VOL. XIX. No. I. JANUARY 1934

MECCANO MAGAZINE

6D.

MACHINING DRAUGHT CHEST OF HUGE HYDRO-ELECTRIC PLANT

(see page 2)

be a FROG PUSS MOTH Private Owner!

A sensational NEW FLYING SCALE MODEL. A beautifully made replica of the popular De Havilland PUSS-MOTH, the famous light aeroplane. This model incorporates many ingenious and patented features.

The fuselage is of all metal construction. The hollow wings are reinforced to prevent warping, and are of the quick detachable type which prevents damage in the event of a crash.

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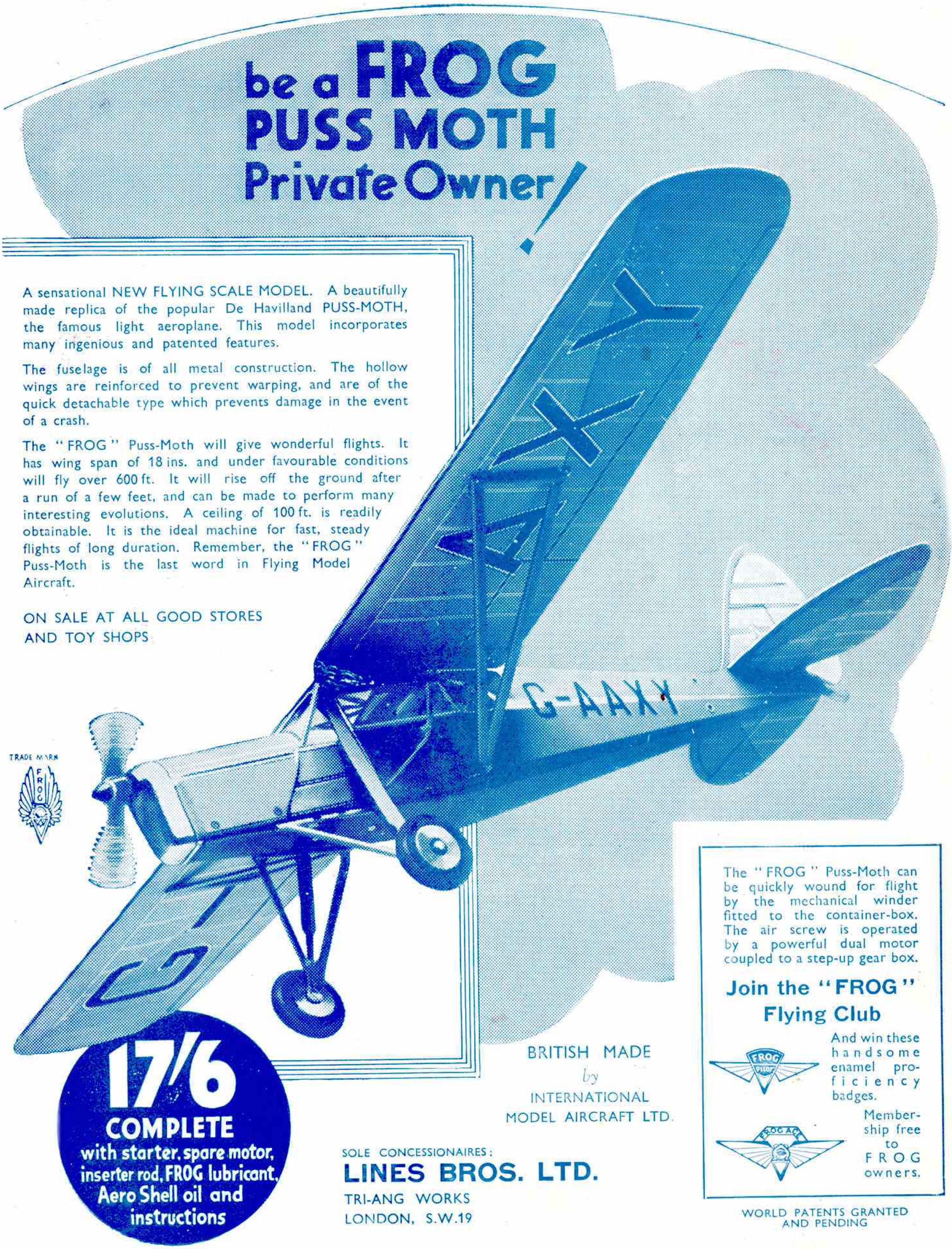
ON SALE AT ALL GOOD STORES AND TOY SHOPS



BEST WISHES FOR 1934 TO ALL MY READERS — FROM THE EDITOR

Warner's QUALITY TOYS NEWCASTLE-ON-TYNE

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January, 1934

With the Editor

Engineering Progress in 1933

At this time of the year it is interesting to look back over the preceding twelve months, and to note what advances have been made in various branches of engineering. Although 1933 has not been remarkable for many events of a really outstanding character, it has nevertheless been a year full of developments in engineering, aviation, and in the railway world.

Perhaps the most interesting engineering event was the opening by the King of the Graving Dock at Southampton on 26th July, for this holds out promise for the future and is evidence of the Southern Railway's confidence in the development of our mercantile marine. The primary purpose of the new dock is to accommodate the giant liners that use the port of Southampton, and it has been planned to be large enough to take the Cunard liner now lying uncompleted on the stocks at Glasgow, and even larger vessels, for it is 1,200 ft. long and 135 ft. wide.

The World's Highest Dam

Among great engineering schemes in progress one of the most notable is the giant dam that is being constructed to curb the turbulent Colorado River in the United States. Boulder Dam, as this great structure is to be called, will be the highest of its kind in the world, and the whole project of which it forms part is believed to be on a greater scale than any similar scheme yet carried out. A gigantic lake 115 miles in length will be formed behind the barrier when it is completed, and this will supply water for drinking purposes, for irrigation, and for the development of electric power. During 1933 the most important part of the preliminary work was completed with the boring of four gigantic tunnels to carry the water of the river away from the site on which the dam is to be built. This paved the way for the excavation of the site to bed-rock, and then will commence the gigantic task of pouring concrete to build the barrier. Splendidly-illustrated articles describing the work that has been carried out so far will be included in early issues of the "*M.M.*"

The two outstanding events in the railway world were the inauguration of the first British main line electrification scheme and the appearance of a larger and heavier passenger locomotive than had previously been employed in this country. The electrification scheme to which I refer is of course that accomplished on the Southern Railway route from London to Brighton, which was brought into operation on the first day of the year. The electric trains have given every satisfaction during the twelve months, and the lines to Eastbourne and Hastings are now to be electrified. The electrical equipment will be similar to that already in use on the Brighton main line, and the work will be of considerable assistance to British industry. As a result the total mileage of electrified track on the Southern Railway will amount to no less than 1,146 miles.

Commander Attilio Gatti, the famous Italian explorer, who has just left England on his eighth expedition to Central Africa. Articles by him will appear in the "M.M." during the year.

Britain's Largest Passenger Locomotive

The new locomotive is the long-awaited "Pacific" design of the L.M.S.R. This company have never previously built an engine of this wheel formation, and have now taken the step in order to have available engines capable of hauling loads of 500 tons up the gradients on the West Coast route between London and Glasgow. "*The Princess Royal,*" the first engine of this class, has proved very successful in main line service. For several weeks towards the end of last year she was responsible for a daily mileage probably greater than has been previously attempted in this country, for she regularly made the double journey between Carlisle and Euston, a total of 598 miles.

The L.M.S.R. locomotive "*Royal Scot*" also has figured prominently in the railway world owing to the wonderful success of her visit, with a train of typical up-to-date rolling stock, to Canada and the United States. The locomotive and train were sent across the Atlantic for exhibition at the Chicago World's Fair, and the interest they aroused during preliminary journeys in Canada and the United States, and at the Fair itself, was so great that a more extended tour than that originally planned was carried out. The send-off given the train at the close of the Exhibition was remarkable for the enthusiasm displayed. School children in Chicago were given a holiday to witness the departure, and locomotives and factories whistled and hooted in salute.

An Aeroplane Without Wings

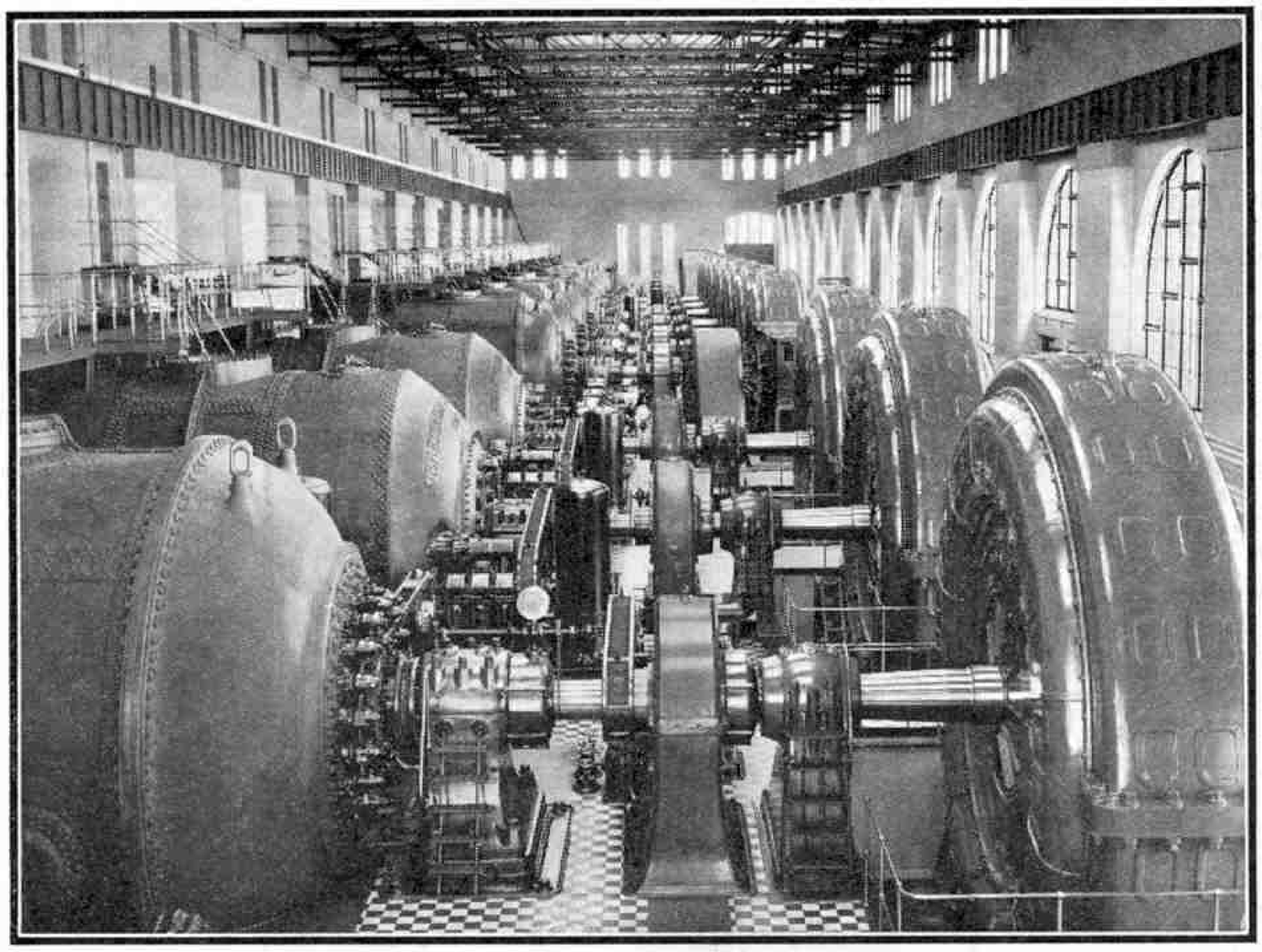
The most outstanding event in aviation probably has been the production of a new form of Cierva "Autogiro." As my readers know from articles and photographs that have appeared in the "*M.M.*," previous versions of this machine have had small lateral stabilised wings. In the present model these are dispensed with, and the machine consists simply of a fuselage above which is a unit comprising three rotors. It is steered by tilting the rotors by means of an inverted "joy-stick," the normal control column and rudder part of the ordinary aeroplane being dispensed with. The success of the "Autogiro" marks a bold experiment that may indicate the lines along which advances in aeroplane design will be made.

One of the boons that we all expect aviation to confer upon us sooner or later is the ability to cross the Atlantic in a few hours with complete safety and with less discomfort than is experienced during average sea voyages. For this reason it is interesting to realise that during 1933 an experimental trans-Atlantic service was actually in operation for a few months. This service was provided by the Deutsche Luft Hansa, the flying boats of which crossed the South Atlantic Ocean. The flights were not made in single hops, for the machines alighted in mid-Atlantic in order to obtain fuel and other requirements from the "*Westfalen,*" a liner that has been converted into a floating aerodrome, equipped with pick-up and catapult gear.

A Swedish Hydro-Electric Plant

Interesting Station at Trollhättan

THE vast development of the world's industries during the past 100 years has been based on a corresponding development of power production and transmission. Electricity provides the most satisfactory means of transmitting power over long distances, and generators for producing the necessary current have been brought to a high pitch of perfection. For a long time these generators were driven by reciprocating steam engines. Then came the more efficient steam turbine, which is in use in most of the large electric power stations of to-day. The amount of coal consumed in raising steam for all these engines is enormous, and during recent years careful calculation of the world's coal supplies has shown that these are rapidly being exhausted. Engineers therefore have turned their attention to another and apparently inexhaustible natural source of energy, namely, water power. Hydro-electric power stations on a large scale are already in existence in many parts of the world, and in this article we give a brief description of the station at Trollhättan, about 47 miles from Gothenburg, Sweden.



A fine view of the giant turbo-alternators of Sweden's largest hydro-electric power station, which is situated at Trollhättan on the Gotha River. For our illustration and the information in this article we are indebted to Mr. George Willock, Trollhättan, Sweden.

Sweden possesses several fine hydro-electric installations, of which that at Trollhättan is the most up to date and powerful. It is owned by the Royal Board of Waterfalls, and is situated on the Gotha River, about 8¾ miles below Lake Vanern, at which point the falls cover a distance of three-quarters of a mile. Our cover illustration shows the interior of a huge draft chest, which forms part of the water-regulating system at this station, undergoing reconstruction. On this page we illustrate a striking interior view of the power house, showing the turbines and alternators.

The power house is 480 ft. in length and 75 ft. in width. The electric current generated is transmitted by cables laid in tunnels from the generators to a switch and transformer house. This accommodates three 44,000-kVA, 10/50 kV 25-cycle banks of transformers, and the necessary switchgear. In addition there is another building in which are three 48,000 kVA, 10/130 kV transformers. From the transformers the current is distributed by overhead cables.

The Trollhättan plant was first put into service in 1910 and was finally completed in 1920, but it has recently been modernised, with a view to increasing its electrical output. The station consists of 11 double-runner water turbines, each running at 187.5 r.p.m. and developing 12,500 b.h.p. These huge monsters drive eight 11,000 kVA alternators, and there are also two 13,200 b.h.p. turbines driving 13,500 kVA, 11-kV alternators. For lighting the numerous lamps required throughout the power station, and also for driving the auxiliary machinery, three small turbines of 500 b.h.p. each are provided, and these are direct coupled to 350 kW, 220-300 volt direct current generators. In addition there is a storage battery with a capacity of 4,750 ampere hours.

One or two of the turbines and alternators have recently been modernised in order to increase their output to 16,000 b.h.p. Experiments were first made on a perfect detail model of a turbine, built in exact proportion to the actual turbines, and a great deal of research work was carried out before the reconstruction work was commenced. The water wheels or runners of the old turbines were made of cast steel and were 5 ft. 11 in. in diameter. It was decided, as part of the reconstruction work, to increase the diameter of the runners to 6 ft. 4 in., and to fit them with 18 buckets made of stainless steel plate. Some of the alternator units also are to be modernised, and it is estimated that when the work of reconstruction is completed the total output of the plant will be increased from 163,900 to 197,400 b.h.p.

In order to control the flow of water to the turbines so as to regulate their speed, there is a regulating dam, which consists of two roller dams each 66 ft. long, through which water is admitted in a stream of variable quantity by adjusting the size of the sluice gates. As the movement of these gates requires great force, special apparatus actuated by the turbines is used for the work.

Carrying the "Grid" Across the Thames

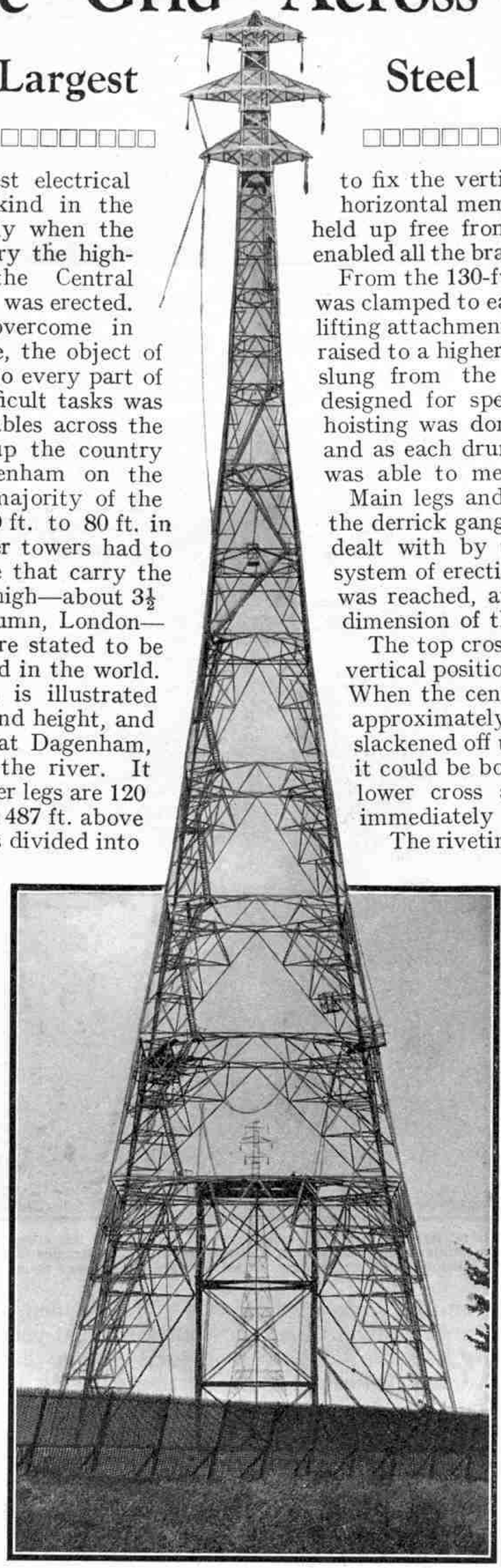
World's Largest Steel Pylons

THE construction of the greatest electrical distribution system of its kind in the world was completed recently when the last of the 26,265 towers that carry the high-power transmission lines of the Central Electricity Board's "Grid" scheme was erected.

Many problems had to be overcome in carrying out this ambitious scheme, the object of which is to bring cheap electricity to every part of the country. One of the most difficult tasks was that of carrying the high-power cables across the River Thames, in order to link up the country south of the Thames with Dagenham on the northern side of the river. The majority of the ordinary land towers are from 70 ft. to 80 ft. in height, but much taller and heavier towers had to be used for river crossings. Those that carry the cables over the Thames are 487 ft. high—about 3½ times the height of the Nelson Column, London—and weigh 300 tons each. They are stated to be the largest steel pylons of their kind in the world.

The two towers, one of which is illustrated on this page, are similar in design and height, and that on the north side is situated at Dagenham, about 50 yds. from the bank of the river. It stands on a square base and its corner legs are 120 ft. apart. The peak of the tower is 487 ft. above the base line, and the total height is divided into six panels, the four lower panels each being 87 ft. high, the fifth 85 ft., and the top one 54 ft. A stairway runs up to the 348-ft. level, but the remainder of the tower is ascended by means of ladders. In addition, provision is made for a lift.

The junction of the four main legs is made at the top of the first panel level, and at this point the tower is 85 ft. square, each leg having a cant towards the centre of 17 ft. 6 in. from the vertical. To effect this junction a temporary joist tower 89 ft. high by 35 ft. square was erected. On this was mounted a circular rail track on which ran three steel carriages carrying a three-ton derrick crane with a 55-ft. jib. This arrangement enabled the constructors to reach a point 130 ft. above the base level. From each corner of the temporary trestle outriggers were fixed at the ends of which 1¾ in. adjusting screws were attached, and these dealt in a speedy manner with the slight irregularities in the square dimension. It was then possible to fix the vertical and horizontal bracings, as the horizontal members connecting the main legs were held up free from sag by the derrick crane, which enabled all the bracing members to be speedily erected.



One of the two enormous steel towers that carry the national electric "Grid" across the River Thames. Each tower is 487 ft. in height, or approximately 3½ times the height of the Nelson Column, London.

From the 130-ft. level a redwood fir pole 55 ft. long was clamped to each main leg, and at a suitable point lifting attachments were fixed to enable the pole to be raised to a higher level. Blocks suitably reeved were slung from the pole top, the whole outfit being designed for speedy lifting and pole raising. The hoisting was done by 28 h.p. double drum motors, and as each drum was independent, one winch man was able to meet the requirements of two poles.

Main legs and main bracings were assembled by the derrick gangs, and the secondary members were dealt with by two further squads of men. This system of erection was used until a height of 400 ft. was reached, at which level the horizontal square dimension of the tower is 12 ft.

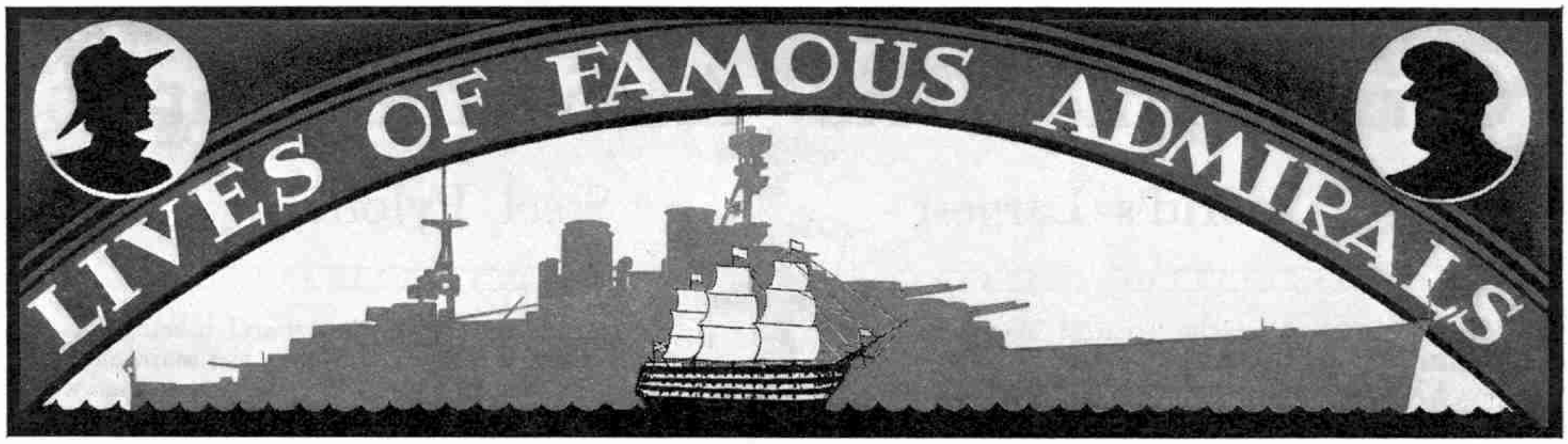
The top cross arm was held during hoisting in a vertical position by means of a second wire lashing. When the centre of the arm had been hoisted to approximately the correct height, the lashing was slackened off until the arm was horizontal, so that it could be bolted to the tower. The middle and lower cross arms were erected from the arm immediately above.

The riveting was done from lightly constructed steel cages suspended by blocks and ropes for raising, and by side guys for lateral movements. Each of the main legs of the tower consists of 17 splices below the galvanised portion of 87 ft., and in each splice an average of 100 rivets had to be put in on the site, while in the bottom panel more than 7,000 rivets had to be dealt with.

Owing to regulations at the site, all naked lights were strictly prohibited, and as a consequence rivets had to be electrically heated.

The south tower is situated at Crossness, about 20 yds. from the river bank, and is a duplicate of the north tower.

Each tower comprises 17,000 pieces of structural steel, 35,000 rivets and 7,000 bolts, a total of 59,000 pieces per tower. The pylons were designed by Milliken Brothers Ltd., London, and were built at Warrington and erected by the Pearson and Knowles Engineering Company Ltd., with steel supplied by the Lancashire Steel Corporation Ltd.



X.—LORD ST. VINCENT

ST. Valentine's Day is remembered chiefly in connection with an old custom by which young people used to exchange tokens of affection. It is also the anniversary of a notable naval battle in 1797 between England and Spain, when a decisive victory was won by the British fleet, under Admiral Jervis.

John Jervis was born at Meaford, Staffordshire, in January 1735. His father was a barrister, and in 1747 he was appointed Counsel to the Admiralty and Admiralty Auditor to Greenwich Hospital. Apparently the family then removed south, as the boy was transferred from a private school at Burton-on-Trent to one at Greenwich. It was intended that he should take up law, but the environment of the naval port aroused in him so great a liking for the sea that, accompanied by a chum, he ran away from school in order to become a sailor. The protests of his parents and relatives proved in vain, and when it was seen that nothing would turn the lad from his resolve an influential uncle introduced him to Lord Anson, then Vice Admiral of the Fleet; and on 4th January, 1749, Jervis began his naval career as an able seaman on board Admiral Townshend's flagship "*Gloucester*."

Admiral Jervis, Earl of St. Vincent. The illustrations to this article are from prints in the possession of T. H. Parker Ltd., 28, Berkeley Square, London, by whose courtesy we are enabled to reproduce them.

During the next 10 years Jervis served in many different ships and gradually rose to a responsible rank. He became a midshipman in 1752 and a lieutenant three years later, and in this latter capacity he served in the "*Nottingham*," one of the ships of Admiral Boscawen's fleet that co-operated with an army under General Amherst in North America in an attack upon Louisburg and Cape Breton. Subsequently Jervis served under Admiral Saunders in the Mediterranean, and returned to England in 1758 on board the "*Foudroyant*," a prize ship of 80 guns that by capture had become one of the finest two-deckers in the British Navy. Saunders' next commission was an expedition to Canada to assist in the great attack on Quebec, and when his squadron left England in January 1759 Jervis was aboard the flagship. In June of that year Saunders appointed Jervis to be commander of the sloop "*Porcupine*," and in her, accompanied by Wolfe, Jervis led the transports safely past the batteries of Quebec. Shortly afterward he was transferred to the "*Scorpion*" and he returned to England with despatches.

In 1760 Jervis was promoted to post-captain and moved to the "*Gosport*," of 44 guns. In this ship he served with the Channel fleet in the North Sea, and in September 1762 joined Commodore Lord Colville, who was then operating for the recapture of Newfoundland, which had been taken by a French squadron under Admiral de Ternay. Colville's ships blockaded the island, but eventually a violent gale drove them out to sea and the French availed themselves of this opportunity to escape. Subsequently the island was recaptured for England, and in 1763 Jervis returned home.

The next 12 years were uneventful, and Jervis spent only a small part of the period at sea. On 1st September, 1775, he was appointed to the "*Foudroyant*," in which he had served earlier as a lieutenant, and during the next few years he was kept busy on cruises and convoy duties. In 1782 the "*Foudroyant*" was attached to a division of the Channel fleet, commanded by Vice Admiral Partington, and on 19th April that year the division encountered off Brest a French convoy outward bound for the West Indies. Partington gave the signal for a general pursuit, and Jervis hastened after the "*Pégase*," a 74-gun French ship of the line, carrying 700 men. The "*Pégase*" set a fast pace, but the "*Foudroyant*" was the swiftest ship in the English division, and she overtook the French vessel shortly after midnight. A sharp engagement followed, and after 50 minutes' fighting the "*Pégase*" struck. Jervis deserved his victory, and when he returned to England he found himself the hero of the hour, and was knighted for his gallant exploit.

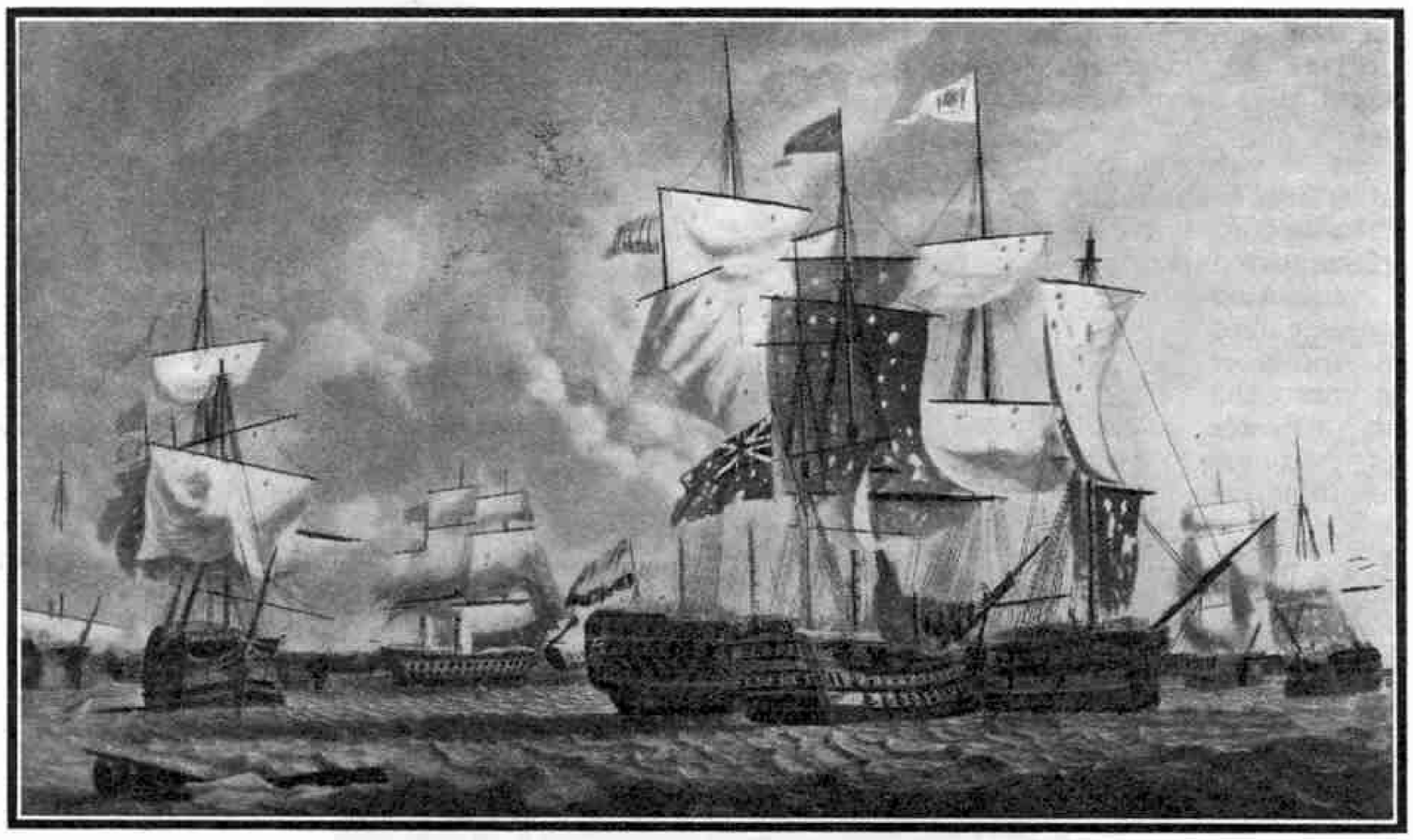
In September 1787 Jervis was promoted to Rear Admiral, and in 1790 he entered Parliament as Member for High Wycombe. When war broke out again between England and France, in 1793, he was promoted to Vice Admiral and in conjunction with Sir Charles Hardy was appointed to the command of an expedition against the French West Indies. The expedition arrived at Barbadoes in January of the next year, and in spite of the ravages of yellow fever among the seamen and troops succeeded in capturing Martinique and Santa Lucia, and also in holding Guadaloupe for a short time. The heavy sickness among the men eventually compelled Jervis to suspend the campaign. He was succeeded in the command in November 1794, and then returned to England.

Jervis was promoted to Admiral in July 1795, and five months later was appointed to the command of the Mediterranean fleet. The alliance of Spain with France in October of the next year rendered the Mediterranean untenable to the English, and Jervis received instructions from home to evacuate Corsica, the inhabitants of which had declared for France, and to withdraw to Gibraltar. He entrusted to Nelson the task of transferring the garrison and stores from Corsica to Elba. At Gibraltar Jervis received orders to evacuate Elba also, and on 14th December, 1796, he despatched Nelson with two small ships to effect this. It was realised in England that as a result of the alliance the Spanish fleet at Cartagena would immediately aid the French fleets at Toulon or Brest in crushing the English Mediterranean fleet. The small force with Jervis was quite inadequate to meet such a combination, and therefore five ships of the line were detached from the Channel fleet and sent under Admiral Parker to reinforce Jervis at Gibraltar. When Jervis learned that these reinforcements were on the way he awaited them off Cadiz, where they joined him on 6th February, 1797.

While cruising several leagues south of Cape St. Vincent a few days later Jervis received news that the Spanish fleet had left Cartagena and had already passed through the Strait of Gibraltar; and he was greatly relieved when Nelson joined him unscathed on 13th February, having passed the Spanish fleet during the previous night. Preparations were at once made for the battle that was expected to take place when the two fleets met.

The Spanish fleet was sighted at daybreak on the 14th, St. Valentine's Day, heading for Cadiz, and when the morning mist had cleared it was seen to include 27 sail of the line, nearly twice as many as the English force. The Spanish ships were superior also in armament, having about 1,000 more guns than the British. The fleet was under the command of Admiral de Cordova on board the "*Santissima Trinidad,*" a fine four-deck ship carrying 130 guns. Six other Spanish ships each carried 112 guns, but only two of the English ships, the "*Victory*" and the "*Britannia,*" carried as many as 100 guns. Jervis was undismayed, however, and he realised that this was his opportunity to win a great victory for England.

The Spanish fleet was in two groups about eight miles apart, and Jervis noted that they did not make any immediate attempt to get into battle formation. The reason for this was that Cordova was not aware that the English fleet of 10 ships known to be somewhere in those waters had been increased to 15, and when he first saw the ships he believed them to be a fleet of merchantmen. As soon as he realised that the approaching fleet was that of Jervis he hastened to close the gap in his ranks. Jervis determined to prevent this, and signalled to his ships to follow the "*Culloden,*" commanded by Captain Troubridge, in a dash through the gap. Troubridge had anticipated this order, and it had barely gone forth when he signalled his acknowledgment.



The Battle of Cape St. Vincent, 14th February, 1797. In the foreground the "Captain," of 74 guns, is seen boldly attacking two Spanish ships of the line, both larger and more heavily armed than herself.

Ernest Protheroe, in his interesting book "*The British Navy,*" tells us that "Jervis was a proud man when he perceived Troubridge's dashing promptitude. 'Look, look at Troubridge,' he cried. 'He manœuvres as if the eyes of all England were on him. Would to God they could see him to be what I *know* him, and what, by heavens, sir, the Dons will soon *feel* him.'"

When the "*Culloden*" was only a few yards from the Spanish main body, totalling 18 ships, her guns began to speak, and she poured a terrific fire into the nearest of two Spanish ships of the line as she passed between them and narrowly avoided a collision. The remainder of the English fleet followed in her wake, and were subjected to a heavy fire.

The "*Captain,*" commanded by Nelson, was well down the English line, and as she moved forward and her crew waited eagerly for the moment when they could join in the firing, Nelson observed that the Spanish ships at the head of the main body were moving off. He realised that by the time the entire English fleet had passed through the gap these enemy ships would have escaped out of range. It was important that this must not happen and, disobeying the order to follow the "*Culloden,*" Nelson steered his ship out of the line and drew her across the path of the fleeing Spanish ships, in front of the great "*Santissima Trinidad.*" The Spanish flagship poured a devastating fire into the "*Captain,*" and it was well that the "*Culloden*" quickly came to Nelson's aid. Thus relieved, Nelson was able to tackle other enemy ships, and he was almost immediately involved in a conflict with the "*San Josef,*" of 112 guns, the "*San Nicolas,*" of 80 guns, and two or three smaller ships. *Continued on page 66*

The Modern Cinema Theatre

(1) The Operating Room and Its Equipment

DURING recent years the cinematograph industry has made remarkable progress, not only in the production of films, but also in the projecting machinery and the general equipment of the cinema theatre itself. The coming of sound pictures brought complications that were not present in the days of silent pictures, and in addition to the need for modifications to the projectors the acoustic properties of the auditorium demanded attention. The result is that an up-to-date cinema theatre contains mechanical devices of great interest, involving many inventions and developments that have been made during the past 10 years.

From an engineering point of view the heart of the cinema is the operating box. No matter how beautiful and comfortable the auditorium may be, the success of a cinema performance depends almost entirely on the projecting and sound-producing equipment used in this box. First and foremost among the mechanisms are the projector machines. Each projector consists of two distinct self-contained portions, the picture-projecting mechanism and the sound equipment. The latter is made as a complete unit, and is designed so that it can be fitted to existing projecting mechanisms. The film is housed on a reel in a spool box at the top of the machine, from where it passes over a continuously-driven steel sprocket that feeds it into the projection gate. This gate is a steel trap with an opening the same size as the picture on the film. The light from a powerful electric arc lamp is focussed on the gate, and this throws an image of the picture on to a projection lens that is situated directly in line with the gate. The lens magnifies the image and projects it on to the screen.

The Zeiss Ikon " Ernemann V," a superb example of a modern talking picture projector that is fully described in the accompanying article. Photograph by courtesy of Walturdaw Cinema Supply Co. Ltd., London.

After leaving the gate the film passes over another sprocket. This is not continuously driven, but has an intermittent motion, and each time it moves it draws the film through the gate exactly the space of one picture. During the movement of the film through the gate the light is cut off by a revolving shutter, so that no movement of the picture is seen on the screen. Immediately the film comes to rest again the shutter uncovers the light, and another picture, differing slightly from the one previously projected, is thrown on the screen. The whole movement and changing of pictures is done so rapidly that the effect viewed on the screen is a superimposition of one picture on another, each slightly different in some respect, thus giving the appearance of actual motion. From the intermittent sprocket the film passes into a lower spool box and is wound on a driven reel.

This is briefly the method of operation of all cinematograph projectors, but while the principle is the same for all machines, the methods adopted by different makers for effecting the intermittent motion of the film differ considerably.

A modern cinematograph projector is a wonderful piece of mechanism, with the utmost accuracy and precision of movement. There are many different makes in use, some suited particularly to small halls, and others designed to meet the requirements of the big cinema of the city. One of the finest of modern projectors is the " *Ernemann V*," which is manufactured by the well known Zeiss-Ikon Company, Dresden. This machine has only recently been put on the market, and it represents the very latest ideas in moving-picture projection. It possesses all the refinements usual in a modern projector, and in addition it has a number of patented improvements, one of which enables it to be easily converted to take the wide film with which American producers have been experimenting for some time. This important feature is effected by making the whole of the standard film gate and the sprocket rollers fitted to the machine, as a detachable unit, which can be removed simply by undoing a couple of screws. The whole unit can then be replaced by one suited to wide film if ever this becomes necessary.

Unfortunately wide film has a great tendency to buckle, and so stiff does the buckle make the film that one can hold out a foot or two of it in a horizontal direction. It is therefore of the utmost importance that buckle shall not be aggravated by the great heat of the arc focussed on the gate, and in designing the " *Ernemann V* " special precautions have been taken in this direction.

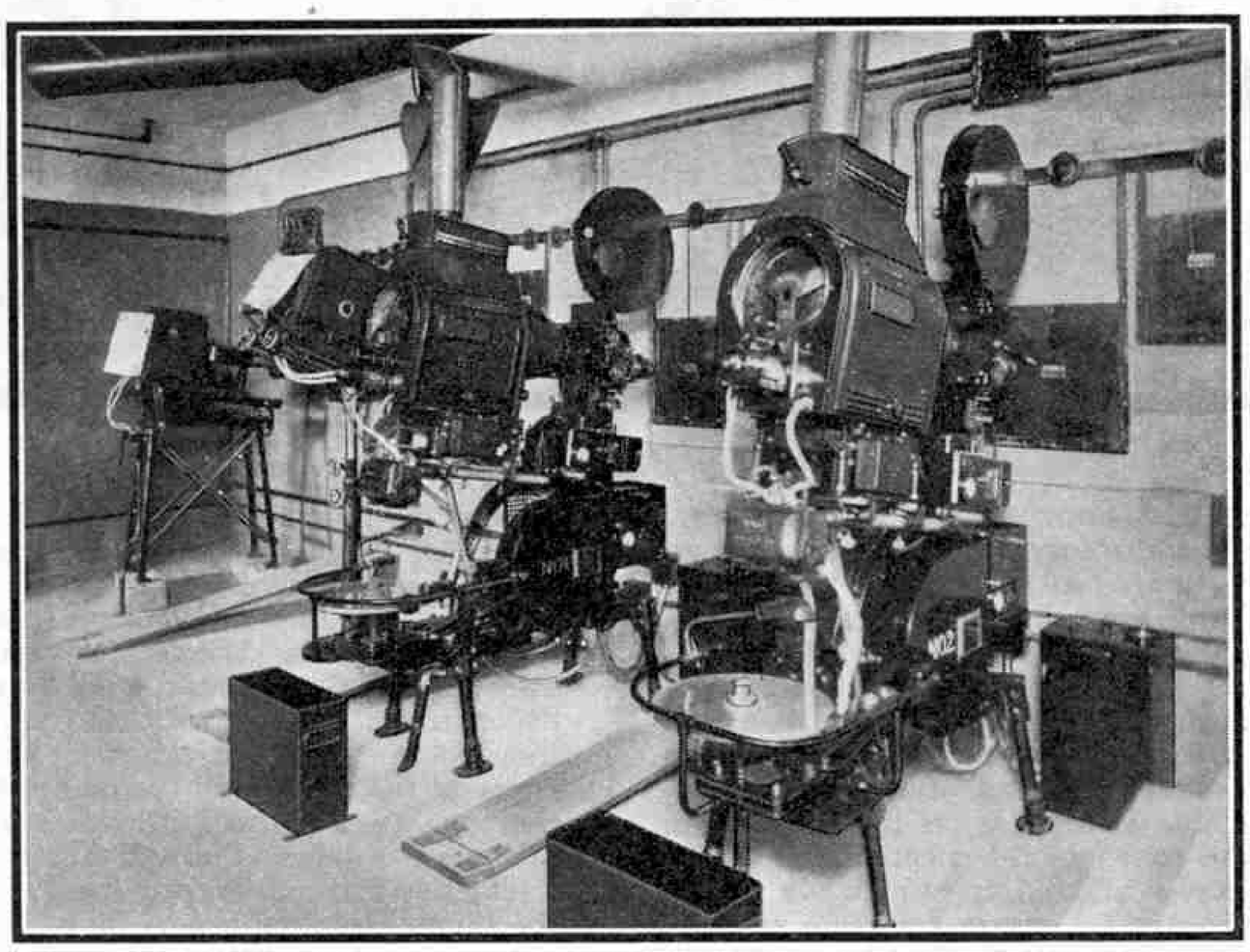
The gate unit slides on a tubular extension that is perforated with holes through which a jet of air is directed on the film. In front of the gate is a smaller tube for the same purpose, and this is hinged to allow the gate to open. Further the whole of the gate casting is hollow, and a constant stream of water circulates round the aperture, so that even without the air blast the gate remains quite cold in the heat of the fiercest illuminant. The water supply can be taken from the mains, or from a special cooling tank. The only joint in the water stream is where the gate fits to the main casting and this is protected by well-fitting spigots with rubber washers so that it is impossible for the water to leak anywhere.

The " *Ernemann V* " is fitted with a $3\frac{15}{16}$ in. diameter lens and this is mounted in an enormous lens mount in front of the gate. The use of such a wide aperture lens enables the principle of the rising and falling front provided in some plate cameras to be utilised. This is particularly valuable in cinemas where the machines are placed close to the roof. In such cases the centre of the screen is considerably out of line with the centre of the lens and usually it is necessary to place the machines at a sharp angle. This angle is known as " projection rake." In the " *Ernemann V* " machine, however, the lens mount is so constructed that it can be adjusted vertically for a sufficient distance to be equivalent to a projection rake of $7\frac{1}{2}$ degrees. The arc lamp is then racked up to a corresponding extent, so whatever the angle of throw may be the projector may be raked at $7\frac{1}{2}$ degrees less, which is an important advantage in the case of very steep rakes.

A particularly interesting feature of the " *Ernemann V* " is the shutter. This is arranged behind the gate and takes the form of a drum. The special feature of this kind of shutter is that it gives a much quicker cut-off than the usual disc type, as it

cuts off simultaneously at the top and the bottom of the picture. Also, it enables a simple and ingenious form of auto-shutter to be used. Inside the drum are two hinged curved flaps, and when the machine is stationary these close the aperture by spring pressure. As the projector attains speed, however, centrifugal force causes them to open, and they then rest inside the curve of the drum.

The shutter is enclosed in a ventilated housing, which is provided with a viewing glass covered by a small door. Above it is fitted a novel safety device that covers the top loop of film round the sprocket. If the film were to break in the gate, this loop would increase and in so doing it would raise an arm, the action of which drops a safety shutter behind the gate, thus cutting off the heat of the arc light. Simultaneously the motor would be switched off, this latter operation being performed by a mercury switch fitted inside the mechanism. Below the shutter is a raking knob for adjusting the position of the film in relation to the gate.

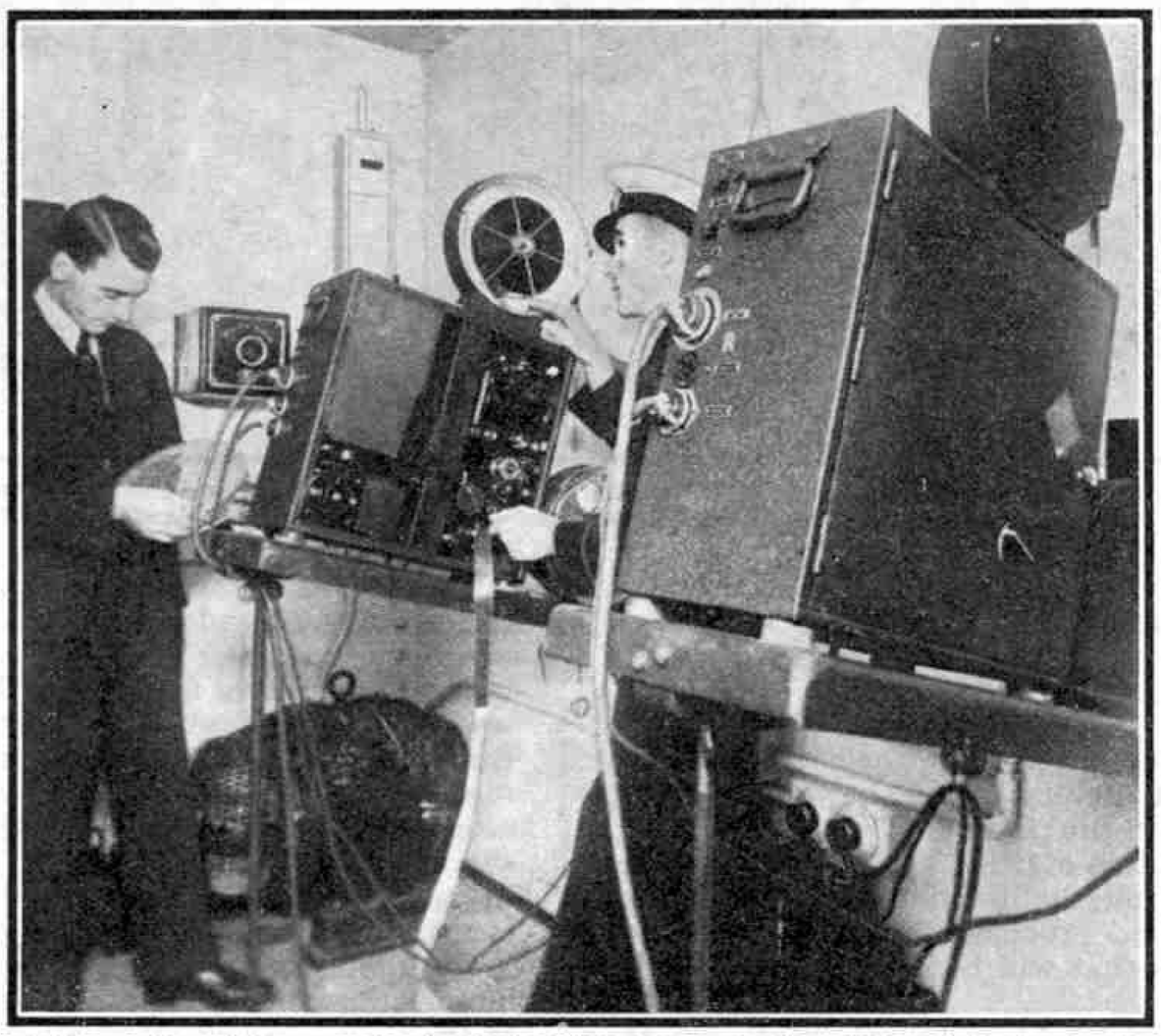


The operating box of a big city theatre equipped with Zeiss Ikon Ernemann "talkie" projectors. Fire shutters are shown in position over the projection and sight apertures, and the sound records and driving gear can be seen at the rear of the machines. Photograph by courtesy of Walturdaw Cinema Supply Co. Ltd., London.

The mechanism is driven from a shaft in the base of the machine, where it most easily couples up with most sound systems. This shaft moves extremely easily and it is difficult to believe that it is turning such a comparatively heavy piece of mechanism. Above this drive there is a removable domed cover that conceals the intermittent motion, which can be removed as a complete unit merely by unscrewing a couple of nuts. Above the intermittent motion is the ingenious shutter mechanism.

An oil pump is provided for forcing oil up to a filter at the top of the machine, from where it is gravity-fed by means of pipes and chutes to every point of the mechanism. The very important intermittent motion is lubricated by oil squirted through gauze filters in the upper face of the oil bath. Every bearing is fitted with an annular oil trap, by means of which the oil is encouraged to flow along the bearing, and is then flung off the shaft and returned to the main pump. Cast iron bearings are used throughout the machine, these being preferred to ball bearings.

In the manufacture of these wonderful machines great care is taken to test each gear tooth before assembly by means of a test indicator, and the result is that in the finished machine there is not half a tooth backlash from the main driving shaft to the uppermost gear.



A cinema at sea ! The operating box in the White Star motor liner "Georgic," showing the operators "threading up" the projectors ready for the show. The machines are R.C.A. Type P.A. 67 "talkie" projectors, and they project into the First Class Lounge. Photograph by courtesy of the White Star Line.

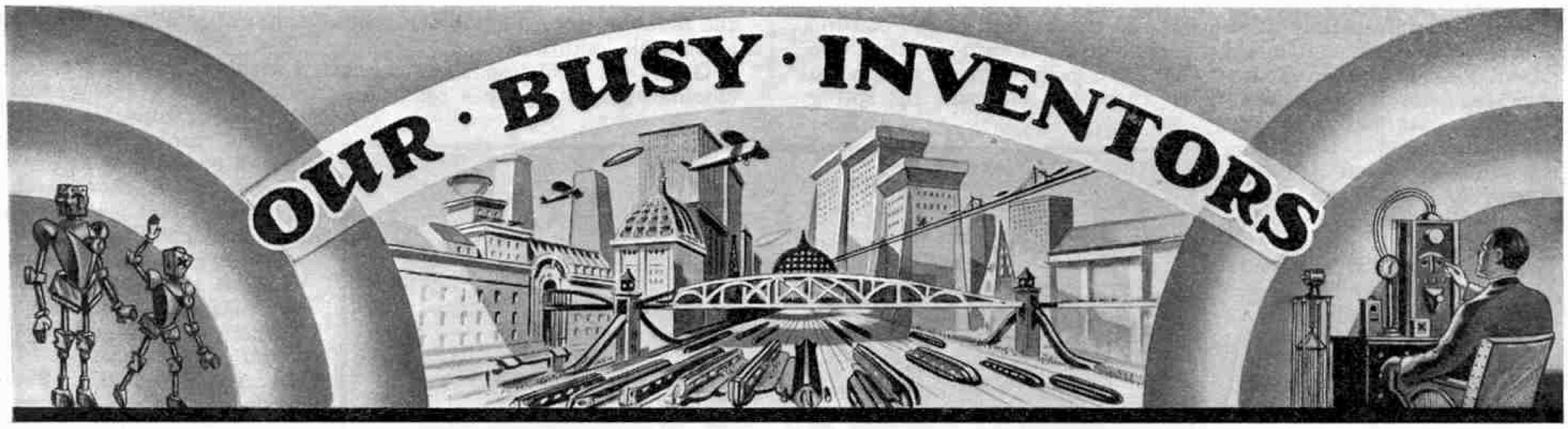
The light for projecting the picture is provided by a powerful mirror arc lamp known as the "Artisol 75" high-intensity lamp. In this a parabolic glass mirror is fitted behind the arc. This mirror receives the light rays, and concentrates them in a parallel pencil of light, which it projects upon a converging lens of the same diameter as the mirror. The lens concentrates the rays on the film gate. As the lamp carbons gradually burn away, an automatic mechanism operated by an electric motor continuously feeds them together, so that an arc of constant brilliancy is maintained. Other types of arc lamps can of course be used with the machine according to the requirements of individual cinemas and local conditions.

Other electrical apparatus connected with the working of the cinematographs includes resistances for controlling the current to the arc lamps, and motor current converters. The films are usually stored in a room situated close to the operating box, and here also are installed the film mending gear, the rewinding machine and sometimes a film measuring machine.

There are two systems of sound projection in use. In one the original sounds produced by the performers are recorded on a gramophone disc, and this disc in the projection of the picture is synchronised, or kept in step with the picture on the screen. Instead of an ordinary gramophone sound box, however, a special electrical pick-up is employed. This may be likened to a miniature dynamo that has a permanent magnet for its field, and the armature, instead of revolving as it plays over the surface of the disc, is caused to vibrate. This vibration is communicated to a tiny coil on the armature, and as this coil moves through the magnetic lines of force of the permanent magnet, a minute current, which fluctuates according to the fluctuations of sound recorded upon the record, is produced. This feeble current is then passed on to valves that magnify it sufficiently to work the big loud speakers arranged behind the motion picture screen.

Owing to the liability of the records to damage, and to the development of a more satisfactory method of recording the original sounds photographically on the edge of the film in a space known as the sound track, this system is not now much used. The sound track is about 1/10 in. wide, and is produced by a photographic method. During the making of the picture in the studio a sensitive microphone connected to valve amplifiers is placed above the scene. This carries the sound to a special type galvanometer, which is an instrument consisting of a large and powerful permanent magnet, between the poles of which is stretched a fine wire carrying a tiny mirror. When the fluctuating currents come from the microphone they pass through the wire carrying the mirror, and this is thus caused to vibrate in step with the currents. A tiny beam from a strong light is focussed on the mirror attached to the vibrating wire, and consequently, as the wire vibrates, the light beam vibrates with it, and this beam, after being reflected from the surface of the mirror, strikes the sound track of the undeveloped film, and causes a wavy line of varying density to be recorded on the film.

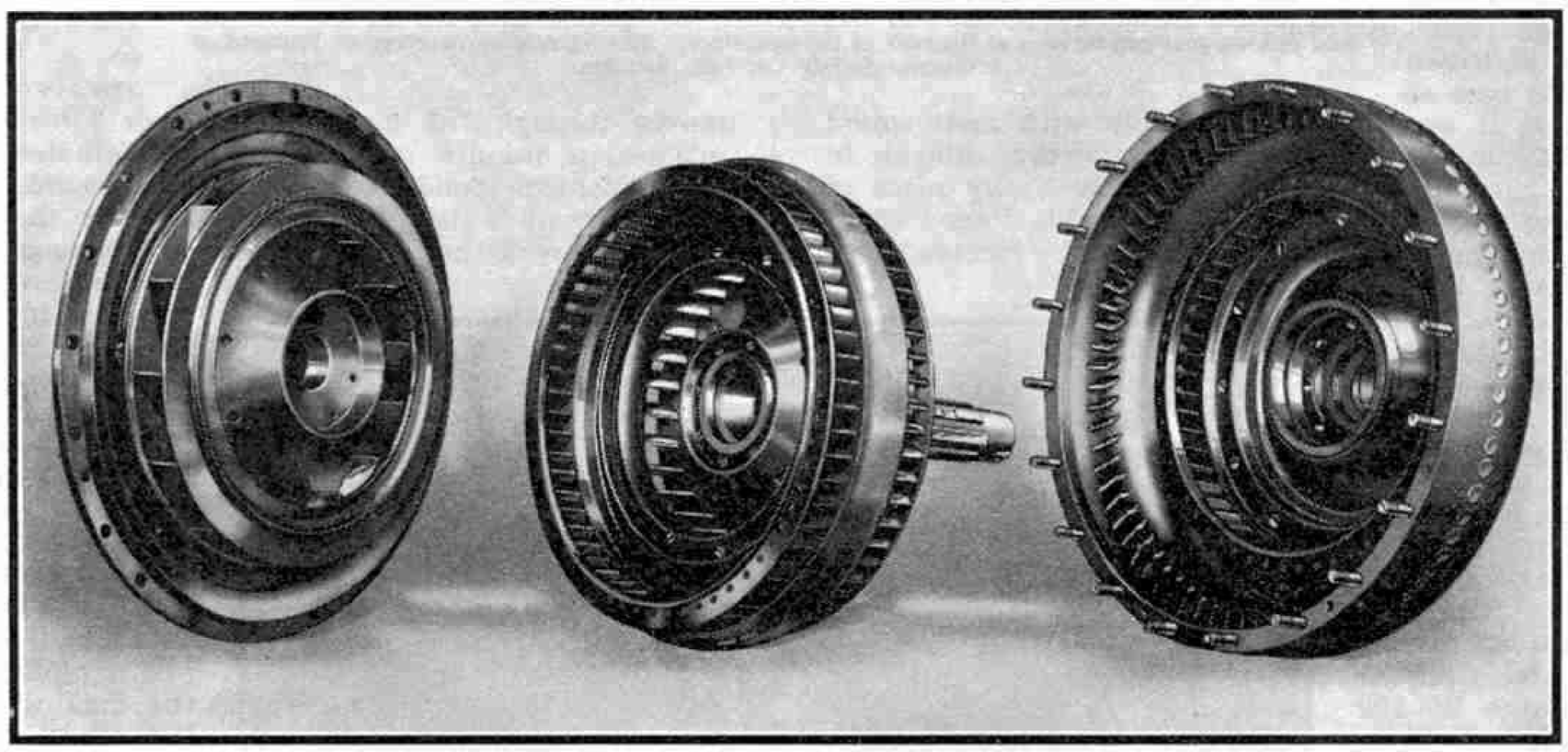
In reproducing the sound from the film that modern marvel the photo-electric cell is employed. In the sound head of the projection machine there is placed a small lamphouse within which is a powerful electric bulb. A tiny shaft of light, about the thickness of a pin, is projected through a small hole and *Continued on page 66*



By P. A. Tent

I POINTED out last month that motor car transmission gears present a wonderful field for the ingenuity of the inventor, and dealt with recent efforts to produce a substitute for the gear box, or to provide a device of this kind that is infinitely variable. An interesting development in this connection is the application of the Daimler fluid flywheel and the pre-selective self-changing gear box to a motor cycle. This machine is a B.S.A. 500 c.c. overhead valve model, and is as easy to control and as smooth in action as the Daimler and other well-known makes of motor car that are similarly fitted. The machine is capable on top gear of all speeds up to 65–70 m.p.h. The trial model has completed 20,000 miles on the road, and was never allowed to stop while it was outside the B.S.A. Works in order to ensure complete secrecy.

It has often occurred to me that a motor omnibus is in even greater need than an ordinary motor car of an improved means of transmitting engine power, for in the course of its ordinary duties it makes frequent stops, and large numbers of gear changes are necessary in restarting and in driving through traffic. These changes make great demands on the skill and endurance of the driver, and incoming passengers often experience difficulty in reaching their seats because of the jerky motion of the omnibus as it gathers speed and the driver changes gear.



The three sections of the Leyland Torque Converter. From left to right they are the pump member, the rotor and the stator, the turbine blades on the last two being shown. Photograph by courtesy of Leyland Motors Ltd.

A Gearless Motor Omnibus

In view of this, great interest will be taken in the gearless motor omnibus introduced by Leyland Motors Ltd. The only controls of this vehicle are the accelerator, brakes, and a special lever for bringing top gear into action, and on starting the bus glides away with effortless ease, however carelessly its controls are handled. The drive is silent, and engine and propeller shaft vibrations are completely damped out, features that will be greatly appreciated by passengers.

The device responsible for this much-to-be-desired improvement is the Leyland hydraulic torque converter. This may be described as an oil turbine, and the three important parts of which it consists are illustrated on this page. On the left is a pump member, which is coupled to the engine flywheel through a clutch, and drives oil on to the blades of the rotor shown in the centre of the illustration. This rotor has three rows of blades, which in the assembled converter are separated by two rows of fixed blades on the stator, the remaining part of the invention. The oil used is a mixture of paraffin and lubricating oil, or ordinary fuel oil used in compression ignition engines. It completely fills the converter, and as it is circulated by the pump member it transmits the motion to the rotor, and thence to the rear axle.

Starting an omnibus fitted with the Leyland torque converter is simple, for the driver merely accelerates the engine, and the oil drive in the converter takes up the movement smoothly and steadily. When a satisfactory speed has been reached the driver pulls a lever that brings into action a friction clutch, giving a direct drive to the rear axle that corresponds to the top gear drive in a car fitted with an ordinary gear box. The converter then becomes idle, for the same action disengages the clutch that connects the engine and the pump member. An important point is that the two clutches are used only as couplings, and do not take up the drive as in ordinary motor cars.

The Leyland gearless omnibus was one of the principal features of the Commercial Transport Motor Show at Olympia in November last. Among other fascinating exhibits at this show I was interested to find what have been called "mechanical horses," which are capable of hauling heavy loads at steady speeds over long distances, and can be manœuvred more easily in narrow streets and confined spaces than horses hauling carts and wagons. The examples seen at the show have one wheel in front and two behind. They are no larger than real horses, and of course have the advantage that they only require feeding when working, and never get tired.

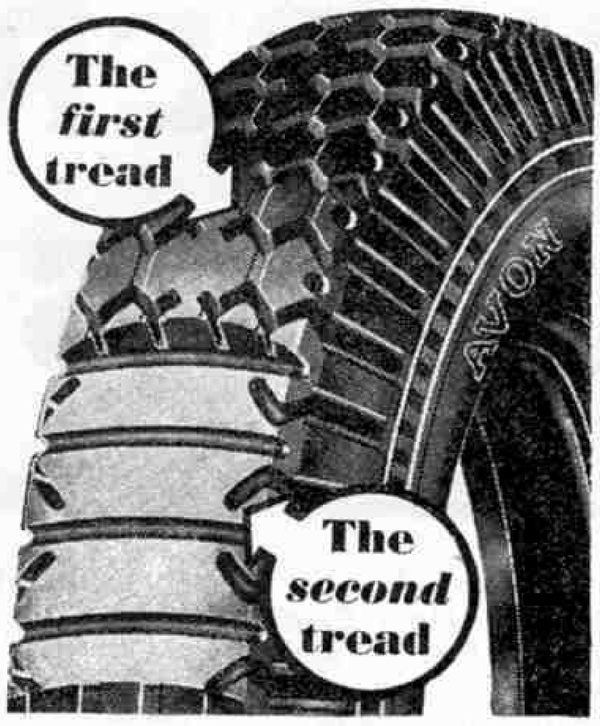
Other attractive features of the show included a Sentinel steam wagon with four wheels in front and four behind. All the four front wheels are used in steering, their relative movements being nicely adjusted to enable them to negotiate corners without difficulty. Another novelty was an electrically-driven milkman's van that is absolutely silent. This would be greatly appreciated in many suburban districts, where early morning deliveries by carelessly-driven motor vehicles are apt to cause noisy disturbances!

An interesting sign of the direction in which future progress in motor transport lies was the attention paid to heavy oil engines at the show. There is no doubt that this type of engine has come to stay, and it has the great advantage over its rival, the petrol engine, that its fuel is much cheaper and its running costs are correspondingly lower. The oil employed costs less than 6d. a gallon, and a large single-decked vehicle fitted with an oil engine is capable of 20 miles to the gallon.

Tyre Provided with a Reserve Tread

While dealing with motoring topics I must refer to the Avon Duo-Tread Tyre, the unique construction of which is shown in one of the accompanying illustrations. This tyre has ingeniously been provided with two anti-skid treads, the second of which comes into use when the first has been worn away. The first tread

of course is fitted over the second, and holes passing through its sides actually form part of the corrugation of the lower surface. The new tyre is said to be practically puncture-proof, and is capable of greater mileage than one provided with a single tread. Another advantage is that the tyre is cooled by the air that circulates through the holes passing through the outer tread, and this has the effect of preventing deterioration of the rubber due to heating. In addition, the air holes provide extra cushioning, for the first effect of running over small stones and inequalities of the road is to compress the air in the holes, and thus the tyre is an aid to more comfortable motoring.

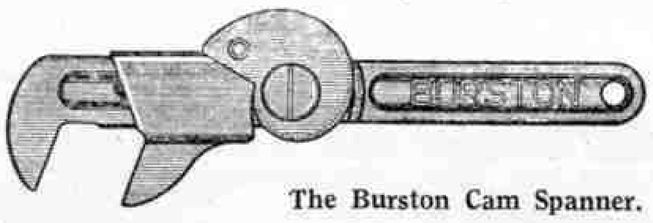


A section of the Avon Duo-Tread Tyre, showing the two treads. Photograph by courtesy of the Avon India Rubber Co. Ltd.

Speaking of the Duo-Tread tyre recalls the first pneumatic tyre, produced in Dublin by J. B. Dunlop as long ago as 1889. This was not worn out after covering 3,000 miles, and the inventor actually rode a machine to which it was fitted at a special display held in Dublin in 1917.

World's First Pneumatic Tyre

There is a story to the effect that Dunlop's first pneumatic tyre was contrived from a piece of hose pipe, but he himself denied this, pointing out that such a tyre would be so inelastic that it would be slower than one of the old solid type. Actually he made the first air tubes himself, and fitted them to a tricycle belonging to his son, then 11 years of age, fastening them on by means of strips of linen applied like bandages. The work was finished on the evening of 28th February, 1888, and the boy was so keen to give the device a trial that he immediately went out, with instructions to ride over all the stretches of freshly-laid macadam that he could find. He came back very soon, for an eclipse of the Moon made it too dark for him to see what he was doing!



The Burston Cam Spanner.

Later he went out again, and returned to report that his tricycle was much faster than when fitted with solid tyres. So efficient were the new tyres that Dunlop's son on a new tricycle fitted with them actually outpaced local cycle agents mounted on what were then regarded as good-class machines provided with solid tyres.

One of the most cunning and ingenious appliances on view at the recent Shipping, Engineering, and Machinery Exhibition, to which I referred last month, was a multiple coil winder. By courtesy of its makers, Automatic Coil Winder and Electrical Equipment Co. Ltd., I am able to reproduce a photograph of this mechanism, which winds small coils from $\frac{1}{8}$ in. to $\frac{3}{4}$ in. in width. Several coils within the range of 1 in. to 4 in. can be wound at the same time on the machine, which is actuated by a special motor running at 6,000 r.p.m.

A device that I have tried and found satisfactory is the Burston rapid action cam spanner illustrated on this page. It is delightfully simple in principle, for the position of the movable jaw is altered by simply rotating the cam fitted to the spanner. This can be done easily and rapidly with the thumb of the hand holding the spanner, and thus no time is wasted in making adjustments. Whatever size of nut within the range of the spanner is being turned, there is no slipping, the jaws closing tightly on the flats and damage to the nut being avoided.

An invention of an entirely different type recently attracted my attention. When a friend of mine was about to make certain calculations, he took from his pocket what seemed at first glance to be a cardboard scale. On enquiry I found that it was a remarkably efficient form of slide rule that costs only 4d. My own memories of slide rules were associated with larger boxwood instruments that cost considerably more than this, and I was surprised to find how accurate and efficient the cheap cardboard model proved to be.

This interesting calculating instrument is the Junior Stelfox slide rule, and is produced by Science Publication Agency, Coventry. It is ingeniously constructed in three parts that can be fitted together in a few minutes, and can be used for a wide variety of calculations, giving results accurate within five parts in 1,000. It should prove especially valuable to junior students in technical schools.

A Wonderful Array of Inventions

Probably the most important event of the year in the world of invention is the International Exhibition of Inventions organised by the Institute of Patentees. The Exhibition for 1933 was held in November last and, as usual, attracted a wonderful array of inventions, ranging from large and important mechanisms that promise to become of the greatest importance in industry, to smaller devices for the home and the workshop.

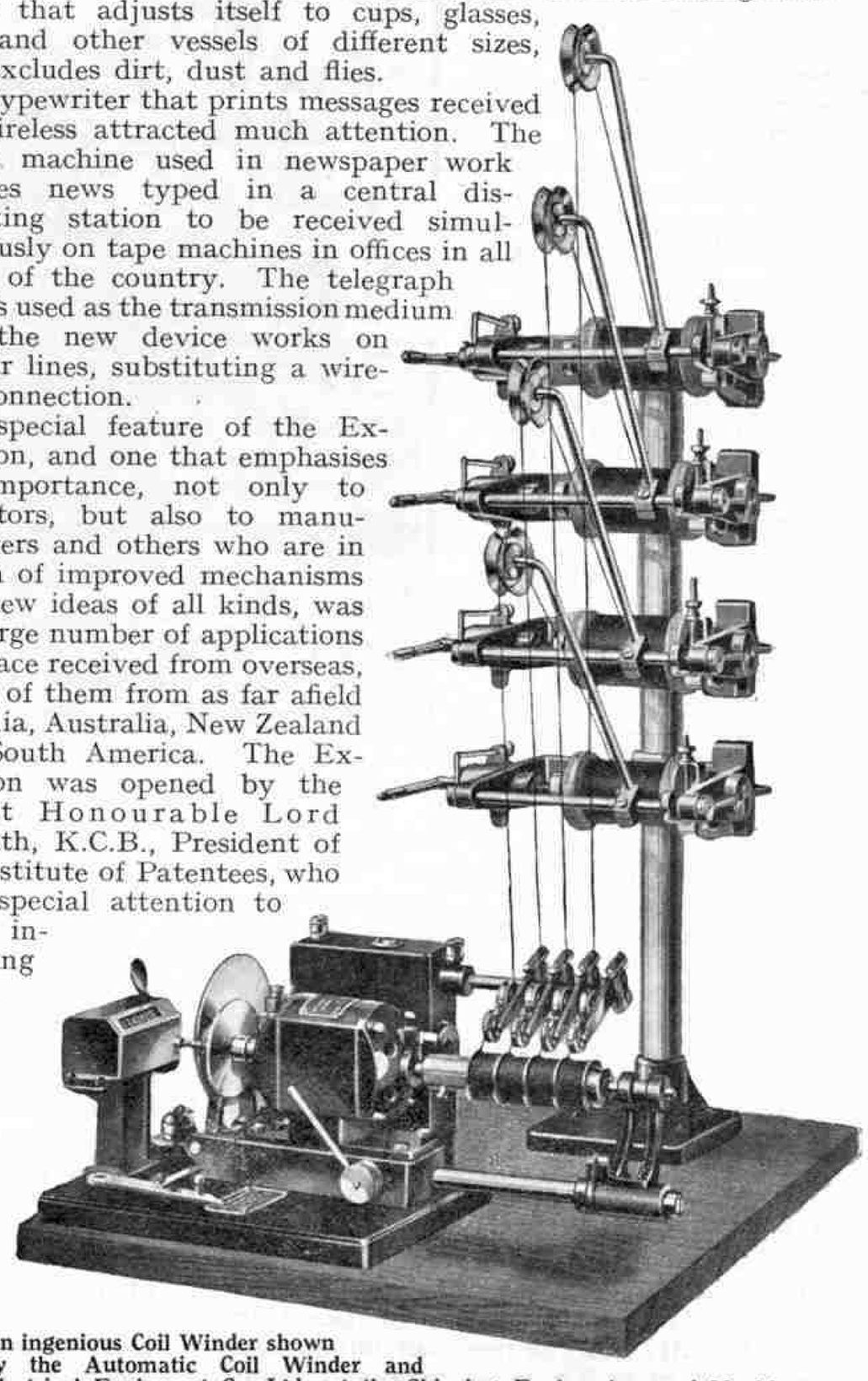
This year the Gold Medal in the New Inventions Section was awarded to the originator of a new type of ammonia washer for use in gasworks. The inventor's attention was drawn to the need for improvement in the washers now in use by the recurring necessity for putting them out of action for cleaning purposes. In the new device gas is sprayed with jets of water issuing from the walls of the washing compartment, and baffle plates in a second chamber collect any liquid carried over by the gas. This ingenious device has no parts that require removal for cleaning, and can readily be enlarged as required. It has been found to remove tar and other impurities in addition to ammonia, and probably will find extensive applications in other branches of the chemical industries.

Other notable inventions to be seen at the Exhibition included an adaptor that enables a casement window to be opened at will in each of three directions. This device was awarded the Institute's Silver Medal, and the Bronze Medal was won by the exhibitor of an electric morse signalling set with which messages can be transmitted by operators who have no knowledge of the Morse Code.

It would be impossible to describe all the new devices displayed at the Exhibition, for there were about 250 of them; but I was specially interested in a four-legged table that would stand without wobbling on uneven surfaces; a lock with a device that illuminates it when the cover is removed, thus overcoming the difficulty of finding the key hole in the darkness; an attachment for taps and spouts that charges liquids passing through it with air distributed in microscopic bubbles that give a sparkle and brightness; and a minor but extremely desirable invention in the form of a non-rusting metal cover that adjusts itself to cups, glasses, jars and other vessels of different sizes, and excludes dirt, dust and flies.

A typewriter that prints messages received by wireless attracted much attention. The Creed machine used in newspaper work enables news typed in a central distributing station to be received simultaneously on tape machines in offices in all parts of the country. The telegraph wire is used as the transmission medium and the new device works on similar lines, substituting a wireless connection.

A special feature of the Exhibition, and one that emphasises its importance, not only to inventors, but also to manufacturers and others who are in search of improved mechanisms and new ideas of all kinds, was the large number of applications for space received from overseas, many of them from as far afield as India, Australia, New Zealand and South America. The Exhibition was opened by the Right Honourable Lord Askwith, K.C.B., President of the Institute of Patentees, who drew special attention to this interesting point.


An ingenious Coil Winder shown by the Automatic Coil Winder and Electrical Equipment Co. Ltd., at the Shipping, Engineering, and Machinery Exhibition.

ENGINEERING NEWS

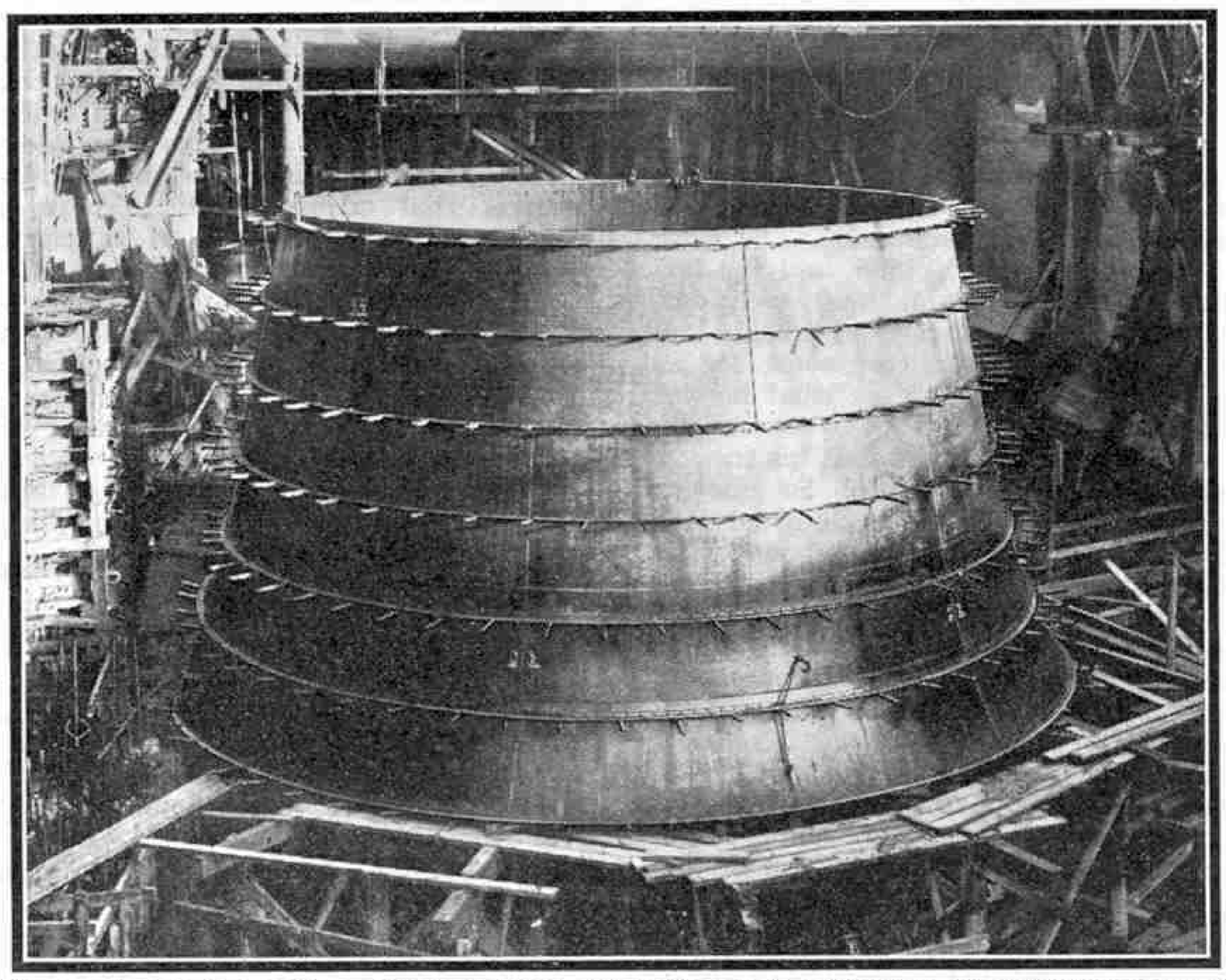
Water Falls 170 Miles

In connection with a scheme for increasing the water supply of the city of San Francisco in the United States, water is to be made to flow entirely by gravity for a distance of 170 miles. During its long journey the water will have to travel across a great inland valley, through 28½ miles of tunnel in the Coastal Mountains, and under San Francisco Bay, in addition to operating a number of hydro-electric plants. One of these plants has been in operation since 1925, and the water has in fact cut its own way, for the power from this station has been used for most of the construction work. The surplus electricity available has been sold and has realised nearly £3,000,000.

The finished aqueduct is designed to have an ultimate capacity of 400,000,000 gallons of water a day, and to be capable of developing about 250,000 h.p. The source of the water is in the mountainous district bordering on the Yosemite National Park, the principal mountain reservoir being at an altitude of about 3,800 ft. To form this reservoir, a glacier lake known as Lake Eleanor has been dammed by a huge barrier 1,260 ft. long and 70 ft. in maximum height, which has increased the capacity of the lake to 9,000,000,000 gallons. Eventually the dam will be raised to 235 ft.

Many big engineering problems were encountered during the progress of the work. The largest single structure to be erected was the O'Shaughnessy Dam on the Tuolumne River. This dam is of the arched gravity type and is 605 ft. in length, 226.5 ft. in height above the bed of the stream, and contains 398,520 cu. yds. of concrete. The foundations are anchored directly in bed rock, which necessitated excavating to a depth of 118 ft. below the bed of the stream; and they have a maximum thickness of 298 ft. and are wide enough to allow the dam eventually to be increased in height to 312 ft. The reservoir impounded by the dam is 7.5 miles long and holds 67,000,000,000 gallons of water.

An interesting feature of the work is the care taken of the labourers. More than 1,500 men have been trained in first aid, and special rewards are given to workers who avoid accidents. For instance, if a "crew" working together on one job avoid personal injury throughout a week they are provided with a chicken dinner on the following Sunday! Crews have also been trained in mine rescue work. They are stationed at all camps and are provided with modern equipment.



The draught-tube lining of one of the largest hydraulic turbines in the world, installed at the Vargön Power Station in Sweden. A special article on Swedish hydro-electric developments appears on page 2.

Locomotive Weighbridge with Special Features

An interesting weighbridge for locomotives has been built by Charles Ross Ltd., of Sheffield. The bridge, which has mechanism of the normal type and is capable of dealing with a load of 168 tons, is arranged so that when a locomotive is run on to it the actual weight carried by each wheel is recorded on a special dial. In order to accomplish this the track on which the locomotive stands while being weighed is divided into 12 separate sections, each with a separate dial recording up to 14 tons. The great advantage of a weighbridge of this type is that when the total weight taken by each wheel has been ascertained from the dials, springs can be adjusted to give correct distribution.

Pneumatic Automatic Traffic Signal

Automatic traffic signals of the fixed-interval type are now common in most parts of the country, while "Electromatic" installations, operated by the passage of vehicles over a detector set in the road, also are being widely brought into service. A difficulty with this type of control is that when the electric contacts are placed under the rubber detector, the contacts receive road shocks every time a vehicle passes over, while water may sometimes percolate through.

It is claimed that a new detector, known as the "Autoflex" type, which is operated pneumatically overcomes these drawbacks. This detector consists of a moulded rubber block that is housed in a shallow fabricated steel trough 3¾" in depth. Two air channels stretch throughout the length of the moulding, and thus when any type of vehicle, from a steam-roller to a bicycle, passes over, pneumatic impulses are set up in the airways, and these are converted in the contact box into electrical impulses of a duration proportional to the speed and number of the passing vehicles. Immediately a vehicle has passed over, the air passages revert to atmospheric pressure.

A New High-Speed Marine Engine

Most airless-injection engines for marine work in cabin cruisers and small vessels are designed to operate at comparatively low speed. Brooke Marine Motors Ltd., of Lowestoft, and the Associated Equipment Co. Ltd., are now producing an engine that is capable of running for short periods at more than 3,000 r.p.m., its normal speed being between 1,000 and 2,400 r.p.m. The engine is of the six-cylinder type, and is essentially a slightly modified form of the A.E.C. 130 h.p. road vehicle engine. When operated at 1,000 r.p.m. it has an output of 80 b.h.p., while at 2,000 r.p.m. the output is 130 b.h.p. The weight of the engine, complete with reverse gear, electric starter and exhaust manifold, is 2,300 lb. By the use of aluminium alloy castings the weight may be reduced by 200 lb.

A 5¼-Mile Tunnel through the Vosges Mountains

Work is now proceeding satisfactorily on a tunnel through the Vosges Mountains, which is to connect up the Est and Alsace-Lorraine Railways, and shorten the railway journey between Calais and Switzerland by 32½ miles. Work on the tunnel was begun about a year ago, and so far a distance of about 1,640 ft. has been driven. Eventually the tunnel will be 5¼ miles long, 30.6 ft. wide, and 20 ft. in height from the permanent way to the roof of the tunnel. The gradient will be a constant one of 8 mm. per metre, which is equivalent to about 1 in 125.

During the first part of the construction work difficulty was experienced with numerous springs that were tapped by the workings, on some occasions as much as 415 gallons of water per minute having to be dealt with. As it is almost certain that these springs will constantly be pouring water into the tunnel, it has been found necessary to make permanent arrangements to drain it off. The tunnel is expected to be completed in about five years.

River Taxis for Thames

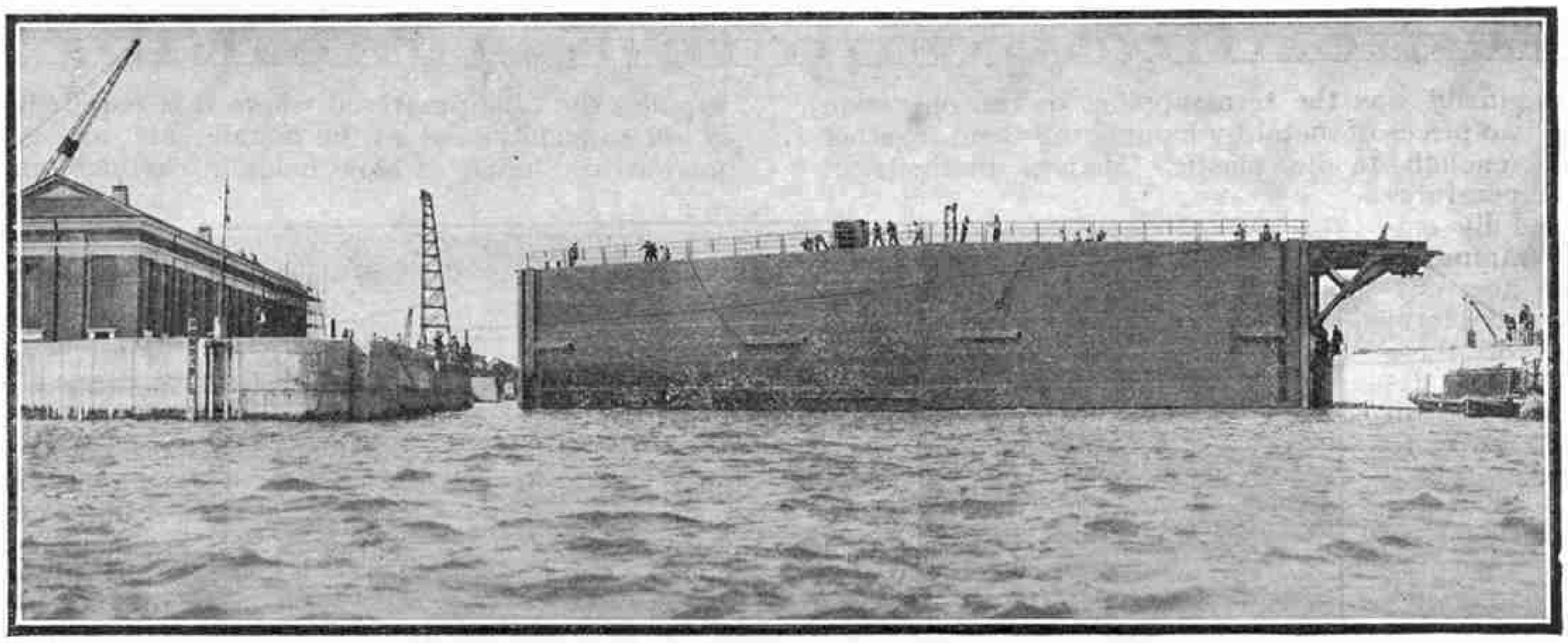
This month boat taxis are to be brought into operation on the River Thames by a company known as Thames Taxis (1933) Ltd. For the work the company has purchased five fast motor launches at a cost of £4,500 each, and these are to be employed to maintain an 8-minute service between Hammersmith and Greenwich and back. The launches will stop at Putney, Chelsea, Lambeth, Westminster and Tower Pier. There is to be another service between Woolwich and London Bridge, and it is stated that the boats will occupy between 31 and 45 minutes on the up-river section, and from 34 to 48 minutes on the down-river section, according to the number of stops. Some of the boats will be used for express services and others will call at all stations. It is intended to make use of existing piers to a certain extent, and it is hoped that eventually 24 sheltered pontoons will be erected on the river, to be served by about 50 specially designed boats.

The launches are 65 ft. in overall length and are capable of attaining a speed of 18 knots. Each will be provided with accommodation for 100 passengers, and there will be a saloon on board where refreshments will be available. In order to prevent annoyance to other river users and to residents along the banks, special efforts have been made to ensure that the launches run very silently, and they have been designed so that a minimum of wash is created. They will be suitable for use in all weathers.

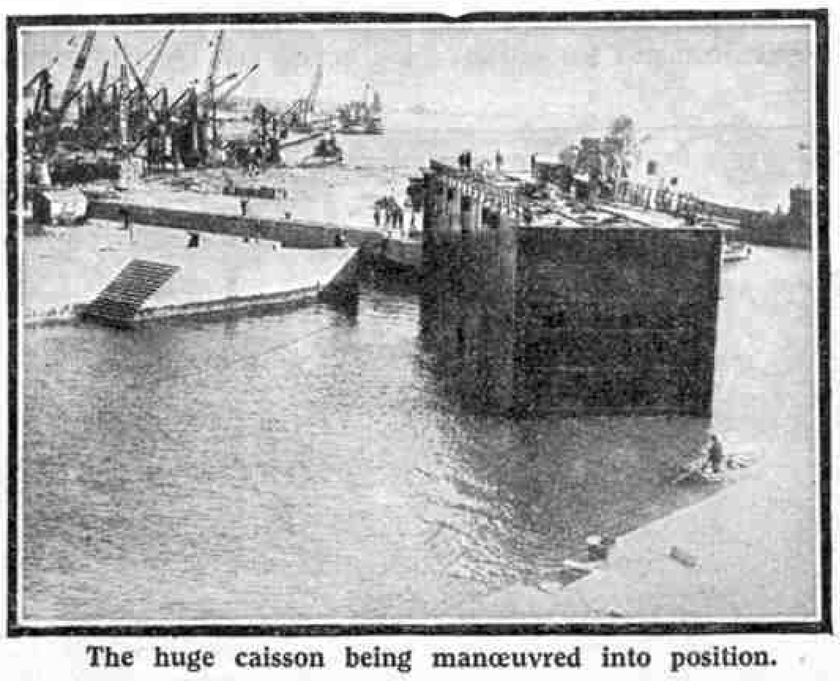
6,000 Gallons of Water Per Second

The Fusenko power plant in Korea makes use of a reservoir that has an area of 9.3 square miles and a storage capacity of 25,000,000,000 cu. ft., and is capable of providing a constant flow of 6,000 gallons of water per second for power generation. The station is situated on the Fusenko River and is the largest hydro-electric installation in the Far East.

The water from the reservoir is led to the station through a pressure tunnel that is horseshoe in cross section and is 13 ft. 4 in. high, 12 ft. 4 in. wide, and 17 miles long. At the station there are four single-wheel double-nozzle Pelton turbines, designed to work under a head of water of 2,180 ft., and to develop 50,000 h.p. each, with a flow of 1,280 gallons of water per second. They operate at a speed of 360 r.p.m. During the official tests carried out on the plant a maximum efficiency of about 92 per cent. was obtained.



The arrival of the 4,600-ton caisson that forms the entrance gate of the new "King George V" Dock at Southampton, the largest dock in the world. For the two photographs on this page we are indebted to the "Southern Railway Magazine."



The huge caisson being manœuvred into position.

British Steel Erection Record

Another British building record has been achieved by Dorman Long & Company Ltd., of Middlesex and London, who recently supplied and erected the steelwork for a new flour mill at Avonmouth. The contract stipulated that erection had to be completed within eight weeks. The first delivery of steel at the site was effected 4½ weeks after the receipt of the order, while only 3½ weeks were occupied in erecting the entire 1,500-ton steel framework.

World's Most Powerful Tug

A new motor tug, named the "*Zwarte Zee*," which is stationed at Brest, is stated to be the most powerful ocean-going towing and salvage tug afloat. She is claimed also to be the fastest and largest tug in the world, and in her construction special attention has been paid to the provision of adequate bunker space in order to allow long ocean trips to be made. Her bunker capacity is, in fact, large enough to enable a trip to be made round the world without refuelling. She is provided with wireless telegraphy and direction finders, together with all the latest navigation equipment, and carries complete salvage gear, including fire fighting apparatus, diving gear, and large capacity salvage pumps.

When running free the tug is capable of attaining a speed of 17¼ knots, her propulsion machinery consisting of two oil engines developing a total of 4,200 h.p. and driving a single propeller through mechanical gearing and a Vulcan hydraulic coupling. She is 208 ft. in overall length, 32 ft. in moulded breadth and 19 ft. 4½ in. in depth, and has a displacement of 792 tons.

Replacing a Railway Bridge

An interesting engineering feat was carried out when a 60-ton bridge that carries a branch line of the L.M.S.R. over a road at Neasdon, Surrey, was dismantled, and replaced by a new bridge more than 160 tons in weight, in a single day. The replacement was taken in hand in order to allow the use of heavier locomotives on the line, and the new bridge was first erected on trestling above the roadway.

The actual replacement operations were commenced on a Sunday morning when a 36-ton steam crane and a train of wagons containing special equipment, engineers and about 100 workmen, arrived on the scene. The demolition of the old bridge was quickly accomplished, the girders and other heavy parts of the structure being lifted out of position by the steam crane, which loaded them into railway wagons in which they were removed. While this was going on other workmen were cutting up the stone abutment of the old bridge with compressed air drills. Actually before the whole of the old structure had been removed the new bridge was slowly drawn into position by four men who wound on winches, the bridge sliding into position on ball bearings placed along the trestling. The line was then connected up, and the bridge was ready for the passage of the first train on Monday morning, the work being completed well within scheduled time.

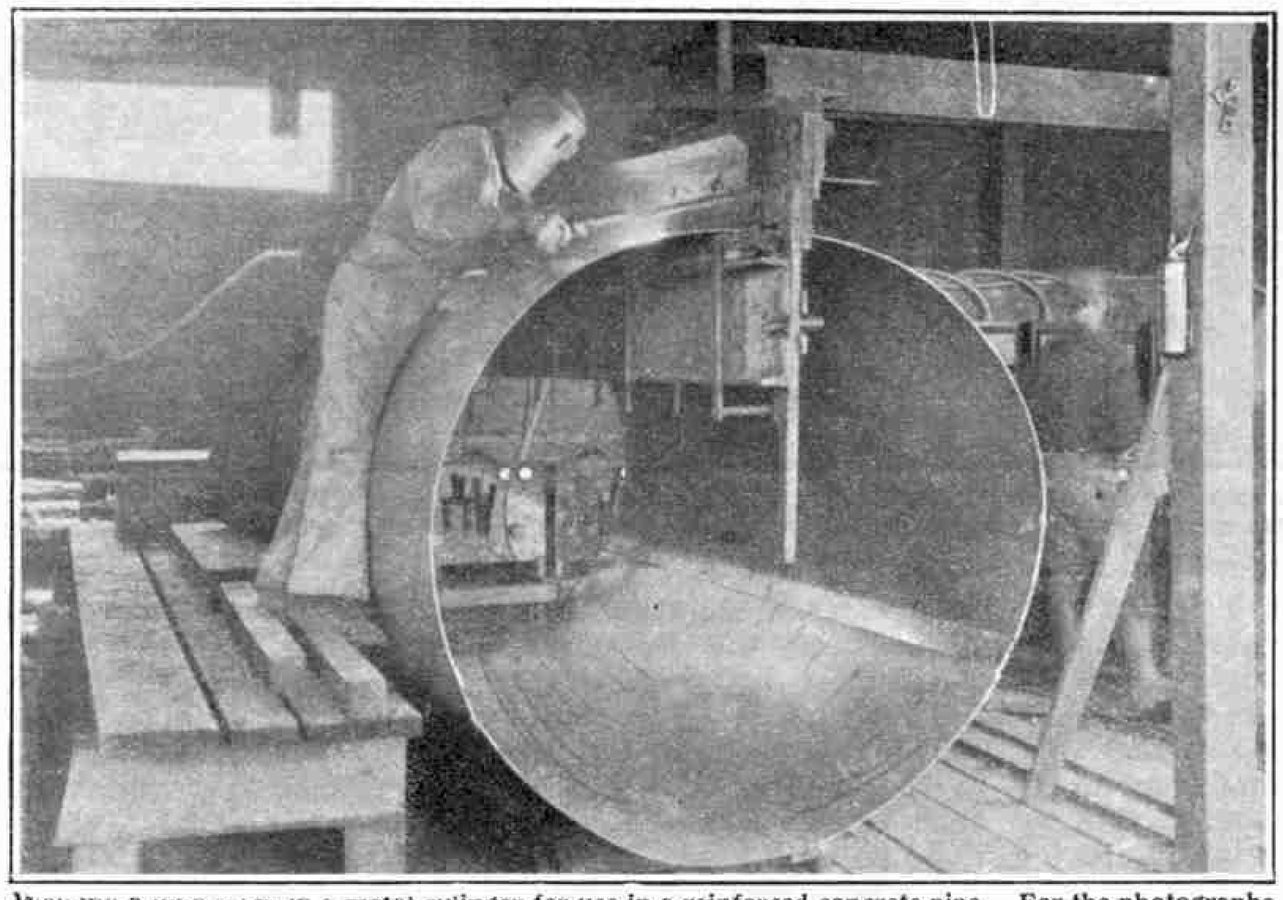
Electric Arc Welding

The Process and Equipment

WELDING originally was the term applied to the operation of joining two pieces of metal by hammering them together while hot enough to be plastic. Modern methods of obtaining high temperatures have been successfully employed for the joining of metals, and it is now customary to apply the term welding to any of these processes. There is gas welding, for instance, in which intense heat is obtained by the combustion in a special blowpipe of acetylene or hydrogen in conjunction with oxygen. These gases produce a flame with an inner core that has a temperature of about 2,200 deg. C. The highest temperature obtainable in concentrated form, however, is that of the electric arc, and in this article we shall describe the main features of the electric arc welding process.

Although the change over from riveting and foundry practice to welded construction is even now only beginning, developments during the past few years indicate that in the near future welding will be much more widely adopted. In a few years' time, perhaps, welding and welded articles will play a far more important part in our daily life than they do to-day. The great demand for ships during the Great War, and the vital necessity of keeping all available craft constantly in commission, gave a great impetus to the adoption of electric arc welding, which otherwise might have taken many years of patient pioneer work. In no other branch of engineering has arc welding received the attention of the engineer to such an extent as in the shipbuilding yard.

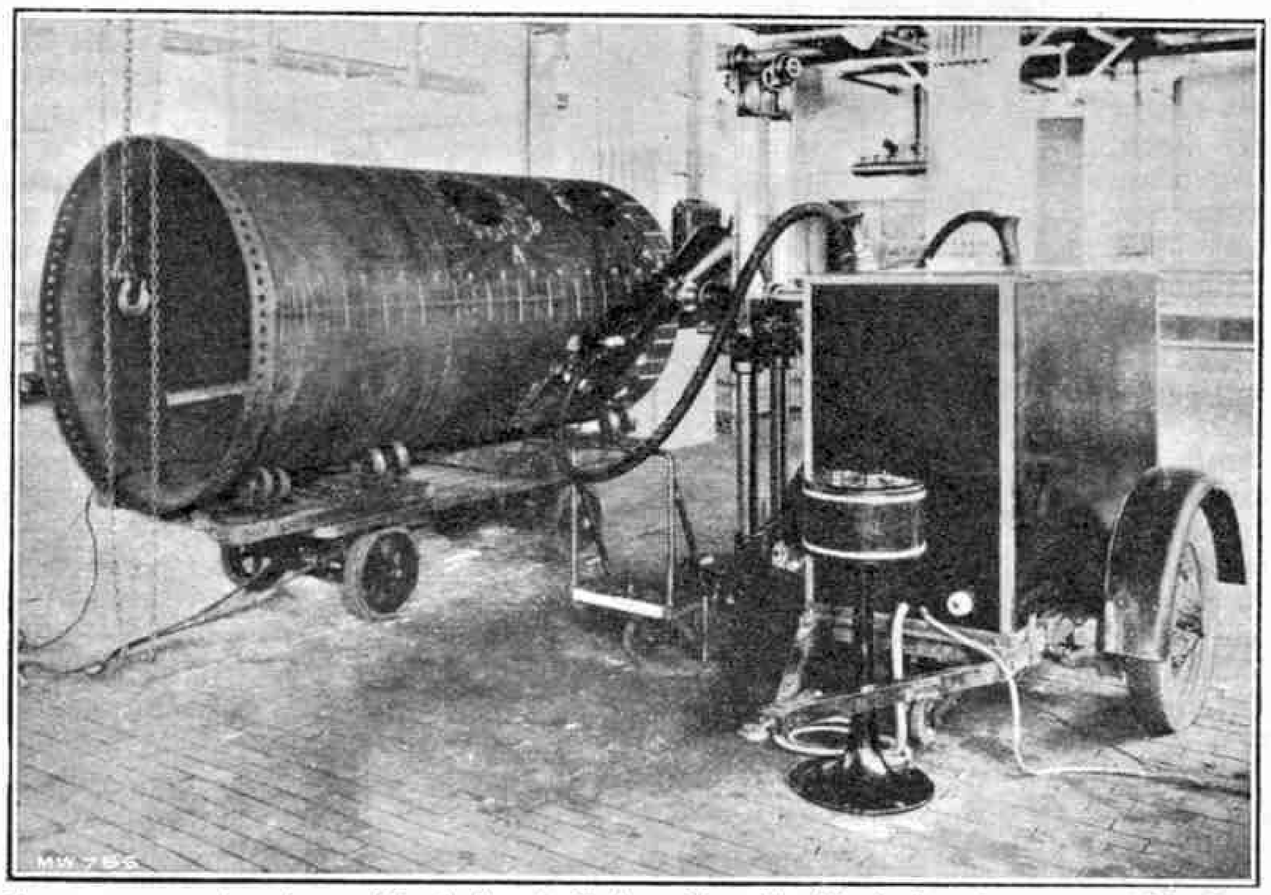
The metals best adapted to the electric arc welding process are wrought iron, boiler plate, and other grades of steel used for general commercial work. Cast iron requires very careful treatment, but offers no practical difficulties that exclude it from the weldable metals. Copper and certain of its alloys can be successfully welded by the electric arc. The temperature of the electric arc is now generally accepted as being between 3,500 and 4,000 degrees Centigrade. There are various methods of applying the heat of the arc, the most important being the carbon electrode process and the metallic electrode process. The carbon electrode process consists of creating an arc between a carbon pencil held by the operator and the metals to be welded, the heat of the arc bringing the metals to the fusing point. In the metallic electrode process a metal rod is used in place of the carbon pencil, and as the result of the heat generated by the arc it melts and supplies the filling material where it is required. The carbon arc is not so widely used as the metallic arc, and is employed chiefly for cutting, filling in blow holes in castings, and the welding of non-ferrous metals.



Welding a long seam in a metal cylinder for use in a reinforced concrete pipe. For the photographs on this page we are indebted to the courtesy of Murex Welding Processes Ltd.

Exactly what happens in the metallic arc process is not definitely known. There appears to be an even flow of metal from the electrode to the work, probably in the form of small particles projected at high velocity on to the work. The main welding equipment consists of a generator and motor, and a switchboard and resistance. Where alternating current mains supply is available a transformer can be used to reduce the supply pressure to that required for welding purposes. The transformer works in conjunction with a special form of choking coil to regulate the amount of current delivered to the electrode.

The operator's tools consist of a special holder for gripping the electrode, a hand screen, a chipping hammer and a wire brush. The holder is provided with a handle of insulating material, so arranged that the welder cannot touch any live part with the hand with which he holds it. The light given off by the electric arc contains infra-red rays, which are so injurious to the eyes and skin that the act of looking for a moment at an unscreened arc, even at a considerable distance, causes extremely painful symptoms, which, however, do not appear immediately. The welding operator is therefore provided with a screen fitted with coloured glass, through which he can watch the operation of the arc in safety. Sometimes the screen is fitted in a mask worn by the welder, and this arrangement has the advantage of leaving both his hands free.

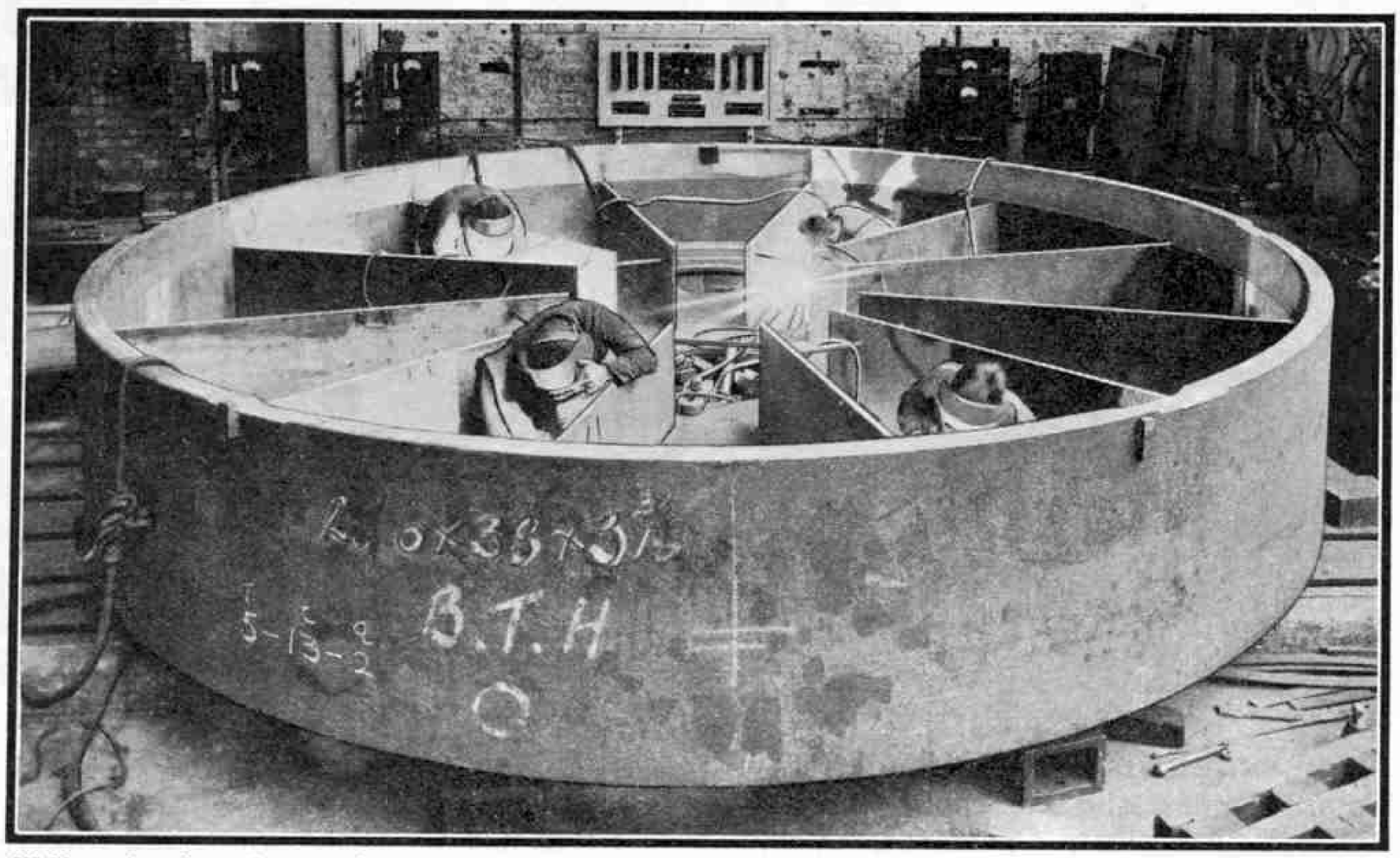


X-rays are now largely used for finding faults in welds. The illustration shows a portable plant which produces X-rays that will penetrate heavy steel.

A flexible lead from the electrode holder is connected to one pole of the current supply, and either the job itself, or the metal table on which it is supported, is connected to the other pole. So long as the electrode is held away from the work the electric circuit is open; but immediately the operator touches the electrode on the work, and then withdraws it slightly with a stroking action, a brilliant arc leaps into being between the electrode and the work. When the current flows between the tip of the electrode and the work to be welded the electric energy is converted into heat energy. The arc, therefore, becomes a small electric furnace in which there are two extremely hot spots, one on the end of the electrode and the other on the work just under it. Although what takes place in the arc is not yet fully understood, it seems that

the arc heat is developed round about the poles, and that of the total heat one-third is developed at the negative pole and two-thirds at the positive pole.

There are various types of electrodes, some of which are heavily coated with a flux-forming material, while others are either bare or have only a light coating. The coating is intended to prevent atmospheric oxidation of the molten metal, and is sometimes made from asbestos yarn, which is wound around the wire, the electrode then being dipped in a special binding mixture that has fluxing properties. Another type of electrode is covered with a pasty flux that is baked on, while some have a very lightly dipped, air-dried coating of flux. The electrodes vary in quality and material according to the metal of the work on which they are intended to be used, and great care is necessary to choose electrodes suitable for the work in hand.



Welders at work on the rotor for the world's largest synchronous electric motor, which was described in the " M.M." for September 1933. Photograph by courtesy of the British Thomson-Houston Co. Ltd.

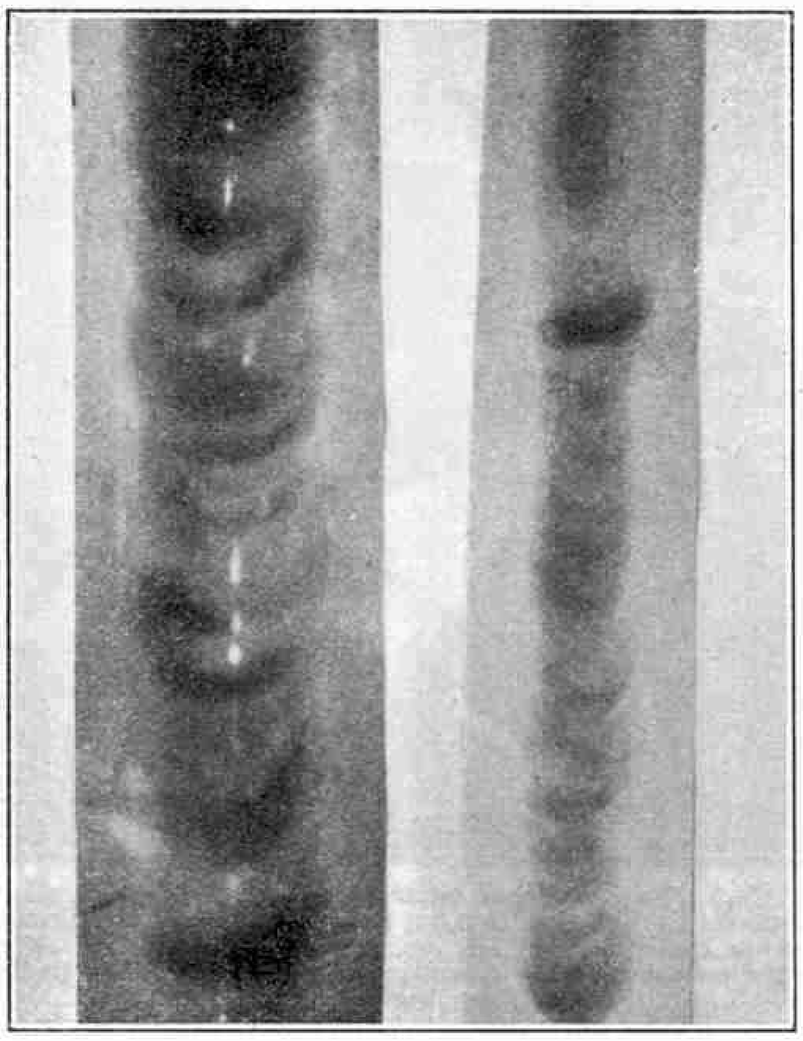
Before the weld is commenced the surface of the job is thoroughly cleaned by removing dirt, grease and rust, with a sand blast, wire brush or chisel. If the edges of two plates are to be welded together the edges are first bevelled to a pre-determined angle. This is a very important item in the success of the finished joint. In making a long seam weld the operator is confronted with the problem of expansion and contraction, which results in warping and the setting up of internal stresses. It is therefore necessary to take special measures to minimise this, and the usual procedure is to tack the pieces together at various points and then weld between these points in a suitable sequence, thus tending to make the expansion even over the whole work.

The operation of welding requires special electrical arrangements for controlling the current supply, because a higher voltage is required to strike the arc than is needed to maintain it, owing to the fact that air is, practically speaking, a non-conductor of electricity. Once the arc has been struck, however, the air between the electrode and the work is displaced by a column of red hot metallic vapour, which conducts electricity fairly easily. This column of vapour is known as the arc stream, and it is inside this stream that the melted electrode passes to the job in the form of drops. Direct current at about 60 volts is necessary to strike the arc, but current at from only 18 to 25 volts is sufficient to maintain it. Murex Welding Processes Ltd., of London, to whom we are indebted for much of our information, supply special dynamos that give the required drop in volts automatically, thus effecting a considerable economy in current consumption. In the early days of electric welding a great deal of power was wasted, owing to the fact that a series resistance had to be inserted to effect the voltage drop. In the Murex patent dynamo the open circuit voltage can be adjusted from approximately 45 to 80 volts, which pressure enables the arc to be struck with ease. Immediately current begins to flow in the welding circuit, however, the voltage automatically adjusts itself to the amount required to maintain the arc, namely, 18 to 25 volts.

For use with alternating current Murex Welding Processes Ltd. have produced a special oil-cooled transformer which, together with a special reactance coil for regulating the current at the arc, forms a complete and efficient welding machine. The secondary or striking voltage of these transformers is 80 to 100 volts. This higher striking voltage, as compared with that for direct current, is due to the fact that the arc voltage when working with alternating current is higher than when direct current is employed.

For such work as repairs to tramway tracks, ships' machinery and boilers, when it is not possible to remove damaged parts and take them to the workshop, portable welding plants are used. The generators of these plants are usually driven by a paraffin or petrol engine or an electric motor, and no doubt the reader will have seen one of them at work in the streets.

In addition to hand welding by the electric arc there are methods in which special machines are used. In spot welding, a method that is used for uniting sheets or thin plates where a continuous weld is not required, the two sheets of metal are placed between electrode clamps that press them together. The current is then switched on, and the surfaces in contact are brought up to welding heat. The sheets are then moved on to the next spot to be welded and the operation is repeated, so that eventually the sheets are united by a line of small welds. Sometimes what is known as seam welding is adopted, and here the electrodes are rollers through which the sheets of metal to be joined are passed. Current is applied and the rollers are set in motion. The current heats up the sheets to welding point as they pass between the rollers, and they are thus united along the whole of the roller path. This continuous seam is stronger than spot welding, is fluid tight, and is rapidly made.



X-ray photographs of a V weld in ⅝ in. steel plate. The photograph on the left shows cavities in the weld, and that on the right the same weld re-welded after examination of the X-ray evidence. Photograph by courtesy of Murex Welding Processes Ltd.

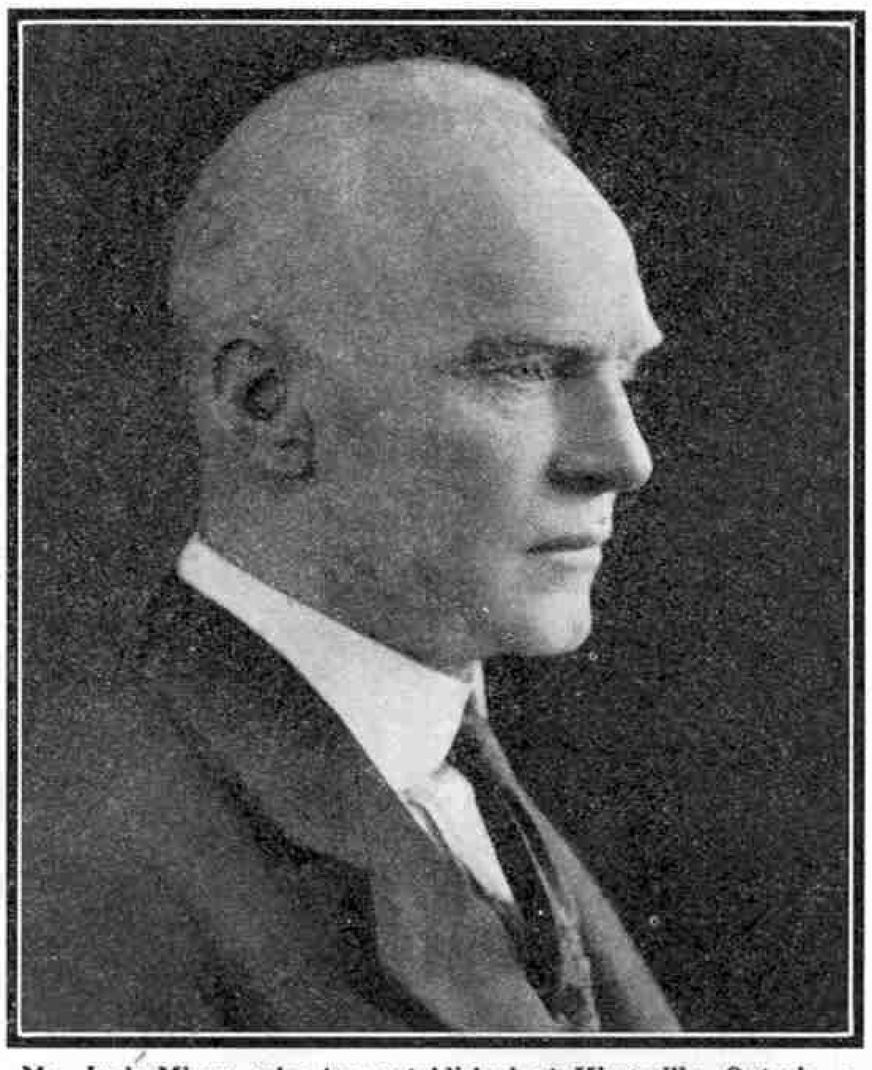
One of the greatest drawbacks to the use of welding in the past was the difficulty of testing the welded seam for satisfactory workmanship and strength. Many attempts have been made to devise a reliable test, but it is now generally accepted that X-rays offer the best solution. A special X-ray apparatus has been developed that produces rays that will penetrate heavy steel, and can be used in the workshop without difficulty.

When it is desired to examine a weld the X-ray apparatus is brought close to the work, and the aperture of the special X-ray tube is directed towards a section of the weld. A special photographic film contained in a light-tight metal " cassette " is held against the inside of the weld, and the necessary high-voltage current is applied to the tube. After a few seconds, the exact time being dependent on the thickness of the metal, the film is removed and developed, and the resulting radiograph reveals any hidden defects that may exist.

Some of the many applications of arc welding will be described in a further article to be published next month.

IT is now some 30 years since I first noticed the decrease begin to take place among the various species of birds on this North American Continent. Very few people realise what an asset birds are to any country, the song and insectivorous birds, and the birds that live on weed seeds, as well as the game birds such as ducks and geese.

Here in North America the birds migrate from one country to another. The largest percentage of them nest and raise their young and spend the spring and summer in Canada, but as autumn approaches and winter comes on practically all the birds migrate from Canada and fly to the southern part of the United States for the severe cold winter months. Therefore, as the birds are natives of no one country, we have what is known as the Migratory Bird Treaty between the United States and Canada. This treaty ensures that all game birds on the continent that migrate secure equal protection from the guns of the hunters in both countries, and also it provides for equal punishment in the United States and in Canada for the person who kills a song or insectivorous bird. It will thus be seen that the Migratory Bird Treaty is a very valuable treaty between the two countries.



Mr. Jack Miner, who has established at Kingsville, Ontario, a sanctuary for wild birds that has become famous all over Canada and the United States. The success of this undertaking has led to the provision by the Canadian Government of many similar bird sanctuaries.

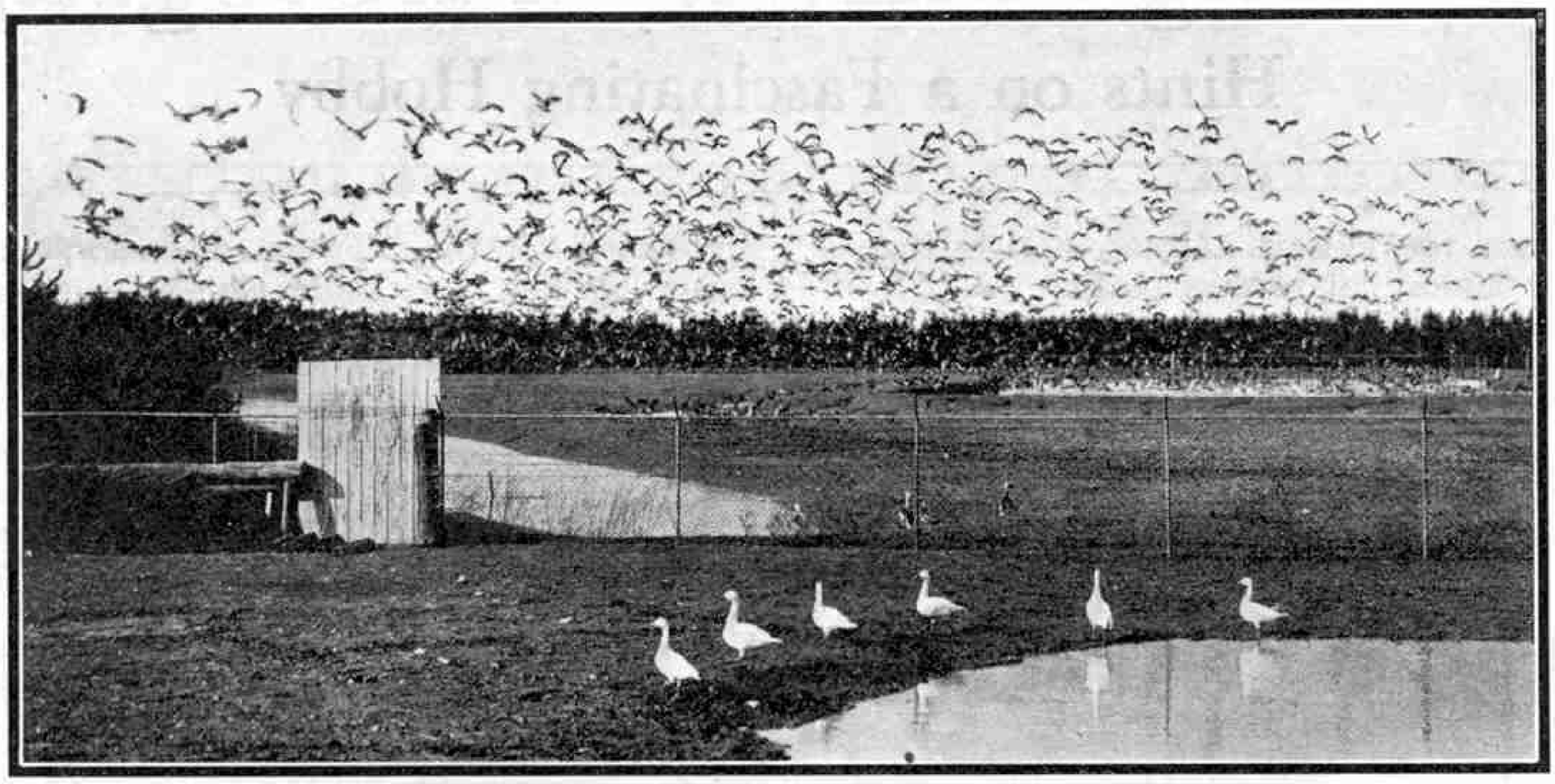
When I began to investigate the cause of the decrease in ducks and geese, I found it was caused by the increase of hunters, and by the substitution of the automatic pump gun for the old single-barrel muzzle-loading gun, and quick nitrate powder for the old black powder. Thus Man had spent too much time in studying the killing of game, and no time at all in conserving the game so that they would not become extinct. These facts led me to conceive the idea of starting a sanctuary where neither rich nor poor could enter, but where birds would be protected from the hunter's gun, and would find food and shelter at all times.

I was not a wealthy man, and therefore was unable to build large ponds. My business was that of a brick manufacturer, however, and thus where I had taken the clay out of the ground I fenced in the excavation that was left to form my sanctuary to be set aside for the birds of the continent. I bought a pair of wild geese that had their wings clipped, and in 1904 I placed them on this little pond, with plenty of corn around the outside bank of the pond ready for any wild geese that might be flying over, and might join them. To show how scarce the geese were, no wild ones joined the first pair until four years later, when 11 wild ones came. They stayed for about two months, and then migrated, and in the following year, 1909, they came back bringing their young. They now made 33 in all, and they stayed about two months and then migrated.

In 1910 I had 350, and in the following year a small cloud of them arrived, since when it has been impossible to estimate the numbers that flock to the sanctuary for food and protection. To give an idea of the number that comes, it costs practically 10,000 dollars per year for food for them, this sum being made up mostly by donations from my many wealthy friends, who contribute liberally. Thus the sanctuary idea for the artificial feeding of water fowl that I conceived nearly 30 years ago has become a successful plan for the protection of birds, and effectively prevents any variety from becoming extinct.

Many people have misinterpreted me since I started the sanctuary by saying that I was protecting birds to die of old age. This is not true. My idea is to protect the ducks and geese so that this generation will not

exterminate these birds, and thus the generations yet to come will have a taste of the wild fowl their forefathers enjoyed. I am not opposed to a man going out round the outside of the sanctuary, say at a distance of a mile or two, and shooting for food half-a-dozen or a dozen ducks and a couple or so of geese that the Creator put here for us; but I am opposed to men going out and slaughtering the birds just for the sake of killing. Remember that a sanctuary does not take anything away from the shooter; it only increases his chances of getting a wild duck or wild goose around the outside of such a bird haven, and to this, as I have said, I have no objection.



Canada geese rising off one of the ponds on the Jack Miner Bird Sanctuary.

On the other hand I think that the hunters, who form less than 10 per cent. of the total population of Canada and the United States, should be considerate and not want to slaughter birds, for the remaining 90 per cent. of the population want to see the birds alive. Ducks and geese multiply very rapidly, and no reasonable man can be opposed to shooting a limited number of them, any more than to taking the surplus of our domestic fowl. The desire to go shooting takes hundreds of thousands of men away from the grind of life, gives them an appetite to eat, and a desire to sleep, and they wake up rested and better husbands and fathers in their homes. This is a positive fact, and so what reasonable man or woman can oppose it?

A few years ago I visited Niagara Falls and found it was true that our beautiful white whistling swans were being caught in a death trap by the hundred. Niagara, for 10 or 15 miles above the Falls, is the first open water in Lake Erie. Thus the swans went there first on their northern migration, put their heads over their wings, and went to sleep for the night, and gradually drifted into the swift water that carried them over the Falls, where 75 per cent. or more were killed or drowned in this 160-ft. drop. The remainder crawled up on the ice bridge below, unable to rise straight up, and there awaited their doom.

Mr. Jack Miner and a friend about to liberate a pair of tagged Canada geese.

I got into conversation with Mr. William Hill, better known as "Red" Hill, the river man, and we sat down and discussed the situation. Finally he looked me in the face and said: "There used to be quite a lot of wild geese get killed here, but I haven't seen a wild goose round here since you harboured them up at the west end of the lake." At this I rose up and whacked him on the shoulder. "Red," I said, "You have told me something. If the wild geese could be taken away from here the swans can."

Afterwards I got some swans to act as decoys, and placed them in my sanctuary. To make a long story short, last spring over 4,000 of these beautiful white birds came, spent a month or six weeks along the lake shore in front of the little town of Kingsville, where the Government furnished Royal Canadian Mounted Police to patrol the shore, both day and night, to afford them ample protection.

Not only do ducks, geese and swans find shelter in the sanctuary, but round the pond there have been planted several rows of evergreen trees that, in addition to forming a wind break to the ponds, serve as shelter for the song and insectivorous birds of the continent.

What pleases me most is that, since my sanctuary has been established and proved a success, hundreds of other sanctuaries have been started during the past 10 years by our Provincial and Dominion Governments of Canada, built on the same principle all over the country. These have proved just as successful as my own sanctuary. In our neighbour country the United States also sanctuaries by countless numbers have already been started, and in motoring through the country you will see signs of bird protection at almost all golf clubs, as bird houses usually are seen dotted here and there about the course.

In conclusion let me say again that a bird sanctuary does not take anything away from the shooter, but is continually building up his chances, and not only his, but those of his children's children. Birds will never become extinct or exterminated as long as *Continued on page 93*

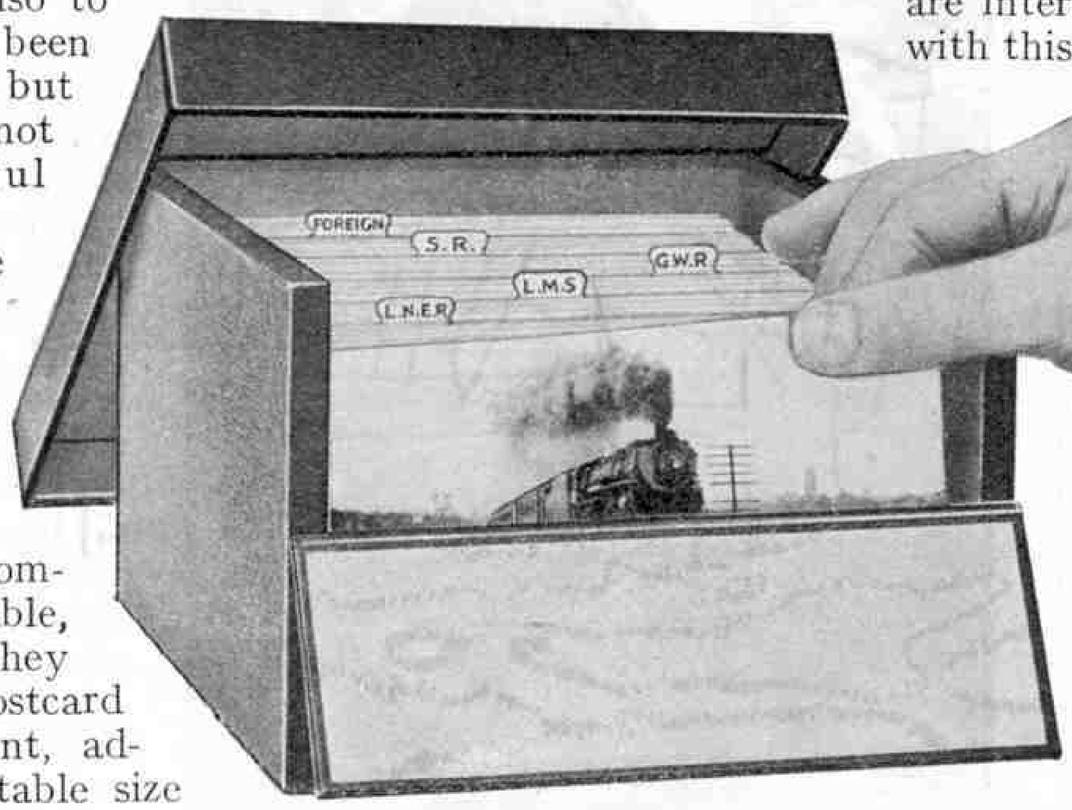
Collecting Railway Photographs

Hints on a Fascinating Hobby

THE enthusiasm for railways and locomotives that is shared by almost all readers of the "*M.M.*," in spite of the many rival attractions of this mechanical age, expresses itself in many different ways. One thing is common to all these enthusiasts, however, and that is a keenness to collect photographs of railway scenes and incidents. We receive many requests from H.R.C. members for advice in regard to making a really good collection of railway photographs, and this article is intended to summarise the main features of this interesting hobby. It is hoped that the advice given will be of assistance, not only to the beginner who is in doubt as to the best method of starting a collection, but also to others who may have been collecting for some time, but for various reasons have not obtained very successful results.

The S.R. "Golden Arrow" Pullman Express leaving Victoria Station for Dover. The locomotive at the head of the train is the well-known four-cylinder 4-6-0 No. 850 "Lord Nelson." This photograph, and the others illustrating this article, are typical of the productions of Railway Photographs, Liverpool.

The first point to be considered in starting a collection is the size of the pictures. Large photographs have an interest of their own, and are specially useful for examining very small details. There are comparatively few of them available, however, and in addition they are relatively costly. The postcard is now, by common consent, admitted to be the most suitable size from an all-round point of view. This is the size adopted by the railway companies for their official cards, and by various publishing firms who specialise in these matters.



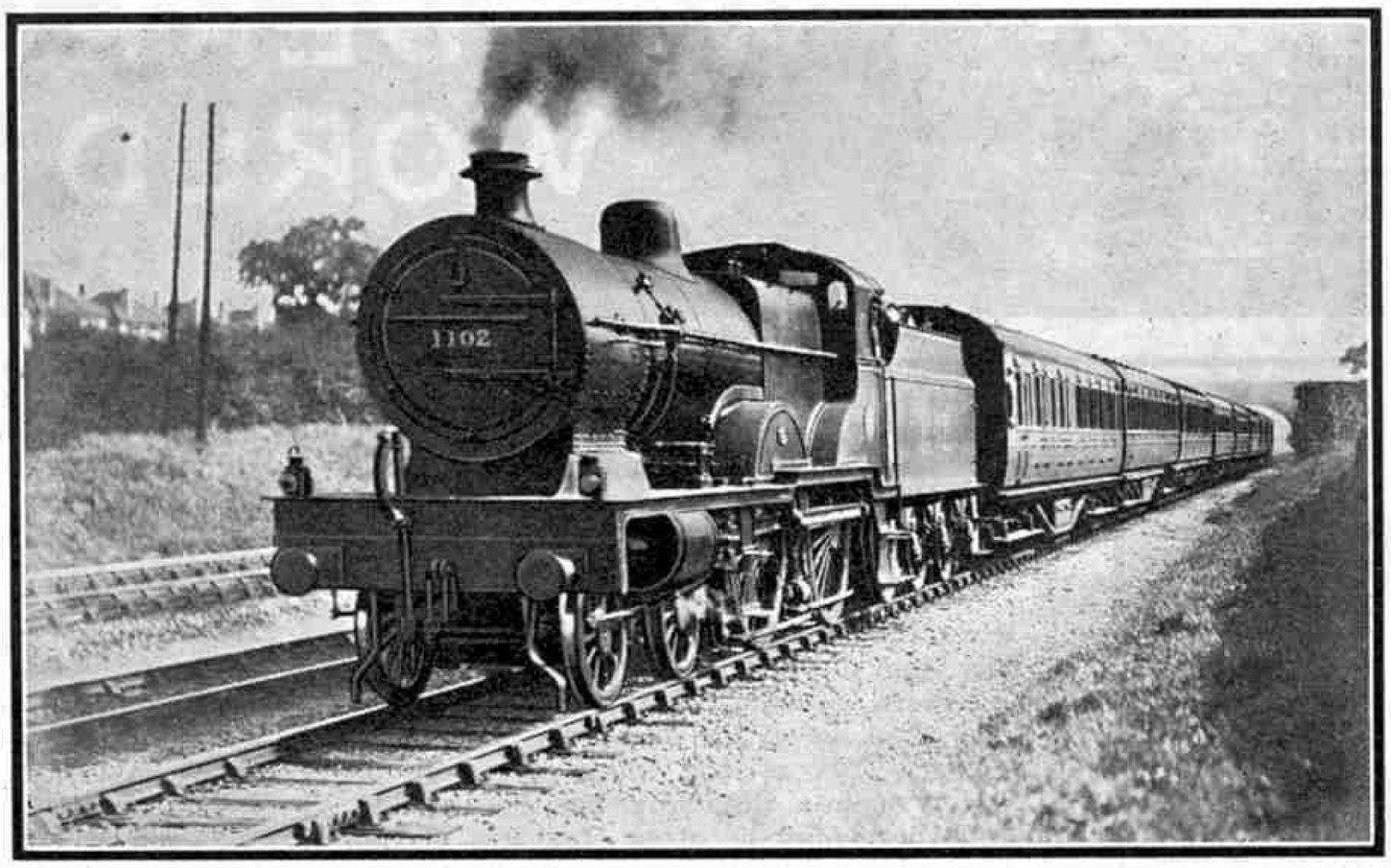
The post-card cabinet mentioned in this article. This photograph shows the drop front and also the method of employing the guide cards to classify the collection.

There are many sources of supply for railway postcards. The L.M.S.R. have two sets of six cards of photographs of their locomotives, one set being coloured. Then there are such interesting views as the cab of the "*Royal Scot*," and the famous old locomotive "*Lion*" with a train of early rolling stock. The L.N.E.R. issue postcards of the "*Flying Scotsman*," and also a set showing the remarkable high-pressure locomotive No. 10000. The splendid "*King George V*" appears on cards issued by the G.W.R., and the S.R. offer a good selection of post-cards of their locomotives and trains. All these cards are usually to be obtained at bookstalls on the respective companies' systems. Finally there is the splendid series of post-cards issued by Railway Photographs, 23, Hanover Street, Liverpool. This firm hold many of the negatives made by Mr. F. E. Mackay, who is famous as a railway photographer, and whose splendid photographs have often appeared in the pages of the "*M.M.*" Readers who are interested are advised to get in touch with this firm, who will forward a complete list of subjects and a specimen card on receipt of 4d.

Apart from such regular sources of photographs, anyone who sets out seriously to make a collection will find that pictures come to him in many ways. For instance, a feature of the Meccano Guild and the Hornby Railway Company is the Correspondence Club run in connection with each, which members may join and thus be put in touch with other railway enthusiasts in this country or abroad. Frequently exchanges of photographs and postcards are made in the course of correspondence, and this forms a particularly interesting way of gaining knowledge of railway practice outside of our own neighbourhood or country, besides adding considerably to the value of the collection as a whole.

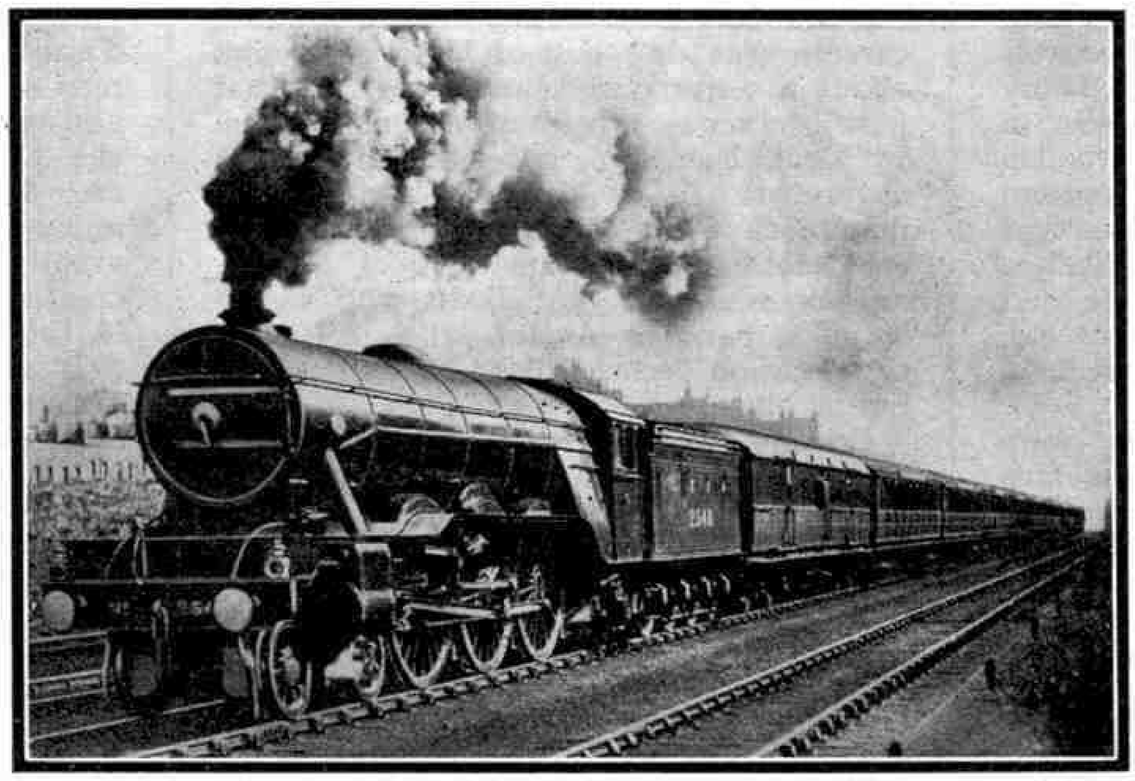
In making a collection of railway postcards some definite system should be followed from the

commencement. If the cards are left lying about loose they quickly become dirty and damaged at the corners, and before long they look so disreputable that all interest in them is lost. However small the collection may be at first, it should be stored in such a manner that all the cards are well protected, while at the same time each one is readily available when required. It is a common practice to classify the cards according to the various railway companies, and to insert them in an album. While this may be successful for a time, a great defect of the scheme is the impossibility of keeping a growing collection systematically arranged, as is desirable in order that the different cards may be fully appreciated and comparisons made between various locomotives or trains. Another point is that a growing collection is likely to soon over-run an ordinary album, and two or three albums take up a good deal of room, apart from other disadvantages they are likely to involve, such as the sequence of the cards representing one particular railway being broken when the end of an album is reached.



An L.M.S.R. Manchester express on the Midland section near Mill Hill. The engine is a Standard Compound No. 1102, one of a class that performs such fine work on this section.

The best arrangement undoubtedly is to employ some kind of cabinet, and a very suitable one is supplied by Railway Photographs, the firm already mentioned, price 2/9, post free. This is shown in one of our illustrations, and has been specially designed for the purpose of accommodating post-card size photographs. It enables the collection to be kept neatly and cleanly in a minimum space, for it is compact and dust-proof. It is strongly made, and covered with imitation leatherette paper, and is provided with a drop front to enable the contents to be reached easily. It will hold about 500 cards.

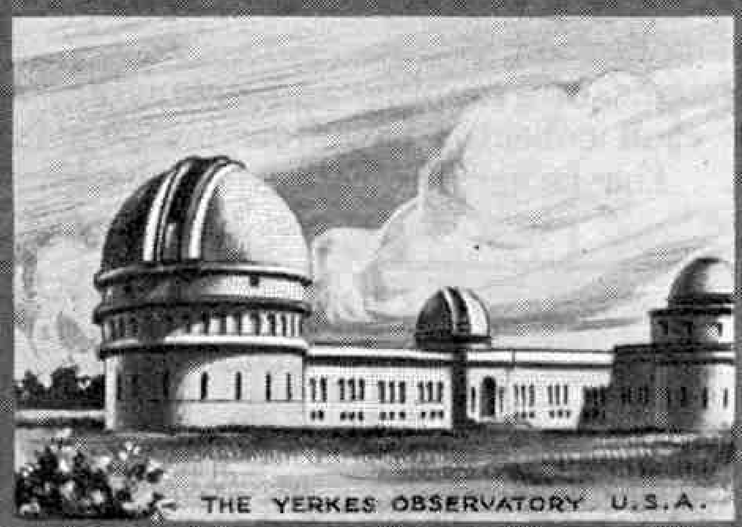

The down "Flying Scotsman" near New Southgate. The locomotive No. 2548 "Galtee More," is one of the well-known Gresley "Pacifics."

To enable the photographs to be classified so that any one is instantly accessible, coloured guide cards are provided for this cabinet, and may be obtained price 8d. per dozen, post free. The use of these guide cards to separate different sections of post-cards is shown in our illustration of the cabinet.

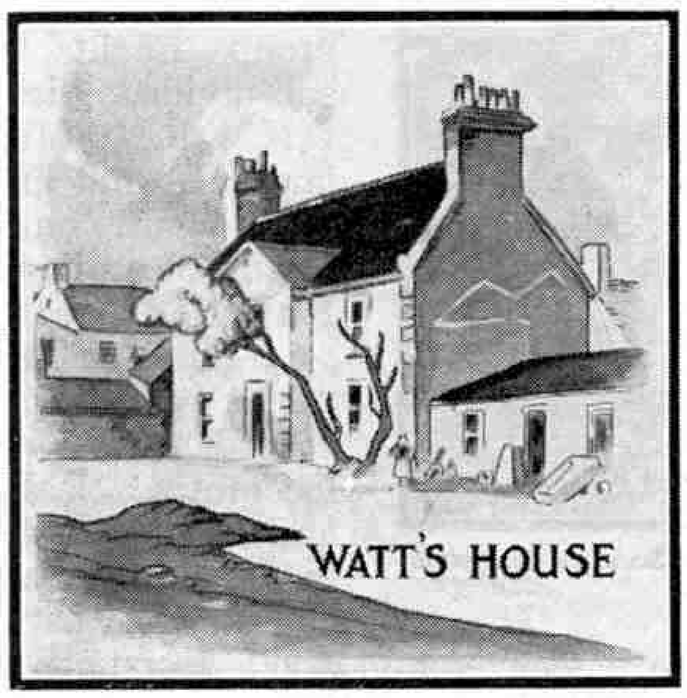
Every railway enthusiast acquires from time to time railway pictures smaller than post-card size. The best method of dealing with these is to paste them on plain post-cards so that they may then be incorporated in the post-card collection.

As regards systems of grouping and arranging, it is usually best for each collector to follow his own ideas and preferences. The larger the collection the greater is the degree of sub-division necessary. For instance, in addition to separating the four British groups, it may be necessary to sub-divide each one. Thus the L.M.S.R. group might be sub-divided into L.N.W.R., Midland, L and Y., Caledonian, and Highland sections. Further useful sub-divisions might be made in accordance with locomotive classes and wheel arrangements, and in a big collection of cards it is best to separate passenger and goods locomotives in each group and section. Considerable aid to the collector in regard to such classification is provided by the method of tabulating the various cards included in the list issued by Railway Photographs. In each case, unless a locomotive is shown alone, the particular train is quoted, the place where the photograph was taken is mentioned, and the name, number and wheel arrangement of the engine are given. It is not difficult, therefore, when starting a collection, to decide on what we may term the "key" cards that are to form the basis of the whole thing. The famous expresses of each group hauled by typical locomotives will be necessary, such as the L.M.S.R. "Royal Scot" train and corresponding locomotive; the L.N.E.R. "Flying Scotsman" with a "Pacific" at its head; the G.W.R. "Cornish Riviera Express" speeding to the West behind a "King," and the S.R. "Golden Arrow" in charge of a "Lord Nelson."

Then we may go on to include other expresses, and in this way the variety of locomotive types and classes will be considerably enlarged. For instance, in an L.N.E.R. division, after the key card might follow a Manchester express hauled by one of the large 4–6–0 locomotives, thus giving a Great Central section representative, and a further wheel type of a lower order than the 4–6–2 locomotive on "The Flying Scotsman." Additional 4–6–0 locomotives of other sections would follow, and then would come 4-4-2 engines, 4-4-0's and so on.


THE YERKES OBSERVATORY U.S.A.

OUR WONDERFUL WORLD


WATT'S HOUSE

The two small illustrations on this page are interesting reminders of conditions obtaining in the 18th century, when mechanical transport was unknown and serviceable roads were few in number. Then goods were largely transported by means of trains of pack horses, similar to that shown in the lower illustration, that passed in single file along narrow tracks leading from town to town. Many of these tracks connected the towns in the north of England where the woollen industry was carried on. They crossed streams by means of arched bridges that were only of sufficient width to allow the files of horses laden with wide and heavy packs to pass between their parapets, and many of these bridges are still in existence.

While the pack horse trains were carrying goods in this manner, a genius whose work played a great part in the development of mechanical transport was building pioneer steam engines. This was James Watt, whose house in Delftfield Lane, Glasgow, is illustrated on this page. In 1764, when Watt married and removed to this house, he had prospered sufficiently to provide employment for 16 workpeople in his instrument-making business, and was just beginning to concentrate on the problem of making a more efficient steam engine than the crude atmospheric engine previously developed by Newcomen, the Cornish engineer. How Watt persevered until he was successful in this aim is told in the story of his life that appeared in the "*M.M.*" a few years ago.

The illustrations on the opposite page also are of interest in this connection. Of the two smaller pictures, one shows the steam engine reputed to have been built by Hero of Alexandria as long ago as the second century B.C., and the other shows a steam hammer forging a giant ingot into shape. The central illustration is a reminder that mechanical transport is not yet universal, for it shows a boiler being hauled by elephants, creatures that for centuries have been used for heavy haulage in India, Ceylon and Burma.

Food Preserved for 20,000 Years

I have been greatly interested to learn that the body of another mammoth has been dug out of the frozen ground in Northern Siberia, with its flesh as well preserved as if it had only just been killed. This is the third occasion on which such a discovery has been made, and there may be other creatures of this kind that sank thousands of years ago in the half-frozen marshes of Siberia, to be preserved in this wonderful natural refrigerator for examination by modern scientists. One of the two frozen mammoths previously found is now in a museum in Leningrad, and the other is in Paris.

The most remarkable feature about these discoveries is that the flesh of the prehistoric mammoths is eatable, although it must be at least 20,000 years since the animal died. The first mammoth carcase was dug out of the icy ground about a century ago, and it is said that part of it was served at a dinner given by Dean Buckland, a celebrated English naturalist. A steak from the next mammoth to be discovered was sent in cold storage to the Institute of France, and members of that body who tasted it at a banquet organised to celebrate the occasion declared it to be "succulent, but a bit tough."

Coming now to a fresher food than prehistoric meat, I wonder how many people realise that milk is a natural source of at least 25 different minerals, in addition to milk fat and water? Although the minerals constitute less than one per cent. of its total bulk, an average sample of milk contains small quantities of nearly one-third of all the known chemical elements.

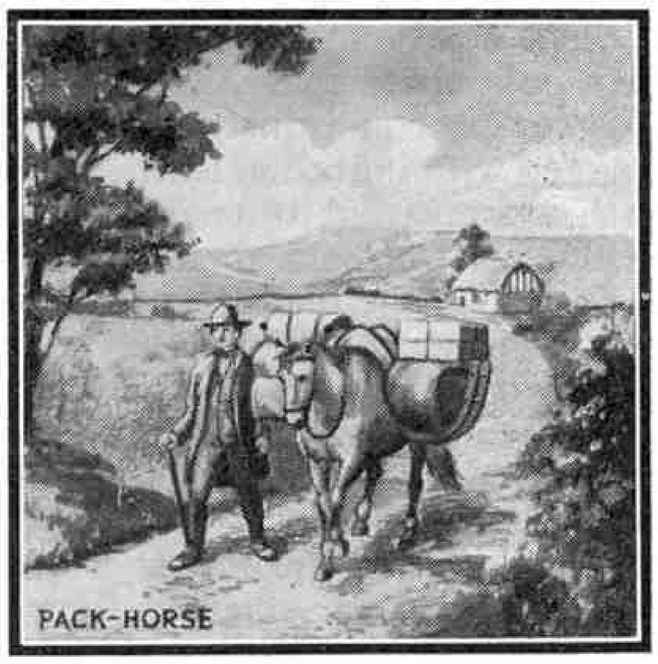
The mineral contents of milk actually play a great part in its use as a food. Calcium and phosphorus are the most important elements in it, for these are necessary for the growth of bone and teeth. The growing human body requires at least one gram of calcium daily, or about the amount contained in a single front tooth. This quantity may be obtained by drinking a quart of milk, the element in this being in a form that can be utilised more completely and efficiently than that in vegetables or any other foodstuff.

Tiny Fish Stamps Out Malaria

References to the deadly effects of malaria have often appeared in the "*M.M.*," together with accounts of efforts to end its ravages. One of the means adopted in the campaign against this disease is the introduction into malaria-ridden districts of the gambusia, a fish less than an inch in length, that eats the larva of the mosquito that carries the disease. In the "*M.M.*" for January, 1928, it was reported that thousands of these tiny fishes had been taken from their home in Central America to Italy, in order to help to stamp out malaria in that country. Since then about 200,000 of them have been liberated annually in the ponds of Istria, a province at the head of the Adriatic Sea, with the result that to-day none of these ponds breed mosquitoes, and malaria symptoms have almost died out. Thus the tiny fish has scored a wonderful triumph, for only a few years ago more than 94 per cent. of the population in the surrounding district showed symptoms of malaria. No doubt the gambusia will be called up for service in other parts of the earth where the scourge exists.

Earthquakes do not trouble the people of Great Britain very much, but in certain parts of the world the fear of a gigantic disturbance, and of the fire and ruin that may accompany it, is very intense. Japan and certain parts of the Pacific Coasts of the United States and Central America are peculiarly subject to earthquakes, and readers of the "*M.M.*" will recollect vividly the disaster of two years ago that created great havoc in certain districts in the North Island of New Zealand.

It is impossible to abandon populous and productive districts that are liable to earthquakes, and instead more attention is being paid to the erection of buildings that are capable of withstanding violent movements. Planning a building for this purpose has been compared to designing a ship, and an American architect believes that if the parts of a well-constructed building form a definite structure, it will


PACK-HORSE

be as little damaged by the rolling, pitching and twisting that accompanies an earthquake as a seaworthy vessel is by the similar movements of the ocean during a great storm. He has therefore built a "quakeworthy" house of wood, with lower walls of reinforced concrete resting on a foundation of the same material four ft. in thickness. The floors of the rooms on the first storey also are of reinforced concrete. The alternative to this method of meeting the earthquake menace is to build small, low houses of material that is easily replaced. The Japanese have followed this plan in constructing houses of bamboo frames covered with paper. This certainly decreases the losses that are incurred by a violent shock, and new buildings are easily erected; but there is always danger of a disastrous fire breaking out after an earthquake.

Marvels of Ant Life

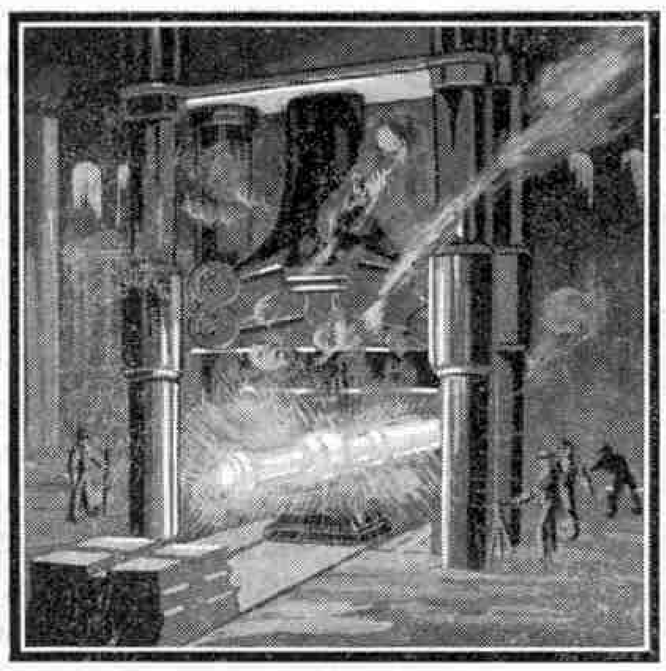
Ever since Lord Avebury and others began to reveal to us the secrets of ant life, the habits of various species of this insect have been a source of wonder. Many interesting stories of the queer behaviour of these creatures come from tropical countries, where ants are very numerous and more destructive than our own British species. In various parts of Africa ant heaps or hills from 10 ft. to 15 ft. in height are common, and special precautions have had to be taken to protect buildings and furniture from the ravages of their industrious but voracious inhabitants.

On the road to a Ceylon Tea Estate. Photograph by courtesy of Marshall Sons and Co. Ltd., Gainsborough.

The most destructive of these creatures appear to be the so-called white ants. These should really be described as termites, and their more usual name has been given to them because they resemble ordinary ants in shape, and are of a creamy colour. They are found chiefly in Africa and India, and seem to be capable of eating their way through almost anything except glass, rocks and living things. In India instances have been recorded in which the woodwork of door posts has been eaten completely away, leaving only the outer painted shells standing. The destruction of large quantities of valuable stores has often been attributed to white ants, and it is said that on one occasion a Hindu clerk even blamed them for the loss of papers stored in a metal box! He may have been right, for it is now known that termites exude an acid that actually corrodes metal.

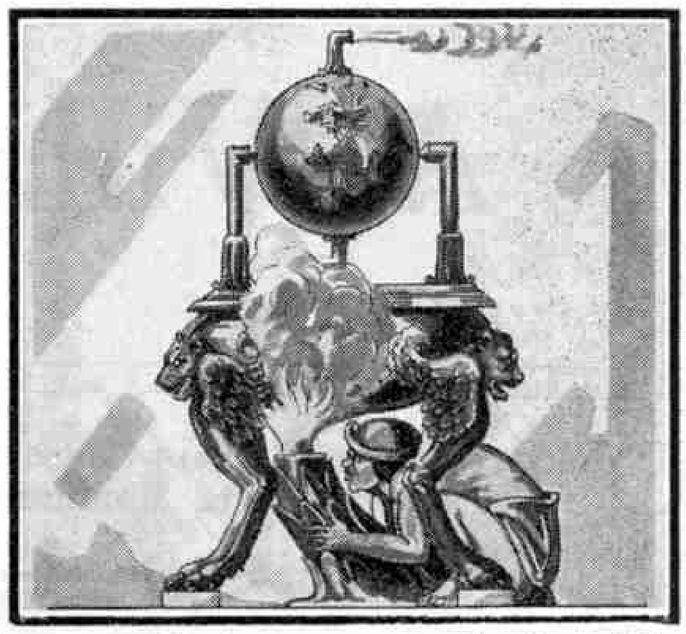
The life of a white ant is a short one. The insect is furnished with wings when hatched out, and soars towards the Sun in daylight and flutters round lights at night. Towards the close of its brief life it loses its wings, and frequently myriads of the creatures have visited bungalows and houses, attracted by the light radiated by powerful lamps, and have there discarded their wings in heaps.

One of the most remarkable of the many species of ants seems to exist for the protection of the Bull's Horn Acacia, a tree that flourishes in Central and South America and derives its name from the curved hollow spikes or horns that cover its branches. In the wet growing season the horns are literally barracks in which live stinging ants that protect the tree from its many foes. They inflict painful bites on animals that attempt to eat its leaves, and repel the leaf-cutting ants that otherwise would quickly strip the tree bare of its foliage. The protecting ants do not go unrewarded. They are induced to make their home on the tree by the provision of a sweet pulp in the horns, and when they have eaten this and made room for themselves, they feed on nectar secreted in tiny hollows at the bases of the leaves. The positions of these hollows ensures that the ants shall patrol the whole of the leaf and branch system of the tree while running from one to another in order to sip the sweet syrup carefully provided for them.



Bird that Travels 22,000 Miles A Year

Most readers of the "*M.M.*" are familiar with the system of tracing the movements of birds by placing rings on their legs, and tabulating the reports of the capture of birds marked in this manner. This plan



has proved of very great value in settling many problems of bird migration, for it enables individual birds to be identified definitely and exactly, whereas formerly they could only be recognised in an uncertain manner by special markings and other peculiarities.

Another direction in which ringing promises to be useful in showing how long birds live. The record so far seems to be held by a black-headed gull that wore a ring for 20 years. A marked heron was reported 16 years after its ring was put on, and cormorant and tufted duck have been found to reach the age of 14 years. Perhaps the most remarkable instance is that of a woodcock that lived for 12 years after being ringed, although during that time it must have been a target for many country sportsmen.

It has long been known that many of our British birds fly as far as South Africa in order to find winter quarters, and "ringing" on a large scale has enabled us to trace British-bred swallows definitely to Natal, Transvaal, the Orange Free State, and Cape Province, which are reached by way of Spain and the Belgian Congo. A ringed lapwing from Cumberland was caught in Newfoundland in 1927, and it is believed that this bird was one of a flock that flew across the Atlantic, although the distance from the Irish Coast to Newfoundland is nearly 2,000 miles. Many crossings of the Atlantic Ocean by other birds also have been recorded.

Undoubtedly birds must be regarded as the most indefatigable of globe trotters, and in its lifetime a single bird may visit many parts of the earth. Some of them have a taste for Arctic exploration, and one bird at least combined this with a crossing of the Atlantic Ocean. This was a kittiwake gull, from the Farne Islands, which was recovered and identified by means of its ring two years later in Davis Strait, the Arctic sea west of Greenland.

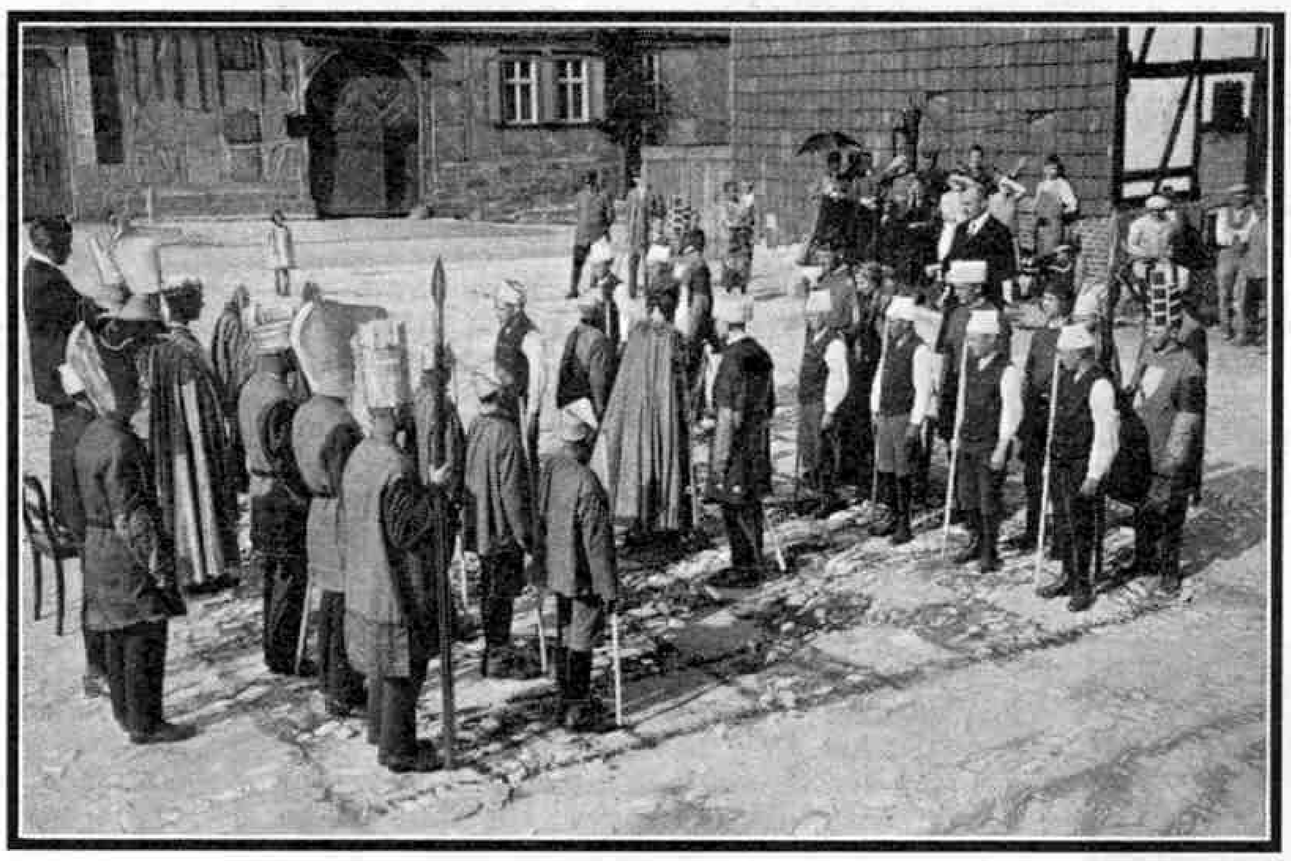
A Village of Chess Players

By Harold J. Shepstone, F.R.G.S.

ON the wide fertile plain that stretches to the north-west of the Hartz Mountains, and about seven miles from the ancient city of Halberstadt, is situated an extremely interesting village, in its way unique not only in Germany but in the whole world. This village is called Strobeck, and it is the home of a race of chess players. For many centuries all its men, women and children have played chess. Indeed, ignorance of the game would not be tolerated on the part of any of the villagers, whose *esprit de corps* in all matters concerning their cherished pastime is really wonderful.

Chess forms a part of the school study of the children of the village of Strobeck, in Germany. In fine weather the boards are taken into the playground.

In olden days a considerable amount of time was evidently spent in the study of the game, and to-day every moment of leisure is devoted to chess playing. Difficult problems are discussed, and all items of news concerning the game and its devotees in different parts of the world are read with the keenest interest. The reflex of this absorbing devotion to the noble game, continued as it has been through so many generations, finds expression in a variety of quaint ways in the village. We find, for example, the remarkable phenomenon of a large iron chess-board utilised as a weather-cock on the spire of the church, and the device of a chess-board in black and white marble built into the frontage of a house formerly occupied by a president of the chess club.



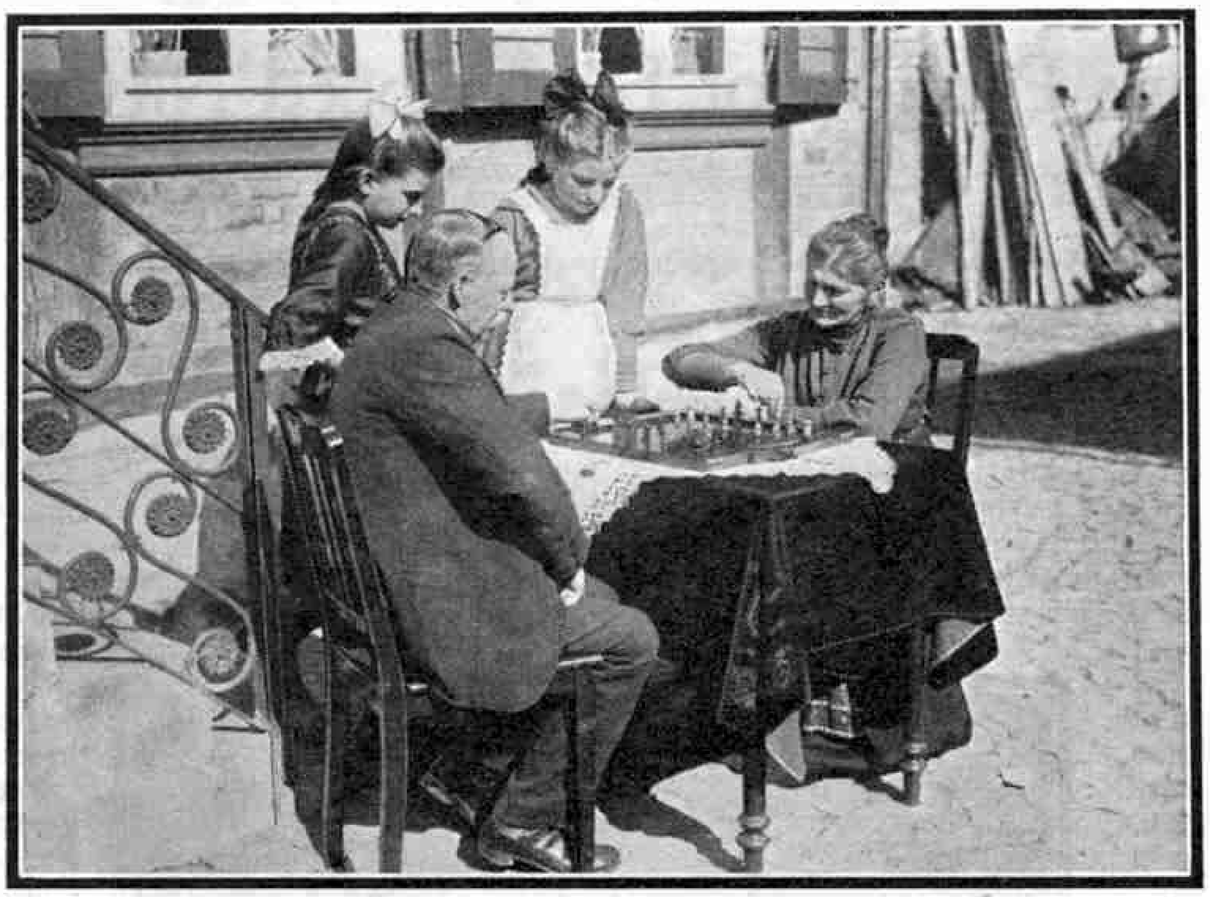
At the annual Chess Festival at Strobeck one of the features is a game played with living pieces.

There are many other indications of the extraordinary influence that chess has exercised over the minds, manners and customs of these villagers. It enters even into their matrimonial arrangements, for a young Strobecker may not wed a girl from any of the neighbouring villages unless she is a good chess player. If he has the temerity to do so, he must pay a certain sum of money into a fund that is devoted to defraying the expenses of the great chess tournament held at Strobeck every five years. If a Strobeck girl marries a man from the outside world, she must play a game of chess with the chief magistrate of the village before she leaves her native heath, in order to prove that she carries with her a knowledge of the game.

Like the royal children of the Kingdom of Cyprus, who had to learn the laws of chess "almost with their mothers' milk," so the children of Strobeck learn with their A B C the rules and regulations of the game. As soon as they go to school, carrying their chess-boards with them, they are systematically instructed in the moves, and encouraged to puzzle out problems for themselves. Every Easter examinations and matches take place, when the three boys and three girls that remain victors are presented with well-made, serviceable chess-boards, bearing the inscription "The reward of diligence." Expert chess playing is therefore a necessary qualification in any schoolmaster or schoolmistress seeking employment in Strobeck.

Chess playing may be described as the ruling passion as well as the sole recreation of the Strobeckers, who are a particularly hardy agricultural race, differing a good deal in appearance from the inhabitants of the neighbouring Hartz districts. Possibly the constant study and concentration of thought needed to master difficult chess problems is indirectly responsible for the clever, earnest faces that one meets at every turn in Strobeck. This applies especially to the children. The hands

of both young and old are also very striking, not only for their good shape, but for their well-cared-for condition—characteristics not usually associated with an agricultural people. In this, too, the influence of chess may be traced, as the prominent manner in which hands are displayed over a chess-board has evidently induced their owners to keep them in good order.



Grandparents take a hand in the game, while their grandchildren look on, keenly interested and critical of every move.

It is curious that, although any number of traditions are current respecting the origin of chess playing in this remote part of Germany, nothing really authentic is known. Records exist, however, that show conclusively that chess was played in Strobeck nearly 1,000 years ago. It appears that in the year 1011 a certain Count Guncellin was made a prisoner of war by the famous Bishop Arnold of Halberstadt who, for security, shut up his captive in a square tower that stands to this day in the centre of Strobeck, and is known as the "Chess Tower."

The captive soon learned how to beguile the lonely hours by playing chess, a game of which he was passionately fond. He chalked out a chess-board on his dungeon floor and carved two sets of chessmen out of wood. Then, being doomed to play alone, this ingenious prisoner made his right hand the opponent of his left, and the game went on. In due time the Strobeck peasants who took turns in guarding the door of his cell became interested in the Count's silent manœuvres on the floor, and asked to be initiated into the mysteries of the game. Soon these pupils became keenly interested, and presently everyone wanted to learn this new and absorbing pastime. By the time of the prisoner's release there was quite a good number of chess players in Strobeck. The peasants lost all interest in games of chance and concentrated their attention upon this new game of skill. The mothers taught the game to their daughters, and fathers bequeathed their chess-boards to their sons as a sort of "patent of nobility." Each family strove hard to surpass the prowess of its neighbour.

The tower at Strobeck in which, according to tradition, the game began in the village in the year 1011.

About the middle of the 12th century the Strobeckers obtained the right of calling on any landowners or strangers to play a game of chess before allowing them free passage through the village. This custom continued up to quite modern times, and even now can be traced in the courteous invitation extended to all visitors to try their skill in the game. It may be mentioned, by the way, that any stranger who takes up this challenge is invariably defeated!

However much the visitor to Strobeck may have heard of the inhabitants' extraordinary love of chess, he is invariably surprised at the complete dominance of the game over every other recreation and sport. While a village merchant waits for customers he entertains himself with the problems of chess, and when business knocks he lays his chess-board aside only for the time during which the purchaser is served. So his father did before him, and so his son will do after he has gone. Wherever people go in Strobeck for entertainment and refreshment they find chess-boards and chessman provided for their amusement. The game is part and parcel not only of the village's educational and recreational hours, but also of its business hours. The entire village breathes chess morning, noon and night, generation after generation.

The game of chess is of great antiquity, and there has been much dispute as to where it originated. It appears now that the balance of historical tradition is in favour of the game having originated in Hindustan, and one theory says it was evolved by the Indian Buddhists. According to the religious ideas of these people, the killing of a fellow-man in war or in any other circumstances is criminal, and will meet with severe punishment in the next world; and in order to provide an outlet for the aggressive side of human nature they invented chess as a harmless imitation of actual war. The game appears to have reached Persia in the sixth century and to have been introduced into Spain by the Arabs in the eighth century. In early times the method of play differed considerably from that of the modern game, and it was not until the 16th century that the game assumed its present form, when castling, the most recent change, was introduced.

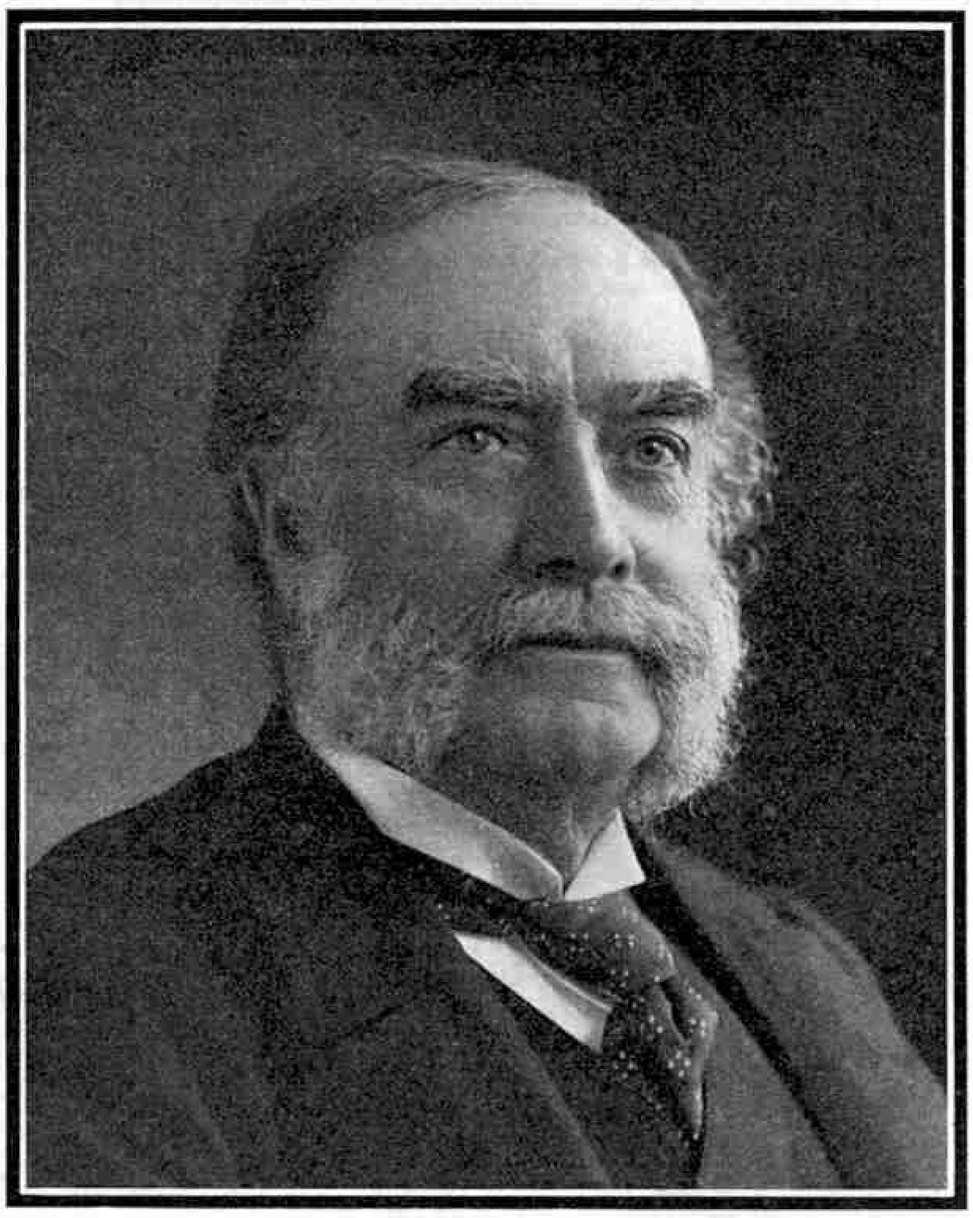
Chess appears to have been popular with the ancient warlike Viking peoples, and during the "age of chivalry" proficiency in the game was generally regarded as an essential qualification of the perfect knight.

Sir Alfred F. Yarrow

A Famous Pioneer of High Speed Naval Vessels

ONE of the greatest among pioneers of fast vessels of the torpedo boat and destroyer types, and of water-tube boilers for marine work, was Sir Alfred Yarrow, the founder of the famous shipbuilding firm that bears his name.

Alfred Fernandez Yarrow was born on 13th January, 1842, in London. He was educated at University College School, where he showed marked proficiency in mathematics and science. At the age of 15, through the influence of a friend of the family, he was apprenticed for five years without payment of a premium to Ravenhill and Company, a London engineering firm that specialised in engines for naval vessels. There he passed successfully through the various departments and acquired a thorough knowledge of the business. He devoted most of his spare time during his apprenticeship to improving his knowledge by working in his own small workshop, which was equipped with an old second-hand lathe, and by attending as many scientific lectures as his limited means would allow. He had as a friend another Ravenhill apprentice named Hilditch, who was a year his junior. The two boys had many serious discussions on scientific and engineering subjects, and during their leisure hours they also devised many mechanical contrivances. It was probably the inspiration of lectures by Faraday that led them to connect their homes at Barnsbury by a private overhead telegraph wire, which Yarrow claimed was the first erected in this country.



Sir Alfred F. Yarrow.

In 1840 Yarrow and Hilditch designed and patented a steam road carriage. They succeeded in interesting a Mr. T. W. Cowan, of Greenwich, in the invention, and he agreed to pay them a royalty on all vehicles built under their patent. One of the carriages was displayed at the International Exhibition in 1862, and was a great attraction. It failed to secure an award, however, as the judges who dealt with the carriage exhibits regarded it as an engine, and the judges who dealt with the engine exhibits decided that it was a carriage! Both groups of judges commented favourably upon the invention. A carriage of this type plied one night a week between Greenwich and Bromley, in Kent, a distance of 10 miles. It must have presented an alarming sight as it travelled along, with flames shooting from the chimney, at a speed then considered excessive; and the enterprise came to a premature end when a policeman's horse took fright at the sight of the vehicle and threw its rider. The accident created a storm of protests, and shortly afterwards an Act was passed stipulating that mechanical road vehicles must be preceded by a man on foot and carrying a red flag, a restriction that remained in force for 30 years. The carriage was sold to Russia, and its success there resulted in several others being ordered from the enterprising inventors.

During the last two years of Yarrow's apprenticeship he and Hilditch invented and patented a steam plough. The invention was taken up by a Mr. Coleman, an agricultural engineer of Chelmsford, and was so successful that eventually he opened a London office to promote its sales, and appointed Yarrow in charge at a salary of £100 a year. This timely offer came shortly after Yarrow had completed his apprenticeship, and at a time when financial misfortune had reduced his father to bankruptcy. The plough continued to be popular, and within a few years the inventors received £600 in royalties. Yarrow further supplemented his income by preparing drawings of all types of machinery for outside firms, and by acting as inspecting engineer.

By the time he was 24 years of age Yarrow had accumulated a capital of about £1,000, and he felt that the time had come to set up in business for himself. Coleman was loth to part with him, and offered him a partnership and the management of his works, but Yarrow would not be turned from his resolve. He purchased two old cottages and some adjacent broken-down sheds on the Isle of Dogs, in the Thames, and with a Mr. Robert Hedley as partner he founded there the firm of Yarrow and Hedley. This small concern was destined to grow into a great shipbuilding business, and to become world-famous. During the first two years the firm devoted themselves to manufacturing pumping and general machinery, but one day it occurred to Yarrow that the construction of small steam launches might prove profitable. He advertised in the papers, and three days later he received an order for a 24-ft. steam launch with cabin accommodation for four passengers. The boat was completed in three months and was a great success, and during the next seven years the firm were kept busy constructing similar craft. By the close of 1875 they had built 350 steam launches, ranging in price from £140 to £2,000, many of which were sent to distant parts of the world. The launches were equipped with vertical return-tube and locomotive types of boilers.

Yarrow became recognised as the pioneer of fast shallow-draught vessels, and he also built numerous special craft for navigation on rivers abounding in shoals and rapids, some of these vessels having side wheels and others stern wheels. He was the first to produce stern-wheel craft built of steel, and these opened up to traffic many rivers hitherto navigable only by canoe.

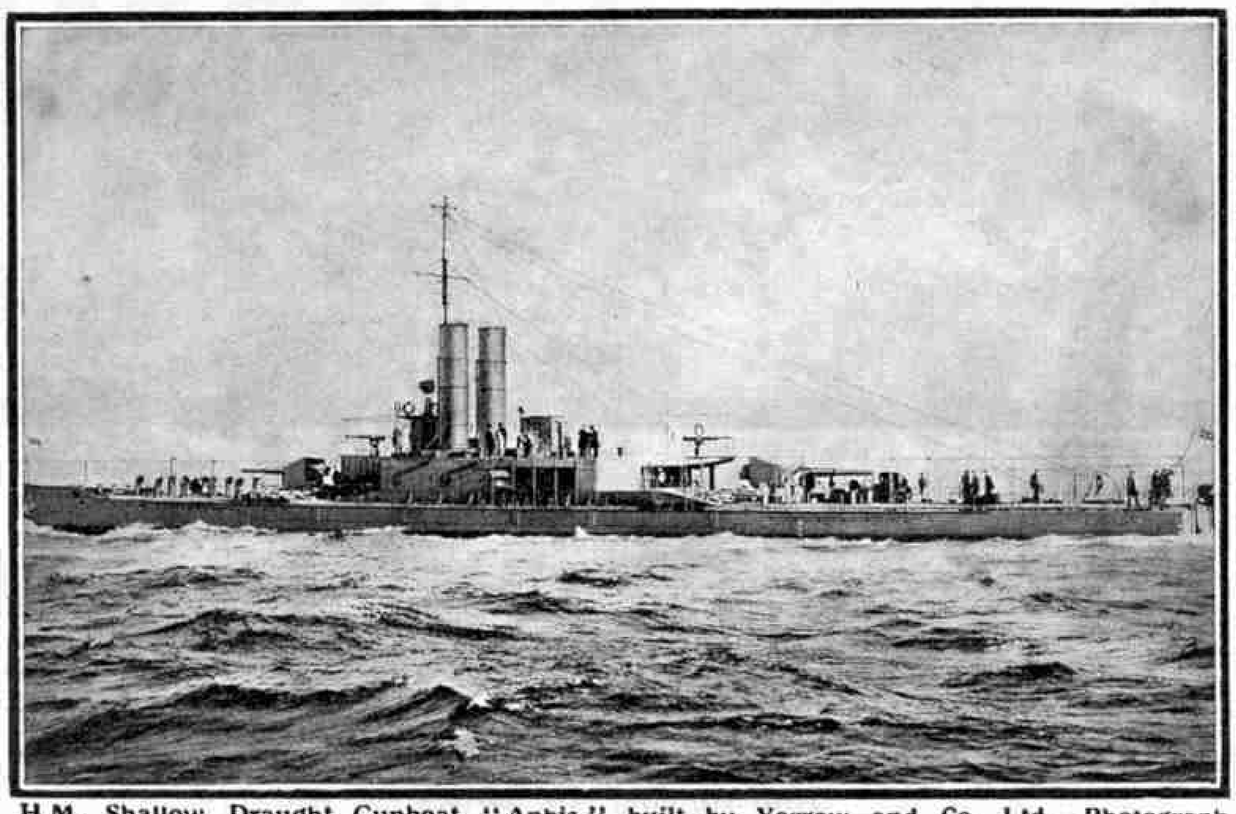
Hedley severed his connection with the firm in 1876, and Yarrow carried on alone, helped later by his eldest son, Mr. Harold E. Yarrow.

In addition to steam launches for river and similar navigation Yarrow built several shallow-draught gunboats, but he is remembered more for his important part in the development of torpedo boats and destroyers. His association with torpedoes began in 1873, when he mounted a spar torpedo on one of his fast steam launches. The first Yarrow launches designed to carry torpedoes were built to the order of the Argentine government, and were 55 ft. long. During the next few years orders for vessels of this type were received from many other foreign countries including France, Holland, Spain, Italy and Chile.

The first torpedo boat built by Yarrow was ordered by the British Government, and was known as the "Admiralty sample boat." A similar order had been placed by the Government with other firms considered capable of carrying out the work, the purpose of these boats being mainly experimental. The order stipulated that the boat must attain a speed of at least 18 knots, and that built by Yarrow actually attained the then extraordinary speed of 21.9 knots, a higher figure than was achieved by any of the competitive vessels. Two Yarrow torpedo boats ordered by the Russian government in 1877 were acquired by the British Government at the outbreak of the Russo-Turkish war, and these vessels took part in a review of the Fleet held in the Solent in 1878. The review was witnessed by Queen Victoria, who remarked afterwards that the performance of the two torpedo boats had interested her more than anything else.

Experience with steam launches had proved that the locomotive

boiler was the only type of boiler that stood up to the demands made upon it in these craft, and this type was adopted in the Yarrow torpedo boats. It proved far from ideal, however, under the severer conditions of service, and frequently when working at high speed the whole of the tubes would begin to leak. Yarrow set to work to design a boiler that would be equal to the heavy demands of torpedo boat work, and after 10 years of research and experiment he produced the Yarrow water-tube boiler. This type of boiler resembles an inverted "V" with a long steam drum at the top, and two sets of tubes, equivalent to the two halves of the letter, leading down from the drum to two cylindrical water pockets. In 1891 a Yarrow water-tube boiler, with 407 sq. ft. of heating surface, was fitted into a second-class torpedo boat, and later other boilers of this type with much larger heating surfaces were constructed.



H.M. Shallow Draught Gunboat "Aphis," built by Yarrow and Co. Ltd. Photograph reproduced from the Editor's "The Book of the Warship," by courtesy of the publishers, G. G. Harrap and Co. Ltd.

In 1892 Yarrow visited French shipyards where high-speed torpedo boats were being built, and as a result of the progress he observed there he called upon the British Admiralty and offered to build boats which, by reason of their greater length, greater speed and heavier armament, would be superior to the French torpedo boats, and capable of pursuing and destroying such vessels. Two of these "destroyers," as they came to be called, were ordered. The first, H.M.S. "*Havock*," attained on trial a speed of 26.1 knots, and the second, H.M.S. "*Hornet*," reached a speed of 27.3 knots. The "*Hornet*" had the distinction of being the first destroyer to be equipped with Yarrow water-tube boilers, and the high speed she attained proved their greater efficiency, as her displacement was 11 tons less than that of the "*Havock*," and her coal consumption five per cent. less.

In 1906 heavy local taxation and high operating costs caused Yarrow to remove his extensive works from the Thames to its present situation at Scotstoun, on the Clyde. The first ship built at the new works was a destroyer named "*Para*," of 600 tons, ordered by the Brazilian Government, and launched on 14th July, 1908.

Five years later Yarrow, then 69 years of age, left Scotland and made his home in Hampshire, leaving his eldest son, Mr. Harold E. Yarrow, in charge under his general supervision. Yarrow was still full of energy and, accompanied by another of his sons, Mr. Norman A. Yarrow, he paid a visit to Canada that resulted in a shipbuilding and repairing establishment being founded, with Mr. Norman Yarrow in charge, at Esquimault, a naval station on Vancouver Island, British Columbia.

When the Great War broke out Yarrow set himself with renewed vigour to develop high-speed destroyers, and during the war period 29 of these vessels were launched from the Scotstoun yard. These included the "*Tyrian*," which attained the remarkable speed of almost 40 knots when fully equipped, and could steam 1,000 knots without refuelling. The company established a shipyard at Abadan, on the Tigris, and by employing native labour launched a flotilla of river gunboats that were despatched in sections from Scotstoun, and proved invaluable during the Mesopotamian campaign.

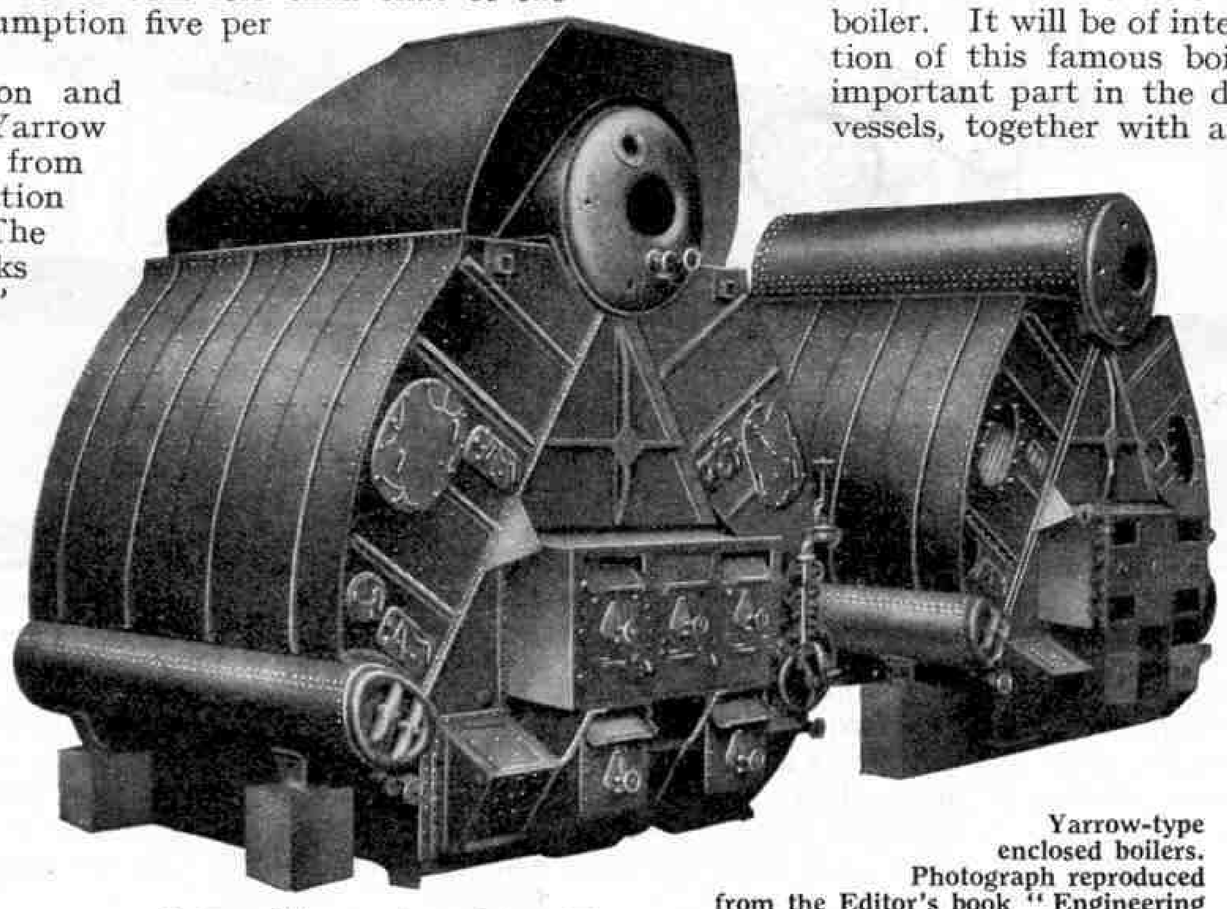
The war-time activities of Yarrow were extraordinarily numerous and varied for a man of his age. He converted the Yarrow Convalescent Home for Children, which he had founded at Broadstairs in 1891, into a well-equipped military hospital; manufactured artificial limbs for disabled soldiers; designed and manufactured an ingenious veil to conceal the faces of snipers, that was adopted by Lord Kitchener, and introduced an oil for preventing frost-bite. He also invented a buoyant waistcoat for sailors, and introduced an anti-submarine smoke system that was applied to several merchant ships. He offered £20,000 in sums of £1,000 to merchant ships that captured or destroyed an enemy submarine, and three of these offers were claimed.

Yarrow was created a baronet in 1916. He continued in active management of his great business until 1926, and on his retirement in that year the concern was formed into a limited liability company under the name of Yarrow and Co. Ltd., with Mr. Harold E. Yarrow, C.B.E., as Chairman and Managing Director.

In addition to endowing the convalescent home at Broadstairs, Yarrow made donations of £25,000 and £20,000 to the London Hospital, and gave large sums to Girton College, Cambridge, the British Association, and other important institutions. He provided the experimental tank at the National Physical Laboratory at Teddington at a cost of £20,000; and in 1922, the year after he was made a Fellow of the Royal Society, he presented to that society £100,000 to promote scientific research.

In 1930 Yarrow, then 88 years of age, broadcast some of his reminiscences, and in September 1931 he had his first aeroplane flight. He greatly enjoyed the experience, and within two months he had completed a 3,000 mile air tour of Europe. He died at his London home on 24th January, 1932, at the age of 90.

Earlier in this article we referred briefly to the Yarrow boiler. It will be of interest to give here a short description of this famous boiler, which has played such an important part in the development of high-speed naval vessels, together with an explanation of its working.

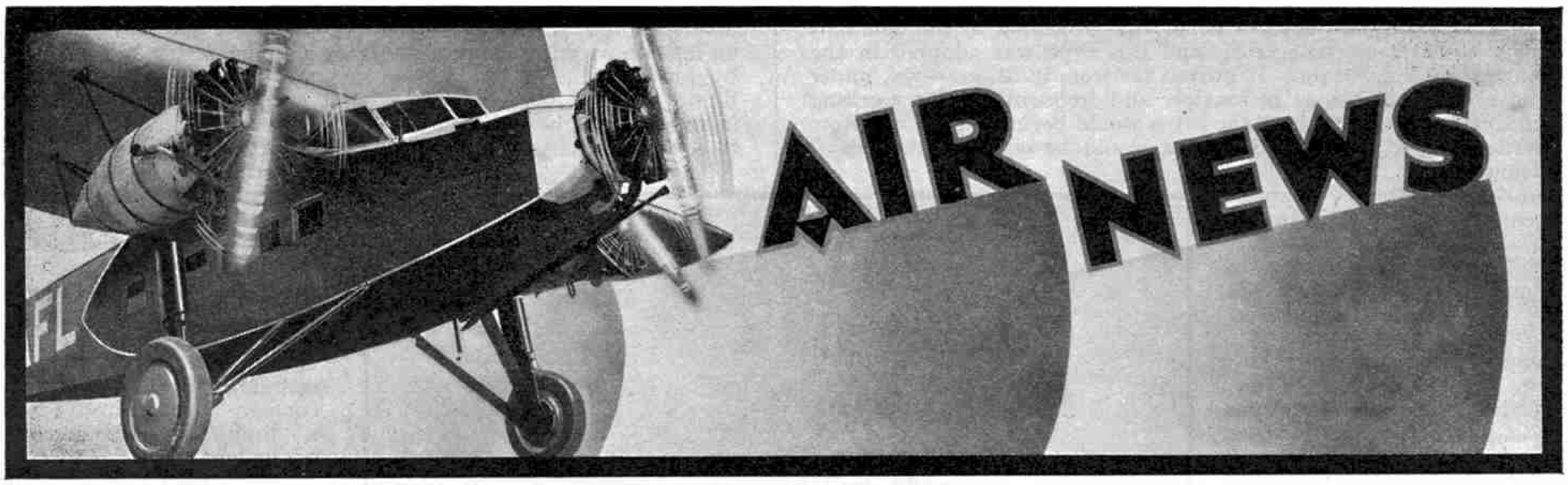


Yarrow-type enclosed boilers. Photograph reproduced from the Editor's book "Engineering for Boys," by courtesy of the publishers, Thos. Nelson and Sons Ltd.

The heating surface is provided principally by inclined banks of water tubes placed like the legs of an inverted "V" at the apex of which is the steam drum, and at the feet two parallel water pockets or drums, the whole arrangement making a sort of arch or short tunnel within which is the furnace. The hot gases and flames from the furnace pass out sideways and upward through both banks of water tubes into an uptake or casing that leads to a chimney above. The inner tubes of each bank, being nearer the fire, become hotter than the outer tubes, and as the water in them is heated it circulates upward to the steam drum and its place is taken by cooler water that moves downward through the outer tubes. In this manner a speedy and rapid circulation of the water is set up and maintained, and this enables a very high rate of steaming to be carried on without damaging the boiler.

The property of raising steam quickly has led to the Yarrow being adopted largely for use in electric power stations, where it can effectively meet sudden increases of "load."

The Yarrow boiler has emerged successfully from many very severe tests, a large proportion of which were totally unforeseen. For instance, on one occasion a vessel fitted with Yarrow boilers was crossing the Bay of Biscay. The weather was unusually severe, and an engineer incapacitated through seasickness allowed the water in one of the boilers to fall within 8 in. of the water pockets. The tubes became red hot, and in these circumstances the boiler might well have been expected to explode. It survived the ordeal, however.



Italian Air Feats in 1933

The most outstanding feature of international aviation during 1933 was the amazing series of flights carried out by Italy. Not only did the usual Italian long-distance formation flight take place, but also Italy secured the world's air speed record and the Blériot Cup.

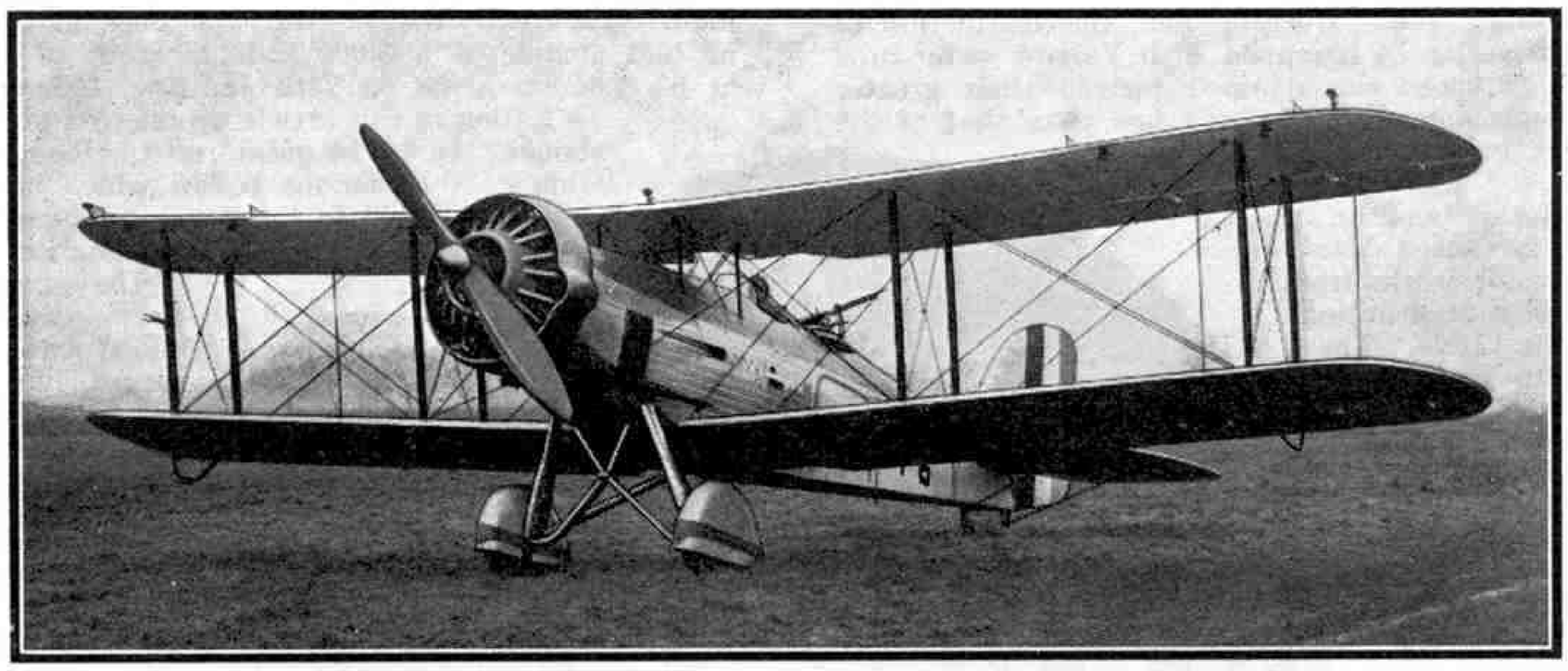
The speed record was set up in April 1933 by Warrant Officer Francesco Agello, who maintained an average speed over five runs of 423 m.p.h. The flights were made over Lake Garda in a Macchi Castoldi seaplane equipped with a Fiat 72 engine. An interesting feature of the engine is that it drives two two-bladed airscrews. In appearance it resembles two normal water-cooled engines placed in tandem with the propeller shaft driven by the rear engine carried inside that connected to the engine in front. The airscrews rotate in opposite directions.

The formation flight took place in the summer, and was undertaken by 24 Savoia Marchetti twin-hull flying boats, each powered by two Isotta-Fraschini 18-cylinder engines. The flight was led by General Italo Balbo and was commenced at Orbetello, from where the machines flew to Amsterdam, Londonderry, Iceland, Labrador, New Brunswick, Montreal, Chicago, New York, Newfoundland, the Azores, Lisbon and Ostia. During the flight a distance of about 12,045 miles was covered, and the Atlantic Ocean was crossed twice, only 43 days being taken. Unfortunately, one machine crashed during the course of the flight.

The same Macchi Castoldi seaplane that was used by Francesco Agello to set up the world's speed record was employed later by Colonel Guglielmo Cassinelli to set up a record for 100 km. in a closed circuit, his speed being 391 m.p.h. The machine was used also by another Italian airman, Captain Scapinelli, to win the Blériot Cup by flying for a period of half-an-hour and covering more than 192 miles. This is equal to 385.057 m.p.h. This Cup was presented by M. Blériot for competition, the minimum qualification for winning it temporarily being to fly for half-an-hour at a speed of more than 600 km. an hour. Scapinelli's speed was equal to 619.74 k.p.h. The Cup will remain in Italy's possession until this speed is exceeded by 5 per cent.

Hull-Holland Air Service

The Royal Dutch Air Lines hope shortly to operate a daily service between Hull and Holland. When this is in regular operation many internal air services will probably run from various parts of the country to Hull. In the summer the service will make it possible for a journey to be made between Hull and Rotterdam, Amsterdam, Berlin, Copenhagen, Malmö, Prague, Vienna and Hamburg in a single day. The service will leave Hull at 7 o'clock in the morning, and on one day a week will link up with the Amsterdam-Batavia service.



A Westland "Wallace" high performance general purpose and Army co-operation machine, similar to those used on last year's successful flight over Mount Everest. Photograph by courtesy of the Westland Aircraft Works.

The First Swedish Aircraft Carrier

The first aircraft carrier to be used by the Swedish Navy has recently been built. It is named the "*Gotland*" and has a displacement of 4,600 tons, a length of about 400 ft. and accommodation for 8 seaplanes. It is more of an aircraft-carrying cruiser than an aircraft carrier as we know it in this country, for the machines do not take off from a flat deck but are catapulted into the air.

The vessel is equipped with two de Lanal turbines each developing 33,000 h.p., which give her a speed of between 27 and 28 knots. She has a complement of 467 men.

Fast New French Four-Seater

An interesting new aeroplane, known as the Farman 390, has been produced by the French firm of Farman Bros. It is a single-engined high wing braced monoplane capable of carrying a pilot and three passengers, and is of all wood construction. The wings are of wood covered with fabric and are braced to the fuselage by means of oblique struts, which have a core of duralumin but are covered with wood. Inside the wings are two fuel tanks that have a total capacity of 60 gallons and give the machine a flying radius of 750 miles.

The fuselage is of wood construction and is covered with plywood. The engine is mounted in the nose and drives a four-bladed airscrew, while the cabin is below the wing centre section, the pilot being accommodated in front of the leading edge. The cabin is 7 ft. 9 in. in length, 3 ft. 4 in. in width and 4 ft. 9 in. in height, and is provided with a skylight and long lateral windows on each side. It is protected from noise by walls of special light rubber insulating material and is cooled by a series of intakes situated in the wings. In cold weather it can be warmed by pipes heated by the exhaust.

The aeroplane is designed to make use of a new Farman engine of the 7-cylinder radial air cooled type, developing 150 h.p., or a Farman 9-cylinder 228 h.p. radial engine. With the higher-powered engine the machine has a maximum speed of 125 m.p.h., a cruising speed of 109 m.p.h. and a landing speed of 31 m.p.h. The petrol consumption is one gallon to 12 miles with either engine. The machine is 32 ft. 6 in. in length and has a span of 45 ft. 10 in.

Automatic Parachutes

Experiments are now being carried out in America with parachutes by which a pilot can "shoot" his passengers into the air when an accident is imminent.

Automatically Piloted Aeroplane

Automatic pilots for aeroplanes have been developed by a number of countries, but the most unreliable part of the equipment so far constructed has been that concerned with steering the machine. Apparatus that has been developed by the General Electric Company of New York, however, makes it possible for the aeroplane to steer itself automatically without difficulty. Once the aeroplane is taken off the ground the apparatus is set to maintain flight in a certain direction and the pilot may then forget all his controls.

A further development is the control of this steering equipment by means of radio beams. This, in combination with gyroscopic devices such as that developed by the Sperry Gyroscope Company, makes it possible for the course of flight and the "attitude" of the aeroplane along all three axes to be controlled without the pilot's assistance.

During tests on the new apparatus an aeroplane was taken off and flown to an altitude of about a mile, when the automatic control was set. After this the two pilots of the machine got into radio communication with people on the ground until it was necessary to return to the aerodrome. The machine was then taken back merely by re-setting the control device. During the flight the two pilots were able to give the whole of their attention to their passengers and their radio conversation.

Another new device with which the aeroplane was equipped, and which adds greatly to the safety of flying, is the General Electric sonic altimeter. This apparatus, using a repeated whistle and its echo from the ground, is designed to indicate the distance between the aeroplane and ground at all times, and especially when landing in bad weather. The interval between the time when the note is emitted from the aeroplane and its echo is received back, indicates the height of the machine. This can be received either audibly or on a meter.

Some of the apparatus fitted in the automatically controlled aeroplane mentioned in the article on this page. The pilots are holding a conversation with engineers on the ground while the aeroplane is flown by the special "automatic pilot." Photograph by courtesy of the General Electric Company of New York.

Huge New Blackburn Flying Boat

One of the most interesting machines launched last year was the Blackburn "Perth," a development of the "Iris" range of flying boats. The machine is similar in general external appearance to the "Iris," and is equipped with three Rolls-Royce "Buzzard" II M.S. engines. It is designed for reconnaissance work and coastal patrol, and in order to enable it to carry this out properly it has fuel tanks that give it a range of 1,500 miles. A crew of five is carried in the boat, this being made up of first and second pilots, the second pilot acting as navigator, a bow gunner, a wireless operator, and an engineer who is responsible also for the rear guns.

The front gunner's cockpit is in the extreme front, and behind it is the pilot's cabin, which is provided with side-by-side seating and dual controls. The navigator's station is behind, and is followed by a room where the officers sleep and live, after which come the men's quarters and the engineer's station. The wireless cabin is on the port side of the boat and the galley on the starboard. A gunner's cockpit is situated in the extreme stern, behind the tail control surfaces.

The "Perth" is 70 ft. in overall length and has a wing span of 97 ft. and an overall height of 25 ft. It has a tare weight of 20,927 lb. and a maximum gross weight of 38,000 lb. It has a maximum speed of 132 m.p.h. and a minimum flying speed of 63 m.p.h. The normal range is 870 sea miles, equivalent to nearly 980 land miles; but when desired the range may be increased to 1,500 sea miles, or nearly 1,700 land miles.

A corner of the Royal Dutch Air Lines Waalhaven aerodrome at Rotterdam. Photograph by courtesy of the Royal Dutch Air Lines.

"Autogiros" for the R.A.F.

As a result of experiments carried out during manœuvres, Cierva "Autogiros" are to be used by the R.A.F. for Army co-operation purposes. They are to be employed mostly to enable staff officers to keep in touch with troops when on the march, as in them it is possible to visit the head of the column and to get back to the base in a very short space of time, whereas by car the journey takes a long time owing to the amount of traffic on the road. In order to demonstrate the ease with which messages can be delivered, a suitcase was handed into the cockpit of an "Autogiro" while it was flying near the ground. Thus it would be possible for messages to be handed to officers, and replies taken from them, when it was impossible to make use of the field telephone. The "Autogiro" would reach the base with the message much sooner than even a despatch rider.

A Fast Mail Flight

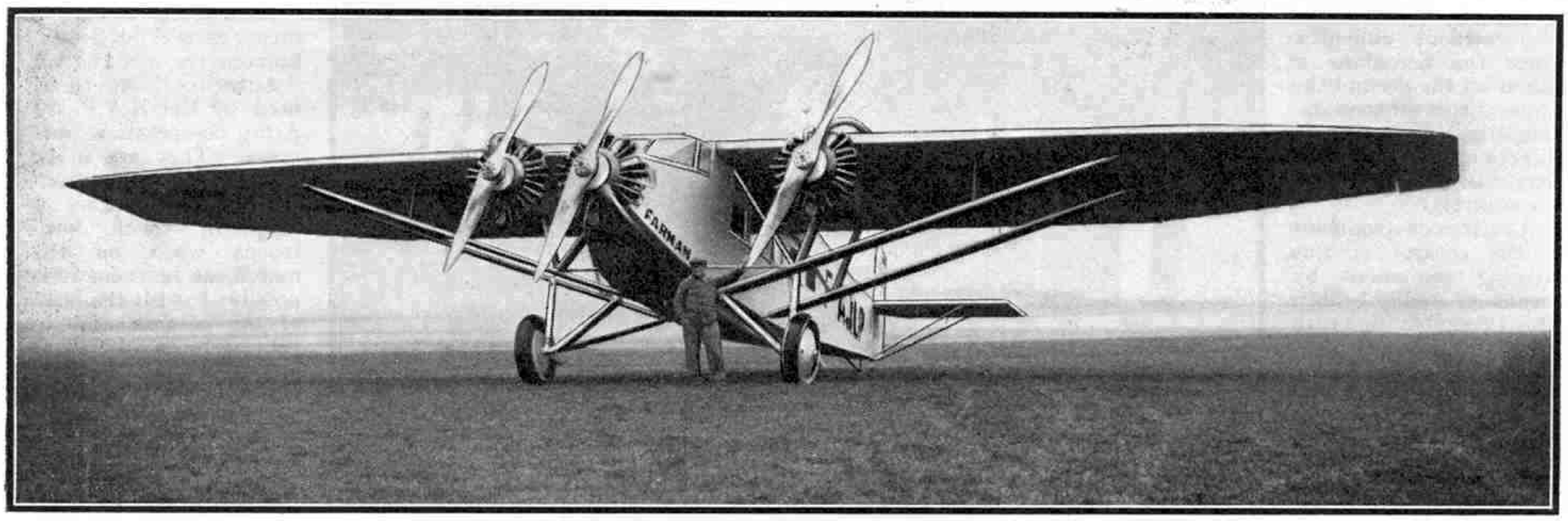
A fast flight was made in connection with the experimental air mail service between Germany and Brazil, operated by Deutsche Luft Hansa, when a Heinkel He. 70 flew from Berlin to Madrid in 8 hours, an average of 217 m.p.h. The aeroplane later flew on to Cadiz, where the mails were transferred to a Dornier "Wal" flying boat that flew them across the South Atlantic, stopping in mid-ocean to re-fuel at the catapult-ship "*Westfalen*."

Three World's Records for Pobjoy Engine

Three world's speed records for light aeroplanes have been secured by the Farman F.239 low wing cantilever monoplane equipped with a British Pobjoy R engine. The records were for machines in the third category, which is for two-seaters with a tare weight not exceeding 616 lb. The machine was flown by MM. Bailly and Reginensi and the records made were over distances of 100 km., 500 km. and 1,000 km., the average speeds being 131.8 m.p.h., 124.46 m.p.h. and 121.63 m.p.h. respectively.

Interesting Foreign Aeroplanes

Monoplanes for General Commercial Work



THIS month we deal with four well-known foreign aeroplanes that have been designed for service on air lines, for passenger work generally, and also for the carriage of freight. These machines are the Fokker F.XII, the French Latécoère 28-1B, the Farman F.300, and the Junkers F.24K. The first of these machines is made in Holland, the next two in France, and the last in Germany. Although they are all monoplanes, they are of different types, for the Fokker and Latécoère aeroplanes are of the high wing cantilever type, while the Farman is a high wing braced monoplane, and the German machine a low wing cantilever monoplane of typical Junkers design.

The upper illustration shows the French Farman F.300 and below is the Dutch Fokker F.XII. Photographs by courtesy of Avions Henri et Maurice Farman, and the N.V. Nederlandsche Vliegtuigenfabriek.

The Fokker F.XII is the largest of the four machines, being an 18-seater that was produced primarily for service with the K.L.M., the well-known Dutch air line company, on their regularly-operated mail service between Amsterdam and Batavia. It has seen much service on this route, which is a good test of the qualities of any aeroplane owing to the different types of climate encountered on the flight. On this service a machine is flown from terminus to terminus, and not, as on Imperial Airways routes, only over certain sections, mails and passengers then being transferred to another machine.

The F.XII is of the triple-engined type and is equipped with Pratt and Whitney "Wasp" engines, each developing 425 h.p. An interesting feature is that although the machine was developed from the Fokker F.IX, which was fitted with three lower-powered Bristol "Jupiter" engines, it is considerably smaller and has accommodation for fewer passengers. The reduction in size and the increase in power of the engines have been carried out in order to make the machine capable of maintaining flight with any two engines running, as a long journey across the Mediterranean has to be made on the service between Amsterdam and Batavia.

The fuselage of the Fokker F.XII is built up on the customary Fokker system, and consists of a framework of welded seamless drawn steel tubes, partially braced with welded steel tubes and partially with steel wire. The wings are built of wood, also on the usual modern Fokker method, and are secured to the joints in the top of the fuselage framework over the cabin. The passengers' cabin in the machine is 16 ft. long, 6 ft. 7 in. wide, and 6 ft. 3 in. high. It accommodates 16 passengers.

The machine has a span of 75 ft. 5 in., a length of 57 ft. 5 in., and a height of 14 ft. 1 in. Its maximum speed is about 137 m p.h., and the machine is capable

of cruising at a speed of 112 m.p.h. Its stalling speed is 68 m.p.h.

The famous Dutch firm managed by Mr. A. H. G. Fokker, one of the pioneers of aviation, builds military and commercial aeroplanes that are used throughout the world. Fokker machines are in daily use in more than 36 countries, and more than 40 air traffic companies employ them as standard equipment.

A three-quarter front view of the French Latécoère 28-1B high wing passenger monoplane. Photograph by courtesy of La Société Industrielle D'Aviation Latécoère.

The Latécoère 28-1B is nearly as big as the Fokker F.XII, having a span of 60 ft. and a length of 44 ft. 3 in. It is a single-engined machine, however, and is only capable of carrying half the number of passengers. It differs also in the fact that it is not a cantilever monoplane, the wings being braced to the fuselage by oblique struts. The monoplane has been produced in both landplane and seaplane forms and, equipped with the 500 h.p. Hispano-Suiza 12 H.br. engine, has been employed extensively on the lines of the Compagnie Générale Aéropostale.

The 28-1B is of all-metal construction, the wings being metal with fabric covering. The ailerons are mounted on ball bearings and are operated by rigid controls. The metal fuselage is built in two sections. The forward section, reaching from the fire-proof bulkhead behind the engine to the rear of the cabin, is constructed of built-up transverse bulkheads, tubular longerons, and longitudinal stringers covered with corrugated metal sheets. The rear section is a wire-braced tubular structure covered with fabric. The tail unit is of the normal monoplane type and the undercarriage is divided. The machine has a maximum speed of about 141 m.p.h., and its normal cruising speed when at sea level is about 133.5 m.p.h.

The Junkers F.24K low wing monoplane, showing the special radiator for the Junkers "Jumo 4" water-cooled heavy oil engine, with which it is equipped. Photograph by courtesy of Junkers Flugzeugwerke A.G.

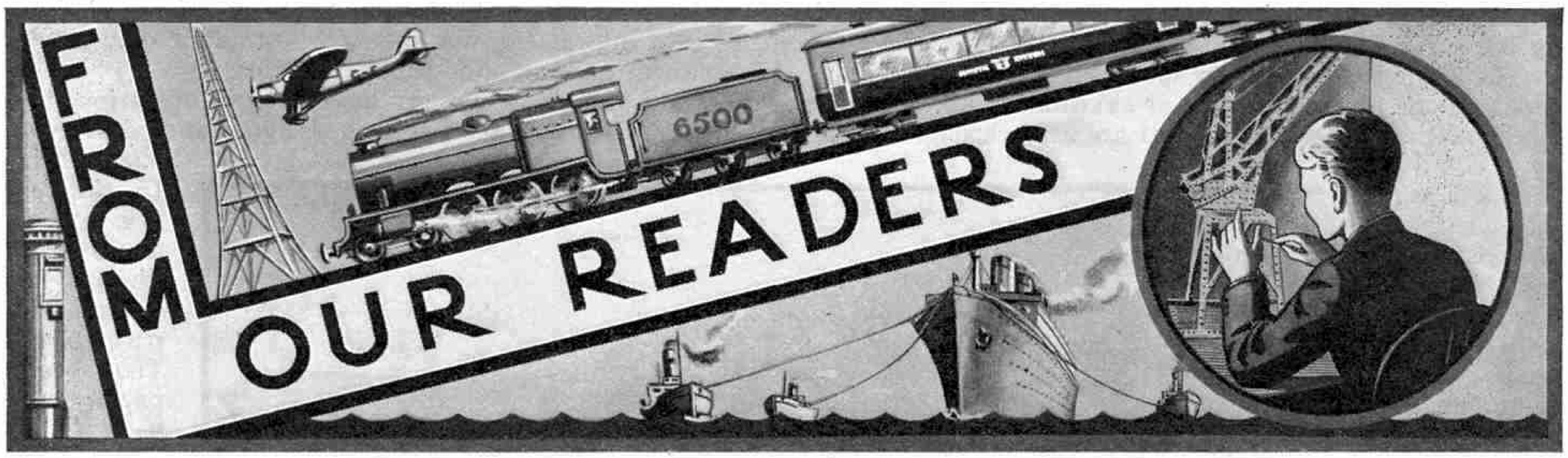
The Latécoère 28 is produced in a number of versions, one of which set up 19 world's records, 14 as a seaplane and five as a landplane. Another type, equipped with floats, made the first commercial crossing of the South Atlantic Ocean. This was in May, 1930, and was undertaken in connection with an experimental flight to gain information for the Aéropostale air mail service between France and South America.

The Latécoère Company have been in operation since 1917, and during this time have designed and constructed more than 15 different types, most of them for commercial purposes. The company have built practically all the aeroplanes used by the Cie. Gen. Aéropostale on their France, West Africa, and South America air line. This is claimed to be the longest air line in the world, and the most difficult to operate.

The Farman F.300 is a triple-engined machine of wooden construction. The wings are braced to the fuselage by oblique struts and are covered with fabric; and the fuselage is built up with box-struts and special internal stiffening ribs, and covered with a double thickness of three-ply. The oblique bracing struts carry the undercarriage, which is of the split type, and also support the two engines that are mounted in the wings. The two pilots are accommodated side by side in an enclosed cockpit situated in front of the wings, and behind this, and below the wings, is a cabin with eight seats. The cabin is provided with sliding glass windows and modern heating and ventilation apparatus. There is also a luggage compartment.

The F.300 has a wing span of 62 ft. 7 in., and a length of 42 ft. 9 in., and weighs 6,018 lb. when empty and 9,986 lb. when fully loaded. It is powered by three Salmson Ab.9 air-cooled radial engines each developing 238 h.p., which give it a maximum speed at sea level of about 132 m.p.h. With any one engine stopped the machine is able to maintain a speed of 95 m.p.h. at an altitude of 6,560 ft., and in this condition its ceiling is 8,200 ft.

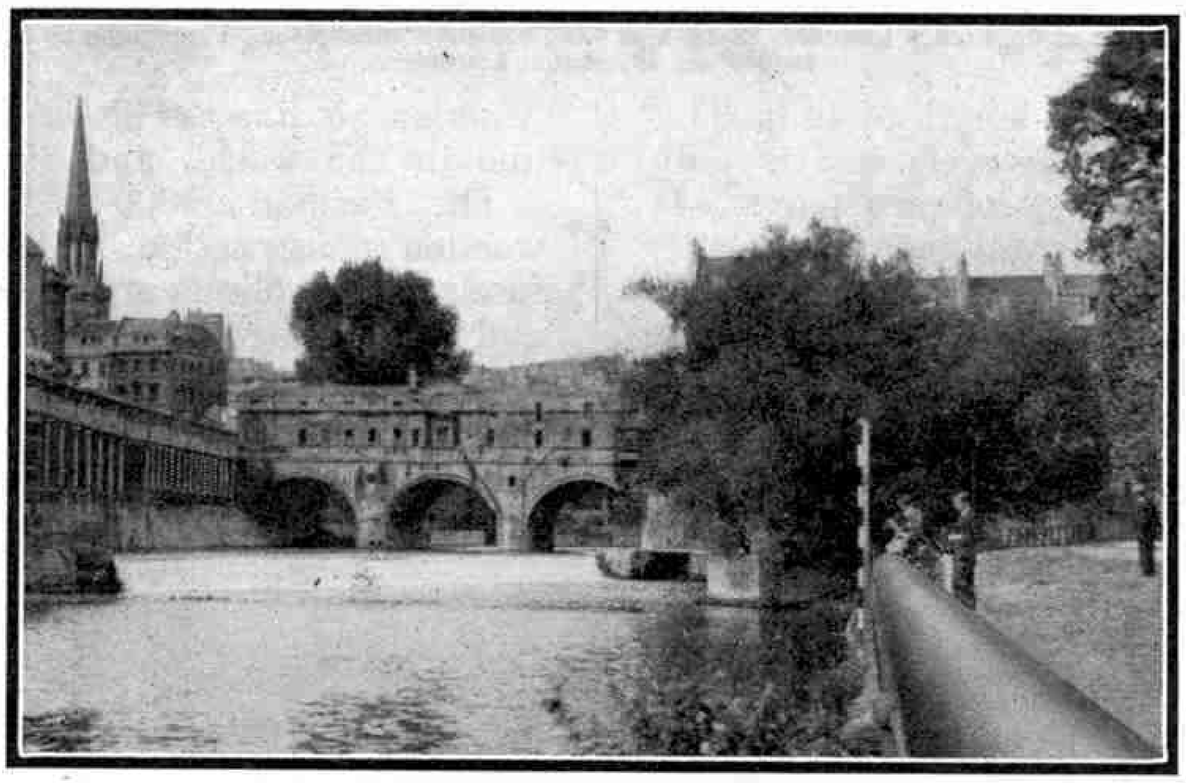
The Farman factory is one of the oldest in France, having been established by Henry Farman in 1908. Later it was combined with a separate (Continued on page 66)



These pages are 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 these pages are accepted as being sent in good faith, but the Editor takes no responsibility for their accuracy.

Houses Built on Bridges

Many visitors to Bath who enter the city by passing along Pulteney Street do not realise that they cross the River Avon, for the bridge spanning the river has houses and shops on each side of the roadway. This remarkable structure is known as Pulteney Bridge, because it was built by William Pulteney, later Earl Pulteney, who wished to connect his Bathwick Estate with the city. Robert Adam, a famous 18th century architect and a friend of Pulteney, was commissioned to design the bridge, while the actual construction was undertaken by a builder named Reed. The bridge was completed in 1770 and about nine years later began to show signs of weakness, with the ultimate result that in 1804 it was necessary to rebuild the west end of the structure.



Pulteney Bridge, Bath. This bridge was built in 1770, and there are houses and shops on each side of the roadway. Photograph by V. Chamberlain, Bath.

Not many yards away from Pulteney Bridge is another example of a building erected on a bridge. This is Cleveland House, which stands on a stone bridge crossing the Bath Canal. This Canal formerly belonged to the Great Western Railway Company, and the building was then used for office purposes. Bridges on which houses and shops are built are now rare, but formerly were not uncommon. The best known example was Old London Bridge, which was completed in 1209 and only taken down in 1832.

V. CHAMBERLAIN (Bath).

R.A.F. Flying Boat at Lerwick

Many types of aeroplane have been seen at Lerwick, and the largest and most graceful of these undoubtedly was one of the "Short" flying boats described and illustrated in the "*M.M.*" for September, 1932. This machine arrived towards the end of September, and alighted practically in the middle of the harbour. When she came to rest she was quickly surrounded by launches and rowing boats carrying people eager to see her at close quarters.

Next day the flying boat remained at her moorings, but on the following day she made a short survey flight over the Islands. I thought she made a beautiful picture as she raced across the harbour with her six powerful engines roaring and a huge wave of water standing up astern.

Officers of an R.A.F. "Short" flying boat coming ashore in a collapsible boat at Lerwick, Shetland. Photograph by P. Fraser, Lerwick.

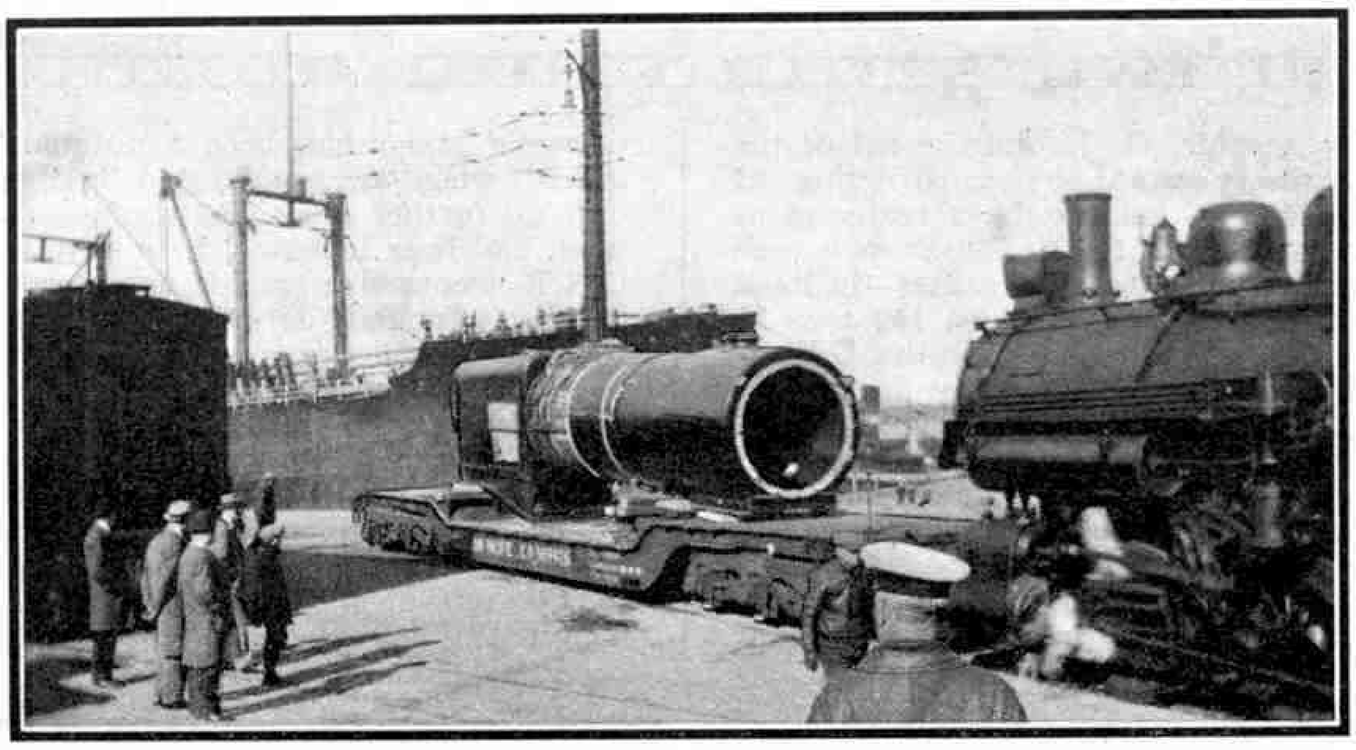
While the machine was at Lerwick it was very amusing to watch officers rowing to and from the shore in their collapsible boat, made of material resembling heavy canvas. When rowed against the wind, the frail vessel seemed to be as difficult to manage as one of the coracles of the ancient Britons, and persisted in turning round instead of following a straight course.

I was sorry when the flying boat left Lerwick. During her short stay in the harbour I was particularly interested in her six engines, arranged in pairs in tandem, which develop a total of 3,480 h.p.

P. FRASER (Lerwick).

"The Royal Scot" in Canada

Considerable interest was aroused in Montreal when the C.P.R. steamer "*Beaverdale*" arrived there with "*The Royal Scot*," the famous L.M.S.R. train. I was one of many railway enthusiasts who watched the unloading of the engine and coaches. As each piece of rolling stock was lifted out of the "*Beaverdale*" by means of a floating crane and placed on the track at the dockside, it was coupled to a C.P.R. locomotive, or to an engine belonging to the Montreal Harbour Commission. The difficulties caused by the differences in the coupling mechanisms were overcome by placing a freight car between the locomotive and the coach, a pair of buffers and a coupling hook similar to those in use on the L.M.S.R. having been specially fitted to the rear of the intervening vehicle. When ready, each coach was hauled to the Angus shops of the C.P.R.



The boiler and firebox of the "Royal Scot" on arrival at Toronto. They are seen in one unit, being hauled to the Angus Works of the C.P.R., where the locomotive was re-erected in readiness for its tour of Canada and the United States. Photograph by L. S. Seton, Montreal.

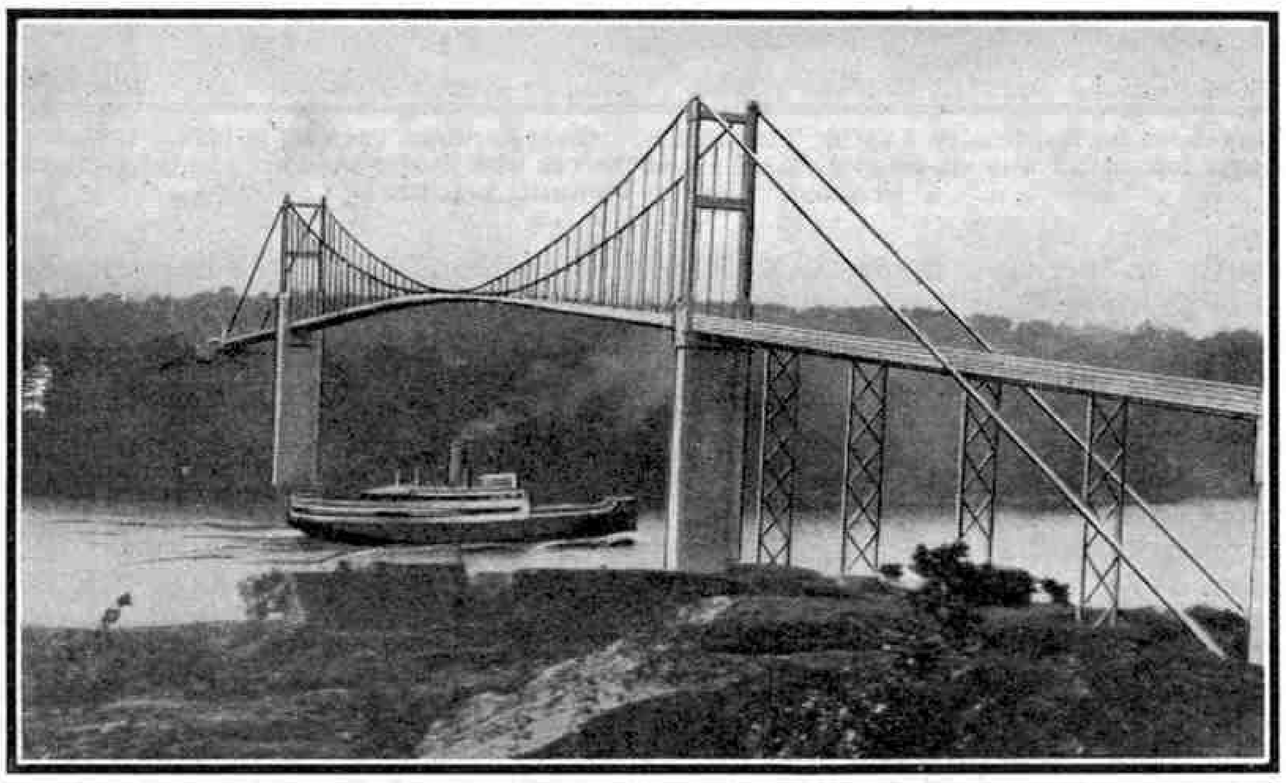
The greatest interest was aroused when the two sections of the "*Royal Scot*" were uncoupled. The first to be lifted out was the fire-box, boiler and smoke-box unit, shown in the accompanying photograph. This was loaded on a trolley for transport to the shops where the locomotive was to be reassembled, and was quickly followed by the second section, consisting of the frames, wheels, cylinders and motion.

The work of re-assembling the engine and of polishing up the rolling stock was carried out rapidly and efficiently in the Angus shops, where many C.P.R. locomotives and much of that company's rolling stock are overhauled, repaired and repainted. Thus when the train emerged to make a trial run, she presented a striking spectacle in the bright sunshine that graced her first official public appearance in Canada, and she was greeted by crowds of enthusiastic spectators who lined the track to see her pass. This also was her experience when she commenced her journey to Chicago, where she was a notable exhibit at the recent World's Fair, and she aroused such widespread interest that an extended tour to the Pacific Coast was arranged, the train returning eastward through British Columbia and the prairie provinces of Canada. L. S. SETON (Montreal).

A New Norwegian Suspension Bridge

A few years ago I made a journey from Oslo to the island of Tjöme, a famous watering place in the Oslofjord. I travelled by train to Tönsberg, and then by omnibus across the island of Nötteröy. The crossing of Vrengen Sound, between this island and Tjöme, my destination, was made by means of a special motor car ferry. As this was not very speedy, and carried only two cars at a time, the row of vehicles waiting to be ferried over seemed endless, and I had to wait nearly four hours before my turn came.

Three months ago I repeated this journey, but in the meantime a new suspension bridge had been built across the Vrengen Sound, and there was no tiresome delay. As the accompanying photograph shows, the new bridge, which is known as the Vrengen Bridge, is very high. The middle of the roadway is 113 ft. above sea level, and the largest ships can pass beneath it. The total length of the bridge is 1,500 ft. The suspended span is 510 ft. in length and its weight is supported by eight cables, each of which weighs eight tons.



The "Kronprinsesse Martha" passing under the Vrengen Suspension Bridge, Norway. The centre of the roadway of this structure is 113 ft. above high water level in Vrengen Sound, which it spans. Photograph by R. N. Torgersen, Oslo.

The new bridge is an important link between the islands in the Oslofjord and Oslo, Drammen, Tönsberg, and other cities, and motor car traffic across it is very dense during the holiday season. A walk across the graceful structure was very interesting, for owing to its great height, even large steamers passing beneath it appeared to be dwarfed. Beautiful views of the surrounding country are obtained from it, and the hills on the opposite side of the Oslofjord can readily be seen, although their distance from the Sound across which the bridge is built is about 20 miles.

The Vrengen Bridge is especially popular in the holiday season, for its construction has provided a ready means of access to Tjöme. It is estimated that as many as 30,000 people made use of it during June, July and August of last year, and they greatly appreciated the substitution for the old-fashioned ferry boat of this magnificent new highway crossing Vrengen Sound.

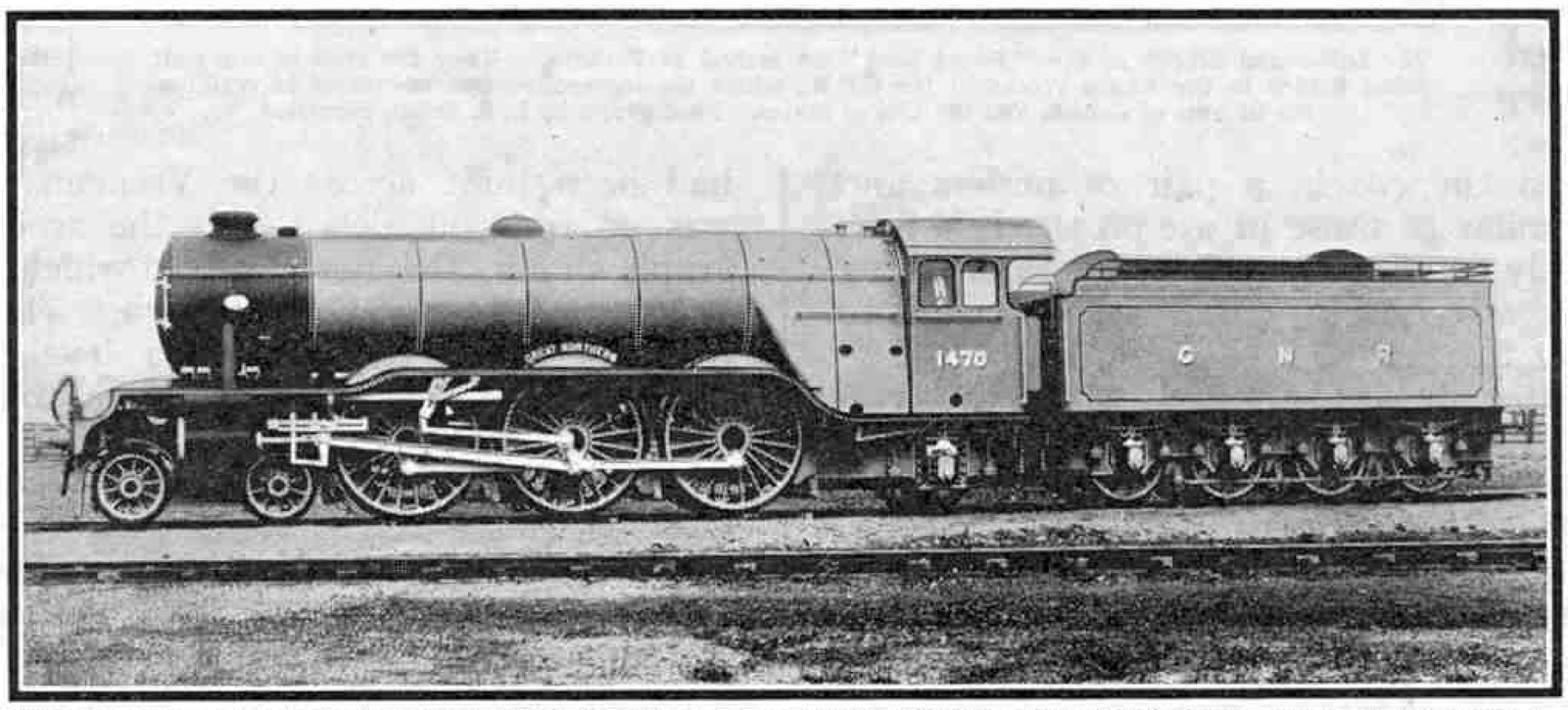
R. N. TORGERSEN (Oslo).

British "Pacific" Locomotives

Some Interesting Phases of Development

A QUARTER of a century ago Mr. G. J. Churchward of the G.W.R. startled the railway world by constructing at Swindon works what was then held to be a really giant locomotive. It was the first 4–6–2 or "Pacific" express engine on a British railway. It was fitted with a superheater—in itself then an unusual feature—and with its tender scaled 142 tons 15 cwt. in working order. The tender was unique for the G.W.R. in having the eight-wheeled arrangement commonly applied on the neighbouring L.S.W.R., and held 3,500 gallons of water and six tons of coal. The ordinary tender then standard would certainly have looked lost behind such a vast engine.

In regard to the cylinder and wheel dimensions, driving arrangements and working pressure, the engine followed the design of the early four-cylinder 4–6–0's—the "Stars" that had been turned out shortly before—so that as regards nominal tractive power it represented no real advance upon that class. The size and capacity of the boiler were considerably greater, however, and although the firebox was of the Belpaire flat-topped pattern, advantage was taken of the small trailing wheels to provide a wider grate than usual, the area of this being 41.79 sq. ft. as against the 27.07 sq. ft. of the "Stars."



This photograph shows the first Gresley "Pacific" locomotive, "Great Northern," as built in 1922. It was the first G.N.R. express passenger locomotive with six-coupled wheels; and the cab with double windows and the eight-wheeled tender were innovations in Doncaster practice.

This mighty locomotive did not set out to break records between Paddington and Plymouth as perhaps many G.W.R. supporters hoped, for on account of its dimensions it was necessary to confine its activities to the London and Bristol main line. Here it took part not only in passenger working but also in express goods service, loads of 70 wagons being taken as part of the latter duties. This restriction of the engine's sphere of action meant, of course, that multiplication of the design was not to be expected for some time, if at all; and in any case "*The Great Bear*" never appeared to be as capable as the remarkable "Stars," "Knights," "Kings" and other four-cylinder 4–6–0's of the pre-"Castle" era, though this may have been due to lack of opportunity.

The coming of the "Castles" in 1923 set up new standards of performance, so that the opportunity was taken in the following year of reconstructing "*The Great Bear*." The frames were cut and welded, "Castle" cylinders and boiler were provided, and the one-time "Pacific" became a 4–6–0 engine, still bearing the number 111, but renamed "*Viscount Churchill*." The eight-wheeled tender was not retained, but was used by a 4–4–0 locomotive, "*County of Dublin*," for a considerable time. Until the recent experimental eight-wheeled tender applied first to a "Hall" and then to a "Castle," it remained the only example of this wheel arrangement on the G.W.R. The latter tender conforms closely to the design of the 4,000 gallon tender used on the "Kings" and many of the "Castles."

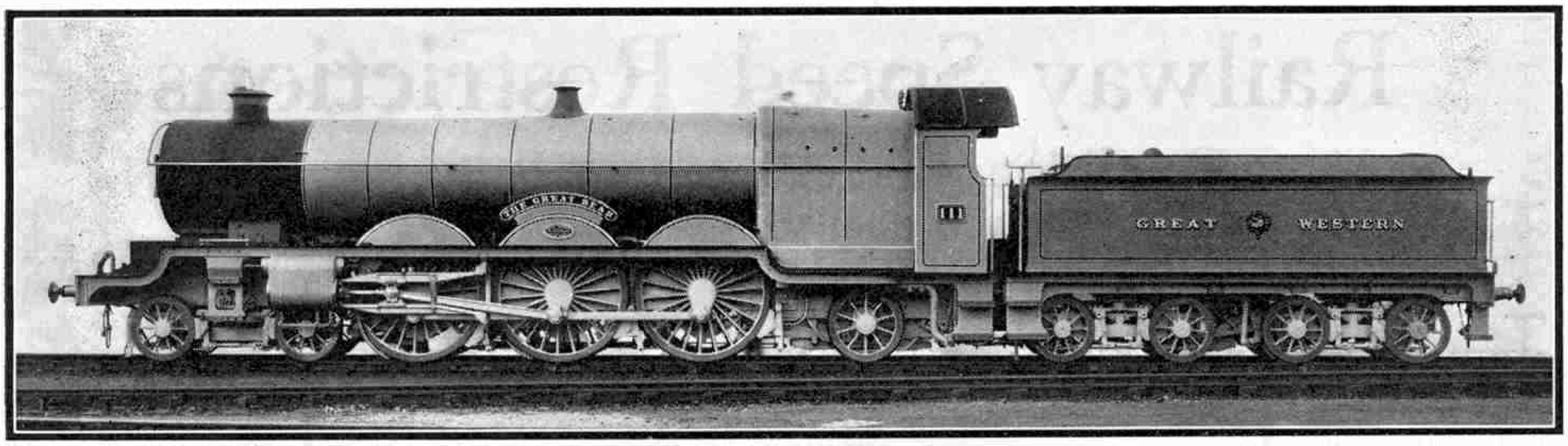
For 14 years "*The Great Bear*" remained the only "Pacific" on British metals, and then in 1922 the first two of the famous Gresley "Pacifics" left the Doncaster works of the then Great Northern Railway. These were named "*Great Northern*" and "*Sir Frederick Banbury*," and bore the numbers 1470 and 1471 respectively, later becoming Nos. 4470 and 4471 of the L.N.E.R. The appearance from Doncaster of a 4–6–2 "Pacific" or 2–6–2 "Prairie" type had been rumoured for some time, and in 1920 the advent of the first of the "1000" class "Moguls" with a 6 ft. diameter boiler had been a notable "false alarm." Since 1910 indeed, when the superheated "Atlantics" Nos. 1452–1461 came out, no further main line engines for fast and heavy passenger work had been introduced, so that any mention of a new type of G.N.R. locomotive created considerable interest. Nor were these Gresley "Pacifics" any mere enlargement of the Ivatt "Atlantics" by the addition of an extra pair of coupled wheels and a lengthened boiler barrel, which appeared an obvious course. Mr. Gresley certainly bided his time, but he was able to give his company a class of engine that embodied features well-tried in practice, and that were thoroughly up to date as understood 12 years ago.

The three-cylinder system of propulsion was applied, together with the Gresley arrangement of operating the three piston valves by two sets of Walschaerts motion. This feature had first been seen in 1918 on a 2–8–0 mineral engine and its successors, and then on the "1000" class "Moguls" in 1920. The running of the latter class on passenger trains of enormous weight during the coal strike of 1921, together with the experience of the "Atlantic" performance both in the heavy-load, high-speed pre-war days, and during the War period when tremendous loads were taken, no doubt accounted for the best points of the two classes being combined in the "Pacifics." The well-balanced haulage power of the "Moguls" and the easy-running and free-steaming characteristic of the "Atlantics" are both marked features of the "Pacifics." As Mr. Gresley stated at the time, they were designed for the haulage of 600-ton expresses, and in September 1922 a load of 617 tons was taken on a main line test run by No. 1471, the average coal consumption being 49 lb. per mile, even with this heavy load. In the time that has passed since then the "Pacifics" have shown themselves well able to repeat such performances.

The design became an L.N.E.R. standard, and after the initial batch up to No. 1481 had been turned out, detail modifications were made, the boiler mountings being cut down and other alterations effected to render the engines suitable for service practically anywhere on the L.N.E.R. main lines. Several of these "general service Pacifics," as they were called, were put to work, the North Eastern and Scottish areas then being added to the "Pacific" field of activity.

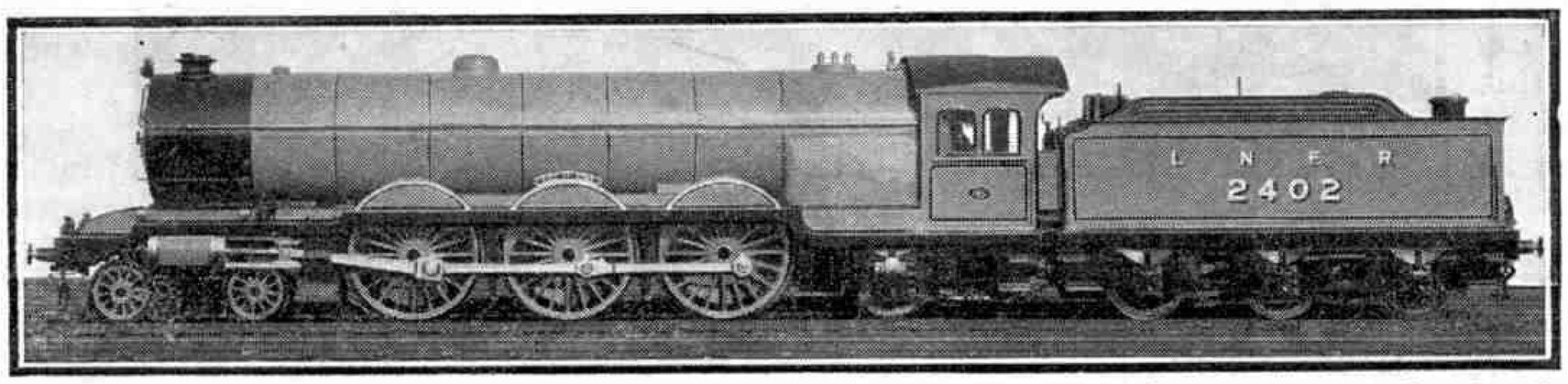
In 1925 comparative trials on each other's metals were made between Gresley "Pacifics" and G.W.R. "Castles," the engines exchanged being L.N.E.R. No. 4474, now "*Victor Wild*," and the well-known G.W.R. No. 4079 "*Pendennis Castle*." This was the more interesting in that the G.W.R. "Pacific" had been replaced by the 4–6–0 "Castle" design. The winding West of England main line somewhat hampered the Doncaster representative, with its long wheelbase of 35 ft. 9 in. and high-pitched boiler, in running at high speed. In this connection the restriction of the activities of "*The Great Bear*" to the Bristol main line will be remembered, though the wheelbase of this engine was less than that of the L.N.E.R. "Pacific," being 34 ft. 6 in.

These trials were followed by alterations to the valve gear of some of the "Pacifics," No. 2555 "*Centenary*" being the first, and the coal consumption was reduced as a result. Long valve travels and high working pressures had for many years enabled



G.W.R. engines to be driven economically on short cut-offs with full regulator openings, and in a further step toward this method of operation No. 4480, "*Enterprise*," was fitted in 1927 with a new boiler carrying 220 lb. pressure instead of the 180 lb. of the initial design. At the same time also the valve gear was modified to enable the fullest advantage to be taken of the high-pressure steam. In subsequent engines built with 220 lb. pressure, the "Super-Pacifics," the cylinder diameter is reduced from 20 in. to 19 in. as the increased pressure renders the original bore unnecessary.

A point of interest in connection with these Gresley "Pacifics" is the fact that for the non-stop running between King's Cross and Edinburgh instituted in 1928, special tenders were built for the use of the engines employed, having an internal corridor or passage along one side, with the rear end connected to the train by a gangway of the usual type. Thus the enginemen could be changed on the run. These tenders are eight-wheeled non-bogie vehicles, as are the ordinary "Pacific" tenders, but they have an increased coal capacity of nine tons against the eight of the original tenders.



The upper photograph shows the first "Pacific" locomotive in service on a British main line, the G.W.R. engine "The Great Bear." In the lower illustration appears "City of York," of the "Pacific" design produced by Sir Vincent Raven for the former North Eastern Railway and built at the Darlington works of that company.

The extreme reliability of these engines, even when constantly engaged on heavy work, is a feature of their performance, no less than their apparently effortless development of power. One of them worked 55 days of duty continuously, covering a mileage of 28,830, or an average of 524 miles per day; and during this period no repairs were carried out. Another of them, No. 2795, "*Call Boy*," was engaged for a month on end on the Edinburgh and London trains, 11,000 miles being covered during that time, of which 9,400 were on the daily 392.7 mile non-stop trips of "*The Flying Scotsman*," and the balance on Sunday trains stopping intermediately.

Soon after the appearance of the first "Pacifics" from Doncaster, the North Eastern Railway followed suit in adopting the 4–6–2 wheel arrangement. Sir Vincent Raven was responsible for the design, and in spite of its size and length he produced a very neat and clean-looking locomotive. Three-cylinder propulsion, which for long had been a feature of North Eastern practice, was applied, but unlike the G.N. engine the Darlington product had a separate set of Stephenson link motion for each piston valve, an arrangement preferred and always used by Sir Vincent Raven. Thus all British "Pacifics" have been multi-cylinder engines, four cylinders being used in the G.W.R. example, and three in the Gresley and Raven designs.

The N.E. design might be described fairly well as a logical expansion of the former class "Z" (now C7) "Atlantics," as in these engines all three cylinders are arranged in line to drive on the leading coupled axle. This has the effect of shortening the connecting rods somewhat and lengthening the wheel-base, the Raven design exceeding the other two in this latter respect. Once again the opportunity was taken to provide a wider grate than usual, the area of the latter being 41 sq. ft. The smoke-box was recessed into the boiler barrel, and the fire-box was also extended forward to form a combustion chamber as in the G.N. engine. Thus an excessive length of barrel was avoided in spite of the great length of the engine, and in this respect the barrel length of 21 ft. was 2 ft. shorter than that of "*The Great Bear*," though longer by the same amount than that of "*Great Northern*," showing how the disposition of the cylinders and wheelbase affects the engine as a whole. In view of the large size of the boiler and the relatively high pressure, 200 lb., three safety valves of the Ross "pop" variety were mounted over the fire-box. Apart from its size and the possibilities afforded by the wheel arrangement, the engine embodied few features strange to N.E. practice, and unlike the other "Pacifics" we have mentioned so far, it had a six-wheeled tender. This vehicle had a capacity of 4,125 gallons of water and 5½ tons of coal.

Five engines in all were built to this design, some subsequent to grouping. In the original design the trailing wheels under the fire-box had inside bearings, but outside frames and bearings are now provided, as the inside position under the fire-box is not so conducive to the cool and efficient running of the journals. In 1924 trials were carried out between the Gresley and the Raven designs in which both engines appear to have shown up equally well, but for standardisation purposes the Doncaster design was adopted for the L.N.E.R. group. All the Raven engines are of course still running, but a particularly interesting step was the re-boilering of one of them, No. 2404, "*City of Ripon*," with a boiler and fittings similar to those used on the Gresley "Pacifics," together with the G.N. type of cab, thus blending the two designs to some extent. The total weight of the engine was reduced by 3 tons, 10 cwt., and as the boiler pressure is now 180 lb. instead of 200 lb., the nominal tractive force is reduced, but the Gresley type boiler has a greater surface exposed to heating.

The Raven engines all bear names of important cities in the North Eastern area and are the only N.E. type express engines so treated, just as the first two Gresley engines, apart from the pioneer Ivatt "Atlantic," No. 990, "*Henry Oakley*," were the only named G.N. engines.

After many rumours at different times "Pacifics" have now been introduced on the L.M.S.R. The chief features of these engines were fully described in the August 1933 "*M.M.*" As these L.M.S.R. engines incorporate features of Swindon practice they may claim some connection with the pioneer British "Pacific" locomotive "*The Great Bear*." The number and disposition of the cylinders are the same, but the L.M.S.R. engines have separate sets of valve motion for each cylinder. Again, the fire-boxes of the L.M.S.R. "Pacifics" are of the Belpaire flat-topped type, but have wide grates, and in this respect resemble that of the Swindon engine. The arrangement at the trailing end of the L.M.S.R. design is quite new to British practice. It embodies a cradle frame, the trailing wheels being carried in a Bissel truck. Large six-wheeled tenders, holding 4,000 gallons of water and nine tons of coal, are used.

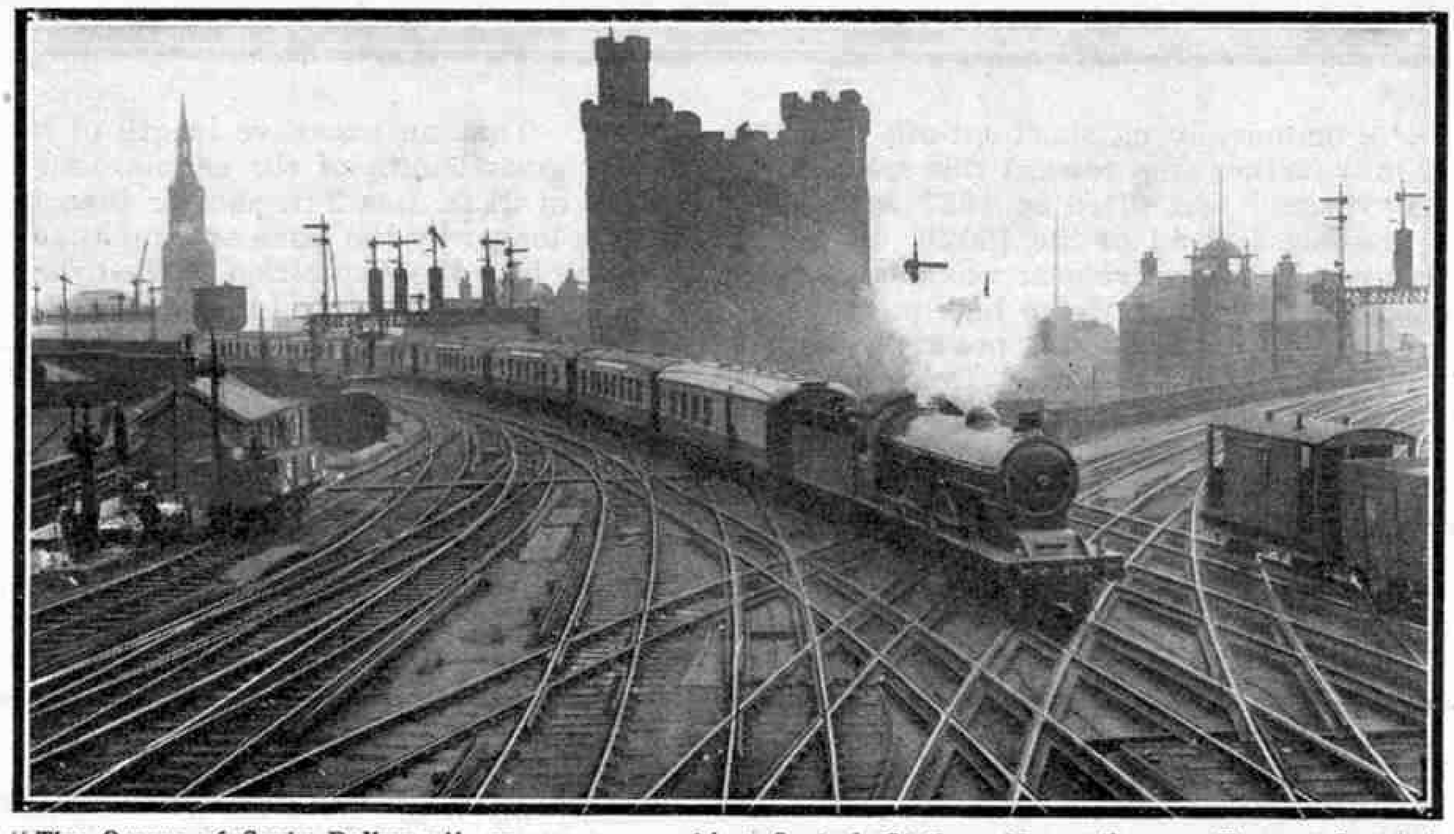
"Pacifics" have not yet appeared on the Southern where the "Lord Nelsons" appear to meet the maximum demands with success, ably aided by the very capable "King Arthurs."

Railway Speed Restrictions

Conditions that Affect Fast Running

By R. D. Gauld, M.Eng., A.M.Inst.C.E.

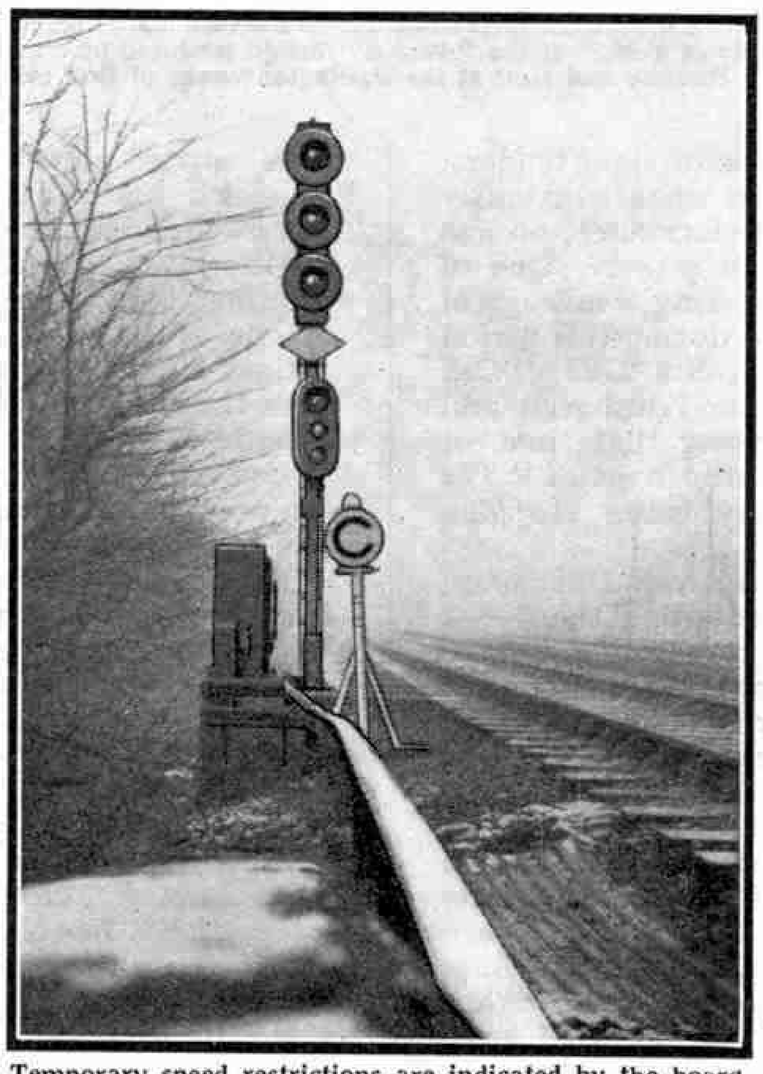
THE high-speed running that has been a feature of the most important Great Western trains for many years, and which reaches its best in the timing of the "*Cheltenham Flyer*," has set a fashion to the other railways that has been followed in no uncertain manner. The Great Western line from London, as far as Bath, is particularly suited to fast running, as it is free from sharp curves and nearly level, which explains the lead set by this line. The limit of what is possible in high speeds has by no means been reached yet, but there are many places and sections on our railways where, owing to restrictions, speeds are already as high as they are ever likely to become. There are various reasons for these speed restrictions, some of which are permanent and others only temporary, and it will be of interest to examine a few of them.



"The Queen of Scots Pullman" express approaching Central Station, Newcastle-upon-Tyne. Speed is necessarily reduced when negotiating curves and complicated points and crossings, such as those shown in this photograph. Photo courtesy L.N.E.R.

Taking the permanent speed restrictions first, the effect of steep gradients must be noted. The term "steep" is a relative one only, but generally speaking we may say that a gradient of less than 1 in 300 would not impose a speed restriction unless it was several miles long. The length of the gradient as well as its steepness is important because, just as a cyclist or a motorist can surmount a short steep hill without much loss of speed by rushing it, so a locomotive can obtain the same result. If the gradient is prolonged, however, the momentum of the rush is gradually lost and the speed falls.

When a train has to face a steep gradient at starting, such as the Camden bank out of Euston, or the Cowlairs incline out of Queen Street, Glasgow, its speed is necessarily very low. In the reverse direction, as the train is approaching a terminus, the speed is again bound to be reduced to avoid the risk of not stopping in time. Of all the main line termini in London the quickest run in is probably obtainable at Paddington, owing to the practically level track, with its very slight degree of curvature.



Temporary speed restrictions are indicated by the board shown here. The letter "C," which is illuminated at night, indicates the commencement of the section affected.

The effect of a curve in the permanent way is to add resistance to the movement of a train, and therefore it tends to reduce the speed. This resistance is due partly to the flanges of the wheels bearing hard against the outer rail of the curve. Also, as the outer rail is longer than the inner, the inner wheels must slip on the rail head, as they have not so far to go as the outer wheels. It becomes necessary, however, to impose a speed restriction on sharp curves, in the interests of safety, and there are many well-known examples on our main lines. A famous one is at Stafford, on the route of "*The Royal Scot*," where there is a long sharp curve on the south side of the station. The position is worse at Shrewsbury, as there are sharp curves at each end of the station, the one from Crewe at the North end being particularly bad, as it comes at the end of a long falling grade from the Crewe direction. The reason for these curves at Shrewsbury was probably to obtain a square crossing of the River Severn, which is here very wide.

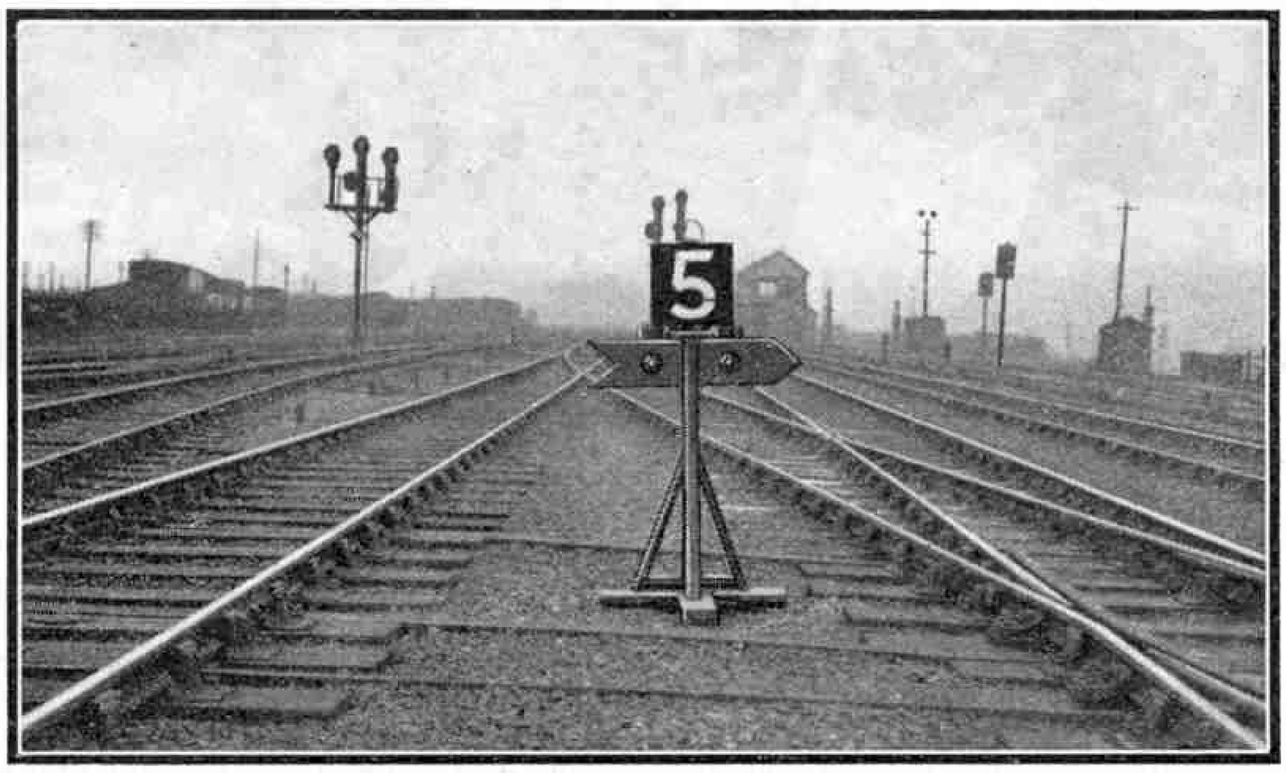
At Salisbury there is a sharp curve over which the speed restriction is 30 m.p.h. Many years ago a train was completely derailed here. It is estimated that this train was travelling at 70 m.p.h., but why the curve should have been taken at this speed was never discovered.

"*The Flying Scotsman*" encounters many speed restrictions due to curvature, the most noticeable of these being at Peterborough, Grantham, York, Durham, Newcastle, Morpeth, Alnmouth and Berwick. At York and at Newcastle there is a very complicated arrangement of junctions to be negotiated in addition to the curves.

On the Kentish lines of the Southern Railway there

are noticeable curve speed restrictions at Tonbridge, Faversham and Rochester, which are particularly troublesome as they come on sections where high speeds otherwise would be possible.

The Great Western Railway had speed restrictions due to curves at Westbury and Frome, and so important were these considered to be in their effect on train timings that the company spent large sums of money in building "cut-off" lines in order to avoid the curves. At High Wycombe the Birmingham two-hour expresses have to steady down to a moderate speed to negotiate the curves safely, while at Rickmansworth the L.N.E.R. Leicester to London trains that use the Metropolitan joint lines have to slow down to 30 m.p.h., a severe restriction.



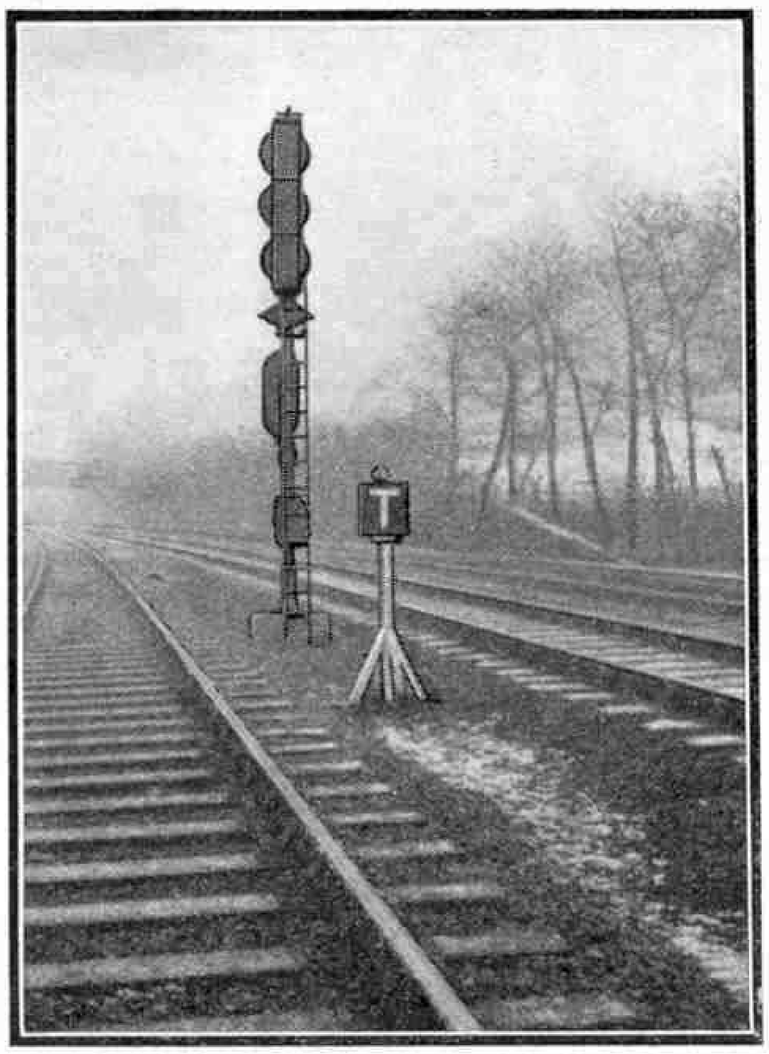
A warning board indicating the speed to be observed. This shows a green and a white light at night, and the figure also is illuminated.

Other well-known speed restrictions due to curves are at Market Harboro', Ambergate and Rowsley on the St. Pancras to Manchester route; Chelmsford, Colchester and Trowse on the Liverpool Street to Norwich line; and Penistone and Dinting on the L.N.E.R. Sheffield to Manchester line.

The speed that would cause a locomotive to become derailed on a curve of a stated radius can be calculated, but actually it would not be safe to get anywhere near this speed. As a rough guide it may be said that on a curve with a radius of 1,300 ft., 50 m.p.h. would be about the maximum speed.

Many bridges require a speed restriction to be enforced, 40 m.p.h. being the limit on the Forth Bridge, for instance. This restriction is probably enforced because the results of a derailment on the bridge would be so very serious if it occurred at high speed. The L.N.E.R., especially in East Anglia, have many swing bridges over which speed is restricted, as it is difficult to keep such bridges as rigid as fixed spans.

When a train is diverted from one route to another by means of facing points at a junction, a speed restriction is practically always imposed on the line that curves away, or on both, if both routes are curved. This avoids excessive strains on the points and crossings, and ensures a smoother passage through the junction. In addition, design considerations make it difficult to get a long radius curve from the points through the junction. There are many hundreds of such places on our railways. Also, where there are parallel lines running in the same direction, and it is required to cross a train from, say, the fast to the slow, the passage through the crossover must be at a greatly restricted speed, certainly not exceeding about 30 m.p.h.



This board indicates the termination of the restriction. The letter "T" is illuminated at night.

In the Railway Clearing House Book of Rules adopted by all British companies, with slight amendments to suit their own conditions, Rule No. 127 is the one governing the general duties of the driver. Section 13 states that the driver must regulate the running of his engine to ensure, as far as practicable, punctual working, care being taken to avoid excessive speed. Section 14 states that he must, when running through junctions to or from lines diverging from the straight road, regulate the speed to ensure a steady passage for the whole train through the junction points and crossings. By Section 15 he must in all instances observe the speed restrictions shown in the Appendices and Notices.

In the Appendix to the Working Timetable there is a list of all the permanent speed restrictions on the railway. The Notices are issued weekly or fortnightly, and show, among many other things, any temporary speed restrictions, such as are required for engineering works.

Passing places on single line railways require to be negotiated at reduced speed unless one route is practically straight. In Ireland many passing loops are so arranged that one side is straight and can be used by trains in either direction. Unless mechanical devices are provided to exchange the staffs or tablets given to the driver by the signalmen on single lines, hand exchanging must not be done at a higher speed than 20 m.p.h.

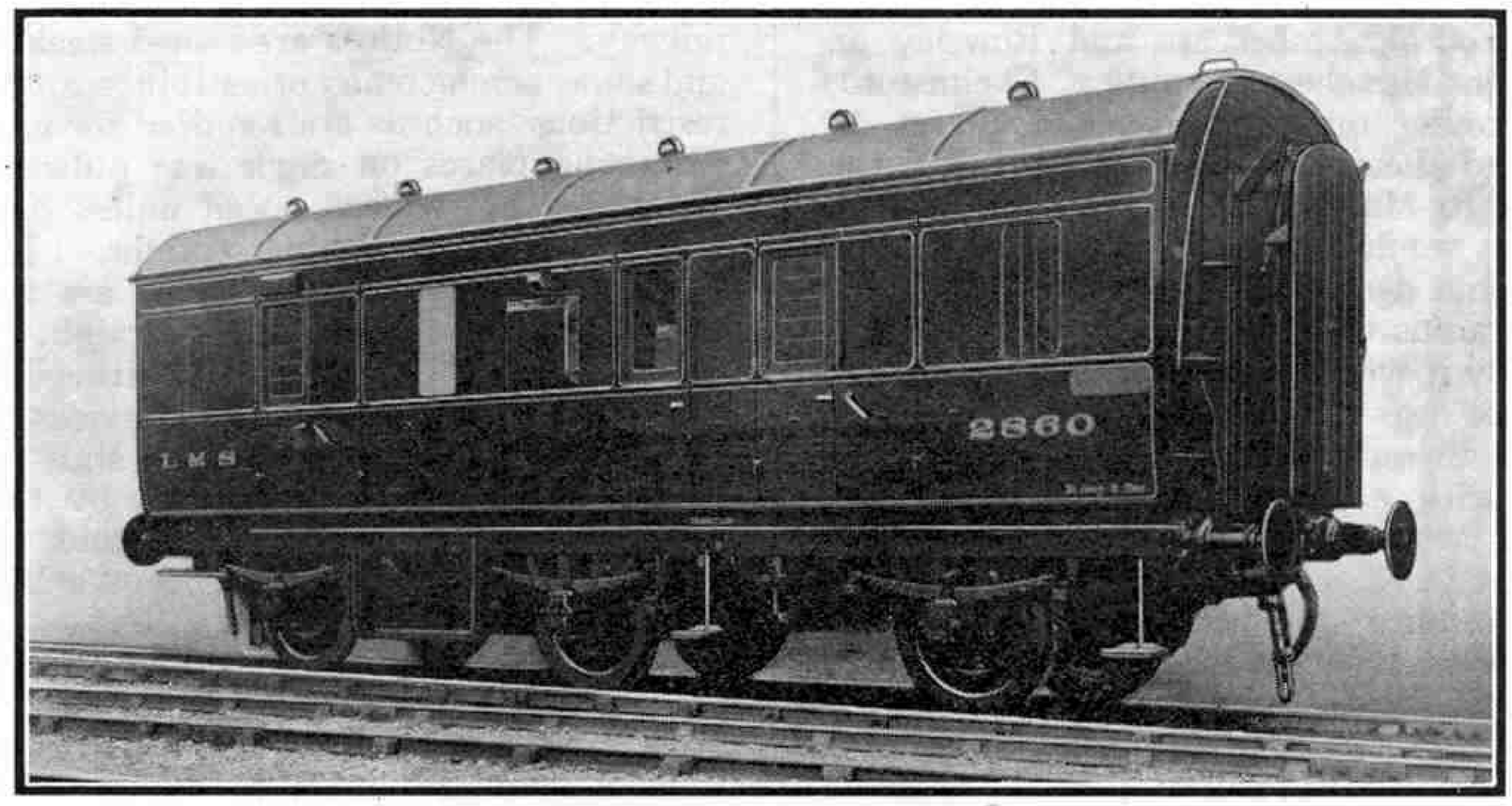
Many of our railways run through mining areas where a particular form of trouble known as subsidence is liable to occur. This subsidence is due to the coal, iron ore, etc., being worked out below ground, and is often a great hindrance to the railway. As soon as a subsidence becomes apparent a speed restriction has to be put on, and that between Polesworth and Tamworth on the main line of the L.M.S.R. has been on for so long as to be almost permanent. The line is gradually lifted on ashes, but further subsidence is continually taking place. Another bad area is near Chesterfield on the main line of the former Midland Railway.

Engineering operations on the line very often involve temporary speed restriction, and any disturbance of the permanent way makes such restriction essential. When the line is relaid, it is generally about a fortnight before the new line is sufficiently settled to allow high speeds. The extent of the restriction is usually marked by a board with a large letter "C" at the commencing end, and one with a large letter "T" at the termination. The actual speed allowed, say, (Continued on page 66)

L.M.S.R. Six-Wheeled Passenger Brake Vans

Some six-wheeled passenger brake vans are running on the L.M.S.R. that have been constructed at their Wolverton Works to the requirements of Mr. W. A. Stanier, the Chief Mechanical Engineer.

These vehicles are 31 ft. long, 8 ft. 6 in. wide, and 8 ft. 4 in. high. The underframe of each is constructed entirely of steel, and is fitted with shock-absorbing buffers and steel disc wheels. The body is soundly constructed of hard wood framing members having holes bored at intervals to allow of free circulation of air in the sides. The outside panels are of steel, with the windows practically flush with the outer surface of the body to facilitate cleaning. Sheet steel projections, or guard's lookouts, are situated on each side of the vehicle, and are provided with standard electric side lamps above.



One of the six-wheeled passenger brake vans of modern construction running on the L.M.S.R. These are similar in style and finish to the latest passenger vehicles, and can readily be connected to them by means of the gangways provided, which are of improved design and construction. Photograph by courtesy of the L.M.S.R.

The sides of each van are strengthened by continuous steel bands on the extreme lower edge, at the waist, and above the windows. The roof is covered with sheet steel panels finished with side gutters for draining purposes. Gangways are provided at each end of the vehicle, and the vans can therefore be connected up to all types of vestibuled passenger stock.

The floors are fire-proof, and are provided with drain holes for washing out. The electric light equipment is arranged on the L.M.S.R. "Wolverton" system. Automatic brake apparatus is fitted, and there is a guard's hand brake in addition. The heating of the van is arranged for by means of vertical gilled heaters of the Westinghouse type.

L.M.S.R. Locomotive News

The second of the new L.M.S.R. "Pacific" locomotives—No. 6201—has been given the name "*Princess Elizabeth.*" Before the end of November, the first "Pacific" No. 6200, "*The Princess Royal,*" having run 50,000 miles, went into Crewe works for overhaul.

Work has gone forward at Crewe on the new series of 40 2–6–0 "Moguls," and the second batch of 10, numbered 13255 to 13264, are just about completed. During their trial running the new engines are located at Crewe, but when they are ready for regular service, 10 are to be sent to Scotland to work on the Highland main line between Perth and Inverness. They will replace the earlier "Moguls" that have been working in that section.

Two more L.N.W.R. 4–6–0 locomotives of the "Prince of Wales" class have been withdrawn. They are No. 5652, "*Onyx,*" and No. 5688, "*Tara.*" The latter was provided with similar valve gear to that of No. 5632, mentioned last month.

The L.M.S.R. building programme for the new year is an extensive one and as a special addition to the new construction in its own works, the Company has placed orders with outside firms for 100 locomotives and tenders. Of these, 50 will be 4–6–0 superheated three-cylinder passenger engines—to be built by the North British Locomotive Co. Ltd., of Glasgow—and 50 will be 4–6–0 superheated two-cylinder mixed-traffic engines—to be built by the Vulcan Foundry Ltd., of Newton-le-Willows, Lancashire. It is understood that the former will be of the popular "Baby Scot" type, while the latter will be of a new design, somewhat similar to the "Hall" class of the G.W.R.

L.N.E.R. Big Programme

The new programme of the L.N.E.R. provides for the construction of 100 new locomotives of various types for use in all parts of the system. Nine more of the splendidly-efficient high-pressure 4–6–2 "Pacific" express engines are to be built and, as mentioned in last month's "*M.M.*," five of a new type of locomotive, having the 2–8–2 "Mikado" wheel arrangement, for the express services between Edinburgh and Aberdeen. Of other passenger types, five 4–6–0 locomotives of the "Sandringham" class are to be built for East Anglian services and 25 4–4–0 engines of the "Shire" class for the North Eastern area. Ten more 2–6–0 "Mogul" mixed-traffic locomotives are also intended for work in the North Eastern area. Of freight classes, there will be 12 of the standard 0–6–0s and eight 2–8–0s, the latter for the East Anglian area; while of tank engines, 16 2–6–2s are to be built for service in the North of England and Scotland. In addition, 10 more N.E.R. 4–4–4 tank engines are to be converted into 4–6–2 type tanks to assist the working of mineral traffic in the Durham district.

The L.N.E.R. programme also provides for 62 new carriages, including sleeping cars, restaurant cars, buffet cars and two further tourist trains fitted with bucket type seats. For freight services, no less than 5,579 vehicles, of many different types, are to be built. The Company will also renew 43 bridges and 371 miles of line during the year.

A contract has been placed for the erection of an electrical coaling plant for locomotives at Boston. When the L.N.E.R. was formed in 1923, there were only two mechanical coaling plants on the system; to-day there are 33 electrical coaling plants in operation or under construction, and locomotives can now be coaled in three minutes instead of the half hour required by the old method.

"*Queen of Scots*" Record Run

By the favour of that keen L.N.E.R. enthusiast Mr. R. A. H. Weight, we are able to give particulars of a very notable run made by the L.N.E.R. all-Pullman train, the "*Queen of Scots*," on 16th November last, when the distance of 185.8 miles from Leeds (Central) to London (King's Cross) was covered in 175 min., start to stop, or 18 min. less than the exacting schedule time!

Owing to delays in the north, it was 18 min. after the booked time when the train left Leeds for London. The load behind the tender was 286 tons tare or, including passengers and luggage, little short of 300 tons. The engine was No. 3284, a G.N.R. "Atlantic" built at Doncaster in 1904. In the early stages, until Wakefield and Doncaster had been passed, it was impossible to do much making up of time. Once Doncaster had been cleared, however, No. 3284 went like the wind, and from there to London an average speed of 67.3 m.p.h. was sustained, the 156 miles from passing Doncaster to stopping at King's Cross being covered in 139 min., in spite of a severe service slack through Peterborough and slight signal checks at Newark and between Hitchin and Hatfield, where several "distants" in the "on" position were encountered.

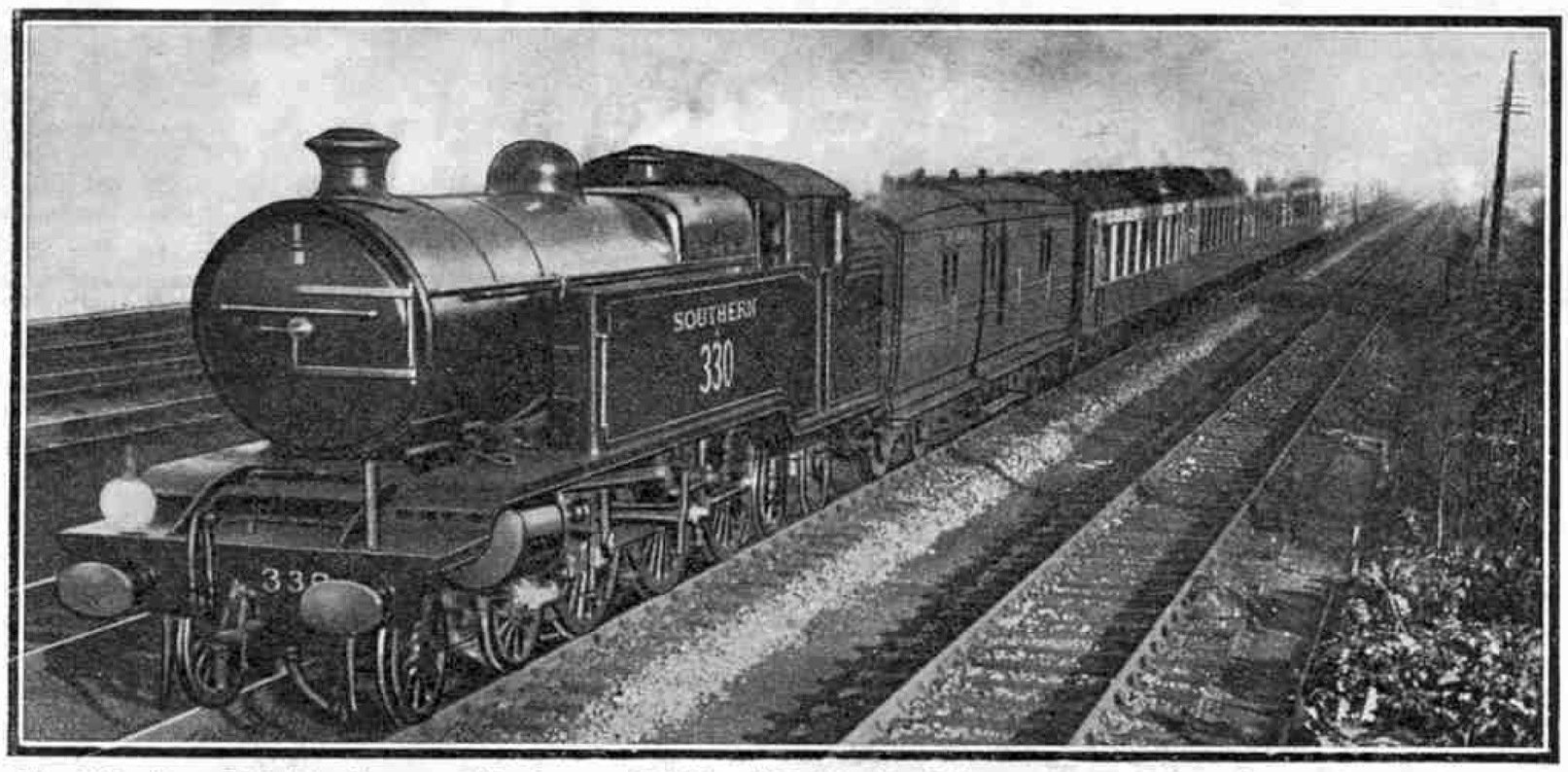
For the 106.7 miles from Retford to Hitchin the average was no less than 70.3. Down the favourable racing stretch of Stoke bank the maximum attained exceeded 90 m.p.h. So it was that the enterprising and skilful enginemen and their speedy 29 year-old "Atlantic" brought the "*Queen of Scots*" into King's Cross exactly on time, notwithstanding the late departure of 18 min. from Leeds. A time of 2 hrs. 55 min. for the journey from Leeds to London is, as Mr. Weight points out, a record.

Electric Extensions on the "Southern"

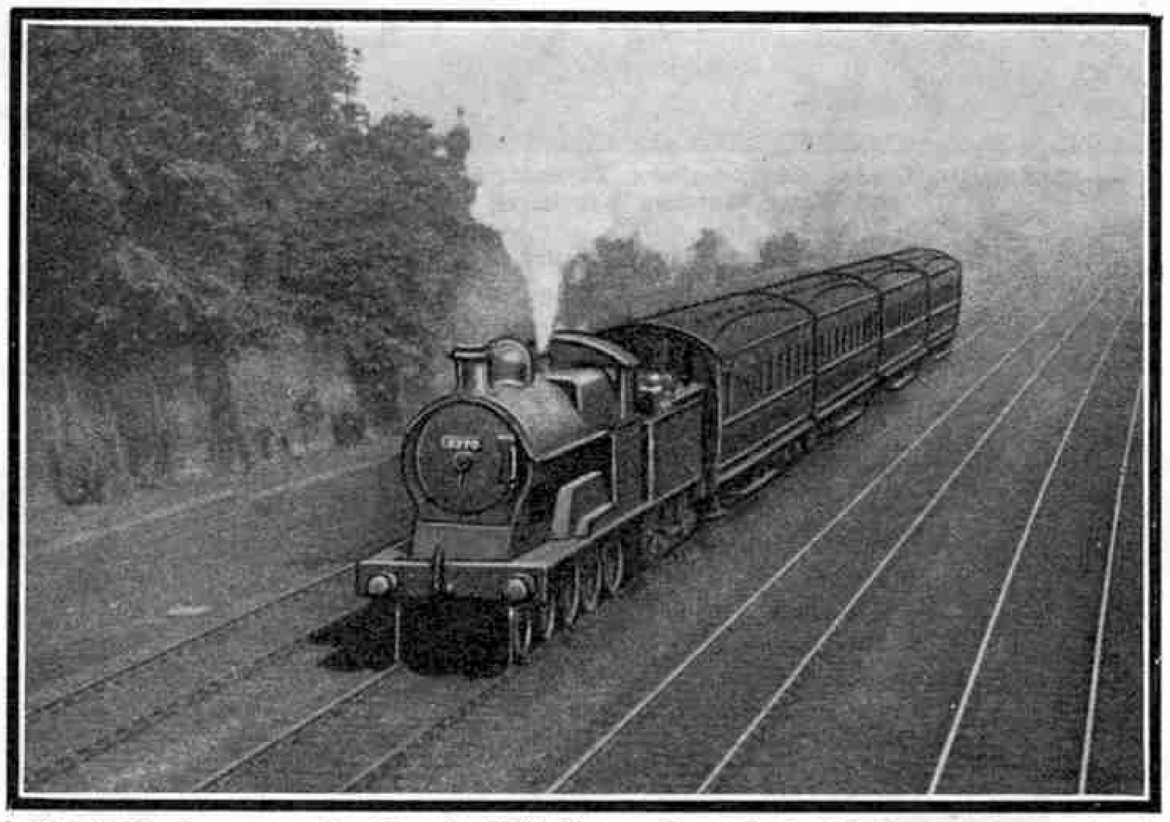
Although the Southern Railway already has the largest suburban electrified system in the world, it has decided to extend its electrified lines still further and to carry them to Sevenoaks on the main line to Tonbridge and Dover. By this, 23 miles will be added to the Southern electric system at a cost of over £500,000. In addition, following on the success of the Brighton electrification, the lines from Brighton and Wyvelsfield to Seaford, Eastbourne, Bexhill and Hastings are to be electrified. This will add another 60 route miles to the "Southern Electric" and cost £1,750,000.

Return of the "*Royal Scot*"

The famous "*Royal Scot*" engine and train, of the L.M.S.R., arrived safely back in England on the 5th December after their remarkably successful tour in the United States and Canada. The tour concluded at Montreal on the 11th of November, when the train steamed into Windsor Station two min. ahead of time on its last schedule over Canadian metals. Throughout its long journeying under very varying conditions the engine No. 6100, "*Royal Scot*," performed its part excellently and won the heartiest praise from American and Canadian railroad officials. On occasion, some really strenuous work was required of it, but it showed itself equal to every demand and, without assistance, took its train over summits of 6,100 ft. in Colorado and 5,600 ft. in the Canadian Rockies above sea-level. The "*Royal Scot*" has always been a popular locomotive, but it will be much more so now that it has won such laurels overseas in covering a total distance of 12,000 miles on Canadian and United States metals. It is assured of an enthusiastic welcome when it returns to active service after its necessary examination and overhaul at Crewe.



The "Southern Belle" with one of the famous Brighton "Baltic" tank locomotives. This train was frequently hauled by engines of this type until the electrification of the S.R. route to Brighton, completed exactly a year ago.



A stopping train approaching Mossley Hill, Liverpool, on the L.M.S.R. The locomotive is one of the "Experiment" class of the former L.N.W.R., as now fitted with a Belpaire fire-box, and with the cab roof modified to suit the Midland Section loading gauge.

The New Year and British Railways

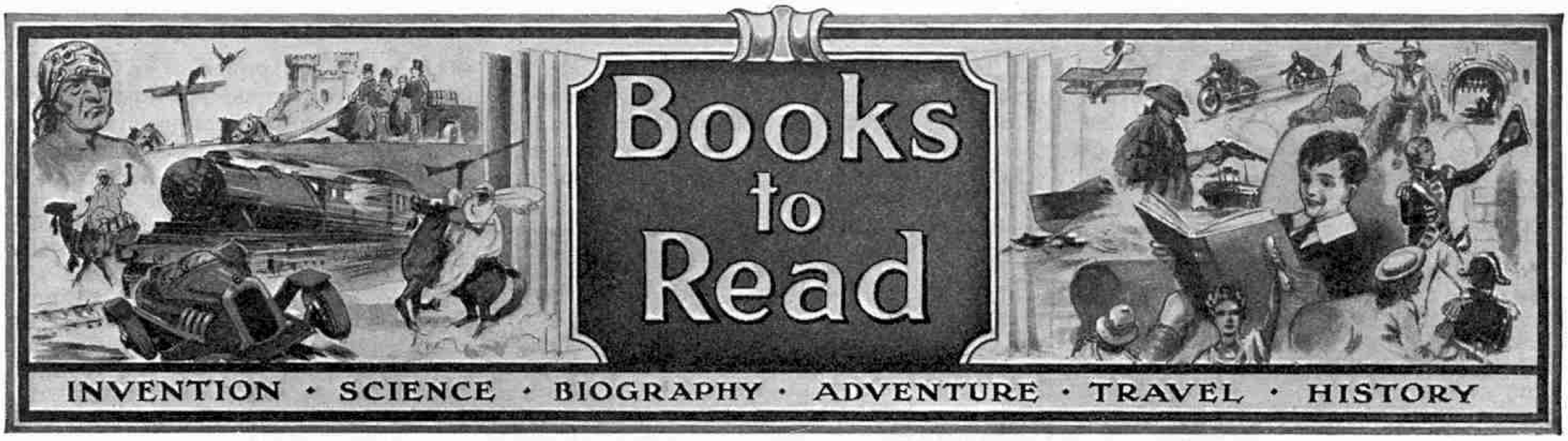
The year 1934 promises to be one of marked progress on the railways of Great Britain. The programmes of development announced by the Companies afford a pleasing indication of the better trade conditions already prevailing throughout the country and are planned to promote the further revival of industry and to meet its growing requirements. The details given in several of the accompanying paragraphs show that a large number of new locomotives is to be built and that many vehicles of various types for both passenger and freight services are to be added to the Companies' stock. Extensive development schemes are to be put in hand and considerable improvements carried out in the renewal of stations, bridges and the permanent way. Much has been done in recent years in the acceleration of services, but it is expected that this year will witness yet further quickenings and additional facilities that will attract an increasing volume of traffic to the railways.

New Construction on the G.W.R.

Swindon works are still building small 0–6–0 tank engines in considerable numbers. A batch of 10 condensing engines, with tanks of increased capacity, was completed before Christmas. These engines, which are numbered 9701–10, are being put to work in the London district. Of the ordinary non-condensing 0–6–0 tank engines, Nos. 8750 to 8764 have been turned out recently, and a further 10—Nos. 8765 to 8774—will be ready for traffic early in the new year. This series will continue up to No. 8799 and some of the remainder are already in course of construction.

The two-cylinder 4–6–0 express locomotive No. 2975 is now named "*Lord Palmer*" in place of "*Sir Ernest Palmer*" as formerly. Engine No. 2974, "*Lord Barrymore*," of the same class has been withdrawn for scrapping.

In addition to the 10 4–6–0 express locomotives of the "Castle" class that are now in hand at Swindon, 10 more 4–6–0 engines of the "Hall" class are to be built during the present year. The programme also includes the building of 70 tank engines of the 2–6–2, 0–6–0, and 0–4–2 types. Passenger rolling stock is to be increased by 140 corridor coaches for long-distance services, 50 coaches for local and suburban services, and 10 trailers for branch line work. Nearly 2,000 new freight wagons are to be built, 850 of which will be vacuum-fitted for use on express freight services.



Here we review books of interest and of use to readers of the "M.M." We can supply copies of these books to readers who cannot obtain them through the usual channels. Order from Book Dept., Meccano Limited, Binns Road, Liverpool 13, adding 1/- for postage to the price. Postages on different books vary, but any balance remaining will be refunded.

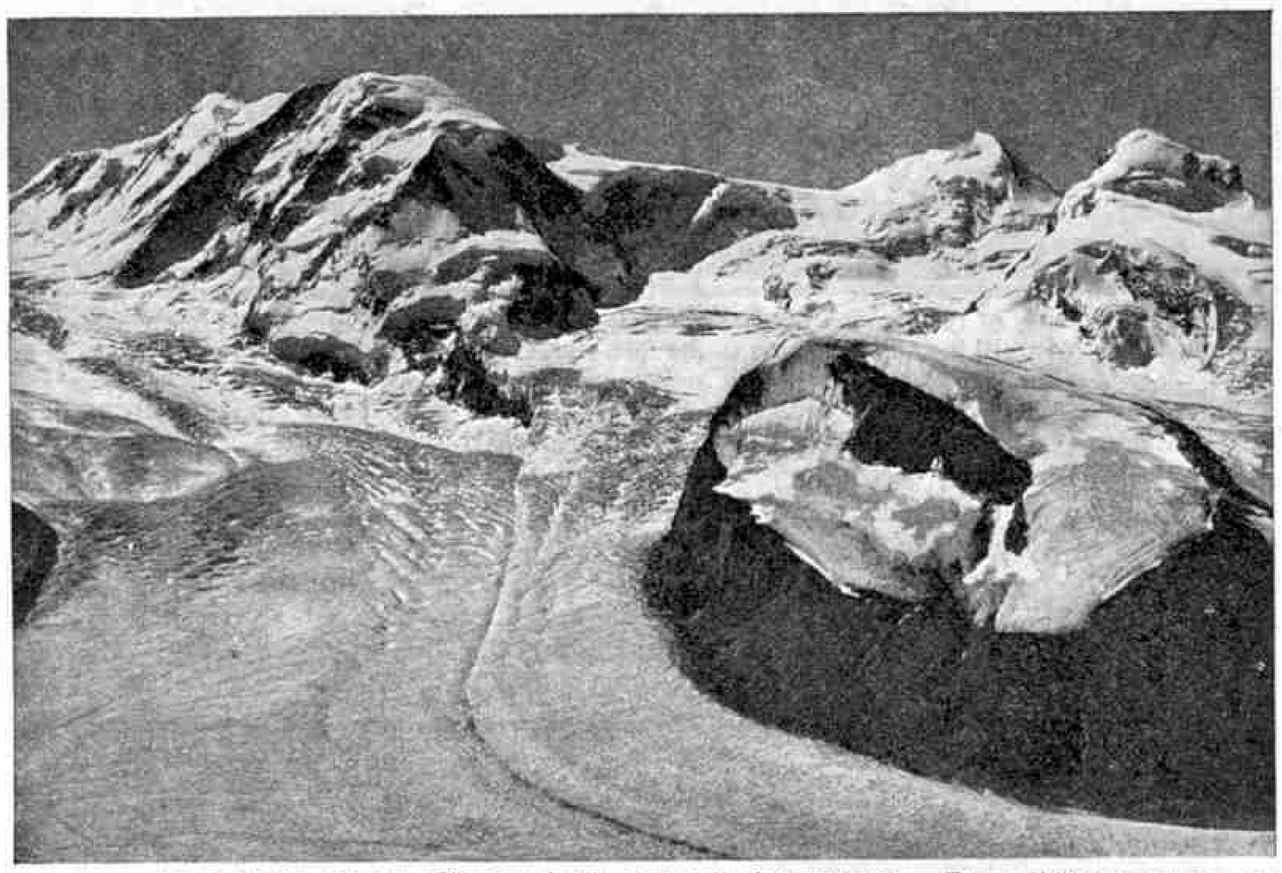
"The Book of Air and Water Wonders"

By Ellison Hawks
(Harrap. 7/6 net)

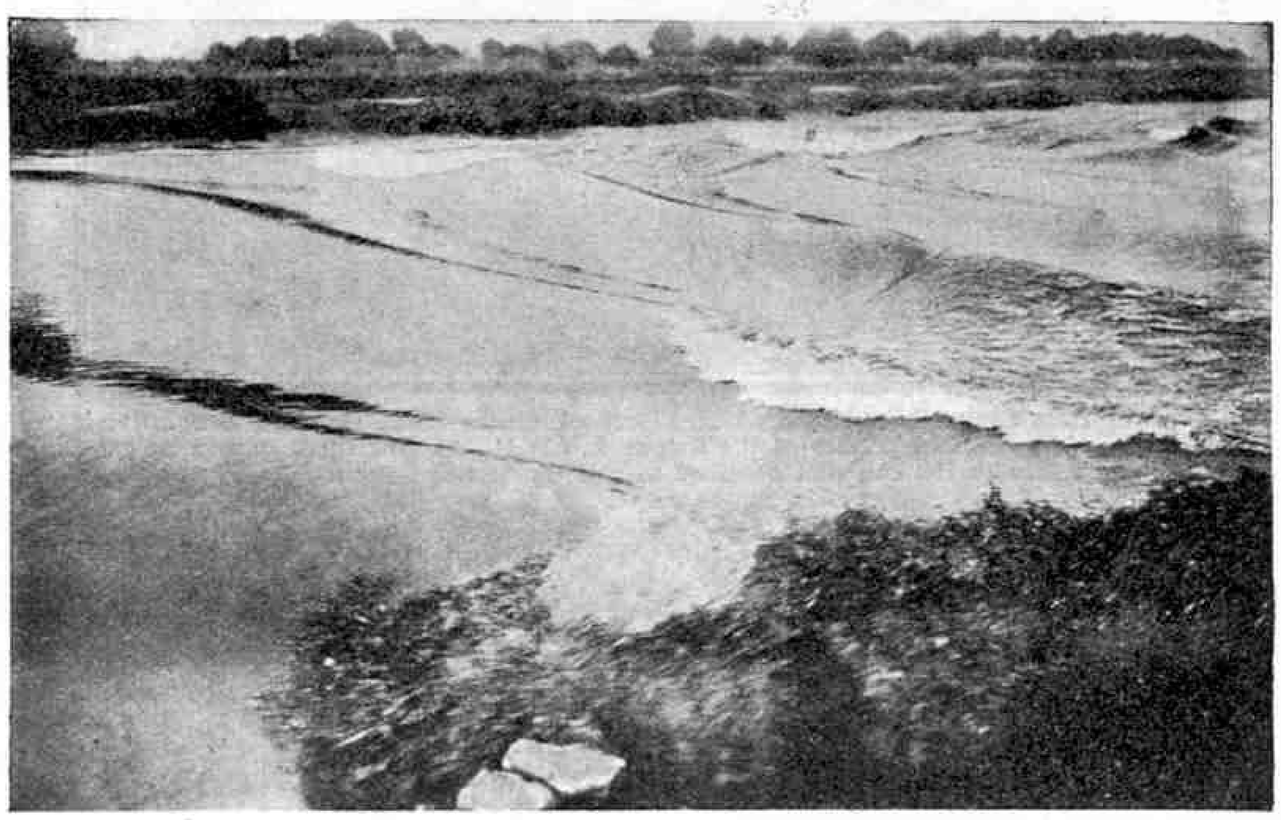
Many readers of the "*M.M.*" will be familiar with the Editor's "*Book of Natural Wonders,*" which deals with the marvels and mysteries of the world around us. This book includes an account of the part played by water as one of Nature's destroyers, and of its work of denudation in the form of rain, frost, glaciers, rivers, and the sea. "*The Book of Air and Water Wonders*" is a companion volume, and it takes us into new and fascinating realms of the world of air and water.

The book commences with a chapter on the composition of the atmosphere, and contains some surprising information in regard to the amount of impurity it contains, largely as the result of pollution in industrial areas. This chapter considers also the problem of the extent of the atmosphere. It is probable that we shall never know the point at which the atmosphere ceases and space commences, but clearly there must be a limit beyond which no air exists. The results obtained by such expeditions as those of the Belgian Professor Piccard, and more recently by American and Russian aeronauts, are of great scientific interest, but they do not really add much to our knowledge of the higher atmosphere. We know that air is present up to a height of 200 miles, but beyond that it probably is too rarefied to be measured by our most sensitive instruments, even supposing that a balloon could carry them to such a height.

An interesting chapter on the pressure and temperature of the atmosphere follows, and then we come to one of the most notable sections of the book, that devoted to dew, mist and fog. It is a curious fact that the ideas of most people in regard to dew are exceedingly vague and generally wrong. The heat-absorbing properties of the atmosphere are greatly increased by the presence of water vapour. Indeed, if this vapour were absent, the Sun's rays would pass through the atmosphere without warming it to any appreciable extent. In addition the water vapour acts as a blanket that prevents the escape of the heat radiated by the earth. Dew is one of the results of the condensation of water vapour in the atmosphere, and differs only from other forms of condensation, such as rain, snow and hail, in being formed on the surface of the earth. Here the author has a surprise for us. Poets have often written of the dewdrop glistening in the cup of a flower as an emblem of purity, but actually it contains a large amount of impurities. It is in fact less pure than rain, for it is condensed principally out of the lowest stratum of air, where impurities are most frequent. The old idea that dew "falls" is quite wrong; it is simply a condensation.


A striking view of the Gorner Glacier above Zermatt, Switzerland. (From "The Book of Air and Water Wonders" reviewed on this page.)

Mists and fogs are familiar to everyone, and although light mists are not very objectionable, a dense fog is not only exceedingly unpleasant, but is a source of serious danger on both land and sea. We are shown exactly how fog is caused, and why, under certain conditions, it may persist for comparatively long periods. The smoke of an industrial city would cause a dense fog at any time if the air remained really still for three hours. As for the "pea soup" fog, its filthy nature is not surprising when one learns that the amount of dirt in the atmosphere of London weighs 390 tons over each square mile! It is interesting to know that some success has been achieved in the dispersal of fog by means of very fine sand, highly electrified, scattered from above by an aeroplane.


The Bore on the River Trent at Gainsborough. (See above.)

Clouds and rain are dealt with in detail, and many interesting facts are given in regard to the greatly varying amounts of rainfall in different parts of the world. The many problems of climate are discussed, and then a section on wind and other storms leads us on to snow and ice. Here the author reveals to us the delicate beauty of the snow-flake and the awe-inspiring grandeur of glaciers and icebergs.

The final chapters of the book are devoted to water in the form of springs, streams and rivers. The world's greatest waterfalls are passed in review and, fittingly, a separate chapter is devoted to the Niagara Falls which, though other falls may surpass them in particular features, have a unique majesty of their own that impresses all who see them. The book concludes with a chapter on the great lakes of the world, and explains

how they were formed and what gives them their individual and characteristic features.

The illustrations play a prominent part in the scheme of this book. The subjects illustrated in the thirty photographic full-page plates have been excellently chosen to add interest to the text, and in addition there are many line drawings scattered about here and there at just the places where they are needed. An excellent index adds to the value of a fascinating and remarkable book.

(Rev.) J. HENRY MARTIN.

"Wireless over 30 Years"

By R. N. VYVYAN
(Routledge. 8/6 net)

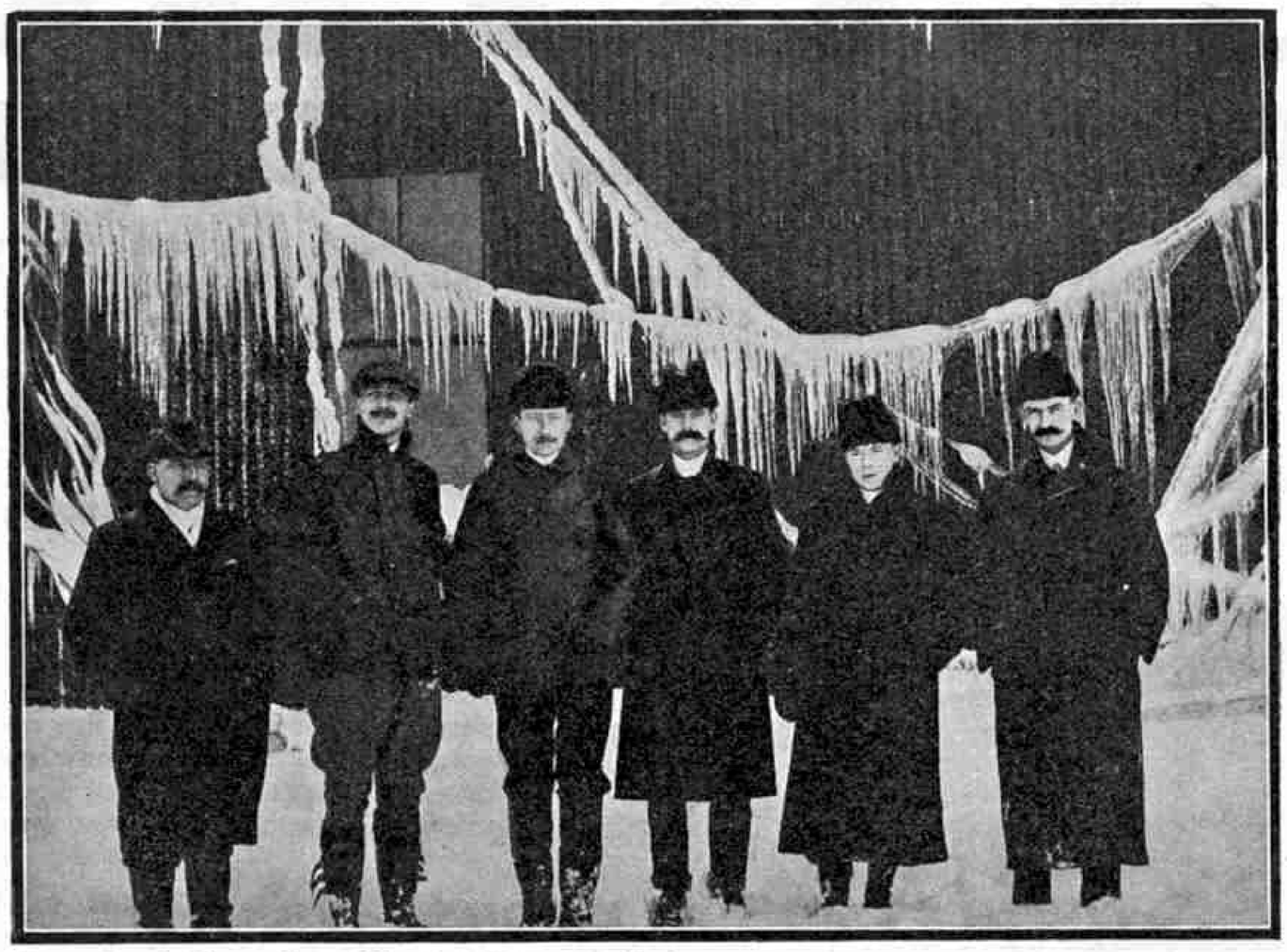
Now that wireless telegraphy and telephony are used every day for world-wide communication, and broadcasting has become one of the commonplaces of life, it is easy to forget that there are still at work engineers and scientists who have been in close touch with wireless development from its early days. The author of this book is one of these. He joined the technical staff of the Marconi Company early in 1900, when the range of wireless communication was limited to a few miles, and helped to build the wireless stations in England, Canada and the United States, between which the first trans-Atlantic messages were sent. Shortly after the War he became Engineer-in-Chief of the Marconi Company, and because of his association with the great inventor and his work he is specially fitted to tell the full story of wireless.

The book begins with a review of the work of Hertz, Lodge, Marconi and other pioneers before 1900, and it is interesting to note that in this connection Mr. Vyvyan expresses his indebtedness to "*Pioneers of Wireless*," by the Editor of the "*M.M.*" Then follow full and authoritative accounts of the development of trans-Atlantic telegraphy, from the building of the famous station at Poldhu in Cornwall to Marconi's triumph in 1901, when for the first time the Atlantic Ocean was bridged by means of wireless. This part of Mr. Vyvyan's story is completed by an interesting review of the famous stations afterwards erected at Clifden, County Galway, and Caernarvon on this side of the Atlantic, and Glace Bay and Cape Cod on the other. The history of the now famous long wave station at Caernarvon is told in full, for this station was always brought up to date whenever possible, and thus its history illustrates the wonderful progress made in wireless since its erection.

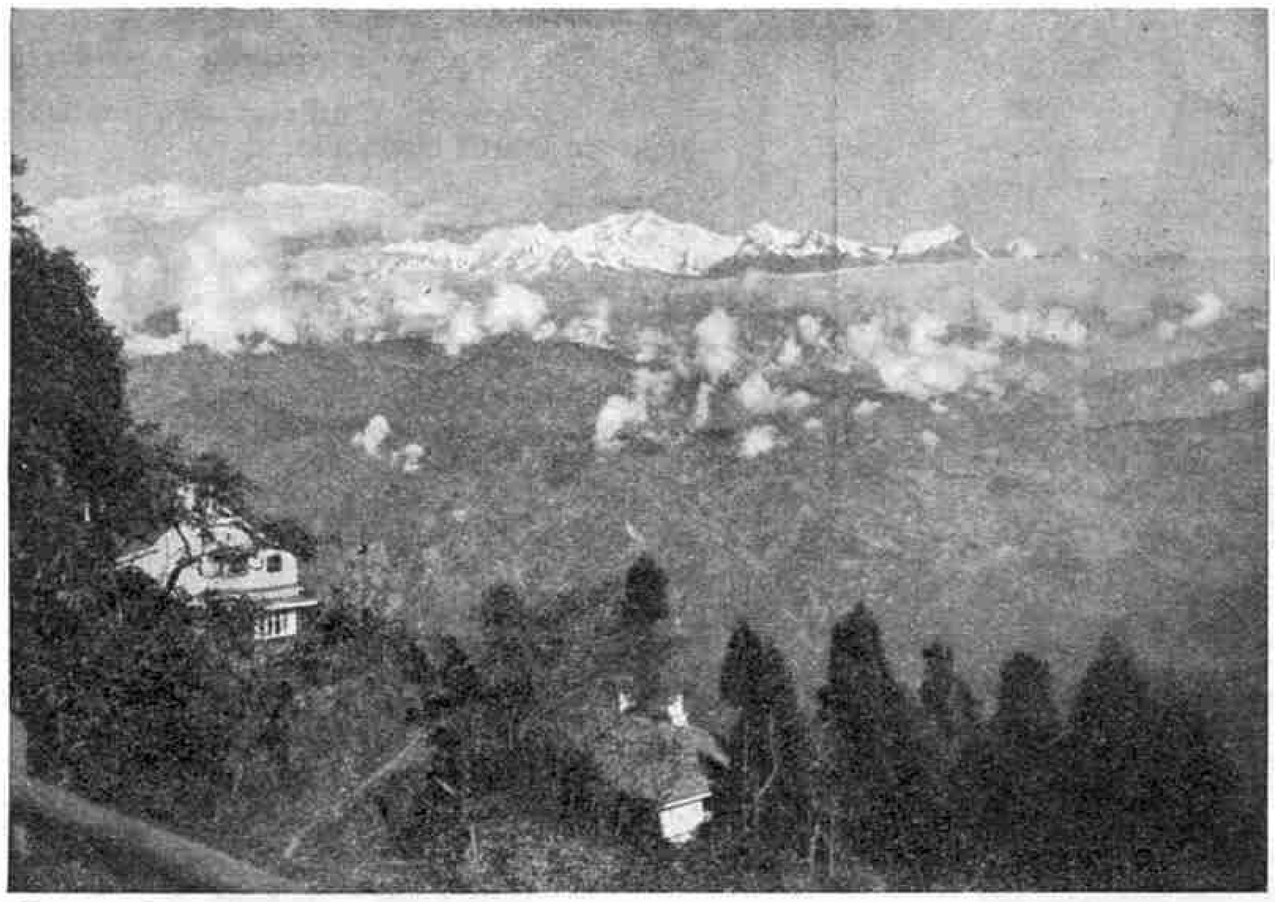
The developments described by the author have culminated in broadcasting and in a network of short wave beam wireless stations throughout the world, in addition to commercial stations working on long waves. Each of these developments is taken up in turn, and described in a concise but authoritative manner. Special chapters deal with the story of wireless in war on land, at sea and in the air. Much of the information given in these chapters will be new to the general reader, who will also be absorbed in Mr. Vyvyan's account of the wonderful record of wireless as a means of saving life at sea.

The book is completed by a chapter on wireless as a career, and a section dealing with the direction in which wireless may be developed as a result of the unceasing research work that is now being carried on by engineers and scientists.

Mr. Vyvyan tells his story without the use of technicalities, and the result is a work that is both interesting and authentic. The book is well illustrated by means of plates and diagrams, but lacks an index.



Marconi and his staff outside the Glace Bay Station. The icicles are suspended from an aerial. (From "Wireless over 30 Years" reviewed on this page.)



Monsoon Clouds coming up the valley at the Mall, Darjeeling. (From "The Book of Air and Water Wonders" reviewed on the opposite page.)

Books on Aviation

"*Conquering the Air*," by Archibald Williams (Thos. Nelson and Sons Ltd., 3/6 net), which first appeared in 1926, has now been extensively revised and more than half rewritten. This interesting and well-illustrated history of aviation begins with the Montgolfier brothers and the first fire balloons, and leads up to modern developments such as floating airports and the Cierva "Autogiro."

In "*Twenty Six Flying Stories*" (R.T.S., 3/6) G. Gibbard Jackson has divided the history of aviation into 26 chapters. He begins with the balloon, and passes on to the pioneers of gliding, the aeroplane and airships. An interesting section deals with the making of maps from aerial photographs, and with the special work of aircraft in Canada, the United States and other countries. The book is illustrated with four photographs and a coloured frontispiece. There is no index.

"The Schoolboy's Diary"

(Charles Lett's. 1/-)

The 1934 issue maintains the high standard of this firm's products, and contains all the old features that have made this diary so popular. There are useful notes regarding a variety of careers, and lists of university and school sports records. The diary pages carry interesting illustrated nature notes.

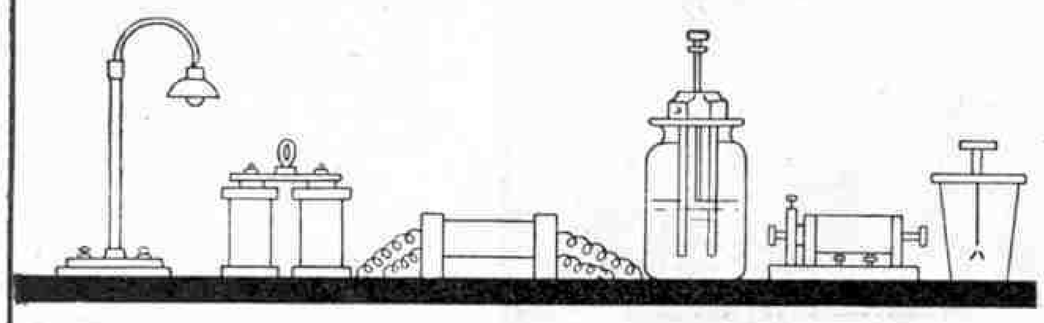
"Sands, Clays and Minerals"

(A. L. Curtis. 1/3)

We have received a copy of the fourth issue of this interesting journal, which is published quarterly by A. L. Curtis, of Chatteris, for the benefit of those who are interested in the production and use of economic minerals of all kinds. In addition to technical articles on such matters as the rapid valuation of coal, and the analysis of sands employed in glass making or moulding operations, this number includes articles that will make a strong appeal to most "*M.M.*" readers, especially those interested in chemistry. These articles deal with cobalt and its uses, the origin of gypsum and its application in industry, and the recovery of platinum and iridium from the worn-out tips of sparking plugs or fountain pen nibs, and other sources of scrap metal.

A particularly interesting article describes the formation of peat, and how this product is extracted from the bogs of Ireland; which occupy no less than one-seventh of the total area of that country. All the articles are well illustrated.

ELEKTRON
ELECTRICAL OUTFITS



In these days of radio, X-rays, and electric trams and trains, every boy should have a knowledge of electricity. The only way to gain this knowledge is by means of experiments, and the Elektron Outfits have been produced specially for this purpose.

These Outfits contain all the materials for carrying out a splendid series of fascinating experiments, commencing with Magnetism and passing on through Frictional Electricity to Current Electricity. In addition many interesting mechanisms can be constructed, including a Reading Lamp, an Electric Bell, a Telegraph, a Shocking Coil that gives real shocks, and Electric Motors.

No. 1 Elektron Outfit Price 8/6

No. 1 ELEKTRON OUTFIT
Magnetism and Static Electricity

The No. 1 Outfit contains two powerful Bar Magnets and a reliable Magnetic Compass, together with everything necessary for the carrying out of a series of fascinating magnetic experiments. In addition there are materials for experiments in frictional or static electricity, and for the construction of an Electric Compass and two forms of Electroscope.

Price **8/6**

No. 2 ELEKTRON OUTFIT
Magnetism, Static and Current Electricity

The No. 2 Elektron Outfit contains all that is included in the No. 1 Elektron Outfit, with additional parts that enable a splendid series of experiments in current electricity to be performed. Among these parts are a Horseshoe Magnet, and Coils and Yokes for the construction of Electro-Magnets that can be used in building a real Electric Bell, and a Buzzer for use in an electric telegraph system. A specially-wound coil and other necessary parts are supplied for assembling into a splendid Shocking Coil that will give hours of fun and excitement.

Price **25/-**

No. 1A ELEKTRON ACCESSORY OUTFIT

An Accessory Outfit is also available that converts a No. 1 Elektron Outfit into a No. 2.

Price **16/6**

No. 2 Elektron Outfit Price 25/-

PRODUCT of MECCANO LIMITED LIVERPOOL

Manufactured by

MECCANO LTD.
BINNS ROAD
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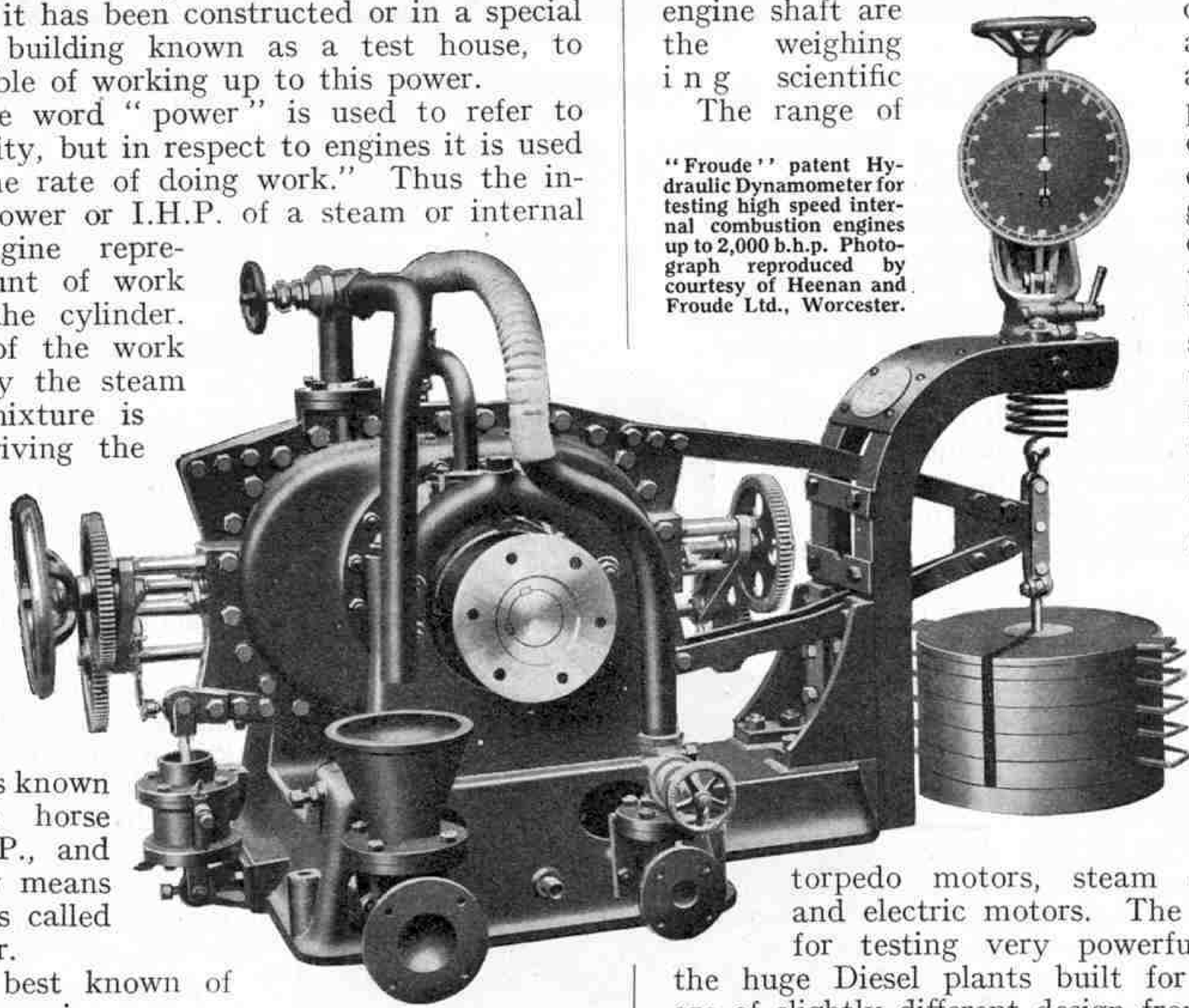
Measuring Brake Horse Power

The "Froude" Hydraulic Dynamometer

EVERY engine, irrespective of its type, is designed to develop a certain maximum power. When a new engine is completed it is tested either in the shop where it has been constructed or in a special department or building known as a test house, to see if it is capable of working up to this power.

Ordinarily the word "power" is used to refer to strength or ability, but in respect to engines it is used to describe "the rate of doing work." Thus the indicated horse power or I.H.P. of a steam or internal combustion engine represents the amount of work performed in the cylinder. A proportion of the work accomplished by the steam or explosive mixture is absorbed in driving the engine itself, and therefore the rate at which the engine can perform outside work is slightly less than the I.H.P. This net figure is known as the brake horse power or B.H.P., and is measured by means of an apparatus called a Dynamometer.



"Froude" patent Hydraulic Dynamometer for testing high speed internal combustion engines up to 2,000 b.h.p. Photograph reproduced by courtesy of Heenan and Froude Ltd., Worcester.

One of the best known of this type of measuring apparatus is the "Froude" patent Hydraulic Dynamometer, which consists essentially of a rotor carried on a shaft and running in a casing. The shaft is carried by bearings fixed in the casing, which is free to swivel upon anti-friction trunnions that support it. When an engine is to be tested it is directly coupled to the main shaft transmitting the power to the rotor revolving inside the casing. Water is then circulated through this casing to provide the hydraulic resistance and at the same time to carry away the heat developed by destruction of power.

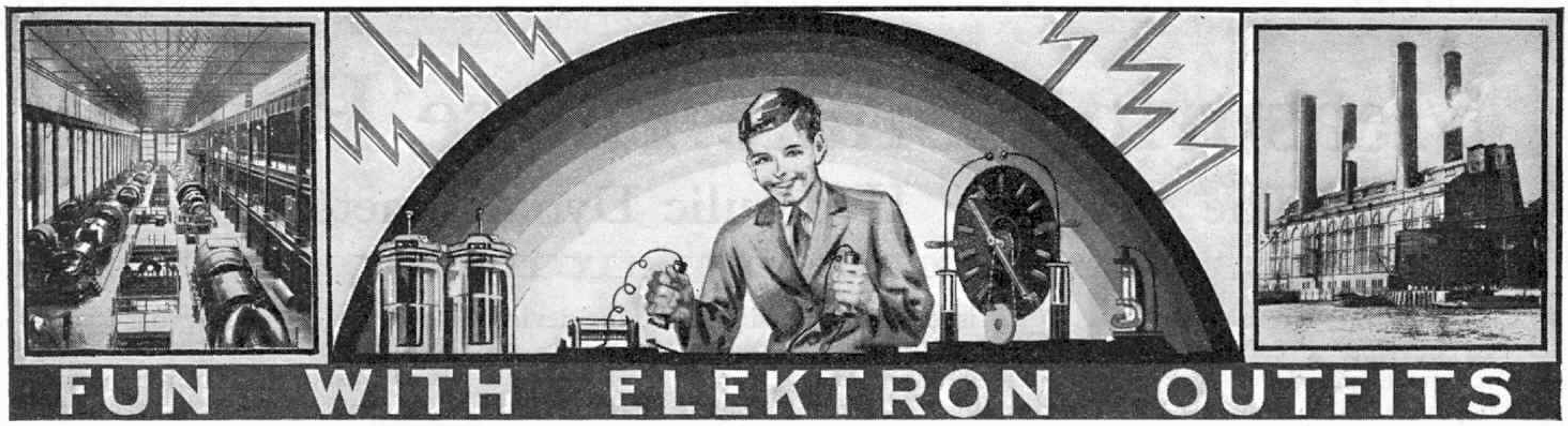
In each face of the rotor are pockets or cups of semi-elliptical cross-section, divided from one another by means of oblique vanes. The internal faces of the casing are also arranged with a corresponding number of pockets. When the dynamometer is in action water is supplied to the pockets through holes in the vanes. The rotation of the rotor discharges this water into the pockets formed in the casing, and a vortex action is set up, water being constantly circulated round each elliptical space formed by rotor and casing pockets. The resistance offered by the water to rotation of the rotor reacts upon the casing, which tends to turn on its anti-friction supports. This tendency is counteracted by means of a lever arm that terminates in a weighing device consisting of either a spring balance or a steelyard, in combination with loose balance weights. Thus the forces resisting rotation of the engine shaft are caused to react upon the weighing apparatus, ensuring scientific accuracy.

The range of power and speed obtainable with this dynamometer is very great, and the load can be altered at will during operations, by infinitely small gradations between maximum and minimum, without changing any part of the dynamometer. The machine is also suitable for continuous non-stop running at full load.

"Froude" hydraulic dynamometers are used for testing motor car and aircraft engines, Diesel, oil or gas engines, torpedo motors, steam or water turbines, and electric motors. The dynamometers used for testing very powerful engines, such as the huge Diesel plants built for large motor ships, are of slightly different design from the machine illustrated above, and "Froude" dynamometers of this larger type and capable of measuring 15,000 b.h.p. are now in use.

The Rolls-Royce engines of the Vickers-Supermarine seaplanes that won the last Schneider Trophy, and also those used in *"Miss England III"* in the successful attack in 1932 on the world water-speed record, were tested on a high-power "Froude" dynamometer. At the other end of the scale, these dynamometers are also universally employed in testing motor cycle engines, the "baby" class of which develop only a few horse power. In a slightly modified form they are also employed as hydraulic brakes, for governing the speed and descent of electric winders and haulage gears; and owing to the hydraulic nature of the resistance which they offer, they give particularly sweet and sensitive braking control.

Among the advantages of the "Froude" dynamometer is that its resistance, being hydraulic, is practically negligible at starting but rises rapidly with the speed. The inertia of the rotor is very slight, and the apparatus exerts a pure torque resistance and imposes no load on the engine bearings. It places at the disposal of engineers a convenient means of accurately measuring the power developed by their prime movers.



MAGNETISING A POKER BY HAMMERING

PROBABLY the most interesting of all magnets is the Earth itself. It is certainly the most mysterious, for as yet no completely satisfactory explanation of its magnetism has been given, although this may have some connection with the immense mass of iron and nickel believed to constitute its centre. Whatever the cause of its magnetism, the Earth has two poles exactly like an ordinary magnet. One of these poles is in the far north of Canada and the other is in the Antarctic Continent, and the movements of the compass needle, or any other magnet suspended so that it is free to swing, are due to the attractions of the Earth's magnetic poles.

A compass needle, wherever it is taken, sets itself along the lines of force due to the Earth's magnetism, and the result of trials of this kind over every accessible part of the Earth's surface is a map of its magnetic field. Thus the compass needle plays on a large scale the part of the iron filings in the fascinating magnetic map experiments described in the Elektron Manual. Magnetic maps obtained with its aid are published for the guidance of mariners, for the magnetic north is not true north, and for navigation purposes it is important to know how these differ.

Compass needles are not the only things affected by the Earth's magnetic field, for every piece of iron or steel comes under its influence. As explained in the No. 1 Elektron Manual, it is believed that a magnet is composed of tiny molecular magnets that have their north poles pointing in the same direction, and thus act with each other. In an ordinary piece of iron or steel the small magnets are not arranged in regular order, but are turned in various directions, with the result that their poles neutralise each other. These tiny magnets are influenced by the Earth's magnetic field, which tends to pull them round so that their north poles all point northward, but the magnetic force exerted is too slight to overcome the resistance offered to their movement.

A proportion of the molecular magnets in a piece of iron or steel can be set free to turn round if the mass is jarred by striking it violently, and an experiment on these lines is very interesting. An iron or steel poker is held with its point towards the north magnetic pole, and the other end towards the south magnetic pole. This position is readily attained by simply holding the poker parallel to the line along which the Elektron Compass Needle sets itself. With the poker thus pointing in the direction of the Earth's lines of magnetic force, as revealed by the Compass, the handle is given two or three violent blows with a hammer. This jars the poker, giving the tiny magnets within it an opportunity to turn, and on testing it is then found to be feebly magnetic.

Fig. 1. A floating battery, the current from which flows through a coil of wire mounted above it.

It is interesting to note that pieces of iron and steel laid north and south and subject to vibration have been known to slowly acquire magnetic powers. For instance, railway tracks running parallel to the position taken up by a compass needle eventually become feebly magnetic, the blows they receive when the wheels strike their ends being equivalent to the hammer blows in the experiment with a poker.

The poker is converted into a more powerful magnet if the end pointing north is dipped at an angle of nearly 70 degrees, as shown in Fig. 2. The reason for this is that the Earth's poles are not on the surface, but below it, with the result that a compass needle swinging freely would not remain horizontal, but would dip down at one end. Often the tendency to dip in this manner can be detected with an ordinary compass needle; and a needle pivoted on a horizontal axis and placed along the magnetic north and south line shows it plainly, the north end of the magnet pointing downward if the experiment is tried in the northern hemisphere, the south end dipping if the trial is made in the southern hemisphere. The angle of dip is of course greatest above the Earth's magnetic poles, for there the needle will point vertically downward.

In order to magnetise our poker as strongly as possible by simply hammering it, it is first thrown violently on the ground in order to destroy any magnetism remaining from the previous experiment. The effectiveness of this rough treatment is tested by means of the Compass Needle, and when each pole of the Needle is attracted

by one end of the poker, it can be assumed that this is no longer magnetic. In Great Britain the angle of dip is nearly 67 degrees, and the poker therefore is held in the magnetic north and south line with its point towards the north and dipping at about this angle, as shown in Fig. 2. Two or three sharp blows on the opposite end of the poker with a hammer then convert it into a feeble magnet.

A poker magnetised in this manner picks up pins and other light iron or steel objects, but it is much more satisfactory to test its magnetism by means of repulsion, for the objects employed may themselves be magnets, and then would be attracted by a piece of iron, irrespective of its own condition. Each end in turn of the magnetised poker therefore is brought near the north end of the Compass Needle. The end struck by the hammer attracts the north pole of the needle, and therefore is a south pole. The opposite end, which dipped downward while the poker was being magnetised, causes the north pole of the Compass Needle to swing away from it, and therefore is itself a north pole. This is exactly what would be expected, for the pull of the Earth's north magnetic pole attracts the north poles of the tiny molecular magnets in the poker, and when the hammer blow is struck, causes some of them to turn so as to point towards it.

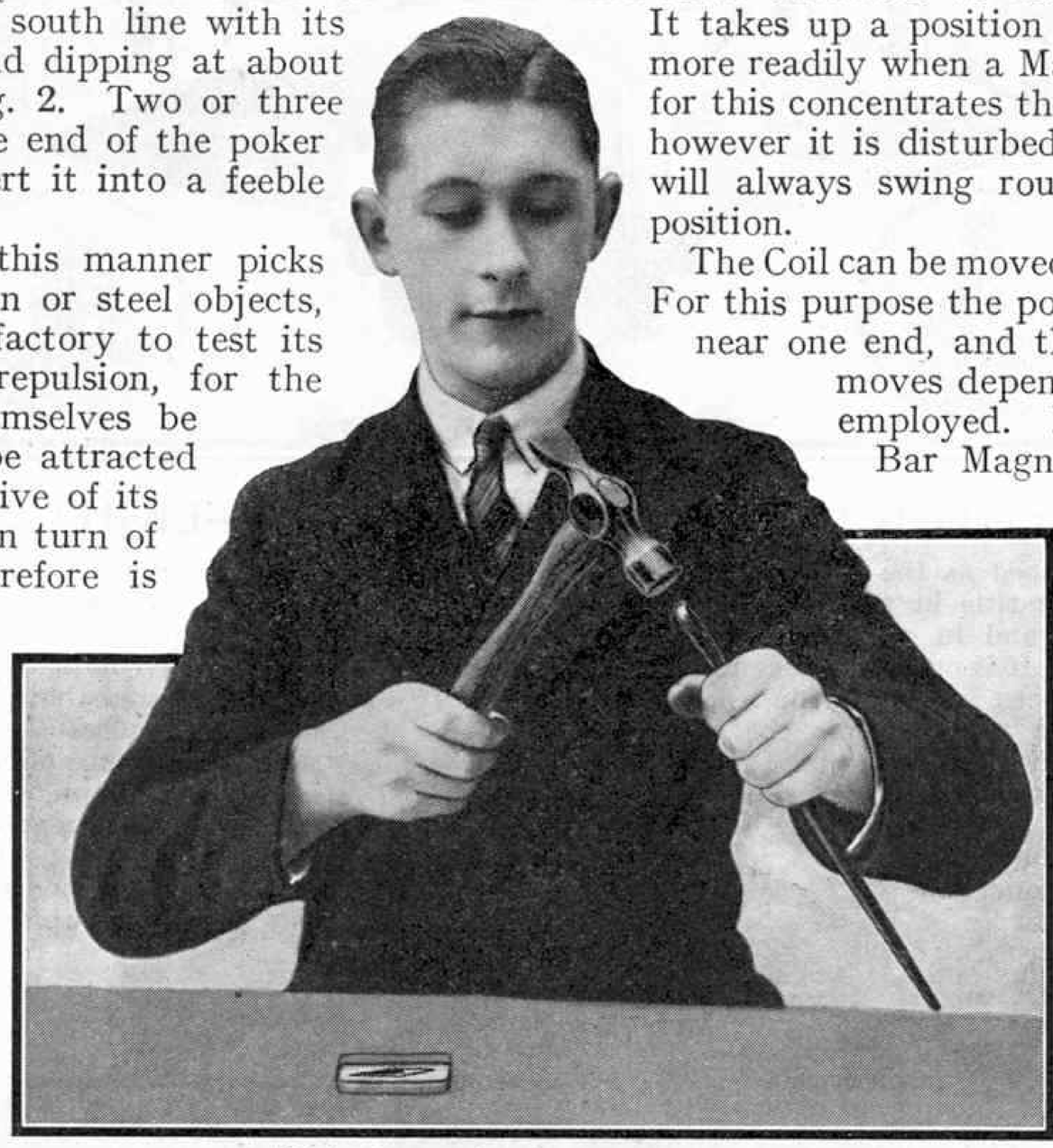


Fig. 2. Magnetising a poker by hammering.

Interesting experiments illustrating the connection between electricity and magnetism can be made by suspending a coil of wire through which a current is passing, in order to enable it to turn freely. A coil of this kind is equivalent to a magnet. Its two ends can be distinguished as north and south poles, and in effect when suspended it forms an electro-magnetic compass.

One of the two Magnet Coils included in the Outfits can readily be suspended from the Elektron Stand in this manner, as shown in Fig. 3. It is supported by means of a length of Silk Thread passing over the Bracket and tied to the Circular Base. The Silk Thread is passed through two holes close to each other in the covering of the winding, or looped round the body of the Coil itself, and is so adjusted that this swings horizontally. In order to enable the current to be passed through the Coil, very fine wires connect the ends of its windings to the terminals of the Elektron Bichromate Cell, and these wires are looped, as shown in the illustration, in order to prevent them from checking the swing of the Coil. For the same reason, wire as fine as is available should be used for this connection.

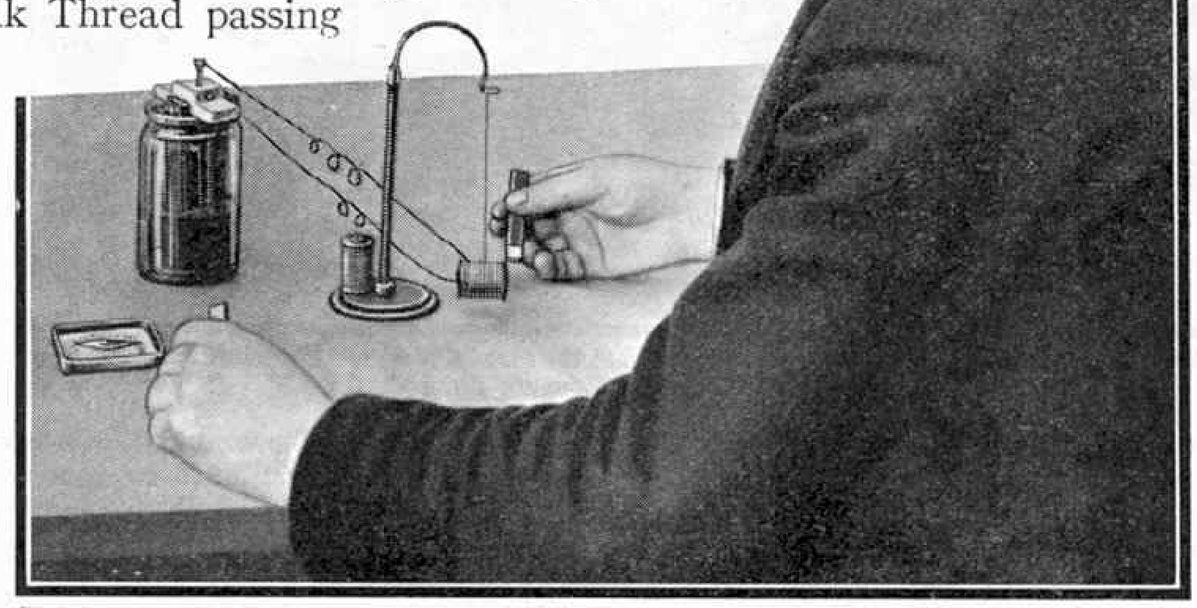


Fig. 3. A suspended Magnet Coil sets itself north and south when current flows through its windings, and the approach of a Bar Magnet causes it to swing round as if it were a compass needle.

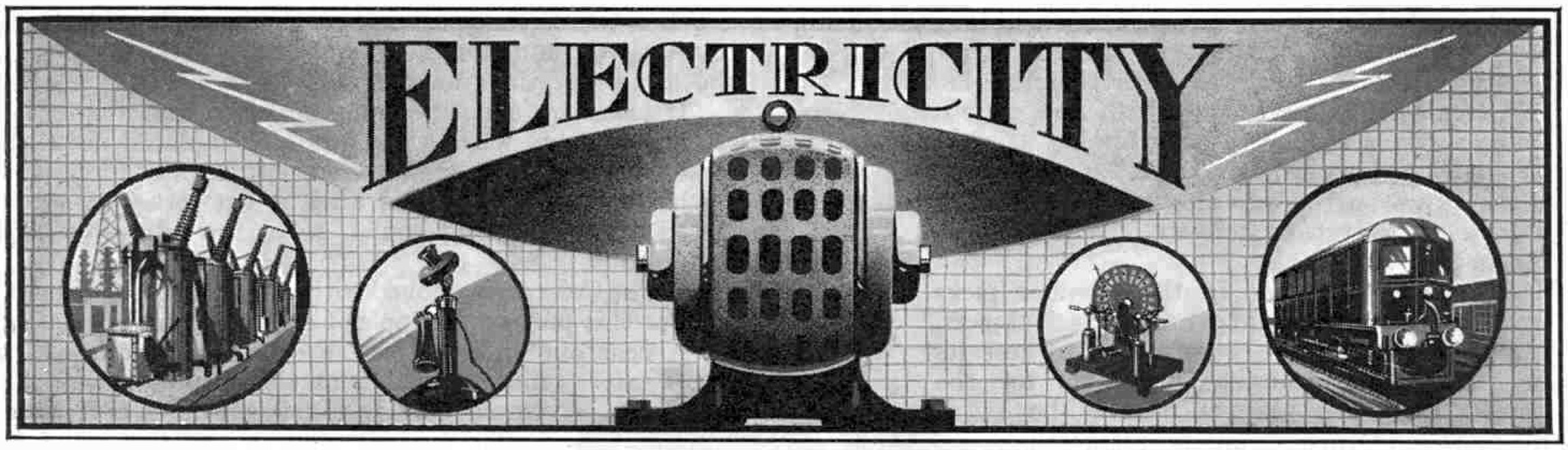
When the current passes through the Coil, this swings round slowly, and comes to rest with its ends pointing in the same directions as the poles of a compass needle. It takes up a position on the north and south line more readily when a Magnet Core is placed inside it, for this concentrates the magnetic lines of force, and however it is disturbed after it has settled down it will always swing round so as to return to this position.

The Coil can be moved without actually touching it. For this purpose the pole of a Bar Magnet is brought near one end, and the direction in which it then moves depends on the nature of the poles employed. In Fig. 3, the north pole of the Bar Magnet held in the hand is held near the south pole of the suspended Coil. The two poles attract each other, and the Coil is pulled out of its normal position to settle down with its south pole as near as possible to the north pole of the Bar Magnet.

An even more interesting way of showing how a coil of wire through which a current is flowing can act like a magnet, and even form a compass, is illustrated in Fig. 1. The coil of wire in this case is flat and is made by winding a 3 ft. length of the No. 35 Gauge Copper Wire provided in the Elektron Outfit round a tube or rod about 1½ in. in diameter. The coil thus formed has eight turns. Its ends are attached to short lengths of thicker wire that pass through a large cork and are connected to the Zinc and Copper Plates, Elektron Parts Nos. 1526 and 1527, respectively. The thick wires are attached to the Plates by means of Terminals on Bolts passing through the holes provided.

The cork supports both the coil and the two Plates, and the device therefore is capable of floating on the surface of a liquid in a deep basin or other suitable vessel. For the purpose of this experiment dilute sulphuric acid is used. The acid need not be very strong, and can be prepared by diluting liquid of the strength employed in accumulators with its own volume of water. Great care must be taken to avoid spilling this liquid.

Besides being a floating coil, free to turn in any direction, this device constitutes a floating battery, for a current flows through the coil of wire joining the Copper Plate to the Zinc Plate, the circuit being completed across the dilute sulphuric acid in which the Plates are immersed. The coil then becomes equivalent to a magnet, and (Continued on page 66)

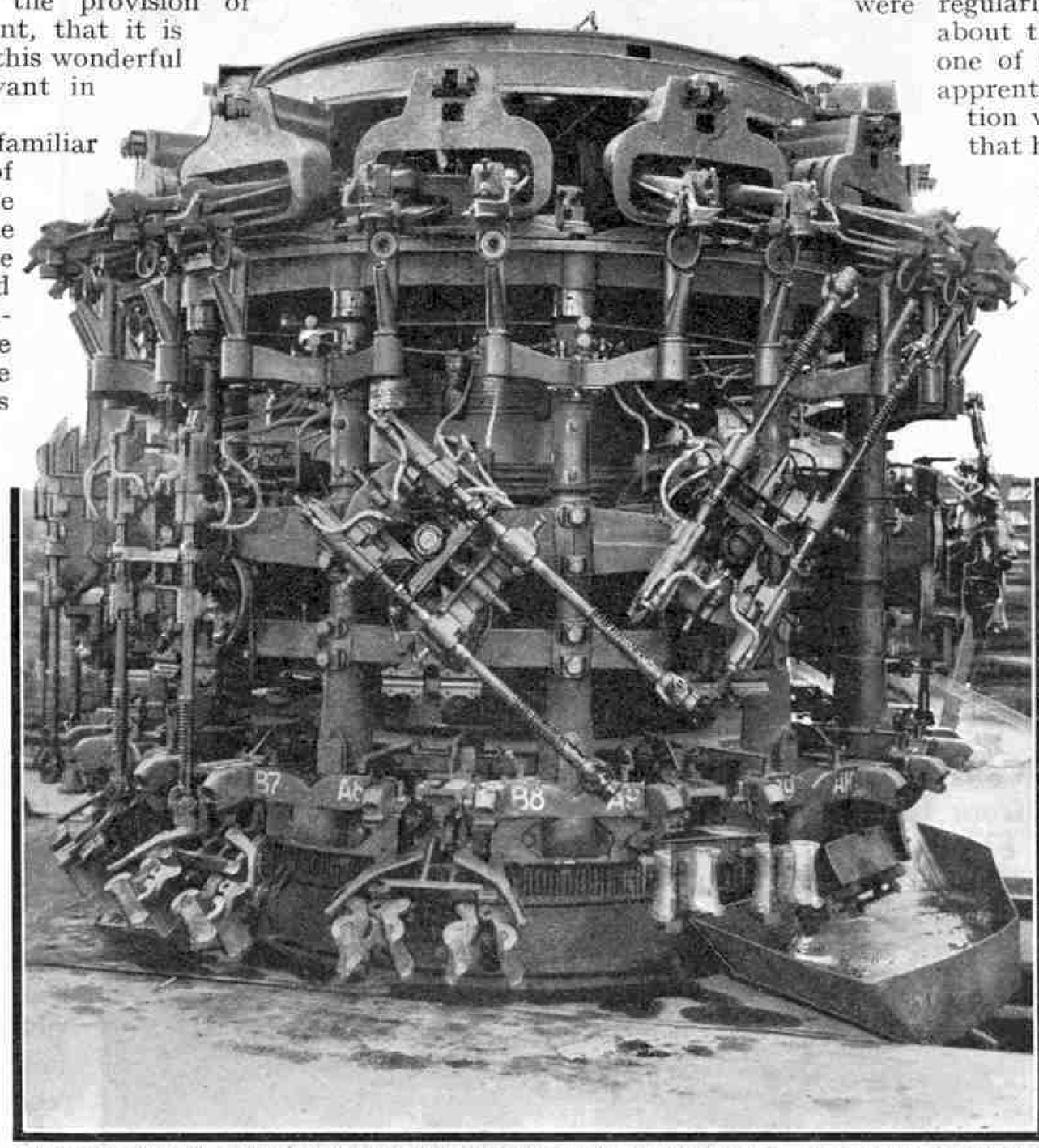


ELECTRICITY IN THE HOME. I.—LIGHTING

THE present era is often described as the Electrical Age, and there is justification for this title in the extensive use we already make of electricity and in our increasing reliance upon it for both light and power. It is only within comparatively recent times that electricity has been introduced on a large scale into our homes, however, and to many people the all-electric house is still a novelty. Electricity can now be used for so many domestic purposes, ranging from lighting and heating to cleaning, cooking, and the provision of amusement and entertainment, that it is worth while to consider how this wonderful power has become our servant in everyday affairs.

In home life we are most familiar with electricity as a source of light. Although it is little more than 40 years since the first crude electric lamps were produced, we have all learned to appreciate their convenience and cleanliness, and the ease with which they can be controlled. Every year sees the wiring of thousands houses for electric light, and new houses are fitted for its use almost as a matter of course, provided that a satisfactory connection with the mains can be made.

The story of electric lighting goes back little beyond the beginning of the present century, but the possibility of using electricity for lighting purposes was appreciated as long ago as 1801 by Sir Humphry Davy. The only source of electric current then available was the voltaic cell, invented shortly before by the Italian scientist Alessandro Volta. Davy discovered that if two rods of carbon, one connected to each terminal of a large battery of cells of this type, were brought into contact and then slowly separated, a brilliant arch or arc of light was formed between them. The voltage must be at least 40.



The "Westlake" Automatic Bulb-blowing Machine at the Mazda Works. Photograph by courtesy of the British Thomson-Houston Co. Ltd.

This experiment may be regarded as the first instance of electric lighting, but it was many years before practical use was made of it, chiefly owing to the lack of a cheap and convenient source of electric current. The coming of the dynamo overcame that difficulty, and our streets were then lighted by means of arc lamps. The effect of the passage of the current between the two rods is to form a bridge of volatilised carbon, and the light of the arc is due to the passage of the current across this bridge. The carbons therefore burn away and thus the gap is slowly increased. For this reason it was necessary to provide an automatic mechanism to keep them the correct distance apart, for otherwise the distance between them became so great that the arc was cut off.

Arc lamps proved their usefulness in lighting streets and open spaces, and were valuable sources of illumination in lighthouses and in other special circumstances. They were not suitable for use in the home, however, and the problem of domestic lighting had to be solved on completely different lines.

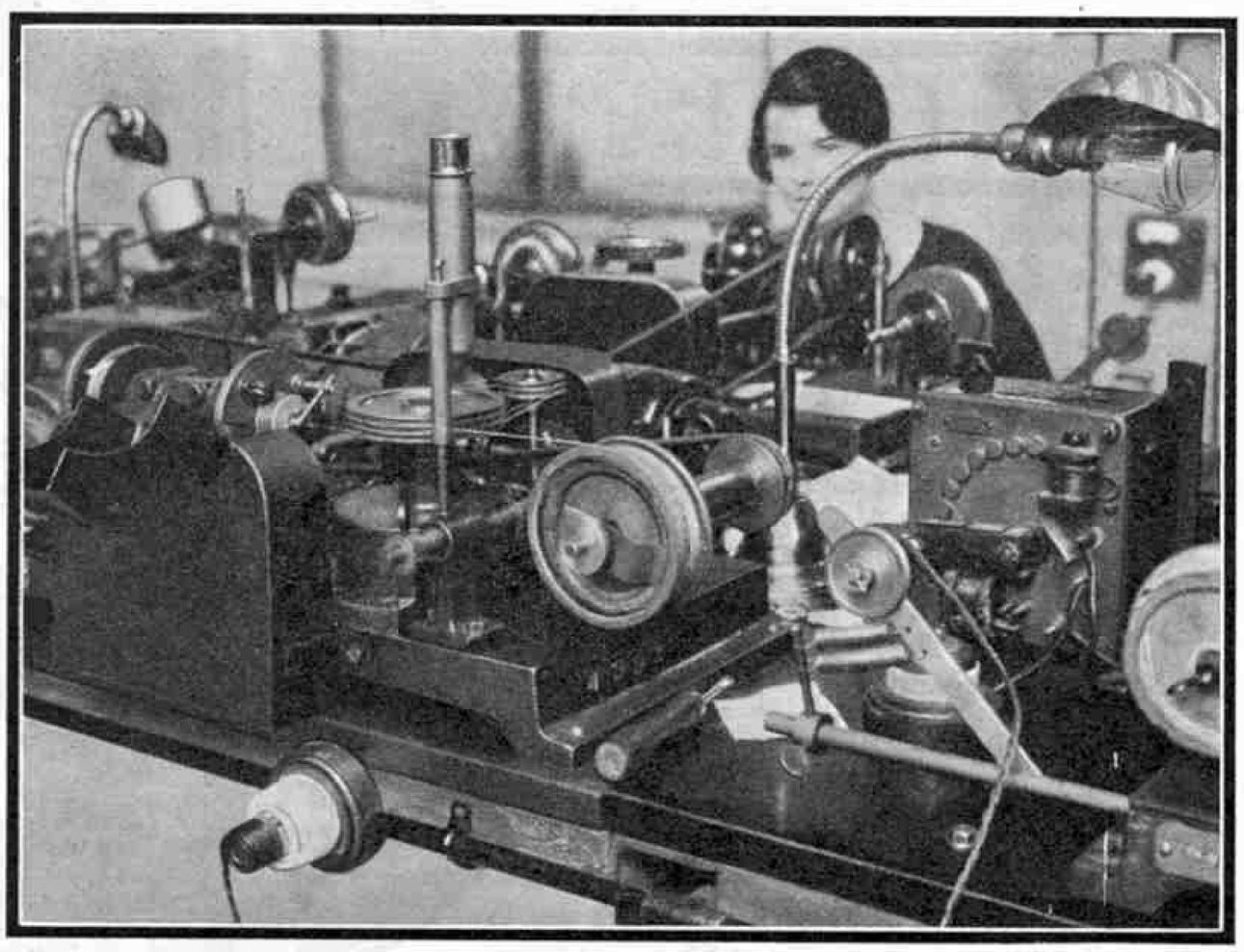
It was early discovered that passing an electric current through fine platinum wires causes these to glow, so much heat being generated by the resistance offered to the current that the metal becomes white hot. Interesting experiments of this kind were regularly demonstrated by scientists about the middle of last century, and one of these was seen by a chemist's apprentice in Newcastle, whose imagination was so fired by the experience that he commenced experiments that led to the production of lamps suitable for use in any position. This youth was Joseph Wilson Swan. He had already heard of the experiments of an American named Starr, who in 1845 took out a patent for a lamp consisting of a thin rod of carbon enclosed in a vacuum at the head of a column of mercury. Starr's lamps gave a very bright light when new, but were unsuccessful because the inner surface of the glass was quickly blackened.

Swan's efforts to improve upon Starr's lamp were continued over many years. He realised that the thin carbon rod was the weak feature of his predecessor's design, and made many experiments in order to find a more suitable material. Eventually he used strips of paper or cardboard, coiled into spirals and carbonised by baking in fire-clay vessels containing charcoal. When suspended in evacuated glass bulbs by means of wires sealed into their walls, these spirals of carbon made efficient filaments, their resistance being high enough to cause them to glow brilliantly when current was passed through them.

At first it was difficult to remove the air completely and the carbon filaments of Swan's lamps quickly burned out. The invention of the Sprengel mercury pump overcame this difficulty, and the blackening that gave Starr so much trouble was avoided by heating the carbon to incandescence towards the close of the operation of pumping out the air. Swan then gave a remarkable demonstration of the efficiency of his lamp at a lecture in Newcastle, when 70 gas jets employed to light the room were suddenly turned out and 20 of his own electric lamps were switched on, producing a brilliant effect.

Meanwhile a second pioneer had been working on similar lines to Swan, and had independently achieved similar results. This was Edison, the famous American inventor, who tried filaments of

platinum and other materials before experimenting with carbon. Describing how his first successful lamp was made, Edison himself says: "We sent out and bought some cotton thread, carbonised it, and made the first filament. . . . We built the lamp and turned on the current. It lit up, and in the first few breathless minutes we measured its resistance quickly and found it was 275 ohms—all we wanted. Then we sat down and looked at the lamp; we wanted to see how long it would burn. The problem was solved—if the filament would last. The day was October 21st, 1879. We sat and looked, and the lamp continued to burn, and the longer it burned the more fascinated we were. None of us could go to bed, and there was no sleep for any of us for 40 hours. We sat and just watched it with anxiety growing into elation. It lasted about 45 hours, and then I said: 'If it will burn that number of hours now, I know I can make it burn a hundred.'"



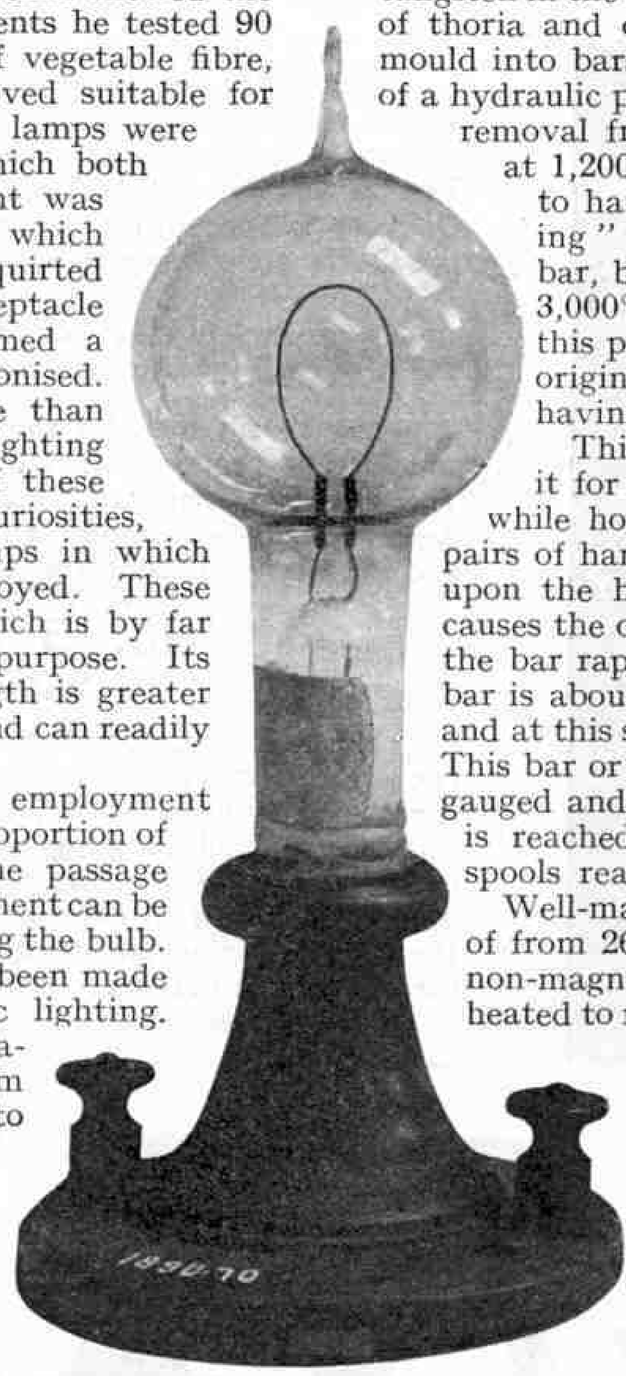
Automatic metal filament making machine in a modern electric lamp factory. Photograph by courtesy of the Edison Swan Electric Co. Ltd.

Many problems still remained to be solved, the chief of which was to make a reliable filament. Edison made a world-wide search for an efficient source of carbon, sending experienced travellers to explore countries where bamboo was grown, for this material showed the greatest promise. It is said that in his experiments he tested 90 different kinds of bamboo and 3,000 varieties of vegetable fibre, to find that only three or four specimens proved suitable for conversion into lamp filaments. When the new lamps were introduced into commerce by a company in which both the rival inventors were interested, the filament was eventually made by an entirely new method, in which nitro-cellulose dissolved in acetic acid was squirted under pressure through a fine die into a receptacle containing a coagulating fluid. There it formed a thread that afterwards could be shaped and carbonised.

The carbon lamp remained in use for more than twenty years, and during that time electric lighting steadily increased in popularity. Specimens of these lamps are still to be seen, but they are now only curiosities, for they were displaced by more efficient lamps in which filaments of osmium and tantalum are employed. These metals in turn have given way to tungsten, which is by far the most suitable material known for this purpose. Its melting point is very high and its tensile strength is greater than that of iron or nickel. It is non-magnetic and can readily be drawn into very thin wires.

The superiority of tungsten as a material for employment in electric lamps is due to the fact that a smaller proportion of electric energy is dissipated as heat during the passage of current through it than with carbon, and the filament can be heated to a higher temperature without blackening the bulb.

Within the last few years, a great advance has been made that has greatly reduced the cost of electric lighting. One of the secrets of the success of the carbon filament lamp was the complete removal of air from the bulb. This process was essential in order to prevent the carbon filament burning out. The first metal filament lamps were constructed on similar principles, but it was discovered that the introduction at atmospheric pressure of an inert gas, such as nitrogen or argon, reduced the consumption of electric current to about half of that required for a vacuum lamp. The greater illuminating power of the gas-filled lamp is due to the fact that its filament can safely be raised to a higher temperature than that of a vacuum lamp. Typical figures for the filament temperatures of vacuum and gas-filled lamps are 2,160°C. and 2,630°C. respectively.



One of Edison's early experimental lamps, with a carbon filament. Photograph reproduced by permission of the Board of Education.

The man who halved the world's electric light bills in this manner is Dr. Irving Langmuir, an American scientist whose name deserves to be coupled with those of Swan and Edison in the story of the electric lamp. Gas-filled lamps of high illuminating power were first employed for the lighting of streets and public buildings, but now similar lamps of lower candle power are available for use in ordinary houses. They give a whiter light than lamps of the old pattern.

The extent to which electric lighting has made its way is shown by the fact that over 600,000,000 lamps are made annually. Their production in this enormous quantity has meant the introduction of high speed electrically driven machinery. Even the bulbs are blown on amazing machines capable of producing 35,000 bulbs in 24 hours, and one of our illustrations shows the "Westlake" bulb-blowing machine installed at the Mazda Lamp Works. This measures out the exact quantity of molten glass required to make a bulb, blows it into shape in a mould, cools it and finally delivers it to a conveyor that carries it to the machine that trims the neck by burning off the excess glass. Each bulb passes through these processes, and also is annealed by raising it to a high temperature and allowing it to cool slowly, before it is touched by hand.

The preparation of the filament is equally interesting. The tungsten in the form of fine powder is mixed with a minute quantity of thoria and other materials, and pressed in a rectangular steel mould into bars about 16 in. in length and ¼ in. square by means of a hydraulic press working at from 10 to 20 tons per sq. in. After removal from the mould the bar is heated for a short time at 1,200°C. in hydrogen in order to make it strong enough to handle. The next operation, which is called "treating" or "sintering," consists of heating the tungsten bar, by means of an electric current, to a temperature of 3,000°C. in a continuous stream of hydrogen. During this process impurities that may have been present in the original powder are volatilised, leaving a tungsten bar having a course grained crystalline structure.

This sintered bar is very fragile, and in order to prepare it for the subsequent drawing operations it is subjected, while hot, to a hammering process known as "swaging," pairs of hammers striking blows at the rate of 100 per second upon the hot bar as it passes between them. This process causes the original crystals to be broken up and elongated, and the bar rapidly takes up a fibrous structure. A fully swaged bar is about 30 ft. in length and 1/30th of an inch in diameter, and at this stage may be regarded as wire, for it is quite flexible. This bar or wire is now drawn hot through a series of carefully gauged and polished diamond dies until the required diameter is reached, and the finished wire is sized and wound on spools ready for mounting into the lamps.

Well-made tungsten wire has a very high breaking strain of from 266 to 292 tons per sq. in. It is elastic, ductile and non-magnetic, and although it oxidises on the surface when heated to redness, it does not change at ordinary temperatures.

The component parts of the stem on which the filament is to be mounted are assembled on ingenious machines, but the mounting of the fine wire is performed by hand. The end of the tungsten wire on a reel is clamped in the hook at the end of one of the leading-in wires, and the filament is then draped on its supports. Special pliers then are used to cut the tungsten wire and the free end is fixed to the second leading-in wire. Good contact is secured either by spot welding the ends of the filament to the leading-in wires or by bedding them in by means of powerful pliers. The finished mount is then sealed into the bulb by rotary machinery.

There now remains the exhaustion of the lamp, and this process also is carried out by a rotary machine. The lamp is placed on one of the heads of the machine, each head being connected independently to the moving element of a centrally mounted slide valve. The exhaustion is usually carried out in two (Continued on page 93)

KEMEX OUTFITS

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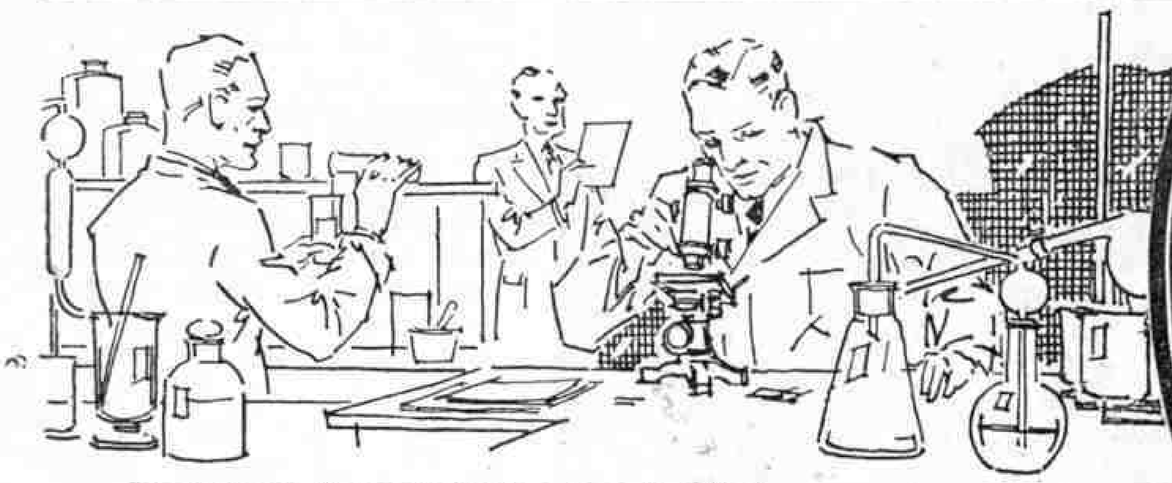

These new Kemex Outfits contain all the apparatus and materials required for a series of fascinating chemical experiments that wil provide hours of fun. There is no difficulty and no oanger. The chemicals are all non-explosive and non-poisonous, and conform with Home Office requirements.

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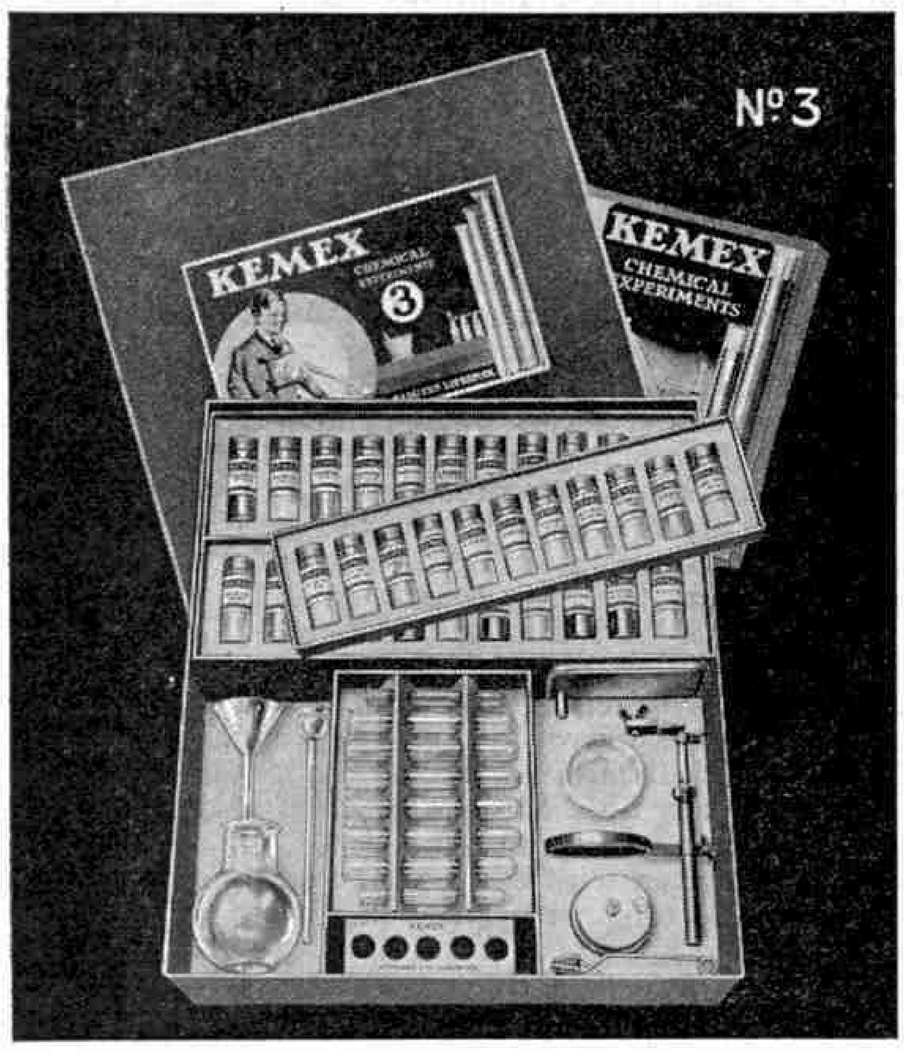

No. 1 KEMEX OUTFIT

130 Experiments

This Outfit contains a supply of specially selected chemicals, together with a length of Magnesium Ribbon, sufficient to perform 130 attractive and varied experiments. The apparatus provided in the Outfit includes Test Tubes and a Test Tube Holder, a Funnel, Filter Papers, and Glass Delivery Tubes, with a simple and highly-efficient Spirit Lamp that makes the Outfit completely self-contained. Price **7/6**

No. 2 KEMEX OUTFIT

250 Experiments

This Outfit includes the whole of the contents of the No. 1 Outfit, and further chemicals that increase the range of experiments up to 250. The additional apparatus includes a porcelain Evaporating Dish, Special Test Tubes to withstand high temperatures, a handsome Test Tube Stand, and the Kemex Evaporating Stand with Wire Gauze. Price **15/-**

No. 3 KEMEX OUTFIT

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This is a splendid complete Outfit that provides a boy with all he requires to carry out between 350 and 400 experiments. It includes the contents of the No. 2 Outfit, with additional chemicals and apparatus. The latter includes a gas-generating apparatus, consisting of a large Wide-necked Flask with Thistle Funnel and Delivery Tubes. These items open up a series of experiments of outstanding interest. There is also the Kemex Universal Stand, by means of which the apparatus required for every chemical operation may be readily supported on similar lines to those adopted by actual chemists. Price **25/-**

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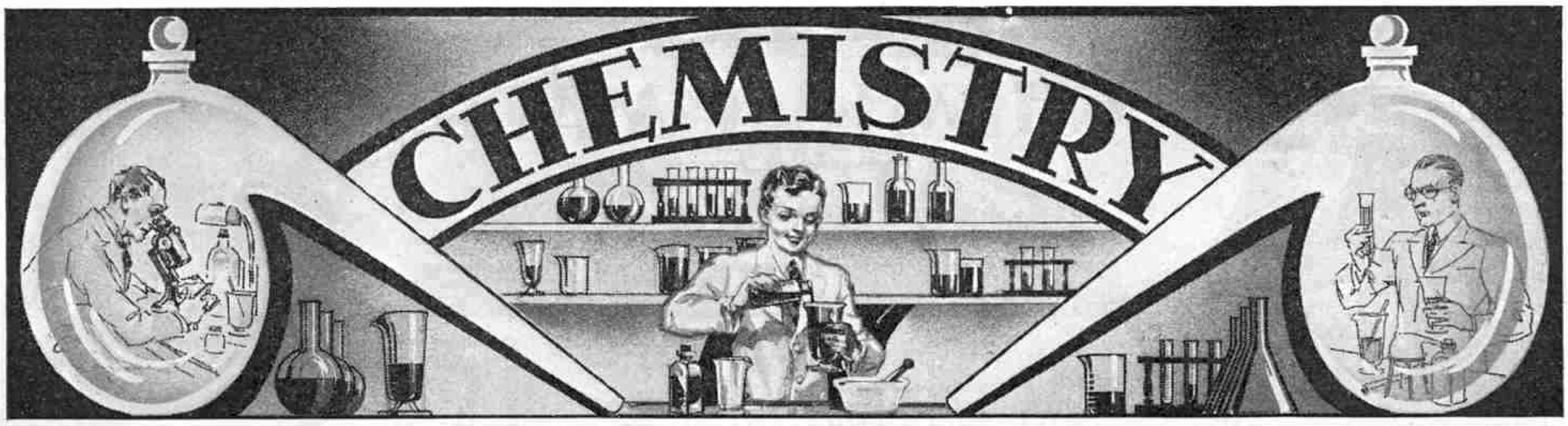


WEALTH FROM WASTE

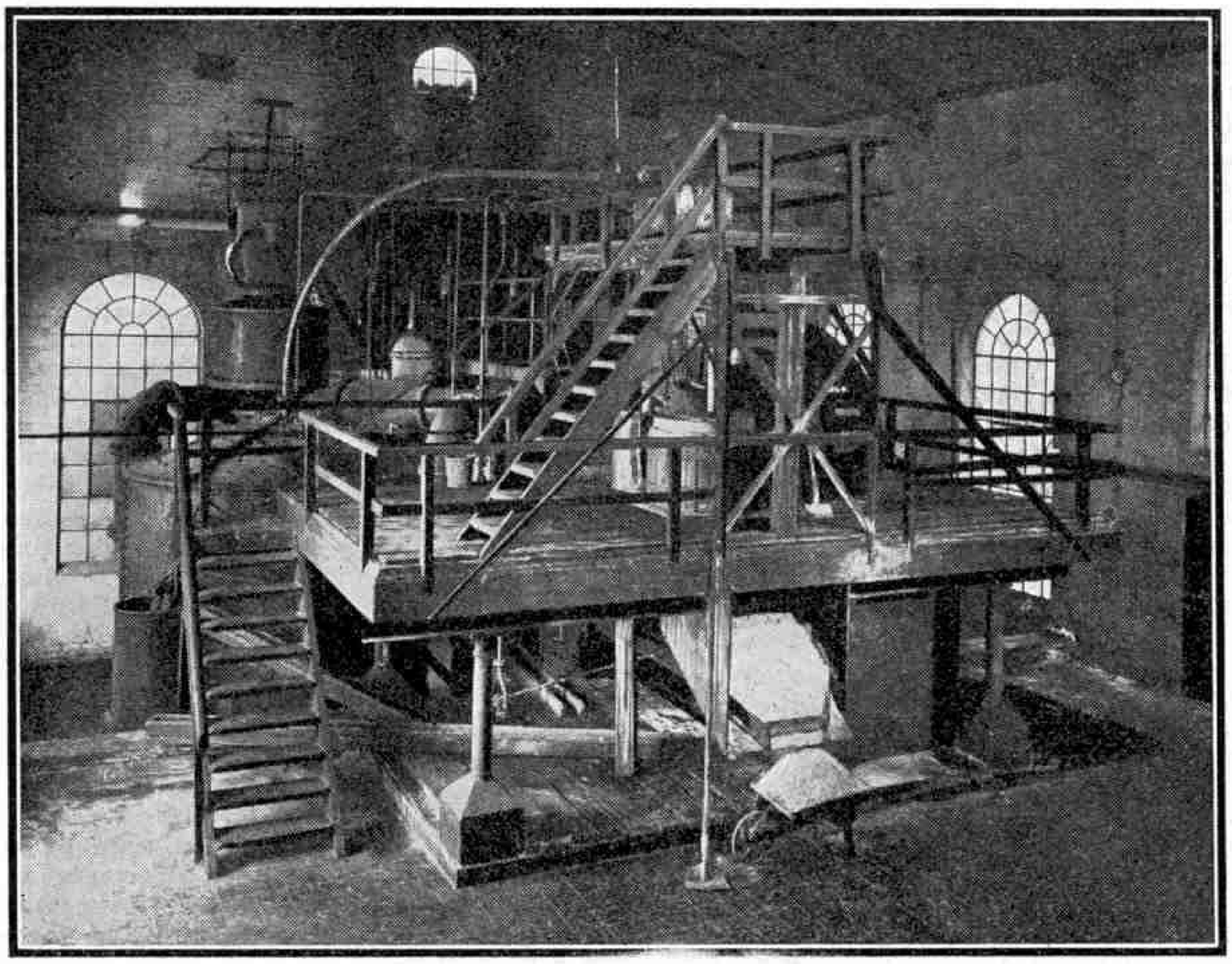
THE chemist is always eager to discover new sources of the important substances in which he is interested, and as the result of his unceasing research he often performs what to the ordinary person appear to be almost miracles by transforming waste materials into products of great value. The discovery of radium, the world's costliest metal, supplies a striking example of chemical achievements of this kind. This metal and its compounds are remarkable for their strange power of continually shooting out electrons and other particles, together with rays more penetrating than X-rays.

We owe radium to the chemist's habit of raking over waste products and finding unexpected riches in them. The first suspicion of the existence of this element occurred to Pierre Curie, a French scientist, and his wife. They were interested in uranium, a rare metal that had been found to possess in mild form the characteristics we now associate with radium. While searching for other material showing similar properties they examined the residue thrown out of works at Joachimstal in Czecho-Slovakia, in which uranium compounds were separated from pitchblende, the chief ore of this metal. To their surprise they found that by means of certain chemical operations there could be separated portions of this residue that were more radioactive than uranium itself. In great excitement they began the task of tracking this unsuspected activity to its source, and after concentrating the radioactive material from several tons of pitchblende residues they finally isolated compounds of the wonderful element radium.

Thus from the dump heap of the pitchblende mines came the world's most precious metal, for the cost of radium compounds to-day is about £7,000 per ounce. This value may seem high, but the element is scarce, and the chemical operations necessary to extract it from the few known ores are intricate and laborious. The trouble of preparing its compounds is well worth while, however, for these have already brought relief to many who suffer from cancer, and it is hoped that further work with the increasing quantities of radium now becoming available will result in the discovery of means of curing this terrible disease.

Chemists have effected equally amazing transformations with the thick black tar and evil-smelling ammoniacal liquor formed when coal is heated in retorts. Coal was first distilled on a large scale for the sake of the gas produced, and both the tar and the ammonia were regarded as unavoidable nuisances that had to be dealt with somehow. To-day these by-products are recognised as sources of valuable chemicals, and plants specially designed for extracting them to the best advantage have been erected. In these plants the ammonia produced is not allowed to collect in the form of a liquor contaminated with tar, but is extracted directly from the gas by passing this through lead-lined tanks containing sulphuric acid. Ammonium sulphate crystallises out and falls to the bottom of the tank, from which it is removed to a draining table without disturbing the onward flow of the gas.

The coal tar obtained when coal is strongly heated in the retorts in gasworks contains many valuable chemicals, such as the benzols. These can be separated from the tar by distilling it, but in the modern direct processes the gas is cooled and washed in order to separate them. The manner in which the benzols have been used in industry is one of the great romances of chemistry, for from them have been prepared an enormous range of brilliant dyes, valuable drugs, scents, and other interesting chemicals.



Recovering ammonia from the gas produced when coal is distilled. The gas is passed through tanks containing sulphuric acid, and ammonium sulphate then crystallises out.

The aniline dyestuffs are among the most interesting of coal tar products. Some of them are exactly the same substances chemically as natural dyestuffs that have been in use for centuries. For instance, after many years of patient and laborious work chemists discovered the secret of the composition of indigo, the wonderful blue colouring matter obtained from the indigo plant, and learned how to build it up, or synthesise it, to use the scientific term, from chemicals that can be extracted from coal tar. The result of this work has been not only the production of synthetic indigo, but also of other brilliantly-coloured dyes of a similar character.

This discovery naturally had the effect of reducing the demand for indigo, and between 1910 and 1913 the acreage devoted to its cultivation in India decreased steadily from nearly 1,000,000 acres to less than a quarter of that area. Even if synthetic indigo can be sold more cheaply than the natural product, however, it is probable that the latter will still be required to some extent; and other chemists have studied means of increasing the yield of the plant.

Two specially interesting coal tar products are acetyl salicylic acid, the chemical that forms the active principle of aspirin, and coumarin, the substance that gives new-mown hay its characteristic smell, and which is largely used in blending scents. It is curious to find that both aspirin and coumarin are prepared by chemical processes from carbolic acid, which is derived from coal tar. Thus the dirty evil-smelling liquid yields a powerful corrosive poison, and this in turn is transformed into substances that are respectively soothing to the nerves and attractive and agreeable in scent.

THE CHEMISTRY OF FAMILIAR THINGS

THE owner of a Kemex Outfit need look no further than his own home to find a very wide field for fascinating experiments.

The production of his food and clothing, and many of the articles and utensils in daily use, depend upon interesting chemical changes, and attractive experimental tests can be made with them.

A striking instance of a familiar substance that is at the same time a highly important chemical is water. The quality of water is of great importance, and the utmost care is taken by water engineers to ensure the provision, not only of an adequate supply of this liquid, but of one that may safely be put to many different uses.

What we call water is in reality a solution of various chemicals present in very small proportions, and the practical chemistry of water therefore really consists of examination of the various impurities that it may contain. These may be gases or solids. The experiment described on page 23 of the No. 2/3 Kemex Manual shows that water exposed to the air dissolves small proportions of the gases contained in it, and these can be driven off by boiling the liquid. Water treated in this manner lacks sparkle and tastes flat and insipid.

The solid contents of tap water are of greater importance than the gases dissolved in it, and they vary in kind and amount. The most important are salts of the metals calcium and magnesium, for these give rise to what is known as hardness. Some samples of tap water resemble rain water in being soft, and these readily form a lather with soap. Others do not form a lather with equal ease, and after using proportionately large quantities of soap in order to produce one, a scum is invariably found on the surface. This scum consists of chemicals formed by the interaction of the soap and the dissolved contents of the water.

Soap consists of salts of certain acids known as fatty acids, because they are present in oils and fats, where they are combined with glycerine. The calcium salts of these acids are insoluble in water, and are precipitated on the addition of soap to water containing this metal in solution. Not until the whole of the calcium present in the water has been precipitated can a lather be formed.

Shaking a sample of water with soap solution in order to form a lather when testing it for hardness.

An experiment in which the formation of these calcium salts can be followed can be made with artificial hard water. This is made by shaking about half a measure of Calcium Oxide in a test tube a little more than half full of water, and filtering the liquid in order to separate any Calcium Oxide that remains undissolved. A small shaving of soap, preferably white toilet soap, is dissolved in a test tube almost full of water. A few drops of this solution are then added to the artificial hard water already prepared, and the liquid then becomes cloudy in appearance owing to the formation of a precipitate. If really hard water is available, a similar experiment should be tried with it and the result compared with that obtained when soft water, such as rain water, or tap water that has been well boiled, is similarly treated.

The calcium salt usually present in hard water is calcium bicarbonate. This is decomposed when the water is boiled, with the production of insoluble calcium carbonate. When this happens in the boiler of a locomotive or the kitchen kettle, in both of which water is boiled repeatedly, the calcium carbonate accumulates in the form of scale or fur on the interior surfaces. The presence of fur in a kettle that has been used for many years is not perhaps of great importance, although a furred kettle is not so efficient as one in which the water is in direct contact with the solid metal; but the formation of the same material in a boiler producing steam at high pressure leads to waste of heat, for scale is not a good conductor of heat, and if it is allowed to become thick an explosion may result. It is therefore important to avoid using hard water as far as possible. This cannot always be done, and instead means are adopted to soften the water by removing the calcium salts before it enters the boiler.

Water can be softened by adding sufficient sodium carbonate to precipitate insoluble calcium carbonate, and analysts have worked out means of determining the degree of hardness of a sample of water in order to enable the exact amount of soda required to be calculated. One of these tests can readily be carried out with the contents of the Kemex Outfits, all that is required in addition to the apparatus included in it being a small glass bottle with a good cork or stopper. A six or eight ounce medicine bottle of clear white glass is suitable.

A solution of soap is first made by dissolving half an ounce in a pint of water. The best soap to use for this purpose is Castile Soap, but if this cannot be obtained readily, a good white toilet soap will do. This should be neutral, and a drop of Phenolphthalein placed on a freshly-cut surface should not turn pink.

Two ounces of the sample of water to be tested are placed in the medicine bottle, the markings of which enable this quantity to be measured. A dropping tube is made by drawing out one end of a glass tube in the flame of the Spirit Lamp. The narrow end of the tube is dipped into the soap solution, and the liquid that enters remains in it when the finger is tightly pressed on the opposite end, and falls out drop by drop when the pressure of the finger is carefully slackened. Allow three drops of the soap solution to fall into the water that is being tested. Then close the bottle containing this liquid, and shake vigorously in order to form a lather.

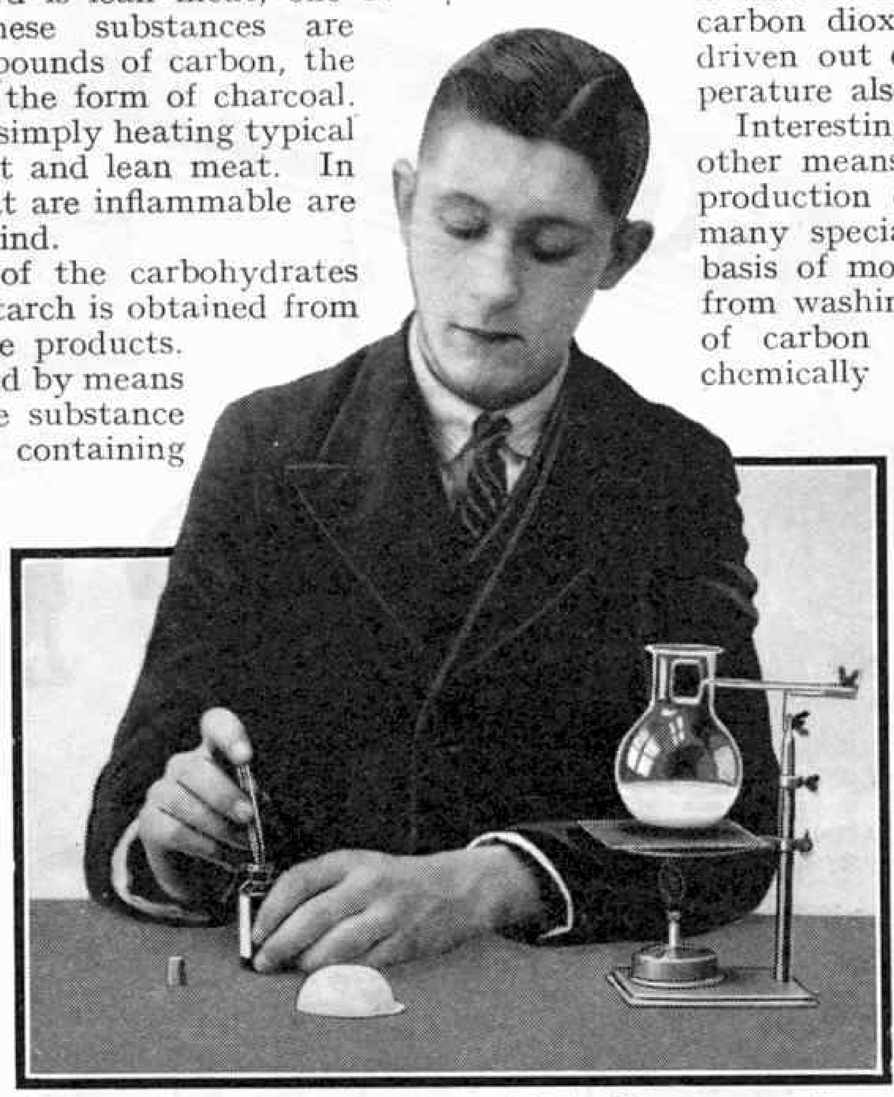
If the water tested is soft, a lather will be formed immediately; on the other hand, if it is very hard, no lather will be produced. In the second case, continue the addition of soap solution three drops at a time, closing the bottle and shaking in order to try to form a lather after each addition. This cannot be done until all the calcium salts in the water have been removed by the addition of soap solution, and the quantity of soap solution needed to bring about this result is a measure of the hardness of the water.

It will probably be noticed in experiments of this kind that a lather is formed on shaking, but disappears on leaving the liquid to stand for a time. For this reason, it is customary to speak of a "permanent" lather, meaning one that persists for five minutes when the bottle is laid on its side and left undisturbed. If in that time a portion of the surface becomes clear of bubbles, more soap solution is required.

It is interesting to compare in this manner samples of rain water, tap water that has been boiled, and untreated tap water. If samples of sea water and hard water are procurable, these also should be included in the scheme; otherwise experiments should be carried out with artificial hard water prepared as already explained.

Foodstuffs provide many interesting experiments for owners of Kemex Outfits. Foods may roughly be classed into three groups. The first group includes those supplying what are known as carbohydrates, including starch and sugar; in the second are fats; and a typical example of the third is lean meat, one of the flesh-producing foodstuffs. All these substances are organic, which means that they are compounds of carbon, the chemical element known to us chiefly in the form of charcoal. It is easy to prove that this is the case by simply heating typical foods of these classes, such as bread, suet and lean meat. In all three cases steam and tarry fumes that are inflammable are given off, and a charred mass is left behind.

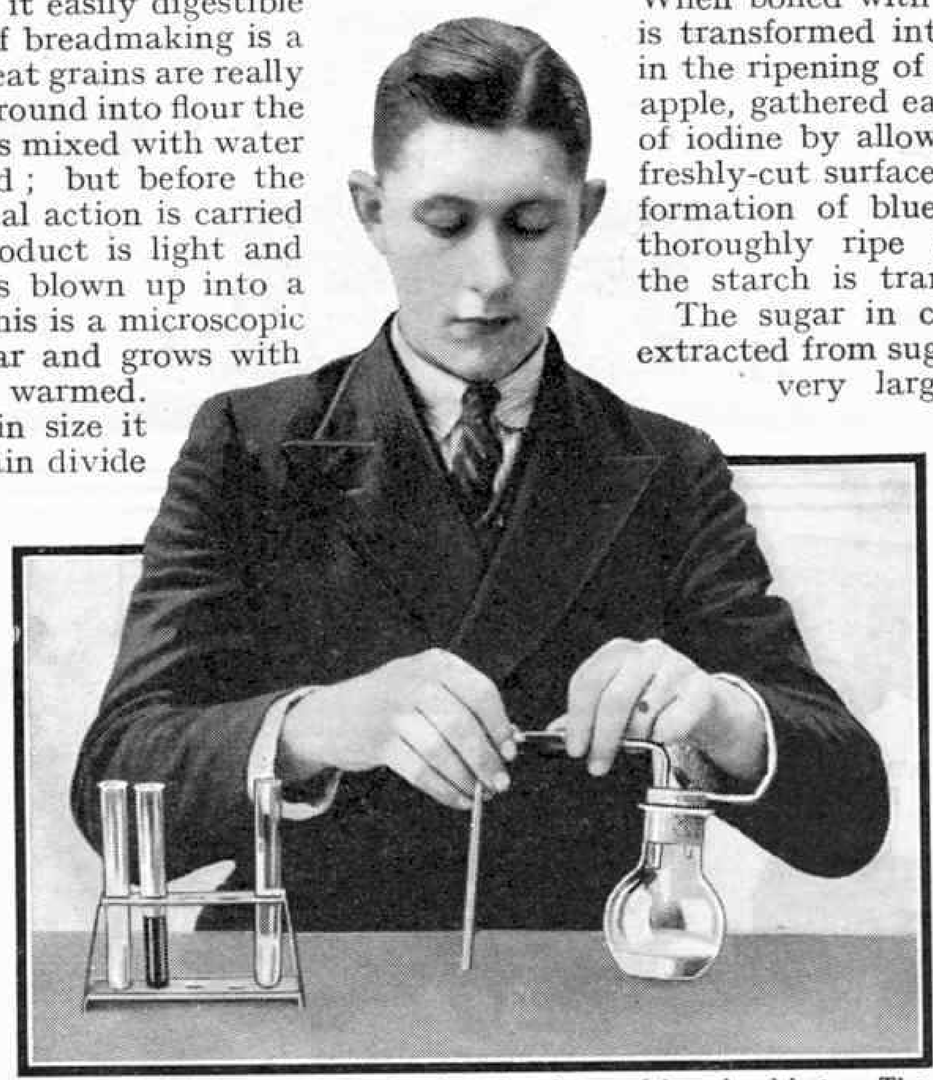
The most important and interesting of the carbohydrates are starch and various forms of sugar. Starch is obtained from potatoes, rice, wheat and other vegetable products. Its presence in any of these is readily proved by means of tincture of iodine, which forms a blue substance known as starch iodide when solutions containing starch are added to it. For instance, in order to prove the presence of starch in rice, a teaspoonful of rice grains is boiled for five minutes with water to a depth of an inch in the wide-necked flask, and the liquid is then allowed to cool. A drop of tincture of iodine is placed on a clean plate, or on the base of the inverted Evaporating Dish, as shown in Fig. 2, and a drop of the liquid in the flask is added to it. The result is the formation of a blue stain.



Testing rice for starch. The rice is boiled with water and drops of tincture of iodine are added to small portions of the solution.

Another method consists of boiling with water in a test tube a small quantity of the foodstuff to be tested, and after allowing the liquid formed to cool, pouring it into a second test tube containing a few drops of tincture of iodine. Blue starch iodide is formed immediately, and on warming the liquid again becomes colourless. It is interesting to test slices of potato, grains of wheat, barley and other cereals, and bread in this manner. Each will be found to contain starch, and this substance can also be extracted from leaves and plants and many other vegetable sources.

Wheat has long been the staple food of a large proportion of the Earth's population, especially in temperate climates. It is transformed into bread in order to make it easily digestible and pleasant to eat, and the chemistry of breadmaking is a complicated but interesting science. Wheat grains are really storehouses of starch, and when they are ground into flour the starch is reduced to a fine powder. This is mixed with water to form dough and the product is baked; but before the dough is baked a very interesting chemical action is carried on in it in order to ensure that the product is light and digestible. Actually the doughy mass is blown up into a kind of froth by adding living yeast. This is a microscopic cellular organism that is greedy for sugar and grows with astonishing rapidity when it is fed and warmed. As soon as a yeast cell reaches a certain size it splits into two complete cells. These again divide after growing, and this process is repeated, so that a small quantity of yeast placed in a solution of sugar and gently warmed quickly increases and spreads through the liquid.



Preparing for an experiment in the chemistry of breadmaking. The action of the yeast on a solution of sugar is to be tested by means of the apparatus being fitted up.

As chemists we are chiefly concerned with the very striking change that happens as the yeast grows. This can be followed by adding yeast to a solution of a teaspoonful of sugar in sufficient water to occupy a depth of an inch in the wide-necked flask, fitted with a double bored cork and delivery tubes, as shown in Fig. 3. One hole of the cork is sealed by means of a length of glass rod or glass tubing closed at one end by holding in the thumb. The large right angle delivery tube dips into a test tube containing lime water to a depth of half an inch. This experiment can also be carried out in a small bottle or test tube fitted with a cork and delivery tube, but then smaller quantities of the materials required must be employed.

On leaving the solution in a warm place, the yeast cells multiply quickly, and bubbles are formed on the surface. From time to time a bubble of gas escapes through the lime water in the test tube, and this liquid becomes milky, showing that carbon dioxide is produced in the course of the chemical changes that take place.

In this experiment the sugar is decomposed into this gas and alcohol, and this change takes place when a solution of sugar in which yeast has been standing for a short time is added to the mixture of flour and water from which dough is made. The result is seen in the rising, or swelling of the dough. The carbon dioxide produced escapes and the alcohol is driven out of the bread on baking. This high temperature also kills and destroys the yeast cells.

Interesting experiments can be carried out with other means of providing the gas necessary for the production of light dough. For instance, there are many special baking powders on the market. The basis of most of these is baking soda, which differs from washing soda in possessing a greater proportion of carbon dioxide. For this reason it is known chemically as sodium bicarbonate, while washing soda is sodium carbonate. Washing soda crystals contain a large proportion of water that is driven off on heating, a white powder being left. Sodium bicarbonate, or baking soda, is usually in the form of a white powder, but it is easy to distinguish it from sodium carbonate, for on heating it gives off carbon dioxide, which may be detected by its action on lime water, while sodium bicarbonate undergoes no such change.

Baking soda itself will help to raise dough or pastry, for in the oven it gives off carbon dioxide, as is shown by the experiment just described, and this blows up the mass. Baking powders often consist chiefly of baking soda and tartaric acid. So long as this mixture is kept dry, it remains unaltered, but as soon as water is added, the acid acts on the sodium bicarbonate to produce carbon dioxide. This action can readily be shown by mixing Tartaric Acid with baking soda, and placing the mixture in a dry test tube. The addition of a few drops of water gives an effervescence owing to the production of carbon dioxide. This experiment also should be tried with samples of baking powder.

There is an interesting connection between starch and sugar. When boiled with dilute acids, the first of these chemicals is transformed into the second. This change also occurs in the ripening of many fruits. For instance, if an unripe apple, gathered early in the season, is tested with tincture of iodine by allowing a drop of this liquid to fall upon a freshly-cut surface, the presence of starch is shown by the formation of blue starch iodide. This test fails with a thoroughly ripe apple, because during further growth the starch is transformed into sugar.

The sugar in common use for sweetening purposes is extracted from sugar-cane and beet. It actually is one of a very large family of similar sweet substances known to chemists under the general name of sugars. Another sugar that is used for sweetening purposes and also in medicine is grape sugar, so called because of its presence in ripe grapes. It is also produced when cane sugar is boiled with acid, and this change enables a series of very interesting experiments to be carried out.

A solution of caustic soda is required for these tests. This is prepared by boiling half a teaspoonful of sodium carbonate, or washing soda, with half a test tube full of water and about a quarter of a teaspoonful of Calcium Oxide for about five minutes. The boiling can be carried out in the evaporating dish, a few drops of water being added to the liquid from time to time in order to compensate for that driven off in the form of steam. A test tube also can be used, but the quantities of chemicals used should then be reduced to half those given. Caustic soda is formed in the solution, and this is filtered in order to separate it from unchanged Calcium Oxide and calcium carbonate formed during the boiling.

About half a teaspoonful of cane sugar is dissolved in a little more than half a test tube full of water, and the solution is divided into two portions. To one portion a few (*Continued on page 93*)

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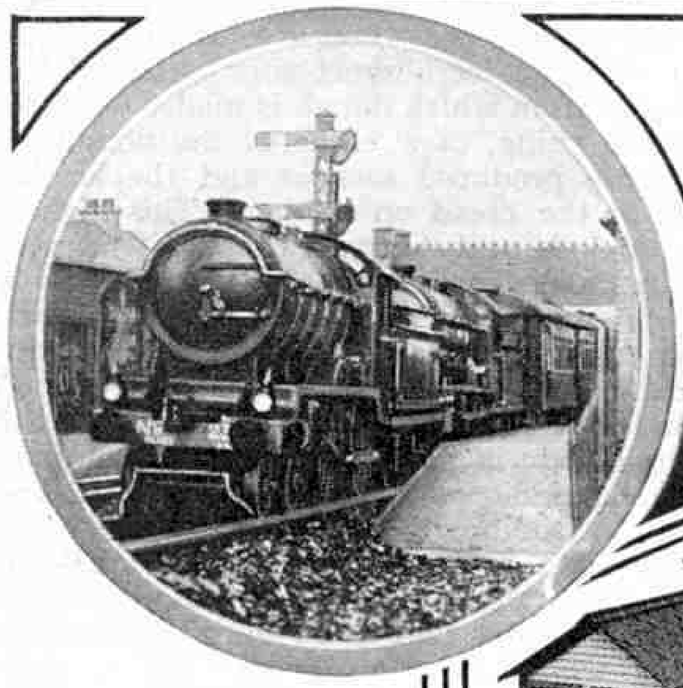

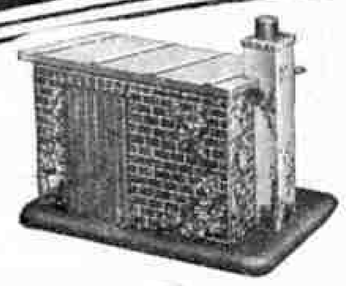

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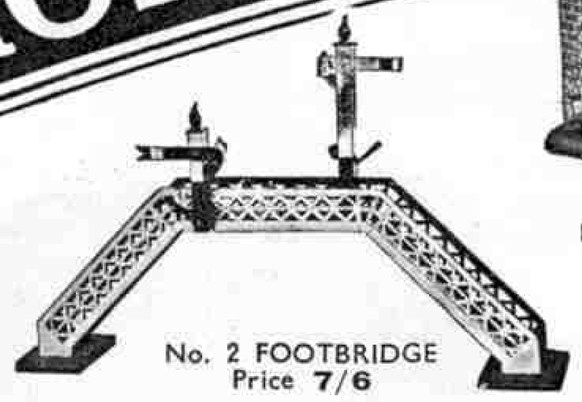

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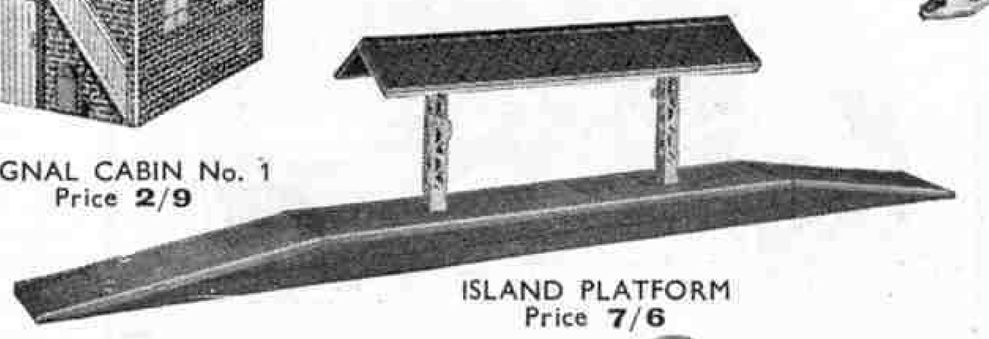

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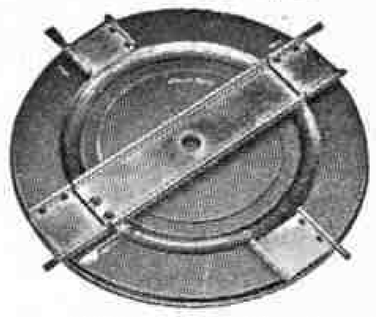

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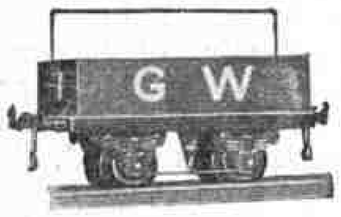

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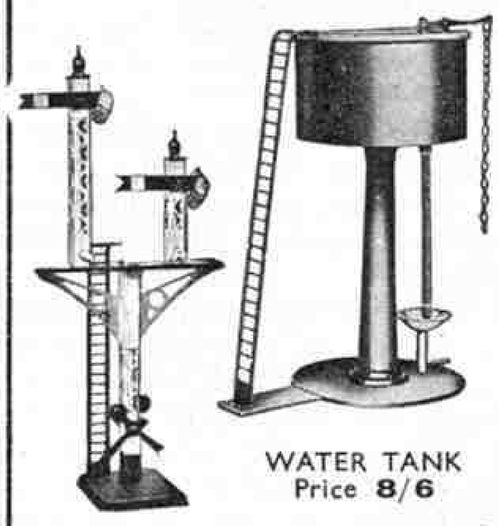

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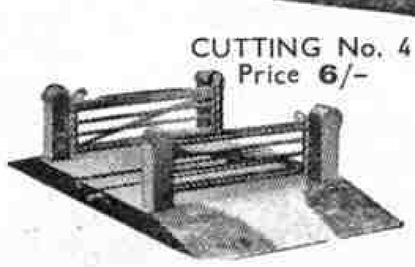

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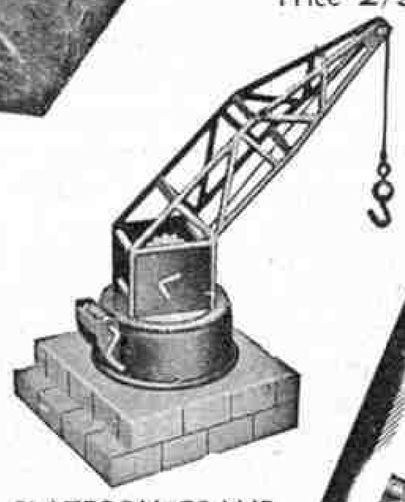

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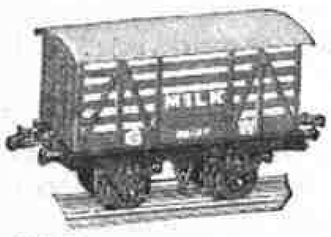

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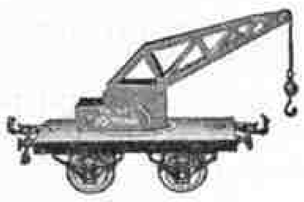

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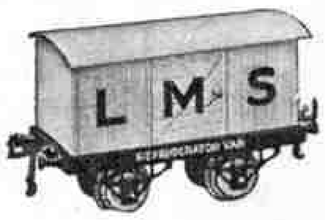

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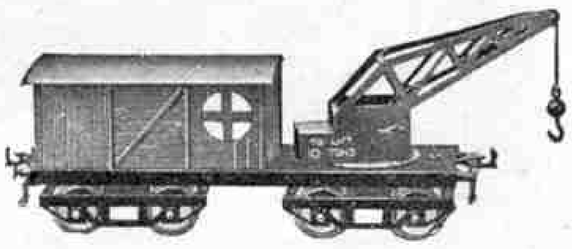

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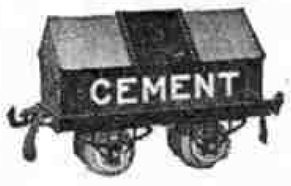

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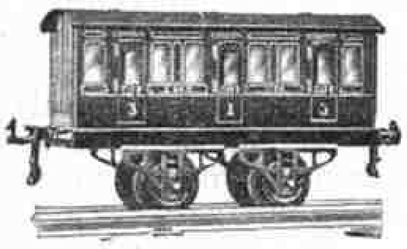

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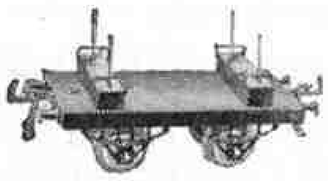

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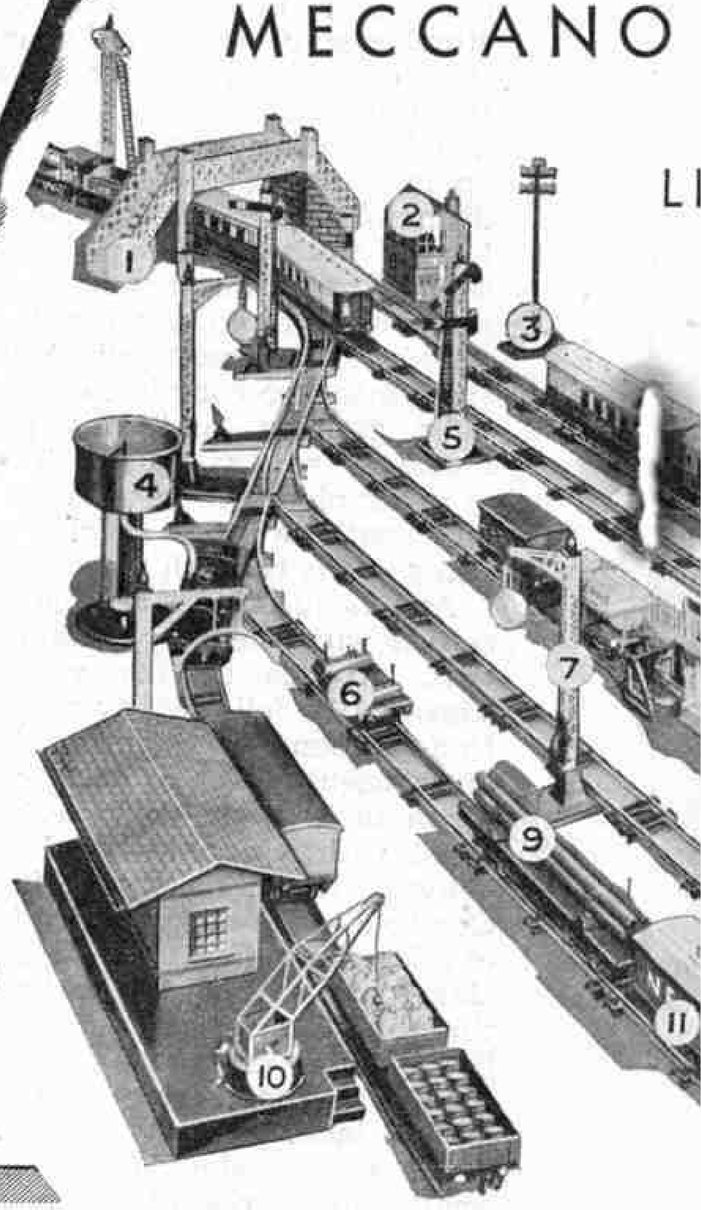

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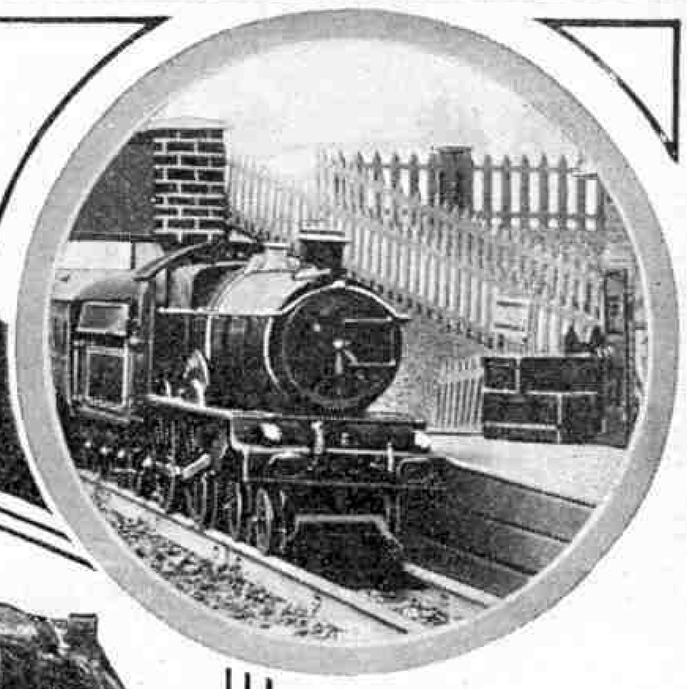

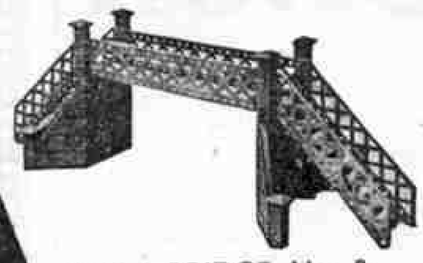

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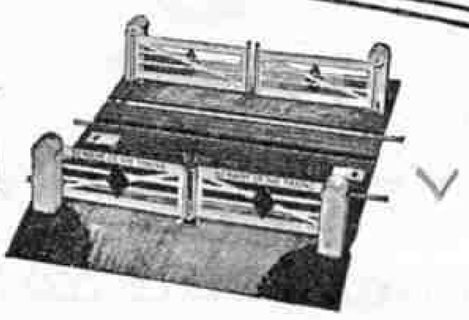

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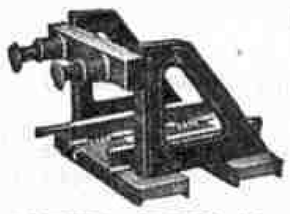

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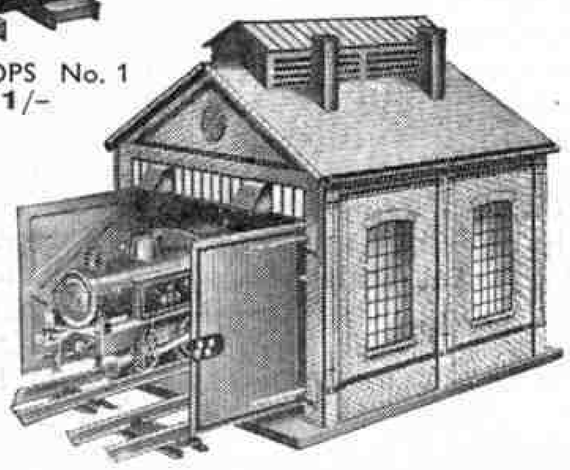

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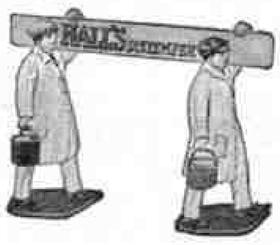

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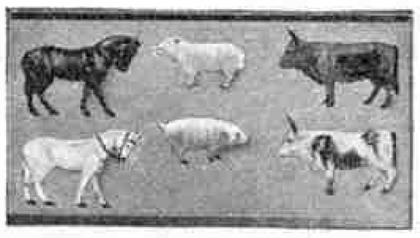

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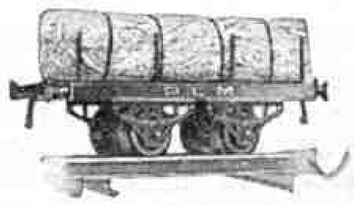

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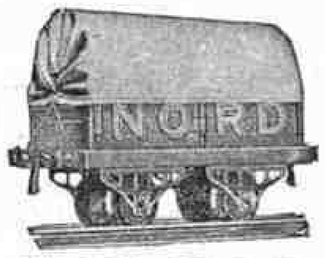

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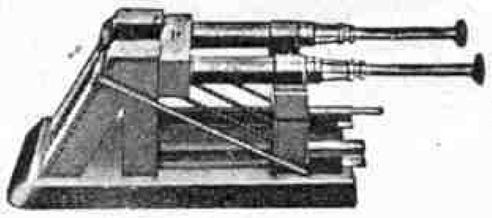

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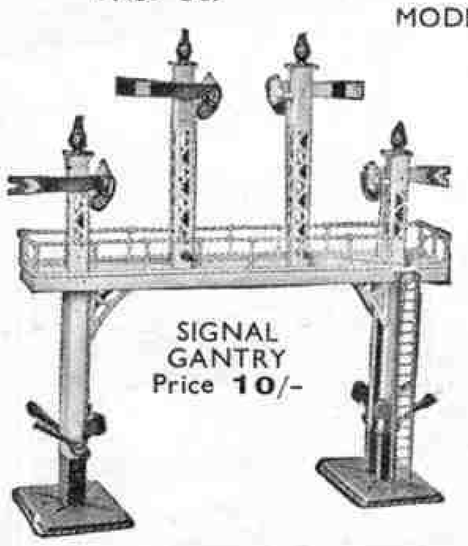

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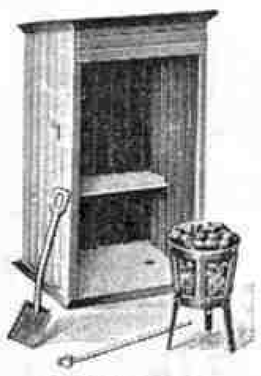

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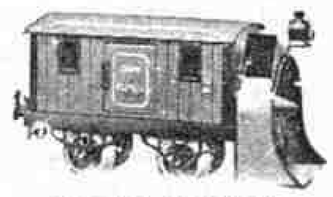

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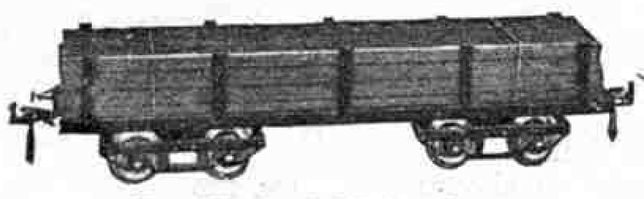

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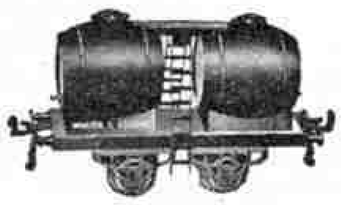

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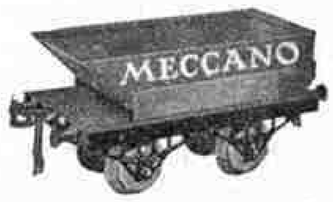

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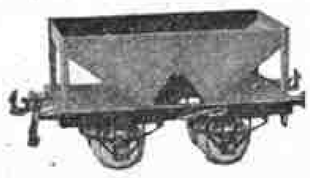

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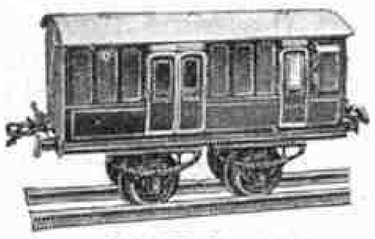

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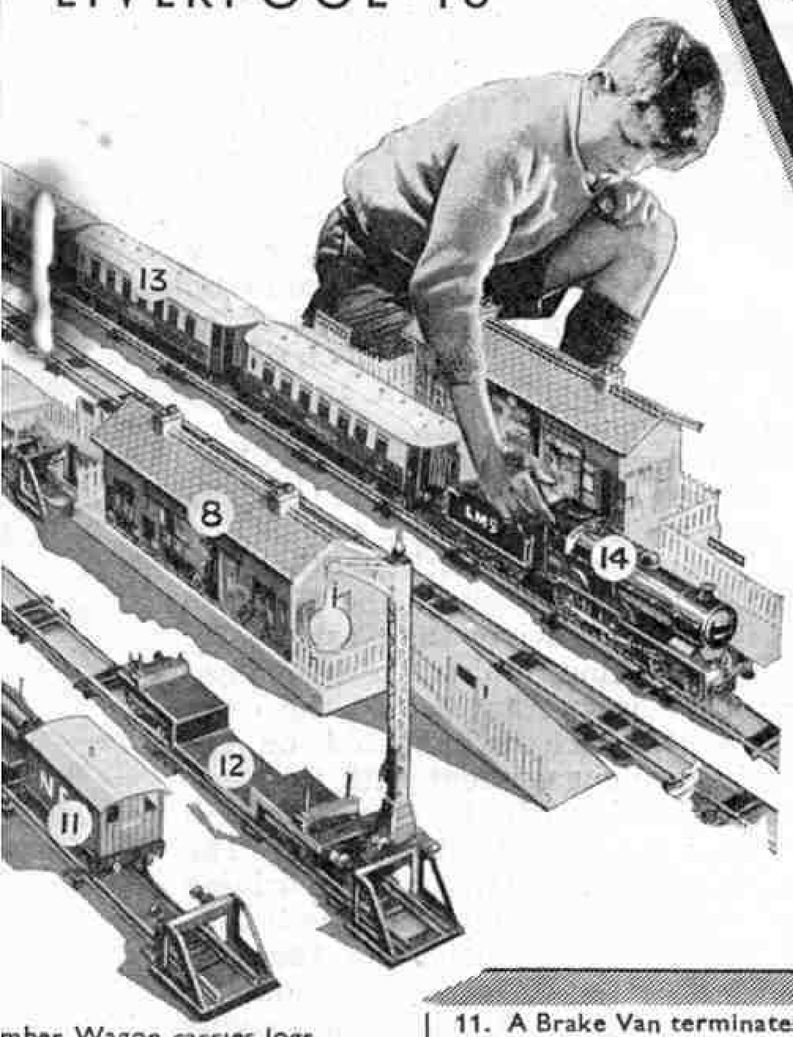

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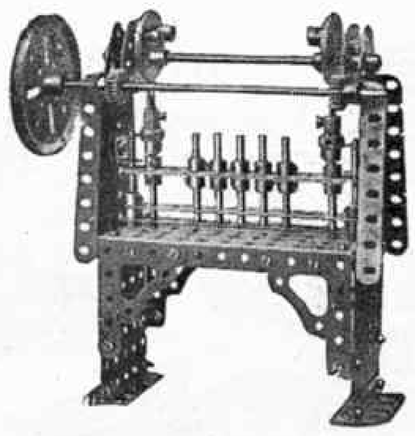


Suggestions Section

Edited by "Spanner"

(300)—Four Speed and Reverse Planetary Gear-Box (I. P. H. Mackillop, Farnham, Surrey)

By means of planetary gearing it is possible to obtain a wide range of gear ratios that are not easily obtained with ordinary Meccano gearing. The construction of a planetary gear-box offers much scope for ingenuity, and a cleverly designed box of this type is illustrated in Fig. 300. The 6½″ Axle Rod 1 takes up the drive from the power unit, and is journalled in the centre holes of a 5½″ Angle Girder and a 5½″ × ½″ Double Angle Strip forming part of the framework for the gear-box. The 5″ driven Rod 2 is journalled in a similar manner at the other end of the frame.

A cage for the planet gears is built up from two Face Plates, between which two 2″ Axle Rods are secured by means of Threaded Couplings rigidly bolted to the Plates, which are arranged with their bosses outermost. The Face Plates should be carefully lined up so that the holes through the bosses are in perfect alignment, and the complete cage is free to slide on the Rods 1 and 2. The Rod 2 carries at its inner extremity a 1″ Gear Wheel 4, in the centre hole of which the end of the Rod 1 is inserted to prevent wobble. The Rod 1 carries a fixed ¾″ Pinion 3.

The sun wheels 6 and 7, consisting of a 57 and a 50-teeth Gear Wheel, are held together by a Socket Coupling placed over their bosses, and the Rod 1 is free to rotate in their centres. The Gears are prevented from rotating by a 3½″ × ½″ Double Angle Strip attached to the 57-teeth Gear by ½″ Bolts, on the shank of each of which is a Collar for spacing purposes. Two 3″ Axle Rods are placed as shown, and passed through the Double Angle Strip to prevent it from rotating, but at the same time allow it to slide to and fro. The 5″ Axle Rods 8 and 9 journalled in the cage carry the planet Pinions that rotate about the Gears 6 and 7. The Rod 8 carries a ½″ Pinion engaging the Gear 6, and the Rod 9 a ¾″ Pinion that meshes with the Gear 7.

Each Rod carries a Coupling, these being connected together by 2½″ Rods held in their end transverse bores. These two Rods engage the groove of the Socket Coupling, so that as the sun wheels are slid to and fro by means of the 3½″ × ½″ Double Angle Strip, they also cause the cage to slide with a corresponding movement, but at the same time allow it to rotate independently.

The Rod 8 carries, in addition to the planetary Pinion, two 50-teeth Gears 10 and 11, and a 1″ Gear 13. The Rod 9 carries a 50-teeth Gear 14 and a 1″ Gear 12, placed inside the cage, and another 50-teeth Gear placed outside the cage at the opposite end to the sun and planet wheels.

The 9½″ Angle Girders forming the top and bottom members of the main frame are fitted with two Flanged Brackets that are spaced from the Girders by three washers on each securing bolt.

A 5″ Axle Rod is journalled in the outer holes of these Brackets and carries two Couplings, in the upper one of which a 3½″ Axle is fitted, and in the lower one a 4½″ Axle. These Rods carry Couplings that are connected by a 4½″ Rod. A third Coupling on the lower Rod carries a Threaded Pin and a 1″ Axle Rod, the Pin forming a handle for the gear-change mechanism, and the 1″ Rod fits into the holes of a 4½″ Curved Strip, fixed as shown. To allow correct placing of the Strip, one end is attached to the slotted hole of a Flat Bracket. The two horizontal Rods are connected by means of Swivel Bearings and pivoted Angle Brackets to the 3½″ × ½″ Double Angle Strip attached to the sun wheels.

The 1″ Rod at the end of the gear-change lever should be adjusted so that normally it fits into one of the holes in the Curved Strip, but by a slight upward movement of the lever can be disengaged to allow the lever to be moved into another position.

In the illustration reverse gear is in engagement. In this position the Pinion 3 on the driving shaft engages with the Gear 10, thus causing the ½″ planet Pinion on the Rod 8 to travel round the sun wheel 6. This movement causes the cage to revolve, and for reverse gear the cage is locked "solid" with the driven shaft by means of a fixed ½″ Pinion that engages the 1″ Gear 4. The Pinion is mounted on a ¾″ Bolt and spaced by two washers from the Face Plate, the Bolt being inserted in one of the elongated holes so that the Pinion can be correctly placed for the teeth to engage the 1″ Gear.

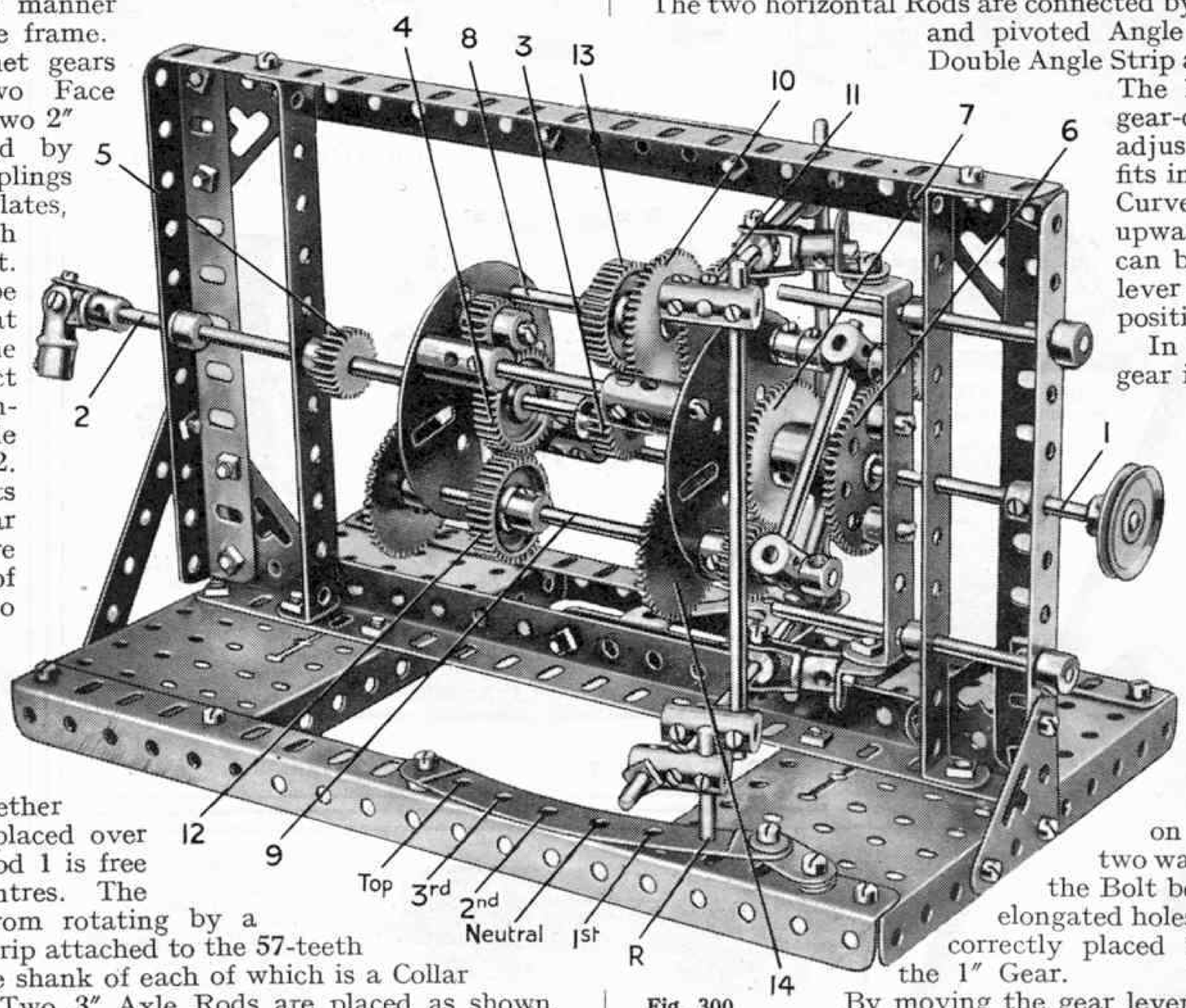


Fig. 300

By moving the gear lever one position to the left, the fixed Pinion is thrown out of engagement with the Gear 4, which is brought into mesh with the 1″ Gear 12 on the Rod 9. The driving Pinion 3 still remains in mesh with the Gear 10, thus causing the cage to rotate, and the ¾″ Pinion on the Rod 9 to run round the Gear 7. Thus the Gear 12 drives the Gear 4. By moving the gear lever into the next position, Pinion 3 is disengaged from the Gear 10, so that no drive is transmitted to the cage.

For second gear, the position of which is indicated on the quadrant, the Pinion 3 is brought into engagement with the Gear 11, and the Gear 12 slides out of mesh with the Gear 4, which engages the Gear 13. In this case the Rod 9 rotates idly. The Gears 4 and 13 remain in mesh for third gear, but the driving Pinion is disengaged from the Gear 11 and brought into mesh with the 50-teeth Gear 14. Further sliding movement of the cage disengages the two 1″ Gears and causes the 50-teeth Gear mounted outside the cage to engage with the Pinion 5, while the driving Pinion 3 remains in mesh with the Gear 14. It will be seen that both driving and driven Pinions are of the same size and engage similar gears, both mounted on the same shaft. This gives the equivalent of a straight through drive for top gear.

(301)—Balanced Aileron Control (E. V. Smith, Stone)

In monoplanes of the cantilever type that have a thick wing section, the aileron controls require considerable force to manipulate when the top speed of the machine is reached. When the aeroplane is dived at greater speeds, the handling of the controls becomes increasingly difficult, on account of the greater wind pressure tending to force the ailerons back into the normal position. In order to assist the pilot in operating the controls, the balanced aileron has been evolved. A small auxiliary flap is incorporated in the trailing edge of the aileron, and pivoted to it. The flap operates with a similar movement to the aileron itself, but its movement is in opposition to that of the aileron. It is connected to the wing by a pivoted link, so that its operation is entirely automatic when the aileron is moved.

A model of a balanced aileron is illustrated in Fig. 301. The flap 2 is made from two 3″ × 1½″ Flat Plates secured together at their outer edges, the inner edges being spaced apart by Collars, and secured by bolts inserted in the opposite tapped bores of the Collars. A Rod passed through both Collars is pivoted in Collars secured in a similar manner in the aileron itself. A Flat Bracket 3 is rigidly bolted to an Angle Bracket secured on the underside of the flap. The connecting link 5 consists of two 2″ Slotted Strips, and a 1½″ Strip 4 is bolted to an Angle Bracket attached to the wing. The link 5 is arranged so that when the aileron is in line with the wing, the auxiliary flap is also in line.

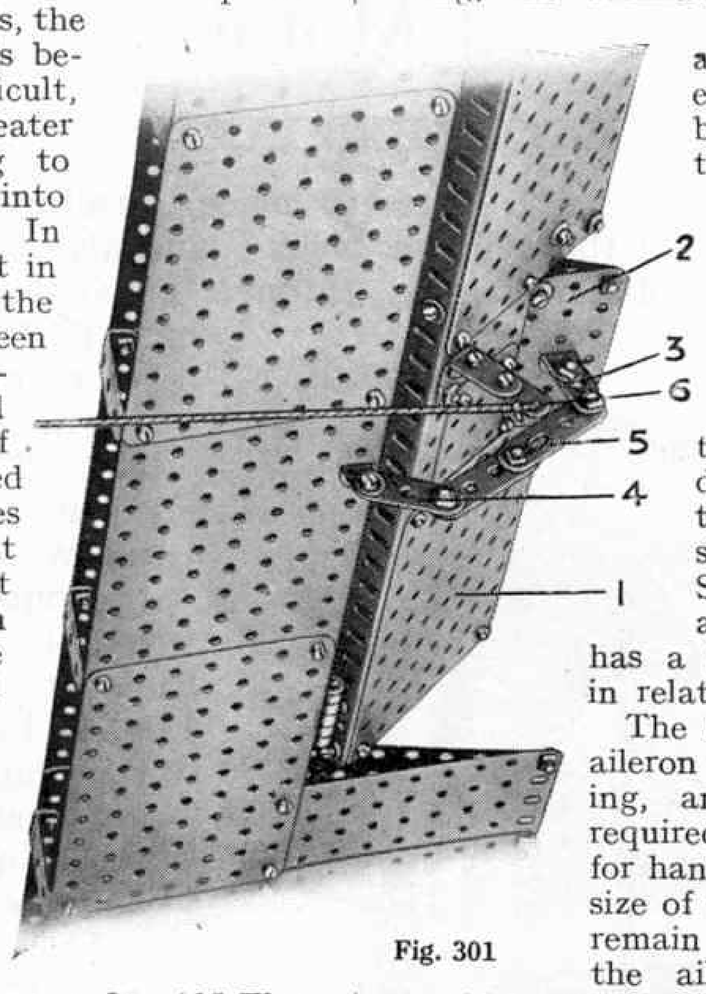


Fig. 301

For operating the aileron, cords are attached to 1½″ Strips 6, bolted at right angles to the upper and lower surfaces of the aileron by means of 1″ × 1″ Angle Brackets. Downward movement of the aileron causes the auxiliary flap to move upward in relation to the aileron. The flap does not remain parallel to the wing but has a slight upward angle. Similarly, when the aileron is raised, the flap has a slight downward angle in relation to the wing.

The flap tends to keep the aileron in position when banking, and reduces the effort required on the part of the pilot for handling the joystick. The size of the flap must of course remain small in relation to the aileron, otherwise there would be the danger of its taking full control. Sufficient "feel" must be left for the pilot, so that he maintains complete control at all speeds, but the handling of the controls is lightened considerably.

We are indebted to General Aircraft Ltd. for much of the above information.

(302)—Microphone (L. Willis, Hull)

This interesting model can be used for transmitting messages that can be received on a pair of wireless headphones or a telephone receiver. By using two microphones and two sets of headphones, a complete telephone system can be fitted up.

The model is shown completely assembled in Fig. 302, and Fig. 302a shows the microphone itself with the cover removed. A Double Bracket is secured at the rear of the Boiler End 2 by means of a 6 B.A. Bolt (Elektron Part No. 1575) which is insulated from both the Bracket and Boiler End by means of Insulating Bushes. The inner end of the bolt carries the ¾″ Flanged Wheel 3, which is in metallic contact, and is spaced away from the Boiler End so that its upper edge is very slightly below the level of the rim of the Boiler End. The inside of the Flanged Wheel is packed up with discs of cardboard so that the carbon shot 4 protrude beyond the rim of the Wheel, but at the same time are retained in position. Tinfoil is placed over the cardboard and round the rim of the wheel, so that the carbon shot resting on this packing are continually in contact with the Flanged Wheel.

The diaphragm 6 is fitted inside a Wheel Flange 7, a brass washer 5 being placed on each side of the diaphragm, which may consist of a disc of tin cut to the required size, great care being taken not to buckle it. A piece of ferrotype plate is much better for this purpose, however. The Wheel Flange is fitted over the Boiler End, and when in this position the diaphragm should make light contact with the carbon shot but should not touch the Flanged Wheel 3. If correctly assembled the diaphragm will retain the shot in place. The Wheel Flange 7 is clamped to the Boiler End by 2½″ Strips and 1″ Screwed Rods as shown in Fig. 302. A cardboard mouthpiece can be gummed in position over the centre hole in the Wheel Flange.

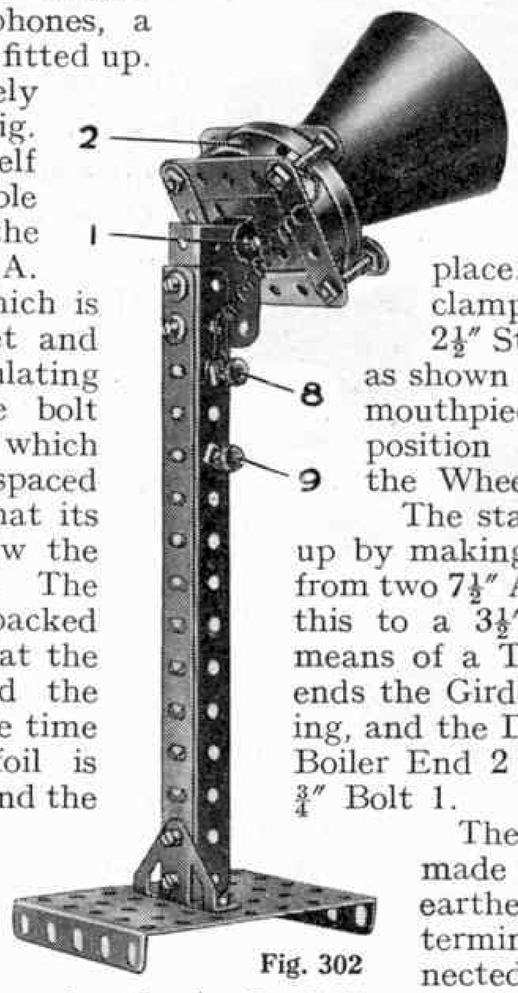


Fig. 302

The stand for the device is built up by making a channel section girder from two 7½″ Angle Girders, and securing this to a 3½″ × 2½″ Flanged Plate by means of a Trunnion. At their upper ends the Girders carry a Channel Bearing, and the Double Bracket behind the Boiler End 2 is pivoted to this by the ¾″ Bolt 1.

The electrical connections are made as follows. Terminal 9 is earthed to the stand, and terminal 8 is insulated and connected to the Boiler End 2. Thus the latter terminal is in contact with the diaphragm, whereas terminal 9 is electrically connected to the Flanged Wheel 3. The current to this goes through the frame to the Double Bracket and 6 B.A. Bolt.

Suggestions Voting Contest

The Voting competitions that have been organised from time to time in connection with the "Suggestions Section" have been met with enthusiasm from readers, and have been a great help to Spanner in assisting him to select for publication ideas that are of greatest interest. To help him in his future selections and in order to ascertain if Meccano boys have made good use of the ideas published during the last year, we announce below another "Suggestions Voting" Contest.

Competitors are asked to write down the four suggestions that they consider to be the best published during 1933. These total twenty-three from No. 277 in the February issue to No. 299 in the November issue. The Suggestion considered to be the best should be written first, with the second-best next, and so on for the third and fourth. The competitor's full name and address should be written below his entry, and only one list of suggestions may be submitted by each entrant.

Entries will be divided into two Sections, A for competitors residing in the British Isles, and B for competitors residing Overseas. Every vote received in Section A will be recorded so that the suggestions may be classified in their order of popularity. The voter whose entry is then found to coincide most nearly with the result so obtained will be presented with a cheque for £1-1s., while the voter who is next nearest to the general consensus of opinion will be awarded a cheque for 10/6. The twelve "runners-up" will receive consolation prizes.

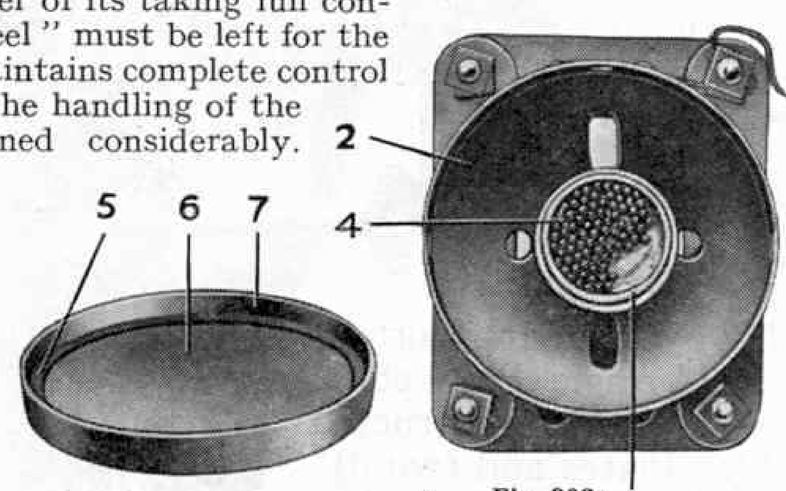


Fig. 302a

The same method will be adopted with the entries in Section B, in which a duplicate set of prizes will be awarded.

The contributor who sent in the suggestion that is voted best in one or both of the Sections will receive a cheque for 10/6, and the three contributors whose suggestions are voted to be the next best in order will receive consolation prizes.

Post cards must be addressed to "Suggestions Voting" Competition, Meccano Ltd., Binns Road, Liverpool 13. The closing date for Section A is 28th February, and for Section B, 31st March.

(303)—Caterpillar Track

(E. Roberts, Whitchurch)

A neat caterpillar track can be made from Hinges and Flat Brackets, a Hinge being bolted at each end of a Flat Bracket, and connected to further Flat Brackets and Hinges to make a track of any required length. It can be used in the form of an endless belt running over two 3″ Pulley Wheels. The shanks of the Bolts holding the parts together, fit into the grooves of the Pulleys. Smaller Pulleys than 3″ in diameter will be found unsuitable for operating the track, and one of the Pulleys should be adjustable so that any slack can be tightened up by means of a screw mechanism.

The Month's New Model

A Realistic Outboard Motor

THE new model to be described this month is a half-scale reproduction of a Marston "Seagull" 7½ h.p. outboard motor, and it is one of the most perfect examples of Meccano engineering yet produced. It is fitted with an E1 Electric Motor concealed within the cylinder block, and this drives the propeller through the medium of a simple gear train, the motor being switched off and on by operating the throttle lever situated on the tiller arm.

The main structural base of the model consists of the crank-case and cylinder block, and therefore these must be built first. An E.1 Electric Motor is bolted in place on a flat plate built up from three 3″ × 1½″ Flat Plates, as shown in Fig. 3. Each long side of this compound plate is fitted with a 3½″ Angle Girder, one end of the plate being allowed to overhang the ends of the Girders for a distance of ½″. This overhanging portion is fitted with two ½″ × ½″ Angle Brackets 4.

A second built-up plate is now constructed from three 3″ × 1½″ Flat Plates and two 3½″ Angle Girders, in a similar manner to that already described. When this is completed it is attached to the plate supporting the Motor by two 3½″ × 2½″ Flanged Plates, which are held in place by the 3½″ Angle Girders and also by four 1″ × 1″ Angle Brackets shown in Fig. 3. It should be noted that certain Nuts and Bolts in this structure have been eliminated, as they get in the way of the gears carried by the Motor.

Before the casing is proceeded with further the first stage of the gear train is fitted to the motor. This consists of a ¾″ Sprocket Wheel, on the armature shaft, that is connected by a short length of Sprocket Chain to a 1½″ Sprocket Wheel 1 locked securely on a 3½″ Rod carrying a ½″ Pinion 2. This Rod is journalled in the 3½″ × 2½″ Flanged Plates forming the top and bottom of the cylinder block. The Pinion 2 is in mesh with a similar Pinion 3, which is carried on a 1½″ Rod journalled in two 2½″ × ½″ Double Angle Strips secured across the visible open end of the structure shown in Fig. 3. It will be observed that the short turned-over ends of these Double Angle Strips are spaced away from the side plates by means of Washers.

The construction of the frame is now continued. The 3½″ Threaded Rod 6 is fitted in order to hold the two 3½″ Flanged Plates in place, forming the top and bottom of the cylinder block; and also to support the far end of the motor, through convenient opposite holes of which the Threaded Rod is passed.

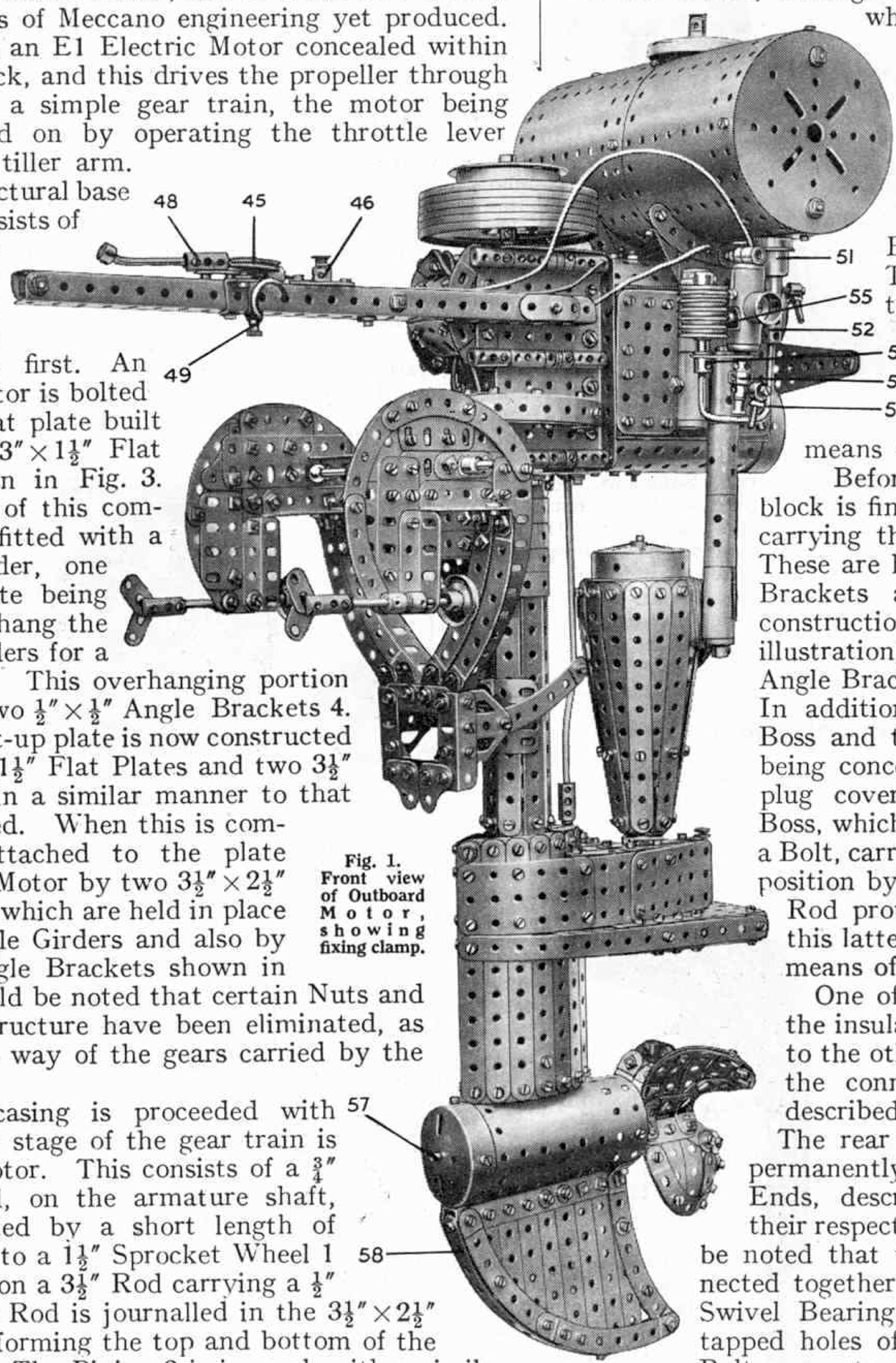


Fig. 1. Front view of Outboard Motor, showing fixing clamp.

The rear of the cylinder block, shown in Fig. 2, consists of two 3″ × 1½″ Flat Plates, secured together by means of two 1″ Threaded Rods 7, the outer ends of which are used for supporting two Boiler Ends forming the cylinder heads. The two Flat Plates are attached to the main structure by means of four Nuts and Bolts, the Nuts being held in place on the inside of the flanges of the Flanged Plates by means of ½″ × ½″ Angle Brackets.

Before the rear of the cylinder block is finally fitted, the two cradles for carrying the petrol tank must be fitted. These are held in place by means of Flat Brackets as shown in Fig. 5. Their construction is shown clearly in the illustration, and the use of the ½″ × ½″ Angle Brackets 19 will be described later. In addition to the cradles, a Threaded Boss and two Terminals are fitted, these being concealed under the dummy spark plug cover 18, Fig. 5. The Threaded Boss, which is secured to the side plate by a Bolt, carries a 1″ Threaded Rod locked in position by a Nut. The outer end of the Rod protrudes beyond the plug cover, this latter fitting being held in place by means of a Nut on the end of the Rod.

One of the terminals is connected to the insulated terminal of the Motor and to the other is attached to 18 in. of wire, the connecting up of which will be described later.

The rear of the cylinder block is now permanently fitted, and the two Boiler Ends, described earlier, are secured on their respective Threaded Rods. It should be noted that the two Boiler Ends are connected together by a "spider" taken from a Swivel Bearing, and one of the unoccupied tapped holes of this carries a ⅜″ Bolt. This Bolt supports an elongated diamond shaped structure that in actual practice is provided to facilitate handling the motor. The construction of this part is shown in Fig. 2.

One more thing remains to be fitted to complete this part of the model; the inlet pipe to the cylinders. It consists of two Sleeve Pieces bolted to one side of the cylinder block, the ends being enclosed by means of two Chimney Adaptors.

The crankcase is now built. The two sides of this consist of $4\frac{1}{2}'' \times 2\frac{1}{2}''$ Flat Plates, and the forward end is composed of two $3'' \times 1\frac{1}{2}''$ Flat Plates overlapping three holes. These three vertical plates are joined together by means of $4\frac{1}{2}''$ Angle Girders, $2\frac{1}{2}''$ Angle Girders being fitted at the top and bottom to the $2\frac{1}{2}'' \times 2\frac{1}{2}''$ Flat Plates 14 and 15. The open end of the crankcase is fitted with two $4\frac{1}{2}''$ Angle Girders as shown in Fig. 3, and these support two pairs of $1\frac{1}{2}'' \times \frac{1}{2}''$ Double Angle Strips carrying the $1'' \times 1''$ Angle Brackets 12 and 13. Each of these Angle Brackets carries a $4\frac{1}{2}'' \times 2\frac{1}{2}''$ Flat Plate, curved to represent the cylinder, and these, when the cylinder block and crankcase are fitted together, will have their ends passed under the flanges of the Boiler Ends representing the ends of the cylinders. They will also be secured to the cylinder block by means of two 1″ Threaded Rods 5 and 5a.

The exterior shape of the crankcase is reproduced in the model as shown in Fig. 5. No description is required for this part of the model, the construction being shown clearly in the illustration. It should be noted, however, that the Strips 16 and 17 are $9\frac{1}{2}''$ and $3\frac{1}{2}''$ respectively, and they are bent to the required curvature when the remainder of the shaping of the crankcase is completed.

The tiller arm is built up from two $12\frac{1}{2}''$ Angle Girders joined together by $\frac{3}{4}''$ Bolts to form a box section girder. While fitting the throttle lever and other accessories, it will be necessary to keep the tiller in two halves. A $\frac{3}{4}''$ Bolt, carrying a $1\frac{1}{2}''$ Strip and 1″ loose Pulley 45 (Figs. 1 and 2), is journalled in the boss of a Threaded Crank. This Crank is bolted to the underside of the uppermost Angle Girder forming the tiller arm, and the $\frac{3}{4}''$ Bolt, supported by it, is locked securely to its Pulley and $1\frac{1}{2}''$ Strip. The $1\frac{1}{2}''$ Strip is fitted with a Coupling 48 that carries a 2″ Rod bent to the shape of a throttle lever, if necessary. A Collar on the end of the Rod forms a suitable finish to the lever. A Threaded Boss 47 carries one end of a dummy bowden cable, the other end of which will be attached to the carburetter when it is fitted. A dummy ignition button 46, is also fixed as shown.

The terminal point 49 is connected by a length of rubber-covered wire to the remaining terminal under the plug cap 18. The terminal 49 forms one side of the starting switch, the other side of which consists of the $\frac{3}{4}''$ Bolt carrying the throttle lever. Thus, if adjustment is correct, by turning the lever from side to side the Bolt is raised or lowered in the boss of the Threaded Crank, and in this manner contact is made, when required, with the terminal 49.

The gearing is now fitted inside the crankcase. Two $1\frac{1}{2}'' \times \frac{1}{2}''$ Double Angle Strips, shown in Fig. 3, support a 2″ Rod carrying a $\frac{3}{4}''$ Pinion 8 and a $\frac{1}{2}''$ Pinion, the $\frac{1}{2}''$ Pinion engaging with a similar Pinion gripped on a 5″ Rod carrying the $\frac{3}{4}''$ Pinion 9. This 5″ Rod is journalled in suitable holes in the Flat Plates 14 and 15. The Pinion 9 engages with a 50-teeth Gear 10 that is mounted on the shaft 11 corresponding to the crankshaft in an actual engine. The flywheel is mounted on the upper end of this, and is constructed from six Flanged Discs, Part No. 168a. The starting ring, fitted to the upper edge of the flywheel consists of a Wheel Flange and a Face Plate.

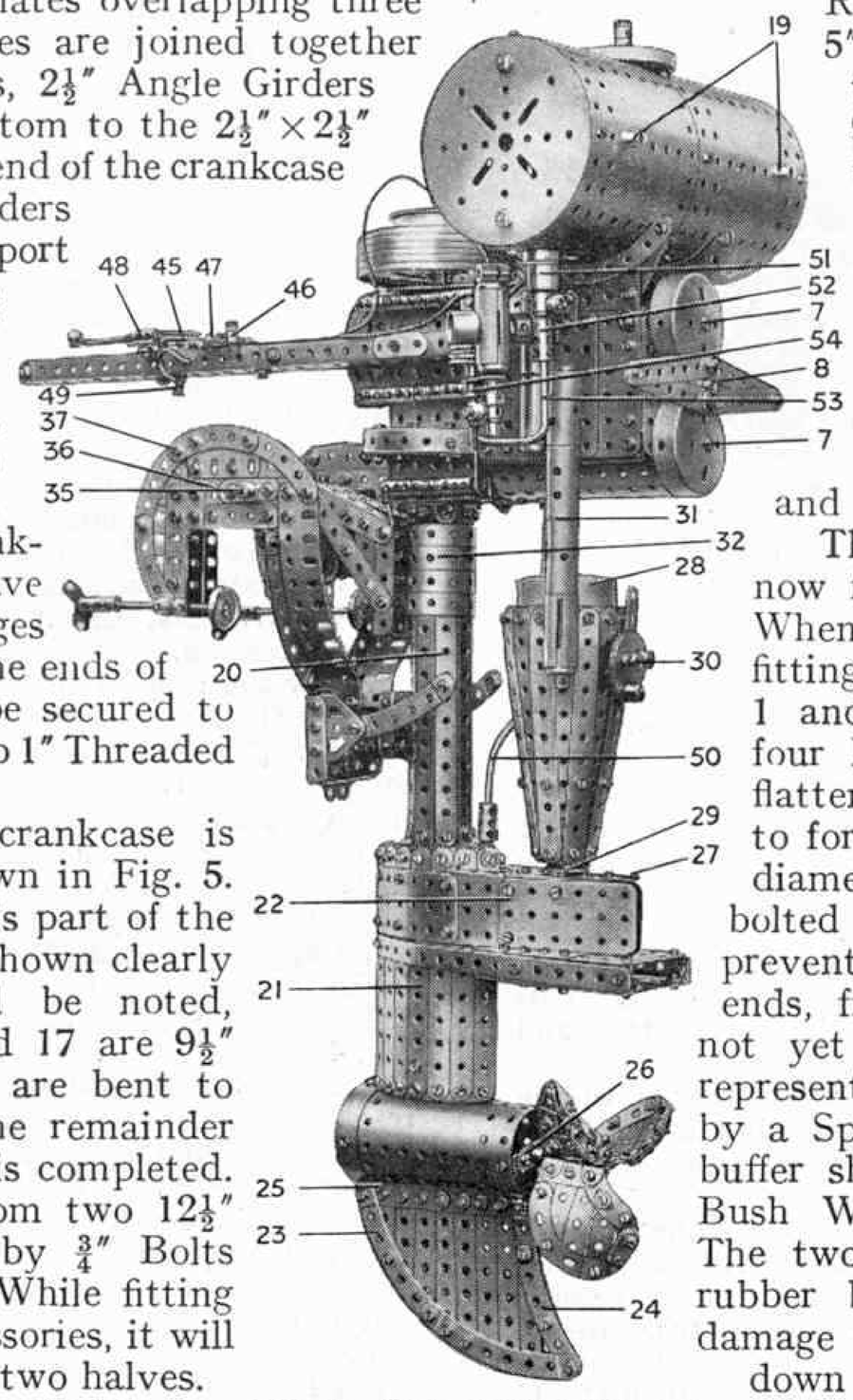


Fig. 2. View showing the construction of the streamlined underwater body of the motor.

The crankcase and cylinder block are now fitted together, as already described. When this is done the petrol tank and fittings are built, as shown clearly in Figs. 1 and 2. The tank is constructed from four Boilers, minus Ends, which are first flattened slightly and then joined together to form a drum 8 in. in length and 4 in. in diameter. Four $\frac{1}{2}'' \times \frac{1}{2}''$ Angle Brackets are bolted to each end of the tank in order to prevent the 4″ Circular Plates, forming the ends, from being forced inward. They are not yet fitted, however. The filler cap is represented by a Wheel Flange surmounted by a Spring Buffer shank and a Collar, the buffer shank being gripped in the boss of a Bush Wheel bolted to the Wheel Flange. The two Spring Buffer stocks 19, represent rubber bumpers fitted in order to prevent damage to the tank when the engine is laid down on a hard surface.

The carburetter is built up in the following way. A 2″ Threaded Rod, carrying the Chimney Adapter 51 and a $\frac{3}{4}''$ Flanged Wheel, is locked to the underside of the petrol tank in the position shown in the photographs. The Chimney Adaptor is held in place by a Threaded Boss, the lower end of which is fitted with a Threaded Pin. A Coupling 52 is carried on this Threaded Pin, and this in turn supports a bent $8\frac{1}{2}''$ Rod 53, the unsupported upturned end of which carries a Crank 54. This section of the Rod also is fitted with a buffer stock and six 1″ loose Pulleys that are held securely in place by means of a Collar. A $1'' \times \frac{1}{2}''$ Angle Bracket is fitted between the bottom Pulley and its neighbour and this supports a Sleeve Piece, the upper end of which is fitted with a Chimney Adaptor carrying a Threaded Boss and a Collar. The loose end of the imitation Bowden cable from the throttle lever is attached to this fitting.

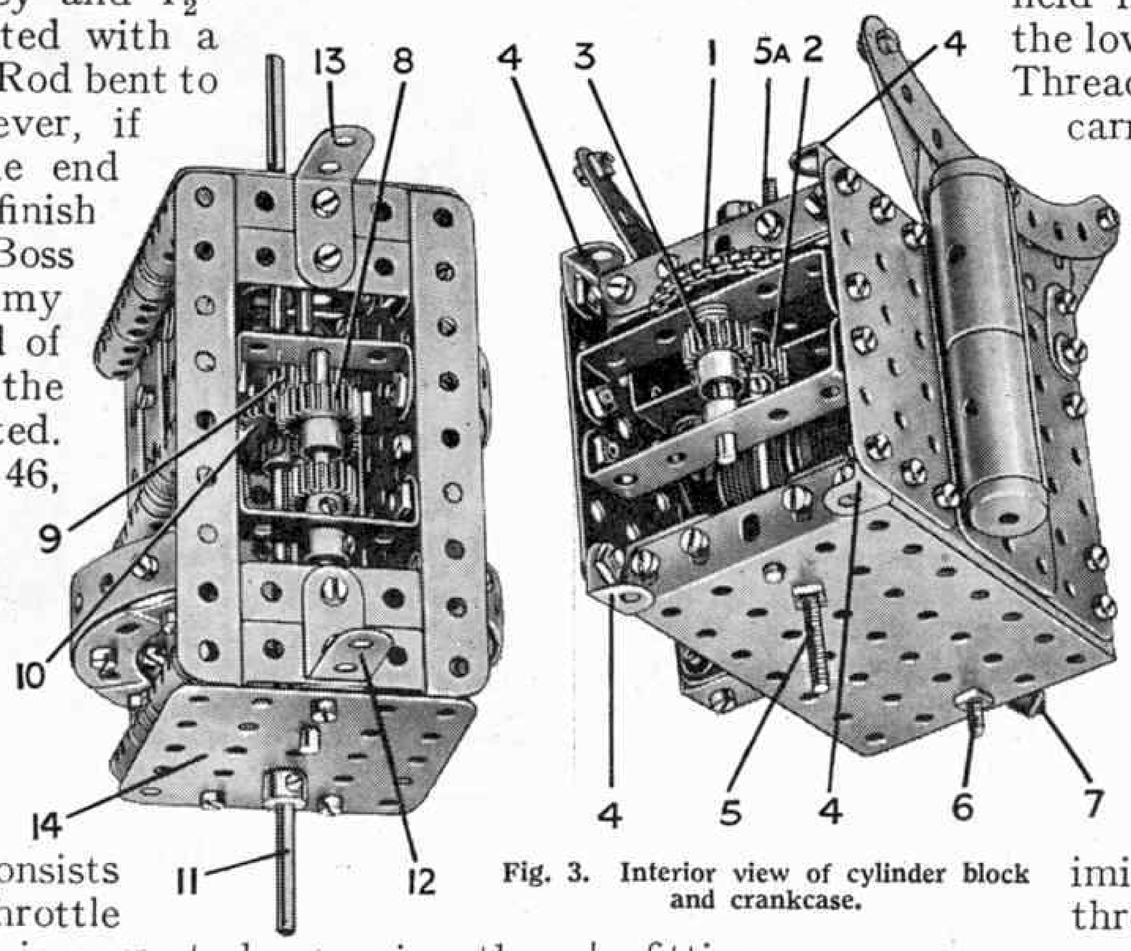


Fig. 3. Interior view of cylinder block and crankcase.

The lower end of the Sleeve Piece is fitted with a second Chimney Adaptor that carries a Threaded Pin, the shank of which passes through the outer hole of the Crank 54. The Threaded Pin supports an Octagonal Coupling, the lower end of which is finished off with the

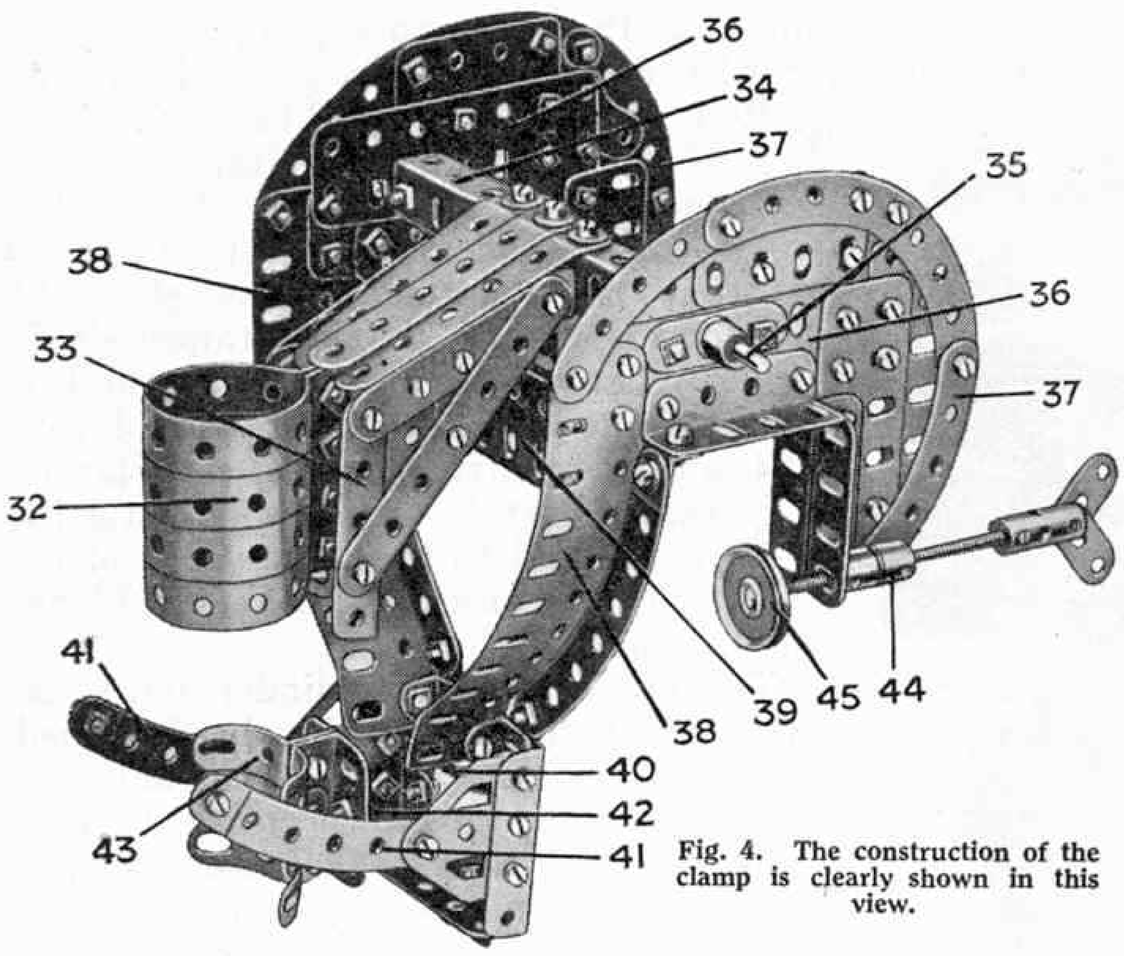


Fig. 4. The construction of the clamp is clearly shown in this view.

stock of a Spring Buffer. The two stop cocks shown in Fig. 1 are now fitted, their construction being clearly shown in the illustration.

The inner face of the Sleeve Piece, mounted on the Crank 54, is fitted with a Threaded Pin supporting a Socket Coupling, the necessary connection being made by means of a Collar. This fitting represents the connection between the carburetter and the cylinders.

The petrol tank is now secured in place by bolting it to the Angle Brackets 19, Fig. 5. The ends of the tank are held in place by two 8″ Threaded Rods passed through from one side to the other and held in place by Nuts.

The next section of the model to receive attention is the tube 20, enclosing the transmission shaft to the propeller. This is built up from six 7½″ Strips and two 12½″ Strips, the latter Strips passing right down into the underwater casing. The eight Strips are all secured together by bent Flat Brackets, and the complete tube is attached to the bottom of the crankcase as shown by four ½″ × ½″ Angle Brackets. Before the tube is fitted in place the crankshaft is lengthened by means of an 11½″ Rod connected to the crankshaft by a Universal Coupling.

The construction of the section 21 is shown clearly in Figs. 1 and 2, and the spaces at the upper end of this are filled in by 1″ Corner Brackets held in place by ½″ × ½″ Angle Brackets. The after Corner Bracket is fitted with a Threaded Pin supporting a Coupling, the other end of which supports an 11½″ Rod 50 bent to the shape shown. The upper end of the Rod is passed into one of the side holes of the cylinder block. This Rod represents the cooling water delivery pipe.

The exhaust mouth, which in actual practice is under water, consists of two side members composed of 7½″ Strips connected together at their upper and lower edges by 2½″ × 2½″ Flat Plates. These Flat Plates, four in number, are bolted together in pairs each one overlapping its neighbour two holes, and are held in place by means of ½″ × ½″ Angle Brackets. The spaces between the exhaust mouth and the body 21 are filled in by means of 2½″ Strips.

Above the exhaust mouth is fitted the streamlined fairing 22, the construction of which will be made quite clear on reference to the illustrations. This part of the model is held in place at the after end by a 2″ Threaded Rod 27. The expansion chamber, which is carried on the fairing 22, is constructed from alternate 5½″ and 4½″ Strips bolted round the periphery of a Face Plate. These Strips are secured to a 7½″ Strip, bent to the correct curvature, that is attached to the Face Plate by four equally spaced ½″ × ½″ Angle Brackets. At the lower end, the 5½″ Strips are secured to a circle of Flat Brackets, eight of these parts being used for the purpose. The 4½″ Strips are held in place behind the longer Strips by Nuts and Bolts fitted with Washers.

The upper end of the complete chamber is fitted with a Boiler End 28 and the lower end with a 1″ loose Pulley 29, the entire expansion unit being attached to the top of the fairing 22 by an 8″ Threaded Rod. This Rod passes right down to the lower side of the exhaust mouth, a securing Nut being placed in this position. The Triple Throw Eccentric 30 represents the back pressure valve which, on being opened, allows the exhaust gas to bypass the underwater exhaust. The exhaust pipe 31 is built up from Sleeve Pieces and Chimney Adaptors, a 6″ Rod being passed down the centre of the complete pipe to hold it rigid.

The lower end of the casing 21 consists of a Boiler, fitted with a Boiler End, held in place by ½″ × ½″ Angle Brackets, the open end of the Boiler being of slightly smaller diameter than the opposite end. This end is fitted with a 1½″ Strip 26 as shown. The extention to the crankshaft passes inside the Boiler for a distance of ¾″ and is journalled in a Coupling, loosely mounted between a Collar and 1½″ Contrate, on the shaft 57, Fig. 1. This shaft is journalled in the centre hole of the Boiler End and the centre hole of the 1½″ Strip 26. The Contrate already mentioned is spaced away from the Coupling by two Washers, and it engages with a ½″ Pinion on the crank shaft extension.

Below the Boiler is fitted two 4½″ Strips 25 that are secured in place at the fore end by a Double Bracket, and at the after end by two ½″ × ½″ Angle Brackets placed outside the 4½″ Strips. These Strips support the rudder fin, which in this engine turns only when the entire motor is turned. The framework of the fin consists of two compound curved strips 23 and 24 built up as shown, and the enclosed space is filled in by Strips of varying lengths. The front edge of the fin is represented by a curved 5½″ Strip 58 held in place at its upper end by a ½″ × ½″ Angle Bracket.

The construction of the propeller is shown clearly in Fig. 2.

The remaining part of the model to be built is the transon clamp, Fig. 4, by means of which the engine is secured to the boat. Four 5½″ Strips 32 are first bent as shown and are passed round the transmission tube in the manner indicated in Fig. 2. They are then bolted to the 2½″ Angle Girders 33 by means of 2″ Angle Girders. A simple swan neck, built up of Strips, then connects this fitting to the transverse 4½″ Angle Girder 34 that is pivotally attached by the 6½″ Rod 35 to the clamp proper. Two Handrail Supports form the necessary connection between the Girders and the Rod.

Each side of the clamp is constructed from four 2½″ large radius Curved Strips 37 and a curved 5½″ Flat Girder 38, strength being given to this frame by means of the built-up angle piece 36, formed of two 3″ Flat Girders. The remainder of the construction of the side of the clamp is shown clearly in the illustration. The two sides are coupled together in the centre by a (*Continued on page 93*)

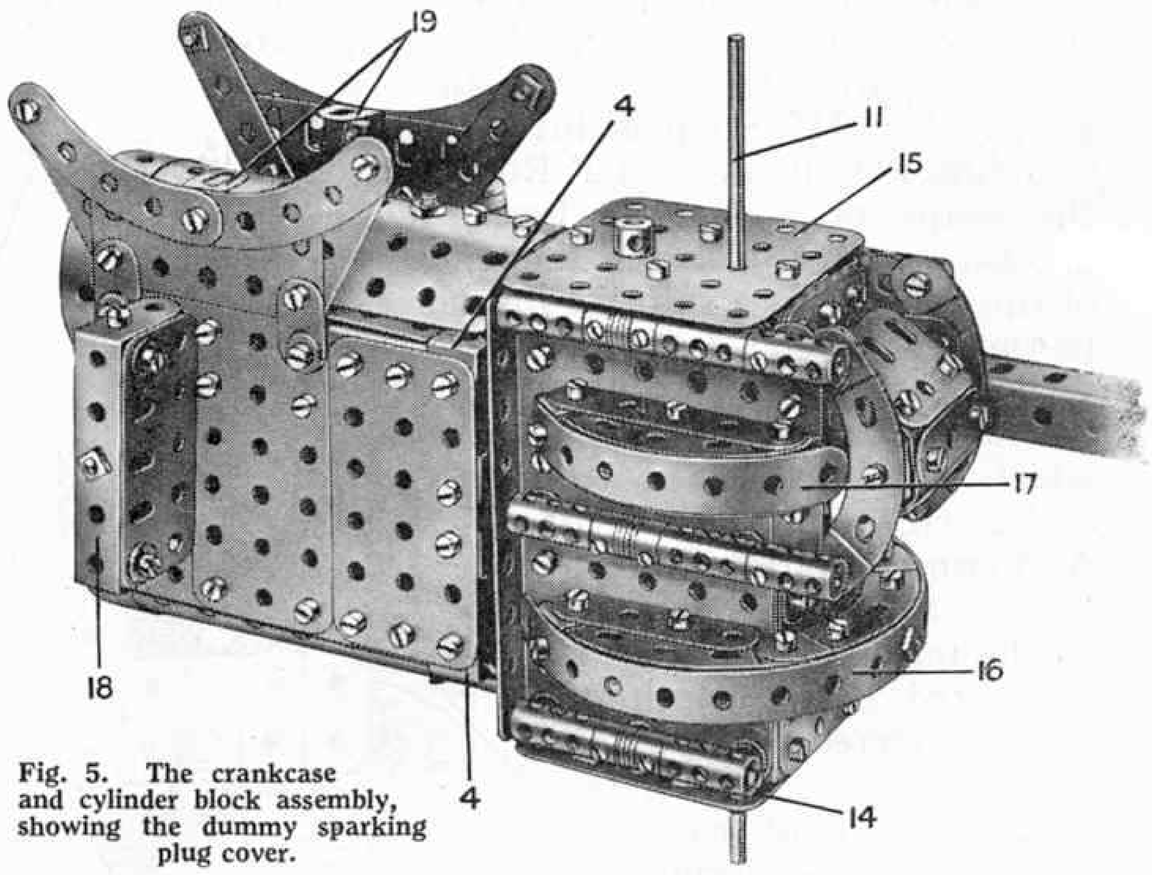
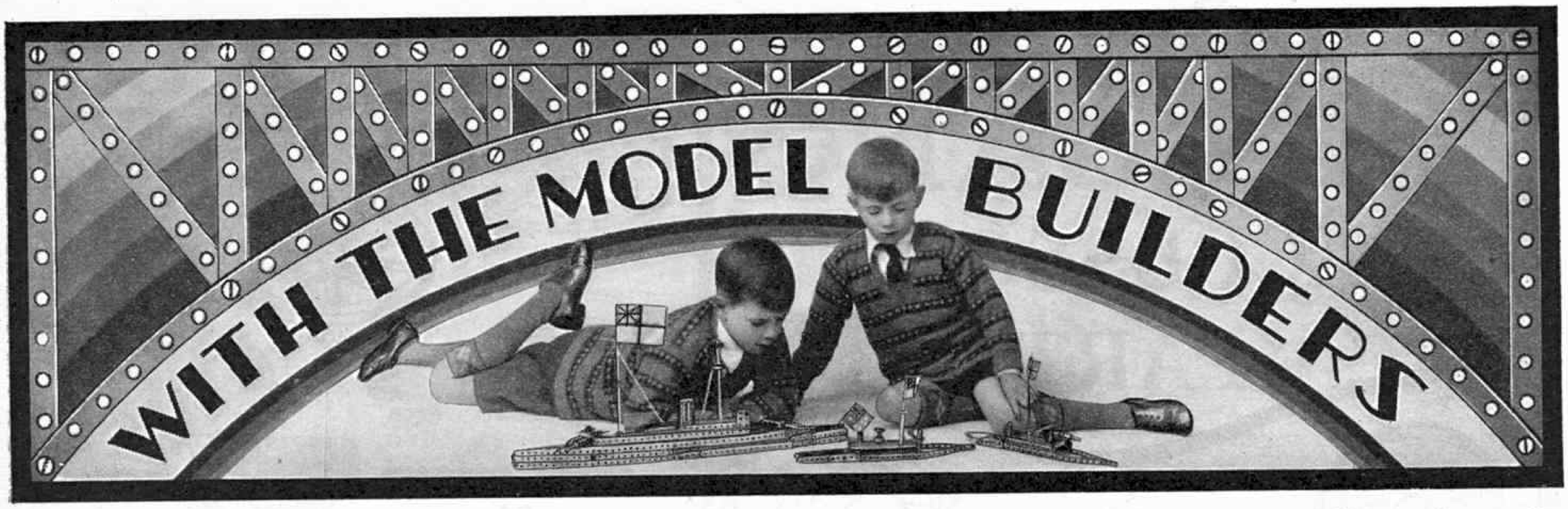


Fig. 5. The crankcase and cylinder block assembly, showing the dummy sparking plug cover.

List of Parts required to Build the Model:—

2	of No.	1	2	of No.	9d	4	of No.	16b	124	of No.	37a	2	of No.	63a	12	of No.	90	4	of No. 111a
1	„ „	1a	15	„ „	9e	5	„ „	17	233	„ „	38	2	„ „	63b	18	„ „	90a	40	„ „ 111c
8	„ „	1b	2	„ „	9f	2	„ „	18a	1	„ „	46	1	„ „	63c	8″	„ „	94	5	„ „ 115
28	„ „	2	92	„ „	10	1	„ „	18b	9	„ „	48	11	„ „	64	1	„ „	95a	4	„ „ 120a
14	„ „	2a	8	„ „	11	1	„ „	20b	2	„ „	48a	6	„ „	72	1	„ „	96a	1	„ „ 125
20	„ „	3	60	„ „	12	4	„ „	22	2	„ „	53	16	„ „	73	2	„ „	103	2	„ „ 126a
5	„ „	4	6	„ „	12a	7	„ „	22a	4	„ „	53a	1	„ „	79	3	„ „	103d	1	„ „ 130
15	„ „	5	15	„ „	12b	3	„ „	24	18″	„ „	58a	4	„ „	80	4	„ „	103e	8	„ „ 133a
20	„ „	6	3	„ „	13a	2	„ „	25	37	„ „	59	2	„ „	80a	4	„ „	103f	2	„ „ 136
27	„ „	6a	2	„ „	14	5	„ „	26	1	„ „	62	1	„ „	80b	4	„ „	103g	2	„ „ 137
2	„ „	8	2	„ „	15	1	„ „	27	1	„ „	62a	1	„ „	81	2	„ „	103h	2	„ „ 140
6	„ „	9a	2	„ „	16	1	„ „	28	2	„ „	62b	8	„ „	82	2	„ „	109	2	„ „ 146a
4	„ „	9b	5	„ „	16a	442	„ „	37	23	„ „	63	14	„ „	89b	5	„ „	111	2	„ „ 162

3	of No.	162b	
7	„ „	163	
11	„ „	164	
6	„ „	168a	
1	„ „	171	
1	„ „	172	
1	„ „	179	
3	„ „	182	
3	„ „	1570	
4	„ „	1575	
4	„ „	1583	
3	„ „	1563	
1	E1 Electric Motor		



A NEAT ELECTRO-MAGNET

A small electro-magnet that is suitable for use in numerous electrical models can be built up from two Double Brackets, which form the centre core. The Brackets are held together by two cheeks of cardboard with narrow slots ½" long cut in their centres. To place the cheeks in position, the two Brackets are placed end to end and the two cheeks dropped over their inner ends. By turning the Brackets round until they are back to back, the two pieces of cardboard will slip into position and are placed one at each end of the Brackets. A strip of paper is wound round the Brackets and glued in position before winding on the wire, and it will also be found necessary to insert the securing bolts into the end holes of the Brackets before the wire is wound on. In this connection it is advisable to make quite certain of the size of bolts required, since once the coil is wound, the bolts cannot be removed.

FIXING MECCANO BOBBINS

Meccano Bobbins (Parts No. 181), when used as electro-magnets or solenoids, can be mounted in position by clamping them in Single Bent Strips, the ends of which are bent slightly to retain the Bobbins in place. These parts can be used only when the Bobbins are not wound fully. Another method of fixing the Bobbins is by means of 1½" Strips. A Strip is placed at each side of the solenoid or magnet, and the two are held together at one end by a 1" Screwed Rod, and at the other end bolts are passed through the Strips and inserted in the opposite tapped bores of a "spider" removed from a Swivel Bearing or Universal Coupling. The spider is provided with a Grub Screw for mounting the unit on an Axle Rod that may be conveniently fixed in a Rod Socket fitted in any suitable place on the model. The arrangement allows the solenoid to be mounted in almost any position.

ROLLING LIFT BRIDGE CONSTRUCTION

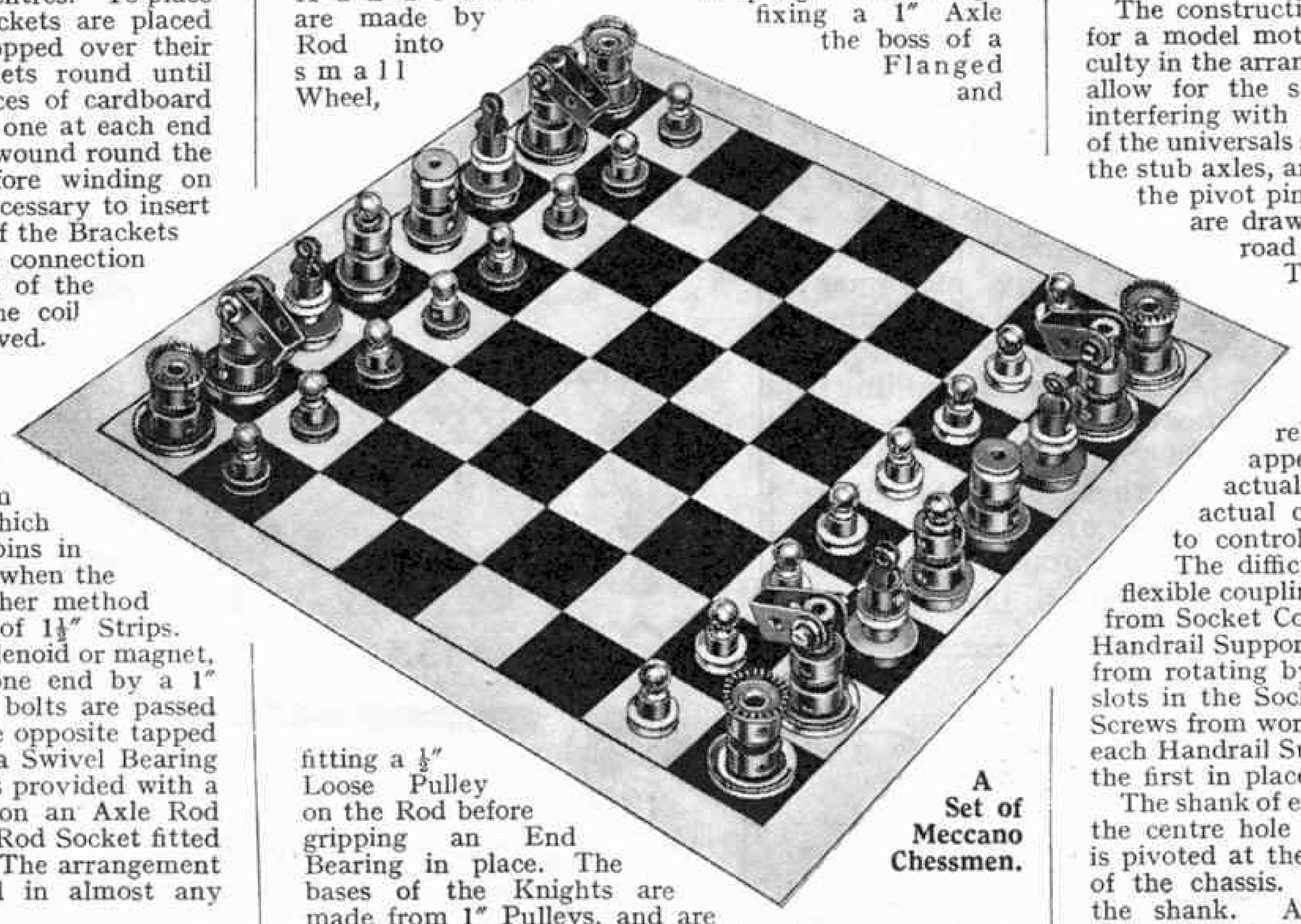
The sectors at the rear of the bascules of rolling lift bridges are generally provided with teeth or studs that engage with holes in the rails on which the sectors roll. With models built from small Outfits this arrangement is not always possible, on account of the limited number of parts available. To overcome the difficulty, cords may be tied at each end of the two rolling sectors and passed round their rims before being tied at each end of the flat rails. These cords prevent the sectors from sliding on the rails, and models fitted in this way operate equally as well as those that are provided with studs to prevent slipping.

GUIDES FOR HOISTING CORDS

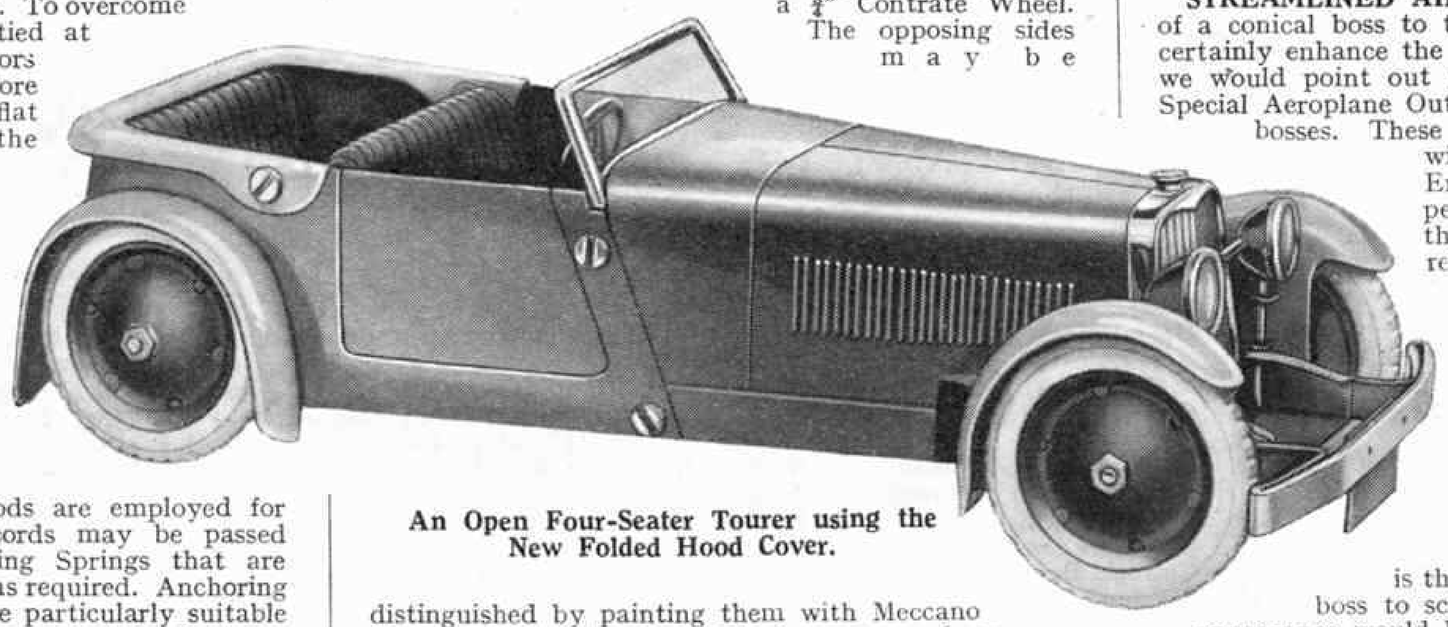
Small models of hoisting gear sometimes require guides for the hoisting cords, but these must be small if the neat appearance of the model is to be preserved. Where Axle Rods are employed for constructional purposes, the cords may be passed through the loops of Anchoring Springs that are placed on the Rods at intervals as required. Anchoring Springs used in this manner are particularly suitable for models of boat-lowering gear where Axle Rods are used for the davits, but numerous similar applications will also be found for them. Where such parts cannot be used it is sometimes desirable to make a small loop from 23 gauge wire (Elektron Part No. 1587) from which the cotton covering has been stripped. The wire may be fixed in position on the model by means of a Nut and Bolt, and if a more rigid guide is required an Angle Bracket can be used, although this is not quite so neat.

A USEFUL SET OF CHESSMEN

The upper illustration on this page shows a complete set of Chessmen built entirely from Meccano parts. The Pawns consist of ½" Pulleys placed with their bosses uppermost, and carrying Handrail Supports. Each Queen is made by mounting a Socket Coupling on the boss of a ¾" Flanged Wheel forming the base, and fitting a Handrail Coupling into its upper socket. For the Kings ½" Pulley Wheels are substituted for the Handrail Couplings. The Bishops are made by fixing a 1" Axle Rod into the boss of a small Flanged Wheel, and fitting a ½" Loose Pulley on the Rod before gripping an End Bearing in place. The bases of the Knights are made from 1" Pulleys, and are provided with Socket Couplings in the upper sockets of which ordinary Couplings are gripped. Single Bent Strips are attached to the Couplings by bolts inserted in the opposite tapped bores, each bolt being provided with two Washers. A 1" Pulley and Socket Coupling is used for each of the Rooks, the Socket Coupling being surmounted by a ¾" Contrate Wheel. The opposing sides may be distinguished by painting them with Meccano Enamel, which is obtainable in green, red or grey. The pieces may be coloured entirely, or only the bases enamelled if preferred. An ordinary draughts board can of course be used for play, or a board may be made from a sheet of stiff cardboard, the squares being coloured with enamel.



A Set of Meccano Chessmen.



An Open Four-Seater Tourer using the New Folded Hood Cover.

NEW MOTOR CAR PART

The Manual of Instructions included in the No. 1 Motor Car Constructor Outfit illustrates four different models that can be built with this Set. The accompanying illustration shows a fifth model that is made possible by the addition of a new part to the range. This part, No. A1225, Cover for Folded Hood (price 2d.) can be substituted for the Tonneau Cover on the Sports Tourer Model No. 4, thus giving an open car. The model illustrated here is similar to the Sports Tourer in other respects, and the Hood Cover is held in place by two bolts, as shown.

FRONT WHEEL DRIVE TRANSMISSION

The construction of a front wheel drive mechanism for a model motor chassis presents considerable difficulty in the arrangement of a suitable universal joint to allow for the steering of the road wheels without interfering with the steering mechanism. The centres of the universals should be in line with the pivot pins for the stub axles, and on correct Ackermann steering gear the pivot pins are so placed that if imaginary lines are drawn through their centres they cut the road at points immediately under the tyres. These requirements necessitate very compact flexible couplings, and the Universal Couplings are somewhat too long for the purpose. If they are used, the wheels must of necessity be incorrectly placed in relation to the pivots, and the result will appear clumsy and will not conform with actual practice. Such an arrangement on an actual car would make the steering difficult to control.

The difficulty can be solved by using built-up flexible couplings of the ball and socket type, formed from Socket Couplings and Handrail Supports. The Handrail Supports are free to swivel, but are prevented from rotating by 7/32" Grub Screws that engage the slots in the Socket Couplings. To prevent the Grub Screws from working out, a second Screw is inserted in each Handrail Support and screwed down until it locks the first in place, but does not protrude.

The shank of each Handrail Support is passed through the centre hole of a 1½" × ½" Double Angle Strip that is pivoted at the top and bottom to the front springs of the chassis. The road wheel is then gripped on the shank. A suitable method of controlling the movement of the Double Angle Strips is to use a 1" Axle Rod for one of the pivots on each. This may be gripped in a Collar that is held by a bolt screwed into one of its tapped bores. The lower end of the Rod may be provided with a Crank or Coupling for connecting to the track rod.

STREAMLINED AIRSCREW BOSS.—The addition of a conical boss to the Aeroplane Propellers would certainly enhance the appearance of the models, and we would point out that Airscrews included in the Special Aeroplane Outfits are fitted with streamlined bosses. These parts are not interchangeable with the Airscrews on the standard Engines, however, as they do not permit lock-nuts to be fitted on the ends of the fixed shafts to retain them in place. They are intended to be mounted on Axle Rods that pass through the centres of the Special Radial Engines.

The suggested part would replace the lock-nuts retaining the Airscrew in position on the standard Engines, and the idea certainly merits careful thought. The chief difficulty that is likely to arise with your proposed part is the method of gripping the conical boss to screw it tightly in position. Its appearance would be marred if a squared section were provided for use with a spanner. *(Reply to D. McGimpsey, Liverpool.)*

"T" SHAPED STRIP.—A Strip in the form of the letter "T" would be useful for securing Strips and Girders rigidly together at right angles to each other. It would enable a neat joint to be made, but a T-shaped piece would not be so adaptable as an "L" member, and such parts are already included in the Meccano range in the form of Architraves, Parts No. 108. Corner Brackets, which are obtainable in two sizes, can also be used for this purpose. *(Reply to R. Jeffs, London S.W.1.)*

MECCANO ACCESSORY PARTS

REAL ENGINEERING PARTS IN MINIATURE

Meccano parts, a number of which are here illustrated, combine to form a complete miniature engineering system with which practically any movement known in mechanics may be duplicated.

New parts are always being introduced in order to keep Meccano model-building in line with the most modern engineering requirements. The greatest care is taken in the designing of these parts to ensure that they function exactly as their counterparts in actual practice.

MECCANO LTD., BINNS ROAD, LIVERPOOL 13

No.		s.	d.
3.	Perforated Strips, 3½" long ... ... ½ doz.	0	4
9b.	Angle Girders, 3½" long „	0	8
17.	Axle Rods, 2" long ... 3 for	0	1
19a.	Wheels, 3" diam., with set screws ... ... each	0	6
20.	Flanged Wheels, 1⅛" diam. „	0	5
	Pulley Wheels with centre boss and set screw:		
19b.	3" diam. ... ... each	0	7
19c.	6" „ ... ... „	2	0
20a.	2" „ ... ... „	0	5
21.	1½" „ ... ... „	0	4
22.	1" „ ... ... „	0	3
23a.	½" „ ... ... „	0	3
	Pulley Wheels without centre boss and set screw:		
22a.	1" diam. ... ... each	0	2
23.	½" „ ... ... „	0	2
24.	Bush Wheels ... ... „	0	4
27a.	Gear Wheels, 57 teeth to gear with ½" pinion ... „	0	6

No.		s.	d.
27b.	Gear Wheels, 133 teeth to gear with ½" pinion (3½" diam.) ... ... each	1	3
28.	Contrate Wheels, 1½" diam. „	0	9
29.	„ „ ¾" „ „	0	6
30.	Bevel Gear, ⅞", 26 teeth „	0	9
31.	Gear Wheels, 1", 38 teeth „	1	0
32.	Worms ... ... „	0	5
34.	Spanners ... ... „	0	2
44.	Cranked Bent Strips ... „	0	1
45.	Double „ „ ... „	0	1
46.	Double Angle Strips, 2½" × 1" ... ... ½ doz.	0	6
53.	Perforated Flanged Plates, 3½" × 2½" ... each	0	3
55.	Perforated Strips, slotted, 5½" long ... . „	0	2
57b.	Hooks, Loaded, Large „	0	2
63a.	Octagonal Couplings ... „	0	8
63b.	Strip Couplings ... ... „	0	8
65.	Centre Forks ... ... „	0	1
72.	Flat Plates, 2½" × 2½" ... „	0	2

No.		s.	d.
76.	Triangular Plates, 2½" each	0	2
77.	„ „ 1" „	0	1
80a.	Screwed Rods, 3½" ... „	0	3
90a.	2½" Curved Strips, cranked, 1⅜" radius, 4 to circle „	0	1
94.	Sprocket Chain, per 40" length	0	6
95.	Sprocket Wheels, 36 teeth, 2" diam. ... ... each	0	5
95b.	Sprocket Wheels, 56 teeth, 3" diam. ... ... each	0	6
99.	Braced Girders, 12½" long ½ doz.	2	6
103d.	Flat Girders, 3½" long „	0	7
109.	Face Plates, 2½" diam. each	0	4
110.	Rack Strips, 3½" ... ... „	0	2
113.	Girder Frames ... ... „	0	3
116.	Fork Pieces, Large ... „	0	3
118.	Hub Discs, 5½" diam. „	1	3
119.	Channel Segments (8 to circle, 11½" diam.) ... „	0	4
120.	Buffers ... ... „	0	2
123.	Cone Pulleys ... ... „	1	3

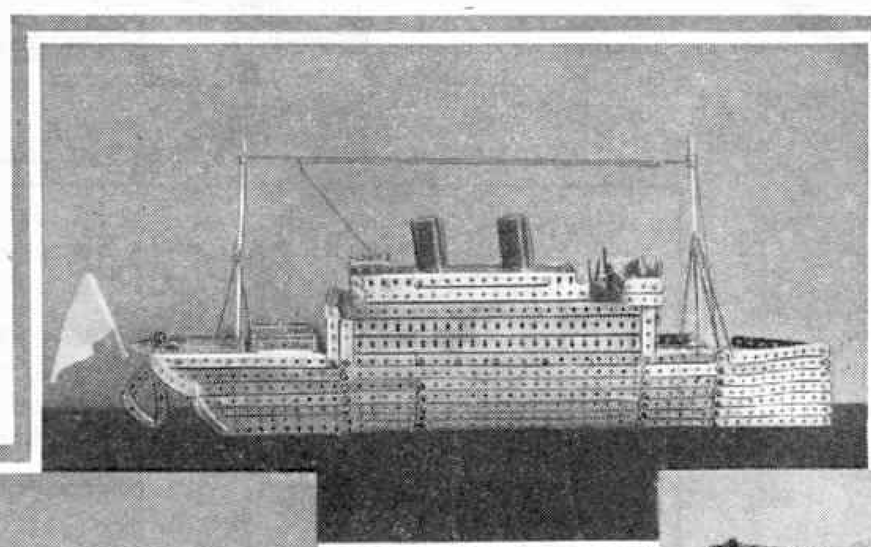
No.		s.	d.
125.	Reversed Angle Brackets, ½" ... ... ½ doz.	0	3
126.	Trunnions ... ... each	0	2
126a.	Flat Trunnions ... ... „	0	1
128.	Boss Bell Cranks ... „	0	3
129.	Rack Segments, 3" diam. „	0	5
130.	Eccentrics, Triple Throw „	1	0
132.	Flywheels, 2¾" diam. „	2	0
133.	Corner Brackets, 1½"... „	0	1
136.	Handrail Supports ... „	0	3
137.	Wheel Flanges ... ... „	0	3
139.	Flanged Brackets (right) „	0	2
140.	Universal Couplings ... „	0	10
143.	Circular Girders, 5½" diam. ... ... „	1	0
144.	Dog Clutches ... ... „	0	6
145.	Circular Strips, 7½" diam. over all ... ... „	0	9
146.	Circular Plates, 6" diam. „	1	0
147.	Pawls, with pivot bolt and nuts ... ... „	0	3
148.	Ratchet Wheels ... „	0	6

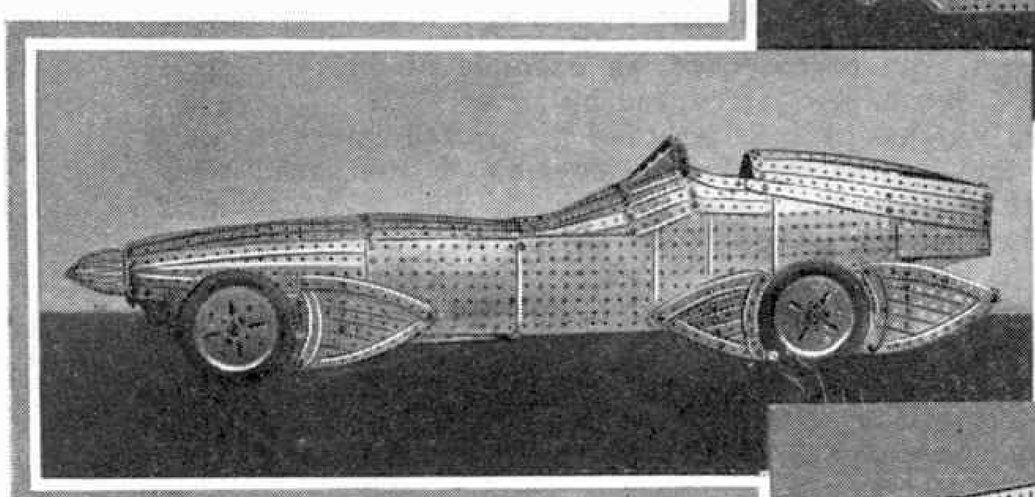
Meccano Model-Building Contest

A Special Announcement to New Meccano Users

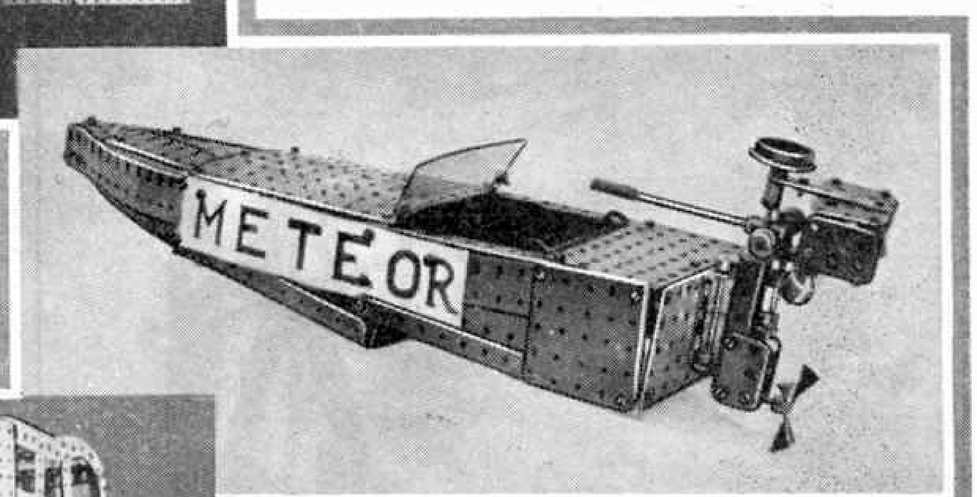
Were you one of the many thousands of boys who received a present of a Meccano Outfit this Christmas ? If so the following announcement will interest you, for it explains how you can turn the Outfit to good use in winning valuable prizes while enjoying the pleasures of model-building.

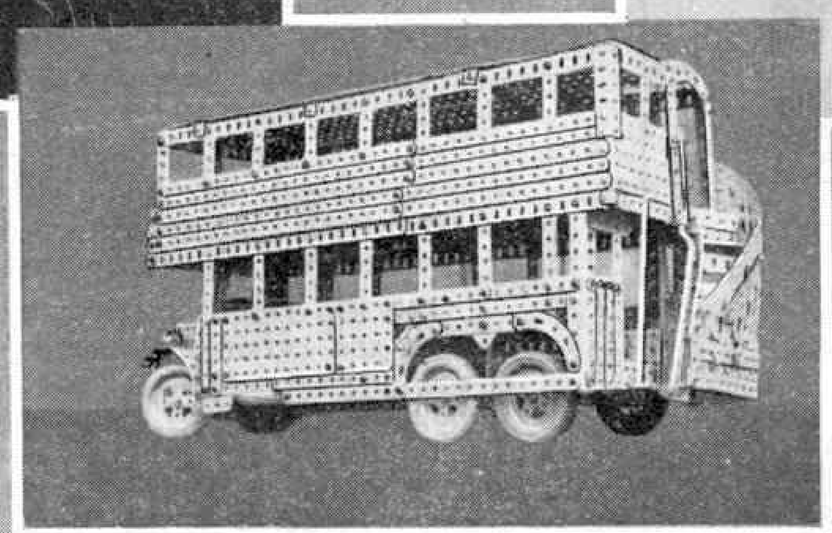
Each month on this page a new model-building competition is announced. These contests are open to every owner of a Meccano Outfit, and there is no entrance fee to pay. The idea of these competitions is to encourage boys to build better models, and prizes are awarded each month to the builders of those models that the judges consider to be the best. The rules and conditions are so simple that there is no reason why any Meccano user should not become a regular competitor.





A selection of prizewinning models from recent Meccano Competitions.





The first of the 1934 series of competitions is announced here, and the prizes offered are listed at the foot of this page. To enter the competition, all that it is necessary to do is to build a model from your own ideas, and then prepare either a photograph or a good drawing of it and send it to us. In building the model you are allowed absolutely free choice of subject. You may build a crane, a ship, a motor car, or any other engineering model that you can think of, and you may use any number of parts or size of Outfit. The model must be entirely your own unaided work. The actual model must not be sent in any Meccano competition.

No matter what your age may be you have an equal chance with other competitors, because the entries will be divided into sections according to age, as follows:– A, for competitors over 14 living in the British Isles ; B, for competitors under 14 living in the British Isles ; C, for competitors living O erseas. Although Overseas entries are grouped into one section, the age of each competitor will be considered when judging the models. It will therefore be seen that no matter where you live or what your age may be, you are eligible to become a competitor.

In building your model you should try to construct it as strongly and realistically as possible. Endeavour to copy the prototype faithfully, but only the most important details should be included, as too many minor details detract interest from the main features. A model that is sturdily built will attract greater attention from the judges than a model that is badly proportioned, and in which little care has been taken to obtain a neat appearance.

After the model is completed the next job is to obtain either a photograph or a good drawing of it. These need not be your own work, but may be prepared by others if necessary. If possible, it is best to send a photograph, and this should be clear and sharp. Write your age, name and address carefully on the back of the photograph or drawing, and also the letter A, B or C indicating the Section for which you are eligible. The envelope containing your entry should be addressed "Winter Model-Building Contest," Meccano Ltd., Binns Road, Liverpool 13.

Entries for Sections A and B should be posted so as to reach Liverpool not later than 28th February, 1934. The closing date for Section C is 30th April, 1934.

Photographs or drawings of prizewinning models become the property of Meccano Ltd., but unsuccessful entries will be returned to competitors provided that a stamped addressed envelope is enclosed with the entry. More than one model may be submitted if desired.

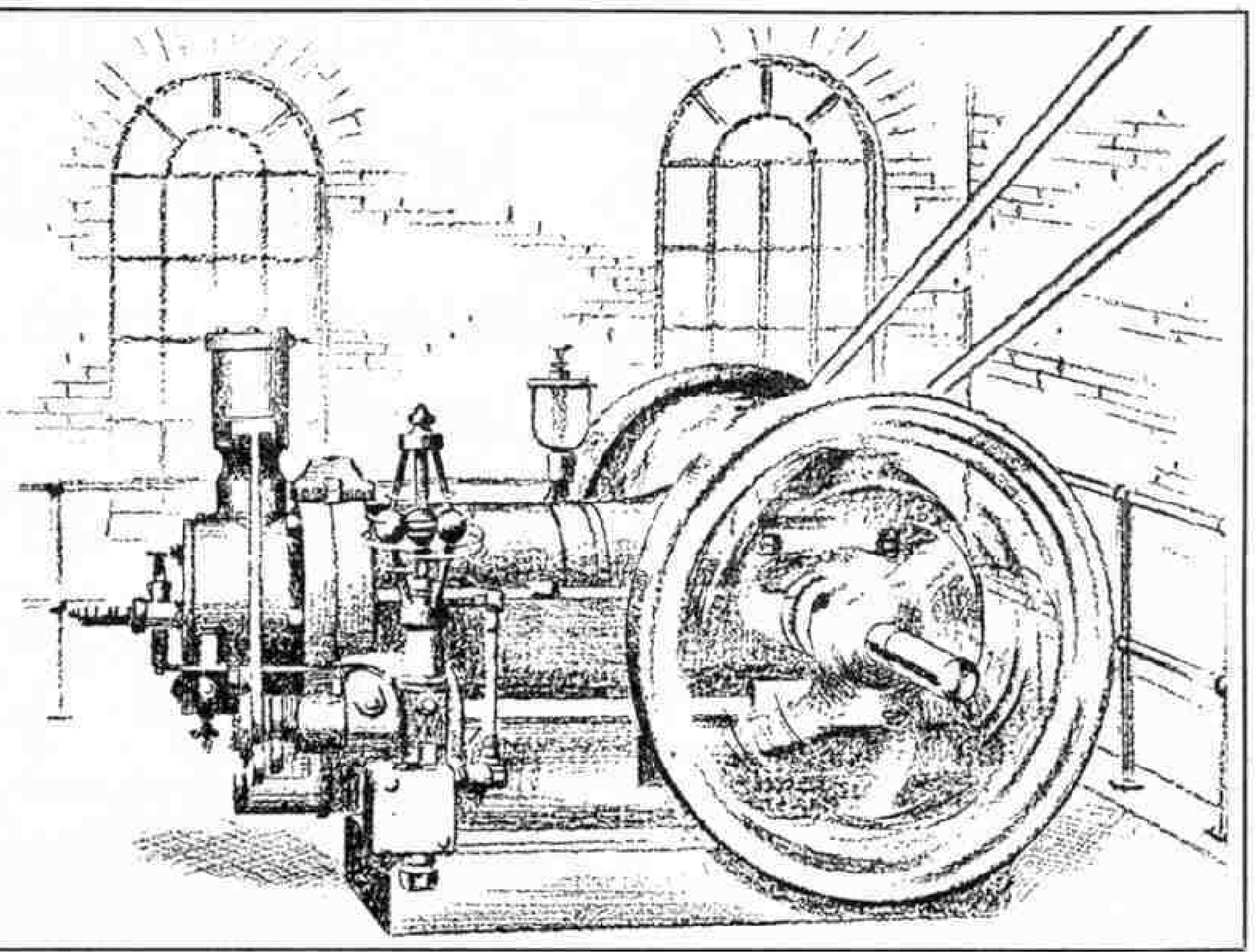
"Winter" Model-Building Contest

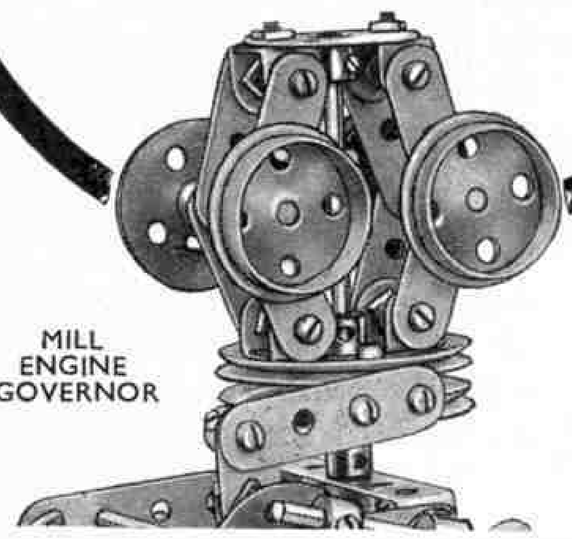
The Prizes

The following set of prizes will be awarded in each of the Sections A, B and C.

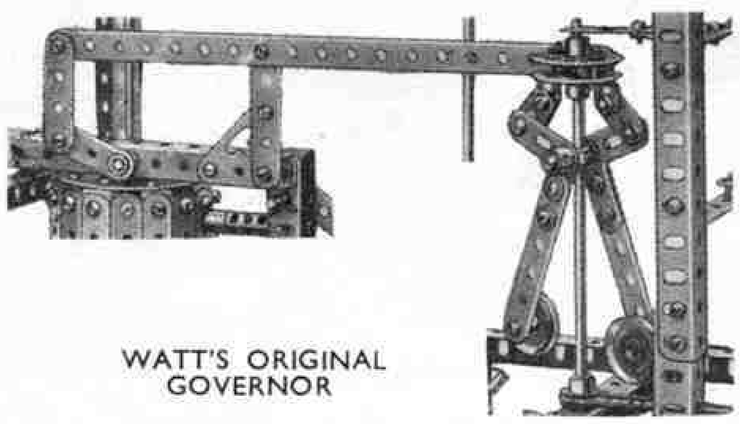
First, Meccano and Hornby Goods value £3-3s.
Second, Meccano and Hornby Goods value £2-2s.
Third, Meccano and Hornby Goods value £1-1s.
Five Prizes of Meccano and Hornby Goods value 10/6.
Five Prizes of Meccano and Hornby Goods value 5/–.
Ten Prizes of "How To Use Meccano Parts" Manuals.
Twenty Certificates of Merit.

Examples of MECCANO Model Construction

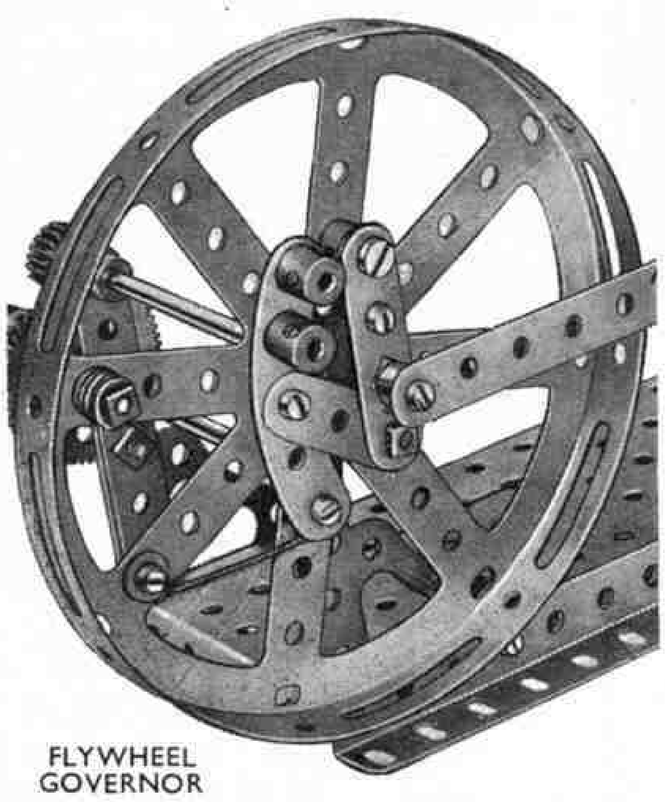




MILL ENGINE GOVERNOR



WATT'S ORIGINAL GOVERNOR



FLYWHEEL GOVERNOR

II. ENGINE GOVERNORS

A steam engine is designed to run under a load at a certain speed. If the load on it is reduced suddenly the engine tends to speed up rapidly and to "race," thus wasting steam and possibly also causing damage. To prevent this a mechanism known as a governor is fitted.

A well-known type of governor, an example of which is seen in the illustration above, was introduced by James Watt. It consists of two or three weights or balls attached to pivoted levers in such a manner that they are rotated by the engine. If the speed rises above normal the balls move outward from the axis of rotation, as the result of the increase in centrifugal force; and this movement is transmitted to a valve that partly closes, and thus reduces the steam supply. As the speed decreases the balls fall inward, the valve opens, and more steam reaches the engine. In this manner the engine is made to run at constant speed under greatly varying loads. Another type of governor is attached to the flywheel of the engine, and regulates the speed by varying the movement of the eccentric that operates the valve.

The operation of engine governors is made perfectly clear by building models of them with Meccano parts. Three interesting models of this type are shown on the left, and they give a good idea of the realistic appearance that is typical of all Meccano models.

The top model shows a type of governor that is used in mill engines and other slow-moving engines. In the centre is a model of the original centrifugal governor used by James Watt in his early pumping engines. By comparing this model with the drawing at the top of the page it will be seen how little this governor has altered since it was first introduced more than 100 years ago. The bottom Meccano model is of the flywheel type, which is more efficient than the centrifugal type for high-speed engines, and especially those that are subject to large variations of load.

PRICES OF MECCANO OUTFITS

Outfit				Outfit			
No. X1 ...	Builds 70 models		1/3	No. 3 ...	Builds 687 models		27/6
No. X2 ...	,, 96	,,	2/–	No. 4 ...	,, 753	,,	52/6
No. OOO	,, 162	,,	2/6	No. 5 (Carton)	,, 798	,,	70/–
No. OO ...	,, 189	,,	3/6	No. 5 (Cabinet)	,, 798	,,	100/–
No. O ...	,, 343	,,	5/–	No. 6 (Carton)	,, 844	,,	125/–
No. 1 ...	,, 573	,,	10/–	No. 6 (Cabinet)	,, 844	,,	155/–
No. 2 ...	,, 629	,,	16/–	No. 7 (Cabinet)	,, 889	,,	415/–

MECCANO LTD., Binns Road, Liverpool 13

MECCANO

Model-Building Contest Results

By Frank Hornby

"Meccanitian" Competition (Home)

As a result probably of the fact that a large Outfit is not necessary to build a really interesting "Meccanitian" model, the number of entries in the Home Section of this Competition exceeded my expectations, and the quality of the work was so good that it was a difficult task to choose the best. Finally, however, it was decided to award the prizes to the competitors named in the following list :—

Home Section

FIRST PRIZE, Meccano or Hornby Goods value £2-2s.: A. Turnbull, Consett, Co. Durham. SECOND PRIZE, Goods value £1-1s.: L. Simson, London, E.17. THIRD PRIZE, Goods value 10/6: B. Pilgrim, Croydon, Surrey.

TEN PRIZES of Goods value 5/-: J. Kemsley, Liverpool 17; A. Stait, Prittlewell, Essex; A. Davies, Swansea; H. Everitt, London, S.W.16; J. Mann, Otley, Yorks.; J. Macken, Bromley, Kent; J. Bailie, London, N.11; J. Espir, London, N.W.6; H. Finch, Walton-on-Naze, Essex; D. Whiting, Newport, Mon.

"MECCANO ENGINEER'S POCKET BOOKS": G. Rayworth, Newark, Notts.; J. Cushion, Chard; B. Boston, London, W.3; J. Jackson, Bournemouth; D. Rice, Liverpool 17; H. Cunningham, Belfast; B. Dwyer, Bromley, Kent; J. Tourtel, Guernsey, C.I.; S. Pain, London, S.W.9; C. Walton, Reading; D. Rooke, Ilford; P. Barefoot, Ipswich; J. Robinson, Rugby; G. Merry, Dunlavin, Co. Wicklow.

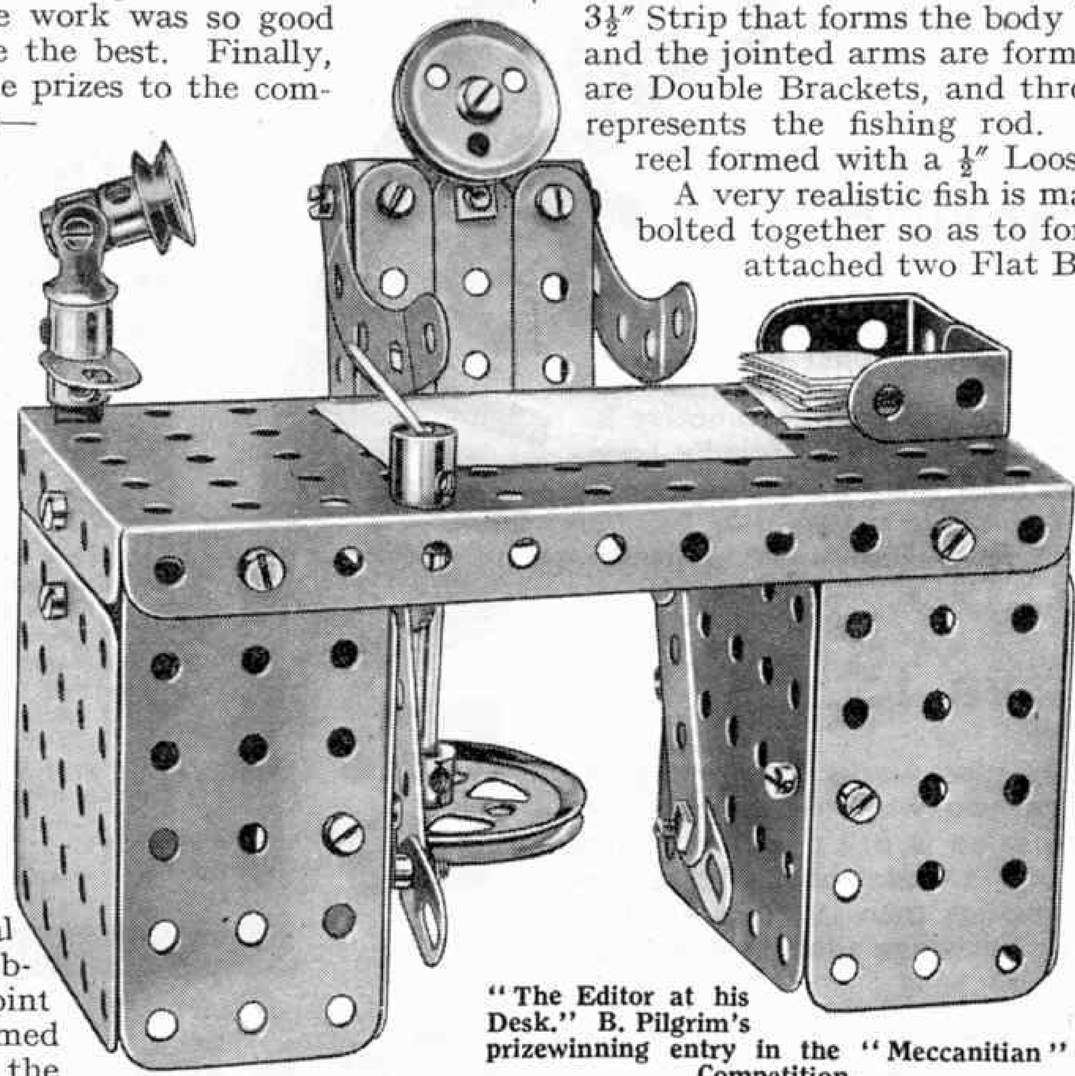
Two models were entered by Albert Turnbull of Consett, and as usual when more than one model is submitted, they were judged on their joint merits. One of the models is named "The Wandering Minstrel," and the other is "G. McKarno riding *Sector Plate* to victory in the Hornby Stakes." The minstrel is built as follows :—The body consists of a Flat Trunnion, to the apex of which a 1″ Loose Pulley is attached by means of a 1½″ Strip. The Pulley represents the minstrel's head, its three holes and a Bolt Head forming excellent features. The right arm consists of a 1″ × ½″ Angle Bracket bolted to the bottom of the Flat Trunnion, which is fitted with ½″ × ½″ Angle Brackets for feet. A 1½″ Pulley secured to the body by the same Bolt as that which holds the right leg in place, and a 2½″ Strip bolted to it, form the banjo, which rests in a Double Bracket that represents the left hand.

Turnbull's other model is equally ingenious. The horse has a body consisting of a Sector Plate, and his neck is made of two Curved Strips, which are bolted to the top and centre holes of the wider end of the Sector Plate. Across the top of the Strips are bolted two 2½″ Strips to form the head, while two Flat Brackets make realistic ears. A businesslike tail is made from a Curved Strip, and the legs, arranged so as to produce a galloping effect, are made of 2½″ Strips.

The body of the rider is a 3½″ Strip to which are attached arms and legs consisting of 2″ Strips, and a 1″ Loose Pulley is used for the head. The rider is fixed to the horse in a most realistic attitude. Besides making excellent use of Meccano parts, the model is most appropriately titled, indeed the title is as ingenious as the model itself.

The model that secured Second Prize shows an angler just in the act of landing an enormous fish, and judging by the expression on his face it appears that he is wondering whether anybody will believe him when he tells them the size of his "catch"! The model is mounted on a baseplate consisting of a 5½″ × 2½″ Flanged Plate. The angler's body is a 3½″ Strip with a Cranked Curved Strip bolted to it, and his legs consist of a 2½″ Strip and a Curved Strip. By using the Curved Strip for one leg, the angler appears to be leaning backward and pulling against the weight of the fish. The head, a 1″ loose Pulley, is secured to the top of the 3½″ Strip that forms the body by means of a ½″ × ½″ Angle Bracket, and the jointed arms are formed by 1½″ Strips. The man's hands are Double Brackets, and through them passes an Axle Rod that represents the fishing rod. The line passes round a winding reel formed with a ½″ Loose Pulley.

A very realistic fish is made from two Cranked Curved Strips bolted together so as to form an oval, to one end of which are attached two Flat Brackets that represent the fish's tail. The space between the Curved Strips is filled in by means of a Flat Girder bolted to one of them. The fish is attached to the end of the line, and a small stool made from 1½″ Slotted Strips and a Flat Bracket is placed in one corner of the baseplate behind the angler and adds the finishing touch to a realistic picture.

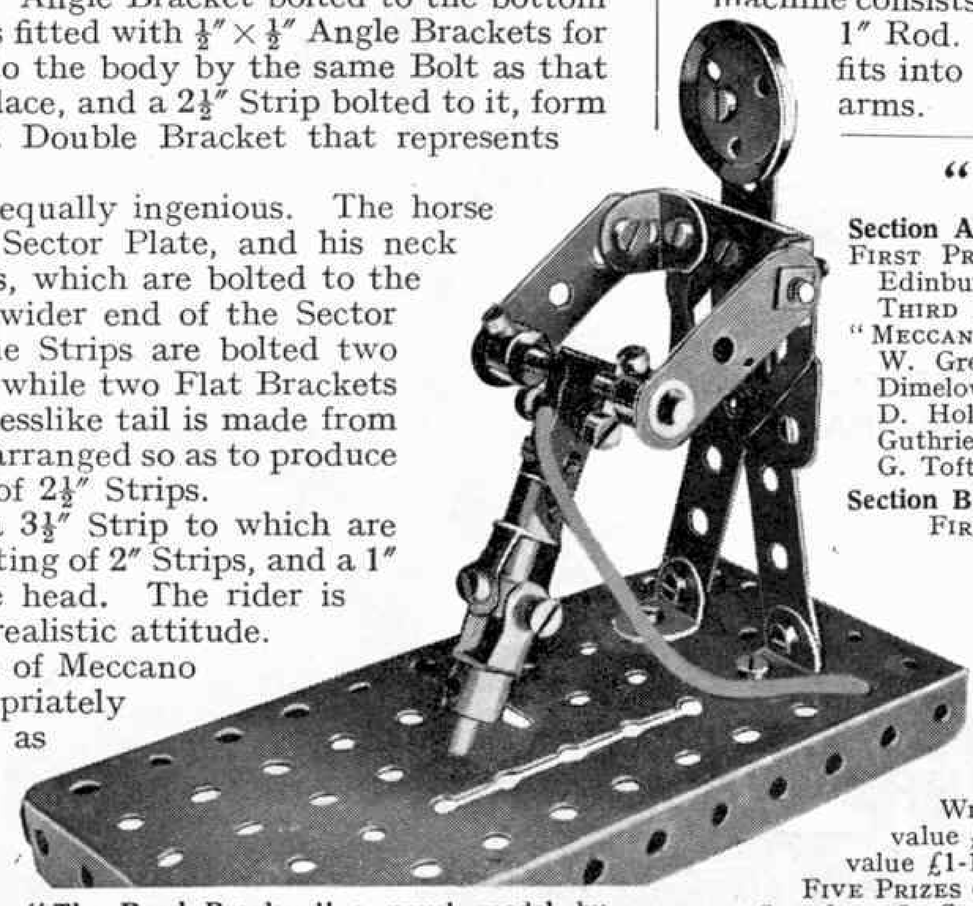


"The Editor at his Desk." B. Pilgrim's prizewinning entry in the "Meccanitian" Competition.

One of the illustrations on this page shows a model of "The Editor at his Desk." It was built by B. Pilgrim, and is particularly interesting because of the detail it possesses, special points being the telephone and an ink-well formed from a Threaded Boss.

I should like to describe the construction of all the prizewinning models, but unfortunately the limited space available permits me to mention only the more noteworthy entries.

The other illustration on this page shows a navvy at work with a pneumatic road drill. The body of the workman consists of two Flat Trunnions, while the legs and arms are made from Strips, Cranks and Angle Brackets. The drilling machine consists of a 2″ Rod, a Coupling, a Universal Coupling and a 1″ Rod. A piece of wool is used for the pipe, and the handle fits into the bosses of the Cranks that form the workman's arms.



"The Road Breaker," a novel model by J. Bailie, London, N.11.

"Model Suggestions" Contest

Section A (Home competitors)

FIRST PRIZE, Meccano or Hornby goods, value £1-1s.: J. Johnson, Edinburgh. SECOND PRIZE, goods value 15/-: W. Bodell, Romford. THIRD PRIZE, goods value 10/6: G. Ransom, Cowes, I.O.W.

"MECCANO ENGINEER'S POCKET BOOKS": N. Taylor, Mitcham, Surrey; W. Greenwood, Stalybridge; P. Howarth, Grange-over-Sands; B. Dimelow, Warrington; H. Taylor, Gerrards Cross; L. Luck, Portsmouth; D. Holloway, Squirrels Heath, Essex; L. Slater, Portsmouth; J. Guthrie, Bonhill; J. Leeson, Brigg, Lincs.; R. Newhouse, Birkenhead G. Toft, Oldham.

Section B (Overseas competitors)

FIRST PRIZE, Meccano or Hornby goods, value £1-1s.: D. Bannerman, Vancouver. SECOND PRIZE, goods value 15/-: D. Tolkowsky, Palestine. THIRD PRIZE, goods value 10/6: W. Thomson, Alberta, Canada.

"MECCANO ENGINEER'S POCKET BOOKS": R. Begg, Hamilton, Ontario; R. Inch, Montreal; H. Eustis, Alberton, S. Aust.

"Tug Boat" Lynx-Eye Contest

FIRST PRIZE, Meccano or Hornby Goods value £3-3s.: C. Wrayford, Moretonhampstead, Devon. SECOND PRIZE, Goods value £2-2s.: A. Khandwalla, Karachi, India. THIRD PRIZE, Goods value £1-1s.: A. Stapleton, Derby.

FIVE PRIZES of Meccano or Hornby goods value 10/-: A. Ingall, Moose Jaw, Canada; J. Gnanadurai, Trichinopoly, India; B. Choksi, Bombay, India; A. Abdulrahim, Karachi, India; J. G. Gnanadurai, Trichinopoly, India.

TEN PRIZES of Meccano or Hornby goods value 5/-: C. Spencer, Warsash, Hants.; S. Cutteridge, Wimblington, Cambs.; S. Smith, Enfield Highway, Middx.; D. Atkinson, Yalwal, Aust.; C. McCain, Sydney, Aust.; R. Atkinson, Punchbowl, Aust.; R. Walton, Sydney, Aust.; M. Bartels, Pretoria, S.A.; N. Gulamabas, Bombay, India; C. Akrell, Stockholm, Sweden.

In addition a number of prizes consisting of "Meccano Engineer's Pocket Books" have been awarded.

NEW LOCOMOTIVES FOR OLD

Hornby Locomotives are the Longest Running and Strongest Pulling Locomotives in the World

Here's a plan to secure a fine new Hornby Locomotive

Just think of it, an allowance of 50% on your old Hornby Locomotive ! This is the finest part exchange offer ever made.

The allowance that will be made for your old Locomotive is shown in the list of Part Exchange allowances for Hornby Locomotives given on this page. Please note that the catalogue price of the new Hornby Locomotive you purchase *must not be less than double the Part Exchange allowance made for your old Locomotive.*

What you have to do

Here is an example of how the plan works. Assuming you have a No. 1 Tank Locomotive that you wish to exchange, you see from the list that its exchange value is 6/3. You then look at the Hornby Train catalogue and choose one of the new Locomotives, the cost of which is not less than 12/6 (or, in other words, not less than double the Part Exchange allowance we make for your No. 1 Tank Locomotive).

You decide, say, to have a No. 2 Special Tank, the price of which is 25/–. Pack up your old No. 1 Tank and deduct 6/3 from 25/– (the price of the new No. 2 Special Tank) enclose a remittance for 18/9 plus 1/– carriage on the new Locomotive—19/9 in all. Send the Locomotive and the remittance to Meccano Limited, Liverpool 13.

Alternatively, you can take your old No. 1 Tank Locomotive to your dealer with a remittance for 18/9, and he will give you the new No. 2 Special Tank Locomotive that you require.

Part Exchange Allowances for Hornby Locomotives

CURRENT TYPES

MO Locomotive...	1/4
M1/2 Locomotive	2/3
M3 Tank Locomotive	3/9
No. O Locomotive	5/3
No. 1 Tank Locomotive	6/3
No. 1 Locomotive	6/3
LEC 1 Locomotive (Swiss Type)	7/6
No. 1 Special Locomotive	8/3
No. 1 Special Tank Locomotive	8/3
LST M3/20 Tank Locomotive (20-volt)	11/3
No. 2 Special Locomotive	11/3
No. 2 Special Tank Locomotive	11/3
No. 1 Electric Tank Locomotive, Permanent Magnet	12/6
LST 1/20 Tank Locomotive (20-volt)	12/6
LE 1/20 Locomotive (Swiss Type), 20-volt...	13/3
LE 2/20 Locomotive (20-volt)	16/6
No. 2 Electric Tank Locomotive	18/9
No. 3E Locomotive	18/9
No. 3E Riviera "Blue" Locomotive	18/9
No. 3C Locomotive	13/9
No. 3C Riviera "Blue" Locomotive	13/9
Metropolitan C Locomotive	11/3
Metropolitan L.V. Locomotive	20/–

OBSOLETE TYPES

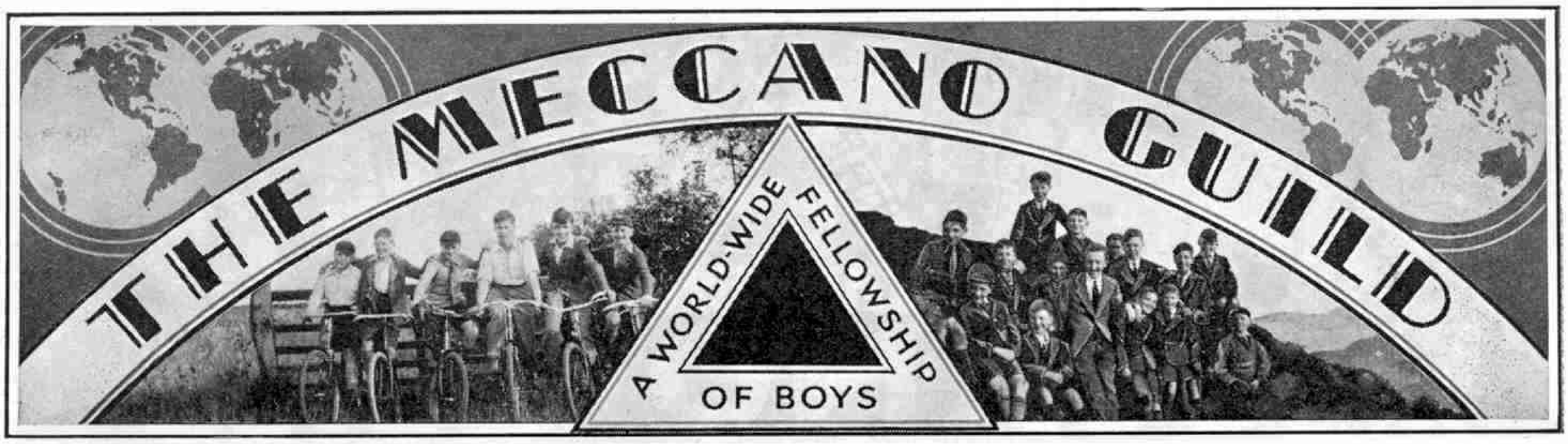
M2930 Locomotive	1/–
George V Locomotive } These models were identical	3/3
No. OO Locomotive } These models were identical	3/3
M3 Locomotive ...	4/3
Zulu Locomotive	5/3
Zulu Tank Locomotive	6/3
No. 2 Locomotive	10/–
No. 2 Tank Locomotive	11/3
No. 1 Locomotive, fitted for Hornby Control	7/6
No. 1 Tank Locomotive, fitted for Hornby Control	7/6
No. 2 Locomotive, fitted for Hornby Control	11/3
No. 2 Tank Locomotive, fitted for Hornby Control	12/6
Metropolitan H.V. Locomotive	20/–

HORNBY TRAINS

BRITISH AND GUARANTEED

Manufactured by
MECCANO LIMITED
Binns Road, Liverpool 13

NO MATTER WHAT THE AGE OR CONDITION OF YOUR OLD LOCOMOTIVE, YOU CAN EXCHANGE IT UNDER OUR "PART EXCHANGE" PLAN.



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 13.

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, and 1/- post free abroad. 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.

In addition to the badge, each member receives a membership certificate, measuring 7″ × 9½″. This certificate is printed in orange and sepia and in design is a smaller edition of the large club certificate.

Write to the Secretary of the Meccano Guild, Binns Road, Liverpool 13, asking for an application form and full particulars. Then fill in the form and return it to Headquarters, when your badge and certificate will be sent you.

Boys living overseas should write to one of the Meccano agents at the following addresses : CANADA : Meccano Ltd., 34, St. Patrick St., Toronto. AUSTRALIA : Messrs. E. G. Page & Co., 52, Clarence Street, Sydney, N.S.W. NEW ZEALAND : Models Ltd. (P.O. Box 129), Paykel's Buildings, Anzac Av., Auckland. SOUTH AFRICA : Mr. A. E. Harris (P.O. Box 1199), 142, Market treet, Johannesburg.

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 more than 300 affiliated clubs in various towns and villages in this country and abroad, together with a number not yet affiliated. 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.

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 many privileges, including the loan of interesting lectures.

All members of the Guild are eligible for the Merit Medallion, which is awarded to those 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 of similar age and interests who live in some other part of the country or abroad.

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 members within three months of the enrolment of his first recruit. As a mark of further merit the medallion is engraved with the name of the recipient and with the words " Special Award " if he recruits three more members in the next three months, making six in all. Full particulars of the Recruiting Campaign, together with a supply of application forms, will be sent on request.

THE THREE GREAT OBJECTS OF THE GUILD

BADGE OF MEMBERSHIP

(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.**

CLUB LEADER'S BADGE

"A Happy New Year"

Once again I have the pleasure of wishing all members of the Meccano Guild a very bright and prosperous New Year. A very large number of them have already sent me their good wishes for 1934, and I have been delighted to receive these, and to read the glowing accounts that accompanied them of happy days spent in Christmas festivities.

During the year the Meccano Guild will celebrate its 15th birthday, and I think that this event should be recognised by record recruiting. This can be done if every member makes up his mind to do his bit, and I shall look forward to the entry into the Guild during the coming year of thousands of enthusiastic Meccano boys, recruited by those who are proud to belong to this world-wide organisation and wish others to share in the movement.

Pursuing a Definite Aim

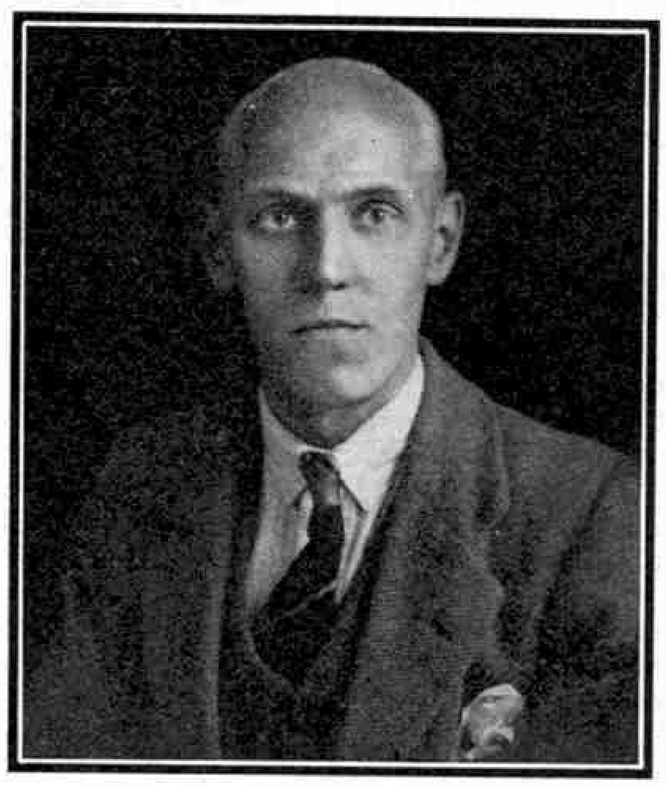
At present club members are in the midst of the gaieties of Christmas and the New Year, and are enjoying Exhibitions, Socials and Concerts. In addition many of them are making excellent use of the special opportunities the season brings them for model-building. Like all good things, holidays will come to an end, however, and soon it will be time to return to normal club life. This need not be less attractive than the special activities of the festive season, however, and members will enjoy ordinary meetings as much as social events if they are made to feel an interest in the purposes behind them. A course I strongly recommend is to arrange that club events in general shall lead up to some definite event. This helps to concentrate interest by providing members with a purpose and they become more closely identified with the aims of the club movement than if they simply attend a succession of ordinary meetings that have no connection with each other.

The usual climax to a series of meetings of this kind of course is an Exhibition. A display arranged to show what members are doing is sure to be beneficial, whether it is attended only by a few parents and friends of members, or is open to the general public. On the one hand, members take pride in being able to show that they are occupying themselves with things that are worth while; and on the other, visitors become keenly interested in a well-planned Exhibition, which may be a means of introducing valuable recruits, or of enlisting the services of grown-up people willing to encourage enterprise and initiative by accepting official positions, or to assist in some other way in the development of the club.

A scheme of this kind need not exclude Games Meetings, Lantern Lectures and other interesting events. These should be arranged at regular intervals in order to give variety to the programme, and after the relaxation they afford, members will return with greater zest to activities connected with their chief purpose. The ideal arrangement is a happy blending of meetings devoted to the club's aim and others specially designed to introduce variety and to stimulate the interest of members.

Meccano Club Leaders

No. 70. Mr. R. Rawlinson



Mr. Rawlinson is Leader of the Hutton Modern School (Bradford) M.C., which received affiliation in March of last year. Its members are keen and capable, and Mr. Rawlinson wisely encourages them to undertake responsibility and display resource by giving them a large share in the management of the club.

Club Reports and Recruiting

The Leader of a well-known club recently sent me a special nomination for a Recruiting Medallion, and I was amused to find, after reading his account of the good work of his nominee, that I was the intended recipient! On reading his letter further, I discovered that my reports on the "*Club Notes*" page of the interesting proceedings at meetings of his club, together with a recommendation to certain members of the Guild living in the neighbourhood of the club room, had resulted in the acquisition of three keen and skilful model-builders.

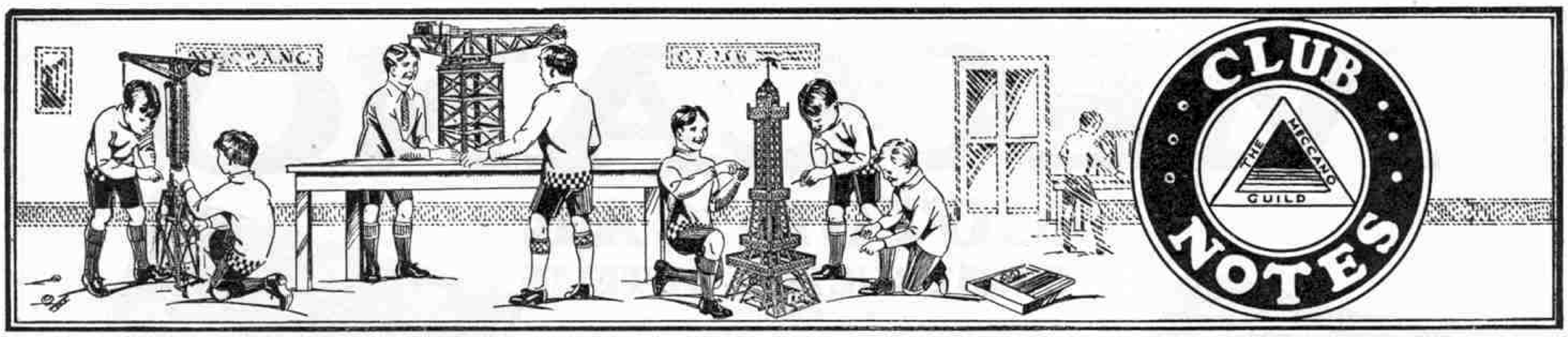
This incident emphasises the value of club reports, and I hope that Leaders and secretaries will continue their efforts to keep me in touch with developments in order to enable me to do full justice to their clubs in the Guild pages of the Magazine. Good reports help members to feel that they belong to an important club, and so stimulate their enthusiasm. They also attract other Meccano boys, some of whom may possess gifts for model-building or organising powers that can be turned to good account in club life. Such opportunities of obtaining recruits should not be overlooked, for a constant stream of new members is by far the best means of ensuring long life and activity to a club, and the point therefore is one of importance to clubs of long standing, as well as to those that are yet in the early stages of their existence and are struggling to become prosperous.

Another point that arises in connection with this incident is the fact that I am often asked by members of the Guild to recommend clubs to them. I am always very pleased to introduce a Guild member to the joys of club life by giving him the information he requires, but I can only do this with complete satisfaction when the clubs with headquarters near the applicant's home are really alive, for it is disappointing to a keen recruit to find that both officials and members of the organisation he has joined are lacking in enthusiasm. Undoubtedly the best means of showing that a club is worth recommending is to produce evidence in regular reports of the enjoyment provided by its activities.

Proposed Clubs

Attempts are being made to form Meccano Clubs in the following places and boys interested should communicate with the promoters whose names and addresses are given below:—

HULL—Mr. H. Mathews, "Sunnymede," 21, Allderidge Avenue, Hull.
NEWBURY—Rev. B. S. Spencer, W. Ilsley Rectory, Newbury.
CLEVEDON—W. Read, 5, Ken Road, Clevedon, Somerset.
TRECASTLE—J. Davies, School House, Trecastle, Breconshire.
ILFORD—Mr. N. G. H. Browning, 5, Valentines Road, Ilford, Essex.
PETERBOROUGH—Mr. F. Law, Abbey Cottage, Thorney, Peterborough.
GT. YARMOUTH—A. W. Allen, 27/8, Broad Row, Gt. Yarmouth.



Old Charlton M.C.—Subjects for Model-Building Contests are set three weeks in advance of the actual competition, and members design and build models at home for display at the appointed time. Recent subjects in these contests have included Motor Cars and Breakdown Cranes. Model-Building Evenings alternate with talks by members, and various entertainments are arranged for other meetings. Club roll: 21. *Secretary:* B. Stevens, 53, Mount Street, Charlton, S.E.7.

Colwyn Bay M.C.—An excellent programme has been arranged for the meetings of this newly-affiliated club, and models have been built for an Exhibition to be held this month. A Cinematograph Show was arranged by one of the members, who brought his own projector for the purpose. A camera, and parts with which to construct a wireless receiving set, have been presented to the club. Club roll: 17. *Secretary:* H. Thomas, Summer Seat, Conway Road, Colwyn Bay.

Anderson Baptist M.C.—The second Annual Exhibition and Concert was very successful. There were many visitors, and the proceeds amounted to £2 10s. 0d. The models entered in the various contests attracted attention, and special interest was taken in the club's printing machine, which throughout the Exhibition was employed in the production of programmes for the Concert that followed. A realistic Hornby Train layout was in operation, and a radiogramophone supplied music. Prizes were presented during an interval in the Concert by the Rev. W. C. King. Club roll: 27. *Secretary:* R. E. Hoffler, 27, Pitcroft Avenue, Reading, Berks.

Constantine (Falmouth) M.C. The winter session began with a business meeting, and this was followed by others devoted to Model-building, and to Billiards, Draughts and other Games. A Firework Display also was included in the programme. Members have taken up cork mat edging and are obtaining excellent results with this new hobby. Club roll: 20. *Secretary:* R. J. Thomas, The Bridge, Constantine, Falmouth.

Queen Elizabeth's Grammar School (Barnet) M.C.—Activities were resumed for the winter with a month of Model-building, leading up to an Exhibition open for two nights. This was well attended, and the Transporter Bridge model, on loan from Headquarters, was a great attraction to visitors. Three Lantern Lectures have been given, the slides for one of them being kindly lent by London Transport. Other interesting events arranged have included a visit to the United Dairies Depot at Finsbury Park. Club roll: 70. *Secretary:* F. Gear, "Quetta," 30, Cranbrook Road, East Barnet, Herts.

St. George's (Edinburgh) M.C.—Model-building and track work on the Club's Hornby Train layout have been carried on. Other interesting features have been short Talks by the Leader. One of these was on "*Foods of all Nations*," and the samples of cake distributed at the end of the Talk were highly appreciated! Members visited the Glasgow Motor Show, and Huntly House, the historical Museum of Edinburgh, and special interest was taken in a friendly visit to St. Giles' Boys' Club. Club roll: 72. *Secretary:* A. Matheson, 18, Hutchinson Terrace, Edinburgh.

Wallington County School for Boys M.C.—Successful Model-building has been the chief feature of the first winter session. Members worked together on a large model of a switchback. In this balls run down from the top of a tower and are returned to the top by means of a mechanism driven by a water wheel through sprocket chains. Concerted Model-building is greatly favoured, and groups of members are busy constructing large models. Club roll: 12. *Secretary:* K. H. Baker, "Glenview," 50, Wordsworth Road, Wallington.

Erith M.C.—The Club Orchestra is busy practising for a Concert organised to increase club funds. New activities in ordinary club work include Stamp Collecting and Electrical Experiments and Demonstrations. Club roll: 35. *Secretary:* S. Tice, 30, Knee Hill, Abbey Wood, London, S.E.2.

Beckenham M.C.—The session began with a Social, at which all members took part in Games and Competitions and enjoyed light refreshments. An excellent programme was arranged at the business meeting that followed. This included Model-Building Contests, Debates, and a Lecture on "*The Story of Petrol*," for which slides were kindly lent by Shell Mex and B.P. Ltd. Club roll: 16. *Secretary:* C. J. Carvell, 45, Sidney Road, Beckenham.

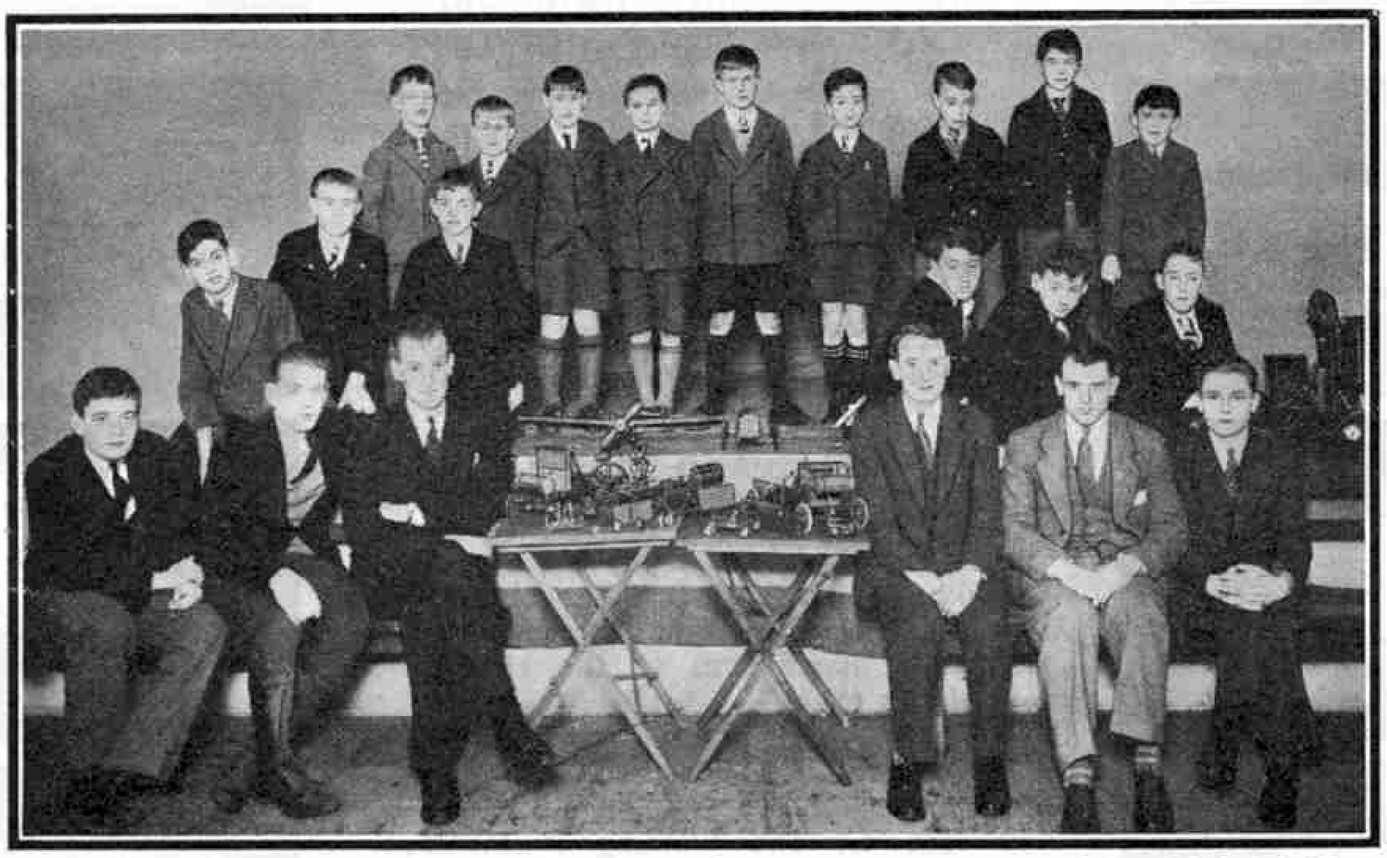
King's School (Peterborough) M.C.—A splendid Model-building programme was followed in the session just ended. Special types of models were built at each meeting, the subjects including Aerial Ropeway, Dockyard Machinery, Cranes, Aeroplanes, and Motors. Contractors' Evening and various types of Model-Building Contests also were included. Special attention this year is being paid to the building of models by the co-operative efforts of members. The Aerial Ropeway was erected in this manner, and the venture is proving very successful, members working enthusiastically with each other in carrying out the plans previously discussed. Members also enjoy Miscellaneous Nights, when they produce interesting and ingenious mechanisms of their own design. Club roll: 28. *Secretary:* C. Shallcross, "Monsville," Garton End Road, Peterborough.

St. Saviour's (Raynes Park) M.C.—Mr. F. T. Newman, Leader of the club since its formation, unfortunately is unable to spare time to attend meetings, and has resigned. He has been succeeded by Mr. Britton, an engineer who has quickly proved capable of inspiring members. The erection of a large Workshop has been begun. This includes Mechanical Drills, Hammers and other machines driven from overhead shafting. A lecture on "*Railways and Railway Working*" has been given by Mr. Willoughby, father of one of the members. Club roll: 8. *Secretary:* R. Woollcott, 33, Crossway, Raynes Park, S.W.20.

Mall School M.C.—Model-building work is being carried on in preparation for the club's Seventh Annual Exhibition. At other meetings cinematograph films have been shown, one dealing with exploration in Yukon being particularly attractive. On Hornby Train Nights engine speed tests have been held, a good number of entries being attracted. A Mock Inquest formed a humorous interlude in the programme. Club roll: 22. *Secretary:* K. W. R. Rubin, Mendy's Lodge, Clifden Road, Twickenham.

Holy Trinity (Barnsbury) M.C.—Model-building is greatly encouraged and all members take part in a Model-building Evening once a fortnight. A special type of model is dealt with on each occasion, and interesting models brought have included an Electricar, a Sand Yacht, a Bentley Racing Car, and several aeroplanes with ingenious mechanisms and accessories. Various sections of the club have made articles for the Church Sale of Work. A Model Aeroplane Section has been formed for junior members, who are at work on the construction of a model of a high-wing monoplane that will be tested by means of short flights. A Branch of the Hornby Railway Company has been formed, and it is hoped that this will be incorporated shortly. Special Instruction Nights have been arranged for various hobbies. Attendance at these is voluntary, but members are very keen. The first number of the new club magazine "*The Flywheel*" appeared in October, and this and the succeeding issues are well-planned and attractive. An interesting feature of the Christmas issue was the reproduction of a series of photographs of members of the club taken in 1918-19 and at intervals down to 1932. Club roll: 62. *Secretary:* J. A. W. Hines, 331, Liverpool Road, Islington, London, N.1.

Hele's School (Exeter) M.C.—A special feature recently has been made of Games Nights and Lantern Lectures have been given on "*Windmills*" and "*The Story of Electrical Communication.*" The first winter session ended with a Social Evening, to the cost of which members made weekly contributions in advance, and an Exhibition of models constructed by members is to be held shortly. Club roll: 15. *Secretary:* J. A. Drake, 7, Barton Terrace, Exeter.



A group of members of the Forest Hill and District M.C. Mr. D. Garnett, Leader of the club, is third from the left in the front row, and E. Barnard, Secretary, is on the extreme right. The club was affiliated in August, 1930, and under Mr. Garnett's enthusiastic guidance, has made splendid progress. Model-building is the chief activity and special attention is paid to originality of design and accurate construction.

AUSTRALIA

Marlborough Mont Albert M.C.—This club has made great progress since its affiliation to the Guild. An excellent club room has been secured through the generosity of Mr. Lothian, an enthusiastic supporter, and members have enjoyed Model-Building Contests and other events of a similar character. Specially attractive items have included a Lantern Lecture by Mr. F. W. Kerr, the City Engineer, on "*A Trip Through Fiji*," and a talk on "*Electricity*" by Mr. C. F. Wright, the City Electrical Engineer. Several keen Debates have been held and Visits have been paid to the Gas Works, the Electric Supply Works, the Printing Office of the "*Argus*" and Newport Railway Workshops. Models exhibited by members of the club were awarded prizes at Exhibitions organised by the Melbourne M.C., and at the Box Hill Hobbies Exhibition. Club roll: 19. *Secretary:* I. L. Scott, 11, Marlborough Street, Mont Albert, Victoria, Australia.

Thebarton Technical High School M.C.—Model-building on a large scale has been carried on, and a specially interesting model constructed is a Cambridge chronograph for measuring short intervals of time. This has been adapted to measuring the time required for members to press a button on hearing a bell ring, and that required to change the direction of a motor car on seeing the lights of an indicator change. Lantern Lectures have been given on "*Switzerland*," "*Wireless*," "*Coins*," "*The Moon*" and "*The Construction of Aeroplanes*." Visits have been paid to the Adelaide Glass and Bottle Works, and to the Thebarton Power House. *Secretary:* D. Medwell, Thebarton Technical High School, Thebarton, South Australia.

NEW ZEALAND

Blenheim M.C.—Model-Building Evenings and Games Nights continue to be the chief attractions. Model-Building Contests are arranged regularly, one that aroused great interest being a Simplicity Contest in which only 15 parts were to be used by each competitor. Working models were built for display in the window of the local Meccano dealer. Club roll: 20. *Secretary:* K. J. Orams, Redwood Street, Blenheim, New Zealand.

Christchurch M.C.—The club organised an exhibit at the Christchurch Winter Industrial Show, the chief attraction on view being a Hornby Electric Train Display. Members continue to show keen interest in Model-Building Contests, in which models of high quality have been entered. Other events have included Lantern Lectures, Cycling Runs and Rambles, and visits to works. Club roll: 44. *Secretary:* J. C. Fleming, 52, Cowlishaw Street, Avonside, Christchurch, New Zealand.

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MOTOR CAR

CONSTRUCTOR OUTFITS

MECCAUTO 538189

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One of the most fascinating of all boys hobbies, either indoor or outdoor, is model car operation with cars built from Meccano Motor Car Constructor Outfits. Perfect miniature reproductions of many different types of car can be built with these splendid Outfits, including sports four-seaters, speed cars, sports coupés and others.

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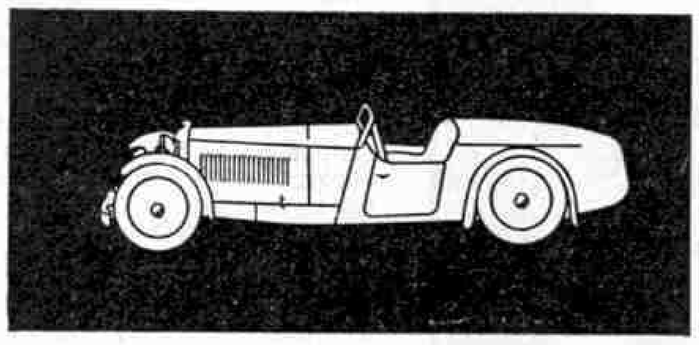
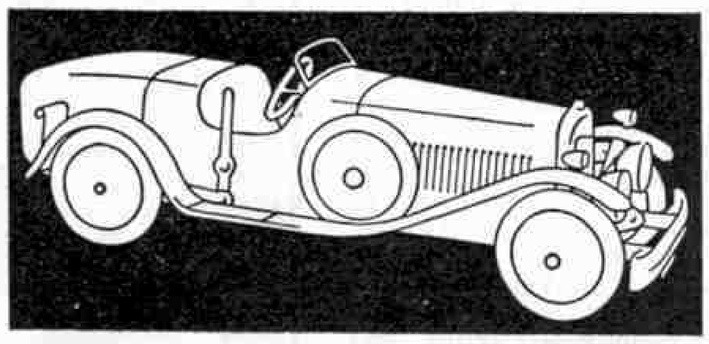
No. 1 Outfit is available in four different colour combinations and is supplied complete with powerful Clockwork Motor.

Price **14/6**



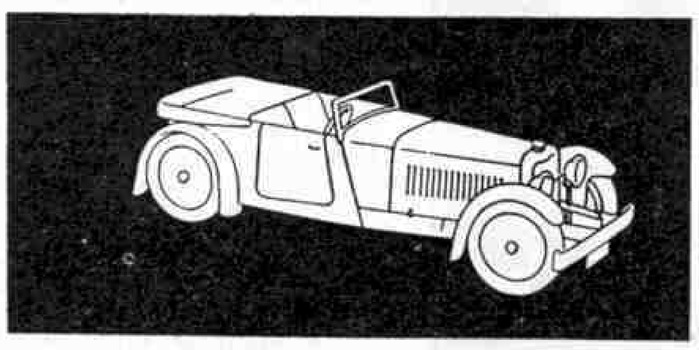


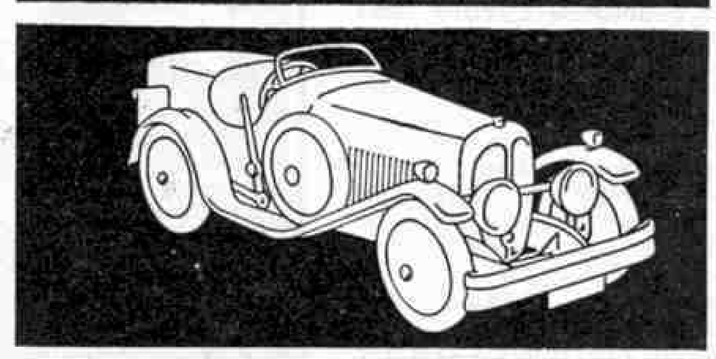
No. 2 Meccano Motor Car Constructor Outfit

Larger models of a superior type can be built with No. 2 Outfit. Their handsome and realistic appearance may be judged from the illustrations at the right-hand side of this page.

No. 2 Outfit is available in four different colour combinations, and a powerful Clockwork Motor that gives a run of 150 feet on one winding is included.

Price **25/-**





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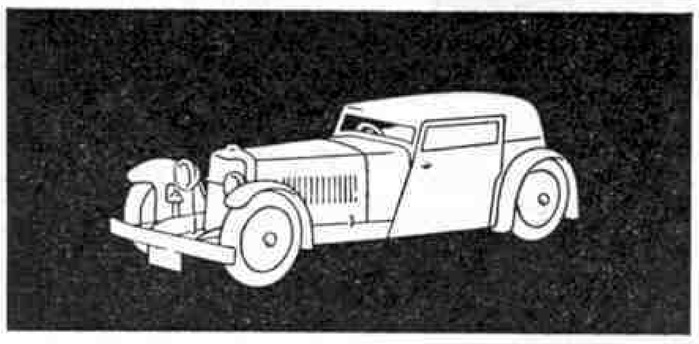
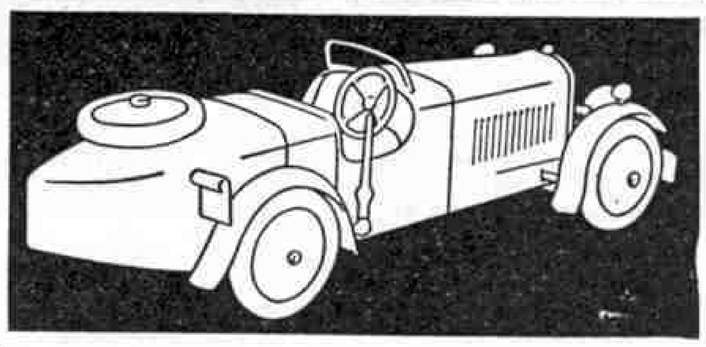
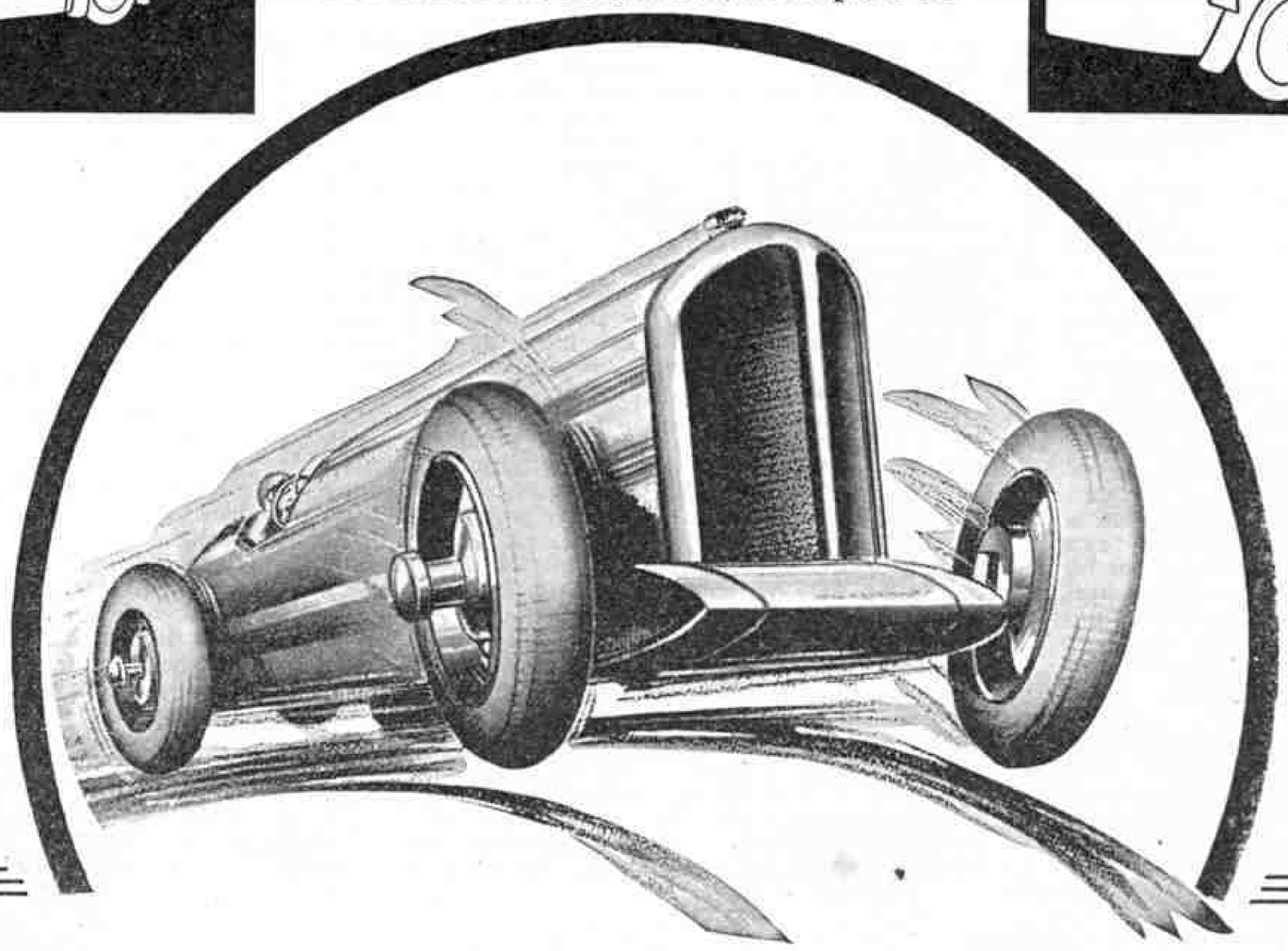




Motor Car Lighting Set

This Lighting Set enables the headlamps of Motor Car models built with the 1933/4 No. 2 Motor Car Outfit to be electrically lighted. Price **2/6**

PRODUCT of MECCANO LIMITED LIVERPOOL



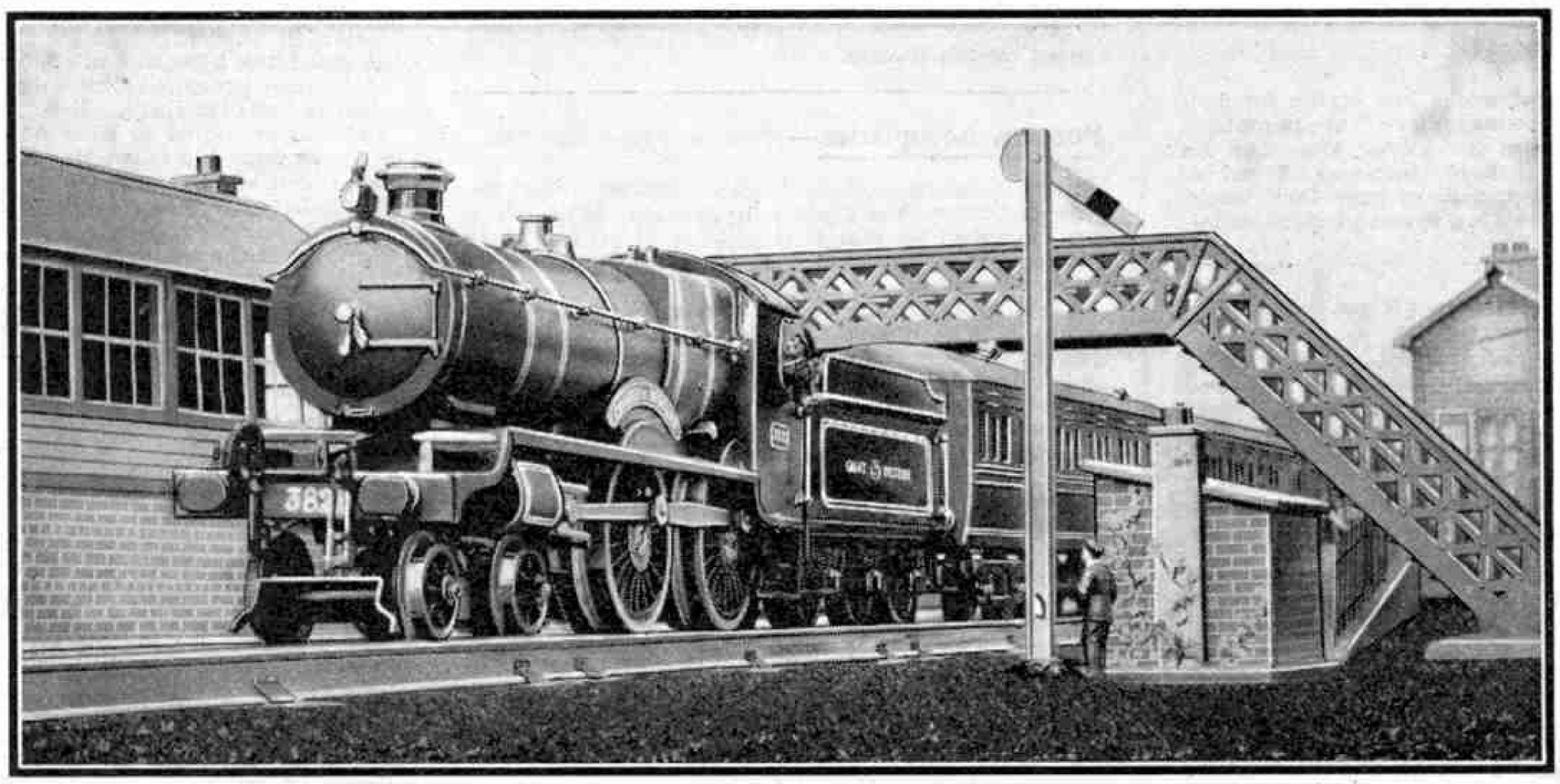
Motor Car Garage

The Meccano Motor Car Garage provides accommodation for any Meccano model motor car or other car of suitable size. It is strongly built, with imitation rough-cast finish. Inside dimensions: Height 5 in., Length 13 in., Width 7¾ in. Price **7/-**

The Hornby G.W.R. No. 2 Special Locomotive

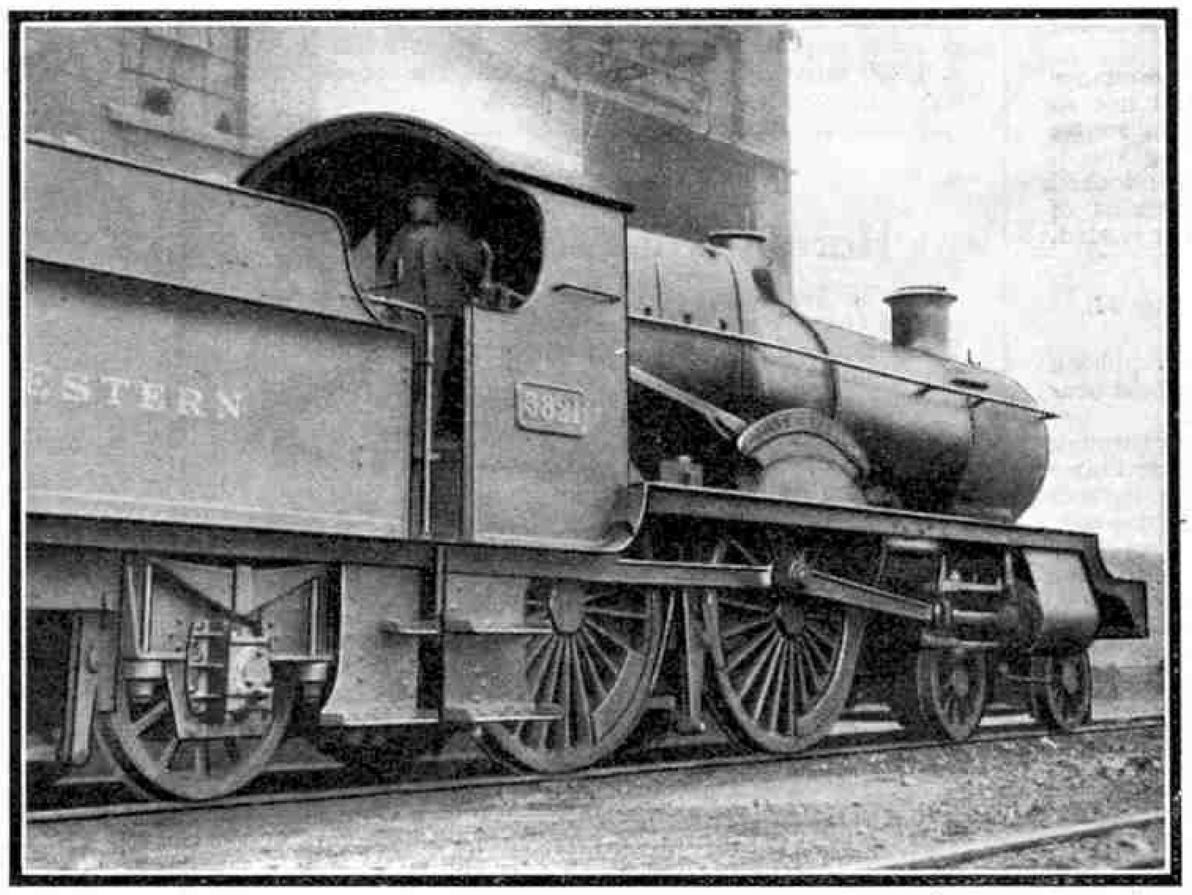
A Fine Miniature Express Engine

A LOCOMOTIVE of the Hornby Series that is extremely popular among miniature railway owners is the G.W.R. No. 2 Special "*County of Bedford.*" Naturally it appeals particularly to those whose layouts are based on Great Western practice, but it also attracts those whose choice favours what we may term a "composite" or joint type of railway on which all groups are represented. The reason in either case is the same, namely, that the essential features of Swindon design are splendidly reproduced, giving the correct "atmosphere" to G.W.R. layouts on the one hand, and on the other hand rendering the engine distinctive and instantly recognisable in an assembly of miniature locomotives of the four groups.



A Hornby G.W.R. No. 2 Special Locomotive leaving a station. Its realistic appearance is very striking, as is evident when it is compared with one of the corresponding real engines shown below.

The most striking feature of the engine is that, like all the principal classes of Swindon origin for the last 30 years, it has a domeless tapered boiler, the safety valves being mounted, not on the fire-box as is usual elsewhere, but on the boiler barrel. The Belpaire fire-box, too, is of essentially Great Western contour, and adds still further to the individuality of the engine. A fire-box detail is that two whistles are provided, as is the Great Western custom, one to give warning of approach, and the other for code signalling purposes.



One of the famous G.W.R. "County" class. The photograph is particularly interesting in that it shows the prototype of the Hornby Locomotive "County of Bedford."

The footplates are raised—a standard G.W.R. feature for many years past—and the cylinders, with their piston valve chests above them, are of the distinctive pattern used on all Swindon engines with two outside cylinders. Each cylinder is connected to the leading driving wheels by a neat piston rod and crosshead assembly and a fluted connecting rod with plain round big end of the pattern commonly applied nowadays with outside cylinders.

The famous No. 2 Special mechanism supplies the motive power, and the latest examples of this have a special method of fixing for the driving wheels. This ensures that the wheels are positively locked in the correct position on the axles by the round nuts that fit in a recess in each wheel boss. These nuts are nickelled, and in conjunction with the plated flange and tyre look extremely smart against the black-enamelled wheel spokes and bosses. This method of fixing has the great advantage of making the wheels removable, which is a convenience for cleaning purposes. To deal with these nuts a slotted screwdriver blade is embodied in a special tool that combines the functions of a rail gauge, screwdriver and spanner. One of these tools is now packed with all Hornby locomotives having this type of wheel fitting.

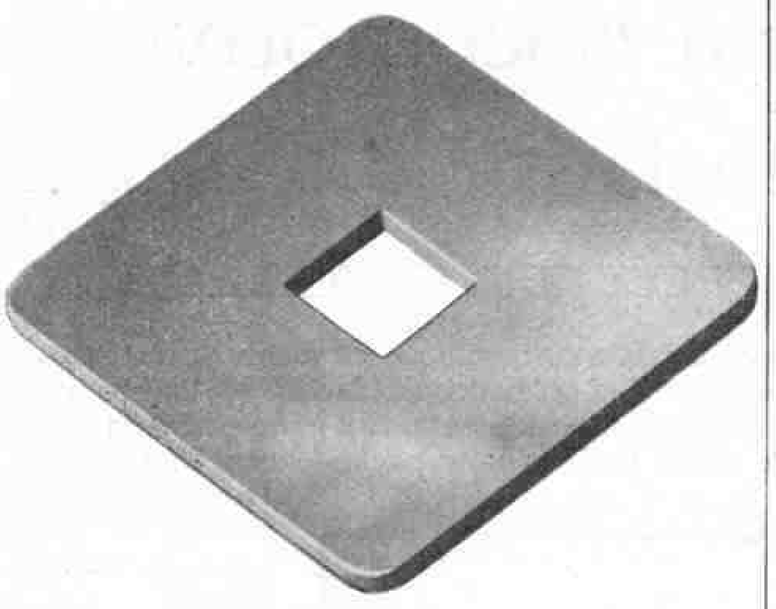
The interior of the cab is well fitted up with a cast dummy fire-box back and footplate. The various fittings are cast in relief, such as the regulator, water gauge, steam and vacuum gauges, and the fire-hole door. These can be picked out individually in a realistic manner by the keen enthusiast who is handy with a paint brush. An illustration and description of the method to be employed appeared on page 387 of the May, 1932, "*M.M.*"

The name of the engine represented, "*County of Bedford,*" appears in the correct style on a large nameplate of the type favoured on the G.W.R., fitted above the driving wheel splashers. The numbers also are transferred on to a raised "plate" on the cab side and they appear on the buffer beam.

The tender follows closely the exterior lines and internal arrangements of the 4,000-gallon vehicle developed during recent years on the G.W.R. The water tanks are specially shaped, so that as coal is shovelled away by the fireman the remaining fuel tends to work its way forward. A division plate is fitted to keep the coal away from the water filler, while air release vents and the typical large dome in connection with the water pick-up apparatus are fitted on the tank. Dummy brake and water scoop handles are fitted on columns at the front end of the tender. Both engine and tender have the correct number of lamp brackets, so that the class of train may be indicated in the orthodox manner by means of the miniature head lamps. Vacuum brake pipes with their dummy hoses are also fitted.

The real "County" class engines of the G.W.R., which the Hornby locomotive represents in such a striking manner, originated in 1904, and formed a notable departure from the usual British types of 4–4–0s then running. Although not extremely large as 4–4–0s go nowadays, the "Counties" were efficient, and certainly assisted in the development of the large modern 4–4–0 locomotive.

An Engineering Problem



At a certain engineering works one of the foremen was very fond of testing the ingenuity of the apprentices by giving them problems to solve. One day he produced a piece of steel plate in which was a hole 1 in. square, and asked the apprentices how they would fill the hole in the plate with a round piece of metal. How can this be done?

Railway Speed Restrictions—(*Cont. from p. 33*)

5 or 15 m.p.h., is shown by what is known as a warning board painted green with a white border. It is shaped like an arrow and is placed about half a mile before the work is reached, and at night it shows a green and a white light side by side. For bridge repairs, or the making of a new bridge under the line, it is generally necessary to carry the rails for a time on longitudinal timbers, and a speed restriction is therefore required.

In order to avoid having a large number of speed restrictions in force at the same time on important routes, engineering work has to be planned long beforehand, and meetings of those concerned are held to arrange a programme so that the number of checks to important trains is kept as low as possible to assist punctuality. Of course emergencies arise, such as slips of earth at cuttings, that cannot be foreseen, and in such cases speed has to be restricted at short notice.

Where men are working in long tunnels that are liable to be full of smoke and generally unpleasant, speed is usually reduced to minimise the risk to the men. This applies especially if the men are working on the roof from scaffolding above the trains.

Although it is not of any practical consequence, it is interesting to note that a very slight check to speed occurs when an engine picks up water from water troughs on the track, the resistance to the scoop being quite considerable. This slight check was recorded by the observers who timed some of the record runs of the "*Cheltenham Flyer*."

It will be realised, therefore, that the maintenance of sustained high speeds on our railways is not so easy as might be supposed, and that certain routes are never likely to provide high figures for speed. Generally speaking the best results may be looked for where powerful engines are used on trains of moderate weight on lines not severely curved or graded.

Magnetising a Poker (*Continued from page 41*)

can be moved by means of the attraction and repulsion between its poles and those of a Bar Magnet held near it, as shown in the illustration on page 40.

In an alternative means of passing a current through a floating coil of this kind, the Copper and Zinc Plates are replaced by thin wires that pass to the bottom of the basin, where they are allowed to form a loose coil. The outer ends of the two wires are led up the side of the basin and thence to the Bichromate Cell. The thinnest wire available should be used for this purpose, in order that its weight may not hamper the movements of the cork carrying the coil.

Whatever form of apparatus is used, this experiment lends itself well to the creation of picturesque effects, for the cork may be cut to the shape of a boat and painted to add to the realism of the scene. Since the coil is flat, it can be hidden in one of the sails, especially if a fore and aft rig is adopted; and the wires leading from it can be disguised as stays or fitted to the mast. If the floating battery is employed, the Copper and Zinc Plates can be concealed by providing the cork hull with a sheath of card or stout paper that extends below water and the vessel will then behave as a completely independent unit.

No iron or steel should be employed in building a magic cutter or schooner of this kind, and the vessel can then readily be controlled by means of magnets, although apparently there are no magnetic materials in it. If in addition, means of concealing the Bar Magnet employed to direct its course are adopted, its movements will arouse great interest and curiosity in the minds of those unfamiliar with the magnetic properties of a coil of wire through which an electric current flows. The employment of wires when current is derived from a separate source will suggest that the means of control used are electrical in character, but that will not decrease interest in the experiment.

Modern Cinema Theatre—(*Cont. from page 7*)

on to the sound track of the film as the film passes through the machine. On the other side of the film is arranged a photo-electric cell that takes up the fluctuating beam of light passing through the film, and causes minute changes in electric current that are amplified and carried to the talkie horns. These horns are usually placed directly behind the screen, in order to produce the illusion that the sound is coming from the figures on the screen. Sometimes the talkie horns are slung on metal tracks so that they may be hauled to the side of the stage when desired, an arrangement that is particularly suitable for theatres where vaudeville items are included in the programme, as it enables the artistes to utilise the full depth of the stage. Alternatively the talkie horns may be mounted on a lift platform that can be raised and lowered as required.

Next month we shall describe the equipment of the auditorium of a modern cinema. Under this heading will be included electric orchestra lifts, colour light apparatus and curtain controllers. In addition will be given some interesting facts concerning the world's largest cinema theatre.

Foreign Aeroplanes—(*Continued from page 27*)

factory established by Maurice Farman, and the present factory was opened in January, 1912. It is now organised so that it is capable of producing 10 machines of various types every day, 5,000 workpeople being employed.

The last machine with which we are dealing in this article is the Junkers F-24K, a commercial cabin monoplane intended for the transport of passengers and freight. It is of the low wing cantilever type, and its most noteworthy feature is that it is equipped with a water-cooled heavy oil engine, the Junkers "Jumo 4," which develops between 600 and 720 h.p. The radiator for this engine is mounted underneath in a special tunnel fitted with shutters. Compressed air equipment is provided for starting up.

The wings and the fuselage of this machine are made of metal on the normal Junkers principle, the metal employed for the skin being the customary Junkers corrugated duralumin sheet. The machine is provided with side-by-side controls in a completely enclosed cockpit, and the main passenger cabin has seats for nine passengers. Behind this is a baggage compartment. When the machine is intended for service purely as a freight carrier, the seats in the main cabin can be removed without difficulty.

The machine is 80 ft. 6 in. in span and 50 ft. in length, and weighs 8,150 lb. empty and 10,350 lb. fully loaded. It has a maximum speed of 122 m.p.h. and cruises at 102.5 m.p.h., at which speed it has a range of 622 miles.

The "Jumo 4" engine is the most recent of a series of Junkers crude oil engines, the first of which was built before the War. It is of the six-cylinder type, the cylinders having a bore of 4.7 in. and a stroke of 8.3 in.; and is 67 in. long, 66½ in. high, and 20 in. wide. When working normally it has an output of 650 h.p. at 1,550 m.p.h., and its maximum output is 720 h.p. at 1,700 m.p.h. During the type test, the engine was tested up to an output of 750 b.h.p.

A New Series of Hornby Miniature Posters

At the beginning of 1932 we introduced a series of Miniature Posters for use with Hornby railways. These Posters consisted of accurate reproductions in full colour of famous advertisements that are to be seen displayed on hoardings all over the country. They were introduced to add to the realism and "life" of Hornby Stations, and they quickly became exceedingly popular.

Readers will be interested to know that there is now available a second series of these Posters. These are even more attractive than those of the first series, and will enable Hornby Railway owners to bring their station advertising up to date.

The Miniature Posters are gummed on the back, so that they may be readily attached to the Station Hoarding, or to walls, buildings, or other features on a layout. They are made in two sizes, and there are available for their display Poster Boards of corresponding size. These Boards are specially suitable for display on Paled Fencing or Footbridges, and are hooked in position by means of two lugs.

There are 53 Posters in the new series, and a sample Poster Board of the smaller size is included in each packet.

"Brooklands—Track and Air"

This interesting magazine (produced at Brooklands Aerodrome, Byfleet, Surrey, price 6d. monthly) is unique in being devoted entirely to motor racing and private flying, with special reference to activities at the famous Brooklands motor course and aerodrome. In addition to a review of the outstanding features of the month, it contains special articles on various topics connected with road, track and air, together with a survey of the most recent machines. The magazine is well produced and excellently illustrated by photographs.

Famous Admirals—(*Continued from page 5*)

The "*Captain*" again suffered severely, and at a signal from Jervis the "*Excellent*," commanded by Captain Collingwood, took a hand and soon silenced the guns of the two larger vessels. Nelson succeeded in boarding both the "*San Josef*" and the "*San Nicolas*," and compelled them to surrender.

During the subsequent confusion among the Spanish fleet the "*San Ysidro*," of 74 guns, struck to the "*Excellent*," and the "*Salvador*," also of 74 guns, surrendered to the "*Orion*," commanded by Captain Saumarez. The remnants of the Spanish fleet drew together and made off toward Cadiz, and Jervis did not pursue them. At the close of the action Nelson went on board the flagship, where Jervis received him on the quarter deck and embraced him, thanking him warmly for his brilliant part in the victory. The total English losses were only 74 men killed and 227 wounded, while the Spanish losses were much more severe and included four ships.

The victory caused great rejoicing in England. Jervis was raised to the peerage with the title of Earl of St. Vincent, suggested by the King; Parliament awarded him a pension of £3,000 a year, and the City of London presented him with sword of honour and the freedom of the city. Nelson received a knighthood, and was promoted to Rear Admiral.

Jervis retired to Lagos Bay to refit his much damaged ships, and when this work was completed he returned to Cadiz and began an intensive blockade of the Spanish port that was maintained until July; and throughout the autumn and winter of 1797 Cadiz was kept under observation. In June 1799 ill-health compelled him to resign his command, but he felt much better by the spring of the next year, and in April he took command of the Channel fleet, and began a severe blockade of Brest. He was promoted First Lord of the Admiralty in 1801, and held this high office for three years, during which time he abolished many abuses in the Navy. In 1806 he was again placed in command of the Channel fleet, but ill-health and his advanced age brought about his final retirement after a brief period at sea.

The great service Jervis had rendered to his country during his long naval career received further recognition in 1820, on the accession of George IV, when Jervis was made Admiral of the Fleet. The significance of this honour lay in the fact that it was a custom of the Navy that there should be only one Admiral of the Fleet, and the office was already held by the Duke of Clarence. Jervis died on 13th March, 1832, aged 90 years, and was buried at Stone, in Staffordshire, and a monument to his memory was erected in St. Paul's Cathedral.

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Branch Notes

CATERHAM SCHOOL.—The resources of the Branch have been increased by a locomotive kindly presented by one of the masters of the school, and by extensions to the Branch track. A special feature has recently been made of Lantern Lectures and similar events. These have included the display of three films, kindly lent by the Canadian National Railways; and lectures by members on "*The History of Railways*" and "*The Centenary of Railways*," slides being kindly lent by the L.N.E.R. Secretary: G. J. H. Dent, Caterham School, Surrey.

WEST LEIGH (LEIGH-ON-SEA).—Special meetings have been arranged for junior members of the Branch. At these layouts previously operated at track meetings have been used in order to give useful practice. An interesting collection of lantern slides of railway and other topics has been made by one of the members and these were displayed at an open meeting arranged for the purpose. Secretary: K. G. Cross, 129, Southsea Avenue, Leigh-on-Sea.

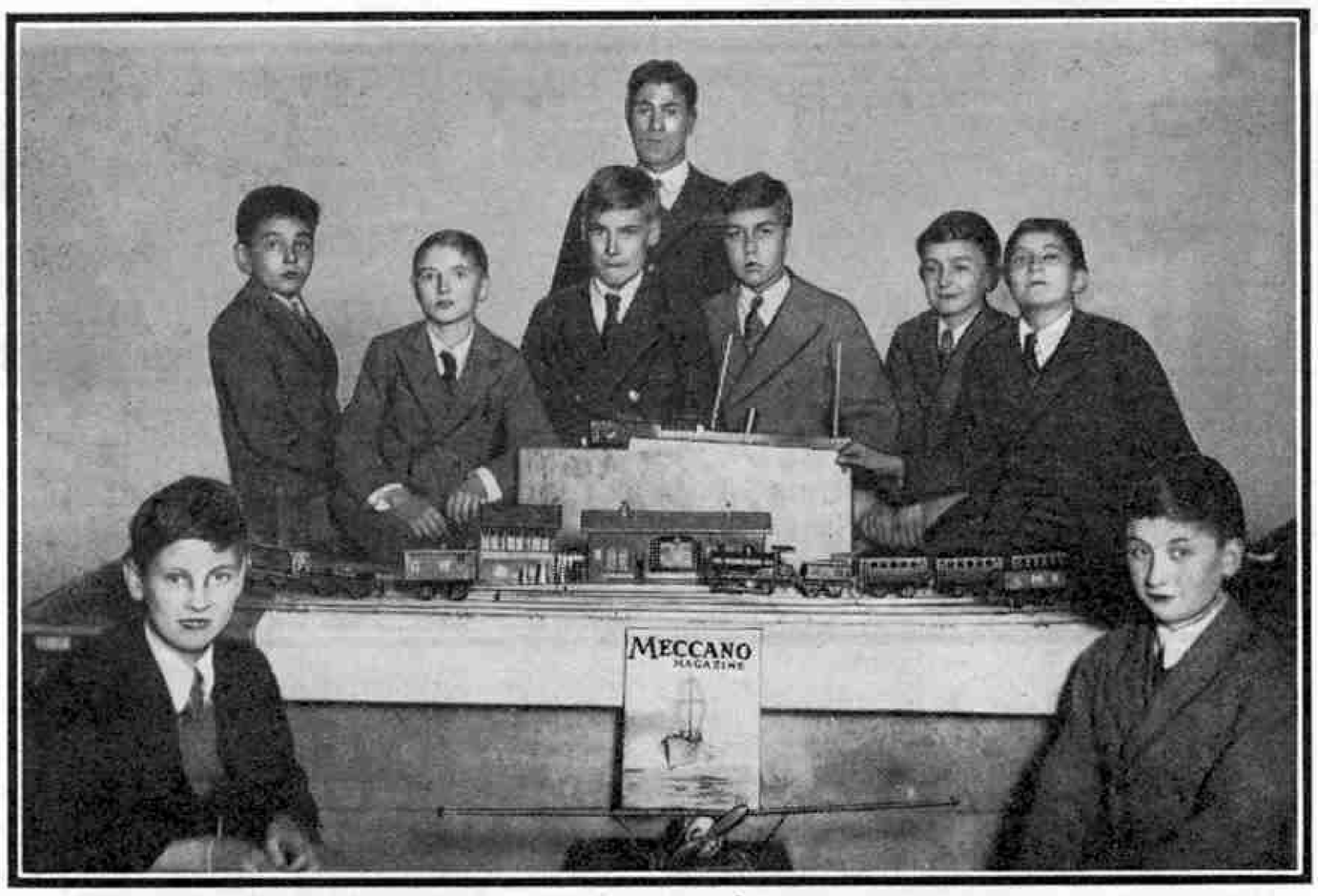
SEFTON.—Interesting meetings have been held in which various new types of track have been tried out. It was decided to keep to simple layouts and timetables, and to arrange an easily-managed system of signalling. The track is continually being extended, and as experience is gained, more complicated timetables are being introduced. A new Branch room has been secured, and this will enable even better layouts to be operated. It is proposed to illuminate the Branch layout by means of floodlights. Secretary: J. Mather, Appleby, Carnatic Road, Liverpool, 18.

MACCLESFIELD CENTRAL SCHOOL.—Good progress is being made, and it is hoped shortly to add to the Branch Hornby Train material from funds built up from members' subscriptions. A special demonstration is to be given at the School Exhibition, and a committee has been arranged to plan the layout. Lantern Lectures on railway topics have been given, slides being kindly loaned by the British Railway Companies, and an excellent Branch Magazine made its appearance. Secretary: A. Morlidge, 4, Blagg Street, Macclesfield.

BELFORT (CATFORD).—A new Branch room has been obtained by arrangement with a local Scout Troop, and a very extensive and interesting track with two terminal stations has been laid down. Members have become interested in Table Tennis, and have been very successful in matches against the local Scout Troop and other Table Tennis teams. "Instruction Night" has been introduced. This is an experimental scheme, by means of which it is hoped to improve track working. Secretary: J. H. Forth, "Gleneagles," 31, Ardock Road, Catford, S.E.6.

BIRSTALL (LEICESTER).—All meetings so far have been devoted to track operations, members being very keen on planning an extensive layout and running passenger and goods trains on it in accordance with correct railway principles. As experience is gained, the track is improved and more ambitious schemes are adopted. An efficient Breakdown Train has been organised, in order to deal with derailments and other accidents. Secretary: G. B. Gibson, 49, Front Street, Birstall, Leicester.

CHARMINSTER (BOURNEMOUTH).—The Branch room has been cleaned and rearranged, and an oil lamp purchased to give adequate illumination. The premises have been made more attractive by introducing new books and magazines in the Library, and several games have been added to the resources of members. A Lantern Lecture on "*The Flying Scotsman*" was given, slides being kindly lent by the L.N.E.R. At track meetings special interest was aroused by the performance of a Hornby No. 2 Special Locomotive, "*County of Bedford*," which out-distanced every other locomotive entered for trial, and showed higher speed. Special attention is now being given to the maintenance of locomotives in good running order. One meeting every month is to be devoted to indoor games. Secretary: B. Guttridge, "Tudor House," Malvern Road, Bournemouth.



A group of members of the St. Saviour's (Raynes Park) Branch, No. 236. Chairman, Mr. W. Brittain, Secretary, D. J. Fielden. At the track meetings of this Branch special attention is paid to timekeeping and two large clocks have been installed in order to leave no excuse for lack of punctuality in the services provided!

AUSTRALIA

PARRAMATTA.—A garage measuring 18 ft. by 10 ft., and fitted with electric light, has been built by Mr. H. H. Matthews, Secretary of the Branch, and meetings are now held in it. The track has been relaid, and members are busy carrying out extensions in order to enable realistic working to be carried on. All are enthusiastic and membership is steadily increasing. Secretary: H. H. Matthews, 27, Ross Street, Parramatta, N.S.W., Australia.

Branches in Course of Formation

The following new Branches of the Hornby Railway Company are at present in process of formation and any boys who are interested and desirous of linking up with this unique organisation should communicate with the promoters, whose names and addresses are given here. All owners of Hornby trains or accessories are eligible for membership and the various secretaries will be pleased to extend a warm welcome to all who send in their applications:—

BRADFORD—Mr. B. Field, 20, West Park Terrace, Bradford, Yorks.

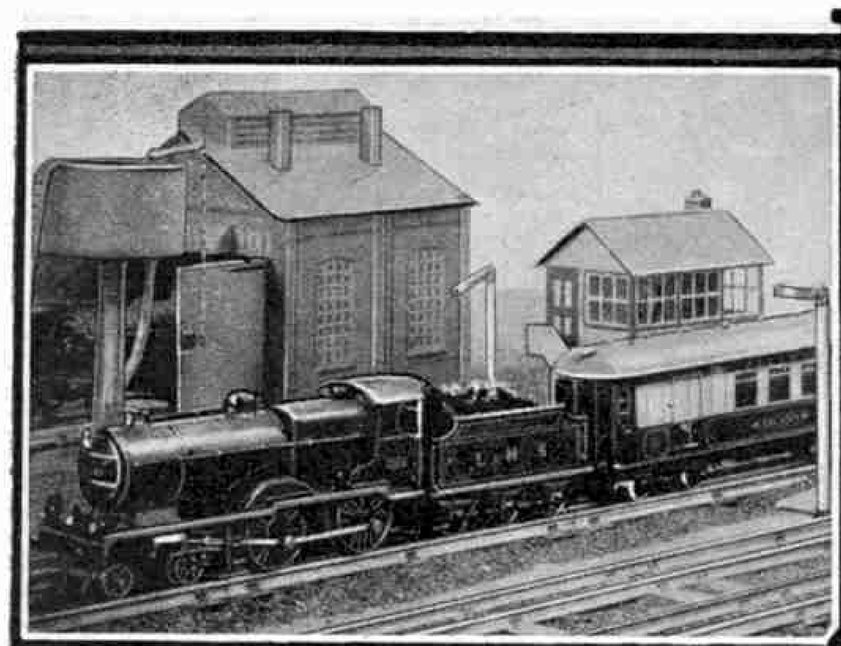
MIDDLESBROUGH—W. Hall, 21, Hambledon Road, Linthorpe, Middlesbrough, Yorks.

NEW MALDEN—Mr. S. W. Hayes, 91, Burlington Road, New Malden, Surrey.

SETTLE—Mr. J. Vant, Whitefriars, Settle, Yorks.

LICHFIELD—H. Wait, 25, Bird Street, Lichfield, Staffs.

BRADFORD—L. Robinson, 21, Beaconsfield Road, Clayton, Bradford, Yorks.



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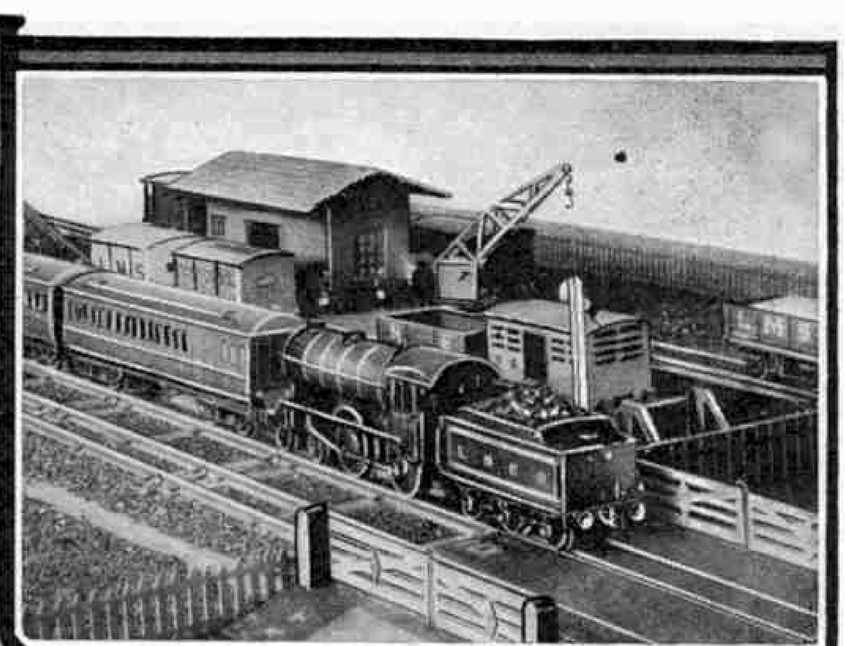
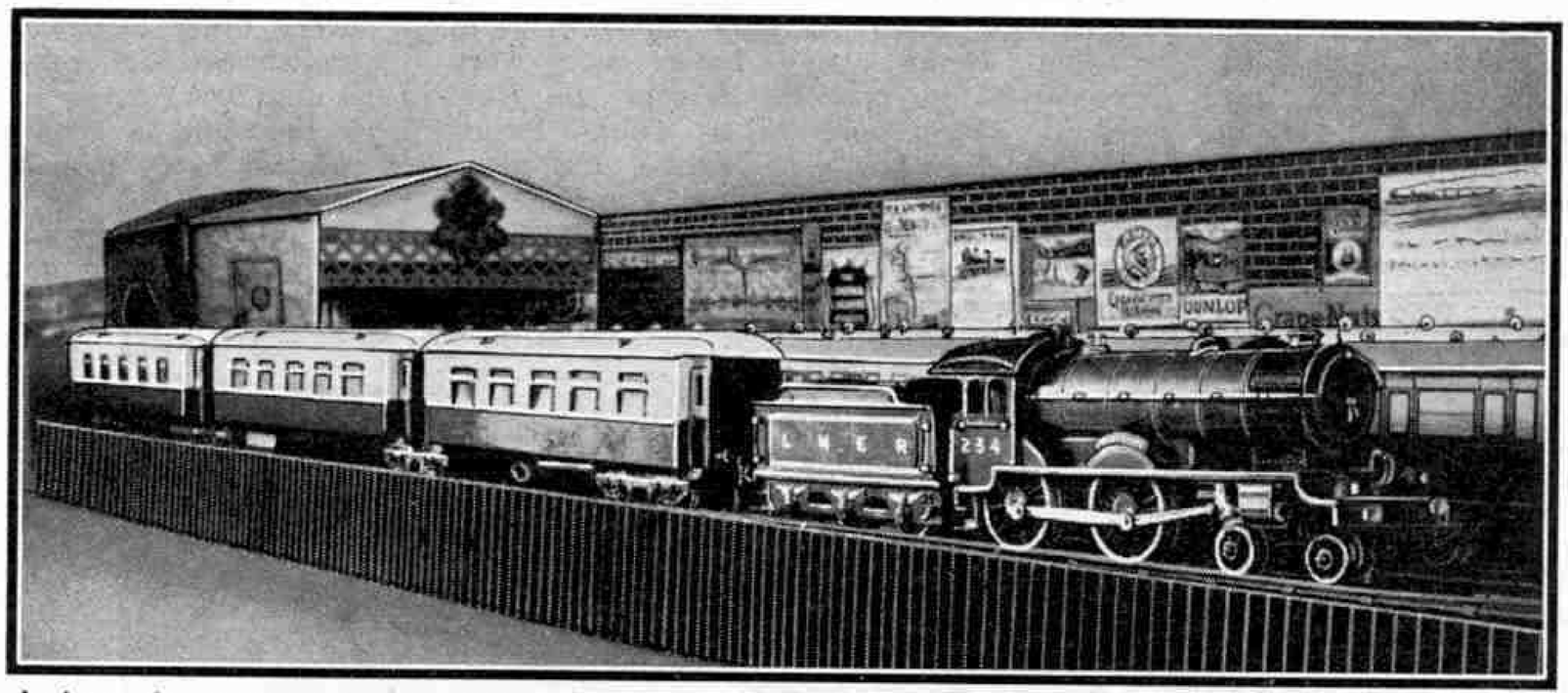


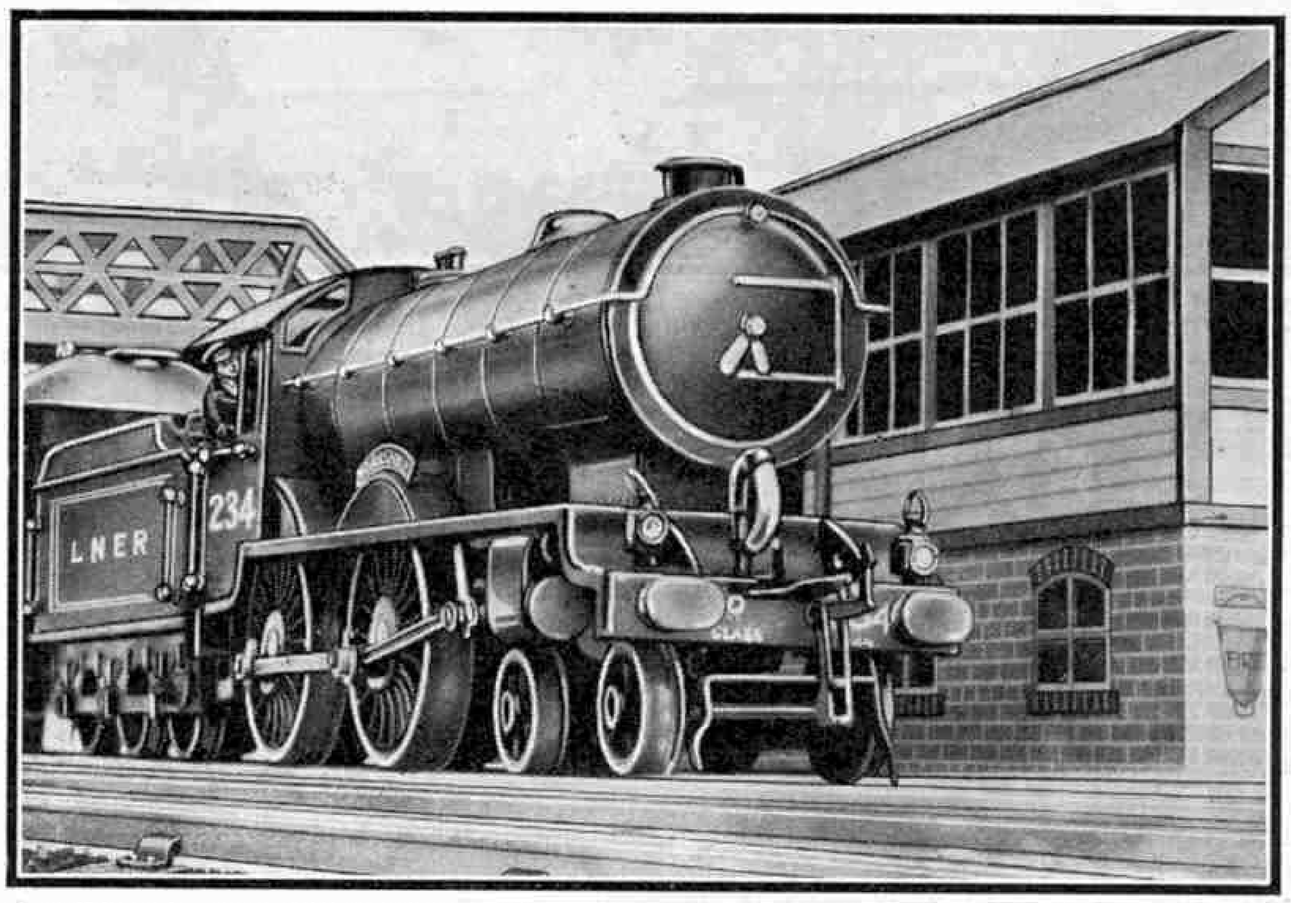
LXIII.—L.N.E.R. (GREAT CENTRAL) TRAIN WORKING

IN the course of these articles we have dealt from time to time with various features of the practice of the four railway groups that can be applied to Hornby railways, thus enabling them to represent more correctly the particular lines favoured by respective model railway owners. Sometimes certain sections of a group exhibit for various reasons characteristics that are not found on other sections of the system, though the advance of standardisation, due to "group" ideas, is gradually doing away with many of the features peculiar to the former independent companies. This month we will consider the Great Central section of the L.N.E.R., which is quite a favourite with railway enthusiasts, and can be made the subject of a very interesting miniature system.



An interesting express on the layout of D. J. M. Thorne, of Upminster. The train is made up of Hornby No. 2 Pullmans, and has been specially arranged by its owner to represent one of the L.N.E.R. "Tourist" trains.

We will assume that the question of the actual layout of the line has been satisfactorily settled. A popular plan with those who design model main line railways is the continuous track, more or less oval in shape, with one or perhaps two terminals situated on branches inside or outside the main track, according to the space available. The London terminus of the Great Central section, Marylebone, is not large, but is compact and well arranged, so that there is little difficulty in making up a similar station on a Hornby layout, particularly if the schemes put forward last month in the article dealing with the planning and layout of stations are followed up. Long trains are not the rule on this line, for it is steeply graded. An advantage of this is that if similar limitations are imposed in miniature the station platforms need not be unduly long, and this will save space on a layout.



A striking view of a Hornby No. 2 Special L.N.E.R. locomotive "Yorkshire." This may be used on layouts based on the Great Central Section, as express engines of standard group design are now working on the more important duties on that line.

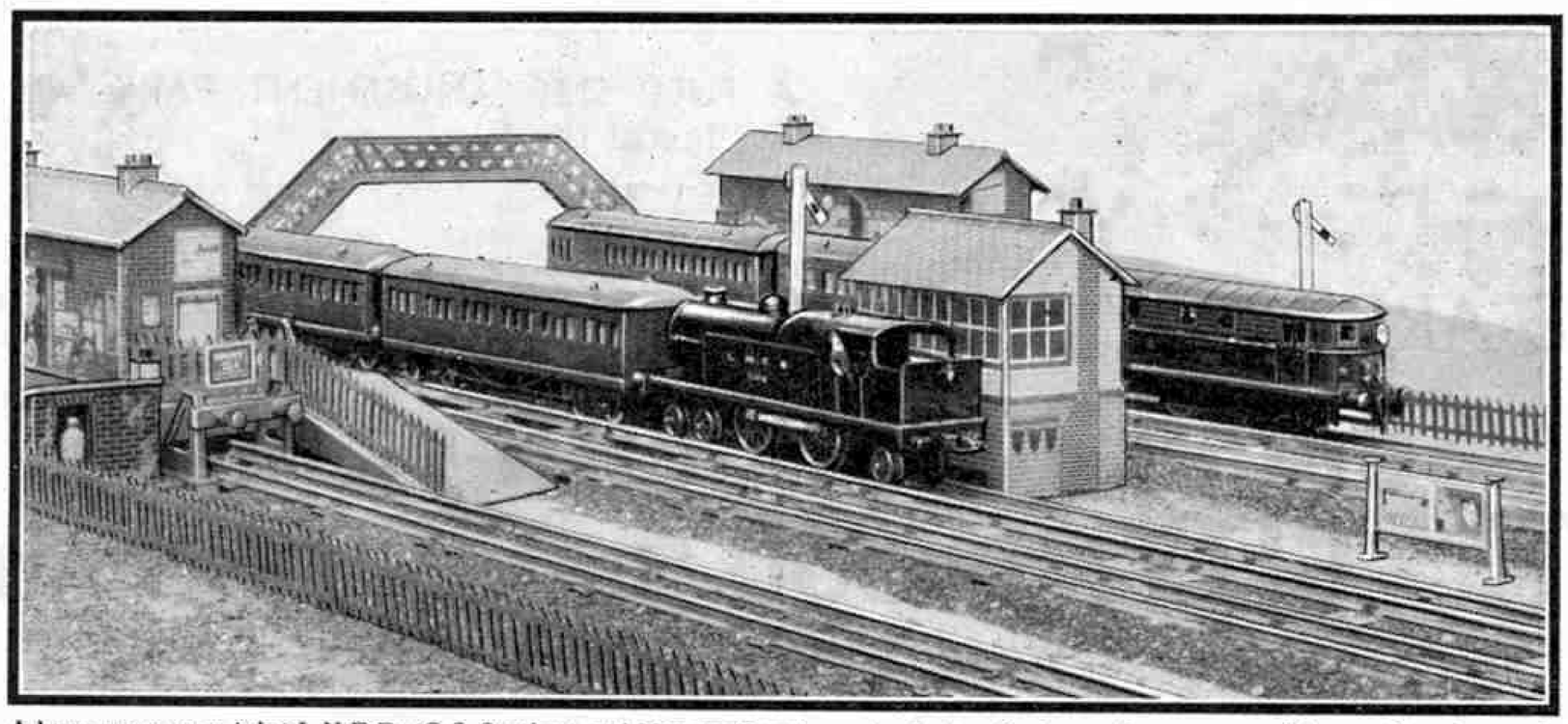
The southern section of the G.C. line is specially interesting in that between Neasden and Grendon Underwood Junctions there is a choice of routes. Trains can travel by way of Aylesbury and the Metropolitan Railway, reaching the G.C. main line proper at Quainton Road Junction, some 44 miles out; or they can take the route via High Wycombe, which from Northolt to Ashendon Junctions is jointly owned with the G.W.R. This association with the Metropolitan system enables some interesting working to be carried out in miniature, as suggested by one of the accompanying photographs. Here a Hornby Metropolitan train, hauled by one of the well-known electric locomotives,

and an L.N.E.R. suburban train with a No. 2 Special Tank at its head, are running side by side.

A four-track section will be impossible on some layouts, and L.N.E.R. and Metropolitan trains will then have to use the same tracks. Alternatively, a single electric track for Metropolitan use alongside the L.N.E.R. line may be sufficient, but this depends on the extent to which the Metropolitan is represented on the miniature layout. A point to bear in mind is that Rickmansworth is the boundary point between steam and electric working for Metropolitan trains. To represent the steam locomotives of that company Hornby Tank engines in L.M.S.R. passenger colours might be used, as their dark red finish is similar to that adopted by the Metropolitan.

A fast fish train at full speed. Such trains are familiar sights on the Great Central Section of the L.N.E.R., and their miniature counterparts can be effectively made up with Hornby components.

Layouts incorporating the alternative route, or perhaps based chiefly on it, will be able to feature G.W.R. locomotives and rolling stock, for important Great Western traffic for Birmingham and beyond passes this way. The dark green domeless Great Western engines, with their brown and cream coaches, will form a striking contrast to the light green L.N.E.R. locomotives and teak-coloured stock. A great deal of exchange traffic between L.N.E.R. and G.W.R. and vice versa is dealt with at Banbury. This is not on the joint line referred to, but on the G.W.R. proper, and is approached by the L.N.E.R. spur from Culworth Junction to Banbury Junction. Such notable cross-country trains as the "Ports-to-Ports" Express from Newcastle to Cardiff, pass over this line. This train was instituted by the G.C.R. as long ago as 1906.



A busy scene on a joint L.N.E.R. (G.C. Section) and Metropolitan layout. Interesting operations are possible on a line arranged in this way, as suggested in this article.

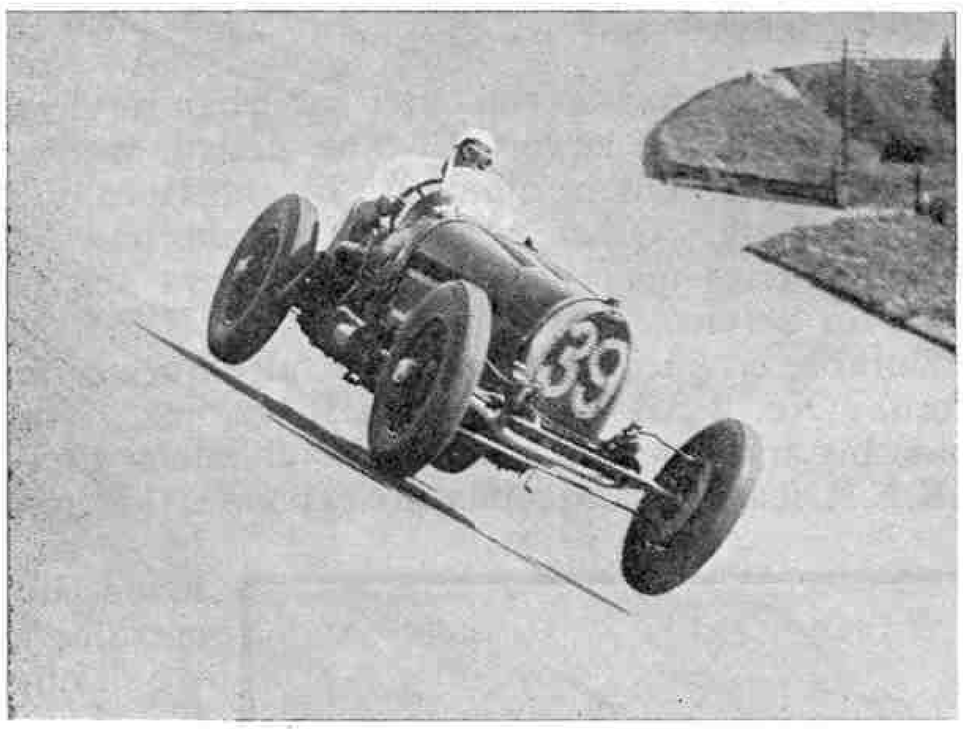
A development of considerable interest to G.C. enthusiasts has been the appearance of L.N.E.R. standard express locomotives on the hardest duties on the London main line, including of course the famous "3.20 down" Manchester express, in place of the locomotives of Gorton design previously used. This gives ample reason for the employment of the famous Hornby "Yorkshire" No. 2 Special Locomotive on miniature Great Central trains as the nearest approach to the "Sandringhams" of actual practice. "Shire" or "Hunt" 4-4-0 engines do occasionally work through to Marylebone, however. The 4-4-2 wheel arrangement of the Hornby No. 3 Locomotive suggests its use as a G.C. "Atlantic," for both have outside cylinders and Belpaire fire-boxes, and the cab and tender outlines of the Hornby engine are close enough to those of the actual locomotive. There is now no really suitable engine in the Hornby Series to represent the familiar "Director" 4-4-0s, but those readers who possess any of the old No. 2 4-4-0s may use them as such.

A notable type of engine used on the outer suburban services from Marylebone is the large G.C. tank design, whose work may be carried out in miniature by the Hornby No. 2 Special Tank. Other standard locomotives of the Hornby Series may be used to represent the various types in service, both of G.C. and L.N.E.R. origin.

Suitable coaches for Great Central expresses are the Hornby No. 2 Saloons in L.N.E.R. colours. The teak colouring and domed roof of the No. 2 Saloon are typical L.N.E.R. features, and miniature expresses therefore may be correctly made up of corridor stock vestibuled together. For semi-fast and suburban working the popular scheme of employing Metropolitan vehicles as L.N.E.R. coaches may be utilised. Their colour is very close to the L.N.E.R. standard finish, and their general design renders them quite appropriate for such work. An L.N.E.R. layout that incorporates a miniature Metropolitan section, as suggested previously, may therefore "borrow" suitable passenger stock when traffic is particularly heavy! or on the other hand such double duty may be necessary owing to limited resources.

A recent development associated with the G.C. section has been the operation for tourist traffic of the special trains described in the November, 1932, "*M.M.*" One of our photographs shows a set of Hornby No. 2 Pullmans arranged to represent a train of this kind.

A REAL BOYS' PARADISE!



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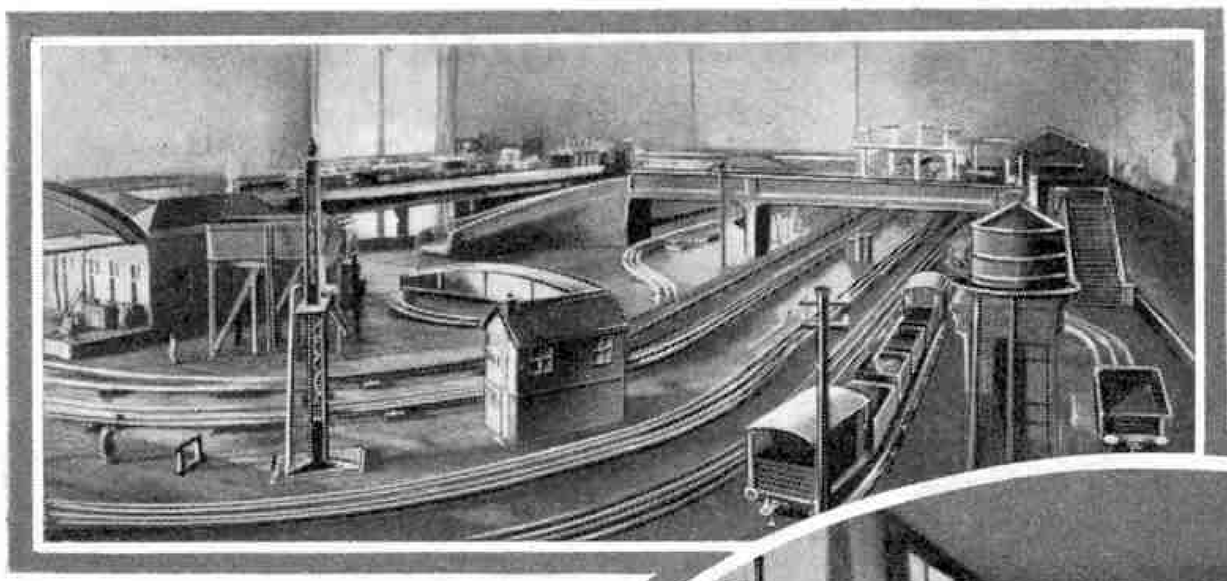
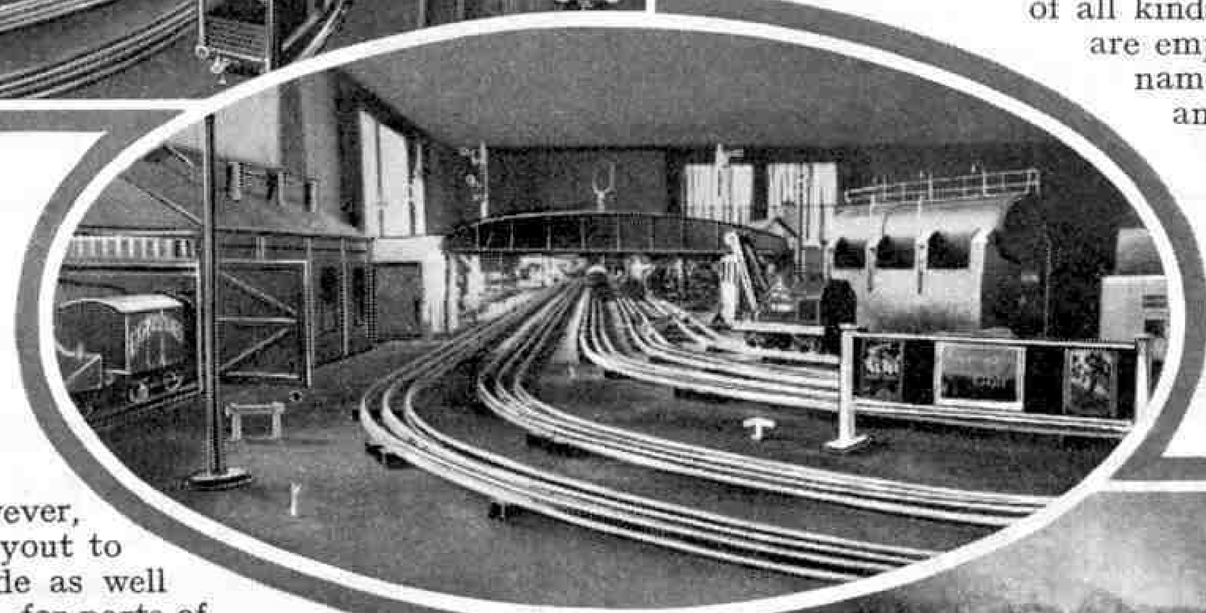
An Anglo-French Miniature Railway

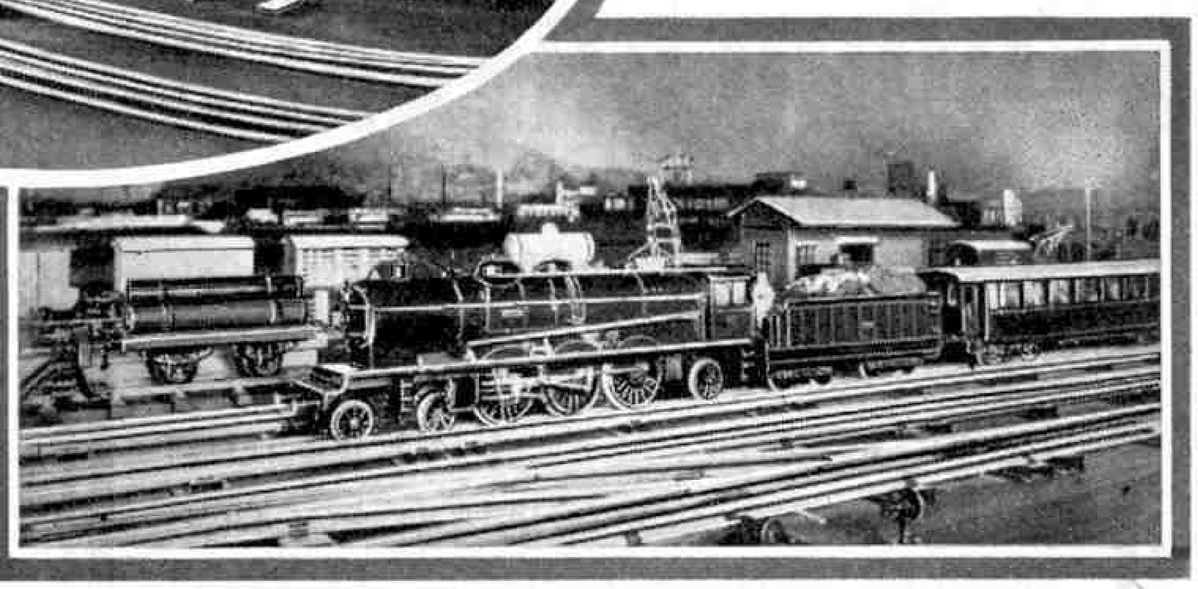
The Layout of Mr. H. Snow

THE miniature railway system illustrated on this page is remarkable both for the general scheme underlying the operations and for the extent and completeness of detail of the line. The owner of the railway, Mr. H. Snow, lives at Cannes, and in laying down and equipping the system his chief aim was to represent the main features of a journey from London to Cannes. Thus locomotives and rolling stock of the Southern Railway and of the Nord and P.L.M. systems are used, but in addition the scope of operating conditions has been extended so as to require engines and coaches of other railways, both English and French.





The layout, which is installed in a room 30 ft. by 21 ft., is electrically operated, and is laid throughout with Hornby rails. For convenience in operation the complete track is built on a special superstructure 3 ft. high, and forms roughly a large rectangle as it follows the walls of the room. There is, however, sufficient space to enable the layout to be attended to from the outside as well as the inside, which is necessary, for parts of the baseboard are some 6 ft. wide. There are four main tracks throughout, each giving a continuous run of about 100 ft. Various loops and sidings are introduced where necessary, but the line is specially laid out for long through runs. Most of the signals and points are electrically operated, so that complete remote control of almost all movements is afforded. A feature that adds greatly to the realism of operation, especially at night, is the fact that the whole layout is illuminated, and the trains themselves are lit up.



(Top) A general view of the miniature railway described on this page. (Centre) The main line near Lyons. (Right) The scale model Nord "Pacific."

Suitable surroundings are provided by a striking panoramic background extending completely round the layout, which was specially prepared to show the chief scenic features of the journey from London to Cannes. Starting at Victoria, Grosvenor Bridge carrying the railway over the River Thames is shown, with the Tower Bridge in the distance. Other notable London landmarks, such as "Big Ben" and St. Paul's, are included, and soon the open country of Kent appears. This typical scenery then gives place to the chalk cliffs in the neighbourhood of Dover, for "*The Golden Arrow*" runs alongside these.

The crossing to Calais made by the well-known S.R. cross-Channel steamers is depicted and also the Maritime Station from where trains leave for all parts of the Continent. The services particularly represented on this layout are those for Paris, and through to Lyons, Avignon, Marseilles, Toulon and Cannes.

The well-known Gare de Lyon at Paris is the next feature, and from here many famous South-bound expresses depart. Through coaches from Calais boat trains off the Nord system are attached to P.L.M. trains, having skirted the city by means of the Ceinture system. This route is followed by the famous Riviera "*Train Bleu*" that is represented on this layout, and is one of the most important trains on the miniature system. It is made up of course of the popular and distinctive Hornby "*Riviera Blue*" components.

Characteristic French scenery follows, and after Lyons notable features are the famous Pont d'Avignon over the River Rhone, built in 1108; the Palace of the Popes at Avignon, built during the years 1336-70, and other ecclesiastical structures. Approaching Cannes an interesting piece of modelling representing a farm scene has been carried out in such a manner as to tone well with the background. It is entered through an old stone arch which, it is interesting to note, is inscribed "Mas del Souleé," which is Mr. Snow's own address. Thus the local scenery by Cannes Station is appropriately arranged, and the station itself is closely copied from the original. The miniature station has three platforms each 8 ft. in length, and is complete with the usual offices and a clock. When illuminated at night it looks extremely effective. The road approach to the station is also incorporated, and here and elsewhere on the layout good use is made of motor vehicles of all kinds, both passenger and commercial, to represent road traffic.

The accessories used on this extensive railway are extremely numerous and varied, and together with the scenery give it a most realistic appearance. Miniature figures of all kinds, railway, civilian and military, are employed with good effect, the last named particularly in connection with an aviation ground provided with searchlights, anti-aircraft guns, and miniature aircraft. Platform machines, luggage, telephone boxes, and poster hoardings are all included. Among the larger accessories are several notable bridges of different types and sizes, and a long viaduct formed of centre sections of the standard Hornby Viaduct. The latter carries an elevated loop line that leaves the main line near Lyons and rejoins it at Marseilles. The gradients thus involved add considerably to the effect of the system in the neighbourhood of the loop, and of course increase the interest of working.

There is nearly 500 ft. of track in the layout, and the heavy traffic passing over it is dealt with by an interesting and varied array of locomotives, coaches and wagons. The fine scale-model Nord "Pacific" shown in one of the illustrations on this page usually hauls a train of six bogie corridor coaches and a luggage brake van. Hornby "Riviera" Locomotives in P.L.M. and Nord finish are in use for the operation of the "*Train Bleu*" and "*Fleche d'Or*" respectively.

The English groups are represented by Hornby No. 3 Locomotives, and appropriate rolling stock, while a miniature L.M.S.R. "Royal Scot" engine has a train consisting of postal, dining and Pullman vehicles. Miscellaneous duties are performed mainly by Hornby Tank Locomotives; and coal, mineral and other goods trains have suitable engines of heavy main line type.

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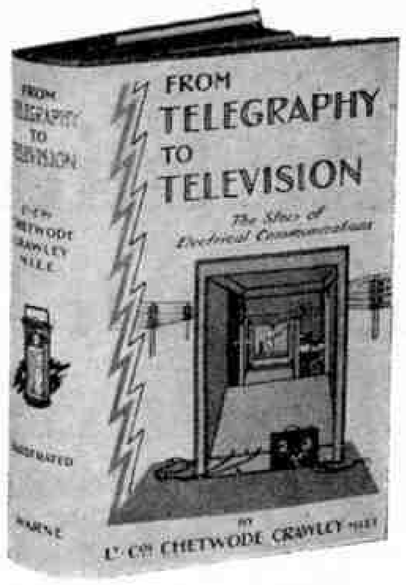

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H.R.C. COMPETITION PAGE

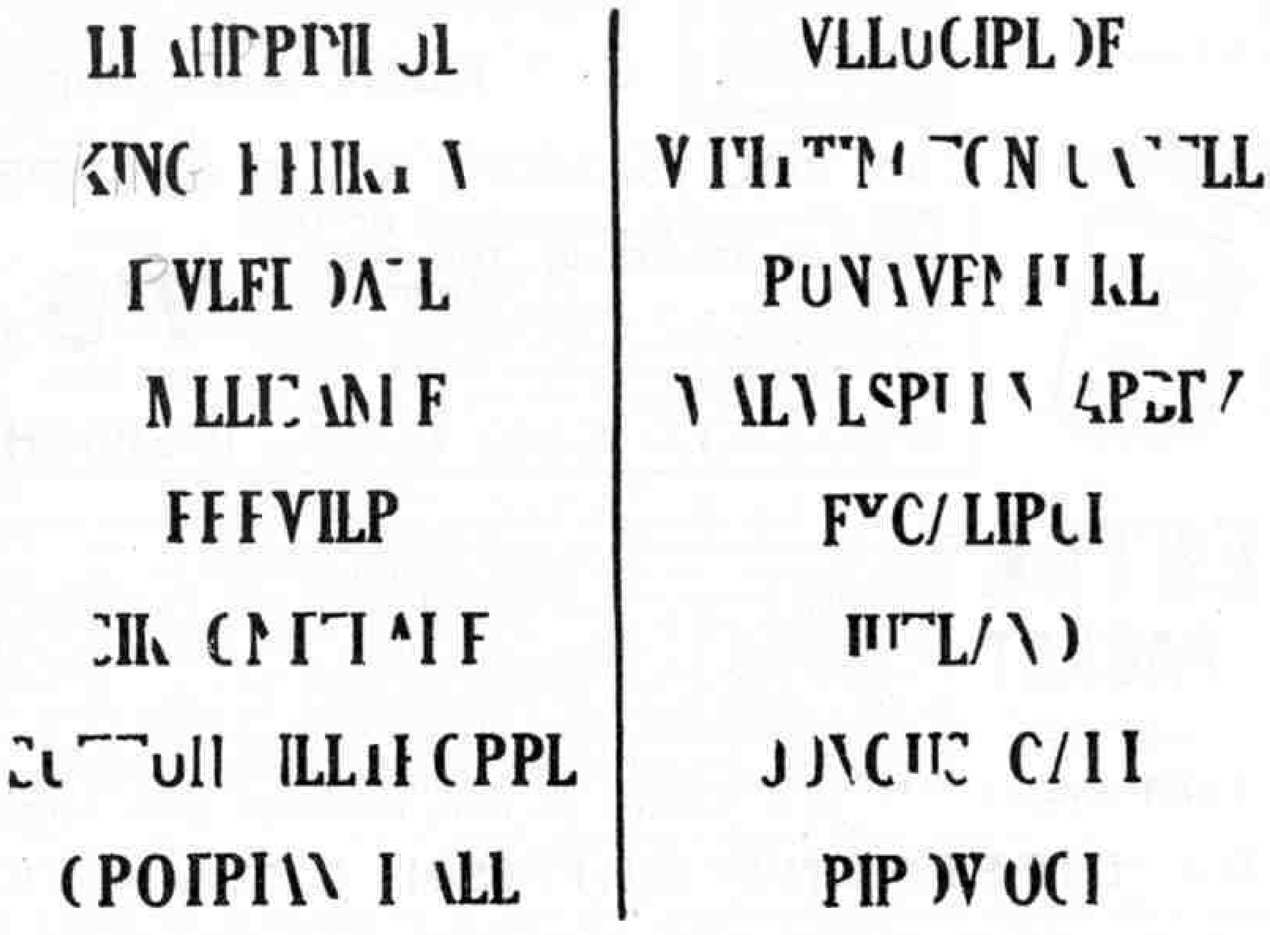
Competitions appearing on this page are open only to members of the Hornby Railway Company. Envelopes containing entries should have the title of the competition clearly written in the top left-hand corner and should be addressed to the Hornby Railway Company, Meccano Ltd., Binns Road, Liverpool 13. The name, address and membership number of each competitor should appear in clear writing on the back of every sheet of paper used.

MUTILATED NAMES CONTEST

This month we announce a contest of a type that is an old favourite, namely, a "Mutilated Names" Contest. It is more than a year since we had a competition of this kind, and we feel sure that the present contest will be popular with both old and new readers.

The accompanying panel contains the names of 16 well-known locomotives, each belonging to one of the four great British railway groups. The letters that make up each name have been badly mutilated, and we think it will tax the ingenuity of readers to discover the 16 names.

When all the names, or as many of them as possible, have been deciphered, they must be written down in a list in the order in which they appear in the panel, the place of any name that cannot be discovered being left blank. Then opposite each name must be set the number of the locomotive, its wheel arrangement, and the name of the group to which it belongs. On each entry—which may be submitted on a postcard—must be written clearly the competitor's name, address and H.R.C. number.



The Contest will be divided as usual into two sections, Home and Overseas. Prizes consisting of Hornby Train goods (or Meccano products if preferred) to the value of 21/-, 15/-, 10/6 and 5/- respectively will be awarded to the four competitors in each section who submit lists containing the highest number of correct solutions. A number of consolation prizes also will be awarded to entries that do not quite come up to prize-winning standard. Competitors should send in their entries even if they have been unable to find the correct details required in every case. In the event of a tie for any prize, neatness will count in making the final decision.

Envelopes containing entries must be clearly marked "*H.R.C. Mutilated Names Contest*" in the top left-hand corner, and addressed to reach Headquarters at Meccano Ltd., Binns Road, Liverpool 13, on or before 31st January. Entries from Overseas competitors must be posted to arrive at Headquarters not later than 30th April.

"My Favourite Locomotive"

Railways probably exert a greater fascination in this country than anywhere else in the world, and interest in British locomotives, from the mighty main line passenger express engines of each of the four great railway groups down to the diminutive shunting tank, is shown by a surprising number of people. Keen debates on the merits of the representative engines of the different groups often take place. This is particularly the case with members of Branches of the H.R.C., and accounts frequently reach Headquarters of lively debates on their relative qualities.

In view of the great interest of this topic, we have chosen as the subject of this competition "*My Favourite Locomotive,*" and we ask members to tell us in not more than 500 words which class of engine they favour and why it makes a special appeal to them. Prizes of Hornby Railway material (or Meccano products if preferred) to the value of 21/-, 15/-, 10/6 and 5/- respectively will be awarded for the four best entries in each section, Home and Overseas. Envelopes should be marked "*H.R.C. Favourite Locomotive*" Contest and must be despatched to reach Headquarters at Meccano Ltd., Binns Road, Liverpool 13, on or before 31st January. Closing date for the Overseas section, 30th April.

Drawing Contest

This month we announce the first of a new series of Drawing Contests in which competitors are required to sketch some particular railway employee carrying out one of his duties. The subject we have chosen is "*A Guard Giving The Right-Away.*" This is a familiar sight to all readers, and we shall look forward to a large entry. Drawings may be in pencil, ink, or in colour, as desired.

To the senders of the four best entries in each section, Home and Overseas, prizes of Hornby or Meccano goods will be awarded to the value of 21/-, 15/-, 10/6 and 5/- respectively. In addition a number of consolation prizes will be awarded to those competitors whose entries do not quite come up to competition standard. The sender's name, full address and H.R.C. membership number must be written on the back of each entry. It must be remembered that the omission of the H.R.C. number from any entry will cause it to be disqualified. This is an important condition to which members should pay special attention, as its neglect in the past has occasionally caused promising entries to be discarded.

Envelopes containing entries must be marked "H.R.C. Drawing Contest" and posted to reach Meccano Ltd., Binns Road, Liverpool 13, on or before 31st January, or 30th April for Overseas competitors. The closing dates should be carefully noted as entries received late cannot be passed on to the judges.

Unsuccessful entries will be returned if they are accompanied by a stamped addressed envelope of suitable size.

COMPETITION RESULTS

HOME

October "Impossible Train Contest No. 4."—First: J. C. Button (10335), Crewe. Second: C. D. Eagling (31292), Mortlake, London, S.W.14. Third: W. B. Hudson (1733), Westham, Weymouth. Fourth: R. Sutton (34561), Wolverhampton. Consolation Prizes: D. C. H. Stamford (17558), Merstham, Surrey; K. Costain (5708), Bolton, Lancs.; S. Maxwell (33312), Lockerbie; E. Beven (35158), Sheffield; J. Everitt (542), Streatham, London, S.W.16.

October "Questions Contest No. 5."—First: B. Hull (30795), Walton, Liverpool 4. Second: H. T. Buckingham (23588), Leighton Buzzard. Third: L. Reason (32408), Bushey, Herts. Fourth: M. H. King (29821), Barnehurst, Kent. Consolation Prizes: E. Beven (35158), Sheffield; J. C. Wright (32750), Prenton, Birkenhead; C. E. Wrayford (6039), Moretonhampstead, Devon; J. L. Makin (30933), Penwortham, Preston; R. C. Cockerill (22837), Wolverhampton; S. Winnard (7843), Ince, Wigan.

OVERSEAS

July "Famous Trains Contest."—First: H. C. Key (24764), Calcutta, India. Second: G. Hallack (17578), Capetown, S. Africa. Third: M. De Lima (34925), Bombay, India.

July "Railway Photo Contest."—First: L. A. Seton Montreal West, Quebec, Canada. Second: E. R. Paasche, Bergen, Norway. Third: J. A. Coates (23863), Greenfield Park, Quebec, Canada. Fourth: H. J. Borgman (29579), Maastricht, Holland. Consolation Prizes: M. Bosch (34964), Maastricht, Holland; P. D. Charlwood (30116) Sydney, Australia.

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5 Cyprus...	3d.	5 Nicaragua	2d.
20 Denmark	3d.	10 New Zealand	3d.
5 Esthonia	2d.	10 New South Wales	5d.
10 Finland	2d.	10 Peru ...	4d.
20 Greece	4d.	5 Porto Rico	3d.
20 Holland	2d.	5 Paraguay	2d.
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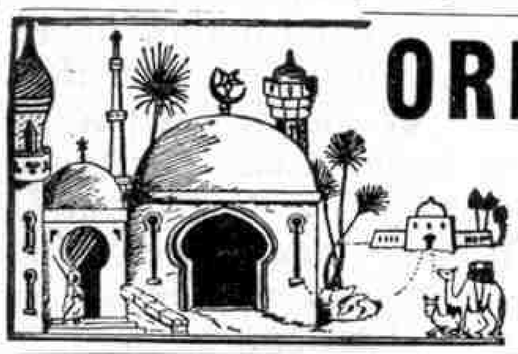

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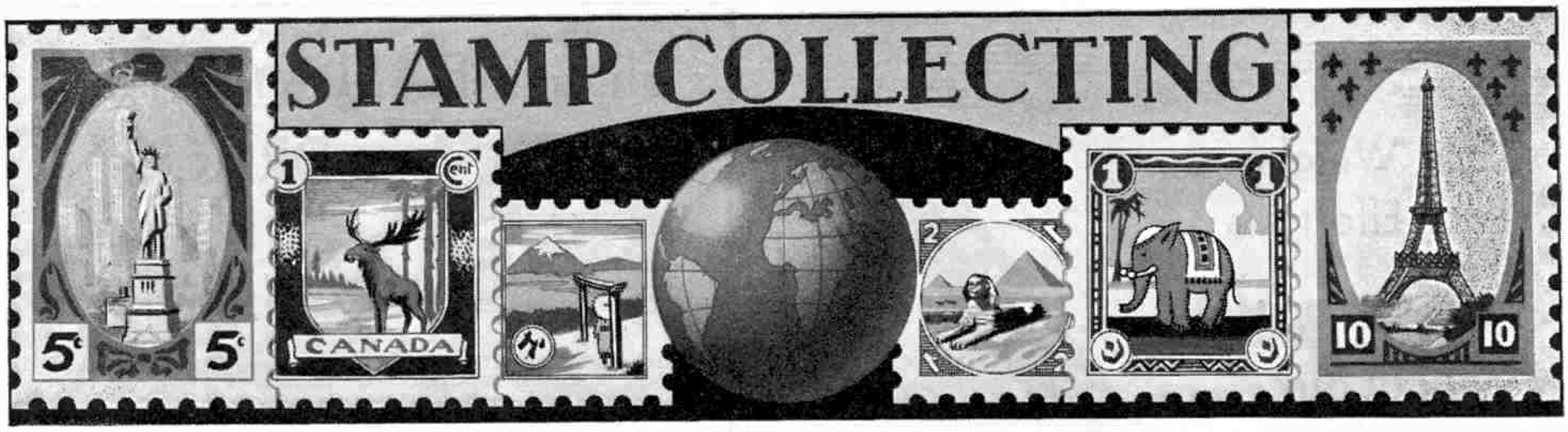

THE OLD LADY WITH THE STAMPS. By H. Thirkell

THE old lady in the shabby grey dress and the antique hat stopped in front of Kaufmann's stamp shop and gazed at his wares. It was a very small shop, wedged tightly between larger, opulent-looking neighbours in a busy side-street of the city. To the window glass were fixed sheets of weary-looking sun-faded stamps, many cockled up into strange twists by effect of the gum on their backs. The stamps were priced from 1d. to 6d. each, and here and there were gaps in their rows where some optimistic youngster had picked his fancy and made a purchase—or possibly where some more discerning collector had chanced on what seemed a bargain. Kaufmann sometimes salted his window, knowing the value of ground-bait. The bottom of the window was littered with cheap packets of many shapes and sizes, ranging from the humble " 100 stamps for 3d." to the lordly " 5,000 stamps for 20s." There were also three albums, some catalogues, a " Handbook on the Stamps of the Australian Commonwealth," some magnifying-glasses, boxes of stamp hinges, and other accessories. Everything looked rather dusty. In the centre of the window was a card plainly lettered " Stamps Bought."

The old lady was aware of this card, had indeed been aware of it for some weeks. She was now gazing neither at it nor at the contents of the window. She was trying to peer beyond into the shop to see who might be behind the counter. From previous scrutiny she knew there might be either a girl, probably pert and ignorant, or Kaufmann himself, tall, fat, hook-nosed and grubby-looking. Satisfied that Kaufmann was in charge, she entered.

There was a glass-topped counter displaying more or less a repetition of the goods in the window. Behind it, against the wall, was a long table, littered with a mass of papers, books, loose stamps, stamps on sheets, stamps on envelopes and some dishes of water on which stamps floated. In a corner was a large safe which, as a matter of fact, contained more stamps than all the rest of the shop put together.

Kaufmann's shop and Kaufmann's appearance were deceptive. His shop and his shop window were merely the frame for that card " Stamps Bought." What he sold there over the counter was petty, mere chicken-feed. He dealt privately or by mail with his real buyers. But what he bought in that little shop was generally useful, often good, sometimes magnificent. Clerks brought in stamps culled from the mail of business houses and banks, parcels of old letters from dingy offices came his way and old collections of forty years ago. It surprised even Kaufmann sometimes the amount of philatelic trove which floated about the eddies of the city.

The man himself was an expert, internationally known. In Paris and New York, London and Berlin, when giants of the stamp-world foregathered —men who might spend a thousand pounds on their beloved stamps as readily as the schoolboy spends his threepence—it was not uncommon to hear it said, " Have you tried Kaufmann for that stamp ; he's about the only man who might have it ? " or " Send it to Kaufmann, he'll know if it's genuine."

The old lady placed a brown-paper parcel on the glass counter and waited. Kaufmann's manners were like his appearance—unattractive.

" Yes ? " he shot at her, interrogatively. The old lady was palpably nervous.

" You buy stamps," she hazarded.

" Sometimes," said Kaufmann. " What have you got ? Show me ! "

He possessed himself of the parcel, flicked the string and paper off it and flipped over the pages with scornful rapidity. Something caught his eye and he turned back to the page and examined it somewhat closely. He went through the rest of the album rather less perfunctorily, put it back in its paper and paused in the act of re-tying the string.

" What do you want for it ? " he snapped.

The old lady cowered under this brusque treatment.

" Oh, I don't know," she said, " I don't know at all. I thought you would tell me what you'd give."

Kaufmann wanted a lead. Did the old lady know nothing or just a little ? Or more than a little.

" I never deal that way," he said. " The seller must make a price—then I buy or I do not buy."

The old lady fidgeted uncomfortably when Kaufmann continued tying the string.

" My nephew, who collects stamps," she suggested, " thought I ought to get twenty pounds for it—oh ! I don't really think it is worth all that," she concluded, hurriedly, as Kaufmann made to move away.

" Well ? " he said.

" Would it be worth ten pounds ? "

" It would not ! " said Kaufmann. " Never ! " He had decided on his tactics now. " I will tell you about this collection now to show you I am speaking the truth and you will tell me if I am wrong. It was made by your husband thirty, forty years ago. So ? "

The old lady nodded.

" Your husband is dead and times are bad and you are hard-up. You were looking through an old trunk and you found this album. So ? "

Again the old lady nodded.

" I will tell you some more truth," said Kaufmann. " This is a common old collection. It is full of common stamps, torn stamps, forgeries. I have bought hundreds like it in my life. But in this one there are one, two, perhaps three stamps which look good. All the stamps are stuck down tight with glue in the album. I must soak them off and clean them before I can sell them."

He paused. His little dark eyes glinted and he pointed a finger at the old lady.

" Still I will tell you some more truth. What will I find when I soak off those two, three stamps which might be worth, perhaps, ten, fifteen, twenty pounds ? What will I find, you old thief ? I will find they are torn and mended, very beautifully mended, by some clever faker in Belgium or (*Continued on page 77*)

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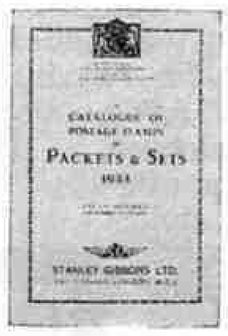

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Stamp Collecting—(*Continued from page 75*)

Switzerland, or somewhere! And worth nothing, nothing, nothing, but two, three shillings. Oh! how carefully you stuck them into the old collection to catch Kaufmann, you old thief!"

He picked up the parcelled album and flung it on to the littered table behind him.

"I give you five shillings for that, so you can't keep it to try on someone else. Here is the money. Now get out and never show your old nose near me again, or I call the police. You caught my friend Anson in Melbourne a while ago, but you do not catch old Kaufmann. Hop it!"

Out of the shop, down the street to the turmoil of Pitt Street went the old lady in grey—very active for an old lady, too. By the way she doubled from one street to another one might have thought she was covering her trail. At last on a corner of Martin Place, she waited until a man in a brown suit crossed the street to join her.

"Well?" he queried.

"No luck! He tumbled!" said the "old lady." "Gave me five bob and kicked me out before he called the police."

* * * *

Half an hour after the old lady had gone Kaufmann unwrapped the old album again. He ignored those pages where the fakes were set as traps. He turned to a page headed "Spain," and scrutinised one stamp under a lens. It was a deep blue stamp showing the figures "12cs." and the words "Espana" at the top and "Correos" at the bottom. In the centre was the head of Queen Isabella printed in pink. It was a dirty stamp, heavily postmarked, ragged at the edges and rather stained by the brown glue with which it had been stuck in the album. It was a valueless stamp save for one fact—*the head of Queen Isabella was printed upside down.*

"They did not see that, the clever ones," mused Kaufmann, "but Kaufmann saw it. It is a dirty stamp, but it is the error and it is genuine. That fellow Martinez will certainly give £10 for it!"—*The Australian Stamp Monthly.*

A Stamp Voting Contest

In our stamp pages this month we illustrate seven stamps from Sierra Leone's new issue commemorating the abolition of slavery.

It would be interesting to know which stamp our readers consider the most beautiful, and they are invited to place the seven stamps in order of merit. Prizes consisting of Meccano products or Stamp Collecting Equipment, to the value of 21/-, 15/-, 10/6 and 5/- respectively, are offered to the four readers whose entries most nearly coincide with the result of the massed voting of all competitors.

Entries should be addressed to "January Stamp Contest." Closing date, 31st January. Overseas, 30th April.

Stamp Gossip

and Notes on New Issues

One Hundred Years of Freedom

A point that will strike the observer immediately is that Sierra Leone's new stamp issue to commemorate the abolition of slavery and the centenary of the death of William Wilberforce, the man who freed the slaves, contains no portrait of Wilberforce and, with the single exception of the 3d. stamp, no explanation of the purpose of the issue. The absence of Wilberforce's portrait is in accordance with Colonial Office practice, which is to debar the appearance on stamps of portraits of identifiable persons other than His Majesty. The absence of any indication of the purpose of the stamps is a weakness, however, for the otherwise excellent designs tell no connected story, and those without knowledge of their origin are left guessing very badly.

We illustrate seven of the more interesting designs this month, the full list of designs being as follows:—½d., the Arms of the Colony (note that the flag does not show the Cross of St. Patrick, from which it may be inferred that the grant of the arms was made sometime between 1787, when the first settlement of freed slaves was made in Sierra Leone, and 1801); 1d., a slave casting aside his chains—a reference to the object of the colonisation, to provide a land for freed slaves; 1½d., a map of Sierra Leone and, inset, a small map of the whole African continent, with Sierra Leone marked to show the actual position of the colony.

Twopence, the old slave market, Freetown, with a giant mango tree in the foreground. Note the specially interesting side panels depicting the progress of transport to Sierra Leone. Apart from its extensive sea-borne traffic, the colony is served by the South Atlantic and North African air mail services; 3d., a native girl carrying a basket of indigenous fruits; 4d., a native hospital scene; 5d., a canoe of the Bullam Tribe crossing Freetown Harbour; 6d., natives punting near the Banana Islands.

Shilling, the Government Buildings at Freetown; 2/-, Bunce Island, an old slaver's resort 18 miles above Freetown on the Sierra Leone River. From 1660 onward this was one of the main centres for those engaged in the slave trade; 5/-, a trumpeting African elephant; 10/-, a portrait of His Majesty flanked on each side by sentries of the Royal West African Frontier Force; £1, sunset at Freetown Harbour, appropriately enough the most beautifully engraved stamp of the whole series.

This series is to remain in service for 12 months, and during that period will replace the general pictorial issue of 1932.

The Christmas Charity Issues

As usual there has been a small flood of issues of special charity stamps for Christmas use, and next month we hope to give brief details of some of the more important of these. Switzerland, of course, led the way with the annual "Pro Juventute" issue, the designs this season depicting typical girlhood of the Vaud, Berne and Ticinio cantons. The high value, as usual, is devoted to a Swiss *savant*, in this instance the philosopher Father Gregoire Gerard.

Luxemburg, having come to the end of its series of portraits of present members of its Royal Family, has gone back to the Middle Ages for inspiration, the chosen design being a portrait of Count Henry of Luxemburg, who was subsequently Henry VII, Emperor of Germany. Lithuania's Child Welfare issue appeared early in October and a specimen, the 1L stamp, is illustrated here. It shows a child being taught to use an old-fashioned spinning wheel. There are six other values in the series.

On 24th December Italy issued a special Mother's Day stamp bearing a 10c. premium. Its use was obligatory, the premium being devoted to various child welfare organisations.

Germany has combined the commemoration of the death of the composer, Richard Wagner, 50 years ago, with the annual issue of National Relief stamps by choosing scenes from the famous Wagnerian operas for the designs of the stamps.

The operas represented are "Tannhauser," "The Flying Dutchman," "The Rhinegold," "Siegfried," "Tristan and Isolde," "The Valkyrie" (these last four comprise the great Nibelungen Ring cycle of operas), "The Meistersinger of Nuremburg," "Lohengrin" and "Parsifal."

There is not space to describe the stamps in detail this month, but we will deal with them fully in an early issue.

* * * *

We illustrate on this page the striking 20 lire air stamp from the recent Italian Colonial issue commemorating the 10th anniversary of the Fascist regime. The full series consists of nine stamps for general use, and seven air mail stamps, 50c. to 20 lire.

We thank Stanley Gibbons Ltd. for their courtesy in loaning the stamps from which the illustrations for our stamp pages have been made.

OVER 10/- WORTH OF STAMPS FREE!

(Including Rare NICARAGUA, Catalogued 7/-)

To introduce you to this new firm, we are presenting an amazing packet, the value of which **CAN NEVER BE REPEATED.** The packet contains unusual and scarce items such as: **ESTHONIA** (mint), **CAPE OF GOOD HOPE, ROUMANIA** (charity issue), **SET OF AIRMAILS** (mint), **TURKEY** (palace), **NEW SOUTH WALES, BRAZIL** (airplane), **PHILIPPINE ISLANDS** (obsolete), **HUNGARY** (war charity), and the earliest issue of **NICARAGUA** (cat. 7/-); also a **FURTHER 30 GOOD QUALITY STAMPS** are included, among which are **COLONIALS, COMMEMORATIVES,** and several **UNUSED.** This grand packet is **ABSOLUTELY FREE** to those who request approvals and enclose **2d.** for postage. Write **NOW,** as the supply is limited.

SUPER STAMPS, "M.M.1," LALESTON, VANBRUGH HILL, LONDON, S.E.3.

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I want **YOU** to see my "**WORTH WHILE**" Sheets. **MY** Stamps and prices will then add you to my regular clients. These sheets are really different, containing only clean, nicely mounted stamps which are **WORTH WHILE.**

20 Canadian Stamps will form a good basis for your collection of this popular colony, so accept my offer, send 1½d. postage, and ask to see some of these interesting sheets. **A WORTH WHILE OFFER.**

JOS. H. GAZE, DIDSBURY, MANCHESTER.

HERE'S JOYFUL NEWS! — **LINDSEY'S LIBERAL LINES!**

6 Belgian Congo, most vivid native set, 7d. Drum-beaters, etc. **A striking Borneo set,** 3d., shows Rail-road, Tapir Beast, etc. **Both sets for 9d.** with free **gift** of scarce **70 cents Russian China,** cat. 1/-. Ask for more Liberal Lines, and some to look over.

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MANCHUKUO PACKET FREE

A fine packet of all different Stamps containing **Manchukuo,** 1932 ½ fen pictorial, **French Indo China Air Mail,** unused, **Eritrea,** 1930 2c., large pictorial **Somali Coast, Tunis** 1933, new issue, **Turkey** pictorial, **Brazil** pictorial, **Nigeria, Portugal, Ceylon,** etc., free to all asking to see my famous Approval Sheets and enclosing **2d. for postage.** (**Abroad 6d. P.O.**)

Albums, **1/4, 2/6, 5/-** and upwards.

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A2	6 Austria, 1932	3d.	N2	18 Nyassa, 1921	1/2
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D2	6 Denmark, 1930... ...	2½d.	S21	6 Spain Silver Wedding ...	3d.
H3	5 Hungary, 1932	2½d.	T2	4 Turkey, 1929	2½d.
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A splendid packet containing **New Guinea Air,** Bird of Paradise, **Siam Air Mail, Spanish Air,** monastery of La Rabida, **Eritrea,** Italy, naval Academy, Chili, Columbia, Dutch East Indies, Salvador, Spanish Morocco, and a host of other good stamps, free to genuine approval applicants. **Free and Post Free.**

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This huge parcel contains **506** genuine Stamps from **MOYEN-CONGO** (Train and Viaduct), **OLD CAPE OF GOOD HOPE,** Japanese, Chilian (Columbus), **OLD PRUSSIA,** Pictorial Pretoria, **MALACCA** (Tiger), etc. Absolutely **FREE** to all sending 2d. for postage and requesting my **FAMOUS EXTRA-LARGE-DISCOUNT** Approval Sheets. (Abroad 6d. P.O.)

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A large **MINT INDO-CHINA AIRMAIL** is included in this magnificent packet of over 40 varieties, and depicts a mail-carrying **AIRPLANE** in full flight. The packet contains a new **CONGO** (Train speeding over Viaduct), **ROUMANIA** (Airplane), and other fine Stamps showing **AIRPLANES** and **TRAINS**; mint Airmails, High Values, British and French Colonials, etc., **ABSOLUTELY FREE** to genuine Approval applicants enclosing 2d.

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£25 IN CASH GIVEN AWAY

We are giving away £25 to buyers responsible for the greatest number of Stamps sold from our Approval Sheets in 1934. Write for particulars of our grand new **1934 PUBLICITY COMPETITION.**

For 30 (abroad 60) days we are giving to all applicants for our Approval Sheets a fine set of **20 DIFFERENT BRITISH COLONIAL STAMPS FREE.**

WRITE EARLY RIGHT NOW

Apply to ERRINGTON & MARTIN, WHOLESALE & RETAIL STAMP DEALERS AND PHILATELIC PUBLISHERS, ESTABLISHED 1880, SOUTH HACKNEY, LONDON, E.9, ENGLAND. Department 236.

TRAIN SET—FREE

We will give you **FREE** a set of Turkey pictorials shewing **train crossing the bridge** over River Kizil-Irmak in Anatolia.

This splendid set is one of the **finest examples of the stamp engraver's art** and should find a place in every album. Just send 2d. for postage and request our Approval Sheets. *You will be glad you sent.*

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Very Special. British Basutoland. Just issued. Mint condition, ½d., 1d. and 2d. 3 stamps. Price **5d.,** postage extra.

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Send your written promise to return the selection within 14 days and I will send a fine approval selection at tempting prices and the above gift.

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Locomotive Colour Plates

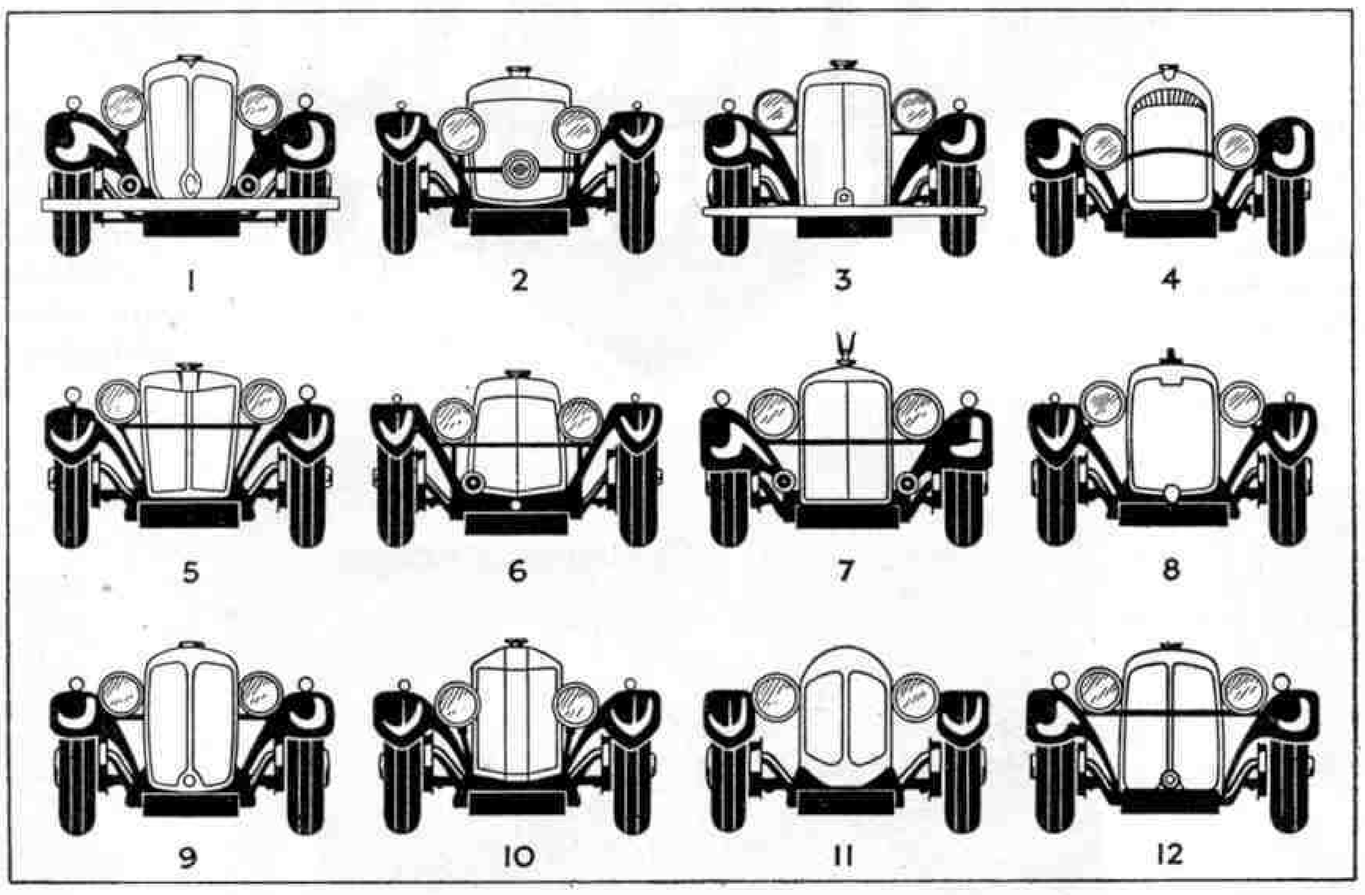
(Locomotive Publishing Co. Ltd. 1/- each)

The latest additions to the excellent series of coloured plates of locomotives issued by the Locomotive Publishing Co. Ltd., consist of reproductions, from paintings by Mr. F. Moore, of L.M.S.R. No. 6200, "*The Princess Royal,*" and S.R. No. 910, "*Merchant Taylors.*" The appearance of "*The Princess Royal,*" the largest and heaviest passenger locomotive in Great Britain, was one of the big railway events of 1933, and it is fitting that it should be chosen for reproduction. "*Merchant Taylors*" is representative of the later batch of "Schools" class locomotives, which are the largest and most powerful 4-4-0s in the country. These two plates are fully up to the firm's usual high standard, and are well worth framing.

Competition Corner

WHAT MOTOR CARS ARE THESE?

Our competition this month is based on one of the most fascinating simple pastimes that we know. We wonder whether there is one of our readers who has never passed a few idle moments in the country sitting on a five-barred gate watching motor traffic pass by, and endeavouring to identify each make of car as it comes into sight! Many young motoring enthusiasts have converted the pastime into a competition by awarding points for correct identification while the car is still a hundred or more yards away—five points for each correct shot, two points deducted for each incorrect shot, and one point added for each incorrect shot by another competitor.



Our illustration, it will be seen, consists of 12 little sketches giving head-on views of well-known makes of car. Readers are asked to identify each of these cars, and prizes of Meccano products, to be chosen by the winners, to the value of 21/–, 15/–, 10/6 and 5/–, are offered to those who succeed in providing the most accurate lists. In the event of a tie for any or all of the prizes, preference will be given to the neatest or most novelly prepared entry.

Entries should be submitted on postcards only, the cars being numbered 1 to 12, as shown on the illustration. Numbers 1 to 4 are in the top row of the illustration, reading from left to right, numbers 5 to 8 in the second row and 9 to 12 in the bottom row.

Entries should be addressed to "Motor Contest, Meccano Magazine, Binns Road, Liverpool 13," and should be sent to reach this office not later than 31st January.

A separate set of prizes will be reserved for entries from Overseas readers, those living outside the United Kingdom and the Irish Free State, whose entries must arrive not later than 30th April.

A Meccano Conundrum

A few weeks ago a reader on the North East Coast sent along the following conundrum: If the Meccano office boy were sacked, what Meccano part would he represent? The answer was: Pawl without Boss!!!

That is the best Meccano conundrum we have seen for a long time, and it suggests interesting possibilities for a competition. Accordingly prizes are offered this month for new Meccano conundrums. The prizes will consist of Meccano products to the value of 21/–, 15/–, 10/6 and 5/–, to be chosen by the winners from our current catalogues.

Readers may submit as many entries as they wish, but no reader may gain more than one prize. Entries should be addressed "Conundrums, Meccano Magazine, Binns Road, Liverpool 13," and should be sent to reach this office not later than 31st January.

A separate set of prizes will be reserved for entries from Overseas readers, whose entries must arrive not later than 30th April.

The best of the entries will be used in the Fireside Fun page subsequently, and the Editor reserves the right to publish any entry without fee.

January Drawing Contest

So great was the interest taken in the October Colour Drawing Contest that it is clear that most of our artist readers would welcome another contest of this type. This month, therefore, we are again asking readers to make a copy of any illustration—other than the cover—from this month's "*M.M.*," but we do not insist that it shall be in colour, as was a stipulation in the October contest. Black and white drawings in ink or pencil are equally eligible.

The entries will be divided into two sections, as usual, A for competitors aged 16 and over, B for those under 16, and two prizes of Meccano products or Artists' Materials, if the winners prefer, to the value of 21/– and 10/6 respectively, will be awarded in each section. In addition there will be a number of consolation prizes. A separate set of prizes will be reserved for entries from Overseas readers.

Entries should be addressed "January Drawing Contest, Meccano Magazine, Binns Road, Liverpool 13," and must arrive not later than 31st January. Overseas entries must arrive not later than 30th April.

Successful entries are retained by the Editor but other entries will be returned if a stamped addressed cover of suitable size is sent with the entry.

COMPETITION RESULTS

HOME

October Drawing Contest.—The outstanding feature of this competition was an amazing instance of the similarity of the work of twins. The judges were quite unable to separate the entries of the 16½-year old twins H. and R. Powell, of Dursley, Glos., and it was decided to augment the first prize and award each of the boys one guinea. It was also decided to give two special prizes in the A Section; these consisted of autographed copies of the Editor's book "Engineering for Boys."

The full list of prizes is as follows:—Joint First Prizes: Section A, H. Powell and R. Powell (Dursley, Glos.); Section B, K. T. Margetts (Wandsworth Common). Second Prizes: Section A, J. A. Preater (Cam.); Section B, A. Wallace (Dundee). Special Prizes: K. Costain (Bolton); R. A. S. Musker (Liverpool).

OVERSEAS

August Photo Contest.—First Prizes: Section A, J. Credie (Capetown); Section B, W. P. Scott (Dunedin, N.Z.). Second Prizes: Section A, A. A. Boult (Auckland); Section B, Joint Second, B. Lumsden (Feilding, N.Z.) and P. K. Wiener (Claremont, C.P.).

August Point Words.—1. D. J. White (Dunedin); 2. F. T. Reich (Rangoon, Burma); 3. E. K. Shorrock (Vancouver); 4. T. F. Nicholson (Johannesburg). Consolation Prizes: N. A. Burt (Murchison, N.Z.); J. C. Carter (Capetown); W. S. Eagle (Byculla, Bombay).

July Sharp Eyes.—1. E. H. R. Tenison (Colombo); 2. D. R. Thompson (Johannesburg); 3. J. D. Collins (Melbourne); 4. Jan Hers (Johannesburg). Consolation Prizes: B. Amm (Grahamstown, C.P.); J. C. Carter (Capetown); W. Dausch (Salisbury, S.R.); P. Klassen (Singapore); J. S. Tegart (Toronto) R. F. Worsley Christchurch, N.Z.).

CHOOSE YOUR NEW YEAR'S GIFTS at

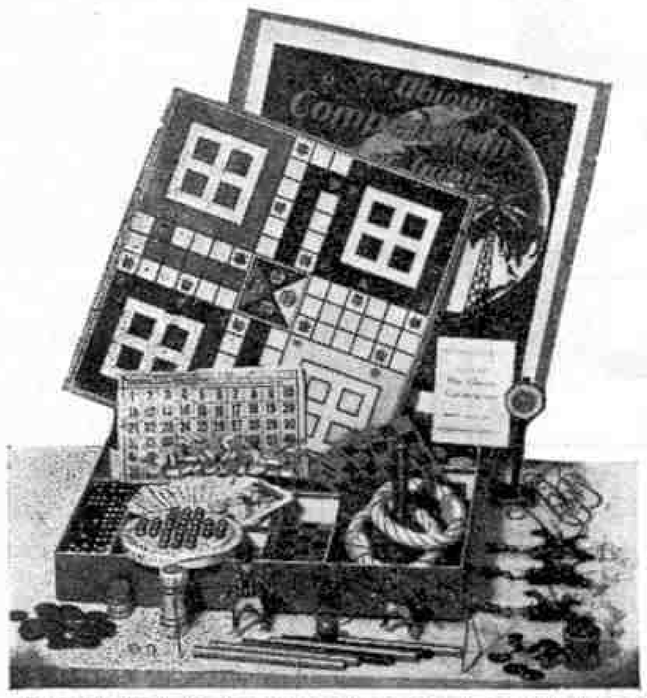
GAMAGES

NATIONAL HEADQUARTERS for MECCANO & HORNBY

As the World's Greatest Boys' Store, and as National Headquarters for Meccano and Hornby, there is a distinct advantage in buying Gifts at Gamages. The variety is infinitely greater—a magnificent display of Meccano and Hornby Trains, and other toys, models, games, etc., is always on view, and expert advice is available to all.

NEW HORNBY LOCOS FOR OLD!

Gamages specialise in Hornby Part Exchange Scheme for Locomotives. Write and ask us how you can obtain a new Locomotive for an old one—we will post you a leaflet with full particulars by return.



COMPENDIUMS OF GAMES

These compendiums contain the most popular games, including all the old favourites. Games for old and young, party games, games of skill, etc., will all be found in GAMAGES COMPENDIUMS.

No. 1. Contains 21 games. Price **3/-**. Post 6d.
No. 2. Contains 40 games. Price **4/6**. Post 9d.
No. 3. Contains 43 games. Including some larger games. Price **5/11**. Post 9d.
No. 4. Contains 39 games in much superior quality (as illustrated). Price **8/11**. Post 9d.
No. 5. Contains 46 games in a de luxe edition. Price **10/6**. Post 9d.

MODEL MACHINE GUN

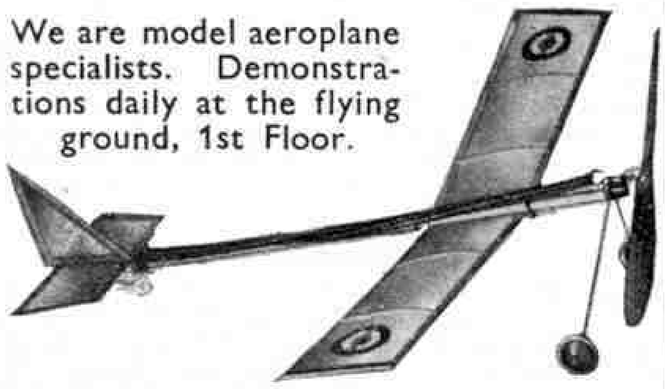
Truly remarkable value in a machine gun. Fitted on collapsible metal tripod. Can be turned to any direction and elevated to an angle of 45 degrees. Fires roll caps at a very rapid rate, and these are easily fixed. Emits a very loud report and smoke pours from barrel giving a realistic effect. No boy should be without this gun. Length of barrel, 25½". Height of gun, 20½ in. Price **10/6** Post 1/-

GAMAGE CHEMISTRY SET

This set contains 23 chemicals (of which 7 are contained in test tubes with rack which may be removed from the box when working), Bunsen burner, filter funnel, filter papers, Florence flask, measuring scoop, large test tube, trays, glass tubing, and a booklet of instructions for carrying out experiments. Price **5/-**

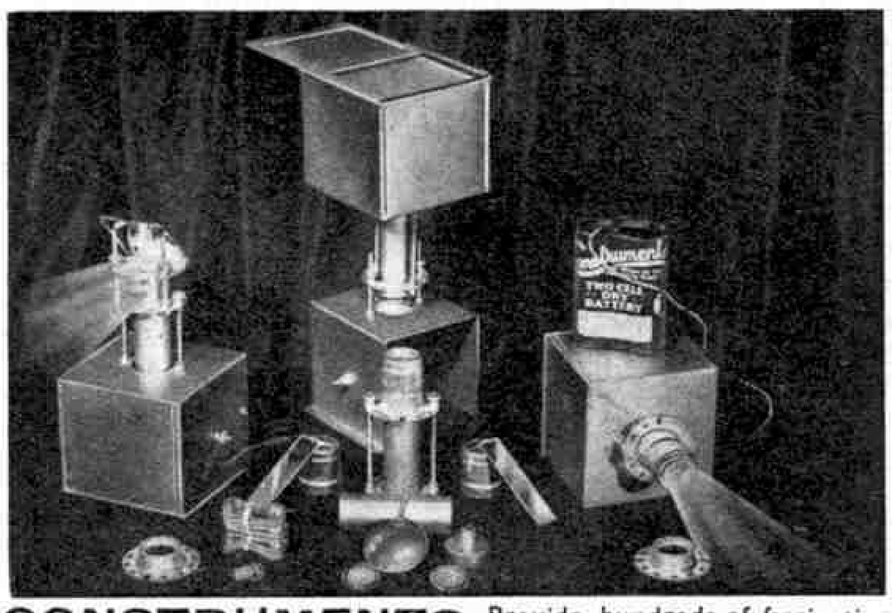
Postage and Packing 9d.
Send for list of higher priced sets.

We are model aeroplane specialists. Demonstrations daily at the flying ground, 1st Floor.



WARNEFORD "DEMON" MODEL AEROPLANE

A very popular flying model of sturdy construction. Fitted with patent shockproof chassis, and covered with yellow proofed silk. Will rise from the ground and has a flight of 300 yards, undoubtedly a fine performance for a machine of this price. Wing span, 23 in. Length, 25½ in. 10-in. propeller. Price **7/6** Post 9d.



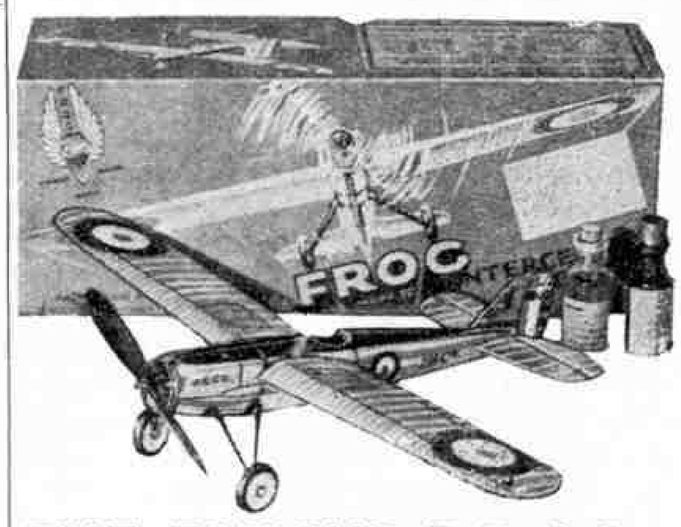
CONSTRUMENTS

Provide hundreds of fascinating scientific experiments.

Construments "10" Outfit. Interchangeable parts, making £10 worth of optical instruments and apparatus such as pocket cameras, photo-copier, picture projector, model of periscope, kaleidoscope, magnifiers, camera obscura, photo-printer, etc. Price **10/-**

Construments "20" Outfit. Interchangeable parts, making £20 worth of pinhole and lens cameras, magnifiers, electric lamps, lamp stands, photo-printers, darkroom shadowgraphs, hand, magnifying and illuminated kaleidoscopes, photo-copiers and enlargers, epidiascopes, watch projectors, signalling lamps, torches, model periscopes, etc. Ask at the same time for a Construments 2-cell dry battery, 1/-. Price **18/6**

Send for the Construments Booklet.



THE FAMOUS F.R.O.G. MODEL AEROPLANES

Without a doubt the most scientific model aeroplane ever made. Has many novel features: collapsible wings, undercarriage and gear-box, making it practically unbreakable. FLIES RIGHT OFF THE GROUND with a run of 8 ft. and travels 75 yards, or when hand-launched 100 yards. Supplied in box with patent winder, inserter rod for new motors, motor lubricant and Shell Oil, R.A.F. markings. Price **7/6** Post 9d.

Also supplied in Italian, Belgian, Dutch, French, U.S.A. and Argentine markings at the same price. New "Puss Moth" Model. Price **17/6**

GAMAGES, HOLBORN, LONDON, E.C.1 *Telephone: Holborn 8484. City Branch: 107, Cheapside, E.C.2*

GETTING HIS OWN BACK

Magistrate: "Haven't I seen you before somewhere?"
Prisoner: "Yes, sir. I had the honour of teaching your son to play the saxophone."
Magistrate: "H'm—six months' hard labour."

* * * *

Prospective Employer: "Parlez vous francais?"
Applicant for position: "I beg your pardon?"
"Parlez vous francais?"
"Sorry, I—er didn't quite catch."
"Do you speak French?"
"Oh, yes, fluently."

* * * *

Little Betty had gone to the country for her summer holidays. One day she saw some farm hands spreading out the top of a stack of hay to dry. At last she could not contain her curiosity any longer, so she politely asked one of the men: "Is it a needle you're looking for?"

* * * *

Counsel: "Defendant said you were a rogue. Is that correct?"
Plaintiff: "Yes."
Counsel: "Then why are you bringing an action?"

* * * *

Secretary: "A gentleman has called for an interview. He wishes you to tell him the secret of your wonderful success in life, sir."
Millionaire: "H'm. What is he, a journalist or a detective?"

* * * *

Visitor (to Farmer): "Haven't those pigs enormous appetites?"
Farmer: "Don't worry. They'll soon be cured."

* * * *

A NON-SLIP DEVICE

A Lancashire man met a friend. "Bill," he said, "I've got an idea for a patent worth a gold mine."
"What is it, lad?" asked his friend.
"Well, tha knows when tha eats peas in the ordinary way, they run off thi knife. I've invented a knife with a lot of holes in the blade like a Meccano strip, and that holds them!"

* * * *

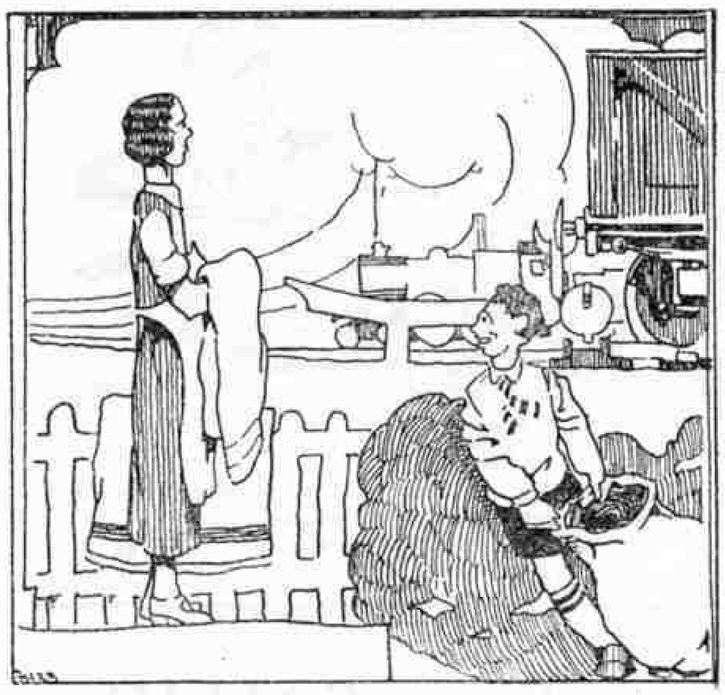
"What's all the noise down there?"
"Motorist turned a corner."
"Well?"
"There wasn't any corner."

* * * *

Woman (to irate booking clerk): "Well, and what if the child did give you monkey nuts, it was a natural mistake, you being behind wire netting an' all!"

* * * *

DRAWING THE FIRE



Mother: "Where did you get all that coal?"
Son: "I sat on the embankment and pulled faces at the engine drivers as they went past."

BAD NEWS

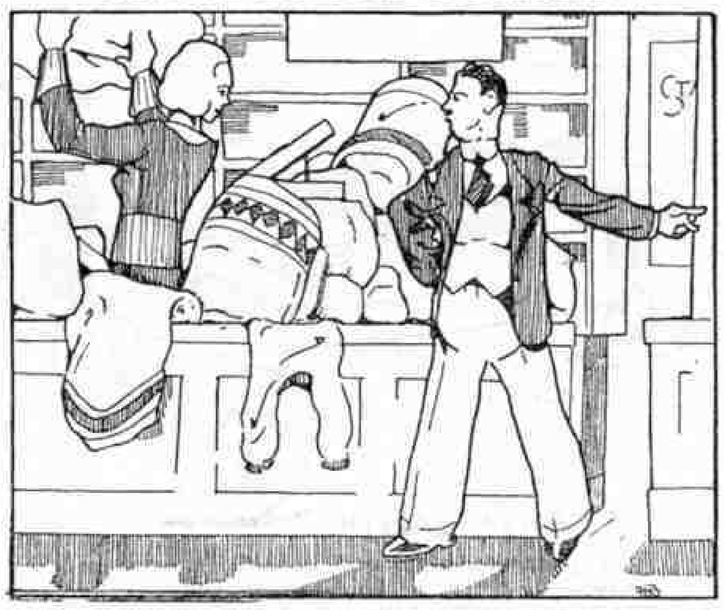
Contractor: "Does the foreman know the trench has fallen in?"
Navvy: "Well sir, we're diggin' 'im out to tell 'im!"

* * * *

Doctor: "Above all, you need plenty of fresh air. What is your profession?"
Patient: "Aviator."

* * * *

THE ONLY THING MISSED



Manager: "That last customer complains that you didn't show her any civility."
Assistant: "Then it's about the only thing in the shop I didn't show her."

* * * *

"He's very argumentative, isn't he?"
"Rather! He even answers back to the wireless announcers."

* * * *

"Our new neighbour knows nothing at all about music," said Johnny, indignantly.
"Why do you say that?" asked his mother.
"Because he told me to cut open my drum to see what is inside it, and I can't find anything!"

* * * *

"Here is a nice welcome," said the Father, who was visiting his son at a public-school. "I've only been here 20 minutes, and already you're asking for money."
"But, Father," said the son, "you must admit the train was 30 minutes late!"

* * * *

"Auntie, will you please wash my face?"
"But I thought you could do that yourself, Bobbie?"
"Well, I can, but I'd get my hands wet, and they don't need it."

* * * *

Porter: "Are you first class, Miss?"
Traveller: "Yes thanks. How are you?"

* * * *

"Mummy, you know the old vase that you said had been handed down from generation to generation?"
"Yes, dear."
"Well, this generation's broken it!"

* * * *

"Please, have you any dry fish?"
"Yes, sonny, I have."
"Then give 'em a drink."

* * * *

"When I was in India I shot a beautiful leopard," said the club bore. "I'll tell you all about it!"
"Oh, I know," said his victim, "you did not know that the gun was loaded!"

* * * *

The new player had tried several times in vain to hit the golf ball.
"Thank goodness, it's gone at last!" he said with evident relief as an object shot forward.
"That's not the ball, sir," said the caddie. "It's your wrist watch."

BEFORE HIS TIME

"Rome wasn't built in a day."
"No, I wasn't foreman on that job."

* * * *

Policeman (to old lady looking ill and ho'ding on to railings): "What's the matter, ma'am? Have you vertigo?"
Old Lady: "About four miles, constable."

* * * *

"Constable, can you tell me the quickest way to the hospital?"
"Sure, just stand where you are."

* * * *

"You say you want to return the parrot after six months. What's the matter with it?"
"The b-b-bird st-st-stutters s-s so t-terribly."

* * * *

A Virginia family was training a coloured girl from the country in her duties as maid. On answering the telephone the first day she brought no message.
"Who was that, Sara?"
"Twarn't nobody, sah, jes a gentleman say 'It's a long distance from New York,' and I says 'Yessir, it certainly is!'"

* * * *

The talkie director approached a small-part actor. "You will have a leading role in this picture," he said.
"A leading role?" queried the actor, scarcely believing his ears.
"Yes," was the reply. "You will be the first to roll down this 200-feet cliff."

* * * *

"When do you work hardest?"
"Before breakfast."
"What do you do?"
"Get out of bed."

* * * *

"What are you gathering fireflies for?"
"For when I go fishing at night or in muddy water."

* * * *

"What is an oyster?"
"A fish built like a nut."

* * * *

"My uncle can play the piano by ear."
"That's nothing. My uncle fiddles with his whiskers."

* * * *

An elderly hunting man had decided that he was too old for the game. To a friend he was retailing his woes.
"Ah, George," he said, sorrowfully, "no more hunting for me. I have burned my bridges behind me."
"Why," said the other, delighted, "if that's the only trouble, I can lend you a pair of mine."

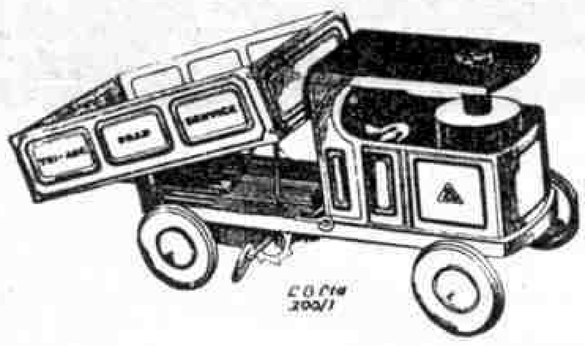
* * * *

THOUGHTFUL OF HIM

"But I told you to wake me at 8 o'clock and it's only six."
"Yes, sir, but I thought you'd like to know you've got two more hours to sleep."

A Happy New Year with your Tri-ang Toys

REGD TRADE MARK

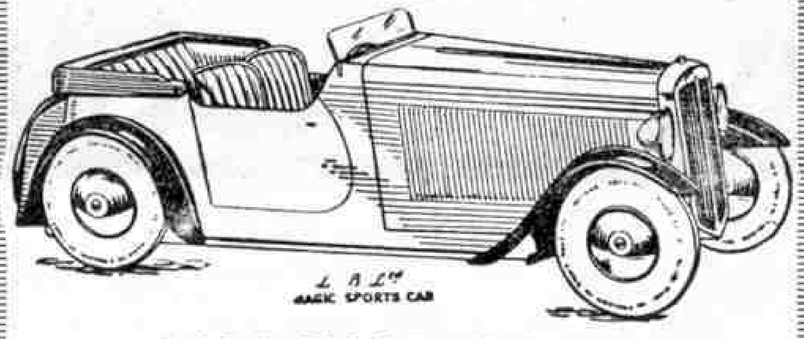


STEAM AND MOTOR LORRIES

Well known road vehicles made as either Steam or Motor Lorries. Strong clockwork, solid rubber wheels, attractive finish. Approx. length, 9½ in.

Price **1/-** Each

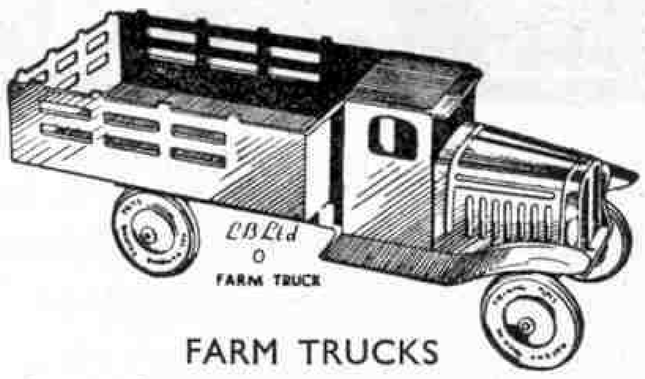
BOX VAN (with two doors at rear)
TIPPING LORRIES
DUST CART (divided opening top)
MILK TANKER (steam chassis)
PETROL TANKER (motor chassis)
TRAILER 6d.



MAGIC CLOCKWORK CARS

An attractive model of a modern sports car. Long-running clockwork motor. Motor-type steering from driver's seat. All-steel construction. Rubber tyres on disc wheels. 16 in. long. **12/6**

Saloon Car. 16 in. long **12/6**
Either model fitted electric light ... **16/-**



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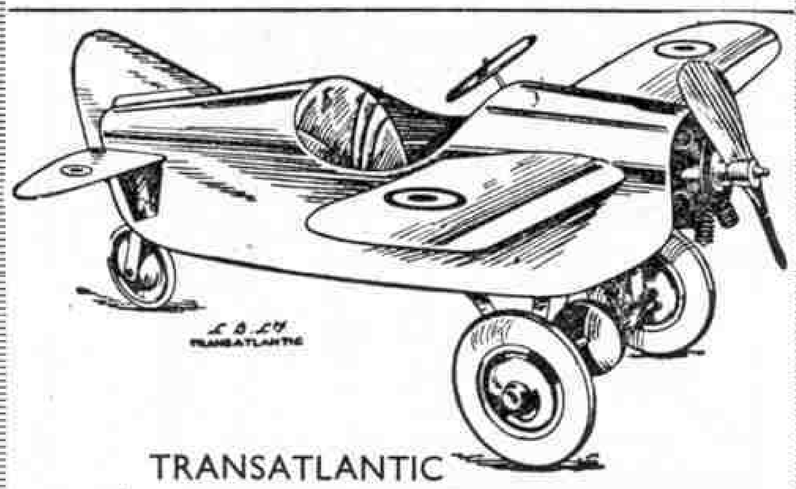
A popular series of toys. Very strong all-steel construction. Solid rubber wheels. Strong, easy running axles. Size OOO. 7½ in. long. **6d.**

Size OO, 10 in. long **1/-**

Size O. 13 in. long **1/11**

TIPPING LORRIES
Sizes and prices as above.



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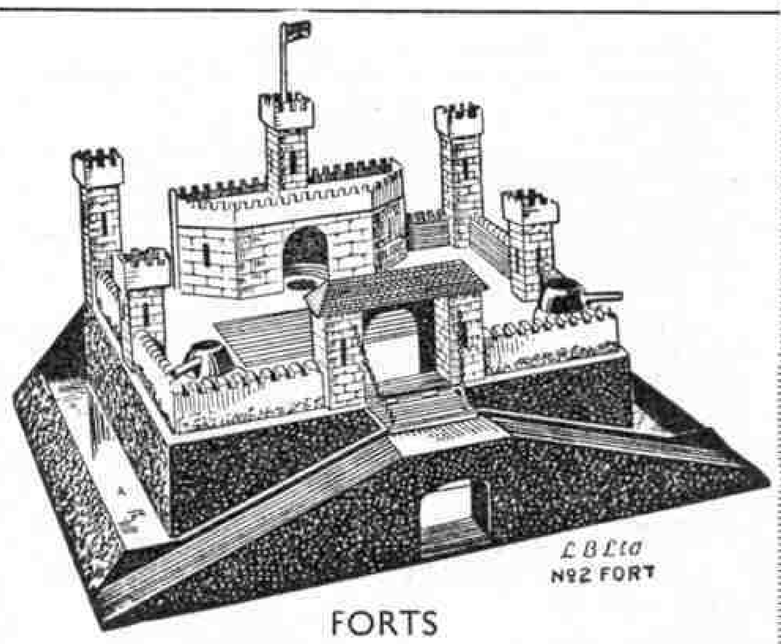
A very attractive design. Polished aluminium body. Cockpit upholstered in red. Solid walnut propeller and dummy rotary engine revolve. Double crank drive, steering from rear wheel. Wings and tail planes detach. **52/6**

SCOOTERS

Tri-ang Scooters are strong and durable. There are twelve different models to choose from.

MODEL D

All steel frame enamelled red. Plated handles, with rubber grips. Hardwood foot board. Thick white rubber tyres on easy running wheels. **9/6**



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FAIRYCYCLE No. 3

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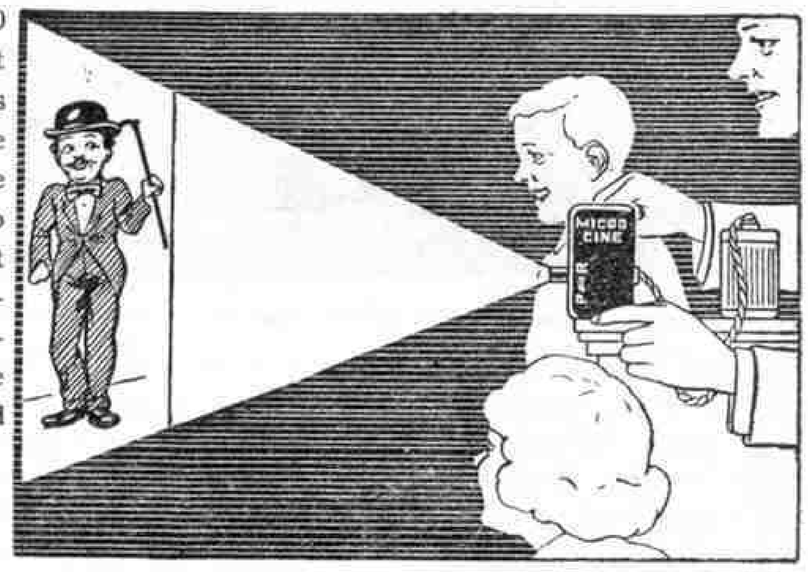
STAMP COLLECTOR'S OUTFIT, containing a magnifying glass, mount damper, guide to collecting, stamp hinges, tweezers, a packet of 200 different stamps, etc. Postage 6d. Price **5'-**

OVER 20,000 different varieties of Toys and Games on five floors. Bring the children to Hamleys and let them see the continual demonstrations of all the latest Games and Models.



THE MICRO-CINE PROJECTOR. Takes 9.5 m.m. Home Cine films, and can be run off an ordinary pocket lamp battery. You can focus the pictures from the Micro-Cine on to a white screen or, by means of the special Eye-Piece supplied, see them in even greater detail. It is the simplest, safest and least expensive projecting apparatus you could possibly have. Complete Outfit. Price **18'6** Post 6d.

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F.R.O.G. machines, including the famous "Puss Moth," can here be seen in actual flight.

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Working scale models of all the principle railways operating continually over 270 feet of track. Three new models can now be seen. The **"Princess Royal," L.M.S., "Lord Nelson," S.R.,** and **"Hush-Hush" 10000, L.N.E.R.** See them on the First Floor.

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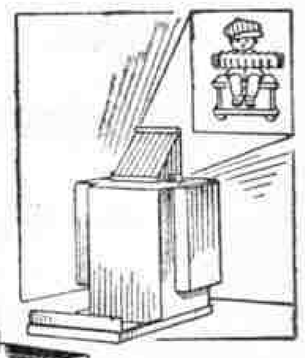

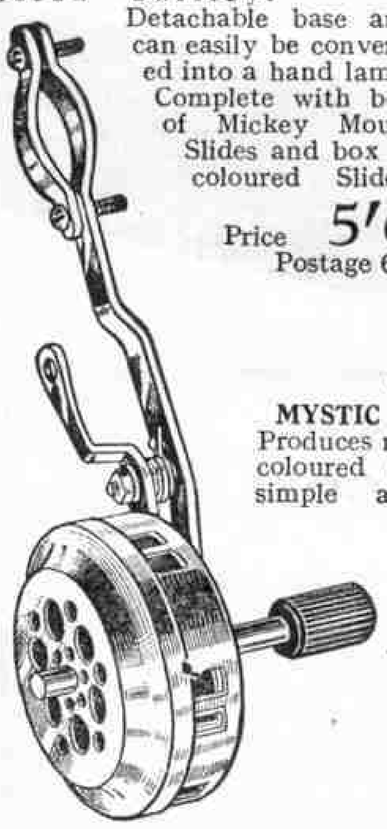

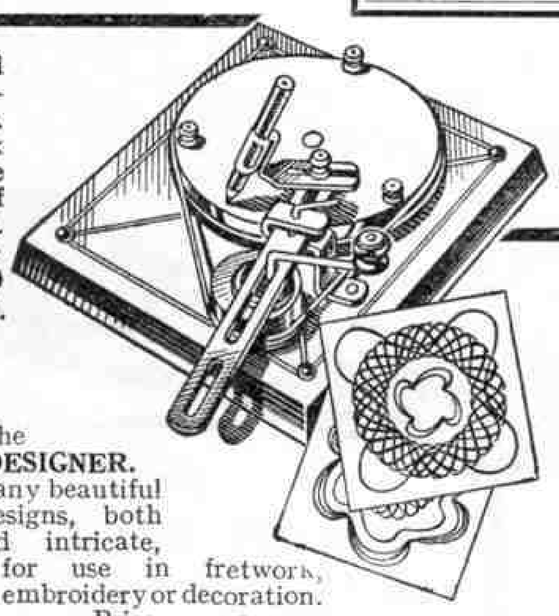

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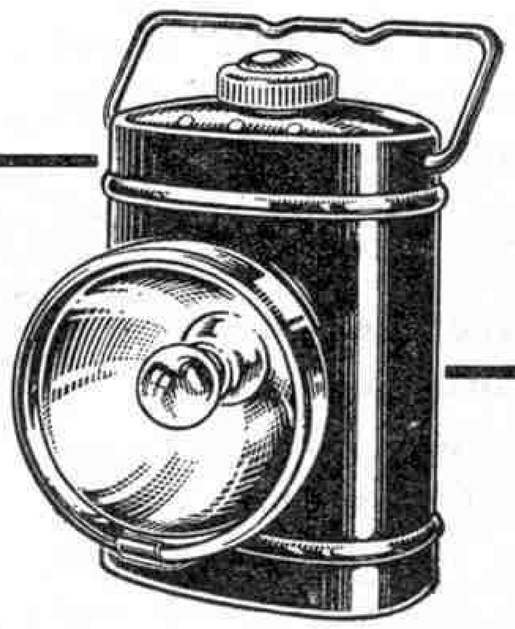

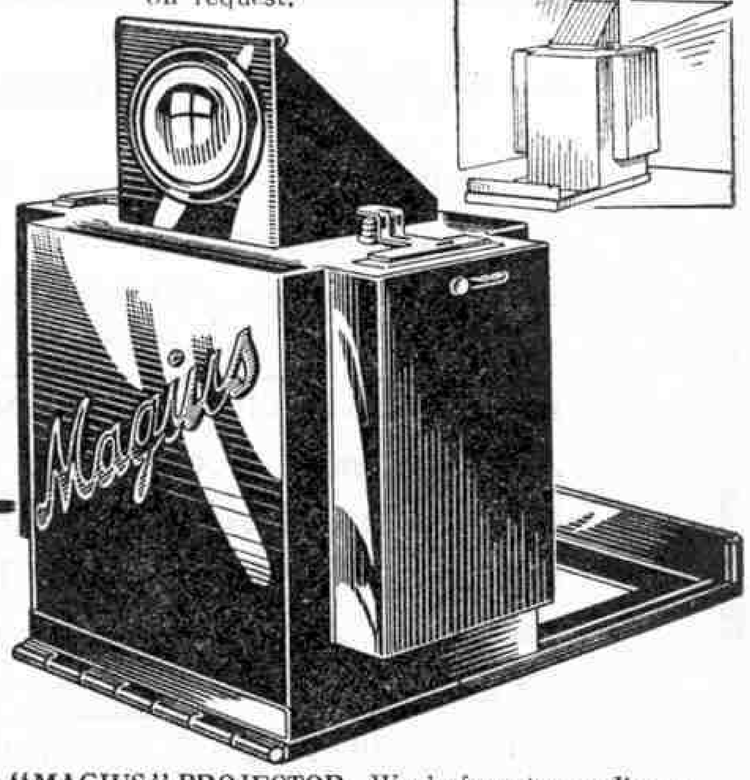

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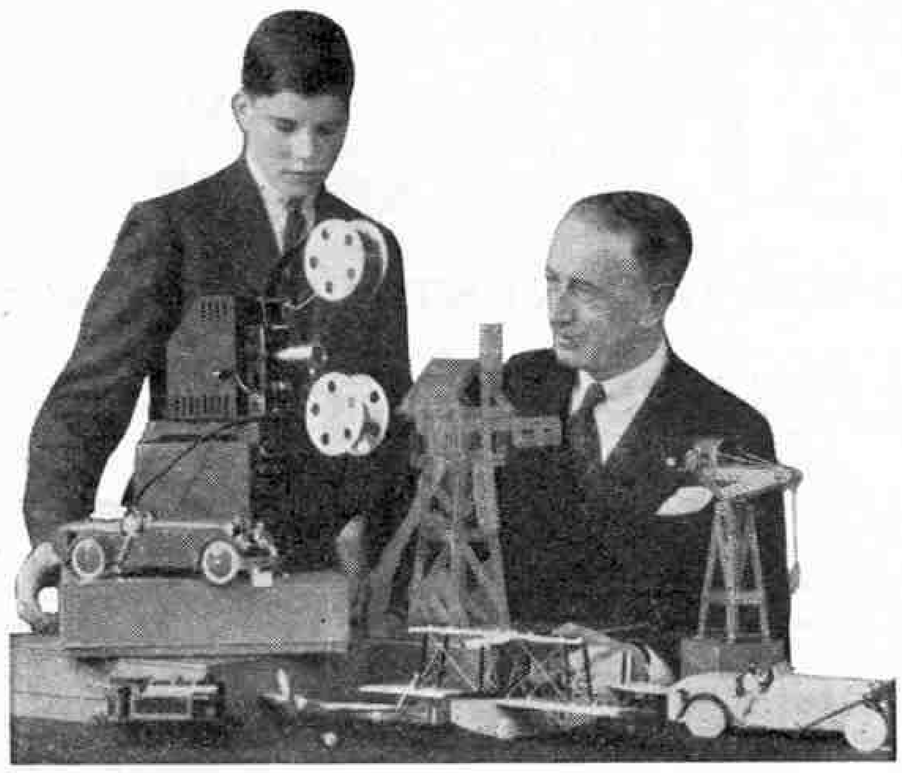

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IT IS A CUSTOM among the railways nowadays to design certain standard locomotive types like the "maid-of-all-work," and therefore we do not doubt that our really handsome new 0–6–0 tank, illustrated here, will be greeted with acclamation by gauge "O" model railway owners, just as it was much admired at the Model Engineer Exhibition. POWER is its principal asset, for the all-British motor mechanism fitted is, whether clockwork or electric, of much the same characteristics as that which has made our "ROYAL SCOT" and "FLYING SCOTSMAN" models so popular. Outside cylinders greatly enhance the external appearance of the model, which is smart and well-proportioned in every respect.

Length over buffers, 9½ ins. Height to top of chimney, 3¾ ins. Weight, 2¼ lbs.

Black eggshell finish with red lining and number in standard railway yellow. Fitted with new automatic couplings. Prices: Clockwork and Electric D.C. **42**/–; Electric A.C. **45**/–.

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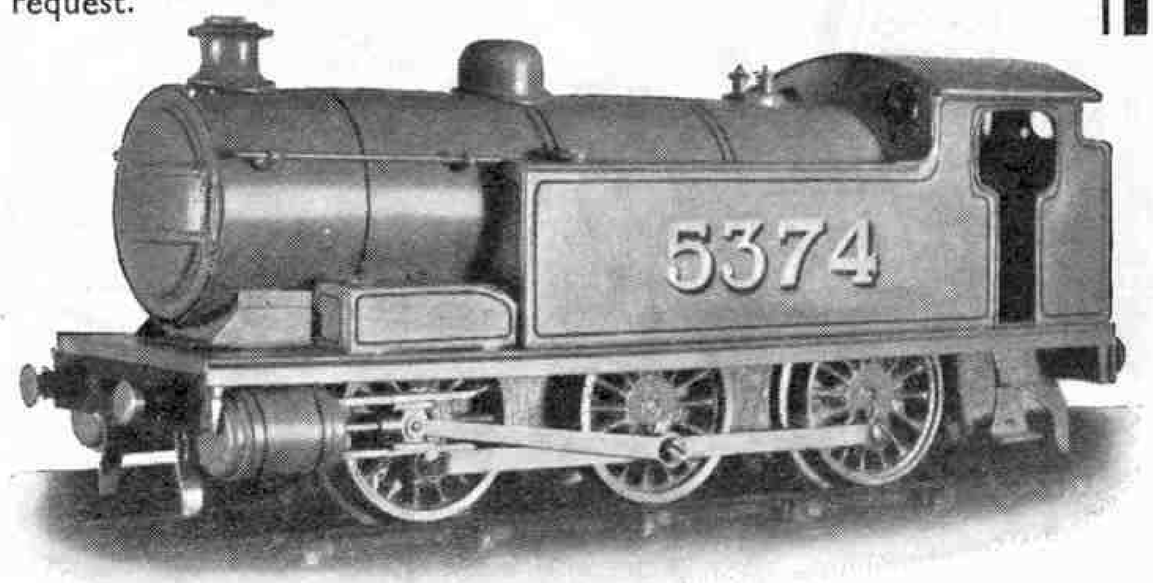

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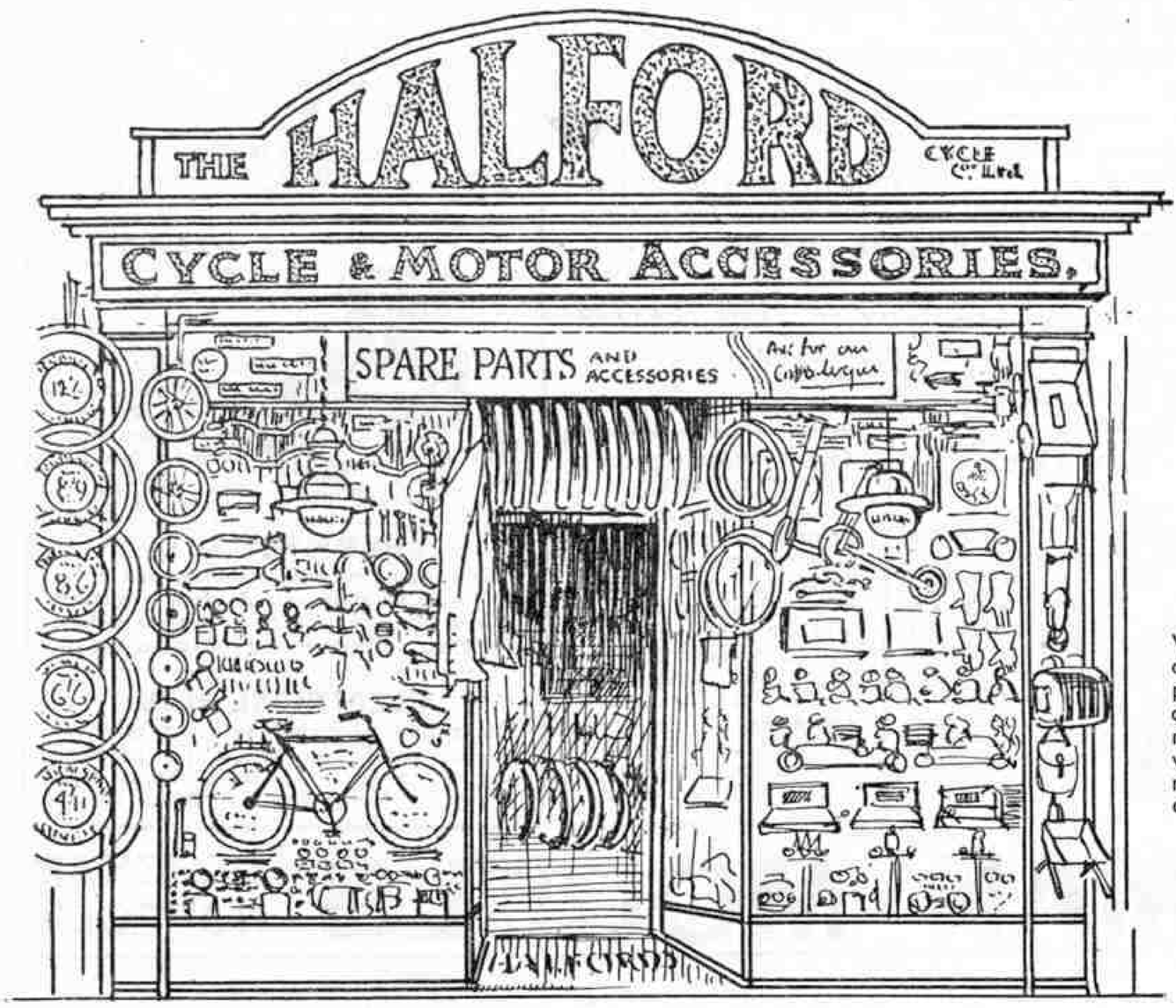

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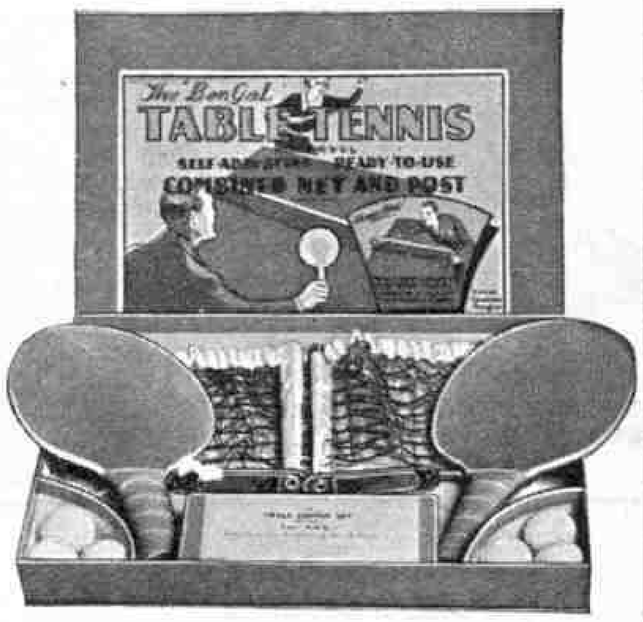

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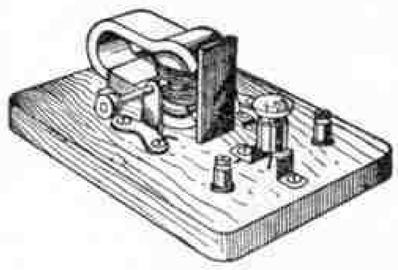

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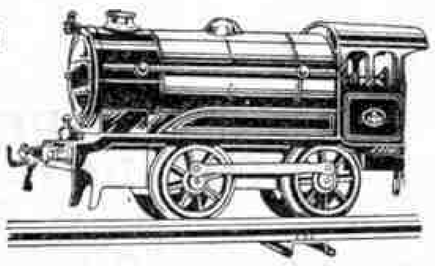

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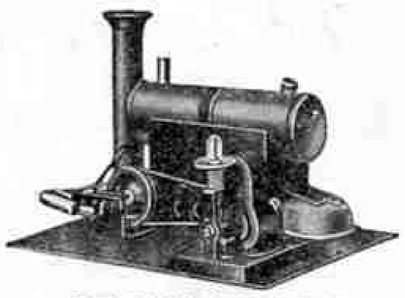

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There's endless fun in a Bowman workshop. Start one to-day ! You can keep on adding extra models as you go along, and make Meccano ones of your own—all driven realistically by a real steam plant capable of 2,000 revs. a minute, and specially designed by permission with drilled metal bases, for use with Meccano.

STATIONARY STEAM ENGINE (M135)

Brass boiler, 5¾" x 1¾" with safety valve. 2-speed gear and 2 driving pulleys. Drip feed lubricator. Steam exhausts through chimney. Postage U.K. 1/–. Price **16/9**

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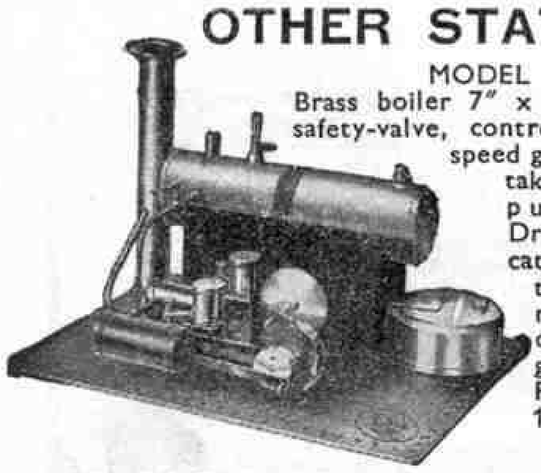

MODEL 122
Brass boiler 7" x 2". Whistle, safety-valve, control tap. Two-speed gear. Low gear takes Meccano pulleys, etc. Drip feed lubricators. Exhaust through chimney. In box complete Fully guaranteed. Postage U.K. 1/–. Price **27/6.**

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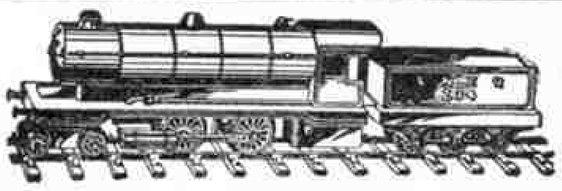
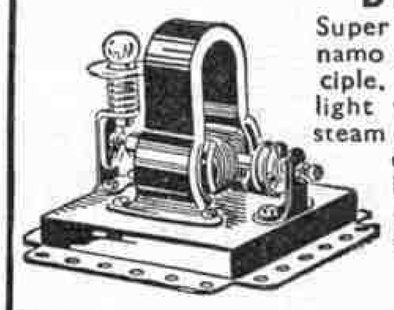
THE BOWMAN BOOK OF MODELS
The Bowman Book of Models—an interesting treatise on model engineering and full details of all models—will be sent you by return of post if you send your name and address (and enclose three-pence in postage stamps) to Bowman Models (Dept. M.M.26), Dereham, Norfolk.



LOCO 234
Runs 1½ miles non-stop. Solid drawn brass boiler. Safety valve. Exhaust through chimney. 2 cylinders. Steel frame. Length with tender 20". Other steam locos **10/6**, **21/–**, **25/–**. Tender, **7/6** extra. **30/-**



DYNAMO
Super efficient dynamo on new principle. Gives bright light with smallest steam engine. Fitted drilled metal base by permission. With bulb. No. 839 **7/6**

CHEMISTRY SETS
This amazing wooden cabinet, size 15" x 22", with all chemicals in glass, is offered at special price of **15/–**. See it before deciding. Other models **2/6** to **21/–**.

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These new electrical sets are splendid value. Of two classes (a) practical application sets ; (b) experimental sets. 8 sets. Prices from **2/6** to **21/–**.

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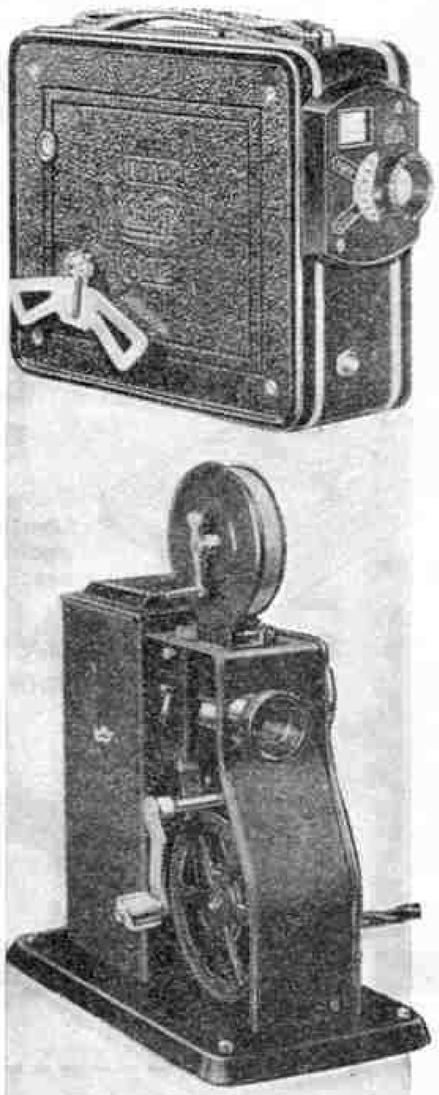

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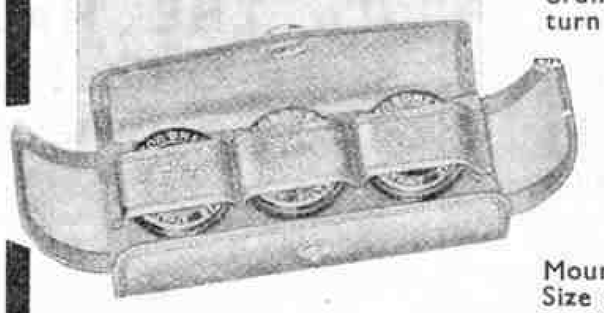
" CORONET " PROJECTOR
Fits standard 9.5 film. All metal construction. All voltages up to 250. Specially powerful lens. Geared crank action. Plug into ordinary lamp holder, switch on current, turn handle, and begin the most thrilling show in your own home. **45/–**



" CORONET " CINE PORTRAIT LENSES AND SKY FILTER
Wallet containing 6 ft. and 3 ft. Portrait Lenses and efficient Sky Filter. Folds up very compactly for vest pocket. Complete Outfit **7/6**

" CORONET " SILVER SCREEN
Mounted on rollers. Practically uncreasable. Size of Picture 2 ft. 6 ins. x 1 ft. 6 ins. **7/6**

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SKYBIRDS

● This is the finest series of constructive model aeroplanes on the market ; not only are the machines themselves more accurate than anything of this type previously produced, but the range of accessories is surprisingly complete.

● This photograph is composed entirely of "Skybird" figures, buildings and the latest model of the A.W. "Atalanta" with four perfect replicas of this machine's 10-cylinder Siddeley Serval Radial Engines. Buy the constructional set and build this handsome model. No. 16. Price **10/6** (as supplied to Imperial Airways Ltd.).

Transfers for registration letters of this machine are obtainable for either "Atalanta" (Cape route) or "Arethusa" (Indian Trans-Continental route), price per set, **6**d.

■ Two other NEW MODELS :–

No. 17 D.H. "GIPSY III" MOTH
2/-

No. 18 PERCIVAL "GULL"
(with folding wings),
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■ **SKYBIRDS** descriptive details with 21 illustrations. Post free, **7d.**

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A Sister Series to SKYBIRDS

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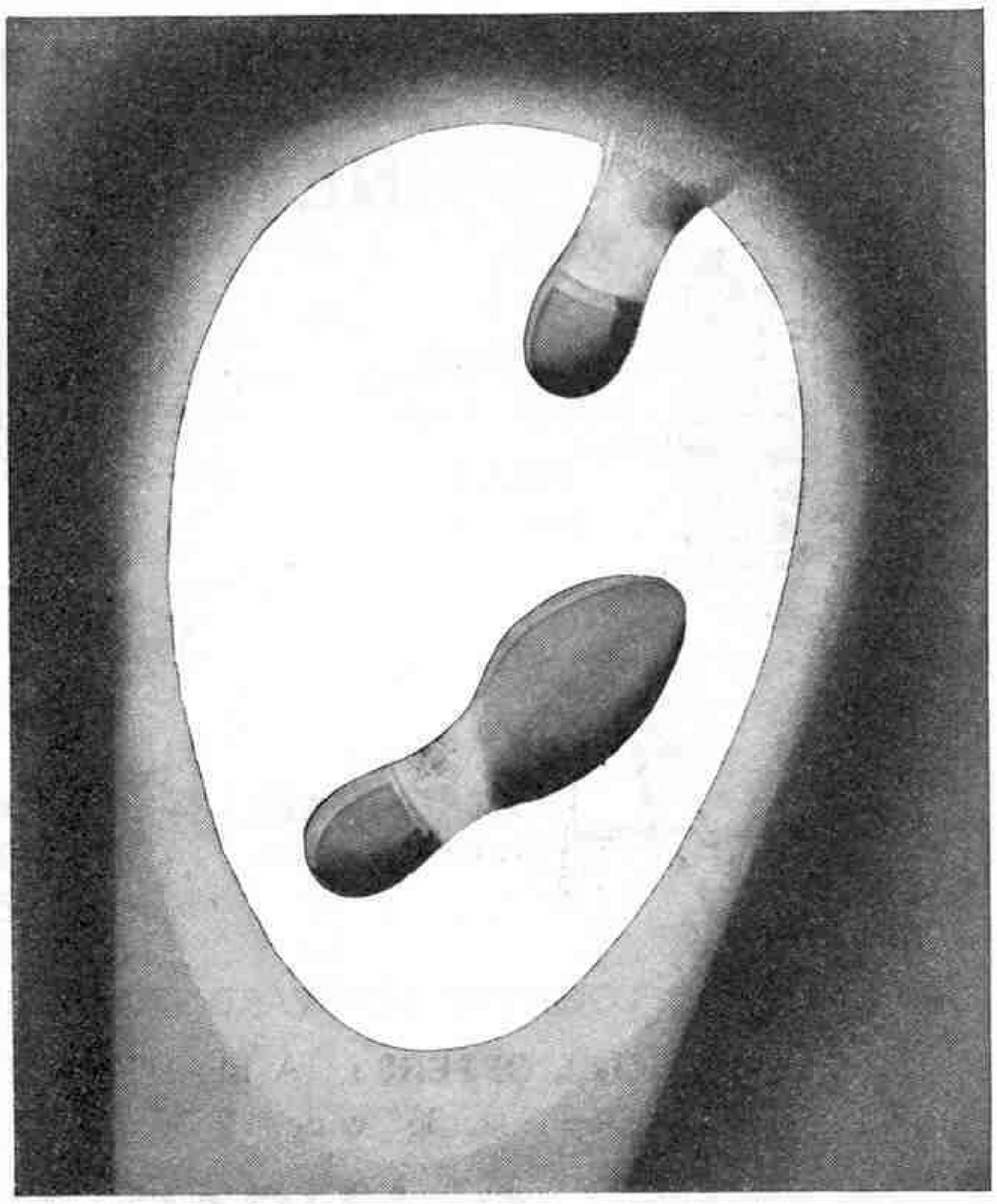

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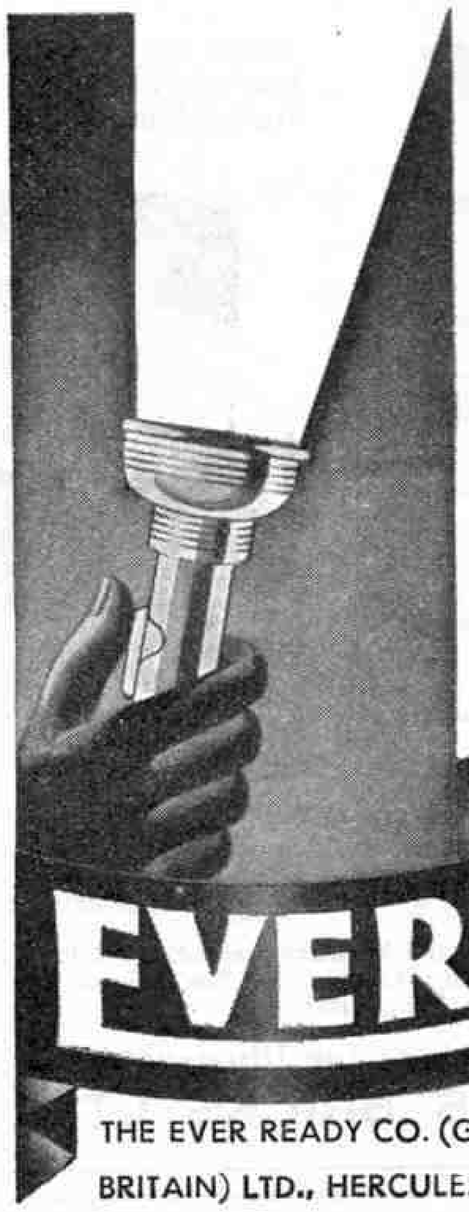
What a fellow he is for finding things out, this Ever Ready torch ! He can creep along with you in utter darkness and will not say a word. And when your fingers tell him to, he'll shoot out a great white beam of electric light that takes in everything at a glance.



What a beauty for a chap to have in his hand! And what a bit of luck that Ever Ready torches can be bought for as little as one shilling. Start saving *now*. Take a tip from us. Always make sure that your Ever Ready torch has the name 'Ever Ready' on the screw cap. And specially be certain that the famous Ever Ready battery is providing the light. It's beams better !

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EVER READY
TORCHES & BATTERIES

THE EVER READY CO. (GREAT BRITAIN) LTD., HERCULES PLACE, HOLLOWAY, LONDON, N.7.

If you see it in the "Meccano Magazine" we probably stock it

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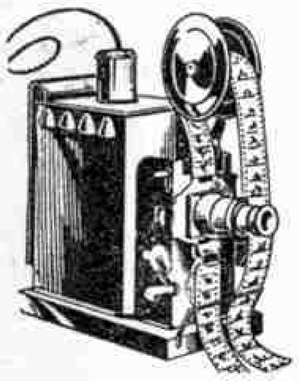

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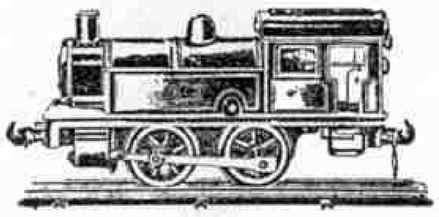

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G.O and G.1.
Big reductions.

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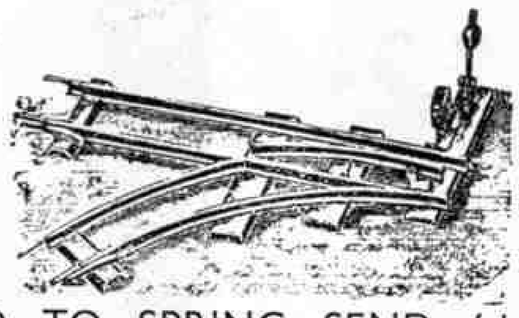
to clear at half price from 2/6



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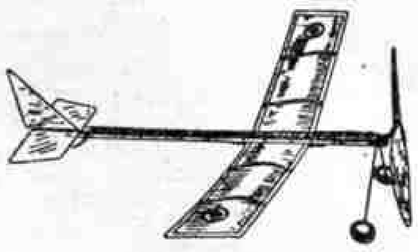

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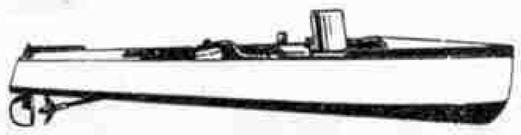

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SPECIAL OFFERS: A BEAUTIFUL FAST YACHT with Auto Steering Gear, £1-2s.
SAIL CLOTH, Union Silk, 36" wide. 2/3 per yd. CHEAP SETS OF SAILS, Masts and Booms from 2/6.

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Box 3
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There are hours of really interesting experimenting ahead of the Boy who possesses a box of Lott's Chemistry or Electricity. Each set contains apparatus, etc., and an illustrated booklet of the experiments which can be carried out. Spare supplies of the Chemicals and Apparatus can be obtained.

Obtainable from all leading Toy Dealers and Stores

BOX. 3 Contains 30 chemicals, bunsen burner with rubber connecting tube, large and small test-tubes, flask with rubber cork and delivery tube, porcelain crucible, glass funnel, filter papers, litmus paper, magnesium ribbon, glass tubing, test-tube cleaning brush and Book of 131 experiments. **Price 10/6**

BOX 5. An especially fine set, Box 5 contains 43 chemicals and apparatus for a remarkable range of 228 experiments. The additional apparatus over and above the contents of the earlier boxes includes retort stand and ring (of great use in arranging the apparatus in a firm and convenient form), wire gauze, beaker and crucible tongs. Extra bottles of some of the chemicals most frequently used are also included. **Price 21/-**

Box 5
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BOX 2. As illustrated below this set contains apparatus and instructions for 84 experiments, including experiments in magnetism and static electricity, measuring of currents, resistance experiments, relay, buzzer, electrically controlled railway and traffic signals, etc., etc. Also contains two complete Leclanche cells with necessary chemicals.
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These prices apply only to Great Britain and Northern Ireland. Obtainable in South Africa at Stuttaford & Co. Ltd., Capetown; Canada: at the T. Eaton Co., Toronto; H. Morgan & Co. Ltd., Montreal.

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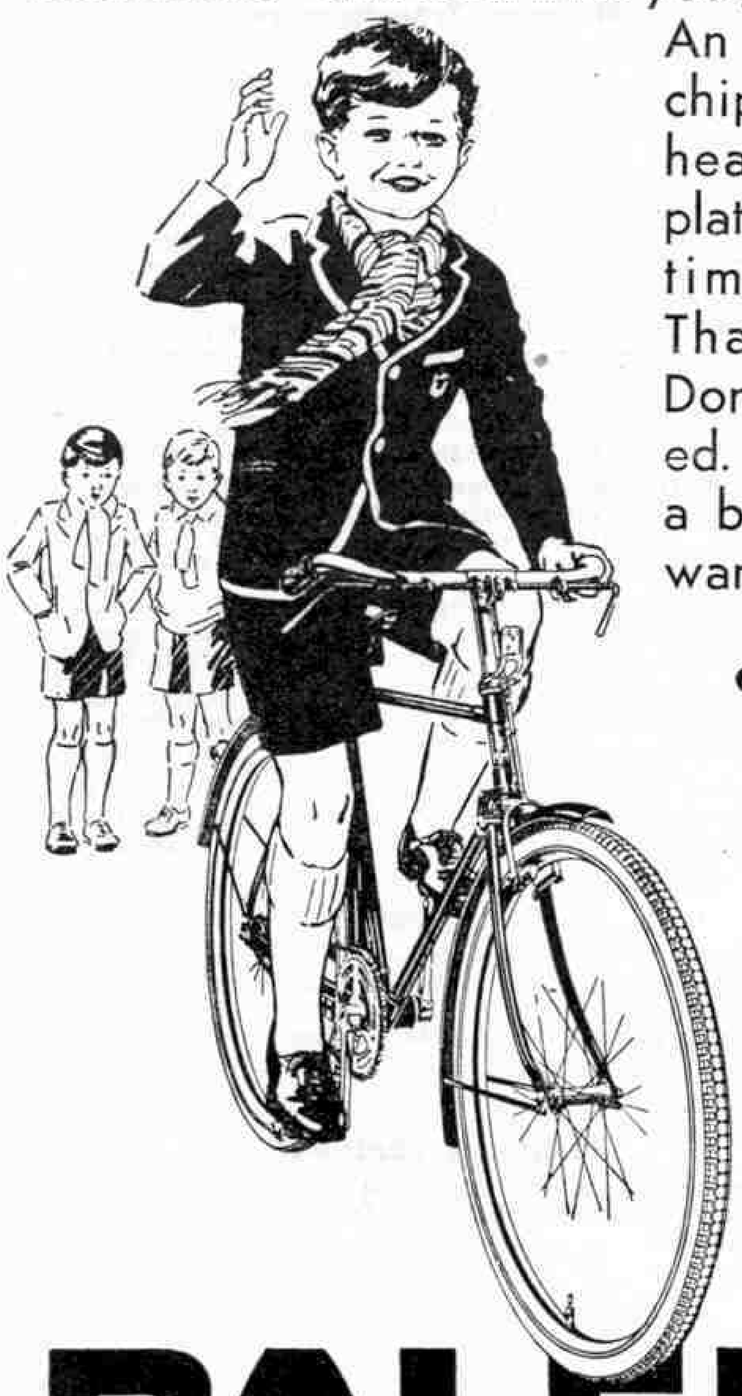
Last year everyone was economising and, of course, you didn't want a cheap "bike." And here it is the New Year again. Bet you're just eating your heart out for a bicycle. Why not agitate for that Raleigh? It doesn't cost so very much more—and look what you get for the money.



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Send postcard for free copy of "The Book of the Raleigh" and name and address of nearest dealer.

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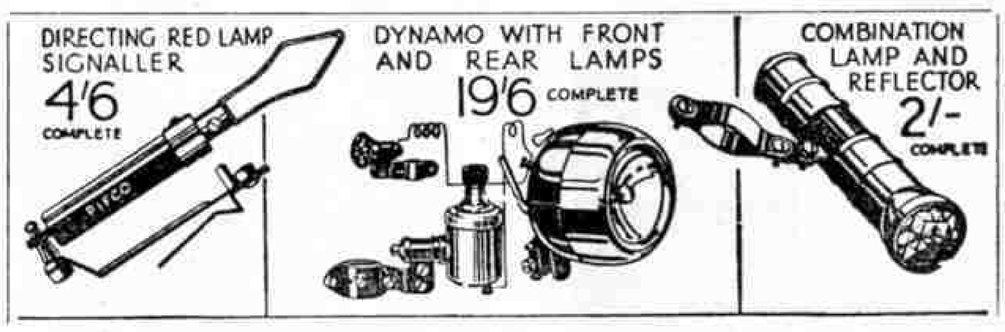
A PIFCO★ HEADLAMP GIVES YOU A POWERFUL BEAM FOR 1/4D PER HOUR

Choose a Pifco Headlamp this autumn on account of economy and the safety it ensures. Study these features—90 ft. beam, 30 hours light from 2 pocket batteries, spare bulb carrier, faceted lens, Twin Switch, alternate current 4 or 8 volt. Decidedly—the **finest lamp in Britain,** and extraordinary value at **5/- complete.**

STOCKED, RECOMMENDED AND SOLD BY ALL GOOD CLASS CYCLE AGENTS AND STORES.



PIFCO

Write to us for free booklet—"7 WAYS TO SAFETY"

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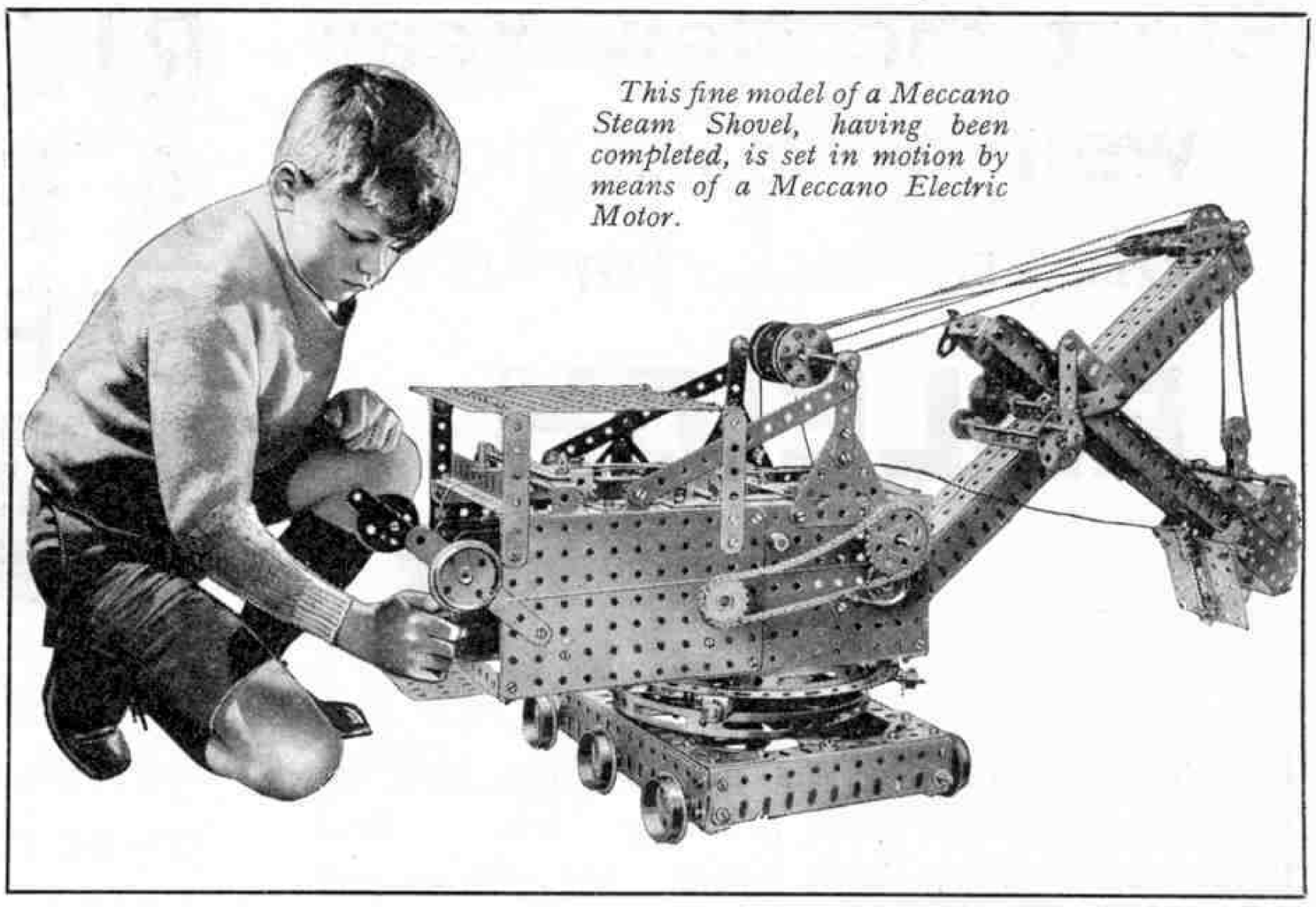
Use a Meccano Power Unit

Building a Meccano model is the greatest fun in the world. Excitement increases steadily as the model grows, part by part, under your hands. Finally there comes the greatest thrill of all. You connect your completed Crane, Motor Chassis or Traction Engine to a Meccano Motor and see it work in exactly the same manner as its prototype in real life!

The Meccano Motors are strongly made and the utmost care is taken in their manufacture to ensure that they will give satisfaction. Particulars and prices are given below.

MECCANO LIMITED

Binns Road Liverpool 13



This fine model of a Meccano Steam Shovel, having been completed, is set in motion by means of a Meccano Electric Motor.

DETAILS OF MECCANO POWER UNITS

Meccano Clockwork Motors

These are the finest clockwork Motors obtainable for model driving. They have exceptional power and length of run and their gears are cut with such precision as to make them perfectly smooth and steady in operation.

X SERIES CLOCKWORK MOTOR. A fine Motor specially designed to drive with ease any of the X Series models. It is non-reversing ... ... Price 2/6

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No. 2 CLOCKWORK MOTOR. This is a Motor of super quality. Brake and reverse levers enable the Motor to be started, stopped or reversed, as required. Price 10/–

Meccano Electric Motors

The five Meccano Electric Motors listed below provide smooth-running power units for the operation of Meccano models. The 6-volt Motors may be operated either from a 6-volt Accumulator or through a Transformer direct from the mains, providing that the supply is alternating current. They cannot be run satisfactorily from dry cells. The 20-volt Motors are most conveniently operated through a 20-volt Transformer from alternating current supply mains.

No. E1 Electric Motor (6-volt). Non-reversing	Price	9/–
No. E6 Electric Motor (6-volt). Reversing	,,	15/6
No. E1/20 Electric Motor (20-volt). Non-reversing	,,	10/–
No. E20A Electric Motor (20-volt). Non-reversing	,,	16/6
No. E20B Electric Motor (20-volt). Reversing		18/6

Meccano Transformers

A Meccano Transformer provides a convenient and safe means of driving a Meccano Electric Motor from the mains supply where this is alternating current.
There are six Transformers in the series, all of which are available for the following A.C. supplies :—100/110 volts, 50 cycles; 200/225 volts, 50 cycles; 225/250 volts, 50 cycles. Any of the Transformers can be specially wound for supplies other than these at a small extra charge. When ordering a Transformer the voltage and frequency of the supply must always be stated.

No. T6 Transformer (Output 25 VA at 9 volts) for 6-volt Electric Motors. Fitted with speed regulator. Price 21/–

No. T6M Transformer (Output 25 VA at 9 volts) for 6-volt Electric Motors. This is similar to No. T6, but is not fitted with a speed regulator ... ... Price 16/6

No. T6A Transformer (Output 40 VA at 9/3½ volts) for 6-volt Electric Motors. Fitted with speed regulator and separate circuit for supplying current for eighteen 3½-volt lamps ... ... Price 26/6

No. T20 Transformer (Output 20 VA at 20 volts) for 20-volt Electric Motors. Fitted with 5-stud speed regulator ... ... Price 21/–

No. T20M Transformer (Output 20 VA at 20 volts) for 20-volt Electric Motors. This is similar to No. T20, but is not fitted with speed regulator ... ... Price 16/6

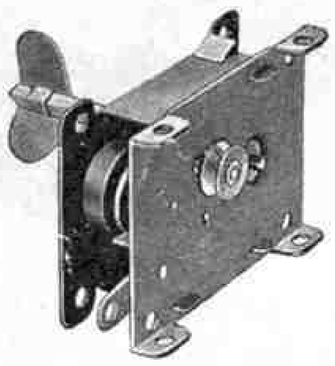
No. T20A Transformer (Output 35 VA at 20/3½ volts) for 20-volt Electric Motors. Fitted with speed regulator and output sockets for lighting lamps ... Price 26/6

Accumulators

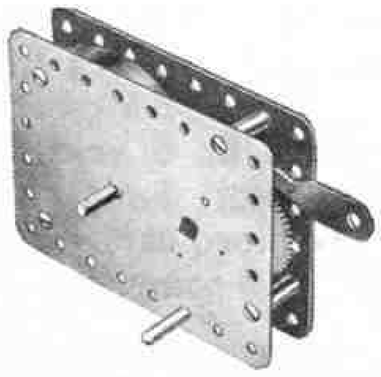
The 6-volt 20-amp. Accumulator is specially suitable for running Meccano 6-volt Motors and Hornby 6-volt Electric Trains ... ... Price 27/9
The 2-volt 20 amp. Meccano Accumulator is supplied for converting 4-volt Accumulators to 6-volt... Price 9/3

Resistance Controller

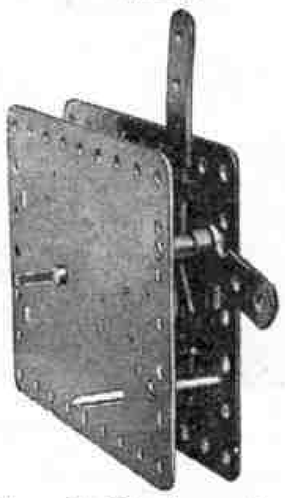
By use of this Controller the speed of Meccano 6-volt Motors and Hornby 6-volt Electric Trains may be regulated as desired ... ... Price 3/9



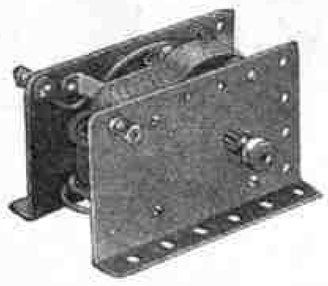
X Series Clockwork Motor



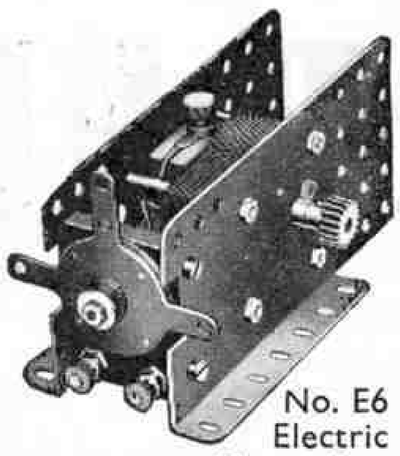
No. 1 Clockwork Motor



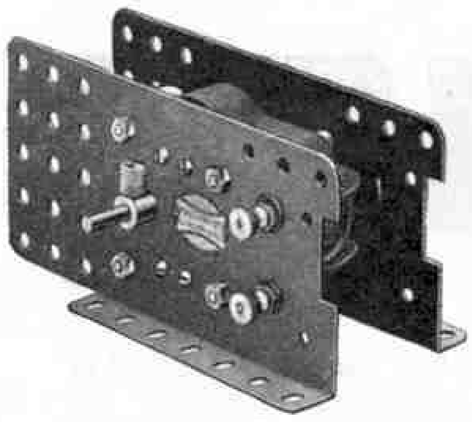
No. 2 Clockwork Motor



No. E1 Electric Motor (6-volt)



No. E6 Electric Motor (6-volt)



No. E20a Electric Motor (20-volt)

No. T20 Transformer

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Make it in Plasticine!

A GIANT airplane . . . a mammoth liner . . . a big sailing ship in full sail . . . an express train of the latest type . . . a fire engine . . . a motor car . . . these are a few of the exciting things you can make in the Plasticine "Travel" series. And they are so easy to model too. Every box contains full instructions. Whatever you are building, there are many things which can be made quicker and more effectively with Plasticine. Tunnels and bridges for your trains . . . railway embankments . . . stations . . . goods for your cranes and trucks . . . and a host of other things. Your local toy shop has a full range of modelling outfits.

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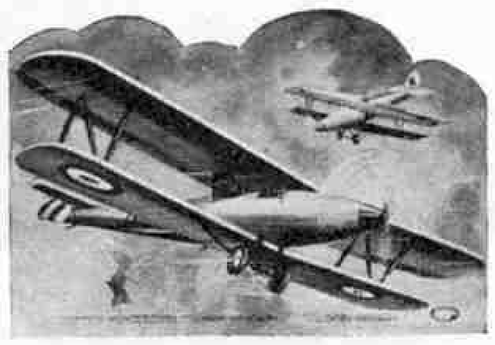

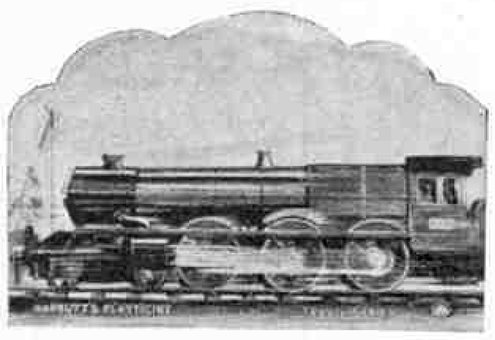

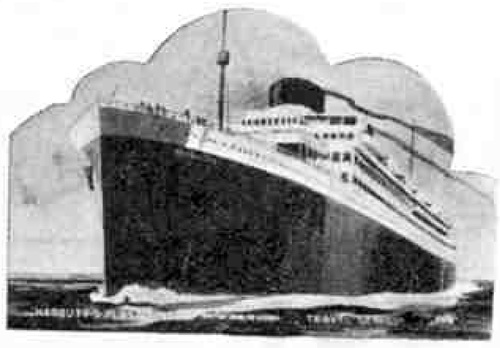

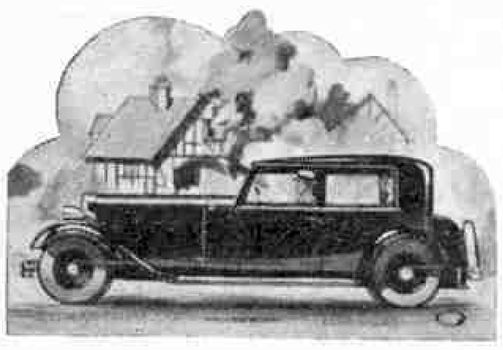

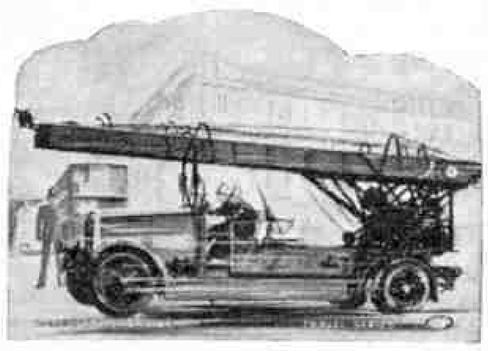

H A R B U T T ' S

Plasticine

Write for full illustrated price list to
Harbutt's Plasticine Ltd., 99, Bathampton, Bath

There's a RILEY BILLIARD TABLE to suit in size and price . . . and you can pay as you play

Riley "Home" Billiard Table resting on ordinary table.

8/- DOWN FOR 8/- DOWN you can have a Riley "Home" Billiard Table delivered to your door on 7 days' free trial, carriage paid. All Riley Billiard Tables are perfect replicas in construction of full size tables. Do not confuse them with inferior toy billiard tables. No matter how small or how large your room is, there is a Riley Billiard Table to fit it. Below is a full range of Riley "Home" Billiard Tables with sizes and prices:

4 ft. 4 ins. × 2 ft. 4 ins.	£7 0 0
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6 ft. 4 ins. × 3 ft. 4 ins.	£11 15 0
7 ft. 4 ins. × 3 ft. 10 ins.	£15 0 0
8 ft. 4 ins. × 4 ft. 4 ins.	£21 10 0

or in 20 monthly payments of 8/-, 10/3, 13/3, 17/-, 24/6.

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Riley's are the largest makers of full size billiard tables in Great Britain. Also specialists in Re-covering, re-modelling, billiard sundries, etc.

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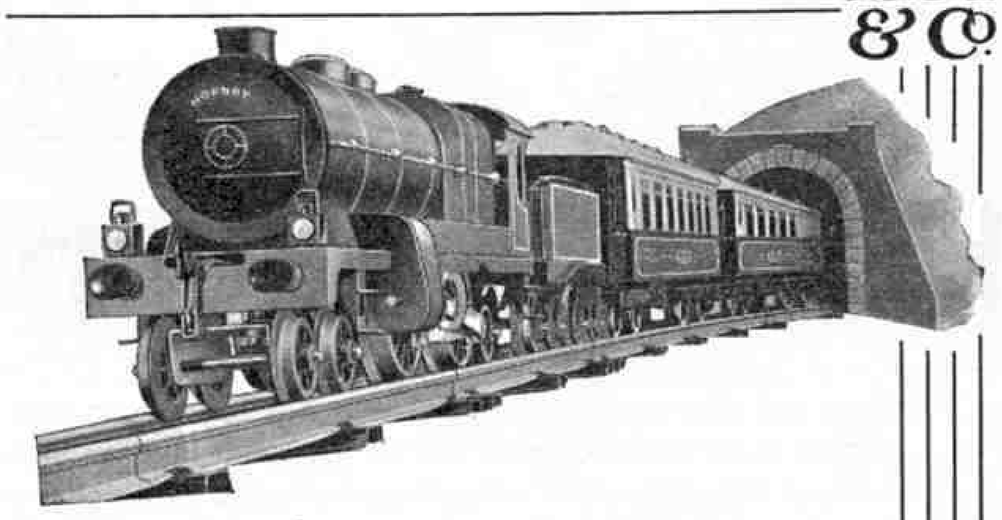

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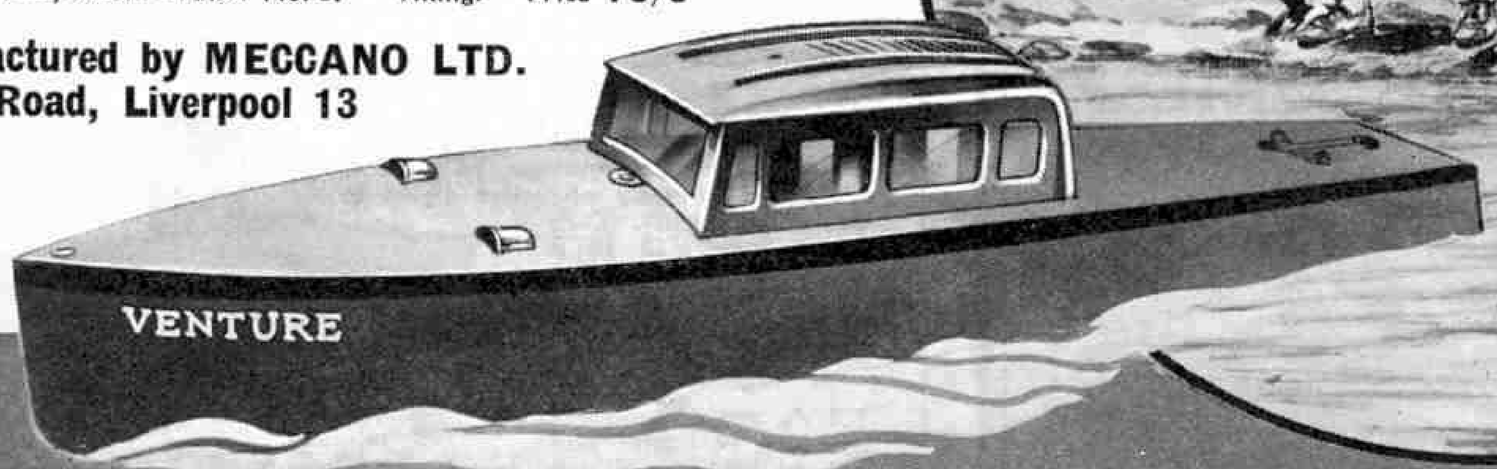

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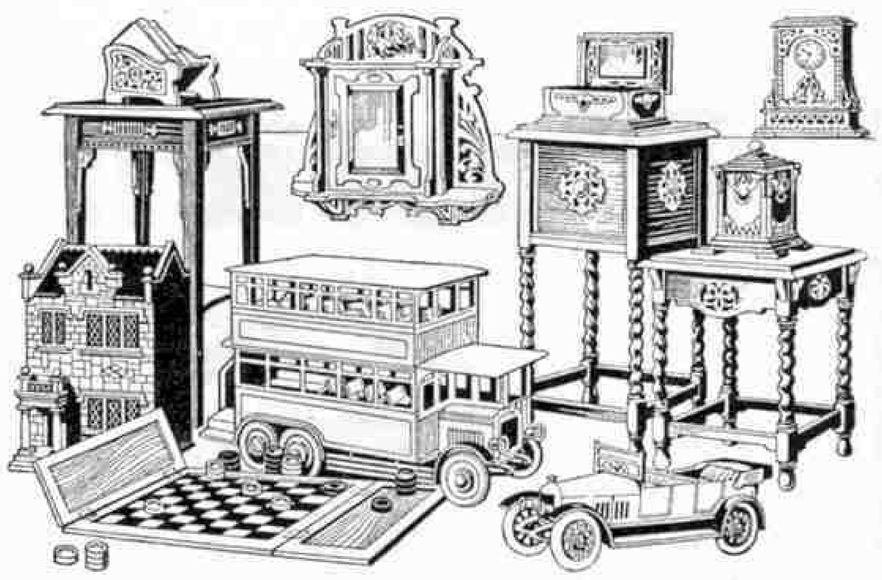

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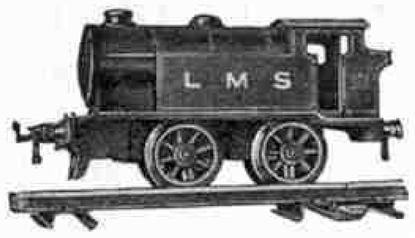
HORNBY TANK LOCOMOTIVES



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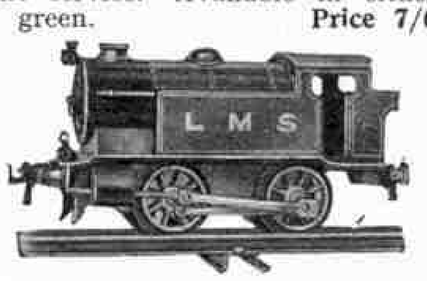
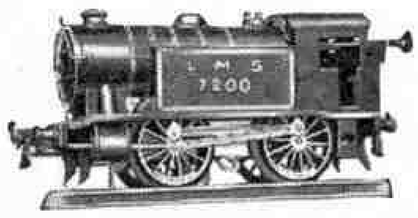


No. 1 Tank Locomotive



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NO. 1 SPECIAL TANK LOCOMOTIVE. This splendid Locomotive which is fitted with brake mechanism and reversing gear, has remarkable power and gives a very long run. It is available in the colours of the L.M.S.R., L.N.E.R., G.W.R. and S.R. **Price 18/-**

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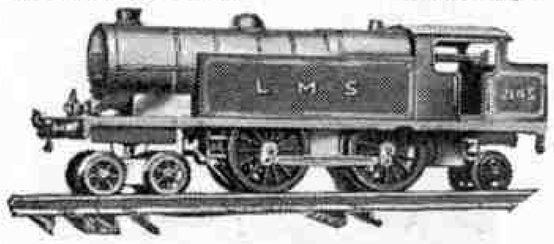

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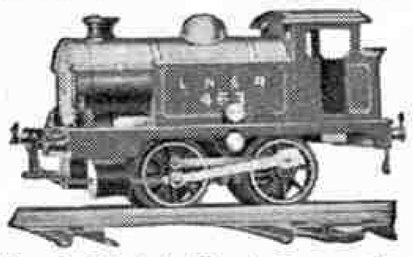

No. 1 Electric Tank Locomotive

No. 1 ELECTRIC TANK LOCOMOTIVE. This Locomotive is of the permanent magnet type, and may be run from a 6-volt accumulator. It can be stopped, re-started, reversed and the speed varied by the operation of levers at the side of the track. It is supplied with a terminal connecting plate, speed and reverse control switch and 3 feet of flex, and it is available in the colours of the L.M.S.R., L.N.E.R., G.W.R. and S.R. Locomotives. **Price 32/6**

This Locomotive cannot be run from the mains supply.

MECCANO LTD. - BINNS ROAD - LIVERPOOL 13

This Month's New Model—(*Cont. from page 54*)

4½" Flat Girder and 4½" Angle Girder 39 held in place by ½"×½" Angle Brackets. At the bottom they are coupled together by a framework of 2" Angle Girders 40 fitted with two 1" Corner Brackets shown in Fig. 1. Each side of this framework carries a Flat Trunnion and two 4½" Curved Strips 41, these two extensions being joined together by a 1½"×½" Double Angle Strip. This Double Angle Strip is spaced away from the Curved Strips by a suitable number of Washers, and it carries a "T" section girder built up from two 1½" Angle Girders. These Girders carry six curved 1"×½" Angle Brackets fitted as shown, and they form a sliding support against which the centre of the transmission tube rests.

Two screw clamps 45 are fitted, and these consist of 3½" Threaded Rods, carrying 1" fast Pulleys at their ends, mounted in Threaded Bosses 44. Wing nut handles are built up from Strip Couplings and Flat Brackets, the latter being clamped in place by Grub Screws. The model is now complete, but before running it all bearings should be well oiled with fairly thin lubricating oil. For this purpose the new Meccano Lubricating Oil will be found most suitable, but it should not be allowed to adhere to the Motor commutator or to the contacts of the throttle lever.

The model will look extremely imposing if it is mounted on an "L" shaped framework, the bottom of the "L" coming under the engine in order to prevent it from falling over.

The Schoolboys' Own Exhibition

Readers of the "*M.M.*" who are in London on any day up to the 13th of this month are strongly advised to visit the Schoolboys' Own Exhibition at the White City. There they will see a wonderful array of aeroplanes, record-breaking motor cars, wireless wonders, ingenious working models, stamps, pets, and in fact everything that the modern boy loves. As far as possible the various items in the Exhibition are shown in action, so that visitors can realise for themselves exactly how they work. Among the outstanding features are the fastest fighting aeroplane in the world; an 8-ft. scale working model of the world's fastest express, and a working model of the largest blast furnace. A special thrill comes from a fascinating exhibit organised by the British Racing Drivers' Club. There is also the Gaumont British Boys' Own Cinema, and a free Gaumont British competition. A modern fun fair and amusement park adds to the gaiety of the proceedings.

The entrance is in Wood Lane, and the Exhibition is open from 10 a.m. to 9 p.m. daily up to 13th January. The charge for admission is 1/6.

Bird Sanctuaries—(*Continued from page 15*)

as there are sanctuaries established for them throughout the country, where they can find food, shelter and rest.

The bird sanctuary system of protecting birds brings the birds to humanity to protect them, instead of humanity, through game wardens, having to chase after the birds to save them from extermination by the hunters' guns. The nature of birds is to be tame and not to fear humanity, and they are wild only because they have to be. It is through their intelligence in staying out around the human race that any birds exist to-day. The desire to kill that some people possess would have exterminated bird life long ago if these little feathered creatures had not known enough to keep out of range of the outlaws' guns. One live bird is worth 100 dead ones in a good many ways. Humanity by hundreds will travel great distances, even as far as from England, to visit my bird sanctuary and see birds alive; but how far would anyone go to see a pile of dead bird carcases or specimens?

Chemistry in the Home—(*Cont. from page 47*)

drops of a dilute solution of Copper Sulphate and an equal amount of caustic soda solution are added. The mixture is then boiled for a few minutes, the result being simply a blue solution.

The experiment is then repeated with pure grape sugar. A small quantity of this can be purchased from a chemist for a few pence, and probably will be in the form of a thick colourless syrup, a little of which is taken up on a rod and dissolved in half a test tube full of water. If it is solid in form, a solution is readily made from it. On heating this solution after the addition to it of Copper Sulphate and caustic soda, a red precipitate is formed. This is a compound of copper and oxygen that is known as cuprous oxide.

The difference in behaviour of the two sugars in these tests enables us to detect grape sugar in the presence of cane sugar, and the ability to do this is useful in the following experiment. The quantity of cane sugar solution not yet used is boiled with a few drops of hydrochloric acid, or a measure of Sodium Bisulphate, for about five minutes. The liquid is allowed to cool and tested by adding a few drops each of the solutions of Copper Sulphate and Caustic Soda and boiling. A red precipitate of cuprous oxide makes its appearance. If it does not, a little more Caustic Soda is added to make the solution definitely alkaline.

The formation of this red precipitate shows that grape sugar is present. The first test in this series showed that no grape sugar was present in the cane sugar employed, and thus boiling with acid has brought about a change from one sugar to the other.

Electricity in the Home—(*Cont. from page 43*)

stages first by rough pumps, which reduce the whole system to a low pressure, and finally by extremely efficient rotary oil pumps. A circular closed heater maintained at a temperature of about 350°F. is attached to the machine through which the lamps pass during exhaustion in order to evaporate all moisture that may be present, and also to assist the extraction of occluded gases that adhere to the interior glass surface and metal parts of the lamp. After exhaustion has been carried as far as is possible on the machine, the top tube is mechanically sealed and the lamp is liberated.

This process is necessary for gas-filled lamps, for only inert gas can be allowed in the bulb and all air must be removed before the new gas is admitted. The gas is admitted to the lamp at a definite pressure, just before the bulb is automatically sealed off. The completed lamp is now capped, cleaned and etched, and after passing final tests is ready for packing.

The range of electric lamps available enables suitable means of lighting rooms of various sizes to be chosen. Each bulb is marked with the voltage at which it is to be used, and care should be taken not to employ it on any other voltage, for the effect may be disastrous. For instance, the use of a 100 volt lamp on 200 volt mains would result in the destruction of the filament, which is not designed to withstand the heavy current that would be forced through it. A 200 volt lamp would give a very poor light on 100 volt mains, for the resistance of the filament is too small to enable sufficient heat to be generated in these circumstances.

In addition to the voltage, the wattage of a lamp is marked on the bulb. The watt is the unit of electrical power or energy and is obtained by multiplying the current in amperes by the electrical pressure in volts. Multiplying power by time during which current is flowing gives the consumption. For instance, if a 20 watt lamp is used for 25 hours the consumption is 500 watt hours. The unit measured by electric meters is the kilowatt hour, or 1,000 watt hours, for a kilowatt is simply 1,000 watts. This lamp therefore would use half a unit in 25 hours, or could be kept glowing for 50 hours for the price of a unit of electricity.

It is interesting to compare directly the efficiencies of the three types of electric lamp that have been used to the greatest extent since the pioneer days of Swan and Edison. In the old carbon filament lamp the energy required per candle power was about four watts. The coming of the tungsten lamp reduced this to about 1½ watts, and the gas-filled lamp is even more efficient, for the energy required for each candle power of light given out is little more than half a watt. For this reason, gas-filled lamps were known as half watt lamps when they were first introduced.

Binding the "M.M."

There are two methods of binding the "*M.M.*" to preserve back copies from the mutilation that inevitably will be theirs should they be handled for any lengthy period without protection. First there is the spring-back binder system, that permits the copies to be inserted or removed from the binding case at will. This is intended primarily as a temporary arrangement for the protection of copies during the currency of their volume.

Handsome spring-back cases specially prepared for the "*M.M.*," with the name blocked in gold letters on the front cover, can be obtained from Meccano Limited, Binns Road, Liverpool 13, price 2/6 and 3/6 for sizes large enough to hold 6 and 12 copies of current issues respectively.

Permanent binding cases for back numbers of the Magazine can be supplied by Messrs. O. H. Bateman and Co., 23, Hanover Street, Liverpool. These cases are supplied in two sizes (1) for six copies, price 3/3 and (2) for twelve copies, price 4/9 post free in each case. The binding cases are supplied in what is known as "Quarter Basil, full cloth"—that is to say three-quarters of the sides are dark crimson cloth and the back and a quarter of the sides are dark crimson leather as shown above. The case is tastefully embossed in gold with the name "Meccano Magazine," and on the back is the name and volume number.

Binding Six or Twelve Copies

These binding cases are supplied so that readers may have their Magazines bound locally, but where desired, the firm mentioned above will bind Meccano Magazines at a charge of 5/9 for six issues or 7/6 for twelve issues, including the cost of the binding and also return carriage. The covers of the Magazines may be included or omitted as required, but in the absence of any instructions to the contrary they will be included.

Whilst the binding of the twelve Magazines is quite satisfactory, they form a rather bulky volume and for that reason arrangements have been made to bind six months' Magazines where so desired, as explained above. Back numbers for any volume can be bound and the case will be embossed with the volume number.

Readers desiring to have their Magazines bound need only make a strong parcel of them, include a note of their name and address together with the necessary remittance, and send the parcel direct to Messrs. O. H. Bateman and Co., carriage paid.

THE RAILWAY MAGAZINE

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A Rare Scottish Railway Device.
Water Pick-up Troughs.
Some Famous Scottish Inclines.
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Notes on Scottish Locomotives and Railway Working, 1895-1910. IV.—The Great North of Scotland Railway.
The Finish of the Royal Scot Tour.
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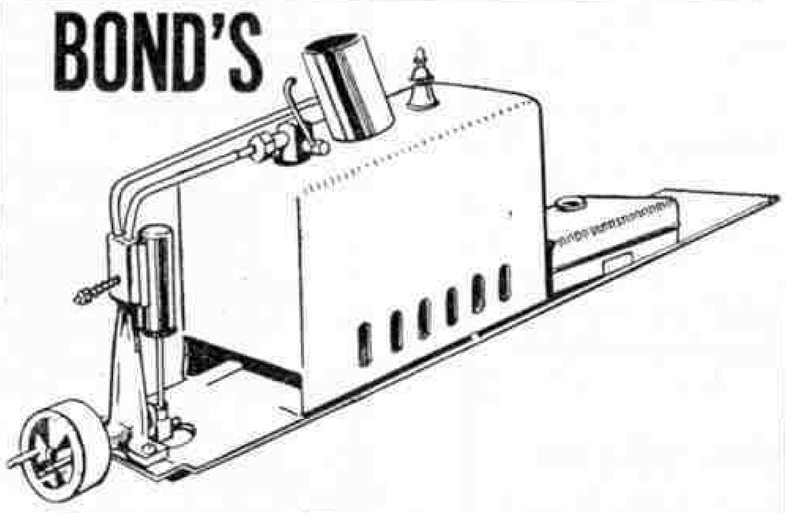

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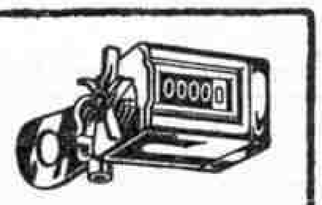

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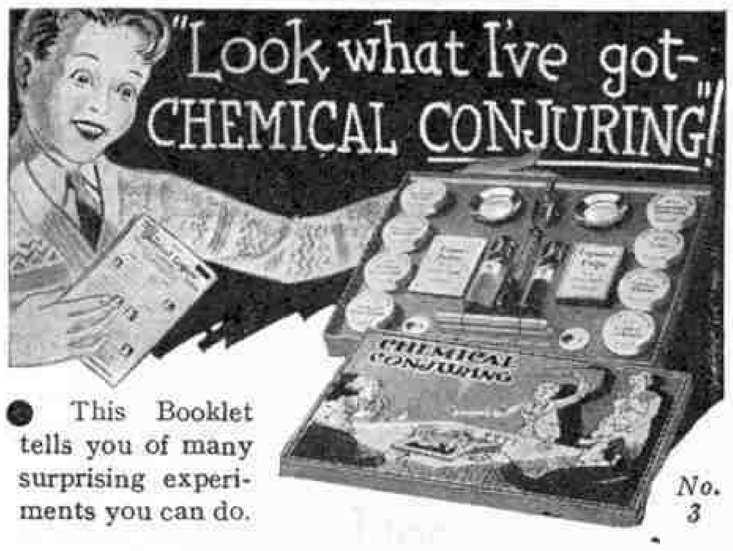

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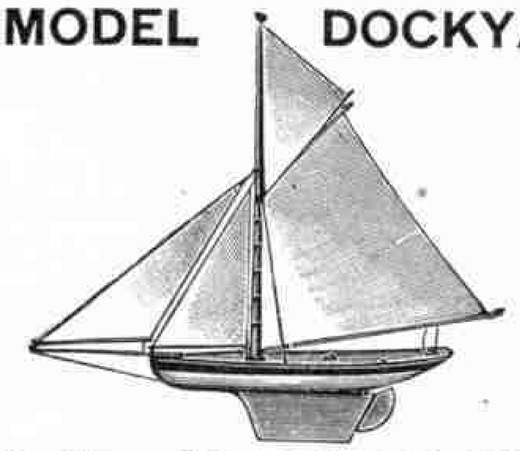

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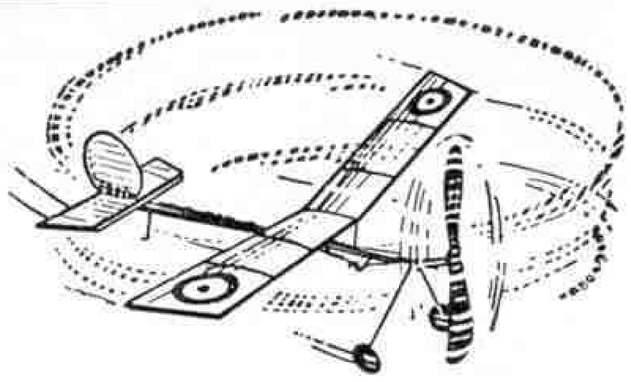

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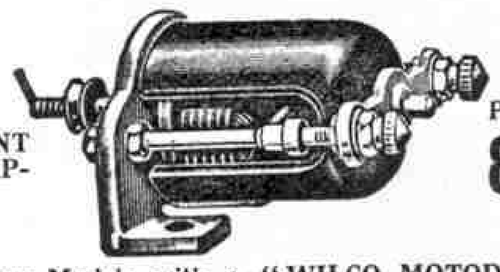

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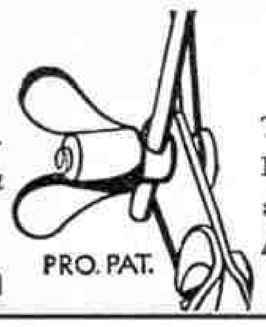

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EDITORIAL AND ADVERTISING OFFICE:—

LIVERPOOL 13, ENGLAND.

Telegrams: "Meccano, Liverpool."

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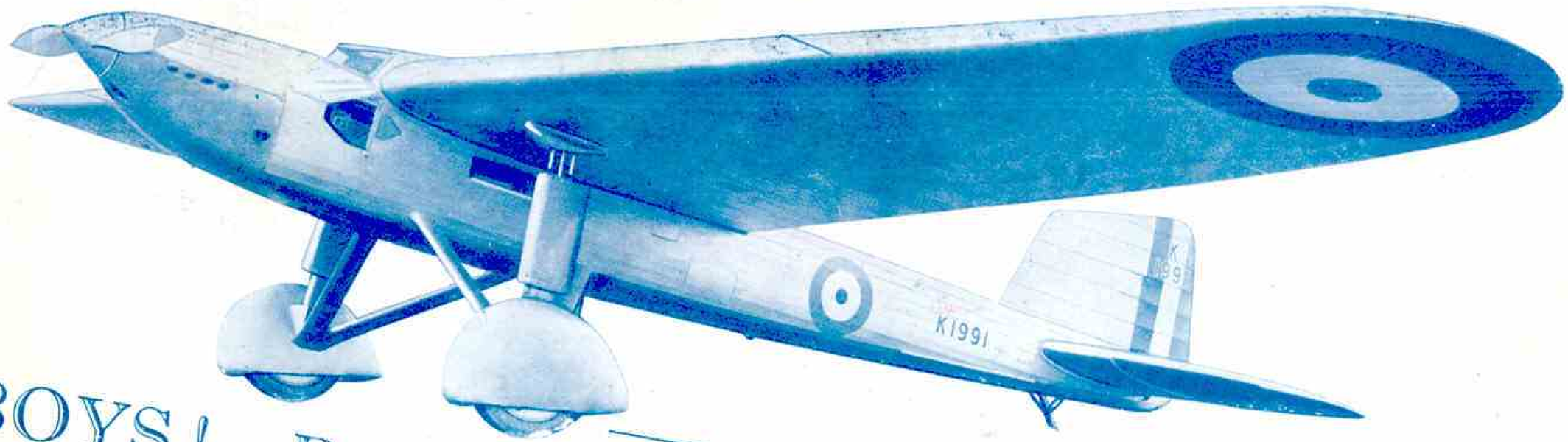

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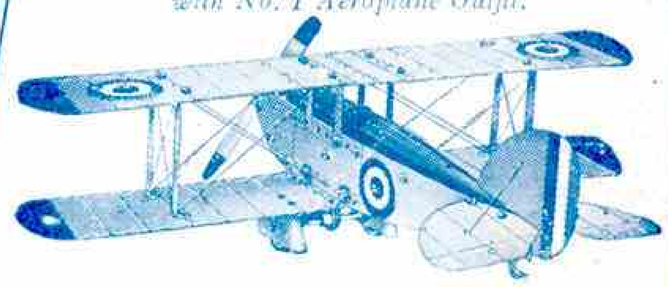

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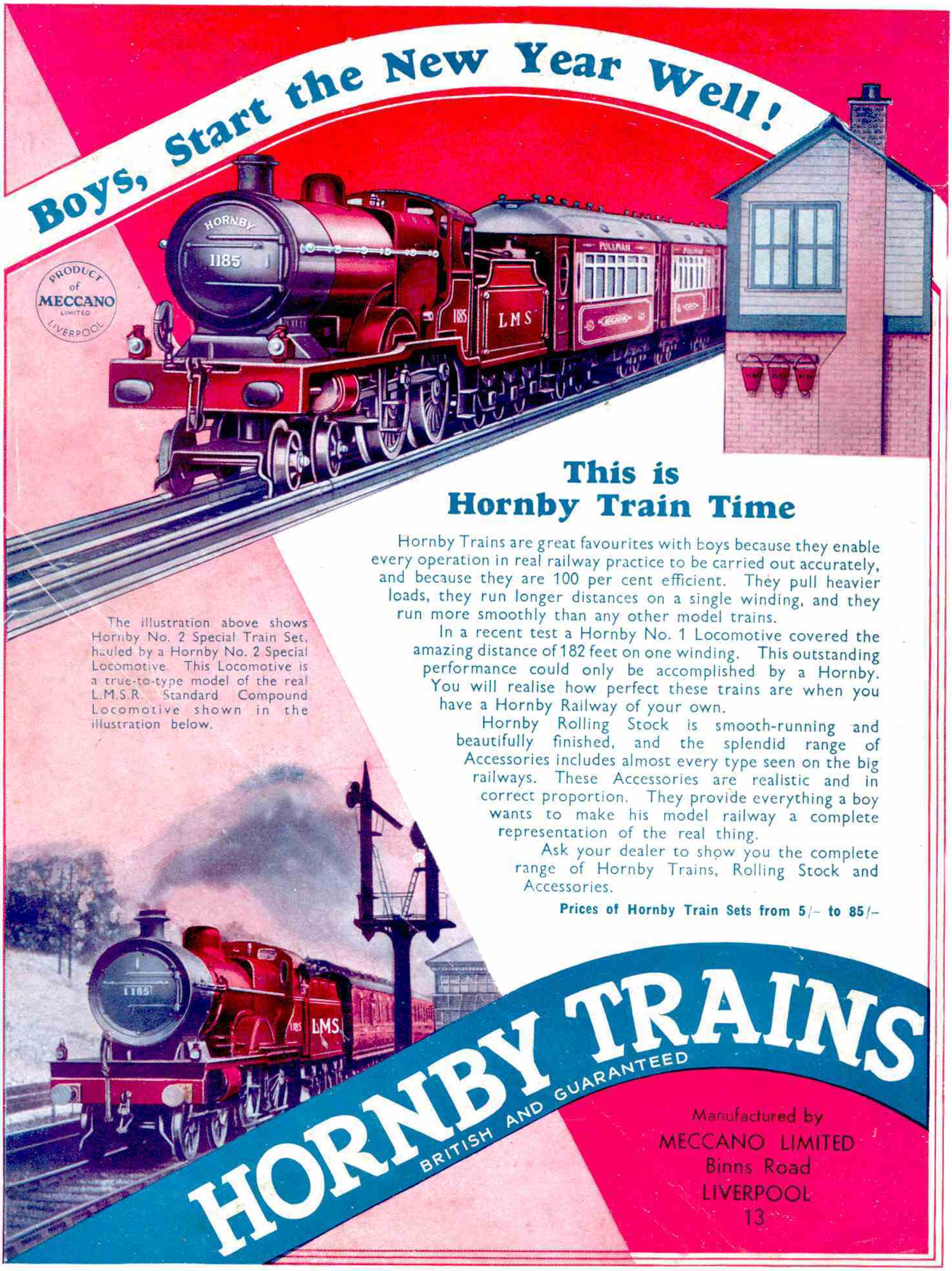

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