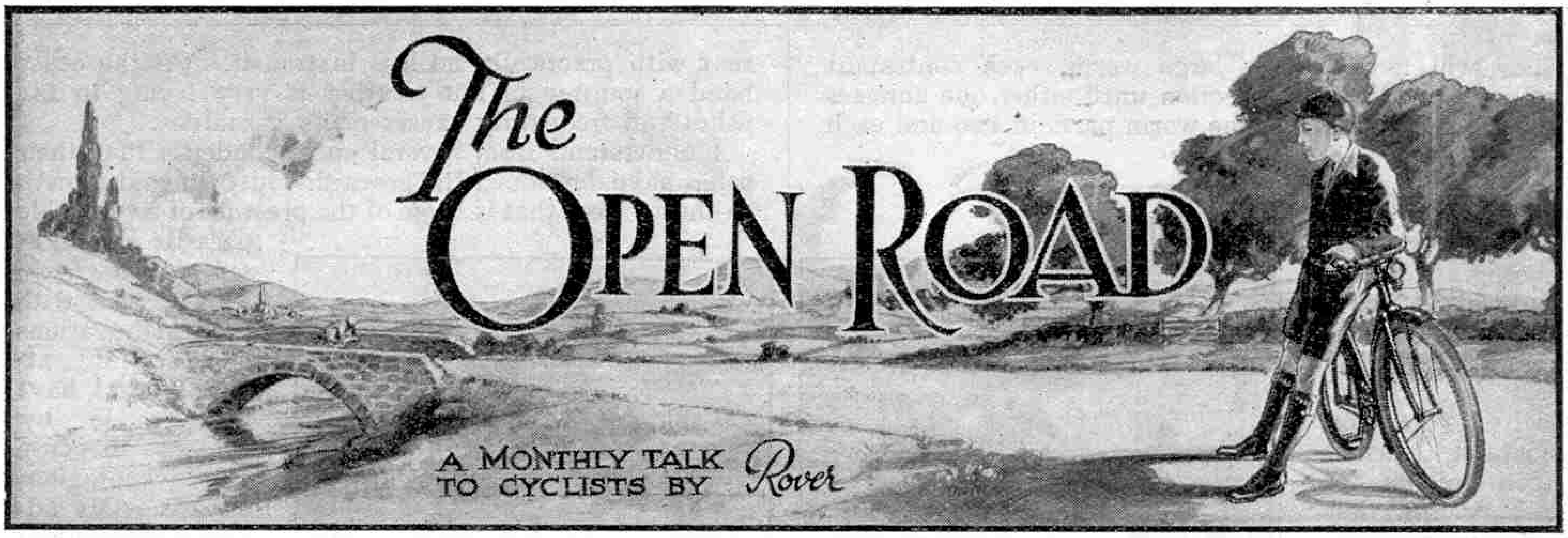
Every aquarium keeper should make a point of observing at least once the life cycle of the frog. The spawn of the frog may be easily obtained from pond or ditch early in the year and should be placed in a shallow vessel, the bottom of which is covered with well-washed river sand. Provided they are given sufficient light and heat the eggs soon hatch out into tiny tadpoles, which should be transferred to a tank after they have consumed as much of the spawn as they will eat. The tadpoles should have the tank to themselves and this should be provided with two or three different kinds of water weed.

Small Tortoises

From this point the existence of the tadpoles surely must be thrilling, for in a short time they pass through an astonishing variety of experiences. They grow little legs, their tails are absorbed within the body and disappear, they lose their gills and finally begin to breathe by means of lungs, although they retain an additional power of breathing through the skin. These changes are interesting to watch and they provide an excellent opportunity for the amateur photographer to portray them step by step. The food of the perfect frog consists of minute insects, and as it is almost impossible to provide sufficient of this food the little creatures should be given their liberty.

Those who desire to break away from the beaten track may experiment with the keeping of one or two small fresh-water tortoises. If these creatures are to live peaceably with fishes they must be small. They make interesting pets, and if provided with an island and fed upon small pieces of meat will thrive well. Remember that these creatures are good climbers and therefore their tanks should be kept covered.

(*For Aquarium advertisements see page 620*)



V. TOUR IN SOMERSET AND DEVON: ON TO THE SEA

WHAT a lovely morning! If I mistake not, we're in for another fine day. The wind has practically dropped, but appears to be more westerly than on Saturday.

Now, as we push out to the high road, some rough plan as to our general movements must be decided upon. We shall, of course, have plenty of time to get to Torquay to-night. The distance is much the same as on Saturday, but we shall have more "calls" to make. We are about 16 miles from the coast, so that in an hour-and-a-half, or thereabouts, we shall make our acquaintance with the sea. I think we shall be doing quite well if we get to Exmouth for tea, and then, that portion safely over, we shall be in a position to judge the latter part of the programme and arrange accordingly.

Here is Chard, quite the average kind of Somerset town. It was, and I believe now is to some extent, a lace-making centre. The water running down the sides of the main street seldom dries up, even in a hot dry summer. We should feel rather pleased we haven't to climb up that steep hill on our right. It is quite a couple of miles long and they call it "Snowdon" locally. So we go on our way, each turn of the pedal bringing us nearer to Seaton and the sea—the thought uppermost in our minds at present.

First we must pass through Axminster, the home of the famous carpet. Note the sign of this inn we are approaching, "The Poppye Inn." The natives call it the "pop in" and do so, I suppose! It is about halfway between Axminster and Chard.

This district is famous for otter hunting, and although I can't say I am in sympathy with this kind of "sport"—I prefer to admire the otter when he is not hunted—I must admit that an otter hunt would make a very fine subject for a painter. The little winding stream, the huntsmen in their bright coloured coats against the fresh green grass and trees, the hounds hot on the scent, the usual straggling batch of followers, and last but not least, the gallant otter making desperate efforts to get away.

Another interesting feature close at hand is the junction of three counties where you may hop into all three in as many hops if you so wish!

Photo courtesy] *[G.W.R.*

Oddicombe Beach, Torquay

The road to Seaton is of the "give and take" variety most of the way, with nothing very steep either way, but you will appreciate our early start if only for the reason that we are not faced with much traffic—a consideration on these narrow roads. That reminds me that cyclists, perhaps more than any other body, should welcome the daylight saving idea. It is not generally recognised, I'm afraid, but it gives us not only a longer or lighter evening, but an extra cool hour in the morning. To reap this advantage to the full one should make a really early start in hot weather. You would be surprised at the difference it makes, to start out say between five and six a.m. You then get some idea of the "freedom of the road." No respectable motorist, of course, would be about at that hour, and just think what that means!

Then the freshness of everything! Old Sol doesn't seem to have the thirst he had yesterday, the dew is simply drenching on the grass and the drops are glistening everywhere you look. The bulk of the day's journey is probably done by the time the sun gets overhead, so that then you are able to take longer rests and spend more time generally over the route, or leave what remains to be done until the cool of the evening.

Our advance to the sea is quite easy—in fact there are few towns this side of Portland Bill that have such a flat background as Seaton. This open country at the back accounts in a great measure for Seaton's reputation for being far more bracing than the neighbouring towns of Lyme Regis and Sidmouth. These latter places, although only a few miles east and west, have high ground at their backs and consequently are more sheltered. Seaton's open door causes a "through draught," if I may put it that way, hence the front there is far more breezy than at the other towns.

At Axmouth, Seaton's pretty little companion, we see the English Channel straight ahead. I don't know what your feelings are at the sight, but I well recall my own on seeing it for the first time. The moment was to me quite thrilling, standing on the edge of the map, as it were. In fancy I could see again the map of England with those spidery red lines covering it.

Then I followed once more the route I had taken—home seemed a long way off, too—dwelling briefly on all I had seen, and I can assure you I felt distinctly proud of my achievement.

I don't think we ever really forget the impressions of our cycling tours, there is such a delightful sense of adventure about them. It is not too much to say that they appear to change our outlook on life. Things that previously we thought of very little importance now become of great interest to us. Take, for instance, the daily newspaper, rather dry apart from the cricket or football reports. Well, now our eye catches a headline—there's something familiar about it. Why, yes, that was the place we went through on our last tour. We become deeply interested and are able to picture the whole scene as described, and in fact we probably could tell the newspaper man a little more about that locality than he appears to know.

Look again at the geographical side. Ask Smith where is Seaton ! He doesn't know, and says he never was strong on geography. Well, he eventually finds it on the map, but to him it is a mere spot on the south coast line. If we had brought him along with us, however, he would have been able to tell practically everything there is to know. For instance, he would have known that there really is a river called the Axe, which runs into the sea just east of Seaton, under a cliff some 500 ft. in height, where the Axmouth golf club have some fine links, and from which point right into Lyme Regis, a matter of five or six miles, lies the famous landslip.

Now we will see about some light refreshments and we can leave our machines at this shop while we have a walk along the front.

That's something like a breeze ! We scarcely felt any wind coming along did we ? Look at the "white horses" out yonder, and what a deep blue the sea is here ! We can stretch ourselves on these fine pebbles for a while, and I daresay in a very short time we shall be following the example of those people and seeing who can get the largest number of pebbles back into the sea in the shortest time ! Notice how the beach goes down in "shelves." It is an unusual sight to see a fairly large steamship run right on to the beach and land her passengers, but that happens here frequently.

Now, what about a swim ? Cycling and swimming, some folk will tell you, do not go together. That all depends. It is better, where possible, to take a dip before starting, but there is no reason why you should not enjoy a swim en route. A little common sense must be used, of course, if you have been riding hard for the best part of the day. The drawing up of the legs and the violent kick are likely to bring on cramp when the muscles are already rather tired. Personally I have bathed many times under these conditions, and I know of few more delightful sensations, after a long, hot and dusty ride, than to strip and simply let the salt water soak in, rolling rather than swimming. The effect is instantaneous, and so soothing and reviving that one forgets that there is such a thing as fatigue.

I don't wonder you wish you were here every day ! Our dip will put us in good fettle for tackling the big hill that separates us from Sidmouth. Before we do so, however, we will run along and see the quaint old fishing village of Beer. It is a striking sort of place, with every suggestion of smugglers and all that kind of thing.

And now we are in for about six miles practically all up hill, and while we are walking the first and worst stretch let me tell you that this district has the reputation of being a dry one. This doesn't tally with my own experience, if getting wet three times out of five visits is anything to go by !

These south coast roads are certainly hot, but in one respect this district is better off than some other parts of our coast—there are more trees to be found here and consequently more shade.

When pushing up a long hill, with a companion, it is a good plan to take turns pushing both bikes, one hand on each handlebar, thus giving each other the opportunity of resting the arms. Supposing we take a 'breather' at this point and look around us. It may be that you will be coming down this hill one day, so that it is well to take particular notice of how it shapes, for the knowledge may possibly serve you a good turn. It is certainly not time wasted for it is always an advantage when descending an awkward hill to know just when to expect the most dangerous point.

Looking back often reveals a view that you "would not have missed for anything !" Just look at the sea ! From this point it is difficult to locate the horizon, and those small yachts away out there appear to be in the sky ! The explanation is that we are standing on a slope and our eyes follow a line suggested by the hedges and the road itself, so that the point where we first expect to find the horizon is really a long way below it. It certainly is a remarkable illusion, helped, of course, by the heat haze in the distance.

And now we can ride again. These slopes now are not very violent, but if they do become a little fierce at the crest it is no trouble to dismount and walk over them. This is a glorious piece of road in any case and doesn't deserve to be hurried over. Look at the gorse, "flaming furiously," and also the heather, so suggestive of freedom. One gets the true sense of it up here, too !

Now we are about to descend, and this hill, I may tell you, has one of the worst of "S" turns about halfway down. I believe it is worse now than ever it was, for at the first turn the road drops what is really a step. This is caused by the heavy motors that sometimes attempt to come up ; they one and all "jib" at that point.

(To be concluded)

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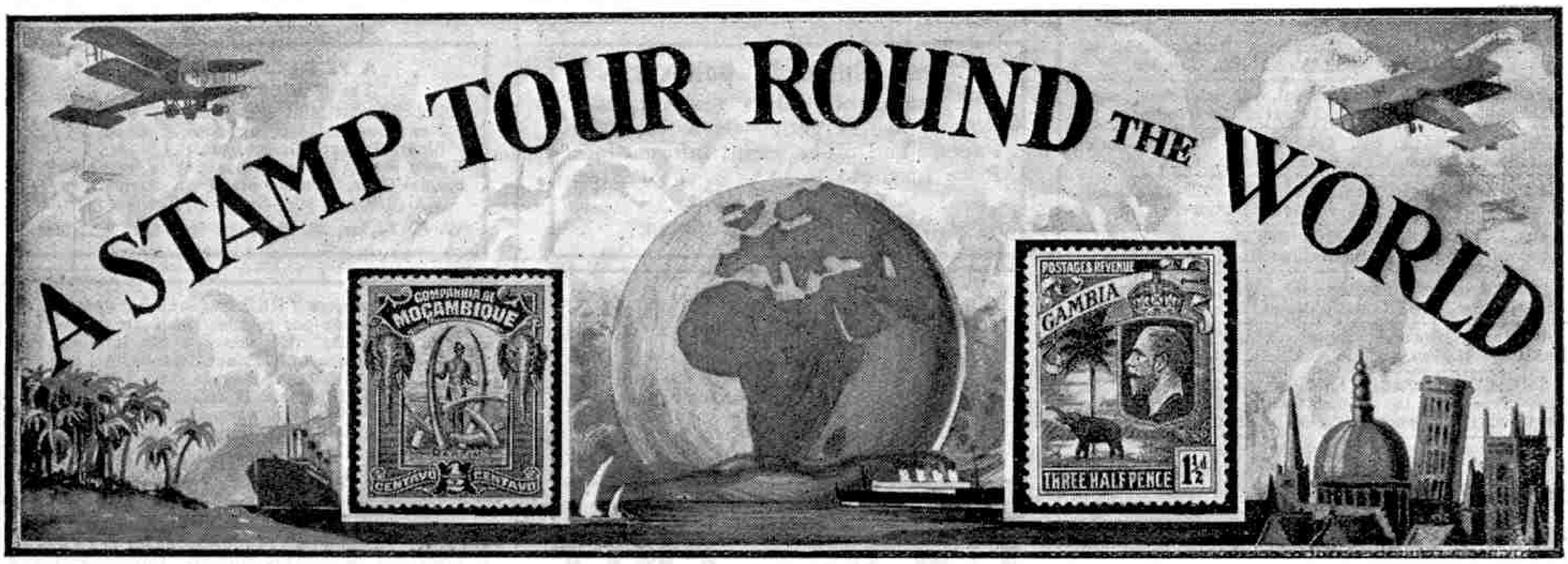

XIV. SOUTHERN EUROPE

FROM Alexandretta we fly across Asia Minor to Constantinople, situated at the southern end of the Bosphorus. In 1913 Turkey issued a beautiful series of views of Constantinople and the surrounding district, the series being engraved and printed by Messrs. Bradbury, Wilkinson and Co., London.

The Sights of Constantinople

In this series the 2 paras value shows the Obelisk of the Hippodrome, a lofty pile of masonry once covered with plates of gilded bronze. This is one of the three remaining monuments that mark out the path of the Spina, around which the chariots whirled in the days when the Hippodrome was the favourite place of recreation for the citizens of Constantinople. Here were held the chariot races, the political meetings, the celebrations of military triumphs—and the public executions! Next to the Hippodrome on the south-east side is the Mosque of Sultan Ahmed, depicted on the 1 piastre of the same series.

The 4 paras (illustrated) shows the Column of Constantine in the Forum of Constantine, about a quarter of a mile north-west of the Hippodrome and at one time a great business centre. The column is built of twelve drums of porphyry, a beautiful speckled marble. It was crowned with a statue of Constantine until the year 1105.

The 6 paras takes us to the extreme south-west corner of the city, near the Sea of Marmora. Here are the Seven Towers or Yedi Kuléh at the southern end of the great Wall of Constantine, which runs from this point to the Golden Horn and protects the city from invasion from the land. The 10 paras shows the Fararak; the 20 paras the Castle of Europe; the 1 piastre the Mosque of Sultan Ahmed, as already mentioned; and the $1\frac{1}{2}$ piastres the Monument erected to the Martyrs of Liberty. On the $1\frac{3}{4}$ piastres are the Fountains of Suleiman; on the 2 pias. an illustration of the Turkish cruiser *"Hamidie."* The $2\frac{1}{2}$ pias. shows a beautiful view on the Bosphorus, as also does the 50 pias. The Ministry of War forms the subject of the 5 pias. and the Sweet Waters of Europe appear on the 10 pias. The 25 piastres shows the Mosque of Sultan Suleiman, situated near the centre of the city and erected in the 16th century, at a time when Turkish architecture was at its best.

Bulgaria's Views

From Constantinople we fly northward and commence our tour of Bulgaria by paying a visit to Varna (shown in the 3 lev. of 1911), the important seaport on the Bay of Varna, an inlet of the Black Sea.

Varna is the third city of Bulgaria in size and has played a very important part in its history. It has a large, deep and sheltered bay and is connected with all parts of Bulgaria by the main and branch lines of the Varna-Rustchuk railway of which it is the eastern terminus.

We now fly due west to Tirnova or Trnova, an important city in the centre of Bulgaria situated on the railway already mentioned at its junction with a branch line to Sofia. Tirnova was pictured on the 3 st. value of the 1911 series and is illustrated here. The city is divided into two portions, one on the higher ground and the other on the lower. The view on the stamp shows the river Yantra on which the city stands and the railway bridge crossing it.

About 40 miles south-west of Tirnova is the Shipka Pass which, with the village of Shipka, is on the main road from Tirnova to Adrianople. This road (pictured on the 75 st. of the 1921 series) is not a pass in the usual sense of the word, since it crosses the main ridge of the Balkans at the highest point and does not pass between lofty mountains as is usually the case. Its altitude is actually about 4,370 ft. The Shipka is chiefly famous for the fierce

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fighting that took place there during the Russo-Turkish War of 1877-1878 when Gourko, the famous general, led the Russian advanced guard across the Balkans against Osman Pasha. Both sides lost many thousands of men.

Continuing over the Balkans in a westerly direction we now make for Sofia, the capital of the country, situated in the centre of a plain about 1,700 ft. above sea level. A view of the town was shown on the 10 st. of the 1921 series and is illustrated here. Since 1880 the town has been altered in many respects and now possesses straight, parallel streets, an electric tram system, electric lighting, and good water and drainage. Owing to its height the climate is rather cold, 4°F. below zero being sometimes reached in winter, while August sometimes brings a temperature of 100°F. The city was selected to be the capital of the new Bulgarian state on account of its position commanding the routes to Constantinople, Belgrade, Macedonia and the Danube.

A little north of Sofia is the river Iskr, a pretty view of which was shown on the 15 st. of the 1911 series. This view also shows an interesting example of mountain road engineering, the road being much higher than the river in the foreground and passing through a tunnel in a projecting piece of rock in the distance.

South-east of Sofia we come to the famous monastery of Rila or Rola, in a picturesque valley in the Rilska Plaina. This monastery owns an immense estate and the abbot acknowledges no spiritual superior but the exarch. The monastery is illustrated on the 30 st. of the 1911 issue.

The Capital of Montenegro

We now fly due west over Jugo-Slavia to visit the monastery near Cettinje, the capital of the old kingdom of Montenegro, now merged into Jugo-Slavia.

The series of stamps showing this view on all values of Montenegro of 1896, was issued to commemorate the second centenary of the commencement of the dynasty of Danilo Petrovitch de Niegush, who was the first vladika, or bishop of Cettinje, to be elected with power to select his successor. Previously each new vladika had been elected by the people but from this date (1696) the succession was from uncle to nephew.

The Beauties of Bosnia and Herzegovina

From Cettinje we fly due north-west into what formerly consisted of the two provinces of Bosnia and Herzegovina, now a part of Jugo-Slavia. In 1906-7 this country issued a beautiful series of view stamps designed by Prof. Moser and engraved by Ferdinand Schrinboeck. This series appeared imperforate and also perforated in eleven different gauges, so that those readers who delight in using their perforation gauge will here be able to enjoy themselves thoroughly! In 1910 various values of the series were re-issued with the date "1830-1910" added in order to commemorate the 80th birthday of Franz Josef I., and in 1912 three additional values and views were put on sale.

Our first call is at Mostar (1906, 2h. and 20h., illustrated), the capital of Herzegovina, situated on the banks of the river Narenta. It is famous for its bridge, which is clearly shown in both views. It has a single arch with a span of 89½ ft.

and a height of 61 ft. It is not known when and by whom this bridge was built and much discussion has taken place on the subject. It is now thought that it was probably built by the Turks in the 15th or 16th century. Its use is now confined to foot passengers, an iron bridge having been opened in 1881 for road traffic.

From Mostar we travel up the valley of the river Narenta to the famous gorge, twelve miles in length, known as the Narenta Defile (1906, 5h.)

Continuing northwards, but this time veering somewhat towards the east, we come to Serajevo (1906, 25h. and 1k., illustrated), the capital of the old Bosnia. This pretty city with its eastern appearance is now chiefly remembered as being the place at which, on Sunday, 28th June 1914, the heir to the Austrian throne, the Archduke Franz Ferdinand and his wife were assassinated while on an official tour of inspection. The two assassins were young men twenty years of age and this event eventually culminated in the Great War.

The mosque of Husref Bey or the Begova Djamia at Serajevo is one of the finest mosques in Europe and was founded in 1465 by Husref, Pasha of Bosnia.

Leaving Serajevo we turn north-west and continue in that direction until we arrive at Jajce (1906, 3h. and 2k., and 1912, 12h.) about 62 miles from Serajevo. Jajce is built on a conical hill near one of the finest waterfalls in Europe. Here the Pliva throws itself into the river Vrbas (1906, 10h.) and five miles to the westward is Jezero (1906, 35h.) in a district of waterfalls, rivers, rocks, and forest-clad mountains.

The "*M.M.*" Perforation Gauge

Send for One To-day

Those of our readers who collect stamps will be pleased to hear that we have printed a supply of a special perforation gauge. A copy of this will be sent, post free, to all readers who send us their names and addresses and enclose a penny stamp.

This perforation gauge is printed on card, measuring 6″ × 4″, and full instructions on how to understand and measure perforations are also given.

The gauge itself is specially designed to enable stamps to be measured quickly, and shows all sizes from 7 to 17 holes per two centimetres—for, as all collectors know, the number of the gauge of a perforation is the number of holes there are in the space of two centimetres.

Perforations determine Values

It is very important that every stamp collector should possess and use a perforation gauge, for a difference in perforation often means a big difference in the value of a stamp. For example, a certain stamp of New South Wales (1882-93, 1d.) exists in nine varieties of perforation and the value varies from 3d. to 30/– used and 8d. to 80/– unused. The used prices of the different gauges serve to show how important it is to measure perforations and are as follows: perf. 11 × 12 comb, 3d.; perf. 10, 4d.; perf. 10 × 13 and perf. 10 × 12, 10/–; perf. 10 × 11, 20/–; perf. 12 × 11, 30/–; perf. 12 × 11½ comb, perf. 11 and perf. 13, too scarce to catalogue the value.

When top and bottom perforations are in a different gauge from those along the sides of the stamp it is necessary to give both figures. This is done by putting the top and bottom gauge followed by the arithmetical sign of multiplication (×) and then the side gauge; thus, "perf. 10 × 13" signifies that the stamp is perforated 10 along the top and bottom and perforated 13 at the sides.

"Comb" Perforations

It will have been noticed that the word "comb" has been used in describing two of the perforations of the New South Wales stamp. This refers to the type of perforating machine. A comb perforating machine punches the holes along the top of a row of stamps and between each pair of stamps in the row at one operation. Thus the arrangement of the punches is something like a comb with very widely spaced teeth. After one punch the sheet of stamps is moved up one row, and the bottom of the first row of stamps is perforated when the top of the next row is punched.

Other machines only perforate a single line at a time and after perforating horizontally throughout the sheet, the stamps are turned and the perforating completed by punching the vertical rows up the sheet. These are known as single-line perforations.

The two types may easily be distinguished since in the single-line style the perforation holes hardly ever coincide where the top and side perforations cross, so that there is a kind of double hole. This is well illustrated in the U.S.A. 4c. stamp illustrated here, which is single-line perforated. This should be compared at the corners with the stamp of Switzerland, also illustrated here, and with the stamps of this country which are comb perforated.

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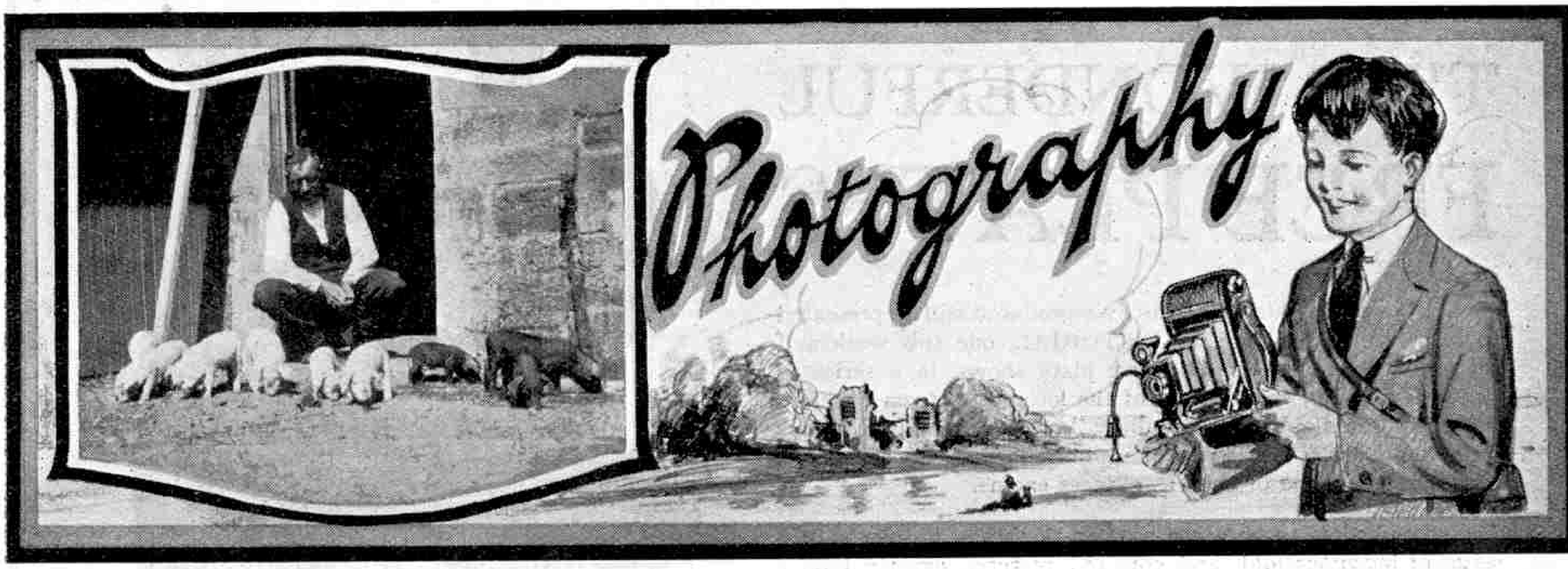


VIII. GASLIGHT PRINTING

During the summer months, with their long hours of daylight, most amateurs print their negatives on printing-out paper, better known as "P.O.P.," or on self-toning paper. As the days shorten, the opportunities for printing by daylight become more and more limited and photographers turn to printing by artificial light, using either gaslight or bromide paper.

Convenience of Gaslight Paper

Gaslight and bromide papers are development papers. The image does not become visible during exposure to light as is the case with "P.O.P." or self-toning paper, but appears only after the paper is developed in a similar manner to a plate or film.

As compared with "P.O.P." or self-toning paper, both gaslight paper and bromide paper are very rapid, but there is a great difference between the two, bromide paper being much the faster, probably on the average some 60 times as fast. Both papers may be printed by exposure to any kind of artificial light—gas, electric, magnesium ribbon, etc.—bu whereas bromide paper is so sensitive that it must be developed by orange or yellow light, gaslight paper may be developed in the same light as is used for printing it. This fact makes the use of gaslight paper extremely convenient and simple, and the popularity of this paper has increased to an enormous extent during recent years.

The majority of negatives produced by amateurs tend to be on the thin side and it is just such negatives that are best suited to the gaslight process.

In this article we shall confine ourselves to gaslight paper, leaving bromide paper to be considered later, when we come to the fascinating subject of enlarging.

There are two main grades of gaslight paper, soft and vigorous, the former being used for normal negatives and the latter for very thin negatives and those lacking in contrast. Both grades of paper may be obtained also with a variety of surfaces, glossy, matt, satin, carbon, etc., so that a paper may be found to suit any type of negative.

Working Conditions

It has been said that gaslight paper can be developed in the same light as that used for printing, but the same *amount* of light must not be used for both purposes. It is obvious that a light that is strong enough for printing the paper must be strong enough also to fog it, and therefore matters must be arranged so that the full strength of the light falls upon the paper only during actual printing operations. This may be effected by having the light on full during printing and lowering it while the other operations are being carried out, but this is not advisable.

A better method is to maintain the light at full the whole time and to carry out development in such a manner that no direct light falls upon the paper. This may be done effectively by setting up a large sheet of cardboard between the source of light and the table on which operations are being carried out. An even simpler and yet perfectly satisfactory method is to have the work table a little distance from the light and to handle the paper in the shadow of one's body.

In certain circumstances when working with a very powerful electric light it is very difficult to obtain sufficient shade to develop in safety, and it then becomes necessary to use the electric light for printing only, and then to switch it off and employ a weaker light, say a candle, for subsequent operations.

From our Photo Competitions
(Enlargement submitted by John Sandham, Preston)

Solutions Required

In using any kind of gaslight paper a developer and a fixing solution are required. The favourite developers are metol-hydroquinone, familiarly known as "M.Q.," and amidol. Amidol has certain very valuable features, but it has the drawback that when made up it must be used practically at once, as it will not keep for more than a few hours. "M.Q." on the other hand keeps excellently.

The makers of the various brands of gaslight paper invariably give special formulæ as being the most suitable for the development of their particular papers. These developers of course may be used with the utmost confidence, but generally speaking any "M.Q." developer sold by a reputable firm, whether in liquid form or as powder to be dissolved in water, will do all that is required.

The same lot of developer may be used to develop several sheets of paper, but it is not advisable to carry this too far. It is better to use a small quantity of developer for two or three prints than a large quantity for a dozen or more prints.

The fixing bath may consist simply of hypo, but an acid fixing solution is strongly recommended as it helps to keep the prints a good colour and free from stain. An acid fixing solution does not discolour with use as is the case with a plain solution, and on this account care must be taken not to use the same solution too long, through relying on its clear appearance. A simple and at the same time very efficient acid fixing bath consists of 4 oz. of hypo (sodium hyposulphite), ½ oz. of potassium metabisulphite and 20 oz. of water.

For practical operations there are required a large dish for the fixing bath, a developing dish of a suitable size for the paper to be used, and a large dish of clean water.

Making the Exposure

Having prepared the solutions the next step is to get ready the printing frame and negative and a packet of gaslight paper. The packet of paper is then opened—in a shaded position as already described—and a piece of paper placed sensitive side downward on the negative. In using glossy or semi-glossy papers there is no difficulty in detecting the sensitive side, but a little trouble sometimes arises in using matt papers, both sides of which are very much alike. Any uncertainty about this matter can be settled immediately by placing a sheet of paper on the palm of the hand, when the sensitive side will curl inward. Another method is to bite the edge of the paper, when it will be found that the teeth adhere slightly to the sensitive side.

We now come to the most important point of all in gaslight printing, namely, the securing of correct exposure. As the image is not visible until the paper is developed, printing operations must be carried out entirely by time. First of all the distance of the printing frame from the light must be settled. For ¼-plate ($4\frac{1}{4}'' \times 3\frac{1}{4}''$) or smaller sizes, 6″ is a convenient distance. For larger negatives the distance must be increased in order to obtain even illumination, and a useful rule is to make the distance between the frame and the light at least equal to the diagonal of the negative.

Once the distance is settled it should not be varied, as even a small increase or decrease has a very marked effect on the exposure. This will be clear if it is remembered that the exposure increases with the square of the distance. That is to say, the exposure at 2 ft. from the light will not be twice as long as the exposure at 1 ft., but *four* times as long. Similarly, at three times the distance the exposure is nine times, and at four times the distance it is sixteen times.

Many amateurs hold the printing frame in the hand during exposure, but this is undesirable, as it is difficult to ensure that the distance between the frame and the light does not vary. The best method is to fix up some kind of stand for the printing frame and this is quite a simple matter to any Meccano boy.

An Experimental Exposure

In commencing gaslight printing for the first time, or in using an unfamiliar paper, the first exposure should be specially designed as a time test. Perhaps the most satisfactory scheme is to place the negative and paper in the frame in the usual way and carry out the exposure in sections by means of a piece of cardboard large enough to cover the frame. Having placed the frame at the determined distance from the light, uncover, say, a quarter of the negative and expose for five seconds. Then move the card along to the halfway position and give another five seconds. Repeat this until the whole negative has been uncovered in four sections, adding five seconds each time. The result is that one section of the paper will have received five seconds' exposure, the next section ten seconds, the next fifteen and the next twenty. When the paper is developed it will be seen at once which exposure is the most suitable for that negative.

It should be understood, of course, that these figures are only given as an example. A rough guide to exposure is always given in the working instructions supplied with each packet of paper, and this supplies a basis for trial exposures. Different makes of gaslight paper vary considerably in speed and the vigorous grades are very much slower than the soft grades.

Some amateurs prefer to make their exposures by means of magnesium ribbon. In this case it is best to use always the same length of ribbon, 1 in. for instance, and to adjust the exposure by varying the distance between the frame and the burning ribbon. This will be found simpler than regulating the exposure by varying the length of ribbon to be burned. The ribbon should be held by means of a pair of pliers and is best ignited in the flame of a small spirit lamp or bunsen burner.

Printing from Thin Negatives

Having thus ascertained the correct exposure for a particular negative it is not difficult, after a little practice, to estimate the exposure for other negatives by comparing them with the first one, and probably it will be found that large numbers of negatives may be printed successfully with the same length of exposure. If, however, on taking up a fresh negative, this is seen to be noticeably thinner or denser, allowance must be made for this. One important point to notice is the colour of the negative. A negative that is yellow as the result of developer stain requires a considerably longer exposure than one of the same density but without any stain.

Very thin negatives may be made to give better results by being printed at a greater distance from the light. Another dodge for dealing with such negatives is to place over the printing frame a piece of green glass, which has the effect of slightly increasing contrast.

Development

There is nothing difficult about the development of gaslight paper. Generally speaking, the print should be removed from the frame and placed dry in the developing dish and the developer quickly poured over it. Some experienced workers invariably dip the print into water before development, but on the other hand certain manufacturers say that this should not be done with their papers. There does not appear to be any particular object in wetting small sizes of prints before development, but this is certainly useful in the case of very large sizes as it makes the instant flooding of the print by the developer much easier. With ¼-plate and smaller sizes, at any rate, the makers' instructions should be followed in this matter.

How Stains are Caused

A gaslight print develops very rapidly. The image appears almost at once and the process is complete in about 30 seconds, the time varying slightly with different makes. If the image flashes up quickly and blackens all over, the print has been greatly over-exposed. On the other hand, if development is not complete in about one minute, the exposure has not been sufficient. Any attempt to bring an under-exposed print up to strength by prolonged development only results in stains.

The process of development should be watched closely and as soon as it is seen to be complete the print should be picked up by one corner, given a quick rinse in the dish of clean water, and then placed in the fixing bath, in which it should be kept moving for at least a few seconds. The operations of lifting the print from the developer, rinsing it and placing it in the fixing bath should be carried out as quickly as possible, as exposure of the unfixed print to the air is productive of stains. The print should remain in the fixing bath for at least ten minutes, during which time it should be moved about at intervals.

A prolific source of stains is the introduction of hypo into the developer via the fingers. Care should be taken to rinse and dry the hands after they have been in contact with the hypo or, better still, use a pair of tweezers for removing the prints from the developer to the rinsing bath and another pair for transfer from the rinsing bath to the hypo. This method is safe and, in practice, very simple.

Fixing and Washing

As each print in turn is placed in the fixing bath it is a good plan to give the prints that are already there a good move round, at the same time turning them over. This prevents prints becoming stuck together so that the hypo has not free access to them.

When fixation is complete the prints must be washed thoroughly in order to get rid of the hypo, which not only is no longer required, but if allowed to remain will seriously impair the permanence of the prints. The most efficient method of washing prints is by means of two dishes of water. The prints are placed in one dish and allowed to remain for a couple of minutes and are then lifted out one by one, allowed to drain and placed in the second dish. The first dish is then thoroughly rinsed out and refilled with fresh water. After a soak of a couple of minutes in the second dish the prints are transferred, after draining, back to the first dish, and the second dish is then rinsed out and refilled. A dozen changes of this kind from dish to dish will free the prints from hypo more thoroughly than the average automatic washer. If such devices are to be used the prints should be washed for at least 40 minutes.

After the washing the prints are dried in the usual manner.

(*For Photographic Competition see page 605.*)

NEXT MONTH:—

TABLE-TOP PHOTOGRAPHY

A Fine Hammer-Head Crane

THE crane is mounted on a fixed base and does not move along the dockside, as is the case with some cranes of this type. In our illustration it is seen hoisting anchor chains on board a ship lying at the wharf.

The crane is electrically operated and its maximum load is 13¼ tons, and this it is capable of handling at a radius of 60 ft. 6 in. It is able to handle a 7½ ton load at a radius of 110 ft. 6 in. and a 5 ton load at its maximum radius of 162 ft.

The maximum height of lift above ground level is 150 ft. and the range of lift below ground level is 20 ft.

The motions of hoisting, slewing and racking are each operated by an independent motor.

This type of crane is particularly useful for work of this nature for, as will be seen from the photograph, the great length of the cantilever arm enables it to outreach a considerable distance over the river. In the case in point, for instance, the load is being delivered to a ship lying well out into the river and is lifted over two other ships that lie between it and the wharf. If a crane with a shorter arm were used it would be necessary to bring the ship to be loaded close up to the wharf, and this would also involve expenditure of additional time in having to clear the other ships out of the way.

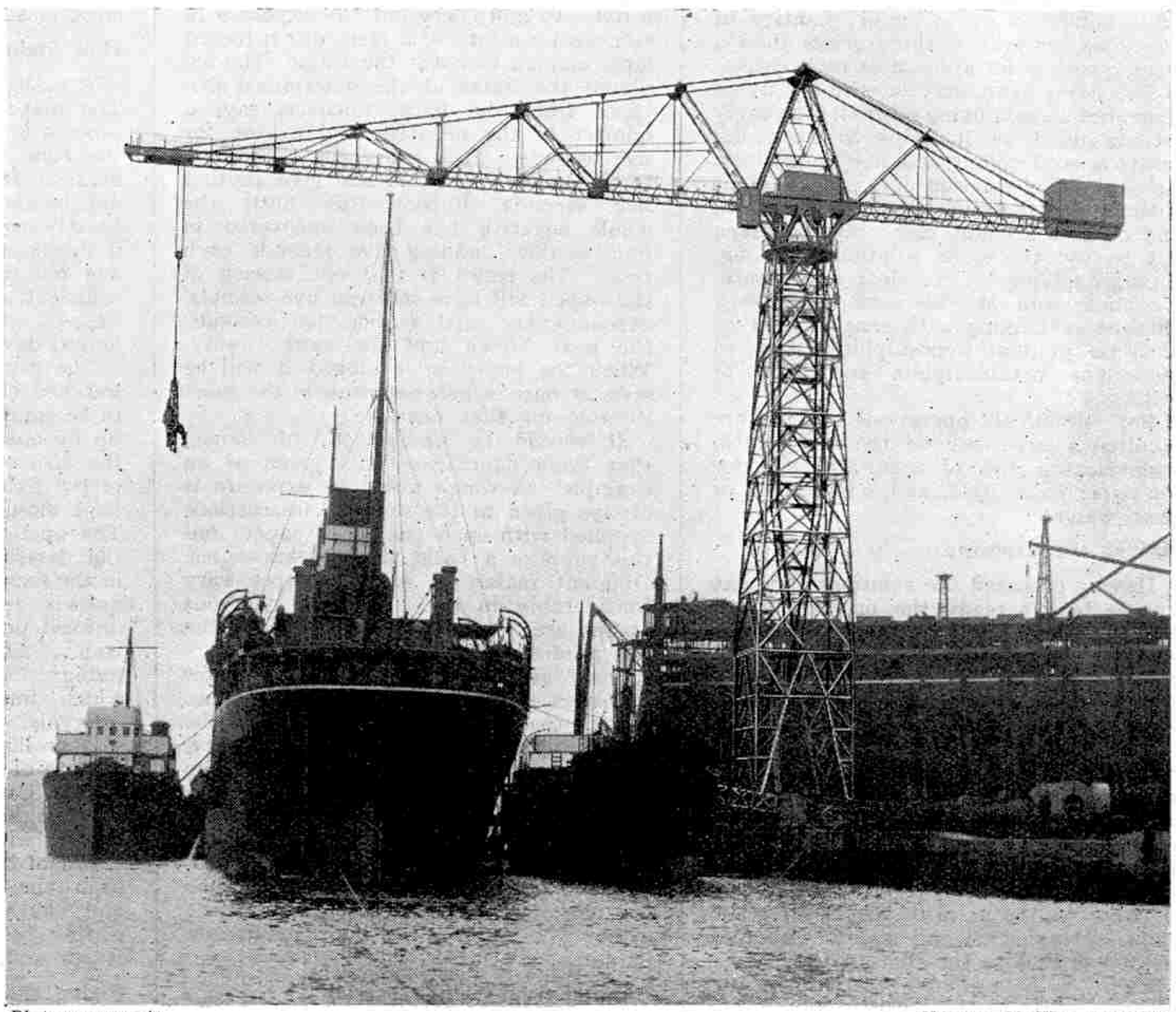


Photo courtesy of] [*Messrs. Sir Wm. Arrol Ltd.*

Our illustration shows a fine radial crane of the hammer-head type at the works at the Hebburn Shipyard of Messrs. Hawthorne Leslie & Co. Ltd. on the Tyne

It is interesting to note that in the background — that is behind the crane —a large ship is being built, as may be clearly seen from our illustration. Away to the right of the illustration is a dry dock 460 ft. in length.

British-Made Fretwork Tools and Materials

The 1926 catalogue issued by Messrs. Hobbies Ltd., is an exceptionally fine production, and it even surpasses the high standard of this firm's previous catalogues. Every variety of tools and accessories for fretwork is listed and shown. In addition, tools and appliances for all kinds of woodwork are included and the amateur carpenter or picture framer will find everything he can possibly desire. The requirements of those who desire to do their own French polishing are not forgotten, and soldering outfits form another interesting feature.

The catalogue, which is printed and illustrated in excellent style, will be sent post free for 1/- to any reader mentioning the "*M.M.*"

Photographic Handbook

A Photographic Handbook that will be of considerable interest to our photographic readers, especially those who have only recently taken up the hobby, has come to hand from Messrs. Agfa. The handbook is in two portions. The first deals with different processes of photography, ranging from a simple description of how a camera works, through the processes of exposure, development and printing, to valuable hints on how to avoid common faults. The second portion of the book is devoted to a full description of the range of Agfa products, the excellence of which is well known. The handbook may be obtained from any photographic dealer or from Messrs. Agfa, 240, High Holborn, London, W.C. at the price of 1/-, and readers are advised to mention the "*M.M.*" in applying for a copy.

Scale Model Steam Locos

We have received from Messrs. Bassett-Lowke Ltd., of Northampton, an interesting booklet describing nine new scale model locomotives of No. 0 (1¼ in.) gauge. These locos are of the 2-6-0 mixed traffic type, and may be used with every satisfaction for either goods or passenger purposes. The steam models are substantially built with the well-known Bassett-Lowke accuracy and finish, and they appear to represent almost the last word in efficiency in this small gauge. The locos may be obtained also in clockwork and electric types, the outward appearance in each case being the same. The interesting and well-illustrated booklet describing these models will be sent post free to any reader who applies mentioning the "*M.M.*"

"King George" Stamps

A useful list of Mint King George Colonial Stamps is issued by H. Lindsey (27a, The Square, G.P.O. Box No. 10, St. Annes-on-the-Sea). These stamps, which are reasonably priced, are of great interest and we recommend the stamp enthusiasts among our readers to obtain a copy of the list for themselves.

Ordering Meccano Parts

Several dealers have recently written to us suggesting that it would be a good idea to mention in the "*M.M.*" that from the dealers' point of view much time is wasted by boys asking for Meccano Parts by their name rather than by their number.

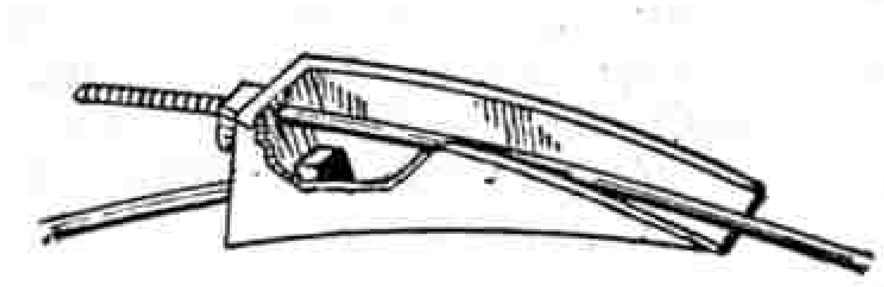
It is so much easier for an assistant to identify a Meccano Part by its number than by its name, that we feel sure we have only to suggest to our readers that they can save Meccano dealers a great deal of trouble by adopting the suggestion.

It is not every dealer or his assistant who knows the names of Meccano Parts so thoroughly as do our readers, and in most cases the parts are stocked under numbers so that by asking for the parts by number or ordering them by number if the order is sent by post, a great deal of time will be saved.

Water-Pipes of Wood

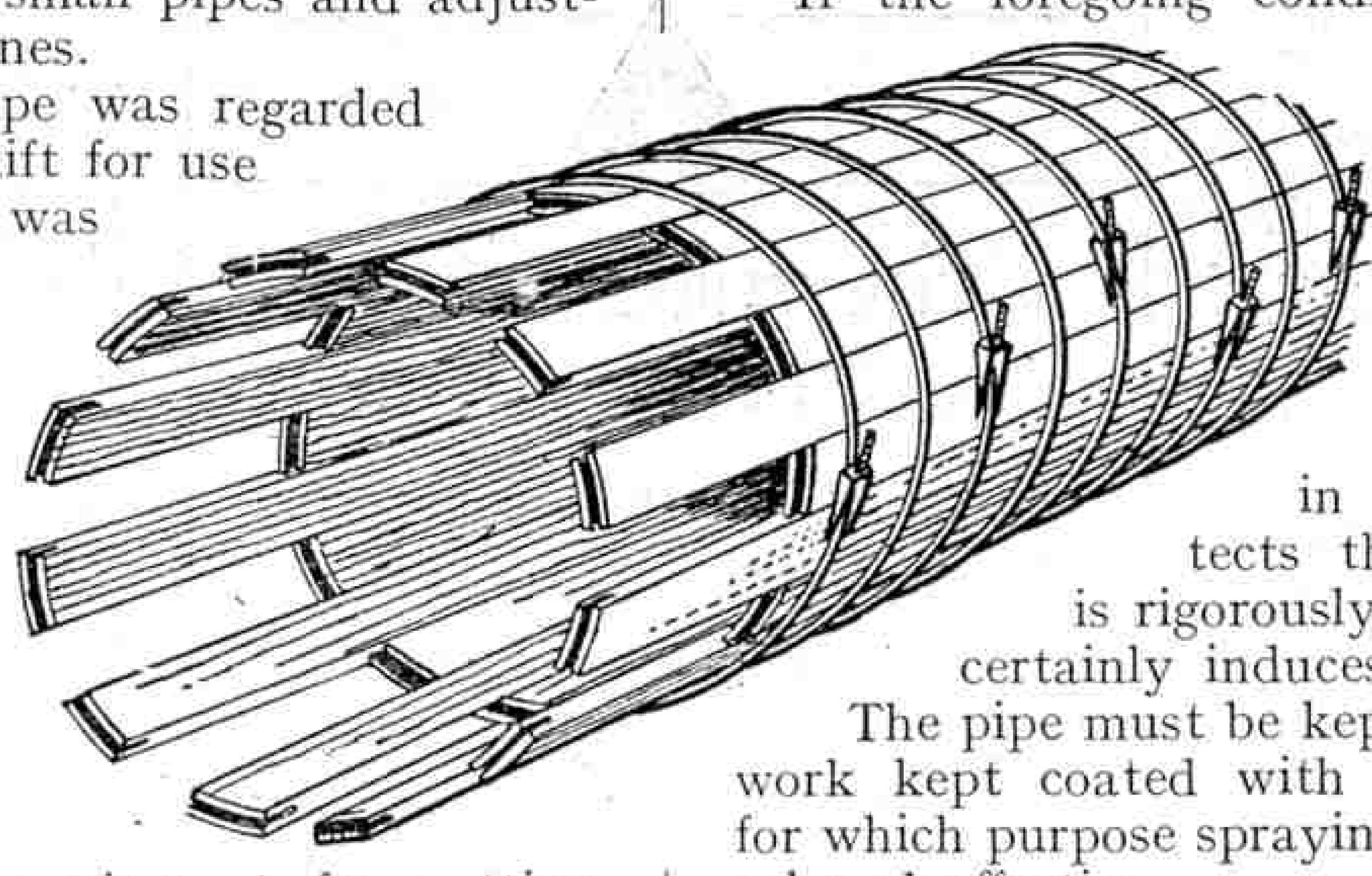
An Ancient Practice Adapted to Modern Requirements

THE use of wood for water-pipes is of great antiquity, and in this connection hollowed trunks of trees appear to have figured in very early times. In American cities wooden water mains of more recent date are frequently unearthed. In the city of Boston, for instance, bored wooden pipes appear to have been laid in the year 1650 and to have remained in use for 200 years. Several lengths were installed in New York as far back as 1793. It is on record that in London a water company used bored logs in 1619, and these pipes also appear to have done service for some 200 years.



These early pipes, being merely bored logs, were strictly limited in diameter, but the fact that they were constantly saturated affected their preservation for very long periods. For the most part their strength depended upon the thickness of the shell, and it is only comparatively recently that metal reinforcement has been introduced, followed by the modern wire reinforcement for small pipes and adjustable screwed bands for larger ones.

For some 50 years wood pipe was regarded mainly as a convenient makeshift for use in localities where timber was plentiful, but such pipe is now manufactured to a considerable extent, chiefly in connection with water power schemes.



Advantages of Stave Pipe

Wood stave pipe possesses many advantages when suitable timber can be obtained locally. The sections, in the form of planks or staves, are comparatively light, and the equipment for cutting and grooving is simple and readily erected in any convenient situation. Further, the pipe itself is simple to construct.

Suitably designed and constructed, it is sufficiently strong for quite heavy pressure work. Curves, both vertical and horizontal, are easily effected, and above all it is non-corrodible. Moreover it is often considerably cheaper than iron or steel, and it compares very favourably in this respect with concrete.

The staves of wood are milled with their outer and inner surfaces conforming to the cylindrical bore and surface of the pipe. The butting edges are radial. Along one edge a triangular grooved tongue is cut and this fits into a corresponding triangular groove along the other edge. This prevents internal projection and also prevents leakage.

Method of Construction

The staves are cut in random lengths with square ends. The joints between the stave ends are made by means of small steel tongues fitted into grooves, and the staves are held together by steel bands.

The general method of construction of a modern wood stave pipe is shown in the accompanying figure, for which (and for much of our information on the subject) we are indebted to "*The Engineer*." The bands employed are usually round steel rods of a tensile strength of 60,000 lb. per square inch and each band is tightened and held in place by a coupling shoe as shown in detail in the diagram. For diameters up to 24 in. wood stave pipe is often factory-made in lengths and wound with wire made of high-grade open hearth steel, galvanised. The wire is wound on the pipe under tension, which compresses the staves.

Durability of Wooden Pipes

One of the essentials to durability of a stave pipe is that it shall be always full of water under at least some pressure. Any drying out is bound to cause leaks, and frequent dryings will result in rot.

If the foregoing condition is fulfilled the internal surface of the pipe does not rot or abrade, and any thin deposit of slime adds to rather than detracts from the carrying power, by lessening resistance.

Creosoting is generally to be recommended. Burying in sand or clean gravel protects the pipe, but partial burying is rigorously guarded against as it almost certainly induces rot.

The pipe must be kept clear of earth and the metal work kept coated with some anti-corrosive solution, for which purpose spraying with creosote oil is economical and effective.

Timber Used

In America, where wood stave pipe is used to a considerable extent, the material employed in the manufacture of the pipe is confined to two timbers, Californian redwood and Oregon or B.C. Douglas fir. The latter is mainly used in Canada on account of the high cost of the former, and it is excellent for the purpose as it possesses considerable strength and is obtainable in long straight lengths. The thickness of the staves is determined by the strength required. There must be sufficient thickness of shell to resist any tendency to go out of shape under pressure, but on the other hand the thickness must not exceed the limit of saturation under pressure.

The question as to whether wood stave pipe is to be installed in preference to iron, steel or concrete is largely one that must be decided by local considerations. If the local conditions are good and the cost is favourable, wood pipe, if properly constructed and maintained with reasonable care, may be regarded as a sound engineering proposition.

The Meccano Guild

A Great Fellowship of Boys

President: Mr. Frank Hornby, Inventor of Meccano.

What the Guild Means The Meccano Guild is an organisation for boys, started at the request of boys, and conducted as far as possible by boys. In joining the Guild a Meccano boy becomes a member of a great brotherhood of world-wide extent, every member of which has promised to observe its three great objects ; wherever he happens to be—even in strange countries—he will know he has met a friend whenever he sees the little triangular badge. The Meccano Guild is bringing together Meccano boys all over the world, and is helping them to get the very best out of life.

How it Commenced More than a million boys in Great Britain derive their greatest indoor pleasure from Meccano. Before the Guild was formed, hundreds of these Meccano boys wrote to us every week. They told us how they wished they could be put into communication with other Meccano boys and how they longed to be able to meet them. They asked if arrangements could be made so that their wishes might become an accomplished fact. We responded to their repeated and increasingly numerous appeals, and as a result the Meccano Guild came into being.

Why You Should Join Every Meccano boy should be a member of the Meccano Guild. All who have studied its objects must agree that the Guild cannot fail to have a profound effect for good on the lives of its members. It is ready to be of service to each individual member—to help or give advice whenever requested. At the head—guiding and controlling, and taking a personal interest in this great movement—is the President, Mr. Frank Hornby, Inventor of Meccano and Managing Director of Meccano Limited.

The Headquarters of the Meccano Guild are at the Head Offices of Meccano Ltd., Binns Road, Liverpool.

THE GUILD RECRUITING CAMPAIGN

Every Meccano boy should become a member of the Guild and do his utmost to help to make the objects of the Guild widely known. With this end in view, a special medallion is presented to each member of the Guild who obtains three new recruits. As a mark of further merit the medallion is engraved with the name of the recipient and with the words "Special Award" when six more members are recruited. Full particulars of the Recruiting Campaign, together with a supply of application forms, will be sent on request.

HOW TO BECOME A MEMBER

Membership of the Guild is open to every boy possessing a Meccano Outfit, or Hornby Train Set, who satisfactorily fills in the prescribed application form. The only conditions are that members promise to observe the objects of the Guild and to wear their badges on all possible occasions.

The price of the Guild membership badge is 7d. post free in the United Kingdom, but members abroad will be required to pay 5d. extra for registered postage. A remittance for the necessary amount should be sent along with the form of application. The Guild badge is beautifully enamelled in blue and white and is made for wearing in the lapel of the coat. Any boy wearing the Guild Badge is at once recognised by other Meccano boys as being a member of the Guild and one who has undertaken to live a clean, truthful and upright life.

In addition to the badge, each member receives a membership certificate, measuring $7'' \times 9\frac{1}{2}''$. This certificate is printed in orange and sepia and is a smaller edition of the large club certificate.

Write to the Secretary of the Meccano Guild, Binns Road, Liverpool, asking for an application form and full particulars. Then fill in the form and return it to Headquarters, when you will be enrolled and your badge and certificate will be sent to you. Write to-day, and put M.N. after your name for reference.

The Secretary receives hundreds of letters every week from members all over the world and he hopes that new members will also write to him as often as possible.

BADGE OF MEMBERSHIP.

THE THREE GREAT OBJECTS OF THE GUILD

(1) To make every boy's life brighter and happier.

(2) To foster clean-mindedness, truthfulness, ambition, and initiative in boys.

(3) To encourage boys in the pursuit of their studies and hobbies, and especially in the development of their knowledge of mechanical and engineering principles.

MECCANO CLUBS

Meccano Clubs are founded and established by enthusiastic Meccano boys under the guidance of the Guild Secretary at Headquarters. At the present time there are over 100 affiliated clubs in various towns and villages in this country and abroad, together with a much larger number not yet affiliated. Each club has its Leader, Secretary, Treasurer and other Officials, all of whom, with the exception of the Leader, are boys. If the nearest club to you is too far away for you to join, or if you are unable to join for any other reason, consider the possibility of forming a new club in your own district. A special booklet explaining "How to run a Meccano Club" is now ready, and will be sent to any reader (post free) on receipt of 2d. in stamps.

AFFILIATION WITH THE GUILD

When a Meccano Club has been successfully launched and good progress is being made, affiliation with the Guild is granted. A beautiful club certificate, suitable for framing and hanging in the club-room, is presented, and the club becomes entitled to such privileges as the loan of interesting lectures and club membership cards. All members of the Guild are eligible for the Merit Medallion, which is awarded to members who display special ability in connection with club work, or in helping the Guild.

THE CORRESPONDENCE CLUB

Members of the Guild are able to join the Correspondence Club, by which they are placed in communication with other Guild members in some other part of the country or abroad. To those boys who are interested in foreign languages the Correspondence Club presents a splendid opportunity of obtaining a correspondent in the particular country in the language of which they are interested. They are able to write to a Meccano boy in his native language, and as he would probably reply in English, the correspondence will be of mutual benefit. Stamp collectors also find the Club of value, as they are enabled to exchange stamps with their correspondents. Full particulars and enrolment form will be sent on application.

The Secretary's Notes

At this period of the year, when the majority of Meccano clubs have completed their preparations for the first Winter Session and have settled down to steady work, it is interesting to look back over previous years and note the various changes that have come about.

A Sign of the Times

One of the most noticeable of these changes concerns club management and organisation. Whereas in the old days clubs had only a Leader and a secretary, upon whom devolved practically the whole task of organising the work and maintaining enthusiasm, to-day the majority of clubs have one or more committees. I look upon this as a step in the right direction. Even in a comparatively small club a committee of, say, three members may be of the greatest possible service. A committee obviously takes a considerable amount of responsibility and worry from the shoulders of the Leader and the secretary, and it causes a widening of interest throughout the club. The members of the committee are elected at a general meeting of all the members of the club, for a period of one session or longer as may be agreed upon. As soon as a member is elected he feels a new sense of interest in the club because he now carries some responsibility.

How a Club was Saved

It is almost impossible to over-estimate the value of a small but enthusiastic committee, working hand in hand with the Leader and the secretary. I remember a case where a club's membership began to fall off owing to various causes, and gradually matters became so bad that the Leader wrote to me saying that he had done his best, but that it was quite hopeless to carry on and that he intended to close down the club. I replied: "Don't give up yet, appoint a committee of three of your members who still remain loyal to the club and with their help make a final effort." This scheme was tried and proved successful. What the Leader could not do alone he succeeded in doing when his efforts were backed up by the enthusiasm and hard work of his committee.

Planning an Exhibition

From the reports to hand it is evident that most clubs are planning an exhibition of some kind for the end of the session. In some cases the intention is for the club to run the whole exhibition itself, while in others the exhibit is to take the form of a stall at some local exhibition or bazaar. In either case a good deal of careful thought should be given to the project. In the past there has been a tendency for club exhibits to consist of a miscellaneous collection of Meccano models in addition to a more or less elaborate Hornby Train layout. An arrangement of this kind is, of course, quite interesting, but it loses a great deal by reason of its lack of co-ordination. I should like clubs to consider the possibility of working out a complete scheme for their exhibit so that every model on view is playing its part in producing the general effect. I strongly recommend clubs to decide upon the best railway layout their resources will allow, and then to build a series of models that can be operated in conjunction with the railway. Hornby Trains running round and round a long track look very effective, but the effect is increased enormously if, along with the trains, are operated cranes of various kinds loading wagons with miniature sacks or other small articles. For this purpose almost all the larger crane models are suitable, and a large model of a warehouse with a lift to the different floors may be added with great advantage. A long telpher span also may be worked in very successfully and never fails to attract attention. I know from long experience that nothing catches the eye of visitors to exhibitions, bazaars, etc., more quickly than a combined Meccano and Hornby Train exhibit every part of which is alive and working. The details of a layout of this kind must be decided by each club for itself, but I hope that I have said sufficient to indicate the lines on which such a scheme may be effectively carried out.

Club Groups

Once more I appeal to Club Leaders to have their members photographed from time to time, and to send me a copy of each photograph. I am very anxious to continue to publish each month a photograph of a club as a whole or of a football or other section of it, but in order to do this I must receive a steady supply of such photographs. I suppose few clubs have not had a group taken at some time or other, but many of them appear to think that these are not of sufficient interest to send to me. This is a great mistake. I am always very glad to receive any photographs connected with Meccano clubs, whether of the members or of some particular model they may have made. I hope that during the present session every Meccano club that has not already done so will have a group taken, and send me a copy of it. Photographs of this kind form a very valuable record for the club concerned, and as the years go on and the membership gradually changes this record becomes of ever-increasing interest. Similarly a series of photographs of the bigger models made by the club serves as a record of what has been done and also as a stimulus to do even better work in the future.

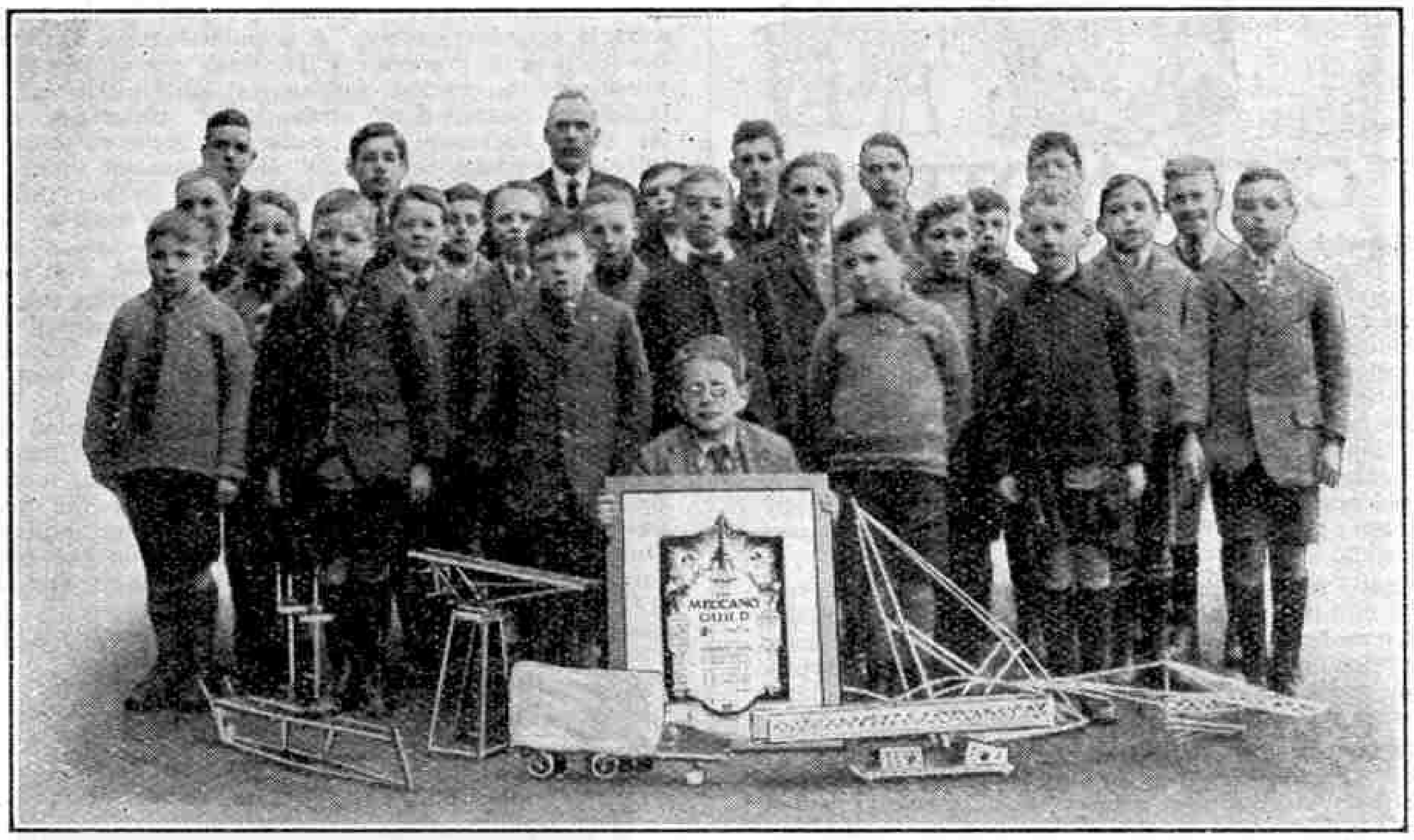
The Merit Medallions

During the past few months the President has had his attention drawn to the fact that certain members living in out-of-the-way places, where the formation of a club is practically impossible, are yet carrying out really excellent work for the Guild. In the past the Merit Medallions have been available to club members only, but the President has now decided that a special Merit Medallion may be won by any member of the Guild who does something of real value towards increasing the strength of the Guild either in membership or influence.

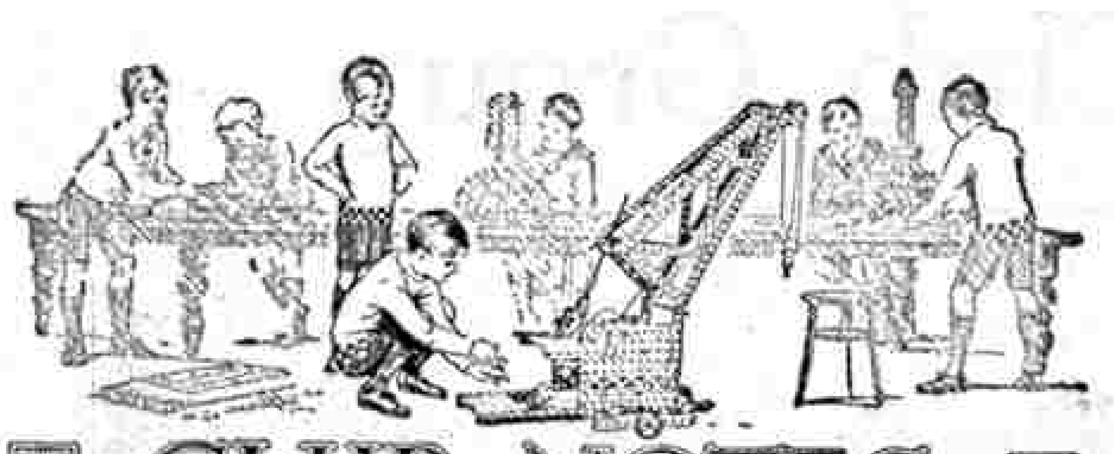
Inter-Club Visits

The practice of clubs exchanging friendly visits is gradually increasing, but there appears to be a tendency for such inter-club communication to be confined to the summer months. This is a pity, and I should like all clubs to consider the possibility of some exchange of courtesies with one or more clubs within reach of them.

A Scottish Club Group



Our photograph shows a group of the members of Chalmers Church Meccano Club, Alloa, which was affiliated with the Guild in December, 1924. At the back is Mr. John Meins, the Leader, to whose enthusiastic guidance the members are greatly indebted. A successful exhibition has already been held, and though structural alterations to the clubroom have delayed the start of the winter session, another active season is confidently anticipated.



CLUB NOTES

Harwich M.C.—A successful display of Meccano and Hornby models was organised at the local Horticultural Show. At the meeting for election of the committee, candidates were required to make speeches explaining their intentions if elected, and then followed a ballot. The session programme includes Drawing, Painting, and art generally, a section for Raffia work, manufacture of lead soldiers, etc., for the next Exhibition, and also a Fretwork section. The clubroom is equipped with reading tables on which are to be found magazines and technical books. Club roll : 37. *Secretary* : A. E. Ward, Osborne House, Pepys Street, Harwich.

Louth M.C.—Regular weekly meetings have been held, and it is proposed to hold an exhibition of models in December on the occasion of the local Church Bazaar. A system of honorary membership has been adopted with great success. *Secretary* : H. Bell, 10, Dyas Terrace, Charles Street, Louth, Lincs.

Newcastle-on-Tyne M.C.—Is busy preparing for the forthcoming Annual Exhibition and Sale of Work. Members are building a large model railway system, and for this eight steam locomotives are being constructed in the club's workshop. Two football elevens, Senior and Junior, have been formed, and it is hoped to have a successful season, including matches with the Stockton and Brancepeth M.C.'s. Club roll : 49. Average attendance : 47. *Secretary* : Harry Levin, 8, Windsor Street, Wallsend-on-Tyne.

Reading M.C.—It has been decided to hold a big Exhibition and Entertainment to wind up the First Winter Session. The Meccano Lecture, "The Story of the Motor Car," was read and greatly appreciated. Club roll : 43. *Secretary* : D. G. M. Wheeler, 72, Pell Street, Reading.

Victoria (Glasgow) M.C.—Commences its fourth Winter Session with a balance of about £5. Advantage will be taken of the offer of the London Underground Railways to loan two Lantern Lectures, one dealing with the Tube Railways and the other with the London Buses, and these should prove very entertaining (conditions of loan may be had from the Press Agent, 55, Broadway, Westminster, S.W.1.) A Leader has been secured. Club roll : 40. *Secretary* : Robert White, 22, George Street, Scotstoun, Glasgow.

St. Mark's M.C.—At the first meeting of the Winter session the new President, The Rev. T. H. Edwards, and the Vice-President, Mr. Wase, spoke and assured the club of their interest and support. The first instalment of books for the Club Library, kindly presented by the President, were displayed. Club roll : 22. *Secretary* : G. C. Green, 21, Hafton Road, Catford, S.E.6.

Accrington M.C.—The session opened with a lecture by the President. Following this was a Model-building evening, a splendid model of a locomotive being the outstanding feature. Club roll : 27. Average attendance : 17. *Secretary* : B. Waterhouse, 45, Ramsbottom Street, Accrington.

Maryfield M.C.—Arrangements have been made to hold a special Anniversary Evening with a large display of models. Mr. W. S. Johnston has been appointed Deputy-Leader. A football club has been inaugurated and matches have already been played. *Secretary* : Stanley Smith, 14, Maryfield Terrace, Dundee.

1st Herne Bay M.C.—At the second annual Autumn Exhibition of the local Horticultural and Industrial Society the club had a stall which was much larger than those at previous Shows. A fine display was arranged, and a large model lent by Headquarters was greatly admired. Several members won prizes and the Judge of Meccano classes generously gave a special consolation prize to every model-building competitor. The club's Fretwork class contributed towards the display and won several prizes. Favourable comments were made by the local press and the Hornby Trains on view were a constant delight to visitors. Several new members were secured. Club roll : 33. *Secretary* : C. W. Russell, 4 Clifton Villas, Herne Bay.

Blagdon St. Andrew's M.C.—At a recent Fête there was a special event for the members of the club. A Recruiting Campaign is in progress. A Football Team has been started and it is hoped that a second team will also be arranged. The membership is now extended to include girls. Club roll : 20. *Secretary* : Miss K. R. Day, "Seymour Arms" Hotel, Blagdon, nr. Bristol.

Claygate M.C.—Several members of the Girls' Section are corresponding through the Guild with Meccano girls in a South African Meccano Club. The Winter programme includes Model Engineering, Carpentry and, for the Girls' Section, Needlework and Knitting. A Sunday meeting has been instituted and is proving very acceptable to members. Club roll : 65. Average attendance : 50. *Leader* : Mr. J. W. Haynes, "Fontmell," Covers Road, Claygate, Surrey.

South Africa

Durban M.C.—Continues to flourish and to increase in membership and in range of activities. The Mayor of Durban (Mr. T. M. Wadley) has been elected President for the ensuing year. The report of the year's work is very interesting. A popular feature has been the lectures of Professor J. H. Neal, one of the Vice-Presidents, on various mechanical matters, including building construction, strength of materials, etc. Mr. G. E. Patterson, the Leader, has lectured successfully on various topics and also arranged visits to various factories and works and to the Durban Industrial Exhibition. The club had a large stall at the Exhibition of the Motor Traders' Association and this was visited by H.R.H. Princess Alice, who congratulated the boys on their display. A floating trophy in the form of a silver cup has been presented by Messrs. Harvey, Greenacre & Co. Ltd., of Durban, to be held for a year by the boy who is the best in attendance, conduct, sportsmanship, etc. The winner for 1924-5 is R. M. Stevens who obtained the full 500 marks, the next boy to him, A. Alltman, with 494 marks, being awarded a silver medal with a gold centre. Another striking success of the year was the camp held during the Michaelmas holidays. Club roll : 110. Average attendance : 88 per cent. *Joint Secretaries* : S. H. White and L. Connett, Durban M.C., Natal Technical College, S. Africa.

Meccano Club Leaders
No. 23. Mr. F. C. Taylor

Mr. F. C. Taylor is leader of the Blagdon St. Andrew's Meccano Club which was affiliated with the Guild in May of the present year. Mr. Taylor now lives in retirement after many years' service in the Birmingham City Police, and devotes much of his time to local affairs. In addition to his connection with the Meccano Club, Mr. Taylor is a Founder of the Blagdon Thrift Society and Vice-President of the local Football and Cricket Clubs.

St. Andrew's M.C. has an enthusiastic membership of over twenty, including girls, and is one of the most popular and efficient clubs in the West of England.

Meads M.C.—Is preparing for a concert in November. The headquarters are to be in the new Parish Hall. Club roll : 20. *Secretary* : A. A. Moore, 7, Rodmill Road, Eastbourne.

Great Baddow M.C.—Has a balance in hand of £3 18s. 0d. A Whist Drive is to be held with a view to raising funds to purchase a new Meccano outfit for Club use. Club roll : 15. *Secretary* : J. Boreham, Post Office, Baddow Road, Chelmsford, Essex.

Holy Trinity (Blackburn) M.C.—All members took part in a Recruiting Campaign during September. The Football Team continues to make good progress. Club roll : 35. *Secretary* : T. Donald, 6, Camden Street, Blackburn, Lancs.

Bures M.C.—Is fortunate in securing as its first President Mr. John Garrard of Brook House. Among the interesting features of the club's recent Exhibition of Models was an extensive Hornby Train system arranged by C. Bays. An Aeroplane driven by a Meccano Clockwork Motor also attracted great attention, while the club secretary operated a Wireless Transmitting Station which worked a four-valve wireless set fitted with loud speaker. The newly-formed Football Team is fixing up interesting matches with other clubs. Club roll : 12. Average attendance : 10. *Secretary* : J. C. Deaves, Radio House, The Croft, Bures, Suffolk.

Holy Trinity (Barnsbury) M.C.—Members have been busily occupied in preparing for their Exhibition, of which we hope to give an account next month. The Club has purchased a Cinema Projector by Pathé of France for club use and with it a camera to take films of future club outings, etc. The resignation of the secretary, S. Bone, is very much regretted by all. His successor is Robert Clark. The syllabus for the session includes Talks on Railways, and on various models, a joint Concert with the Holy Trinity Radio Club, a stall at the annual Church Sale of Work, Lectures by members and various Competitions, sectional and otherwise. The last half-hour of every meeting, except on special occasions, is devoted to games. Club roll : 30. *Secretary* : Robert Clark, 77, Richmond Road, Barnsbury, N.1.

Unaffiliated Clubs

Eagle (Enfield) M.C.—Was formed in June under the Leadership of Mr. F. Kebbell, and members are looking forward to affiliation with the Guild. Club roll : 10. *Secretary* : H. J. Simmons, 75, Fotheringham Road, Enfield, Middlesex.

Seestu (Paisley) M.C.—Members meet regularly in their clubroom at Paisley Y.M.C.A. The programme for the session includes visits to the local Observatory and Fire Station, and several evenings devoted to Model-building. There is a balance in hand of £1 7s. 0d. Club roll : 15. *Secretary* : Wm. Robertson, 1, Kerr Street, Paisley.

Royal Grammar School (High Wycombe) M.C.—The membership is increasing steadily. There are Meccano, Photographic, Fretwork and other sections. Lectures are delivered to the whole club at alternate meetings. Members pay an annual subscription of 2/6. Affiliation with the Guild has been applied for. Club roll : 60. *Leader* : Mr. G. A. Grant, Royal Grammar School, High Wycombe, Bucks.

Uppingham M.C.—Is making steady progress. It is proposed to hold an Exhibition very soon. Club roll : 14. *Secretary* : S. J. Riches, High Street, Uppingham, Rutland.

Southport M.C.—Continues to make satisfactory progress and hopes to be affiliated soon. Stamp Meetings are a feature and there have been two good Lectures on Motors. Arrangements have been made to meet on Fridays in the future. Club roll : 10. *Secretary* : E. Williamson, 10, Delamere Road, Ainsdale.

St. John's (Sevenoaks) M.C.—Since 30th January 1925, 30 meetings have been held and the standard of attendance has been well maintained. During the summer a visit of inspection was paid to the local Gas Works. *Secretary* : S. Williams, 20, Greatness Lane, Sevenoaks, Kent.

Mansfield (Notts.) M.C.—Has its own library and is shortly to start a Magazine, while a most comfortable club room has been secured. The recent Exhibition was a pronounced success and has encouraged the members greatly. A large Hornby Train System was laid out, and the display of rolling stock and accessories was very complete. The Meccano models on view included a Suspension Bridge, Electric Tram, Signals, and Big Wheel. There were also refreshment tables and a jumble stall, and the attendance was highly satisfactory. Club roll : 20. *Secretary* : H. R. Wright, "Rotherwood," Marlborough Terrace, Mansfield, Notts.

Amsterdam M.C.—H. N. Van der Sluys, a keen Meccano enthusiast, has succeeded in forming a club in Amsterdam. Many boys have joined, and it is anticipated that a suitable clubroom will be found very shortly. *Secretary* : W. van Mastrigt, c/o M. H. Trompstraat 29, Amsterdam, Holland.

Diss (Norfolk) M.C.—Now has a good clubroom and an interesting programme arranged for the winter session. Meetings take place on Saturdays under the leadership of Mrs. D. M. Maling. Affiliation has been applied for. Club roll : 11. *Secretary* : John J. Maling, 15, Heywood Road, Diss, Norfolk.

Proposed Clubs

Worcester.—There is a movement on foot to start a Meccano Club in Worcester. Enthusiasts in the city or district should apply to R. G. Price, 36, Sansome Walk, Worcester.

Colne (Lancashire).—Mr. James N. Rushton, 205, Skipton Road, Colne, is inaugurating a club in Colne, and several enthusiasts have already decided to join. Mr. Rushton has had extensive experience in club organization work, and prospective members should apply to him at the above address.

Kilmacolm (Renfrew).—Guild members or others interested in the formation of a club in this district are invited to apply to G. D. Howard, St. Oswald's, Kilmacolm, Renfrew.

Putney, S.W.15.—It has been decided to form a club in Putney for the new session. The many Guild members residing in this area of London should make a note of the founder's address : F. C. Burland, 229, Putney Bridge Road, London, S.W.15.

Hoylake M.C.—An effort is being made to form a Meccano Club in Hoylake and all boys wishing to join should communicate with J. L. T. Young, 86, Market Street, Hoylake.

Story of Metals—*(continued from page 583)*

must be about 28 per cent. larger in diameter in order to have the same resistance per foot as that of copper wire. In spite of this larger diameter the aluminium wire would weigh only about half as much as the copper wire, and above all would be considerably cheaper. It is for these reasons that aluminium has been used for large electrical conductors such as the busbars in generating stations.

Another important application of aluminium in the electrical industry is for conductors for overhead transmission lines. The transmission of electric power over very long distances, as much as 400 miles at a stretch, is now an important branch of electrical engineering, and for this purpose pressure of as much as 220,000 volts are employed. The conductors are stretched between supports, which are often high steel towers spaced apart by amounts up to 1,000 ft., and it will be appreciated that great strength is desirable as well as good electrical conductivity. Plain aluminium has been used for the purpose, but the smaller strength of this in comparison with copper is a disadvantage when the span between supports is long, and though the cheapness of aluminium enabled it to be used in place of copper there was a need for some means of increasing the strength. Alloying was tried and the conductors were made up with alloy wires, but this was not very successful for various reasons, among which was the fact that the addition of an alloying constituent reduced the electrical conductivity.

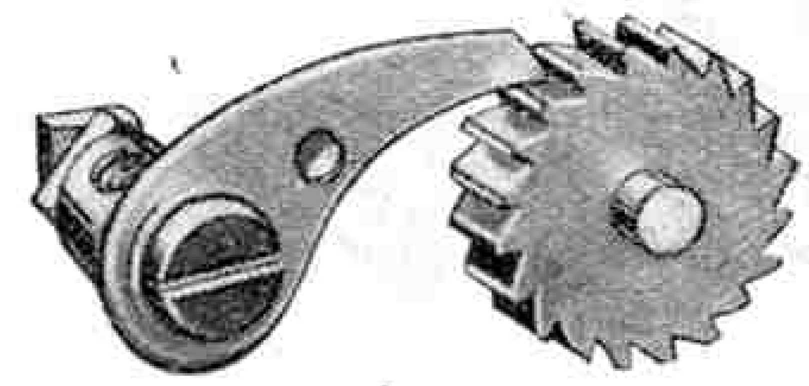
Steel-Cored Cable

The problem was solved by the invention of a special type of conductor which combines within itself the strength of high tensile steel with the electrical conductivity of aluminium. This type of conductor, known as steel-cored aluminium, is made by stranding aluminium wires around a central steel core, and many exhaustive tests have shown that, in spite of the wide difference in the physical properties of steel and aluminium, such a composite conductor behaves exactly as though it were made of some new material having physical properties intermediate between those of aluminium and steel.

The breaking load of a steel-cored cable is only a little less than the sum of the breaking loads of all the wires added together. Taking a copper and a steel-cored aluminium conductor of equal resistance per foot, the ratio of strengths is of the order of 1 for copper to 1.6 for steel-cored aluminium. At the same time the addition of the steel has not resulted in a complete sacrifice of the lightness of aluminium, for the composite conductor is still about 20 per cent. lighter than the equivalent copper. Moreover, the cost is still appreciably smaller.

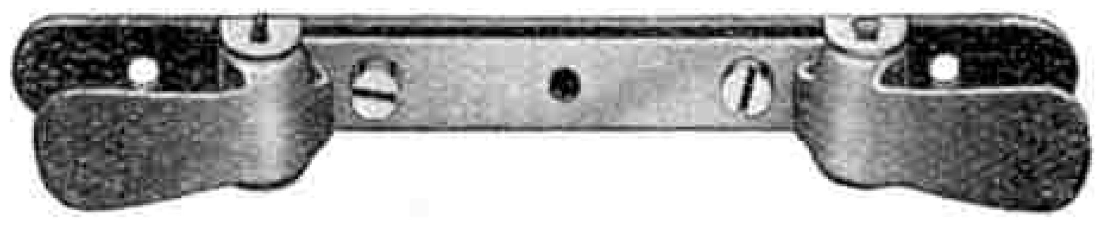
These various features are of the utmost importance to the transmission engineer and in practically every particular steel-cored aluminium is superior to copper for this purpose. Such conductors have now been in use for a sufficiently long time to prove that they are in every way as reliable as copper, and that there is no foundation whatsoever for the fears expressed, when the construction was originally introduced, that difficulty would arise due to corrosion of the steel-core or to unsatisfactory jointing. Steel-cored aluminium is now being employed for the longest transmission lines in the world.

New Meccano Parts



Pawl and Ratchet Gear

No.		Price. s. d.
147.	Pawls, with pivot bolt and nuts ... ... each	0 3
147a.	Pawls ... ... ,,	0 2
147b.	Pivot bolts with two nuts ,,	0 2
148.	Ratchet Wheels ... ,,	0 9



Collecting Shoe for Electric Locos

With spring-controlled brass contact pieces hinged to fibre base. The shoe is designed to pick up current from a centre "live" rail, and may be bolted to any Meccano model.

Part No. 149, Price 1/6 each.

On exposure to the atmosphere aluminium becomes coated instantly with a thin transparent film of oxide. This film prevents further action, and if it is removed it is instantly replaced. About 20 years ago it was shown that this film of oxide would withstand a pressure of half a volt and it was found that this automatic insulation made it possible to wind magnet coils with bare aluminium wire, provided some other insulation was used between the different layers of wire. In practice the film of oxide is usually strengthened artificially. One method of doing this consists of running the wire through sodium hydroxide solution as it is wound on to the coil and subsequently driving off the moisture by passing a current through the coil.

The film of oxide to which we have just referred is one of the main causes of the difficulty of soldering aluminium. It is not the only cause, however, another important one being the liability to galvanic action through which a joint that is quite sound at the time breaks down after a short period owing to internal electrolysis. At the same time aluminium can be soldered quite successfully by the use of a suitable solder combined with skilful manipulation.

"Thermit" Welding

Aluminium has a very powerful affinity for oxygen and this property is utilised as the basis of "Thermit" welding. "Thermit" is a mixture of finely granulated aluminium with iron oxide, and this, when ignited by a fuse such as a strip of magnesium ribbon, re-acts violently, producing iron and aluminium oxide at the intensely high temperature of 3,000° C. or thereabouts. The mass is reduced to a molten condition and separates out into two layers consisting of aluminium oxide and pure molten iron respectively.

When the "Thermit" process is to be used for welding rails a mould is placed round the parts to be welded and the molten metal is run through the mould until the parts fuse together. A permanent mechanical joint is thus formed, so that fish-plates may be dispensed with, and in the case of electric tram rails, there is no necessity for bonding wires. The "Thermit" process enables very remarkable and interesting operations to be carried out with perfect success.

A Useful Explosive

The high temperature that results when aluminium unites with oxygen is utilised in the explosive called ammonal, which is a mixture of aluminium powder with ammonium nitrate. This explosive is exceptionally safe to handle. If thrown on the fire it burns harmlessly away and it can only be fired by means of a suitable detonator. Ammonal has a further advantage that no harmful fumes are produced by its explosion, so that it is very suitable for use in mines.

Among the minor uses of aluminium may be mentioned its employment for spraying on to metal, wood, paper and various fabrics, so as to cover them with a thin metallic coating. In the form of extremely fine powder the metal is used as a paint and it is employed to a very great extent in the manufacture of "silver" powders. Further uses of aluminium are as a substitute for magnesium for flashlights, signal flares and fireworks, and in the form of foil as a wrapping material for certain perishable goods.

NEXT MONTH:—

THE STORY OF TIN

Massive Gear Wheels—
(continued from page 556)

type of gearing varying according to the individual requirements. They are not only made in the form of wheels with a flat face but are made as Double Helical Bevel Gears that are cut by the end mill process, which we shall endeavour to describe in some future article.

Ratios and Reduction

Single reduction gears are generally used for ratios up to 20 to 1. This form of gear is used wherever possible, because of its greater efficiency and general simplicity. Double reduction gearing with double helical wheels is more economical for ratios exceeding 20 to 1, except where very light loads are concerned. Double reduction gears, however, are made for ratios ranging from 12 to 1 upwards.

The full load efficiency of double reduction gears is about 96-97%, and for single reduction gears an efficiency of 98½% is usually obtained by gears made by The Power Plant Co. Ltd., who guarantee for their reduction gears a gain in efficiency of at least 15% over that of worm-gearing of equal load capacity and ratio.

The Manchester and District Model Railway Club

Meetings of this club are held on the second and fourth Tuesdays of each month during the Winter, at the Club's Headquarters, the Clarion Cafe, Market Street, Manchester, at 7.30 p.m. Readers of the "*M.M.*" who reside in the district are cordially invited to attend. In addition to meetings at Headquarters, the members visit locomotive sheds and other places of interest on Saturdays. Full particulars may be obtained from Mr. Archibald Dean, 29, Gorse Lane, Gorse Hill, Stretford, Manchester.

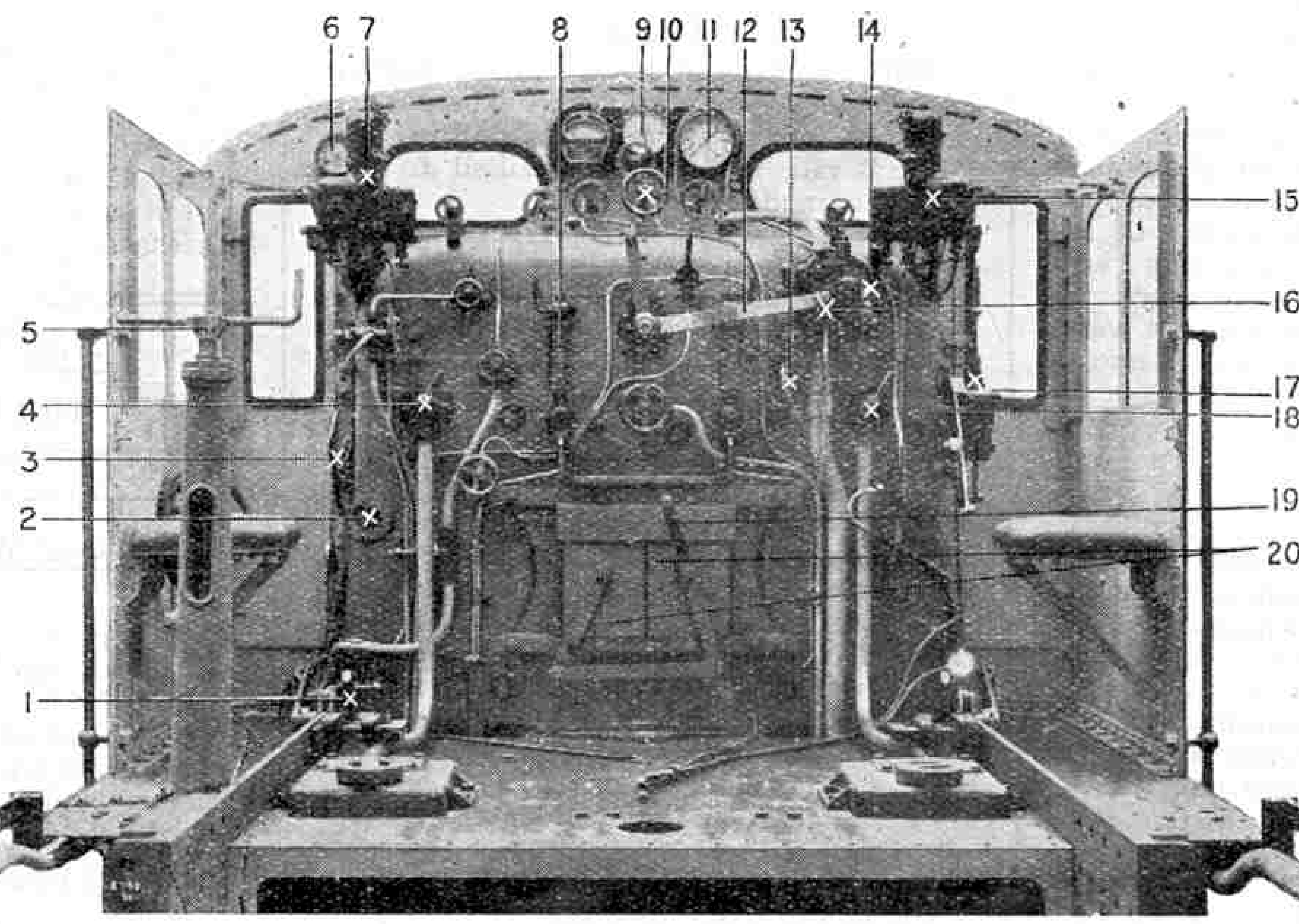
Competition Corner

Could you Handle a Real Loco?

A Chance to Test your Knowledge

WE suspect that most Meccano boys of every age have an ambition to drive a real locomotive. Many of them wrote to say that the annoying thing about a visit to Wembley, both last year and this, was the very short time they were allowed to stand on the footplate of one or other of the great locos exhibited there. At the same time they one and all agreed that it was a thrilling half-minute while they were driving, in imagination, the gleaming "Iron Horse."

This month's competition will make a direct appeal to all locomotive enthusiasts and we prophesy that few will be able to resist having a try at it! The accompanying photograph is of the footplate of a modern British-built locomotive, specially selected for the purpose of the competition in order to give an equal chance to all readers, no matter with which company's locomotives they are familiar. It will be observed that the roof and wooden floor-lining are not depicted, the photograph having been taken at the works of the builders. The footplate is arranged for right-hand driving.



In reproducing the photograph we have indicated by direction-lines and numbers some of the most important fittings and controls. Competitors are required to identify as many of these as possible, taking particular care in compiling their lists to give the correct number, starting from No. 1. All that is required is the name of the particular fitting or control, together with a brief note explaining its operation and purpose.

Prizes will be awarded to the readers who name the various fittings most accurately and show the best knowledge of their operation. We leave it to each competitor's honour not to accept any outside help in the preparation of his entry. Fathers and uncles may, of course, submit their own efforts under Section A, but must not assist other competitors.

The competition will be divided into Section "A" for those of 16 and over and Section "B" for those under 16. In both sections each of the numbered fittings must be named, but in Section B only 10 of them need have their operation described. Any 10 may be selected.

The prizes will be Hornby Trains or accessories to the value of £1/1/– and 10/6 for the best and second-best efforts in each section respectively. Six consolation prizes will also be awarded.

Lists and descriptions must be written on one side of the paper only, and the competitor's name, address and age must appear on the back of each sheet used. Competitors may submit more than one entry.

In the event of a tie, neatness will be taken into consideration.

Closing date, 30th November (Overseas, 31st March 1926).

11th Drawing Competition

The subject of our 11th Drawing Competition is a "Motor-boat." In all recent drawing contests no subjects have been more popular than those with a maritime interest—a passenger liner, a fishing-boat, or a man-of-war. With the splendid work submitted for these competitions still in mind, we are confident that this month's subject will be keenly taken up by our artist-readers.

The subject gives very wide scope to entrants, as there are so many types of these craft. In particular we hope to receive some good drawings of racing motor-boats at speed. Any readers who cannot recall having seen a motor craft of any sort might submit a design of their own!

Competitors may send in more than one drawing if they desire, but each must be clearly marked on the back with the name, address and age of the entrant.

As usual the contest will be divided into two classes—A for those of 16 and over and B for those under 16. Drawing or painting materials (or Meccano Products), to be selected by the winners, to the value of 10/6 and 5/– respectively, will be awarded to the entries placed first and second in each class.

Closing date 30th November (Overseas, 28th February 1926).

Results

8th Drawing Competition

The Editorial office had the appearance of a naval architect's quarters when the numerous entries for this competition began to arrive. The subject, "A WARSHIP," certainly gave ample scope. Throughout the eight weeks during which the competition was open almost every post brought in drawings of ancient Viking vessels, Spanish galleons and early Victorian warships, in addition to present-day naval craft and even imaginary warships of a hundred years hence!

Awards:—

First Prizes (Drawing or painting materials value 10/6)—Section A, C. F. CRUICKSHANK (Insch, Aberdeenshire); Section B, W. D. COOK (Anerley, S.E.20). Second Prizes (Drawing or painting materials value 5/–)—Section A, J. ASHTON (Manchester); Section B, E. A. ROBBINS (Kidderminster).

August Essay

There is always a specially memorable day in one's holiday that remains fresh in the mind for a long time. Our August Essay appealed to boys all over the country, and a large number of very good essays arrived. Every class of holiday outing was described, and many competitors who missed the good weather found their chief enjoyment in hours spent indoors with their Meccano and Hornby outfits.

After careful consideration the prizes were awarded as follows:—

First Prizes (Meccano goods value £1/1/–)—Section A, W. H. SIMPSON (Wavertree, Liverpool); Section B, W. BASIL WILLIAMS (Winchester). Second Prizes (Meccano goods value 10/6)—Section A, Miss E. HINES (Ipswich); Section B, LESLIE K. GRIFFIN (Barrow-in-Furness).

21st Photographic Competition

With the passing of "summer" time the opportunities for using one's camera out of doors become fewer, and it is unfortunate that this seasonal change is regarded by many amateurs as a signal that all photographic work must be put on one side until the return of spring. There are many photographic processes that make the hobby one possessing winter interest and, of these, gaslight printing, the subject of our Photographic article this month, is probably the best for all-round purposes. During the winter months our photographic articles will consist of a series of winter subjects and it is intended to base each month's competition on the appropriate article.

The subjects for our 21st Competition give readers a choice of either "A Harvest Scene" or "An Interior," the only condition being that each print must be made on gaslight paper.

We hope that many competitors will select as their entry "An Interior," whether taken by daylight or by gas or electric light. The photography of interiors has certain fascinations entirely its own, and in an early issue of the "*M.M.*" we shall have an extremely interesting article dealing with the subject in detail, including the remarkable results to be obtained by flashlight.

The back of each entry must bear the name, age and address of the competitor and a note stating whether the work is entirely his or her own work or not, and in the event of a tie preference will be given to the print which is solely the work of the entrant.

No print can be returned unless accompanied by a stamped addressed cover.

The competition will be divided into the two usual classes, A for those of 16 and over, B for those under 16. Four prizes will be awarded—Photographic Goods (or Meccano products) to the value of £1 1s. 0d. and 10/6, to be chosen by the winners, as first and second prizes respectively in each section.

Closing date 31st December (Overseas, 31st March 1926).

Results

18th Photographic Competition

The subjects for this competition gave competitors a choice of either "A BEACH ENTERTAINMENT" or a "LANDSCAPE (OR SEASCAPE) WITH CLOUDS." Cloud scenes were predominant among the entries, which depicted clouds of all known and—in one or two cases—unknown varieties. The general standard of the prints was good but many competitors ignored our advice to use a screen to ensure correct rendering of both landscape and clouds, with the result that many efforts contained jet black foregrounds plus midday cumulus clouds! No amount of labelling such as "Moonlight at Margate" can convince us that such an entry is other than a broad daylight scene! However, the judging gave rise to no small difficulty and it was pleasing to note the really genuine efforts of the great majority who showed a desire to achieve something above the ordinary.

Awards:—First Prizes (Photographic goods to value of £1/1/-)—Section A, N. CRANBROOK (Southampton); Section B, N. W. HARRISON (Burton-on-Trent). Second Prizes (Photographic goods to value of 10/6)—Section A, L. KILLICK (Rugby); Section B, G. D. BROADY (Leyton, E.10).

Best Railway Puzzle

The prize of £1/1/- offered for the best Railway Puzzle submitted by a Home reader is awarded to J. McIVEN (London, S.E.6). A selection of the puzzles submitted will be published on the "Puzzle Page" when the Overseas results come to hand.

September Puzzle Contest

The three prizes offered in connection with this competition have been awarded as follows:—

Hornby Trains or accessories value £1/1/-, 10/6 and 5/- respectively to W. CLARKE (Middlesbrough), C. W. SEX (Kingston, Surrey), and H. FAIRBAIRN (St. Abbs, Berwickshire).

Overseas Results

Easter Holiday Contest

Easter seems to be a long way back now, but the last entries for the Overseas section of our May Essay Competition have only recently come in. Many readers wrote a most interesting and detailed account of how they spent their Easter holiday, and it is evident that a vacation at Eastertide is as popular in many countries as it is here.

The essays submitted were well up to standard and a refreshing feature was the number of interesting ones from African readers. It was a difficult problem to select the prize winners, but we consider that the best essays were submitted by the following:—

First Prizes (Meccano goods value £1/1/-)—Section A, P. A. KURANCHIE (Assen Darmang, via Cape Coast); Section B, JOHN McEWEN (Nairobi, British East Africa). Second Prizes (Meccano goods value 10/6)—Section A, R. A. DISUE (Lagos); Section B, NELSON EUSTIS (Alberton, South Australia).

Hornby Train Painting Contest

The entries for the Overseas section of this competition were of excellent quality, although they were not so numerous as those in the Home section.

A feature of these Overseas efforts was the interesting settings competitors gave to their Hornby Trains. This added considerably to the attractiveness of the work and, as may be imagined, a clever representation of a Hornby Train crossing a bridge similar to that over the Victoria Falls, or placed in a splendid setting reminding one of the Canadian Rockies, made a most effective picture. For once in a way the judging of the entries presented few difficulties, and the first and second prizes were awarded respectively to L. CREASEY (Simonstown, S. Africa) and W. HOTHER (Lombardy, Italy).

Guild Motto Competition

A very large response was made to our invitation to Meccano boys the world over to suggest a motto suitable for adoption for the Guild. A great number of letters from every country came in, but for various reasons many of the suggested mottoes were not suitable, the chief fault being that of unwieldiness. It is essential that a Guild slogan should be brief and "catchy," while at the same time expressing the Guild spirit. A further announcement as to the final selection of a Guild motto will be made in due course.

The prize of 10/6 for the best effort submitted by an Overseas reader is awarded to MAXWELL GAGE (Auckland, New Zealand). Additional consolation prizes of a Magazine Binder have been awarded to P. GOLDIN (Melbourne, Australia) and LOUIS DENARO (Birchicara, Malta).

15th Photo Contest

This competition, "MY FAVOURITE PET," proved to be one of the most popular photographic contests we have ever held. Entries came from all parts of the world and the average quality was unusually high.

As was the case in the Home section of this contest, we were particularly interested in the very wide range of creatures selected by competitors as their favourite pets. The Overseas entries included snapshots of a young alligator, a pelican, a stag-beetle, a crane—obviously a very suitable pet for a Meccano boy!—and several creatures, apparently quadrupeds, which we were unable to identify.

The majority of the photographs were very good technically, quite apart from the interest of the subjects, particularly such as depicted a pet in some characteristic attitude of "asking for more," or in action with a plaything. It is no easy matter to "snap" animals, and we sympathised with one reader who explained in a letter: "I took several snaps of my pup, but he didn't come out on any of them!"

The awards were as follows:—

First Prizes (Photographic goods to the value of £1/1/-)—Section A, F. VAN BULCH (Paris); Section B, LEE E. KENG (Singapore). Second Prizes (Photographic goods to the value of 10/6)—Section A, E. H. WHITNEY (Maclear, S. Africa); Section B, N. R. DOIG (Dulwich, S. Australia).

In this column the Editor replies to letters from his readers, from whom he is always pleased to hear. He receives hundreds of letters each day, but only those that deal with matters of general interest can be dealt with here.

Correspondents will help the Editor if they will write neatly in ink and on one side of the paper only.

M. E. St. Hill (Ealing, London).—Your suggestion for a Meccano camp next year is very interesting. We are anxious to encourage outdoor activities during the summer months, and if your idea could be carried out successfully it would give great pleasure. We are afraid that we could not undertake to organise a Meccano camp, however, but we think a scheme might be carried out by a committee formed from some of the larger Meccano clubs. Probably in its first year such a camp would have to be small, but there is no reason why, when once started, it should not grow and become an annual event of great importance.

S. H. Singh (Ferozepore City, India).—We read your letter with keen interest. Nothing pleases us more than to hear of Meccano being used in schools to stimulate interest in engineering. We think that all Meccano boys will agree with your remark: "A boy feels proud when he gets Meccano and when he begins to build models he thinks himself the happiest boy in all the world."

E. J Flintcroft (Whitefield, Manchester).—We wish to assure you, E.J.F., that we do not find it tiresome to wade through hundreds of letters every day from readers of the "*M.M.*" Of course if all these were business letters we should get horribly bored, but our readers send us such interesting and friendly notes that to read them and reply to them is a real pleasure. The demand for publication of the "*M.M.*" at shorter intervals is increasing. We should like to be able to publish fortnightly, or even weekly, but at present it is impossible. However, we are developing steadily, and before long may be able to do something in this matter.

H. V. Reynolds (Georgetown, B.G.)—We hope you will be able to write to us oftener in future, now that you have finished studying for your examination. We are afraid your idea for a bee-culture column would not be sufficiently popular with our readers to justify its introduction. We agree with you that beekeeping is exceedingly interesting, but on the other hand we fancy that many of our readers regard bees simply as annoying little insects with hot feet!

R. H. Wiegold (Luton).—We were quite startled when we read in your letter: "Do not reply that there will not be a 1926 Model-building Competition, because if that is the case there will most likely be a riot in Meccanoland." We are sorry to say that there will not be a big general competition next year but, as you will see from your "*M.M.*" we are commencing a series of splendid competitions that we believe will be even more popular than our big contest. A great feature of our competitions in future will be the inclusion of a section for younger Meccano boys who do not possess anything bigger than a No. 3 Outfit and possibly only a No. 0. Let us know what you think of this scheme.

A. Anker (Kettering).—We agree that during the very hot weather you had some excuse for not writing to us, but now that it is colder we shall expect letters regularly. It seems to us quite an exciting game to be listening-in to Daventry and writing a letter at the same time, but we do not think it fair to blame the B.B.C. for mistakes in your letters! There is no doubt that the transmission from the Daventry station is the best yet.

H. A. Vlies (Alexander Park, Manchester).—We are glad to hear that you are as much "Meccanofied" as ever. You appear to have done quite well with your Loom. The photograph of your aquarium is very interesting and we hope to reproduce it in the "*M.M.*" before long. Send us some more "fishy" photographs.

F. H. Culverhouse (Benllech, Anglesey).—We feel that you have a distinct grievance in regard to your Dad. It must be very annoying to miss your "*M.M.*" and then find that your Dad has it and is comfortably settled in his armchair absorbed in reading it. We are afraid there is no remedy, however, except to grab your "*M.M.*" first, or to order an extra copy for him!

C. W. Wilbraham (Hoole, Chester).—The growth of the "*M.M.*" has certainly been very rapid, and we appreciate your congratulations. We have many articles on scientific subjects in preparation, and as you are interested in science we think you will enjoy these. We are afraid we cannot at present avoid having the price of the magazine printed on the cover.

NEW MECCANO

Model-Building Contests

TWENTY-SEVEN PRIZES TO BE WON

These competitions are the first of a series that we propose to run through the winter months. Each competition will be arranged on similar lines, with the exception that the class of model involved will continually change. In this way we hope to extend the opportunity of competing to all our readers, whether they possess a No. 0 or a No. 7 Outfit. All the competitions will be complete in themselves, and their results will be announced in the " *Meccano Magazine* " two or three months from the date of the issue in which they appear.

We hope the " Outfit " competitions will result in our being able to publish particulars of many entirely new models which may be built with the smaller sets, and we cordially invite our readers' co-operation in making this new feature an all-round success.

"LOCO" COMPETITION

As announced last month, we are offering nine splendid cash prizes for Meccano models of Locomotives. The competition closes at the end of this month for inland readers and entries from overseas competitors must be received by 28th February, 1926. Meccano boys should now get really busy and send along their efforts as soon as they are completed !

Entries will be divided into the following sections :

SECTION A, for competitors residing in the British Isles ;

SECTION B, for competitors residing outside the British Isles.

Competitors' ages will be taken into consideration when judging the entries.

Prizes will be awarded for the best entries from each section as follows :—

FIRST PRIZE, £5-5s. ; SECOND PRIZE, £3-3s. ; THIRD PRIZE, £1-1s. ; six consolation prizes of 10/6 each.

WHAT YOU HAVE TO DO

The first prize in each section will be awarded to the competitor who sends in the loco that the judges decide to be the best model received in that section, and the second and third prizes will be awarded to the second and third best models.

You may build your loco from any Outfit or number of parts, but it is wise to remember that very often the simplest and most straightforward models are better than the more complicated structures. If you can embody in your model some ingenious use for a Meccano part, or an original movement, this is a distinct advantage that is likely to score more heavily than the most elaborate model submitted.

When you have built your model, you should send in a photograph or a good drawing, together with any explanations you may think necessary, although the latter should be made as brief as possible. Write your name and address only on the back of each sheet used, and state your age, and section in which your model is entered.

Closing date for Section A, 30th November, 1925. Overseas Section, 28th February, 1926.

Mark envelopes " Loco Competition."

Do not send models. A clear photograph or good drawing is all that is necessary.

"0 OUTFIT" COMPETITION

In this competition, as first announced in the October "*M.M.*," prizes are offered for the best models made entirely from a No. 0 Outfit. Models comprising parts that do not appear in this outfit will be disqualified. It is not necessary to use all the parts contained in the outfit.

This competition offers a splendid opportunity for newcomers to Meccanoland, and to those who refrained from entering previous contests because they did not possess larger outfits.

We hope to receive some very interesting entries in this competition, and we shall endeavour to publish as many of the prize-winning models as possible in next January's "*Meccano Magazine.*" An interesting feature of the contest is the fact that all competitors will be using the same parts.

Entries will be divided into the following sections :—

SECTION A, for boys under 12.

SECTION B, for boys over 12 and under 16.

SECTION C, for boys residing overseas, and not exceeding 16 years of age.

Prizes will be awarded for the three best entries from each section as follows :

FIRST PRIZE : Meccano Goods to the value of £2-2s.

SECOND PRIZE : Meccano Goods to the value of £1-1s.

THIRD PRIZE : Meccano Goods to the value of 10/6.

Closing dates for Sections A and B ; 30th November, 1925. Overseas Section, 28th February, 1926.

Entries should be sent in as soon as possible, although they will not be finally judged until after the closing date of the Competition.

Mark envelopes " 0 Outfit Competition."

We append the latest list of parts contained in a No. 0 Outfit, for the reference of competitors.

Contents of Meccano Outfit No. 0.

4 of No. 2	2 of No. 17	6 of No. 35	4 of No. 48A
9 " " 5	1 " " 19	1 " " 36	1 " " 52
5 " " 10	4 " " 22	25 " " 37	1 " " 54
2 " " 11	1 " " 23	6 " " 38	1 " " 56
8 " " 12	1 " " 24	1 " " 40	1 " " 57
2 " " 16	1 " " 34	1 " " 44	2 " " 125
			2 " " 126A

Models should not be sent. A clear photograph or good drawing is all that is necessary.

November Puzzle Competition

MANY of my readers have confided to me that it is their ambition to become Editors of Magazines like the *"M.M.,"* and judging by the amount of enterprise some of them display in writing to me with ideas for the " Puzzles Page " I predict successful editorial careers for them! Many very interesting suggestions have been submitted and I hope to give some of them a practical test.

The result of the competition for the " Best Puzzle Connected with Railways " (Home Section) appears on page 605. I expected this contest to prove popular, but the deluge of entries certainly surprised me. Many competitors accompanied their puzzles with well-drawn plans and sketches and most of the entries showed a sound knowledge of railway affairs.

This month I am offering a special prize of £1/1/- for the best " Match Puzzle " submitted. There are endless possibilities in the way of tricks and problems with matches and I shall look forward to receiving a large number of entries. Competitors may send in more than one attempt, but each will be judged independently. Once again I must emphasize the necessity for competitors to *write their name and address on the back of each sheet of paper they send in.* Entries must reach this office on or before the 30th November (Overseas, 31st March).

I am offering the usual three prizes of Meccano or Hornby Train goods to the value of £1/1/-, 10/6 and 5/- respectively for the three best sets of solutions of 10 of the puzzles on this page.

Sometimes puzzles on this page have more than one solution and in such cases any correct solutions are accepted. No. 127 and No. 135 are examples.

The closing date is 30th November, and there is no Overseas section.

Puzzle No. 136.
A certain man was asked his age. He replied :—" If you multiply together the two digits forming my age the number produced will be my age 22 years ago ; and if you add together all the digits of the two ages the result will be one-third of my present age. How old was the man ?

* * * *

Puzzle No. 137.
The initial and final letters of the ten words indicated by the following definitions, spelled downward, give the names of two Meccano parts :—

1. Dormant ; 2. To allude to ; 3. Division of a poem ; 4. Insinuation ; 5. To bring on ; 6. One of the muses ; 7. Fantastic or sentimental ; 8. To affirm ; 9. An authoritative prohibition ; 10. Fault.

* * * *

Puzzle No. 138.
At a school treat it was calculated that if each teacher contributed 5/- there would be 3d. for each child and 3d. over. Shortly afterwards two more teachers arrived bringing with them one-third as many children as were there before. It was now found that if each teacher contributed 5/6 each child would receive 3½d. How many teachers and children were there at first and afterwards ?

Puzzle No. 139.
A school magazine was printed by a local firm whose work was of very doubtful quality. In a certain issue the following sentence was printed, without any punctuation marks :—" Jones where Smith in an examination had had had had had had had had had had had more weight with the examiners." How should the sentence have been punctuated ?

* * * *

Puzzle No. 140.
Using fourteen matches make five diamonds, each side of each diamond being the full length of a match.

* * * *

Puzzle No. 141.
How can fifteen birds be placed in four cages so that there will be an odd number of birds in each cage ?

* * * *

Puzzle No. 142.

Twenty are six of us ;
Twice three are three of us ;
Nine are but four of us,
O, what a mystery !
Twelve are just six of us ;
Eight are but five of us ;
Five are now four of us,
What can we be ?

* * * *

Puzzle No. 143.

'Twas last Bank Holiday, so I've been told,
Some cyclists rode abroad in glorious weather.
Resting at noon within a tavern old,
They all agreed to have a feast together.
" Put it all in one bill, mine host," they said,
" For every man an equal share will pay."
The bill was promptly on the table laid,
And four pounds was the reckoning that day.
But, sad to state, when they prepared to square,
'Twas found that two had sneaked outside and fled.
So, for two shillings more than his share,
Each honest man who had remained was bled.
They settled later with those rogues, no doubt.
How many were they when they first set out ?

* * * *

Puzzle No. 144.
A gentleman entered a tobacconist's shop one day, and bought cigars and tobacco. The cigars cost as much in shillings and pence as the tobacco cost in pence and shillings. He tendered a 10/- note and received in change what the tobacco cost. What was the cost of the cigars and tobacco ?

* * * *

Puzzle No. 145.
I am found in England, Ireland, Scotland and Wales. I am always in battles and brawls, never in peace and quietness, yet I have as much to do with the lamb as with the lion. You are all greatly indebted to me, for without me you could not have pleasure. I belong to a large family and am one of its tallest members. What am I ?

* * * *

Puzzle No. 146.

From maid who laboureth with churn
Remove assistance ; then in turn
Reverse what's left, and you will see,
Ten thousand plain as plain can be.

* * * *

Puzzle No. 147.
Take one letter from each of the following words and arrange these letters to form the name of an English poet. Then re-arrange the remaining letters to give the name of one of this poet's most famous works :—

Tears ; hut ; tun ; heal ; cab ; cry ; care.

* * * *

Puzzle No. 148.
A man divided 7/6 between two fathers and two sons, each father and each son receiving 2/6. How was this possible ?

* * * *

Puzzle No. 149.
Find a number that is just as much less than 50 as its quadruple is more than 50.

Answers to Last Month's Puzzles

No. 125. The word was Pyx.

* * * *

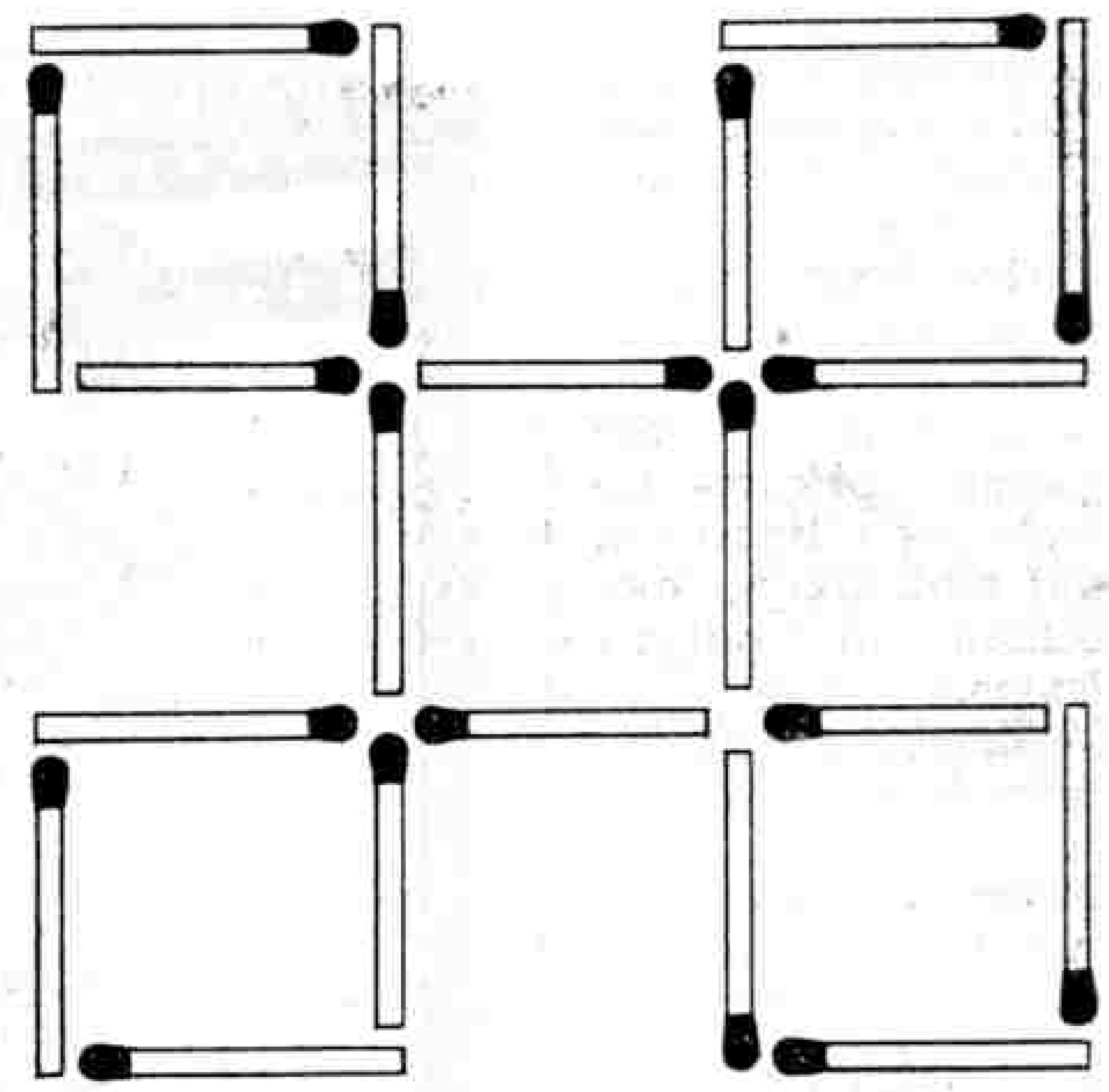
No. 126. The inscription means :—" **Beneath this stone reposeth Claud Coster, tripe seller of Impington, as doth his consort Jane.**"

* * * *

No. 127 The word is " Idea."

* * * *

No. 128. The matches are re-arranged **as in the** following diagram.



No. 129. Fox, Ox, X.

No. 130. The sentence is :—I understand you overheard and undertake to overthrow our undertakings.

* * * *

No. 131. The father's age is 44.

* * * *

No. 132. The hidden coins are as follows :—(1) Peso ; (2) Sen ; (3) Anna ; (4) Real ; (5) Cash ; (6) Guilder ; (7) Rupee ; (8) Dollar ; (9) Peseta ; (10) Cent ; (11) Para.

* * * *

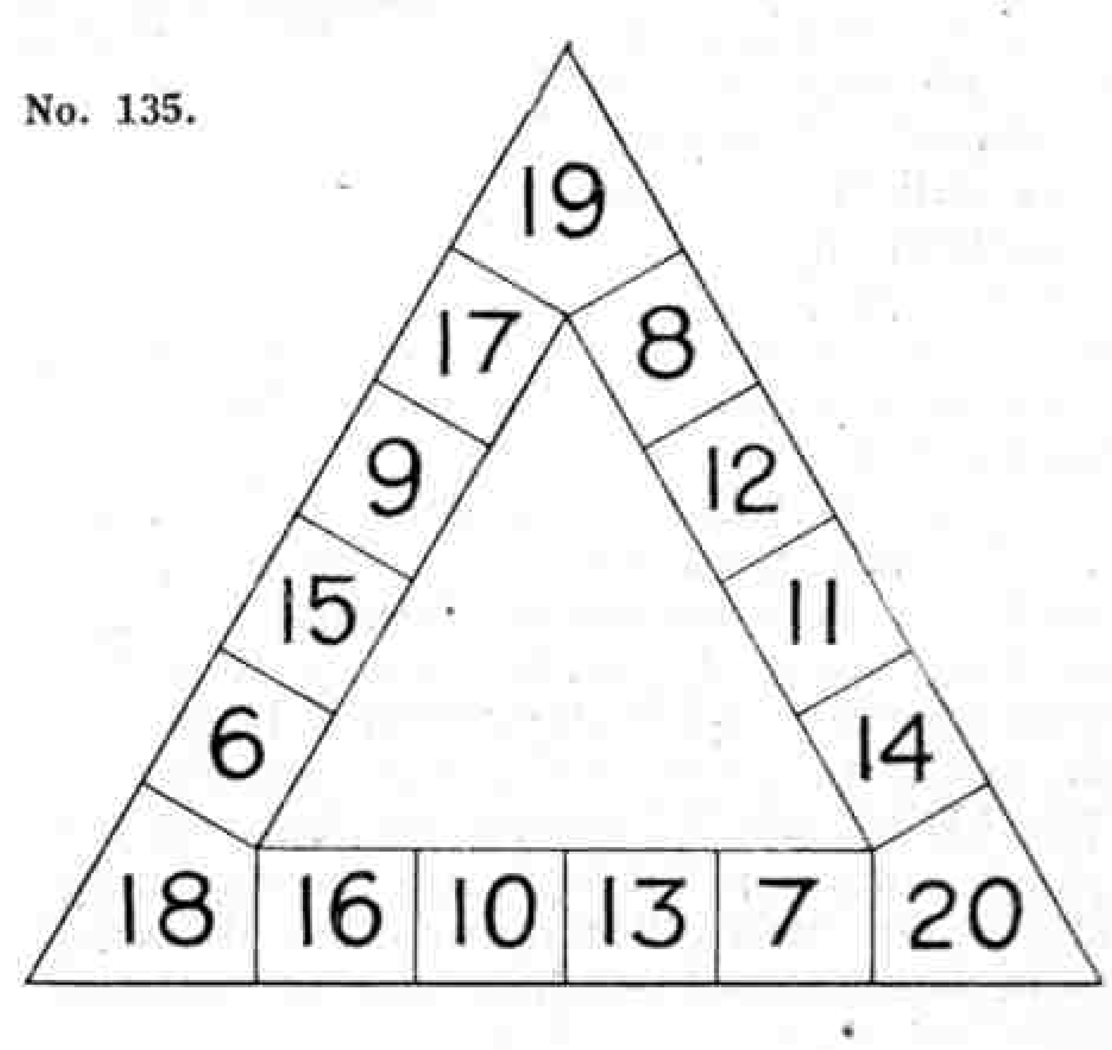
No. 133. The cards must be arranged in the following order :—Ace, Queen, Two, Eight, Three, Knave, Four, Nine, Five, King, Six, Ten, Seven.

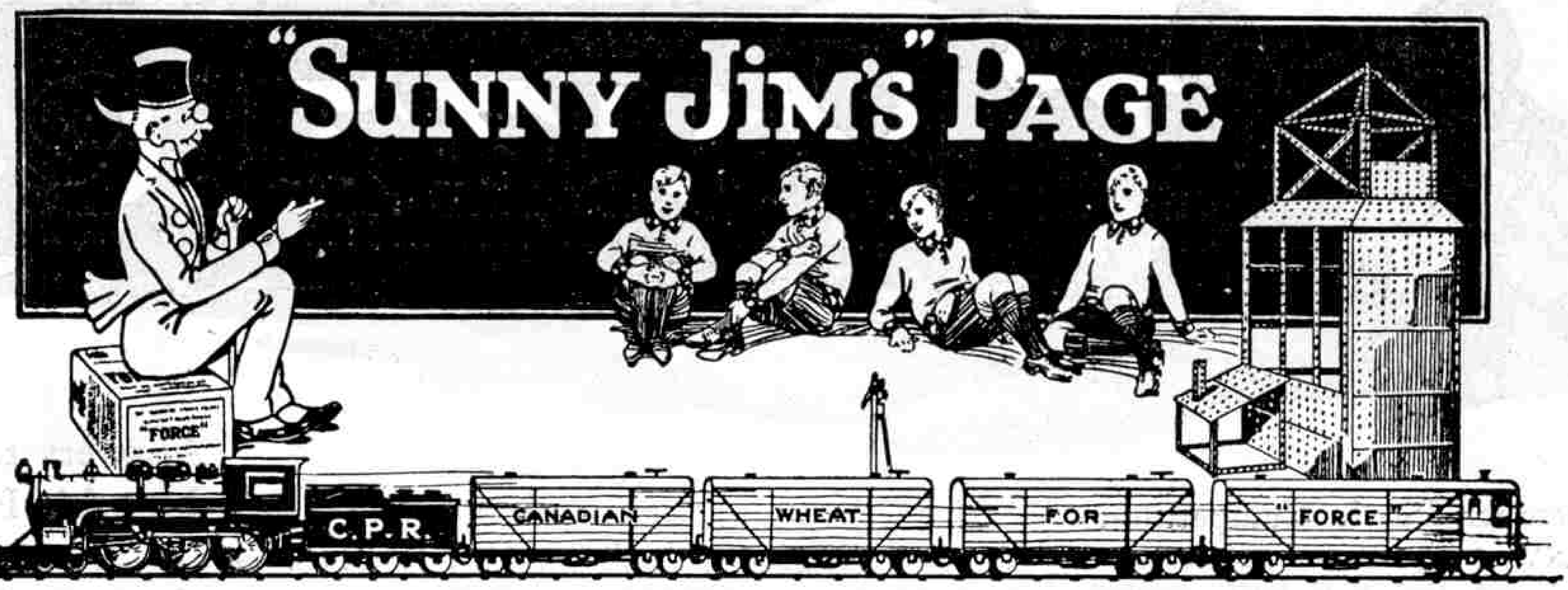
* * * *

No. 134. There were 301 eggs.

* * * *

No. 135.





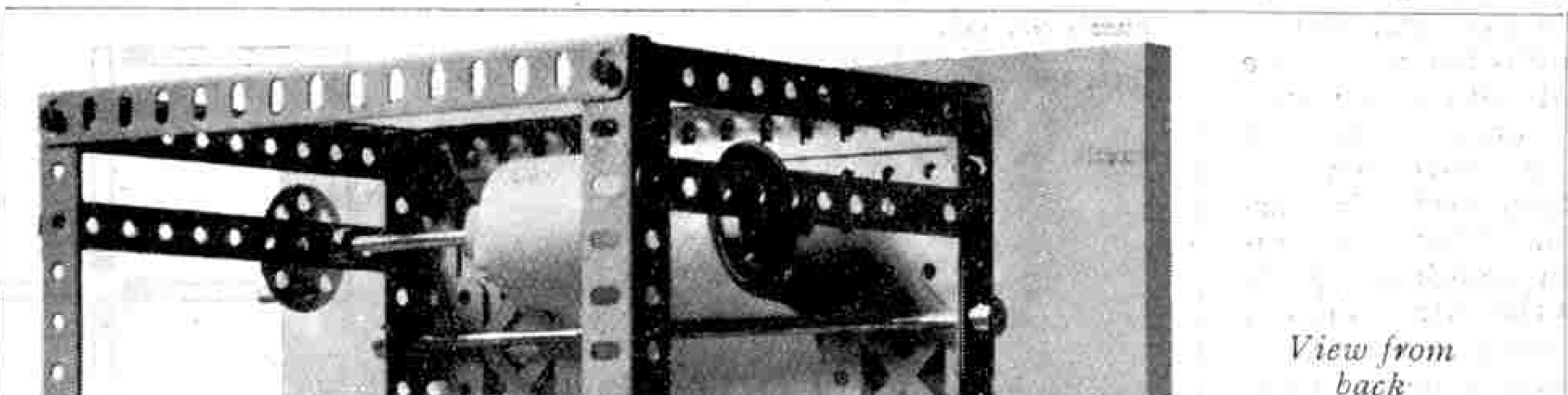
HOW TO MAKE A CHANGING ADVERTISEMENT SIGN

High above the roar of the city's traffic and the thousands of people passing below, silently proclaiming the flavours of a chocolate, the fizziness of a ginger ale, or the deliciousness of a breakfast food, stands the Changing Advertisement Sign.

Its busy wheels seem never still, as, one after another, come into view the coloured pictures advertising all sorts of different things, from toffees to railway trains.

Almost every big town has a changing advertisement sign placed in some conspicuous part of its most busy thoroughfare. Perhaps you have watched one working. Have you thought that if you had a nice strip of advertisements, all the right size, you could, with your Meccano set, make a sign for yourself? Do so! I have specially made an advertisement strip for this purpose. By writing to me as explained below, you can get a copy of it.

Look carefully at the photograph reproduced on this page. You will see that the construction of the "Forceograph" is really quite simple. It could be made even if you had only some of the parts shown here.



How the "FORCEOGRAPH" is put together

Notice that the strip of pictures (there are 14) passes round the rollers from the back. This is important because it helps to keep the strip taut. Notice that the wheel for changing the pictures is geared in order to slow down the movement. The little "shelf" across the back is for you to put a night light on, or anything else that will illuminate the pictures from behind and so give you as realistic an effect as possible.

When you have sent off for the advertisement strip, get yourself a piece of cardboard 13 ins. high and 12 ins. wide. In the centre, and three inches from the top, cut a rectangular hole $2\frac{3}{4}$ ins. deep and $2\frac{1}{2}$ ins. wide.

Paint your cardboard frontispiece. Write on the name of your model "The Forceograph," and copy the word "FORCE" from a "Force" packet, as shown in the small circle. Now build your framework using the following parts:—

2 of No. 2. 2 of No. 6a. 4 of No. 8. 4 of No. 8b. 6 of No. 9. 5 of No. 13a. 2 of No. 24. 1 of No. 26. 1 of No. 27a. 47 of No. 37. 4 of No. 38. 14 of No. 59. 2 of No. 70. 2 of No. 72. 2 of No. 100. 1 of No. 103k. 2 of No. 106. 2 of No. 115. 4 of No. 133.

Lastly bolt on the cardboard front. When the advertisement strip comes, get out your paint-box again and colour the pictures.

One picture shows a boy eating "FORCE" with cherries—"FORCE" is very nice that way. Another shows Sunny Jim telling us "FORCE" is fine with hot milk—and it needs no cooking. Yet another, showing Sunny Jim in the middle of a wheatfield, telling us that, whatever the weather may be, "FORCE" is always "just right." That's because "FORCE" can be eaten with either hot or cold milk, or with fruit and custard.

When you get your coloured pictures in position with the illumination behind, you will have a real working model of one of the big Changing Advertisement Signs, such as we see over our busy city streets.

Forcefully yours,

Sunny Jim.

This Month's Free Gift

Quite free of charge you can obtain a 14-picture strip (each picture measuring $2\frac{1}{4}'' \times 3''$) ready for colouring and fitting to your "Forceograph." Send a lid from a "FORCE" packet, with your name and address to—"FORCEOGRAPH,"

"SUNNY JIM,"

197, Gt. Portland St., London, W.1.

and your picture advertisement strip will be sent in return.

Fireside Fun

QUITE LIKELY!

Vicar: "They tell me, Mrs. Smith, that your son is a good footballer."
Mrs. S.: "Yes, sir."
Vicar: "Do you know in what position he plays?"
Mrs. S.: "I am not sure, sir, but I think he is one of the drawbacks!"

* * * *

Small boy (to big brother): "What is a narrative?"
Big brother: "A tale."
Small boy: "What does extinguish mean?"
Big brother: "To put out."
Small boy: "Well then, I am going to take that dog by his narrative and extinguish him!"

* * * *

First Man: "Poor chap, he was driven to his grave."
Second Man: "Well, what about it! Did you expect him to walk?"

* * * *

Highwayman's victim (looking nervously down the barrel of a gun): "Please be careful with that, it may go off."
Highwayman: "Don't worry about that, I can easily re-load."

* * * *

Teacher, after explaining the points of the compass: "If I turn to the east and look at the rising sun, what is behind me?"
Jimmy: "Your shadow."

* * * *

SOME RUN!

Teacher (explaining algebra problem): "Now watch the board while I run through it once more!"

* * * *

Disgusted Diner (to waiter): "What kind of meat do you call this?"
Waiter: "Spring lamb, sir."
D. D.: "I thought as much. I've been chewing one of the springs for an hour!"

* * * *

Q. When is a lamp-post a lamp-lighter?
A. When the lamp is taken off, of course.

* * * *

Sam: "Have you heard the story of the bell?"
Bill: "No."
Sam: "That's surprising, because it has very often been tolled!"

HOT STUFF!

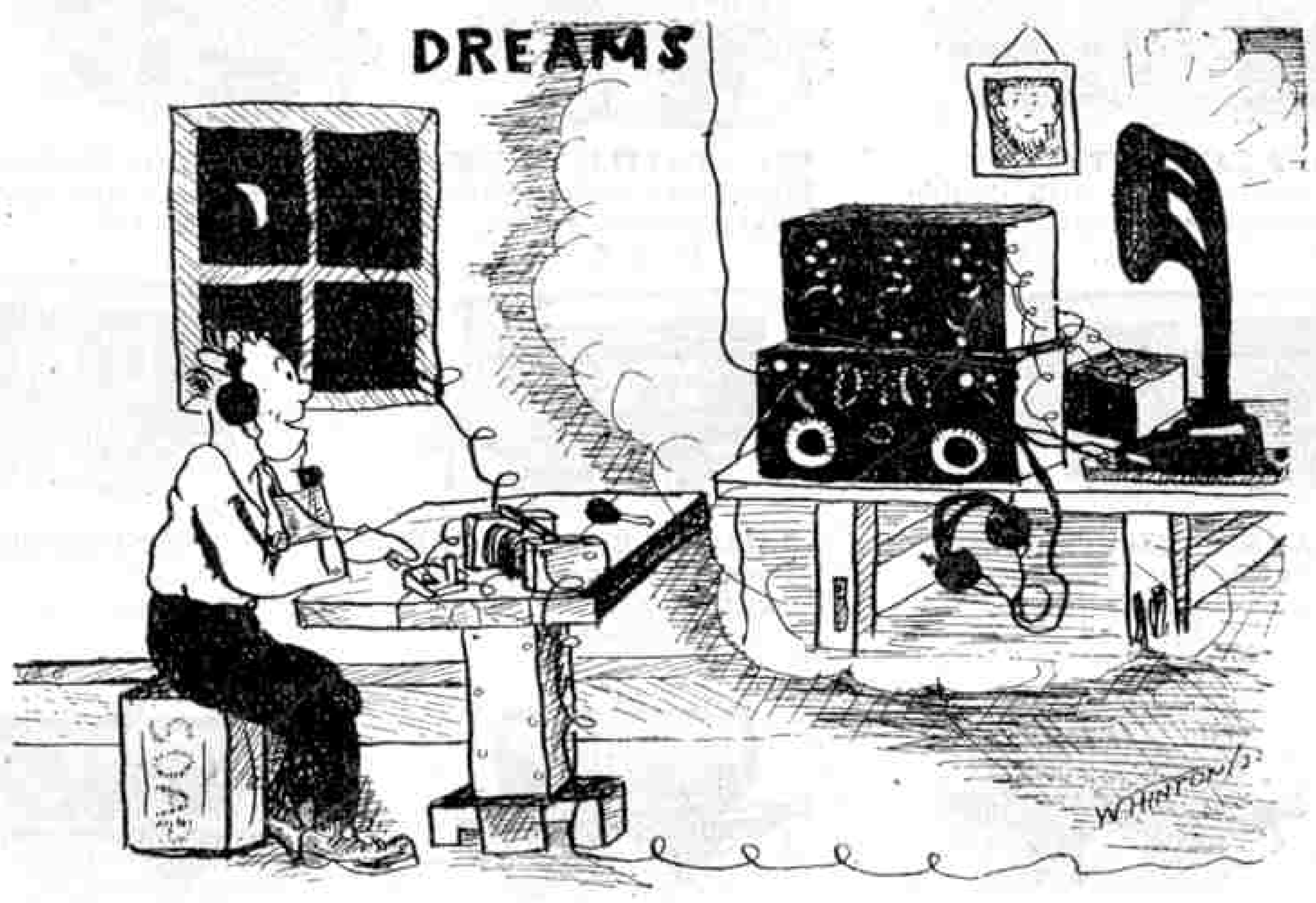
Teacher: "Tell me the names of the seasons."
Little Willie: "Pepper, salt, vinegar and mustard!"

* * * *

Q. Why is it unwise to take a nap in a train?
A. Because trains run over sleepers.

* * * *

Invalid: "Show me some books on illumination."
Bookseller: "Electric or gas?"
Invalid: "I don't mind. My doctor says I need some light reading."



Valvular Disease!

Big Brother: "How was your teacher's temper this morning?"
Johnny: "In apple-pie order."
Big Brother: "In apple-pie order?"
Johnny: "Yes, crusty."

* * * *

Artist: "You must be very careful with that picture, it is not dry yet."
Porter: "That's alright sir, I've got an old coat on."

* * * *

WHY THEY SMILED!

Professor, lecturing on the rhinoceros and finding his students inattentive: "If you wish to realise a true picture of this hideous animal you must keep your eyes fixed on me!"

* * * *

Teacher: "Willie, what is an 'exit?'"
Willie: "An exit is an entrance you go out of."

* * * *

Student: "I have a cold or something in my head."
Professor: "It is undoubtedly a cold."

* * * *

Q. Why did the lantern-slide?
A. Because it saw the film-roll.

POOR OLD DAD.

Small boy: "A shillingsworth of castor oil."
Chemist: "The tasteless kind, I suppose?"
Small Boy: "No, sir, it's for father."

* * * *

Old Gentleman, to comic artist: "Do you find this pen-and-ink drawing profitable?"
Comic Artist: "Well, it just keeps the pot boiling."
Old Gentleman: "I see, you light the fire with them."

* * * *

Tim: "I wonder what keeps the moon from falling."
Tom: "I don't know exactly, but I expect it has something to do with the beams."

* * * *

Teacher: "A fathom is 6 ft. Can anyone give me a sentence using the word?"
Pupil: "Yes, sir. Flies are able to walk on the ceiling because they have fathoms."

* * * *

Tommy could not go to sleep, so his father advised him to start counting and keep on until he felt drowsy. Some hours later a small and weary voice was heard calling: "Daddy."
"What is it?"
"What comes after millions?"

* * * *

Q. Why is a newsboy never cold?
A. Because selling papers maintains the circulation.

* * * *

Q. What part of a locomotive needs the most careful attention?
A. The tender part, of course.

* * * *

SEEMS UNJUST!

Mother: "Now remember, Tommy, there is a ghost in the cupboard where I keep the cake."
Tommy: "It's a funny thing you never blame the ghost when there's any cake missing!"

* * * *

Tom: "Why is that aviator always looping the loop?"
Jim: "He used to be a Boy Scout and he still tries to do his daily good turn."

* * * *

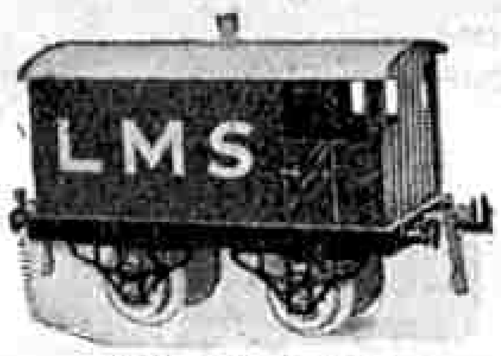
Visitor: "Things are pretty dull around here."
Oldest Inhabitant: "Perhaps they are just now, but you wait a couple of months and see how the place is stirred up."
Visitor: "What's going to happen?"
O.I.: "Ploughing."

ROLLING STOCK AND ACCESSORIES

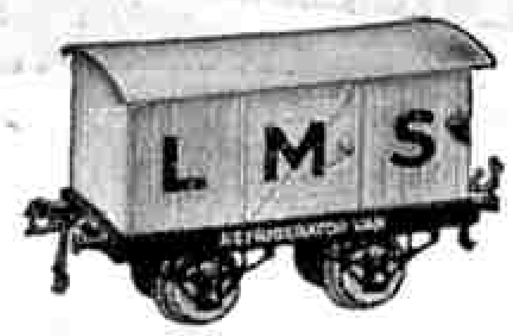
(HORNBY SERIES)

There are now 50 different train accessories—Stations, Signal-boxes, Lamps, Wagons, Level-Crossings, Foot-Bridges, Turntables, etc. Further accessories will be added to the system from time to time, and will be announced in the pages of the " *M.M.*"

All Hornby Rolling Stock and Accessories are built in correct proportion to the size, gauge, method of coupling, etc., of the Hornby Trains and all have the uniformly beautiful finish that is the great feature of the Hornby series. With these accessories you can build up a most realistic railway system, and the splendid range of rails, points, and crossings make possible endless variety in rail layout. Hornby Trains are British made, and your dealer will be able to show you specimens of the new products.

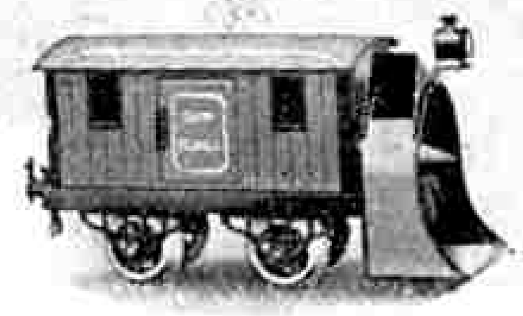


BRAKE VAN
Finished in grey, with opening doors. Price **4/-**

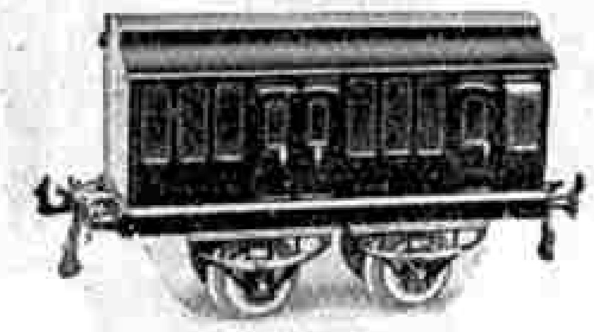


***REFRIGERATOR VAN**
Enamelled in white, with opening doors. Price **4/-**

BRAKE VAN
Finished in grey, with opening doors. Price **4/-**

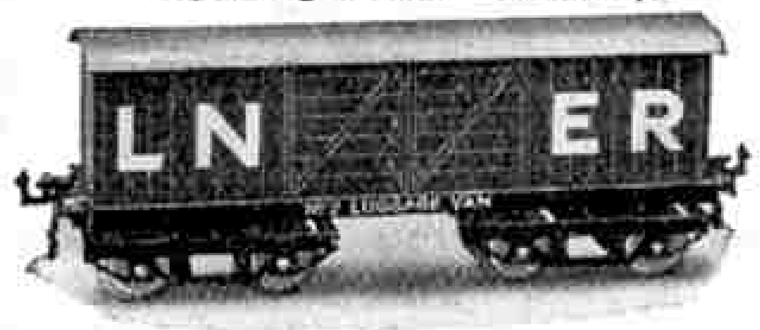


***SNOW PLOUGH**
With revolving plough driven from front axle. Price **5/6**

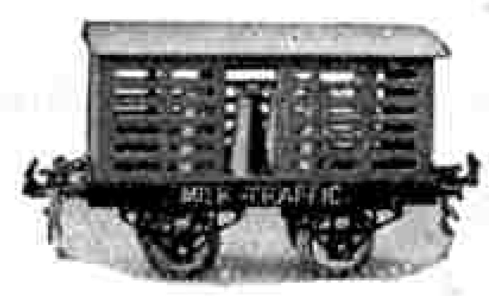


***GUARD'S VAN**
Realistic design, fitted each side with opening doors. Price **3/6**

***No. 1 LUGGAGE VAN**
With opening doors. Price **4/-**

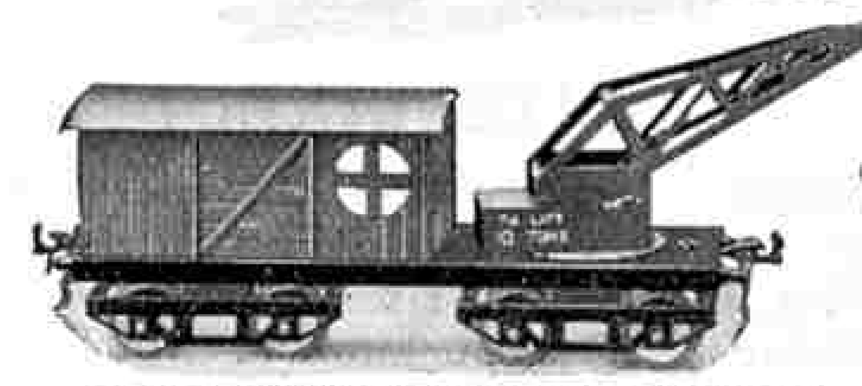


***No. 2 LUGGAGE VAN**
Finished in blue and green. Fitted with double doors. Suitable for 2-ft. radius rails only ... Price **6/6**



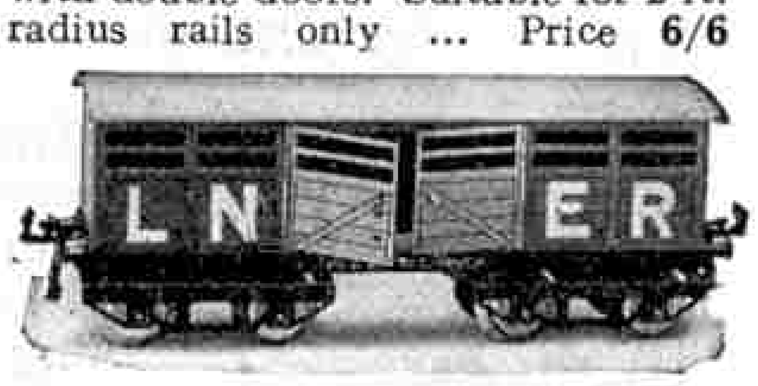
***MILK TRAFFIC VAN**
Fitted with sliding door, complete with milk cans. Price **4/6**

***CEMENT WAGON**
Finished in grey and black. Price **4/-**



***BREAKDOWN VAN AND CRANE**
Beautifully coloured in grey and black, with opening doors. Suitable for 2-ft. radius rails only ... Price **7/-**

SECCOTINE WAGON
Beautifully finished in blue, with opening doors. Price **4/-**



***No. 2 CATTLE TRUCK**
Splendid model fitted with double doors. Suitable for 2-ft. radius rails only ... ... Price **6/6**

***No. 1 CATTLE TRUCK**
Fitted with sliding door. Very realistic design. Price **4/-**

SIDE TIPPING WAGON
Excellent design and finish. Price **3/6**

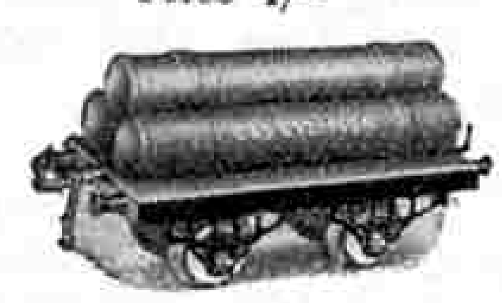
ROTARY TIPPING WAGON
Finished in grey and green. Price **4/-**

CRAWFORD'S BISCUIT VAN
Finished in red, with opening doors ... Price **4/-**

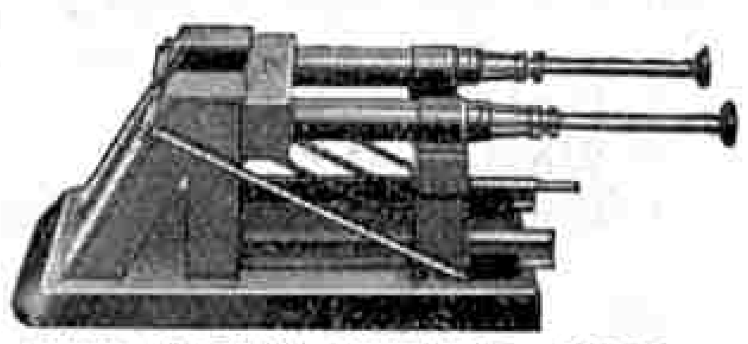
CARR'S BISCUIT VAN
Finished in dark blue, with opening doors. Price **4/-**

JACOB'S BISCUIT VAN
Finished in crimson lake, with opening doors. Price **4/-**

***GUNPOWDER VAN**
Finished in red, with opening doors. Price **4/-**

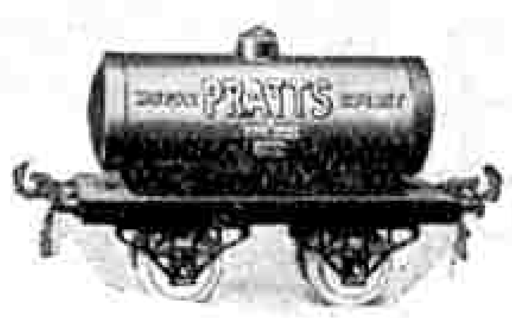


***GAS CYLINDER WAGON**
Finished in red, lettered gold. Price **3/-**



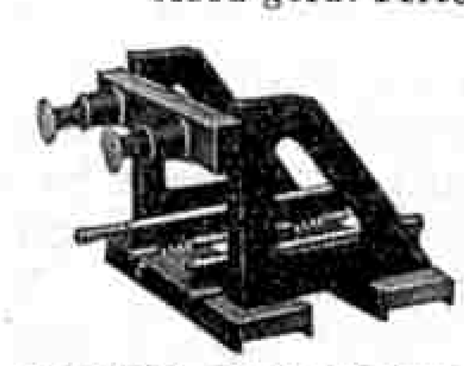
HYDRAULIC BUFFER STOP
Price **5/-**

PETROL TANK WAGON " SHELL "
Finished in red. Price **3/-**

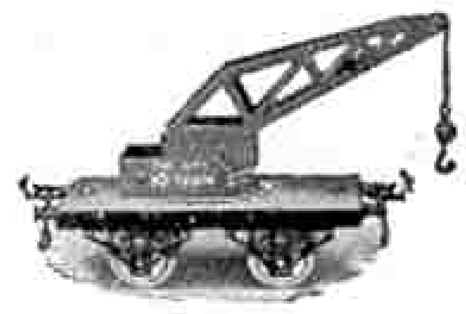


PETROL TANK WAGON " PRATTS "
Finished in green. Price **3/-**

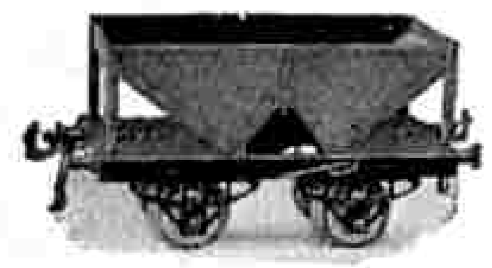
MOTOR SPIRIT TANK WAGON " NATIONAL BENZOLE"
Price **3/-**



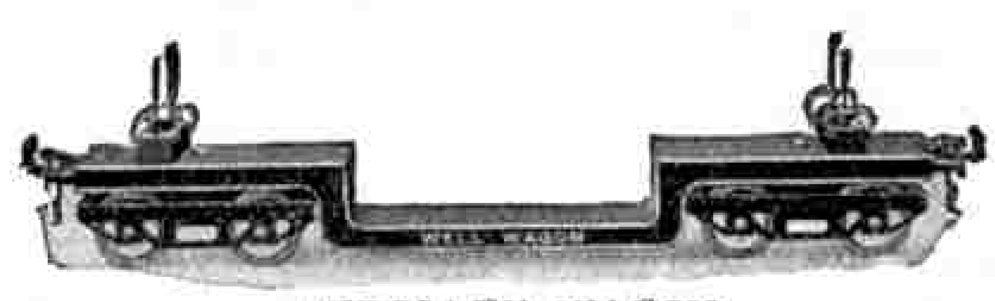
SPRING BUFFER STOP
Price **1/6**



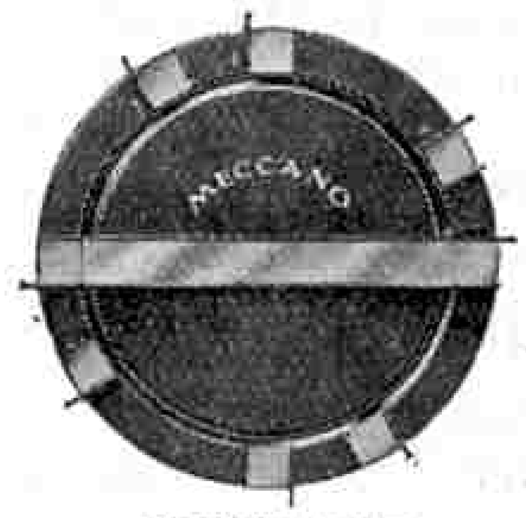
***CRANE TRUCK**
Finished in grey and black ... Price **4/6**



***HOPPER WAGON**
Mechanically unloaded. Finished in grey and black ... Price **4/-**



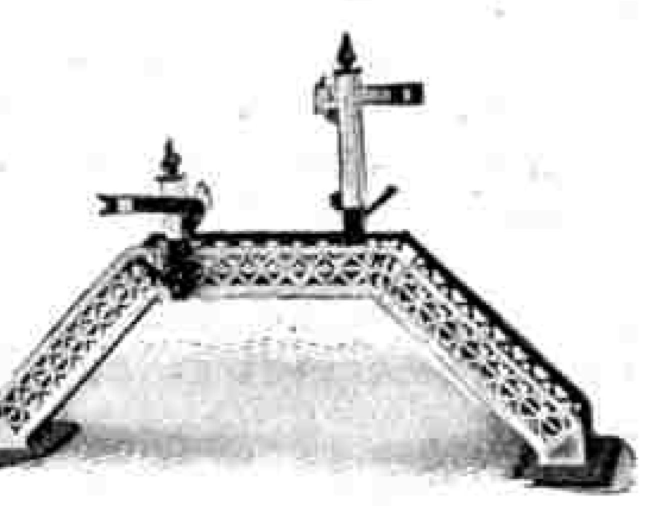
***TROLLEY WAGON**
Finished in grey and red. Suitable for 2-ft. radius rails only ... Price **6/-**



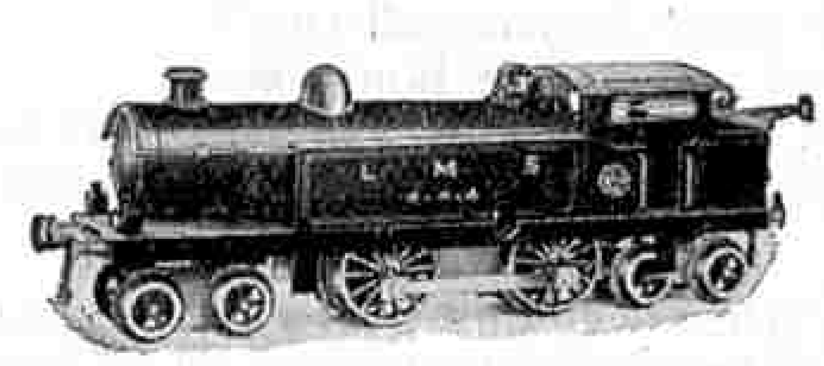
TURNTABLE
Price **5/-**

TUNNEL
Realistic and finished in colours ... Price **7/6**

HORNBY No. 1 TANK LOCO
Gauge 0, in colours to represent L.M.S. or L.N.E.R. Companies' locos. Price **12/6**



FOOTBRIDGE
No. 1. With detachable Signals Price **6/-**
No. 2. Without Signals ... „ **3/6**
Signals only ... per pair **2/9**



HORNBY No. 2 TANK LOCO
Beautifully finished in colours to represent L.M.S. or L.N.E.R. Companies' locos. Fitted with reversing gear, brake and governor ... ... Price **30/-**

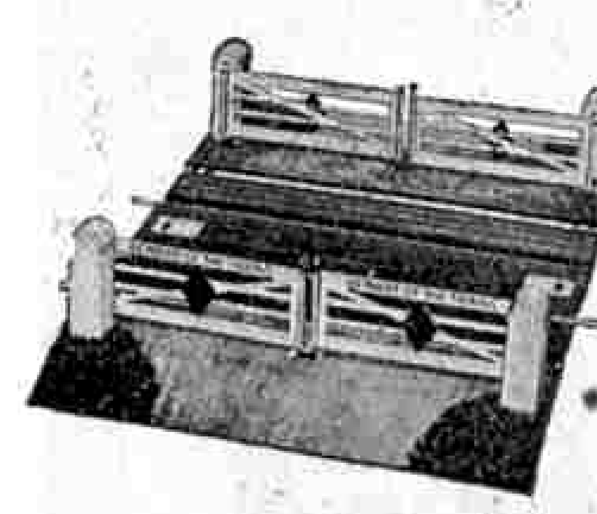
**Lettered L.M.S. or L.N.E.R.*

ROLLING STOCK AND ACCESSORIES

(HORNBY SERIES—*continued*)

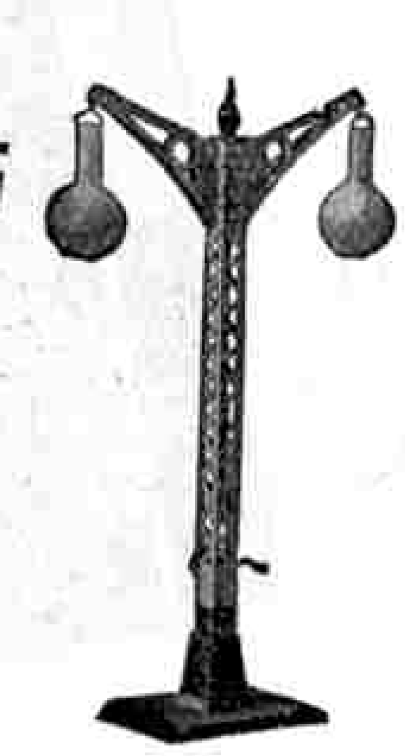
SIGNAL CABIN
Dimensions: Height 6½-in., Width 3½-in., Length 6½-in. Finished in colour and lettered "Windsor." Roof and back open to allow signal-levers to be fitted inside cabin if desired.
Price 6/6

RAILWAY STATION. Excellent model, beautifully designed and finished.
Dimensions: Length 2-ft. 9-in., breadth 6-in., height 7 in. Price 12/6

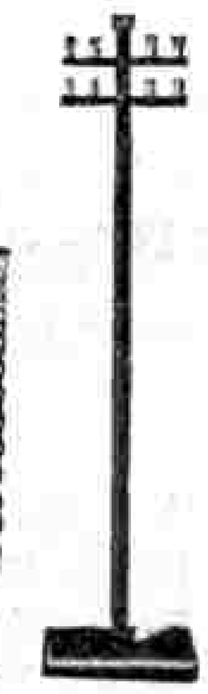


LEVEL CROSSING
Beautifully designed in colour. Measures 11½ × 7½-in. with Gauge 0 rails in position.
Price 6/6

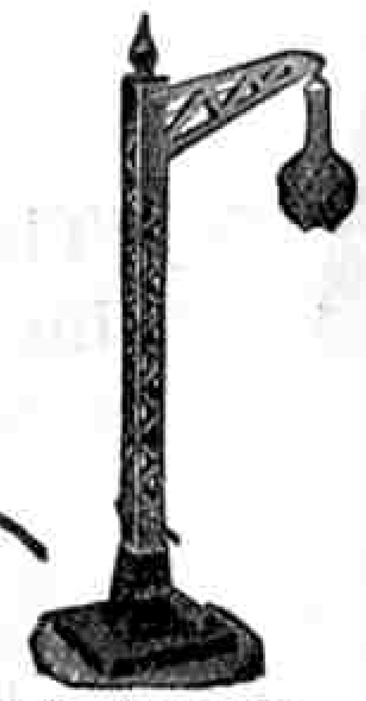
VIADUCT. Price 7/6
ELECTRICAL VIADUCT. Price 8/-



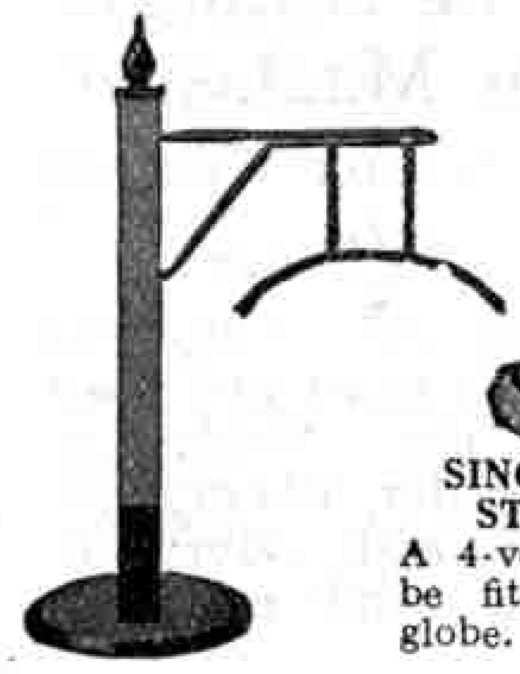
DOUBLE LAMP STANDARD
Four-volt bulbs may be fitted into the globes.
Price 4/-



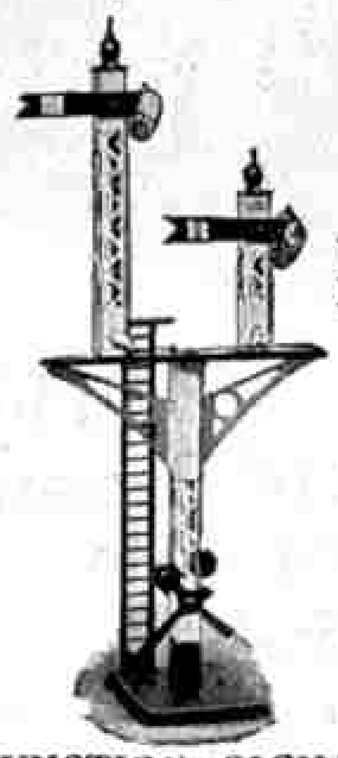
TELEGRAPH POLE
Price 2/6



SINGLE LAMP STANDARD
A 4-volt bulb may be fitted into the globe. Price 3/-

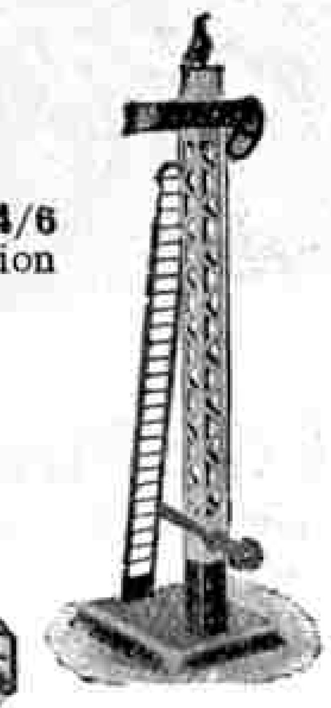


LOADING GAUGE
Price 1/9

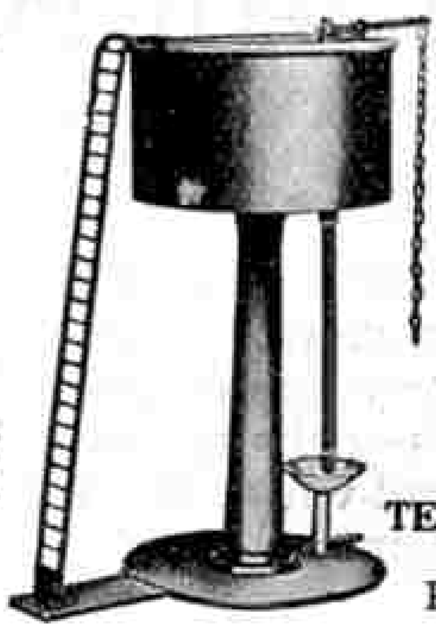


JUNCTION SIGNAL
Signal arms operated by levers at base. Very realistic model standing 14-in. in height.
Price 5/6

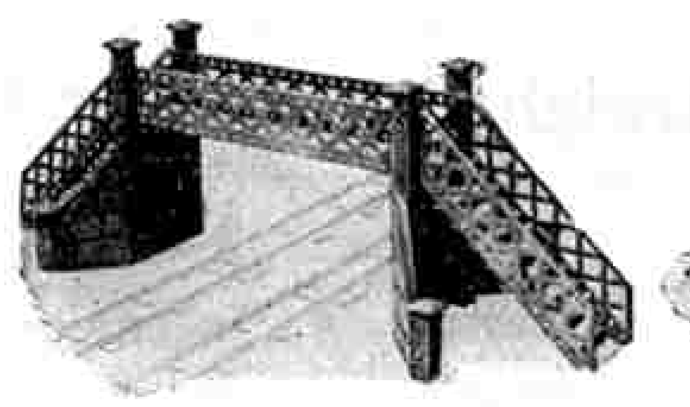
VIADUCT (Centre Section only) Price 4/6
ELECTRICAL VIADUCT (Centre Section only) Price 5/-



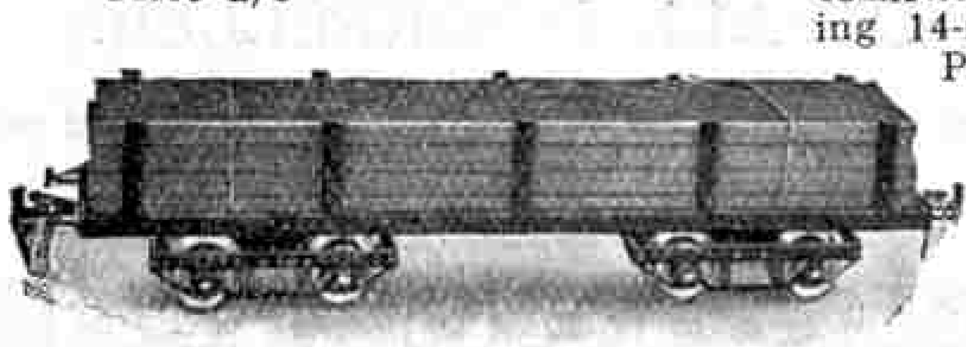
SIGNAL
Price 2/6



WATER TANK
Brightly coloured in red, yellow and black, 8½-in. in height, with flexible tube and pump lever.
Price 6/6

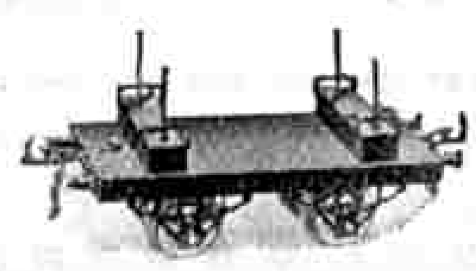


LATTICE GIRDER BRIDGE
Constructional type. Strong and well proportioned.
Price 10/6

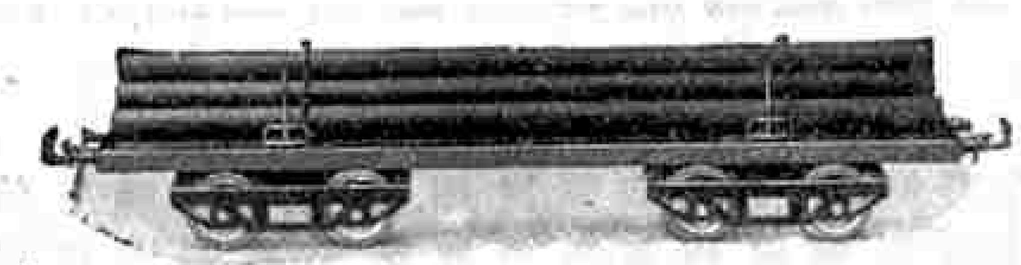


***No. 2 TIMBER WAGON**
Beautifully enamelled in green. Suitable for 2-ft. radius rails only ... ... Price 4/6

No. 1 TIMBER WAGON
Beautifully enamelled in green.
Price 2/-



***No. 1 LUMBER WAGON**
Fitted with bolsters and stanchions for log transport
Price 2/-



***No. 2 LUMBER WAGON**
Fitted with bolsters and stanchions for log transport. Suitable for 2-ft. radius rails only.
Price 5/-

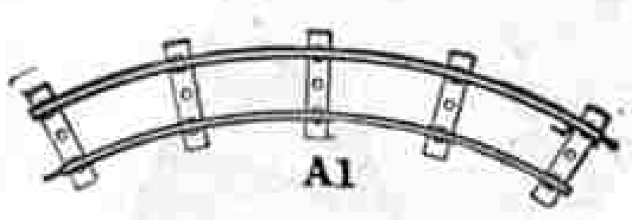
PLATFORM ACCESSORIES
No. 1. Miniature Luggage.
Price per set 2/-

PLATFORM ACCESSORIES
No. 3. Platform Machines, etc.
Price per set 2/-

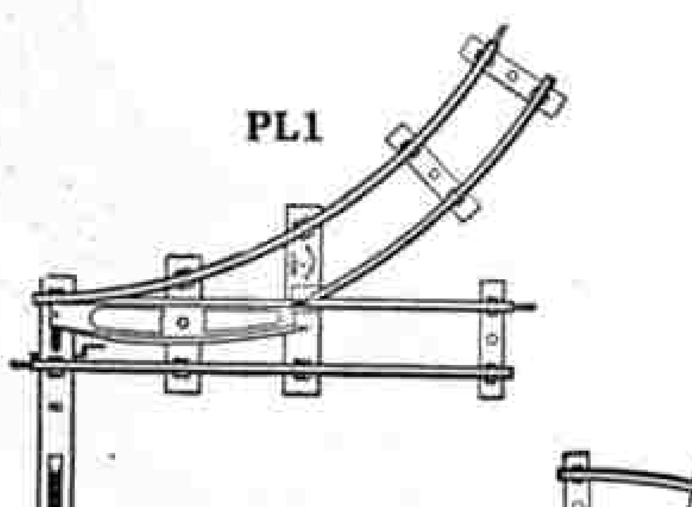
PLATFORM ACCESSORIES
No. 2. Milk Cans and Truck.
Price per set 2/-

**Lettered L.M.S. or L.N.E.R.*

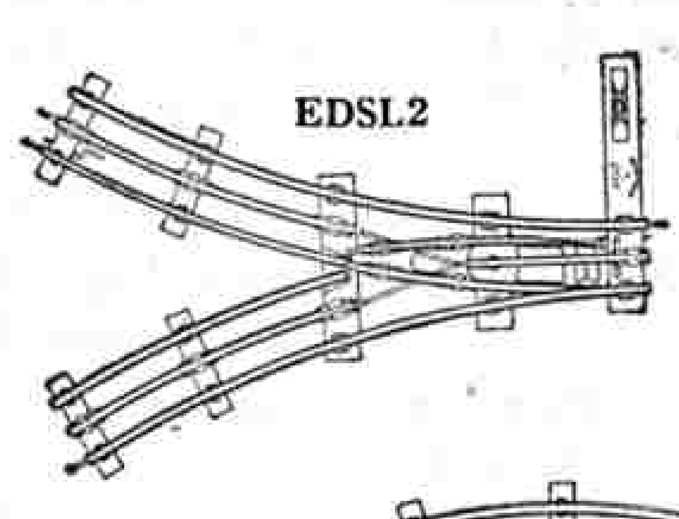
RAILS, POINTS AND CROSSINGS



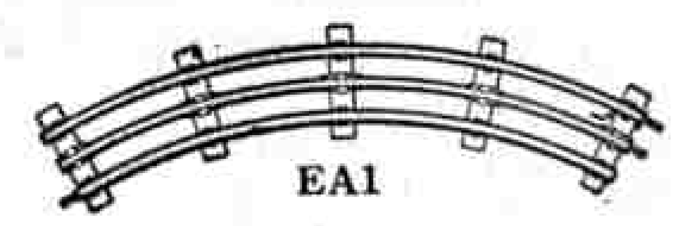
A1



PL1



EDSL2



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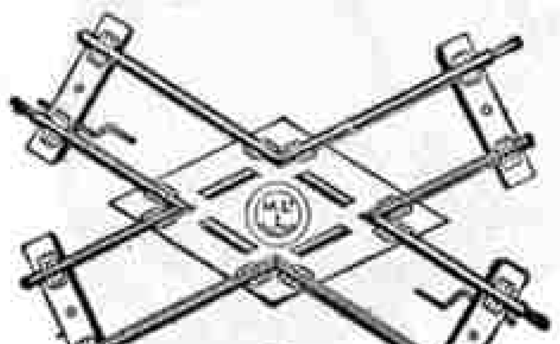

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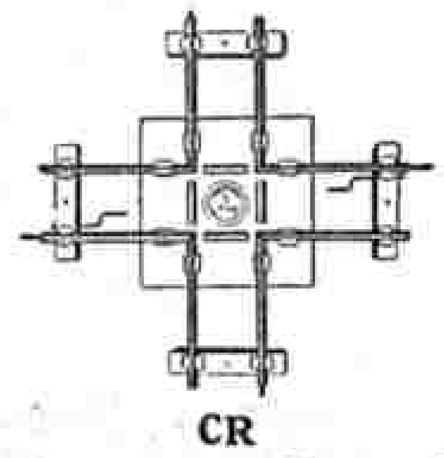

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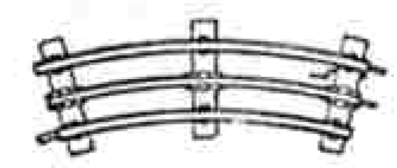
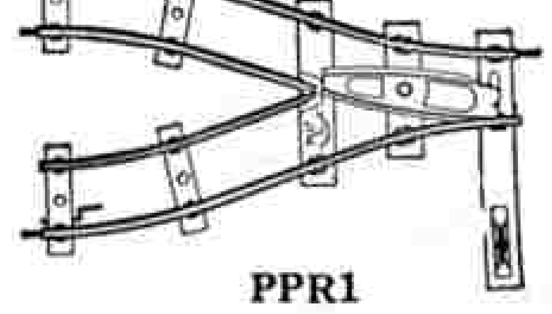
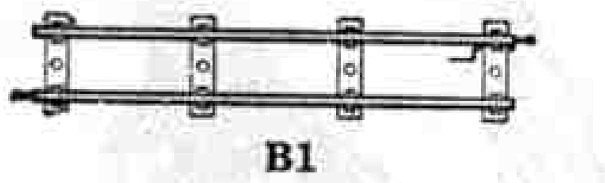


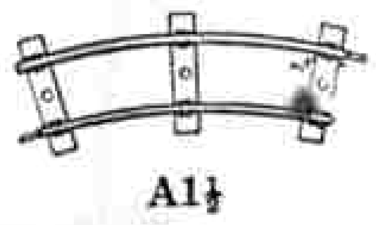
EA1½



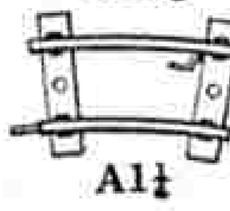
PPR1



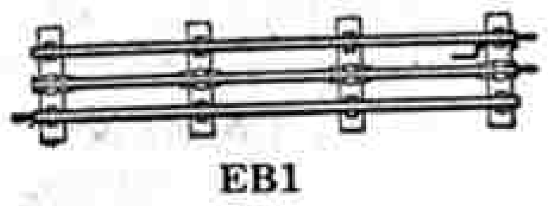
B1



A1½



A1¼



EB1

Hornby Rails, Points and Crossings are built for hard wear and for smooth running. They are made of the finest materials and hold together rigidly and strongly, for real workmanship is put into them. Note the great superiority both in quality and appearance of the Hornby rails compared with other rails and note also the extra sleepers, giving added strength and steadiness to the track. All Hornby Rails, Points and Crossings are Gauge 0, 1¼", and the Electric rails are fitted with a third rail for collecting shoe.

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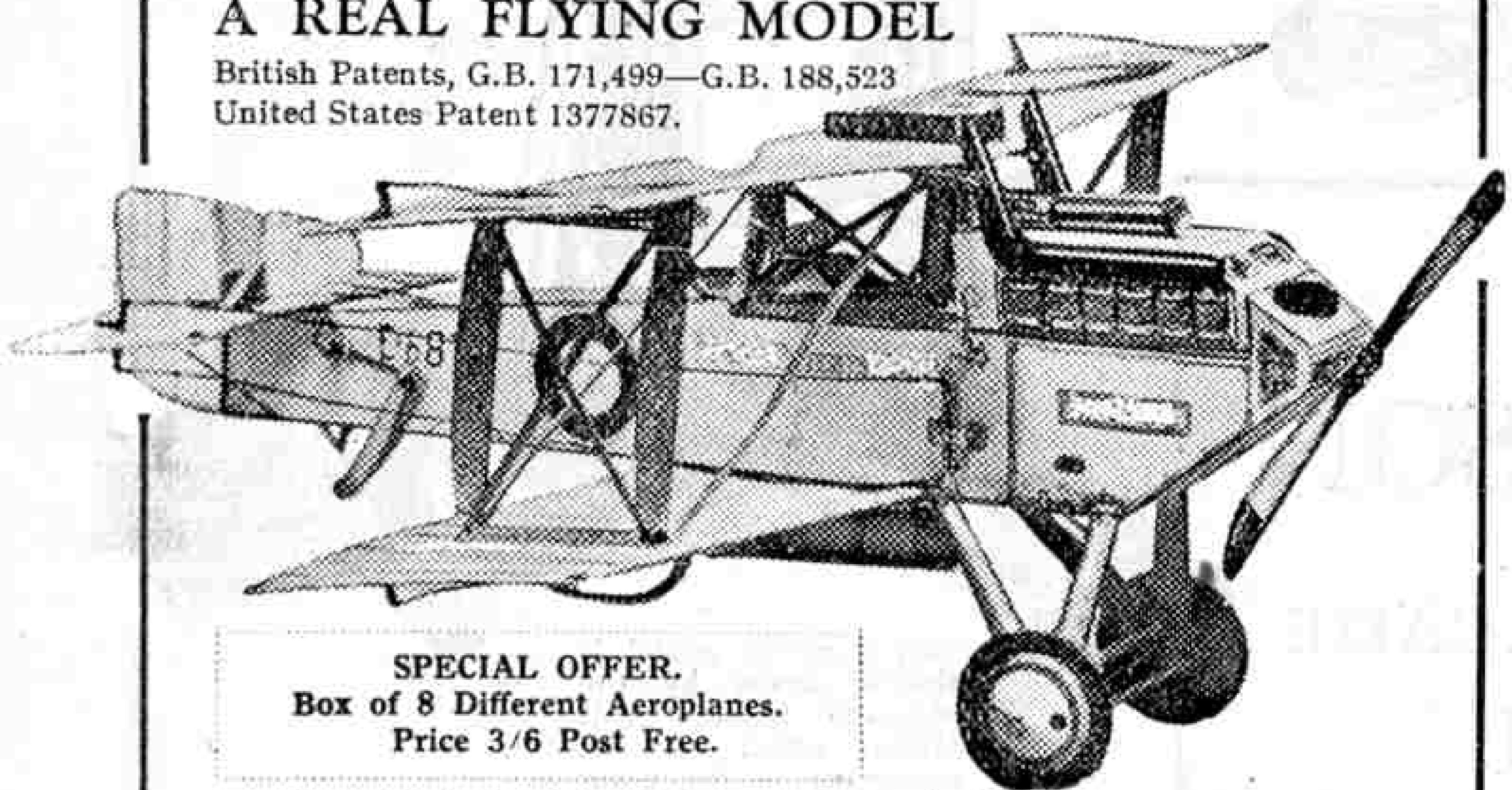
British Patents, G.B. 171,499—G.B. 188,523
United States Patent 1377867.



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Size of Model 12″, Span 13″ Long.

Complete Set of Cardboard Parts printed in colours, together with all necessary Elastic, Wood, Wire and Book of Instructions.

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OF MECCANO RADIO APPARATUS

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or 11/3 post free

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The Meccano Receiver with a good aerial should give effective reception from a radius of 30 miles, according to local conditions, on which the range at over 15 miles largely depends.

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(BRITISH MADE)

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(4,000 ohms resistance)

Of the highest quality procurable, they give loud, clear, undistorted reception and add greatly to the efficiency of any type of receiver. Comfortable to wear and easily adjusted. Only a limited number available.

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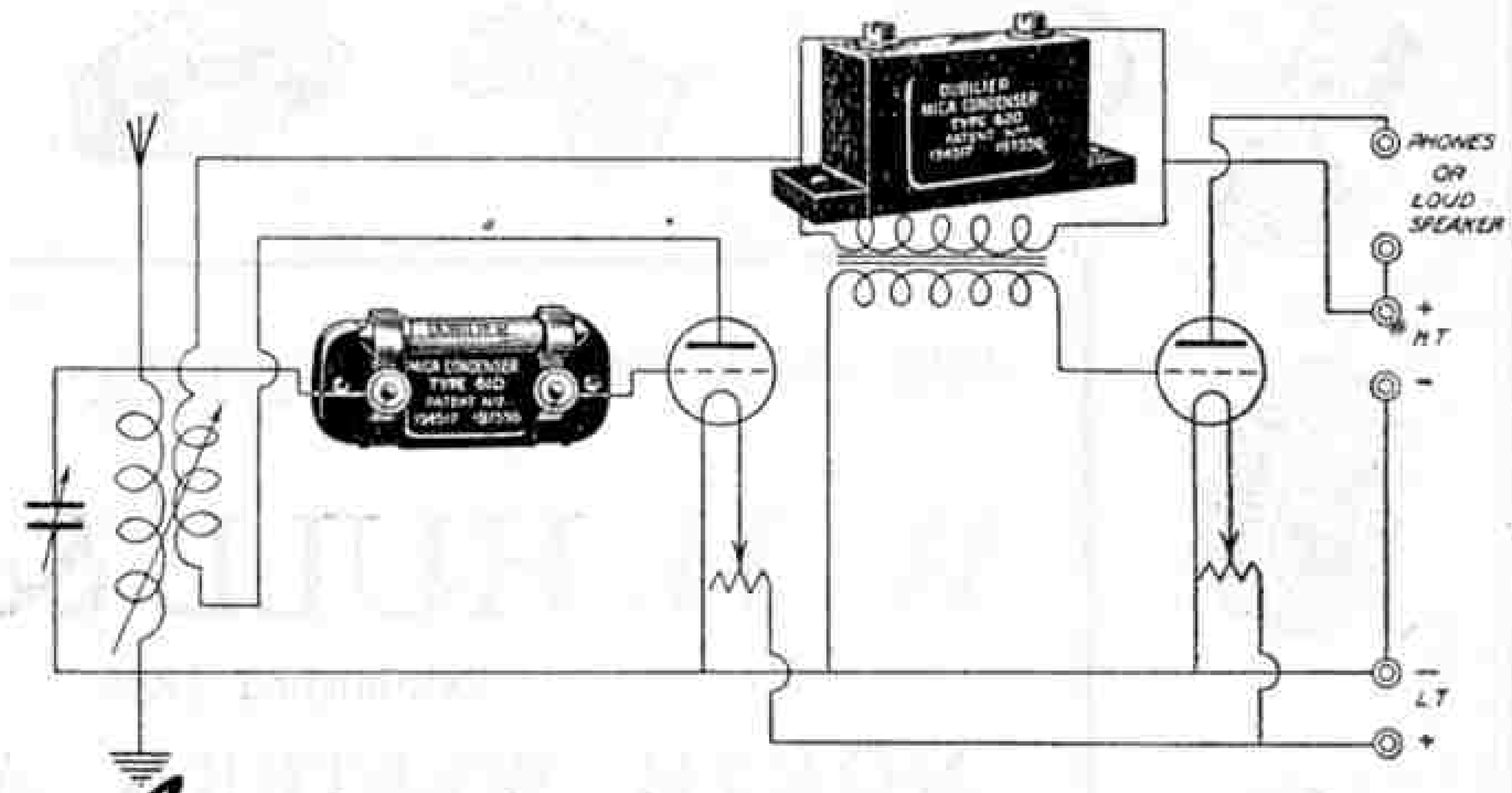

Little things that matter!

It has always been difficult to pick out the little things in life that matter. It takes accountants to find the little errors in accounts; engineers those little failures in a machine that mean so much; and experts to tell what is really wrong with an inefficient wireless set.

This last is always a troublesome affair; a number of very minor defects and mal-adjustments, each insignificant in itself, may together make a good set apparently useless.

For example: condensers, which are really essential in EVERY set, can, if defective, cause rapid exhaustion of H.T. Batteries, and in a grid circuit, they can prevent the grid from reaching its maximum efficient potential, thus weakening the signal strength.

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Specify Dubilier

REGISTERED DUBILIER TRADE MARK

DUBILIER CONDENSER CO (1925) LTD

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NOW

as a result of improved apparatus, searching tests and expert experience **YOU can have A VALVE SPECIALLY FOR DETECTION;** this means that your radio rectification will be **purer and stronger.**

MULLARD DOUBLE WHITE RING VALVES ARE REAL MASTER DETECTORS.

They are **specially selected** for the detector stage in YOUR set. Obtainable from all dealers in two types.

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Type D·3 for accumulators (1·6-2 volts) - - - 14/- each

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Ask your dealer for Leaflet V.R.26

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THE ◆ MASTER ◆ VALVE

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Adjustable Diaphrams 4,000 ohms, extra long cords. Every pair tested and guaranteed ... ... per pair 10/6
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FREE!

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When ordering state "Meccano."

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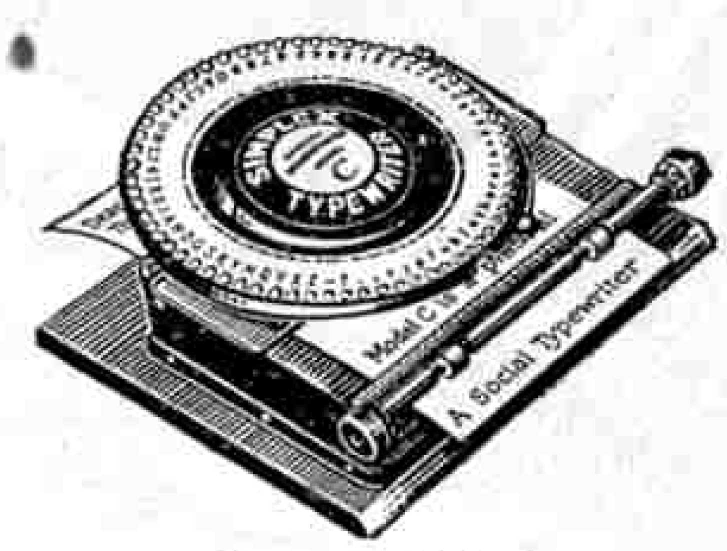

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POST FREE **1/6**

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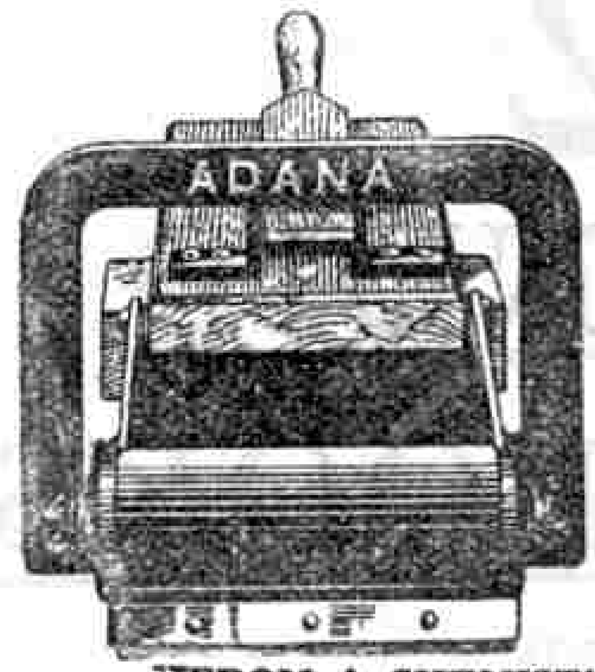

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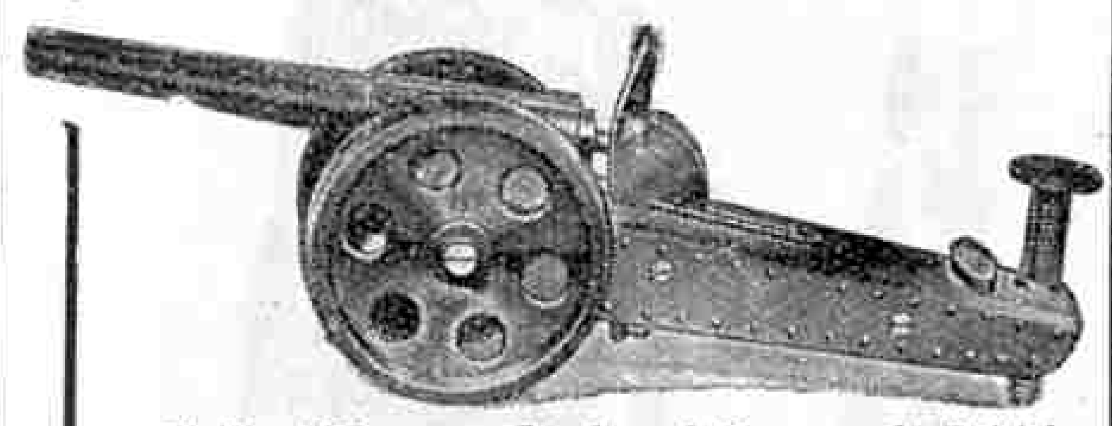

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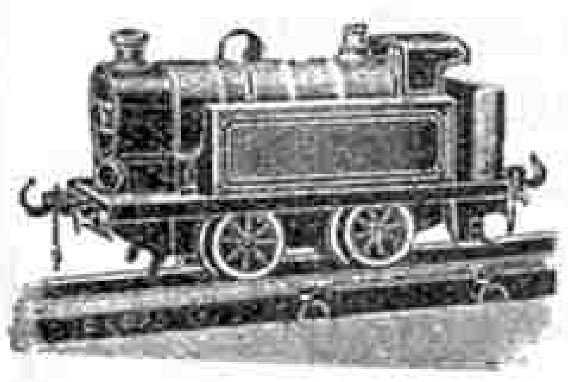

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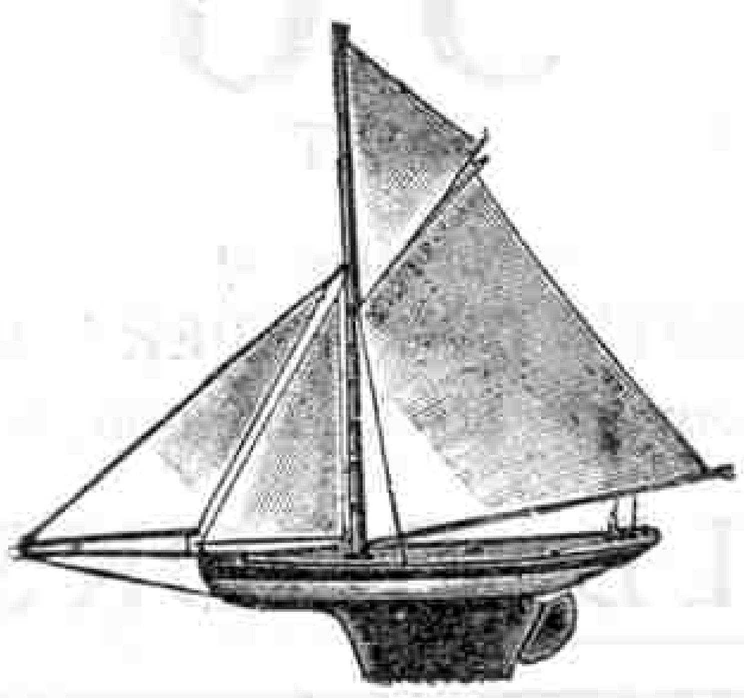

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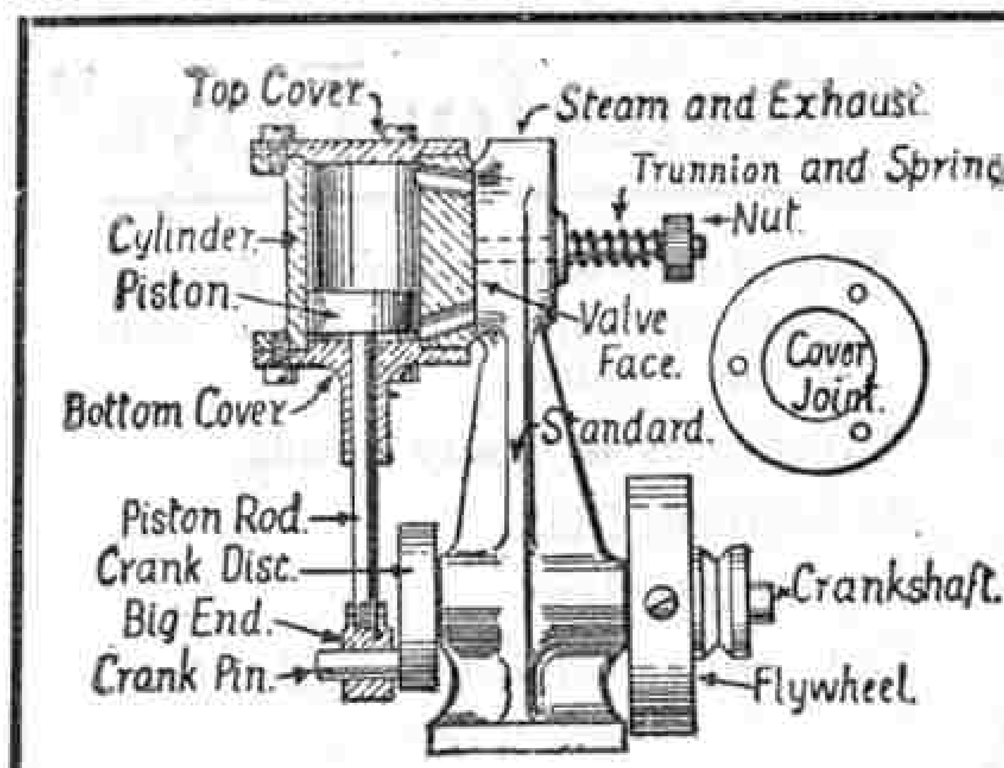

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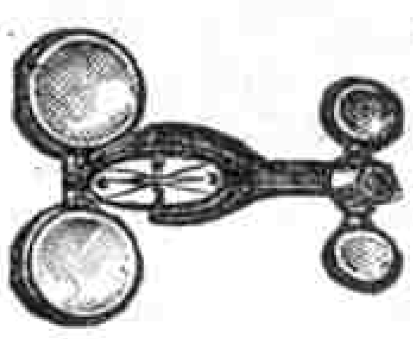

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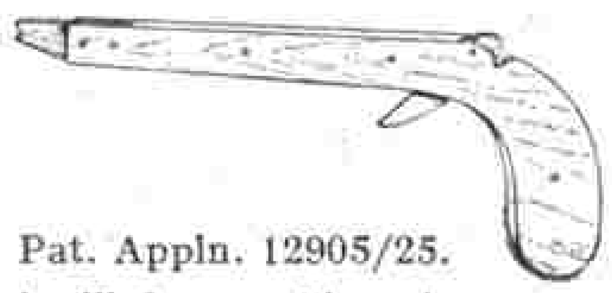

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Publication Date. The next issue of the "*M.M.*" will be published on the 9th December, and may be ordered from any Meccano dealer, or from any bookstall or newsagent, price 6d. per copy. The "*M.M.*" is mailed direct from this office, 2/- for six issues and 4/- for twelve issues.

To Contributors. The Editor will consider articles and photographs of general interest; payment will be made for those published. Whilst every care will be taken of those submitted, the Editor does not accept responsibility for any loss or damage. A stamped addressed envelope should be sent where the contribution is to be returned if unacceptable.

Binding Cases. Spring-back Binders to take a number of "*M.M.'s*" are supplied, covered with imitation leather and lettered in gold, price 3/- each (post free).

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Advertisements

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Small Advertisements. 1/- per line (average seven words to the line), or 10/- per inch (average 12 lines to the inch). Cash with order.

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Press Day, etc. Copy must be received not later than 10th of each month for publication in following issue. Half-tone blocks up to 100 screen.

Proofs of advertisements will be sent when possible for space bookings of not less than half-an-inch.

Voucher Copies. Sent free to advertisers booking one inch or over. Other advertisers desiring vouchers should add 4d. to their remittance and should order voucher copy at same time.

Remittances. Postal Orders and Cheques should be made payable to Meccano Ltd.

Obtaining the "*M.M.*" Overseas

Readers Overseas and in foreign countries may order the *Meccano Magazine* from regular Meccano dealers, or direct from this office. The "*M.M.*" is sold Overseas at 3d. per copy, or mailed (post free) direct from Liverpool, 2/- for six issues, or 4/- for twelve issues.

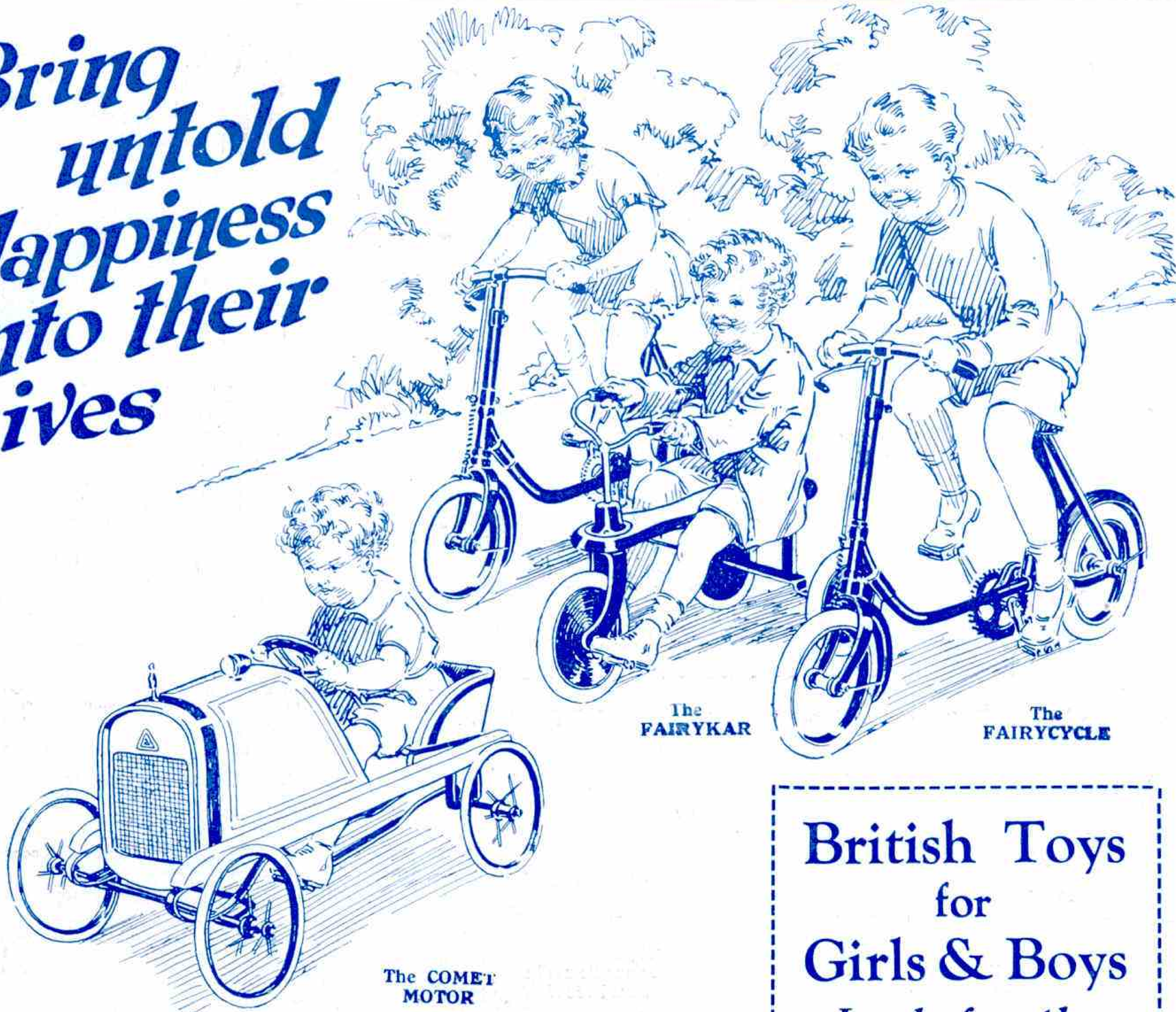
IMPORTANT.

Overseas readers are reminded that the prices shown throughout the "*M.M.*" are those relating to the home market. Current Overseas Price Lists of Meccano Products will be mailed free on request to any of the undermentioned agencies. Prices of other goods advertised may be obtained direct from the firms.

CANADA: Meccano Ltd., 45, Colborne Street, Toronto.
AUSTRALIA: Messrs. E. G. Page & Co., 52, Clarence Street, Sydney, N.S.W.
NEW ZEALAND: Messrs. Browning, Ifwersen Ltd., P.O. Box 129, Auckland.
SOUTH AFRICA: Mr. A. E. Harris (P.O. Box 1199), Textile House, Von Brandis St., Johannesburg.

This Month's Special Articles

Bring untold Happiness into their Lives



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Only 27/- each

with wired-on rubber tyres. Many other models up to enclosed Saloons with ball-bearing pedals and balloon size tyres.

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BE SURE YOU RIDE A FAIRYCYCLE

49/6

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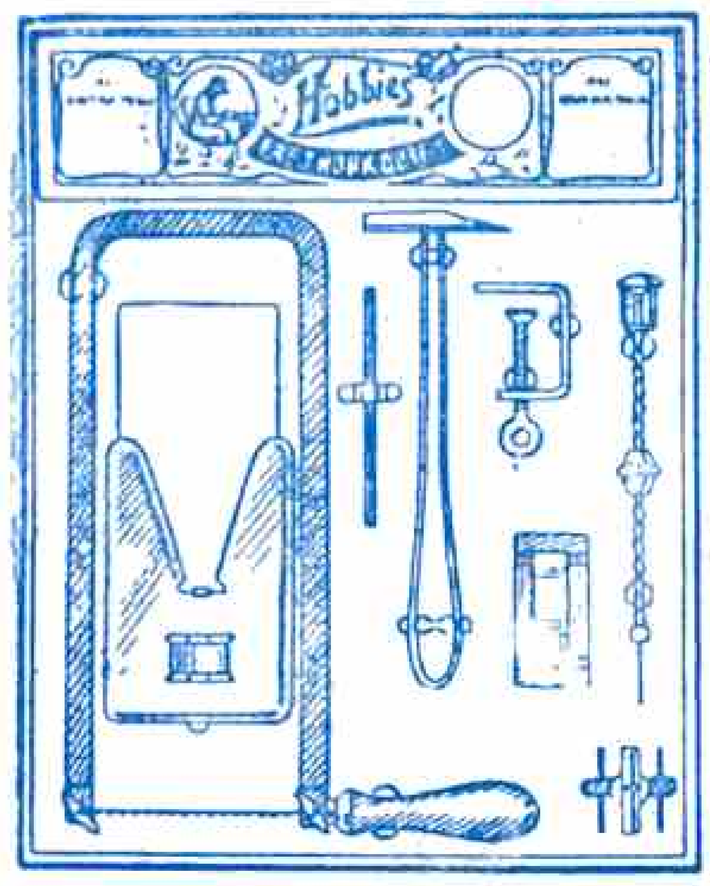

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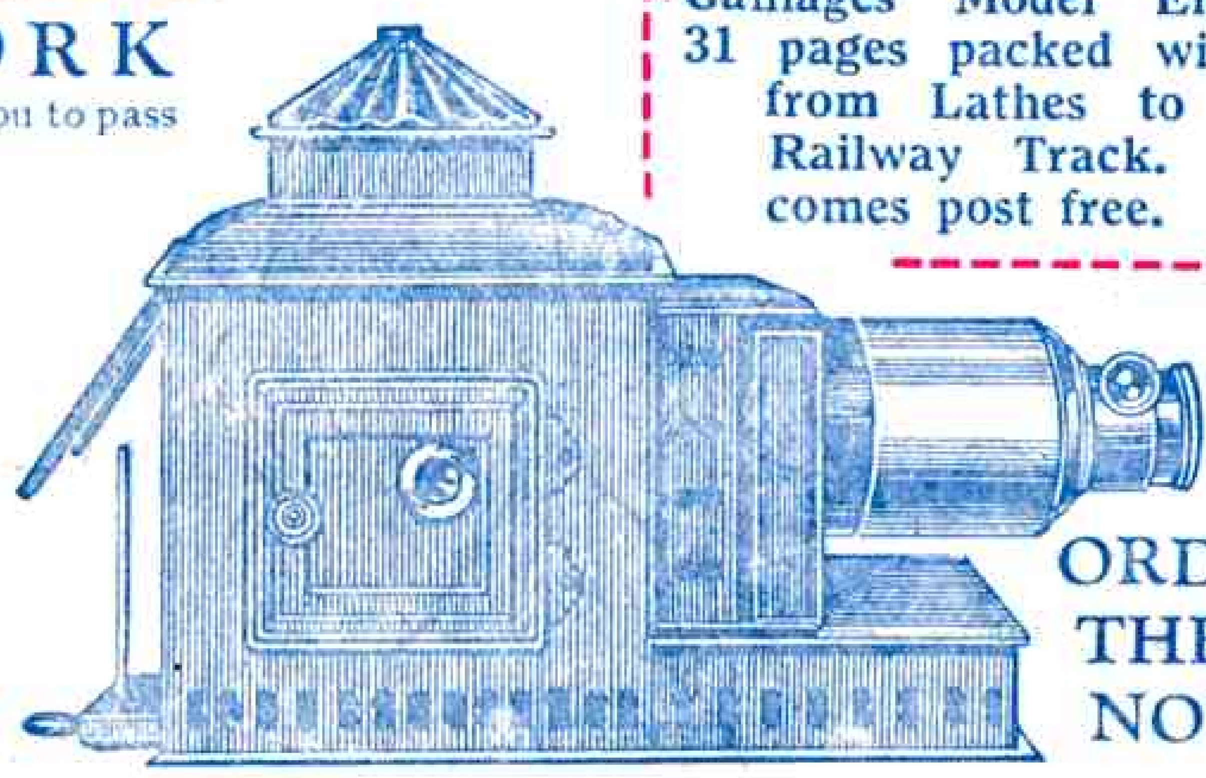

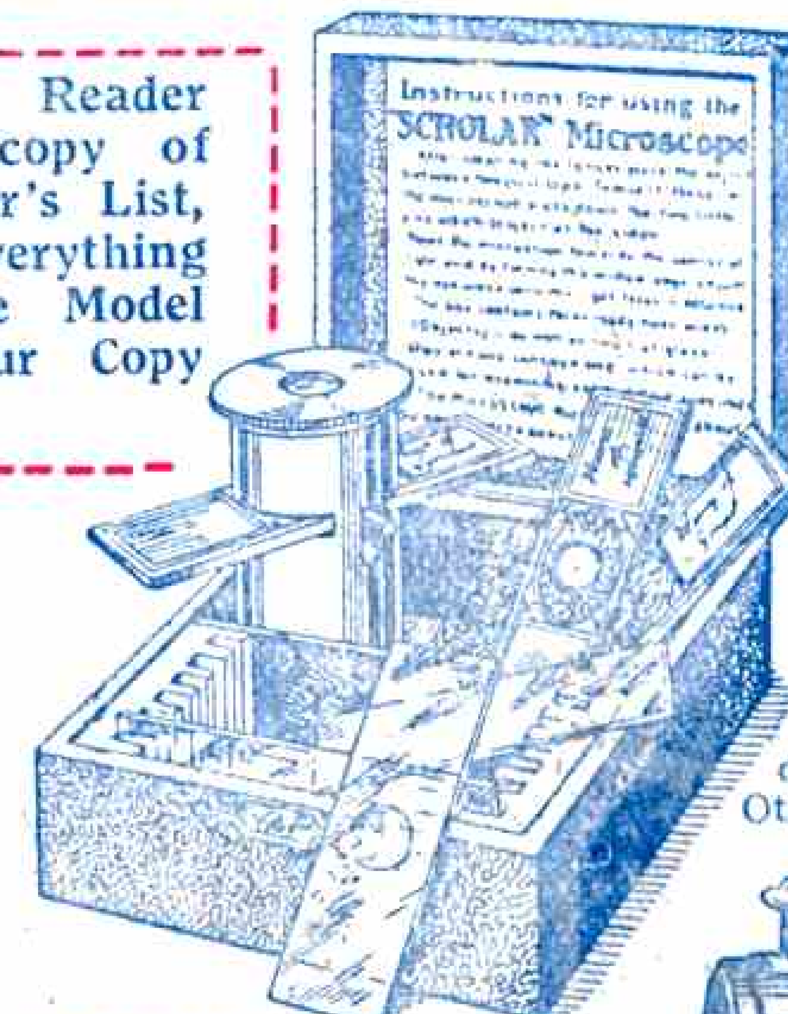

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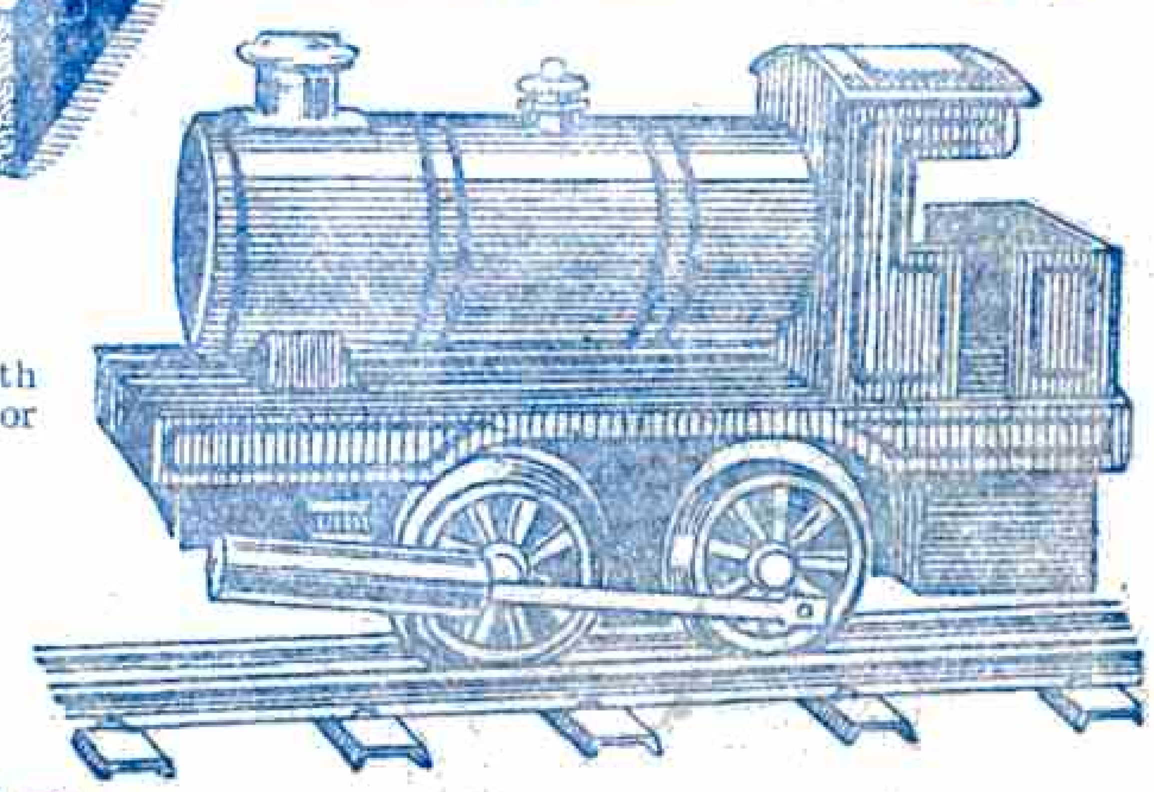

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