

A Seven-Day Journal

Director of Mechanisation, War Office.

THE announcement is made that Major-General Alan Brough, C.M.G., C.B.E., D.S.O., has been appointed Director of Mechanisation at the War Office, with effect from June 29th next, in succession to Major-General S. C. Peck, C.B., D.S.O. Major-General Brough entered the Army through the R.M.A., Woolwich, in 1895, when he received his first commission in the Royal Engineers. He served for several years in India, where at the outbreak of the war he was working on the railways. His war-time service included duty on the Transportation Directorate in France, and later he was Railway Adviser to the British Military Mission in South Russia. His work gave him an opportunity of testing the performance of all kinds of vehicles in France, Mesopotamia, the Caucasus, Salonika, and the Black Sea Region. In 1927 he was appointed Assistant-Director of Engineering at the War Office, where he was responsible for the design and provision of all the new war equipment of the Royal Engineers and Signal Corps. The activities and researches of the Royal Engineer Board were also under Major-General Brough's control during this period of War Office service. Major-General Peck, whom Major-General Brough is to succeed at the end of June next, is a gunner, and he is the first Director of Mechanisation. He has been at the War Office since 1923.

Big Road Scheme.

At a meeting held last Friday, October 30th, at the Ideal Homes and Building Exhibition at Cardiff a project for the construction of a road between London and Cardiff was discussed. If brought to fruition the new road would cost £5,000,000, of which £1,000,000 would be required for the construction of a bridge over the Severn at Chepstow. The scheme is sponsored by the Roads Improvement Association. It is pointed out by the sponsors that the new road would pass through the comparatively undeveloped country lying between the Bath and Gloucester roads, and would provide an avenue for the travel eastwards of the large surplus mining population of South Wales in search of employment. It is thought that these men might be able to support themselves in the rich agricultural land through which the road would pass. The new highway would reduce the distance between London and Cardiff by 30 road miles, and between Bristol and Cardiff by 60 miles. At the same time it would obviate the necessity for widening existing roads and relieve existing towns of heavy and fast traffic. Another advantage claimed is that new factories might be attracted southward, especially those connected with foodstuffs, such as fruit-canning and bacon curing. The proposed road would be 100ft. wide between the fences, the carriageway being 30ft. wide. About 5000 men would be employed upon its construction for five years. The exit from London is already planned, and partly completed, being the new Uxbridge by-pass road. Thence the road would run almost due west to cross the Severn near Chepstow, and connect up with the existing Chepstow-Cardiff road. The Lord Mayor of Cardiff agreed to bring the scheme before the Cardiff Development Association.

Windmills.

THE sympathy of all mechanical engineers who desire to do honour to their illustrious antecedents is freely given to the Windmill Section of the Society for the Protection of Ancient Buildings, which is endeavouring to preserve selected relics of such mills from destruction. A very famous mill—that known as the Outwood Mill, near Redhill—was discussed on Friday last at a meeting convened by the Society at Outwood, when Mr. Hilaire Belloc spoke in favour of preservation and gave some particulars of his own mill at Shipley, in Sussex. He mentioned that he had to pay a tax of £16 a year upon it, and that repairs necessitated by a storm two years ago cost him a couple of hundred pounds. He paid the bill, he said, as he would pay for the restoration of a picture, regarding the mill as a valuable amenity. It was, he thought, just possible that the movement for using English bread made of English flour might have the effect of restarting old windmills, but he was not very sanguine that the old windmills would ever again wake to useful life, and if a few of them were to be preserved lovers of them must give of their charity, "hoping for the worst." At the meeting, Mr. Lloyd, in whose house it was held, exhibited the original deed of the Outwood Mill. It shows that the structure was erected in 1665.

A Fifeshire Colliery Explosion.

It is with great regret that we have to place on record a serious colliery explosion which occurred at the Bow Hill Colliery, of the Fife Coal Company, Ltd., at Cardenden, near Lochgelly, Fifeshire, on Friday morning last, and caused the loss of ten lives. The men who were killed were members of a special

repair squad which was engaged in altering the position of an electric fan, and other work. The explosion took place about a mile from the foot of the pit shaft at about 11.30 on Friday morning. Bow Hill Colliery is one of the largest and best equipped pits in the Fife coalfield, and normally about 1200 men form the full complement of workers. Friday, however, fortunately, was an idle day, and at the time the explosion occurred only about thirty men were below ground. The alarm was quickly given and seven rescue teams under the direction of Mr. J. J. Ford, Safety Inspector, Mr. C. Carlo Reid, the general manager of the company, and Ministry of Mines Inspectors, took part in the work, and were assisted by portable fans and air screens. Some eight hours of difficult work passed before the entombed men, who were dead, were reached. The explosion was a severe one, and gave rise to large falls of coal and duff. The explosion is the worst mining accident which has occurred in Fife since 1901.

A New Federation Formed.

At a meeting of members of the steel structural industry, held in London last Friday, the decision was taken unanimously that a new organisation, to be known as the National Federation of Bridge and Structural Engineers, should be formed. This resolution shows that a keen desire exists on the part of the section of the steel industry represented that the industry should be capable of dealing with every phase of economic policy with which it may be confronted. The Federation will direct much of its efforts to the improvement of the conditions affecting the supply and delivery of steel work for all classes of public and private contracts. At the meeting referred to above Mr. James Halliday, of Francis Morton and Co., Ltd., was elected as the first chairman of the Federation, while Mr. E. A. Wilson, of Archibald D. Dawney and Sons, Ltd., was elected vice-chairman. A very large number of firms interested in structural steel engineering are represented by members on the executive committee.

Engineers as Managers.

IN accordance with custom, the new President of the Institution of Electrical Engineers, Captain J. M. Donaldson, took the chair at the Institution's first informal meeting held this session on Monday, October 26th. In opening a discussion on "Is the Engineer Given His Share in Management," Captain Donaldson said that it would be possible to dismiss the question with the word "No," but it was essential to ask whether an engineer necessarily made a successful manager. The most necessary qualification of a manager was ability to handle men, for men were tools with which the works manager worked. Some technical knowledge of production was essential, but that did not mean practical skill. Few managers were taught. They were either selected from the senior staff or appointed by an outside agency as the result of some financial development. Those managers were generally of the accountant class, but a solicitor or bankers' official was often set to watch the interests of some investing body. Good engineering could not be carried on without consideration of costs, and without business aptitude an engineer might provide extravagant margins or tolerances. The conditions of electricity supply were so unusual that directors of electricity committees had little understanding of the engineer's problems. Following the President, Mr. E. S. Byng expressed the view that the engineer was not getting his share of management and was still less likely to get it in the future, as the amalgamation and rationalisation of industry were creating new conditions which would require more special aptitude than in the past. Another speaker, Mr. S. B. Jackson, said that he understood that in America managers of corporations were selected for a preliminary training of six months. They were subsequently weeded out, and the most promising men were temporarily appointed as vice-presidents. He thought that one of the most essential qualifications of a successful manager was that of indomitable courage.

Accidents in Civil Aviation.

LAST Friday, Captain A. G. Lamplugh read a paper before the Royal Aeronautical Society on "Accidents in Civil Aviation." He gave some percentages and statistics as to the causes of accidents over a number of years. During the period under review, that from January, 1928, to date, errors of judgment accounted for at least half the accidents that occurred. Accidents resulting from structural or mechanical failure had declined during the same period to an approximate figure at date of 20 per cent. Captain Lamplugh then gave comparative figures for professional and amateur flying, stating that it was necessary to bear in mind that the aircraft used by the two categories were not the same and that while the professional had the advantage of a better organisation, at the same time he was called upon to fly in all weather conditions and at night. In 1926 the error of judgment factor for both classes was approximately 35 per cent. By 1930 the percentage for professionals had dropped to 17.06 per cent., whereas that for the amateur had only fallen to 33.65 per cent. The small fall in the amateur

figure was to some extent caused by the great increase in amateur flying and the consequent increase in the number of comparatively inexperienced private owners. The majority of aeroplane failures without some contributory cause occurred in comparatively new types, and so far as this country was concerned such failures in large passenger-carrying vehicles were practically non-existent. Failures of this kind in light aircraft have occurred to a far greater extent than in the large types. The latter part of the paper was concerned with the methods of investigation of accidents employed in various countries, and possible remedies.

Launch of the Destroyer Flotilla Leader Kempenfelt.

THE destroyer flotilla leader "Kempenfelt," which has been built and engined by John Samuel White and Co., Ltd., of East Cowes, was successfully launched on Thursday, October 29th, the naming ceremony being performed by Lady Waistell, the wife of Admiral Sir Arthur K. Waistell, Commander-in-Chief at Portsmouth. The "Kempenfelt" is a destroyer of the 1929 programme, which includes the "Crusader" and "Comet," recently launched at Portsmouth, and the "Cygnet" and "Crescent," launched at Barrow-in-Furness. These four destroyers were referred to in a Journal note of October 2nd. Like her sister destroyers, the "Kempenfelt" is a vessel of about 1375 tons displacement, with a speed of 35 knots. She has a length of 329ft., a beam of 33ft., and a depth of 19ft. 3in. Her propelling machinery comprises a twin-screw arrangement of geared turbines, with a designed output of about 34,000 horse-power, and steam is supplied by Admiralty type three-drum, small-tube, oil-fired boilers. The design of the new destroyers embodies the latest tactical features, provision being made for powerful offensive and defensive armaments, a larger radius of action, high speed and economical steaming, with good stability and seaworthiness. The armament includes four 4.7in. guns, two anti-aircraft guns, eight 21in. torpedo tubes, and depth charge fittings. The "Kempenfelt" is noteworthy as being the first destroyer to be built for the British Navy at Cowes since the war, although the firm has in the same period built and reconditioned destroyers for some foreign navies.

Salving the Egypt's Gold.

FROM time to time we have recorded in these columns the progress made in the process of salving the gold which was aboard the P. and O. liner "Egypt" when she was sunk off the coast of Brittany. The divers of the Italian salvage steamer "Artiglio II." have now, according to a special article in *The Times*, succeeded in opening the bullion room, and, as far as they can tell, the bullion is in its place. If suitable weather conditions continue, it is hoped to bring some of the gold or silver to the surface before the winter storms interfere with the further progress of the salvage operations. The work on the "Egypt" was begun in 1929, and most of the summer of that year was spent in trying to locate the wreck. The following year the salvage steamers "Artiglio I." and the "Raffio" identified the wreck in August, and the site was marked out by buoys. By unfortunate accidents, however, the two steamers "Artiglio I." and the "Raffio" were at a later date both lost, the first vessel being sunk by an explosion of munitions on a wreck in Quiberon Bay on which she was working, and the second ship off Guernsey. The salvage operations were continued by the divers and engineers on "Artiglio II.," and during the summer they have, despite untoward weather conditions, at last succeeded in their objective. To do this they have had to blast a hole some 30ft. in depth and some 50ft. across into the structure of a well-built ship, which lies at a depth of 66 fathoms.

Humber Bridge Scheme.

ALTHOUGH the great scheme for bridging the river Humber, at Hull, is held up for the time being, it is not to be allowed to sleep. There were some interesting references to it last week at a meeting of the Humber Conservancy Board. The Board had written to the Ministry of Transport, asking whether the Humber Bridge Bill was one in respect of which the Minister proposed to withdraw the promise of assistance out of the Road Fund. In reply the Ministry called attention to the Minister's statement, made in the course of debate on the National Economy Bill, to the effect that the scheme is regarded as one which, in the present position of national finances, must suffer some postponement. It was added that the Minister must reserve for future consideration his attitude towards the project should it be revived, and the question of the assistance that could be offered to it. Mr. Arthur Cargill, a member of the Conservancy Board, said he had the authority of the chairman of the City Council's Economy Committee to state that it was intended to proceed with the Bill before the Select Committee of the House of Lords in order to obtain powers, but on the understanding that no work should be done in connection with the construction of the bridge until the Minister of Transport had given permission for the project to go forward.

Press-Tool and Fixture Design.

By HENRY C. LANE.

No. XII.—JIGS AND FIXTURES (conclusion).*

SECTION IV.—VICES AND CLAMPS.

SUBSEQUENT to the straightforward blanking, piercing, and forming press operations on parts for a composite article, the assembly of the various parts can frequently be accomplished on hand or power presses, and as in many cases riveting of parts plays no small rôle in such an assembly chain, perhaps it would be advisable to outline the various types of quick-acting and self-acting vices that can be used for riveting or other processes where a vice may be required.

The simplest form of quick-acting vice is that illustrated in Fig. 82, open, and Fig. 83, closed, and can

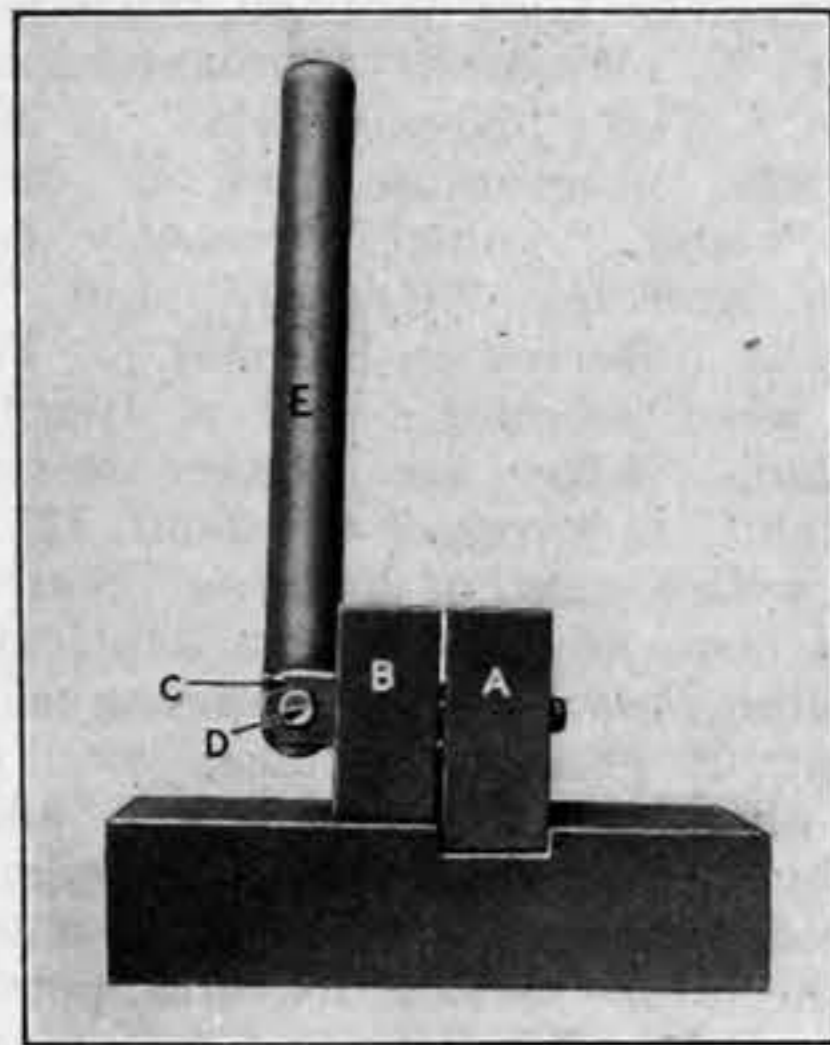


FIG. 82

be referred to as a "cam action" vice. The fixed jaw is shown at A. Two eye bolts C act as guide rods for the moving jaw B, through which they pass before being screwed into the fixed jaw. The cam drive is located on the end of the operating lever E, which is pivoted between the two eye bolts on the peg D. For some types of work this vice cannot be improved upon on account of its great simplicity from a manufacturing point of view. For drilling small articles, light riveting, and all purposes where only a light grip is required, it can be recommended, but in fields where a powerful grip is required, as for heavy riveting, while preserving the shape of the

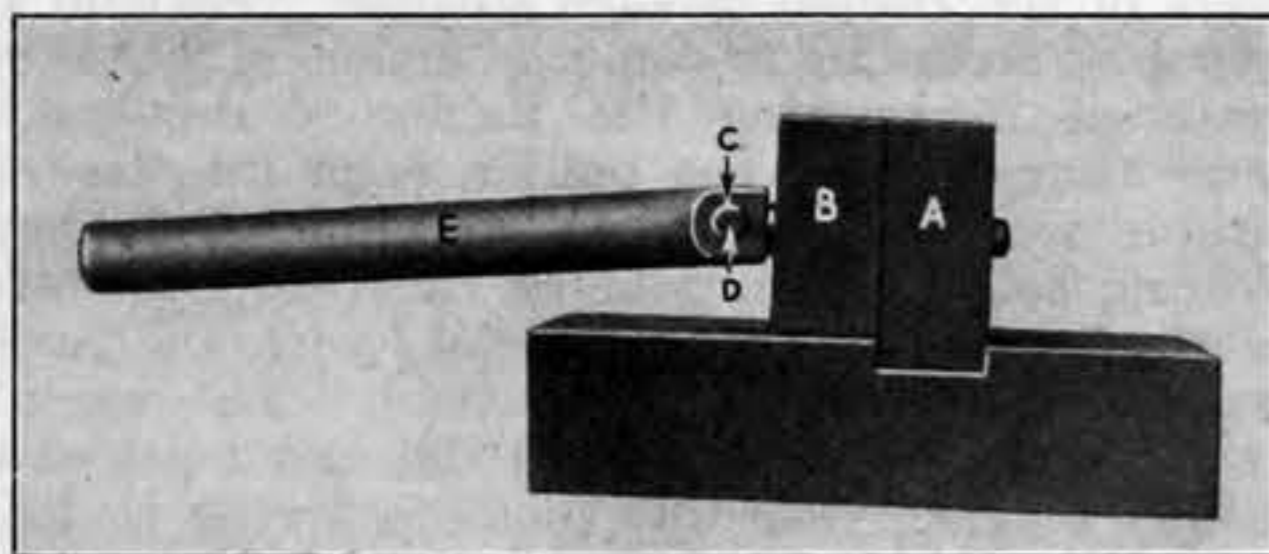


FIG. 83

blank being riveted, the friction of the cam drive reduces the possible amount of gripping pressure tremendously, and it is generally advisable to pass this design by for such types of work. Adjustment of the cam vice is attained by screwing the eye bolts further in or out of the fixed jaw prior to the assembly of the cam lever, and if finer adjustment is required, the eye bolts can be screwed into nuts bearing on the back of the fixed jaw, adjustment being carried out from these nuts.

Passing on to more complicated requirements, Fig. 84 shows at A two small pierced pressings required to be riveted side by side in the pressing C, as shown

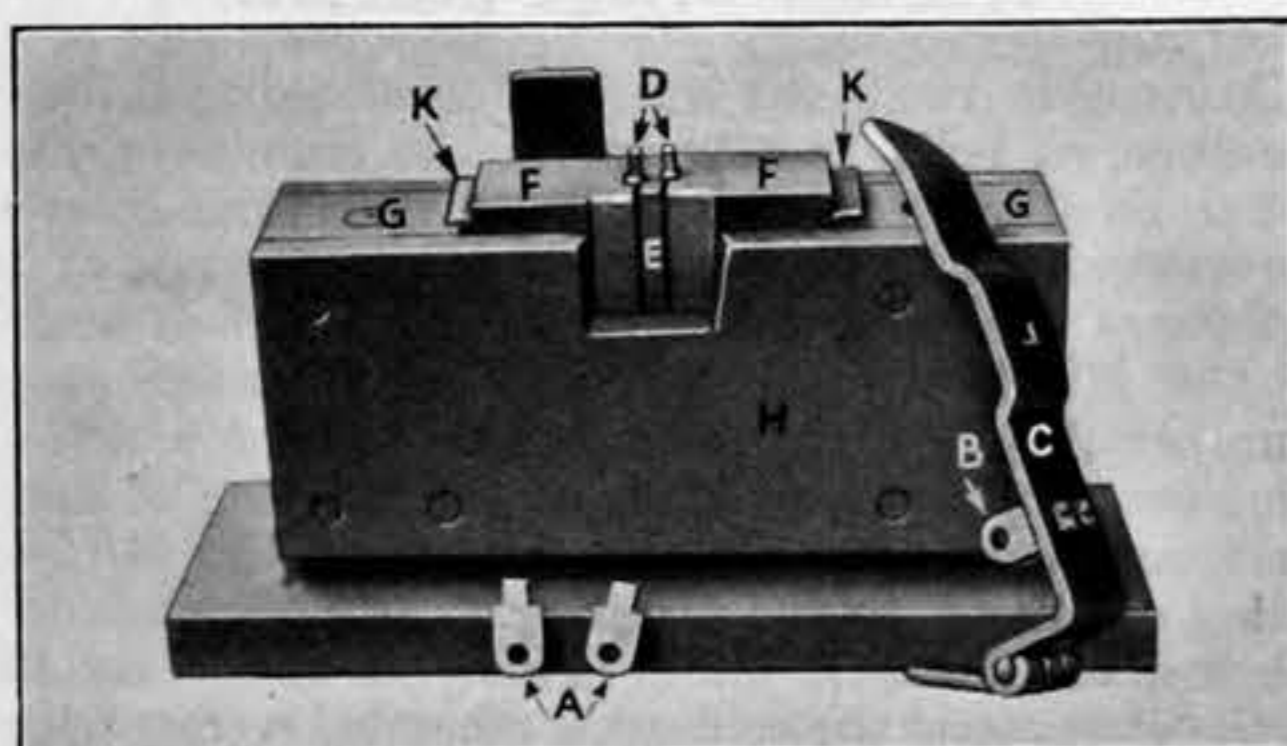


FIG. 84

at B. The chief difficulty was obviously the firm holding of both of the small pieces simultaneously, leaving them free for withdrawal after riveting, and yet gripping them firmly enough to preserve the shape of the holes in their free ends. A cam vice was originally tried, but proved to be incapable of providing a sufficiently powerful grip with reasonable ease, and the vice illustrated in Figs. 84 and 85 was designed for the job, and gives increased pressure according to the power of the riveting blow. In this instance

* No. XI. appeared October 30th.

the increase in vice pressure is not in direct proportion to the increase in riveting pressure, but the present design for this particular job was arrived at after experiment to attain the greatest production speed in operation. As may be gathered from the illustrations, the riveting is carried out with a cross punch, which requires less power to rivet than a flat or shaped heading punch, and therefore the tendency to distort the holes in the free ends of the riveted parts is less difficult to overcome. The vice is designed to give just sufficient pressure to counteract the distorting tendency, and as a result the stripping of the assembled parts from the vice is made considerably easier.

The vice is composed of a hardened steel V block G, which is strengthened by the side straps H, which also act as guides for the vice jaws F. The vice jaws are sunk on their gripping faces to the shape of the pieces to be riveted, and to a depth equivalent to about two-thirds the thickness of the blanks. A

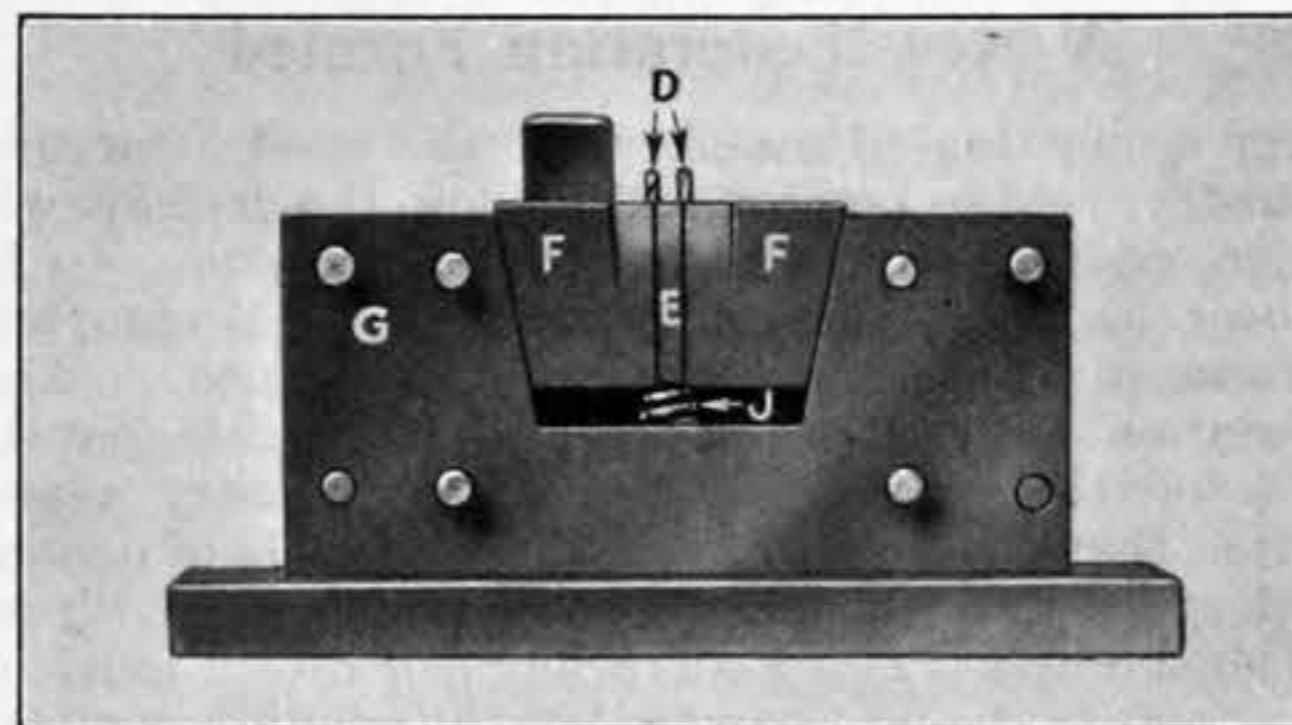


FIG. 85

distance piece E is inserted between the vice jaws to hold the two blanks apart, as will be seen from Fig. 84, in which the blanks are shown inserted at D. The two vice jaws and the distance piece are kept in horizontal register with each other by two horizontal dowels, passing through all three, and the three parts are kept separated when not in action by small springs mounted on these dowels. The angle of the V block is too close to the perpendicular to enable these separating springs to force the complete jaws upwards, and consequently the main return spring J is fitted, as shown in Fig. 85.

Within certain limits, it will be seen that the vice is self-acting and self-adjusting when no stop is used on a hand press, but any extra adjustment is easily carried out by slipping in plates of suitable thickness to reduce the width between the angle faces of the V block. Two such adjusting plates are shown at K in Fig. 84.

Fig. 86 shows another development of the same

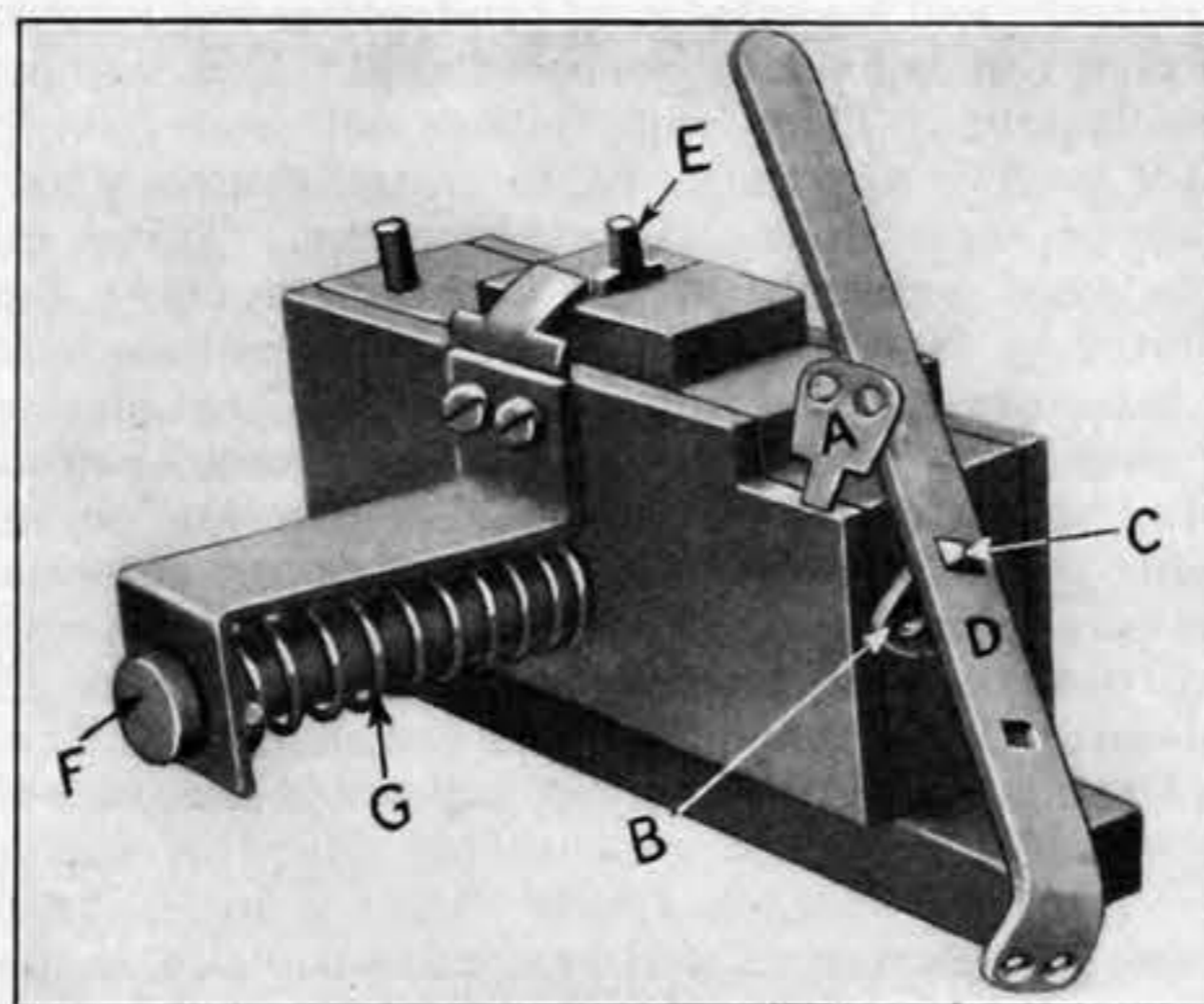


FIG. 86

principle of action as that just described, but in this instance the blank shown at A is pierced with two holes and has to be riveted into the pressing D, as shown at B, with a pyramid head, as shown at C. This pyramid head causes the shank of the rivet to swell in its hole, and render the joint extremely secure, but the gripping pressure required to hold the blank firmly is so much increased that it was advisable to aim for a vice that would automatically increase its grip at a greater rate than the pressure required for riveting increased. A dead action vice was out of the question in this particular instance, as there was a considerable rolled variation in the thickness of the blank to be held and a V block vice with angles almost perpendicular had to be utilised in order to obtain the required amount and type of pressure.

In this instance, the vice jaws are recessed in the same fashion as for the job previously described, but the recesses are only sunk to a depth of approximately one-third the thickness of the blank to be held. A certain amount of grease and oil is present on the blanks, and, as a result, a smooth gripping face for the vice jaw is unsuitable, so that, in addition to the recesses in the vice jaws, the gripping surfaces are cut with a small half-round chisel, something after the fashion of a wood rasp. The points raised in the gripping faces are eventually completely embedded in the metal of the blank, so satisfactory is the gripping power of the vice, and, in consequence, the two holes in the blank remain entirely free from distortion so long as the vice jaws are kept in decent condition and the "rasp points" are not cut in

positions where the embedding action is likely to displace any of the metal around the holes.

With the closer approximation to the perpendicular in the drive faces of the V block, the jaws under full compression became something in the nature of a driven taper fit making it impossible for any normal spring pressure to release them. To overcome this difficulty of stripping the bar F was fitted as shown, and is kept in the fully out position by the spring G. The concealed end of the bar passes through the side strap of the V block and passes under the two vice jaws. The end of the bar is chamfered, so that when it is given a sharp blow at the visible end it imparts the momentary force to the vice jaws in an upward direction. Once freed from the V block, the jaws are raised and kept up by the main return spring as in the vice previously described.

With some operations it is necessary to have a powerful pressure easily applied and to maintain the same level for the blank, so that it is possible to set the stop on the press. It may be necessary with other operations to have a quick-acting vice, giving a wide

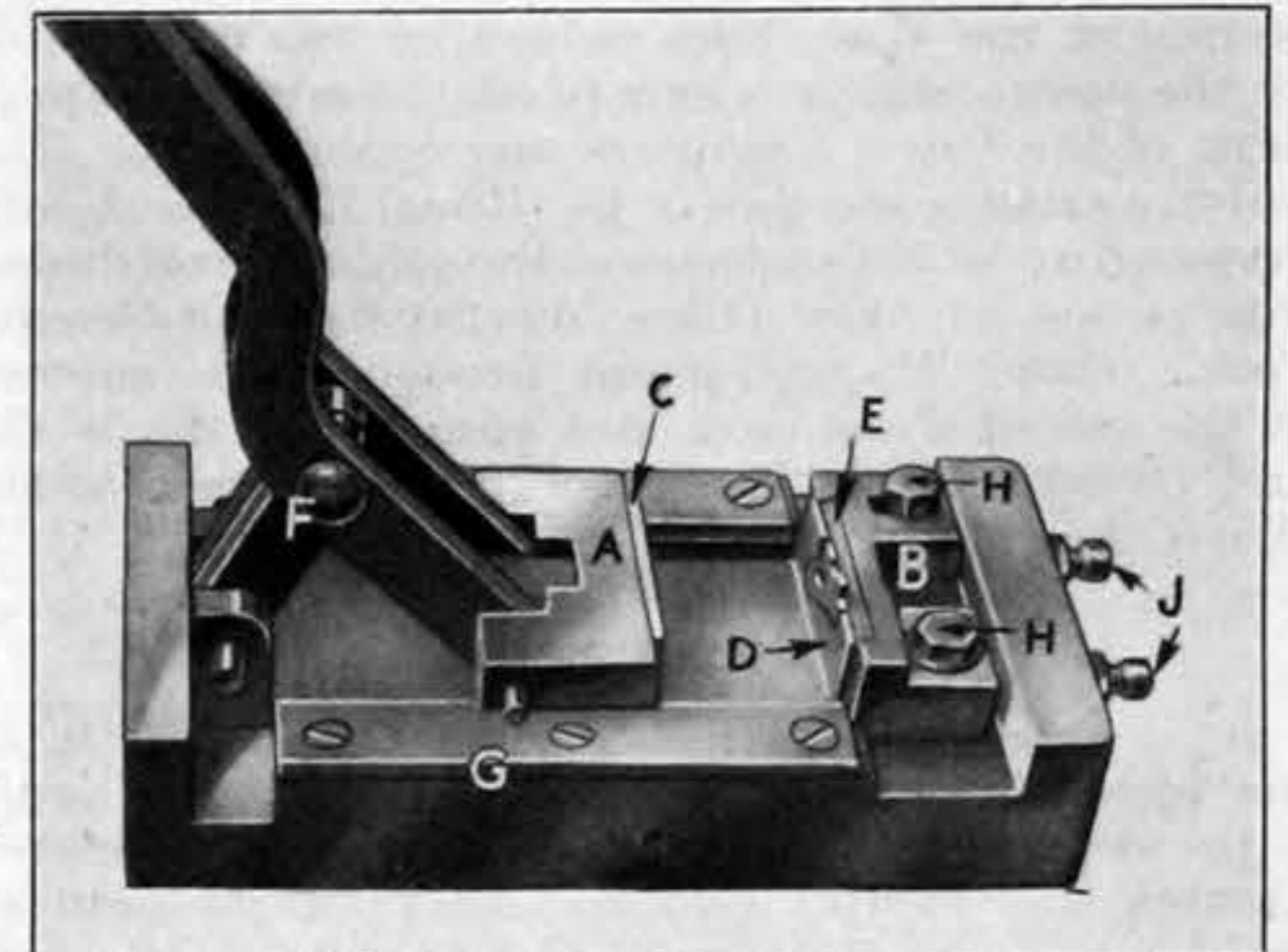


FIG. 87

open jaw measurement closing rapidly to give a powerful maximum pressure when fully closed. Both these types of operations are catered for by the toggle-action vice shown in Figs. 87 and 88 in the open and closed positions respectively. The vice itself is considerably more expensive to make than the two principles already outlined, and, in many cases, it is possible to have the jaws adaptable to a number of requirements, thereby saving the majority of the cost of the vice for certain jobs. It is built on the base plate G, which is provided with a longitudinal slide for the moving jaw A operated by the lever toggle action F. Transverse slots are cut in the base plate as shown, to enable solid support to be given to both jaws when in compression. Adjustment to individual requirements is made to the fixed jaw B by means of the adjusting bolts J and clamping bolts H, and the fitting of the interchangeable gripping faces of the vice jaws. Fastened to the fixed jaw is the gripping face plate E and the blank support or gauge plate D, while, in most cases, the removable gripping face plate C on

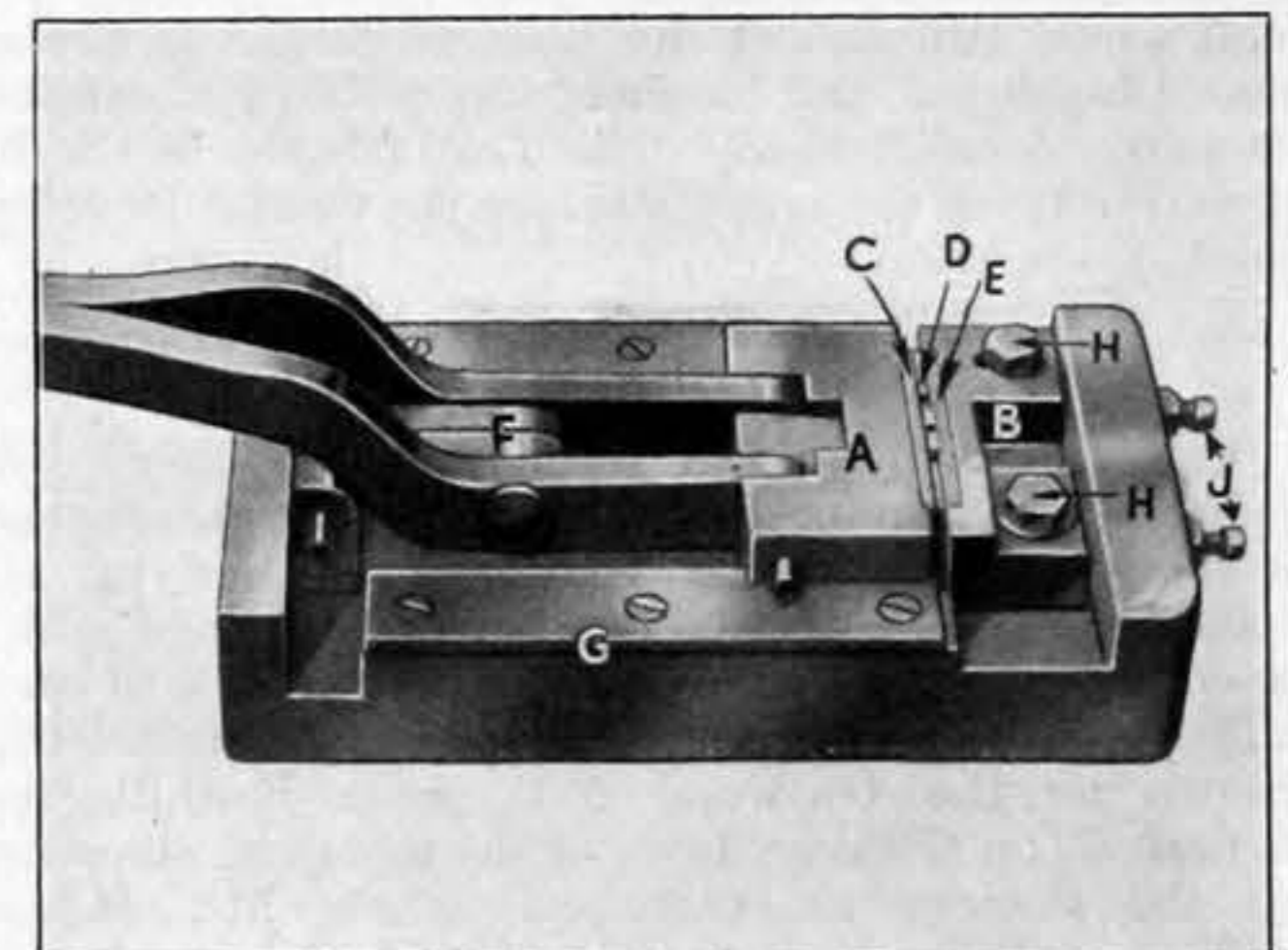


FIG. 88

the moving jaw need not be changed for different jobs, though it is interchangeable if necessary. Where it is not essential that the blank should remain unmarked, it is advisable to cut the gripping face plates for riveting operations on account of the lesser power required for closing the vice and the correspondingly greater speed in production; but, providing the gripping plates are renewed before any appreciable wear takes place, plates with smooth faces will hold quite satisfactorily if the vice is originally adjusted correctly. It should be remembered that the shorter the toggle centres, the greater the power applied and that, in consequence of this fact, the vice should be designed to give no more than the minimum amount of jaw movement required. With some operations that may require a large movement and very great pressure, it may be advisable to incorporate two toggle actions, the one to give a large movement to one jaw and the other to apply the maximum pressure through the second jaw.

SECTION V.—BRANDING OR MARKING FIXTURE.

It is doubtful whether it is generally recognised what a large part in low first cost of plant is played

by careful consideration of the many ways open for the production of most jobs. Instances are continually cropping up to prove this point once it is recognised, and, referring back to Part I. of these articles, I might cite a very glaring example. The tools described in Section III. of that part cost round about £30 to produce, and were operated in a press costing £120. After they had been in operation for some time I was approached by a firm of engineers inquiring whether they could design and make any special machines for me. I intimated that we were satisfied with our present principles, but, on being pressed further, I consented to give details of the pressing referred to and promised to consider any suggestions that they might put forward. The first rough design that was submitted was totally unsatisfactory, but a later design incorporated improvements to overcome all the difficulties that I have outlined in the section describing my tools. Probable production was stated to be one gross in 15 minutes—as compared with my production time of one gross in 15½ minutes. The price for the complete machine with one set of tools was not excessively high for the work entailed, but at £350 it did not compare at all favourably with our existing principles, especially as the machine could only handle the particular part illustrated in three sizes, tools for the two extra sizes promising to cost £20 per set as against our £30 per set to fit to a machine that could handle an infinite variety of work.

Another instance of this same saving in plant cost is the subject of this article. Some years ago I was visiting another works in my district and was shown an engraving machine costing £60, which had been installed to mark a quantity of parts in duplicate with various combinations of letters and numbers. At the time I thought it was an unnecessarily expensive way of doing the job, as no very fine finish was required, but it was not until a somewhat similar requirement came into my own work that I troubled to go into the matter any further.

After our productions have gone through all the stages of manufacture and assembly, they are inspected, checked, and adjusted as necessary. We considered it advisable to mark each product that passed the final inspection with its particular catalogue number, and as there are something over a hundred different three-figure numbers, I decided to build an experimental fixture to try out my principle of a composite marking punch. The experimental fixture proved so satisfactory that my improved designs still remain designs only, the experimental jig having been in regular daily use for the last four years. The first cost was something under £5, and since then the only repair or renewal cost has been the replacement of the three sets of single figure punches.

I propose to describe the experimental fixture first, and later to indicate how it can be adapted to make the setting of different numbers nearly as rapid as changing the templates of an engraving machine.

Illustrated in Fig. 89 is the complete fixture, as

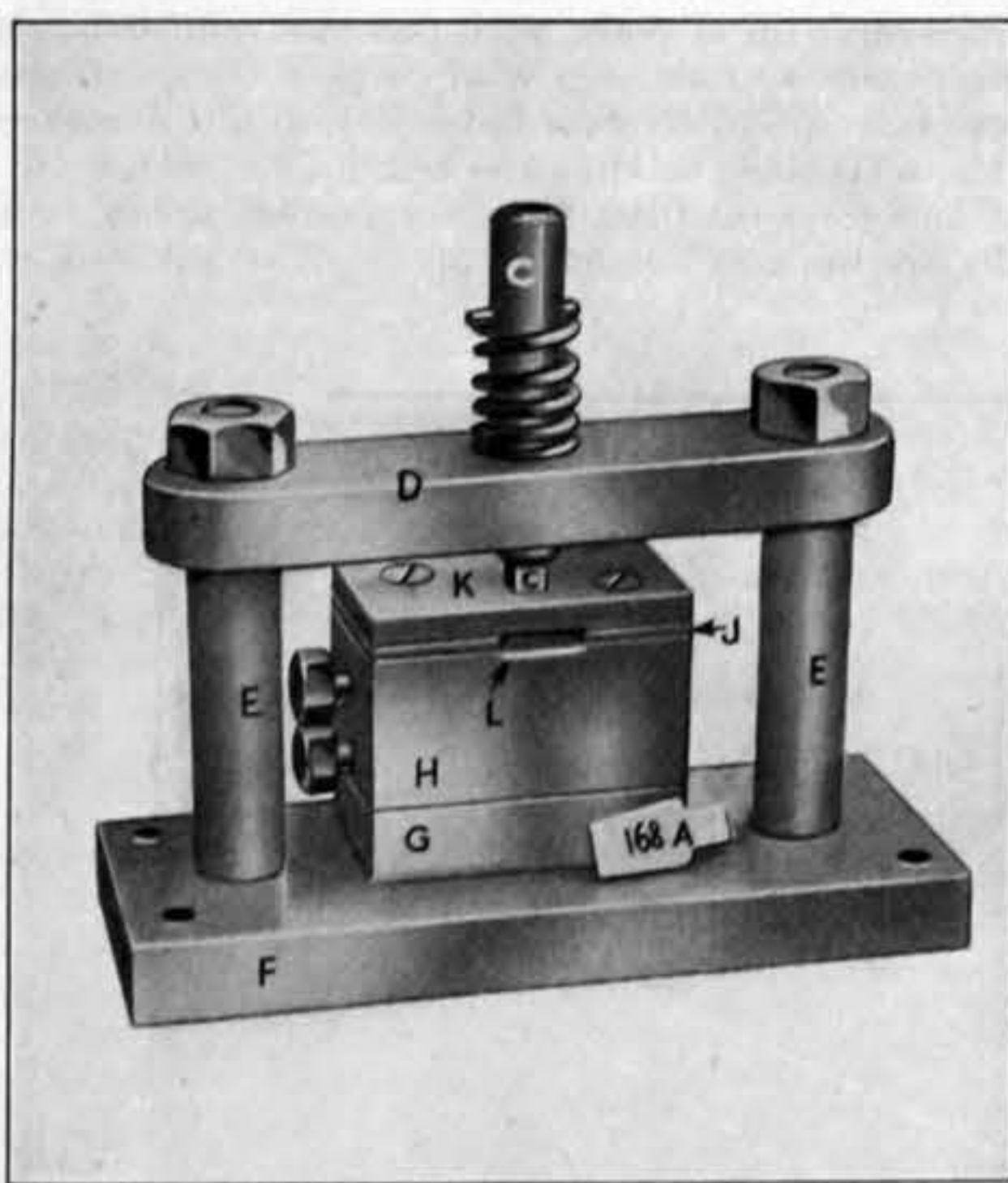


FIG. 89

clamped to the checker's bench, and at A is shown the part that is marked when assembled to the complete production. Fig. 90 shows the fixture dismantled for setting a different combination of figures. For the sake of clarity, the figure punches have been pulled up from their working level to show at B that each figure punch is separate. In the fixture itself the normal procedure for marking is reversed, the composite punch remaining stationary, while the anvil imparts the pressure required for marking. The anvil—or, as I will term it, the ram—is shown at C, spring mounted on a cross bar carried on two pillars E located on the bed F. The upper end of the ram is domed suitably for blows with a hammer, while the lower end is of a rectangular section sufficient to cover the area of the figures to be marked, and this rectangular section, in passing through a cover plate with a rectangular hole serves to prevent the ram from swivelling in its bearing. The complete composite marking block, which I will term the die,

is composed of four main parts, in addition to the actual figure punches. The hardened steel pad G, the vice block H, the gauge plate J, and the cover plate K—all four are fastened to the bed by the three screws shown. The four hexagon bolts in the vice block clamp up two packing pieces against the figure punches after they have been inserted into the vice block, as shown at B, and allowed to drop their lower ends on to the steel pad below. The figure punches are originally ground true to length, width and thickness, so that the tightening up of the hexagon bolts grip them firmly in position. The gauge plate is, of course, interchangeable to meet individual requirements, while the cover plate remains the same in all cases. It will be seen that an aperture is left at L in the complete assembly in which the piece to be marked is inserted, and to allow of this insertion being as easy as possible, the upper edge of the vice block and the lower edge of the cover plate are chamfered slightly at this point. For our requirements,

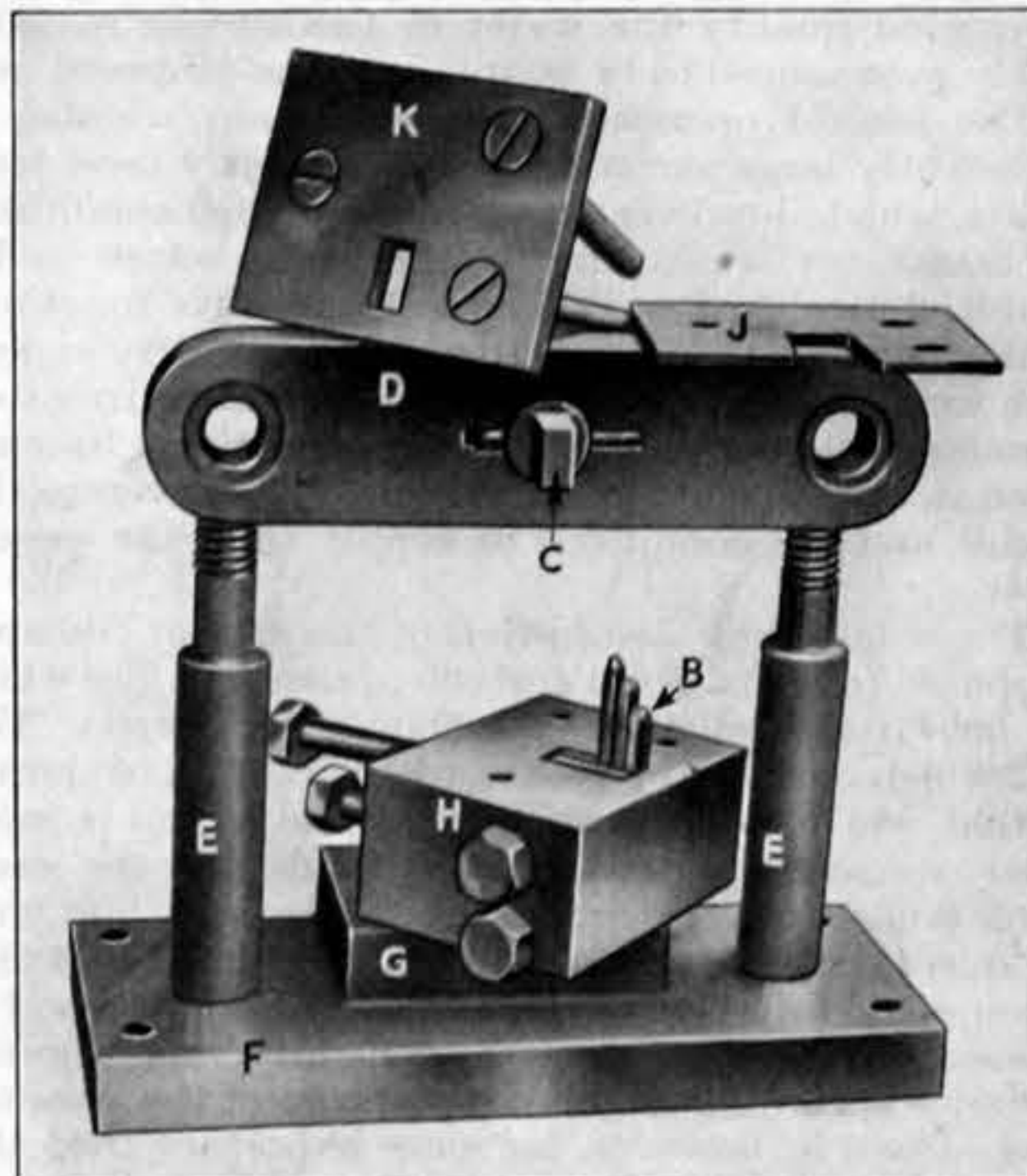


FIG. 90

as the setting of the figures are not constantly being changed, there is no need for very rapid operation in setting, such as would be necessary in cases where it is required to change the setting for every single or every few parts produced.

Quick changes of setting could be effected by careful design of the fixture, which, working upwards from the bed, might be as follows:—

The hardened steel pad and the vice block would be permanently fastened to the bed in the same relation as at present. The vice block would be re-designed to obviate the hexagon bolts for tightening up, cam or toggle action levers would operate on plain round push-rods passing through the present bolt holes, and tighten up the figure punches instantaneously. With the permanent anchorage of the vice block to the bed, allowance would have to be made for the easy removal of unwanted punches, and to do this they would have to be of a length suitably in excess of the thickness of the vice block to allow of their being gripped with the fingers and withdrawn from the block. Nevertheless, the points of the punches must be practically level with the working surface of the complete composite block, in order to ensure even marking, and a frame for the figure punches could be hinged to the vice block or a separate piece dropped over dowels to bring the working surface up to the required height. This completes the re-design in the rough of the existing die, with the exception of the gauge plate and cover plate, which would be transferred to the ram assembly—though for rough marking neither of these plates may be necessary. The complete ram assembly would be altered with the exception of the ram itself. The ram, operating on the same principle as that illustrated, would be carried on the "carrier pad," which would be in the form of a flap, hinged away from the working point on suitable supports carried on the bed. In this way the upper half of the fixture would be rapidly removed for change setting, but, to counterbalance the loss of solid anchorage for the ram guide, the carrier pad would have to be made sufficiently heavy to withstand any tendency to "chatter" under the required hammer blow applied to the ram for marking. Similarly, if guide and cover-plates could not be designed to act as stops for the hinge action of the carrier pad, some other dead stop would have to be incorporated, adjustment being made so that the ram was perpendicular to the die surface when in position for working. The ram itself should be of hardened steel of minimum section to eliminate as far as possible any marked absorption of the hammer blow as a result of undue weight in the ram.

For very rough marking it might be quite possible to dispense with the slide action of the ram in the carrier plate, the marking anvil being incorporated in a plain hinged flat which would be lifted slightly from the fully down position by suitable springs.

I do not know exactly what methods are employed for marking various products, but I believe that large

numbers of parts and products could be more cheaply marked with a fixture on the lines described than with some of the methods employed, such as single punch marking, or multi-blow pencil engraving. Incidentally, the small numbering punches used last considerably longer than much more robust hand punches, mainly, I think, on account of the regular directness of the blow delivered and, secondarily, on account of the support given throughout their length by the vice grip in both directions.

Flowing Water.

By J. M. LACEY.

No. V.—IRRIGATION.*

PART I.

INTRODUCTION.

LIKE all other arts and sciences, irrigation appears to have been derived originally from the East; for it is recorded to have been employed by the inhabitants of those regions from the earliest periods. In China, Assyria and Egypt the mode of increasing the fertility of the land seems to have been coeval with the establishment of definite forms of society, or at least the earliest records we possess of those nations mention the attention paid by the respective communities to irrigation.

In China, as rice is one of the staple products of that country, and as it cannot be produced except under very peculiar circumstances without irrigation, it is reasonable to suppose that the process of irrigation must have occupied the attention of this singular nation at a very early period of its history. The extreme subdivision of property in China has modified the application of the science of irrigation, because as the holdings are small and manual labour cheap, waters are usually raised by machines moved by hand, or occasionally by the labour of animals. It does not appear that the Chinese were much in the habit of constructing irrigation canals on a large scale or reservoirs to store flood water, or levees to direct or control the periodic overflows of their great rivers. In fact, this art long remained in a rudimentary state in the hands of that nation, but in recent years engineering works have been constructed to prevent the rivers in high floods from overflowing their banks, and River Conservancy Boards are investigating and are carrying out works with this end in view.

In India the inhabitants appear to have early felt the necessity for and to have taken measures to secure an artificial supply of water to the agricultural districts not immediately situated upon the banks of the large rivers of that peninsula. To attain this object many vast canals were formed conducting the waters of rivers or their distributaries to the districts to be irrigated, and large reservoirs were also formed to store the torrential rains which fall at certain periods of the year. In fact, every principle of legislation, religion, or superstition appears to have been made to co-operate with the extension of the system of irrigation.

But perhaps the origin of this science may be traced to the Iranian Empire, alike the cradle of the arts as it was of the language of the civilised worlds. All the authors who have treated of that singular nation have assigned a very remote date to the irrigation canals on the banks of the Tigris and the Euphrates.

In Egypt the peculiar character of the climate and of the Nile appears to have occupied the attention of the earliest legislators and rulers of the country. Immense canals were cut by means of which the rising waters of that river were distributed over larger areas than they could reach naturally, and transverse dykes appear to have been formed to facilitate the deposition of the fertilising mud by constructing, as it were, so many ponds of still water. The canals which served to conduct the water during the inundations became reservoirs when the floods had subsided; but as they were necessarily at a low level the waters had to be raised by artificial means. The Archimedean screw is said to have been invented by the philosopher from whom it derives its name during his travels in Egypt.

The Greeks do not appear to have paid any attention to the useful application of hydraulics for either irrigation or for domestic purposes. Nor do the Romans appear to have devoted much attention to the former subject, whilst the latter occupied one of the most prominent places in their consideration. No authentic remains of canals, watercourses, or reservoirs for this purpose constructed by the Romans have been found in their numerous possessions, whilst it would be impossible to cite a province in which vestiges of the colossal works they erected to secure a domestic water supply for their towns may not be found.

In the Middle Ages the Visigoths constructed several important irrigation canals in the South of France and in Spain, and the Arabs who subsequently became masters of the latter country continued the work of their predecessors, adding to them the construction of storage reservoirs and the application of the "noria"

* No. IV. appeared July 3rd.

—a machine they introduced wherever they established their dominion. In Catalonia, Valencia, and Andalusia the irrigation canals constructed by the Arabs are even at the present day in a perfect state.

In Italy, singularly enough, the science of irrigation would appear to be most practised in the districts formerly occupied by either the Gothic or Visigothic tribes. In the Piedmontese dominions, and in Lombardy, perhaps the most perfect system of irrigation which can be cited exists; while in Central and Southern Italy very little has been done to apply to useful purposes the numerous streams draining the country.

In the South of France also the Gothic tribes introduced the system of irrigation. One of the largest canals formed for this purpose in the Eastern Pyrenees is called after Alaric, and is usually believed to have been constructed by the orders of that conqueror, who would seem occasionally to have had ideas of a different nature from those usually attributed to him.

In Germany, Holland, and Flanders it is very rare to find any other kind of irrigation than that known in this country by the name of water meadows. The climate of Northern Europe is far too moist to require any great outlay in securing an artificial augmentation of the prevailing characteristic, and the difficulty the agriculturist has to encounter is rather the excess than the want of water.

America has only in recent years employed the science of irrigation for the extraction of its agricultural wealth, the bulk of the irrigation being in the Western States. The advantages of irrigation are also being appreciated in Australia, owing to the lack of an adequate rainfall.

It may be asserted as a general rule that there are no countries to which irrigation may not be usefully applied; but the atmospheric conditions of the inter-tropical and the glacial zones are such as to render the economical results of the operation often very questionable in their cases. For it is well known that as we proceed from the temperate zones towards the Poles the average annual rainfall tends to distribute itself more equally over the year, even if the total quantity be not greater.

A general system of irrigation in such countries would necessarily cost as much as in any other, but the occasion for its use would diminish more and more as we approached the Poles. In the intertropical regions, on the contrary, the excessive heats would require much greater quantities of water, and the class of vegetation thus called into existence would be of a nature totally different from that aimed at in the temperate zones.

IRRIGATION ENGINEERING.

There are few branches of engineering which require more skill than the works required to carry out a system of irrigation, especially in countries where water is valuable.

Of the various classes of channels necessary to carry out a system of irrigation attention should be directed to the following:—(1) The leading canals or conductors are placed directly on the banks of a stream or river, with which they communicate by means of works whose nature depends on the character of the source, and the extent of the area of land to be irrigated. They are divided into two parts: one lying between the point of junction and the first point to be irrigated; the second comprising the remaining part of the conductor or main canal, with all its ramifications. The first part only serves as a leading channel from the river and does not give off water laterally; it retains a uniform depth and section. The second part, containing numerous branches, has a width varying successively according to the consumption of water by the subsidiary branch channels.

(2) The secondary channels bear the same relation to the main canal which the latter does to the river from which the supply is derived, and they should be formed upon the higher portions of the land to be irrigated. Their use is principally to distribute the waters over the remoter portions of the area to be irrigated.

(3) The feeders, minors, or field channels are principally designed for the purpose of distributing the waters brought down by the channels, previously described, over the whole surface of the stages or planes.

(4) Drainage channels are formed in the lower parts of the land to be irrigated for the purpose of receiving the waters after they have flowed over the land and to receive the quantity which may be in excess of that required for the particular object of the irrigation.

The first operation to be performed before commencing any large work of irrigation is to ascertain whether the land is near a river or watercourse with a comparatively considerable fall, and retaining in the dry weather a sufficient discharge to ensure a constant supply of the quantity required, or otherwise to ascertain if with a variable flow the yearly discharge is such as will enable the surplus over requirements to be stored to provide for periods of low water flow.

The waters used for the purpose of irrigation are not equal in quality, and care must be taken in their selection. Those which flow from forests, peat moss, or such as contain large quantities of the oxide of iron are but little adapted to such uses, even if the two latter may not be considered positively injurious.

As a general rule those waters are the best which have been the longest exposed to the air, or in the proportion in which they have traversed fertile lands are able to communicate some of their properties. It is on this account that the waters flowing through towns or villages are most desirable. Streams which rise from the granite or primary rocks are always more advantageous than those from secondary formations. It must be always borne in mind that the condition to be fulfilled by any water for irrigation is to correct the deficiencies of the soil to be irrigated. Thus waters derived from calcareous formations may be most adapted to improve the argillaceous formations to be met with in some of the primary districts. Sea water mixed with fresh, or the brackish water of embouchures, is highly fitted for meadow land, and cattle are known to eat the grass grown in salt marshes with remarkable avidity. A simple criterion of the quality or adaptation of water for the purpose of irrigation may be found in the vegetation of the natural channel. If it be covered with a luxuriant vigorous herbage and of a good quality the water of the stream may be safely pronounced to be adapted for the proposed use.

The second operation is to ascertain whether a sufficiently large surface of level or nearly level land exists, which, however, must combine such conditions of transverse section as to allow the water to be removed freely after it has performed its functions without it being necessary to execute any very expensive works. The extent of the surface to be irrigated is one of the most important considerations, because upon it will depend the dimensions to be given to the canals and the conditions of supply from the parent river.

The colour and description of the soil of the area proposed to be irrigated and the presence of any white or brown salt efflorescence should be noted. The soil which derives the greatest benefit from irrigation is that which is most permeable, and which is most easily warmed. Compact clayey lands gain the least. Such lands are very retentive; the water they hold produces a very injurious effect by cooling the ground when evaporation takes place. In this kind of soil it is necessary to let the water on at intervals of some distance according to the temperature of the seasons. The subsoil is, however, far more important than the superficial soil. If a stratum of clay overlies a bed of gravel it may be irrigated as fully as a light soil; while a sandy stratum overlying an impermeable one may under certain conditions be unfit for irrigation.

When these conditions are ascertained to be satisfactorily solved a complete delineation of the drainage lines of the country should be made on a suitable map. If no good map exists one must be made. Towns and villages are generally found close to lines of drainage; and sandy soil generally marks a watershed. Whenever a well is met with the level of the water surface should be noted, and its variation during the year should, if possible, be ascertained. Bench marks should be left at all wells. These observations of the surface levels of springs should never be omitted when opportunity offers. If no contour map of the district is available, as many longitudinal and transverse lines of levels should be run across the land to be irrigated as possible. Upon the map so laid down the system of irrigation is to be arranged, observing in so far as the direction of the main conducting canal is concerned that the shortest line is to be

INCLINATION OR SLOPE.

The question of the inclination or slope of the canal or channel bed is really a very complicated one and far removed from easy solution. In navigable canals any great fall between a set of locks would only impede the ascending navigation; where the water is intended to be used as a motive power as well there exists an additional reason for rendering the falls as slight as possible between the separate portions of the course. One of the most remarkable instances of the adaptation of an artificial watercourse to the three uses of navigation, irrigation, and mill work is to be found in the canal of Pavia; this canal from Milan to Pavia with an average volume of discharge of 245 to 250 cusecs served to support a very active navigation, to irrigate a large district, and to drive numerous mills. The maintenance of banks of the canal is also most favourably effected when the rate of flow is moderate. There is, however, a limit in this direction beyond which it becomes dangerous to diminish the rate of inclination, for should the river from which the supply is derived bring down much matter in suspension, a canal with a feeble inclination would be silted up very rapidly. All these conditions again may be modified by the nature of the soil through which the canal runs; for if it be of a nature to retard the velocity of flow, that may require that the inclination or slope be augmented. In short, the balance will have to be carefully considered so as to avoid a velocity which will impede navigation and to limit it to that which will not cause deposit. Moreover, in the design of canals and channels for irrigation alone the velocity of flow, even if the strata traversed be able to bear a greater, without suffering erosion, should be limited to that which will not reduce the pressure of water against the sluices or vents, for the distribution of supply to the land, to such an extent as would cause the water to flow past them without giving to each its required supply.

In most countries certain rules prevail which appear to be founded on local experience. Vitruvius recommends an inclination of 55 in 10,000 for water-courses. In the sixteenth and seventeenth centuries the hydraulic engineers of Lombardy adopted an inclination varying from $\frac{1}{1500}$ to $\frac{1}{2000}$. In the mountainous areas the inclinations are considerably greater; for instance, in the upper valleys of the Alps and in the valleys of the Pyrenees the inclination or bed slopes of the channels are often $\frac{1}{500}$.

(To be continued.)

Retaining Walls of Concrete Crib Work.

A TYPE of retaining wall construction which, although it was only developed within the past five or six years, is coming into extensive and increasing use in the United States consists of cribs or frames built up in place with pre-cast reinforced concrete beams to form a row of cells or compartments. These cells are filled with loose well-draining material as the wall rises, so that the cribbing is embedded in and anchored into the filling or embankment. Such walls are built in heights of 3ft. to 25ft. A long wall



FIG. 1—CONCRETE CRIB WORK RETAINING WALL AT HOBOKEN

preferred, unless the expense of earthworks, bridges &c., justifies a deviation. If, however, the source of supply be in a river whose summer level is exposed to variation, it may frequently happen that it would be desirable to give a considerable length to the conductor canal for the purpose of ensuring a regular supply. As soon as the principal directions of the important works are settled the ground must be levelled in the directions of the important works, and a sufficient number of cross sections taken to allow of the alignment being afterwards diverted should such a course be found necessary.

of this kind for an inclined track in the goods terminal yards of the Delaware, Lackawanna and Western Railroad at Hoboken, U.S.A., is illustrated in Fig. 1. A typical form of construction for high walls is also illustrated in Fig. 2.

While this type of retaining wall is not universally applicable it has definite advantages, both economic and practical. In comparison with monolithic or mass concrete construction it is lower in cost, eliminates deep and expensive foundations, is more rapid in construction, and has a salvage value in case of removal of the wall for widenings or other

works. It is used largely in railway and road work: (a) to retain embankments where earth slopes would extend beyond the property line or on to adjacent roads or railway tracks; (b) for toe walls of cuttings and embankments to reduce the total width required; and (c) for wing walls or approach embankments at bridges. It has also many minor applications, such as, for example, the head walls of culverts, or to hold

must be properly designed for adequate strength and made of properly proportioned concrete.

In general, these walls are built with an open face, the stretchers being separated by the headers. A closed-face construction is also used, largely for its rather better appearance, as it may be made to resemble masonry closed-face construction. It has an advantage, also, in preventing the escape of the filling,

each. The headers, at right angles to the line of the wall, are 6ft. to 10ft. long and 5in. by 8in. or 5in. by 10in. in section, laid with the 5in. dimension vertical. They have T-shaped heads, 10in. high. Behind these heads, at front and back of the crib, are laid the stretchers, which are rectangular beams, 6in. by 6in. or 6in. by 8in. in section, and 6ft. or 8ft. long. They are laid with the 6in. dimension vertically, so that the

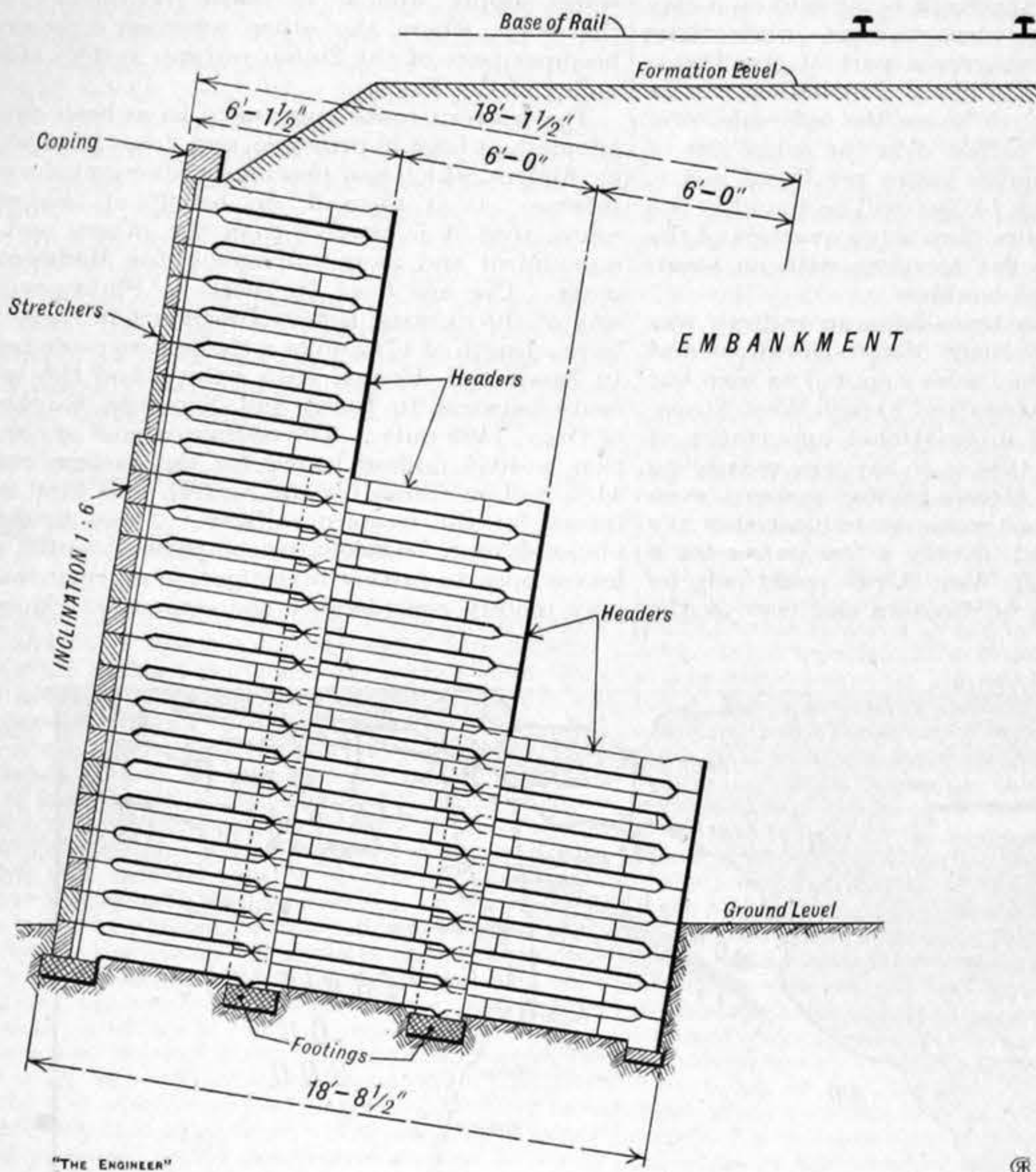


FIG. 2—CONSTRUCTION OF RETAINING WALL

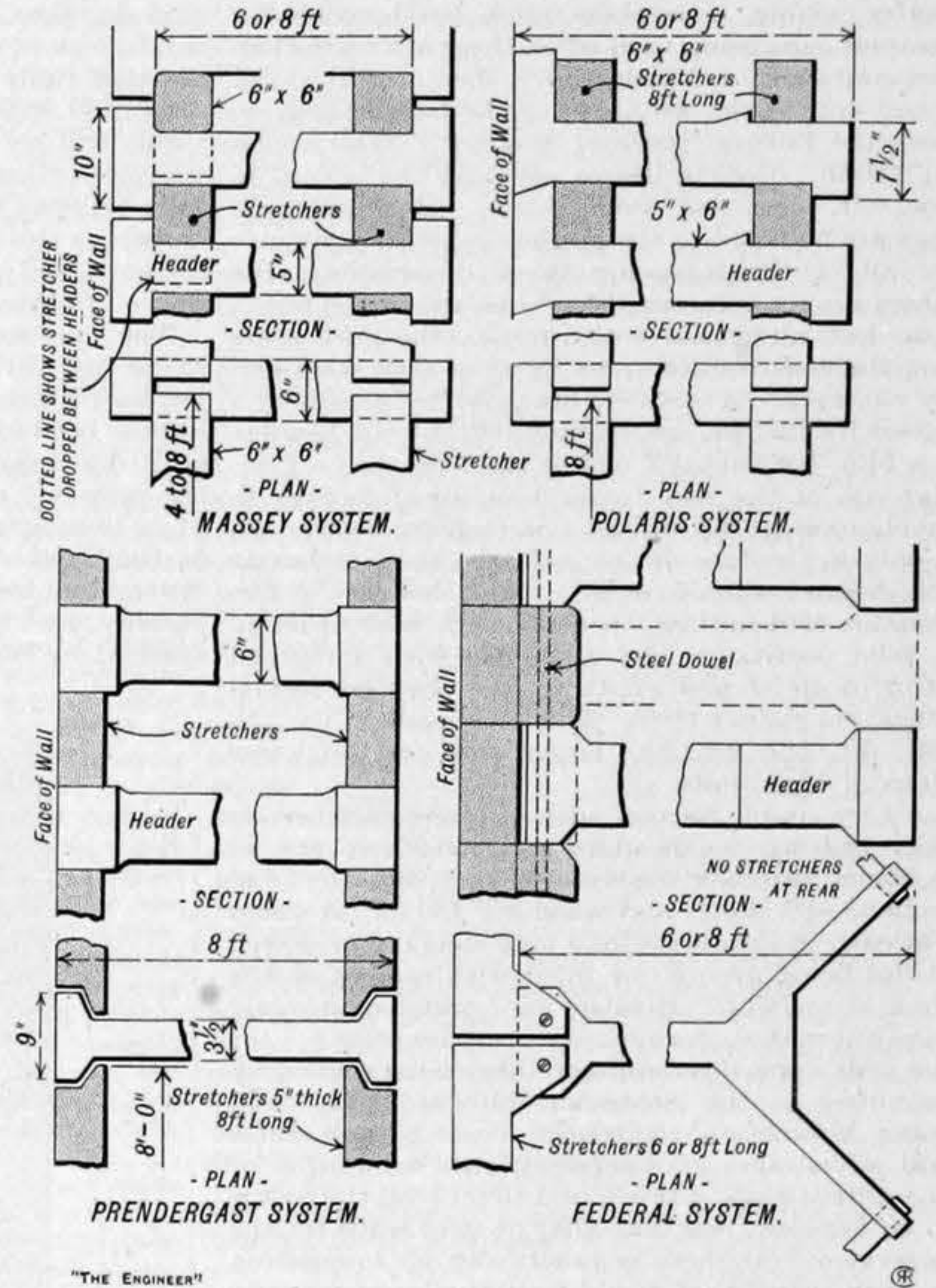


FIG. 3—TYPES OF CRIB RETAINING WALL CONSTRUCTION

the shallow embankments of inclined tracks between other tracks in railway goods yards.

A good bearing or base in stable ground is needed, but that usually means no more than removing the surface soil to a depth of 2ft. to 5ft., levelling it to a slope conforming to the inclination or batter of the face of the wall, and then spreading 8in. to 12in. of clean gravel or broken stone for drainage. Two rows of concrete sills or stretchers are laid first to support the bottom course of cribbing, and a line of beams on top of the face of the wall serves as a curb or coping to retain the toe of the earth slope above the wall, if the wall is surcharged. In exceptional cases a concrete slab with a toe wall under the outer edge is built as a base for the wall; but that is rarely necessary or desirable and adds materially to the cost.

Gravel with a small proportion of clay to act as a binder is the best material for filling, as a rule. Crushed stone, cinders, slag, and sand are also used. Too much clay is to be avoided, as it is likely to swell and displace or distort the wall. The filling is placed in layers and is well packed, being rammed thoroughly under the beams or crib members to ensure a solid and uniform bearing. The cribbing should be kept not more than about 2ft. above the level of the filling, as otherwise the packing will be less effective. The assembling and filling of the crib work can be done by unskilled labour, the beams being placed either by hand or with the aid of a portable hand-operated or power-operated crane.

There are several manufactured designs of the precast concrete crib members, and certain railways have designs of their own. In most cases there are simply two forms of straight beams; stretchers or longitudinal beams forming the face of the wall, and sometimes at the rear of the cribbing also; and transverse beams or headers which form the partitions between the compartments. These headers and stretchers interlock in various ways so as to form a unit structure. In the principal variation from this general type the headers have Y or forked rear ends, and thus get exceptionally good anchorage in the filling or embankment.

A batter of 1 1/2 in. or 2 in. to the foot is usually given to the face of the wall. In high walls the width of the lower portion is increased either by the use of longer headers—two or three different lengths being used according to the height—or by building one or two rows of cribs behind the front row. This latter method is illustrated in Fig. 2. To ensure stability care in design and construction are necessary, as in any type of retaining wall. Drainage of the ground must be provided, to prevent its softening, with consequent settling. However, the construction is flexible and will adjust itself without injury for any ordinary settlement. The concrete beams, of course,

although well-packed filling will not flow much through open crib work. Where the stretchers are in direct contact for their entire length some drainage openings may have to be provided for the filling, but in some designs they are in contact only at the ends, leaving a narrow slot of 1/2 in. or 1 in. width that is practically invisible but still adequate for drainage.

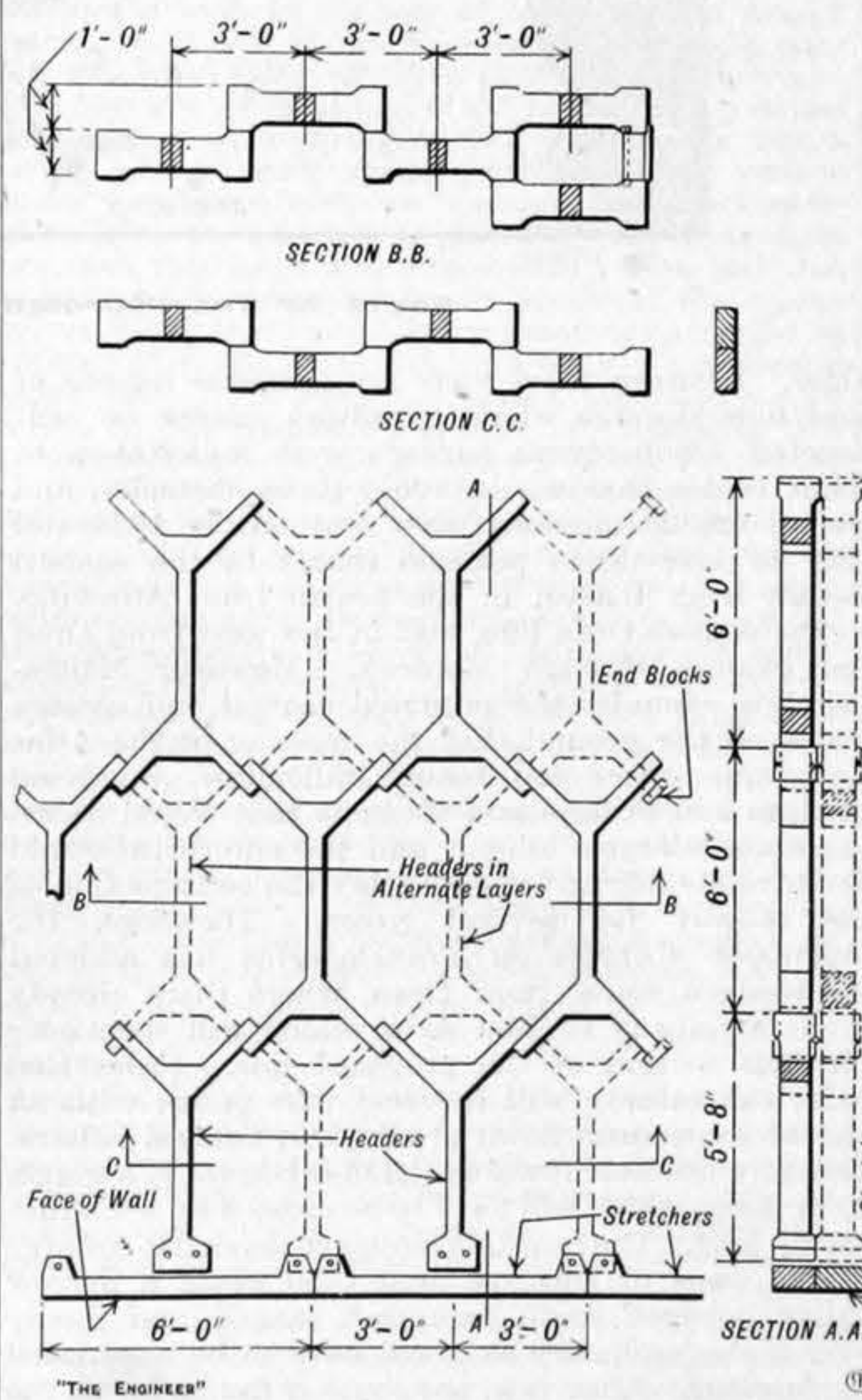


FIG. 4—ARRANGEMENT OF HEADERS IN FEDERAL SYSTEM

Four types of crib retaining wall construction are illustrated in Fig. 3. These are manufactured and sold by commercial companies, the purchasers having the erection done by their own forces or by contract. In the Massey system all members are made of concrete designed for a compressive strength of 3500 lb. per square inch, and they weigh 250 lb. to 500 lb.

T-heads of the headers are 1 in. apart. For flexibility, the continuity of the wall is broken by using a double line of headers at every twelfth panel or bay. With the construction as described there are 5 in. openings between the stretchers. For a solid-face wall, however, the stretchers are made 10 1/2 in. deep, except at the 6 in. ends, which rest on the headers. The 1/2 in. opening or slot is sufficient for drainage.

In the Prendergast system the headers and stretchers interlock to form a smooth face, thus differing from the Massey system, where the T-heads of the headers project beyond the stretchers. The Prendergast headers also have T-shaped ends, but the Ts are horizontal and the stretchers are 5 in. slabs having the ends halved to fit over the flanges of the T heads. These headers are 6 in. deep and 3 1/2 in. wide, with the T heads 9 in. wide. Both headers and stretchers are 8 ft. long, but the headers in alternate rows are staggered, 4 ft. apart, the middle of each stretcher resting on the header below. This construction gives a solid-face wall.

The Polaris system differs from the others in having headers with L-shaped ends. The header is 5 in. by 6 in. in section, with the 5 in. vertical. At the front end it is turned up 6 in. high to hold the stretcher above in place. At the rear end it is turned down 4 in. to hook over the rear stretcher of the course below. A lug on the header also engages this rear stretcher, which is thus locked in position. The front ends of the headers engage by inclined surfaces and are thus held to an even surface. Where the headers are 6 ft. to 10 ft. long, as at the base of the cribs, they are supported at intermediate points by concrete blocks fitted between them. With this construction the face of the wall is open cribbing, with 5 in. spaces between the stretchers, and the face is irregular, since the ends of the headers project beyond the stretchers.

A quite different arrangement is used in the Federal system as the headers do not interlock with the stretchers, and do not extend through to the face of the wall. In addition to this, the headers are of Y or forked shape. Those of the front row of cribbing have the stem of the Y behind the stretchers and the forked end at the rear. In the rear rows of cribbing the headers have both ends forked. The headers are also staggered in the alternate courses or layers. This construction is shown in Fig. 3, while the peculiar arrangement of the headers is seen in Fig. 4.

The stretchers are beams 6 ft. long, 1 1/2 in. high, and 6 in. wide, but with a 1 in. projection or seat under each end, so that the wall has a solid face except for 1 in. openings between the stretchers. On the back of the beam there is a 6 in. rib or flange at each end, the two flanges at each joint forming a seat for the enlarged end of the header, which is secured to each one by a

3/4 in. steel pin or dowel. These headers are 6ft. or 8ft. long, 12in. high and 4in. wide, with a spread of 3ft. at the forked ends. As the headers are staggered, the ends of each fork in one course rest upon the ends of two headers in the course below. No dowels are used at the rear, as the beams are well anchored in the filling.

Unlike the other systems mentioned, no stretchers are used in the back of the cribbing. Headers weigh 390 lb. for walls up to 10ft. high and 470 lb. for those of greater heights. Stretchers weigh 360 lb. to 430 lb., the heavier ones being used when there are more than twelve courses of cribbing above them. Sills, 12in. high and 4in. thick, are used for the base course, to support the bottom layer of headers. They weigh about 300 lb. Coping beams are 12in. by 10 1/2 in. in section, 6ft. long, and weigh 700 lb. Both sills and copings are fastened to the headers by steel dowels.

For all of the foregoing types of cribbing, the members are manufactured by firms which sell them, but do not undertake construction, the purchasers having the construction done by their own workmen or by contract. A system, designed by a railway's engineers for its own use, employs 6in. by 6in. headers with a 14in. horizontal T end at the front and a 21in. similar end at the rear to serve as an anchorage in the embankment or filling. Stretchers, which are used only in the face of the wall, are slabs or beams placed behind the T ends of the headers. The headers are laid in direct contact with each other to form solid partitions, and are made with a vertical offset or joggle at mid-length so that they are locked together and cannot slide. They are made in lengths of 3ft., 6ft. and 9ft., the larger ones for the lower portions of high walls.

In a very simple form of such cribbing designed on another railway the headers and stretchers are all alike, being precast concrete beams, 6in. by 8in. in section, 6 1/2 ft. long, and weighing 450 lb. A cored hole at each end provides for a long steel rod or dowel, the holes being grouted or filled with cement as the cribbing is built up. Headers and stretchers are laid in pairs alternately, forming open square cribs.

This crib, type of retaining wall has been studied by a committee of the American Railway Bridge and Building Association, the report of which enumerates several advantages as compared with monolithic or mass concrete walls. It is found that:—(a) the cost is 25 to 40 per cent. less than that of solid walls for the same service; (b) there is practically no foundation work, even on soil that would require piles or concrete piers to carry a wall of mass concrete; (c) there is greater speed of erection, and the wall can go into service at once instead of having to be left while waiting for the concrete to set and harden; and the construction can be done by common or unskilled labour, and without the use of extensive special equipment. Ample drainage is provided for the ground or embankment. In case of alterations, the wall is easily taken down and the material re-used or salvaged. It has advantages in busy goods yards or termini, where waiting for poured concrete to harden would be highly inconvenient. It can also be used beneficially where very small amounts are required. As to actual cost, estimates for both types of construction were made in connection with the crib wall shown in Fig. 1. The mass concrete walls were estimated at £25,660, while the actual cost of the crib construction was £15,860, or a saving of 38 per cent.

The Trans-Saharan Railway.

THERE is so much controversy about the commercial value, and even the feasibility, of the proposed Trans-Saharan Railway that the committee which has been advocating this scheme for years past has issued a summary of the report prepared by Monsieur Maître-Devallon, director of the *Organisme d'Etudes du Transsaharien*. Towards the end of last year a commission of experts appointed by the Government spent three months surveying the projected routes across the Sahara, and its report was favourable to the immediate construction of the line, but the Government has so far done nothing, and adverse criticisms have introduced an element of doubt into the problem which the advocates of the scheme are doing their best to remove. The report of Monsieur Maître-Devallon deals with all the technical and commercial aspects of the scheme, though obviously a good deal is based upon supposition.

In the first place, there can be no question of laying the track through a desert of sand hills where there is no rain and no means of consolidating cuttings, nor should it skirt mountains where violent storms are followed by cascades down the sides that sweep everything away. On the plains it is believed that there is no rain for years together, though the existence of dry courses shows that the possibility of the track being disturbed by extremely rare, though heavy, rainfalls must be taken into account. The fear that the occasional violent sand storms may obliterate the track is held to be justified to a certain extent, but the promoters claim that they have some experience to go by on the desert sections of the lines from Oran and Constantine, where the track is slightly raised, and is never covered with sand, while even between Biskra and Touggourt, where the railway runs occa-

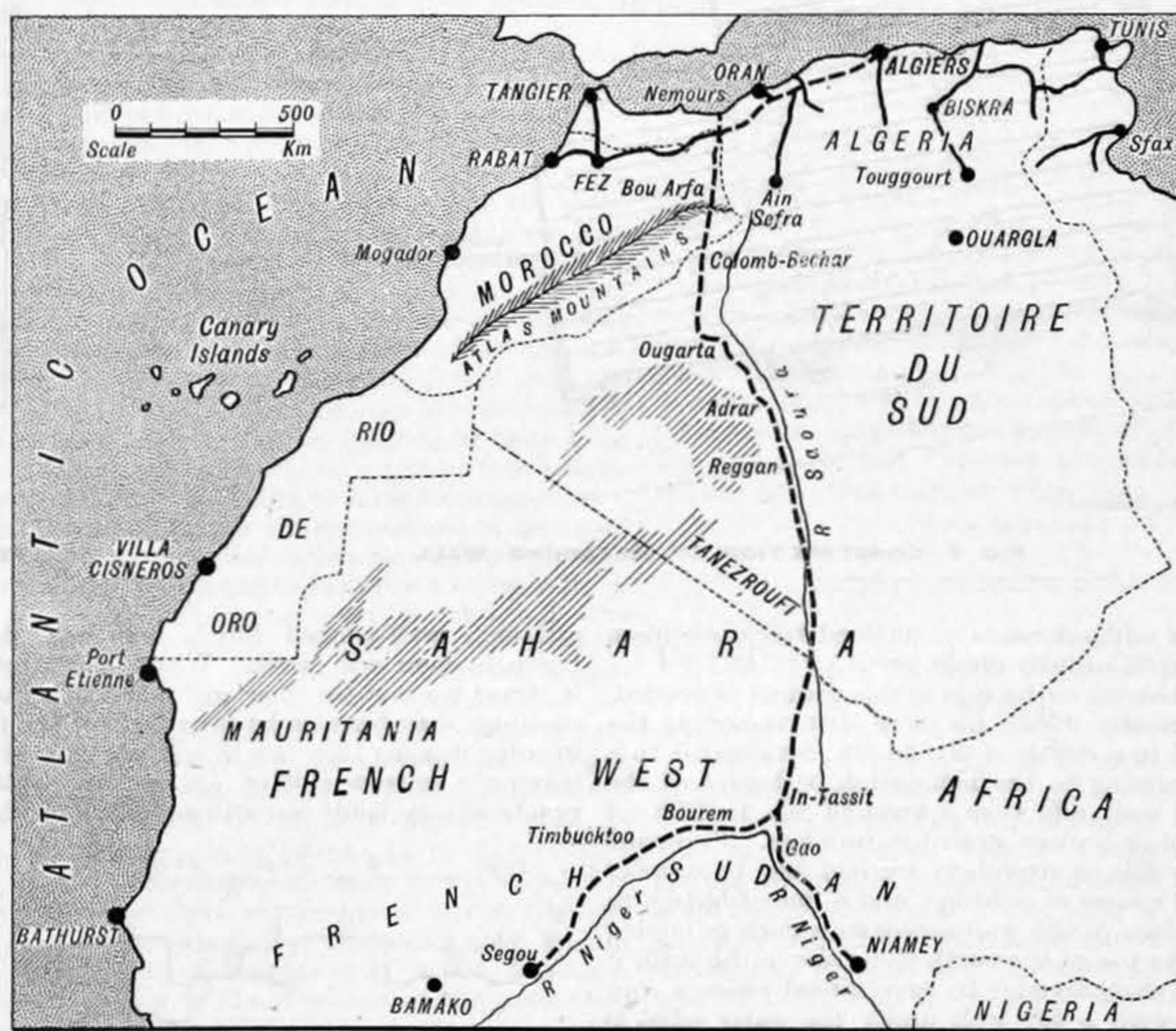
sionally in wide shallow cuttings, there is no difficulty in keeping the line clear. Sand, it is said, is far less troublesome than snow.

Water supply has not been a prominent factor in the selection of routes, now that oil-electric locomotives can be employed, and water for passengers and for the few stations can be carried, if necessary, by rail, thereby avoiding longer and more costly routes where water can be found. On the Biskra-Touggourt line there is no ballast, the track being laid on a clay that hardens under the sleepers, and while these conditions probably exist over a part of the Trans-Saharan route, it is hardly likely that ballast can be dispensed with, so that, to be on the safe side, provision will be made for ballast over the entire line in the proportion of 1.4 cubic metre per lineal metre. It is believed that all the ballast will be found in the desert, as the line for more than three-quarters of the distance will pass over flat territory with an abundance of loose stones and boulders.

The first survey for a trans-Saharan railway was made in 1913 by Monsieur Maître-Devallon and Captain Nieger, when they were required to map out a route between North Africa and French West Africa, with due regard to the international importance of the proposed railway; that is to say, the possibility of its linking up all the African railway systems, even to the Cape. It was then made quite clear that the Atlas Mountains allowed of only a few passes for a railway, and that French West Africa could only be reached by flat country to Bourem and Gao on the

desert, and being half way between the Mediterranean and the Niger it is of considerable importance in the organisation of railway and motor car traffic. Through the flat Tanezrouft the ground is mostly stony, and for more than 300 miles the line will be straight, except where it curves slightly now and then to avoid sand hills. South of the Tanezrouft the route enters the Sudan, where the country gradually changes to green, undulating territory, with frequent sources of water supply, and at In-Tassit the railway reaches the point where the other schemes converge and becomes part of the Sudan railway system along the valley of the Niger.

The western route appears to have been definitely adopted, at least in principle, and it has been accepted by Algiers, which had previously favoured the central scheme. It is claimed, on behalf of the western route, that it is shorter than the others and more economical and more convenient for Mediterranean ports. The line from In-Tassit to Philippeville, by way of the existing Biskra-Touggourt railway, would have a length of 1747 miles; the central route between In-Tassit and Algiers, 1645 miles; and the western route between In-Tassit and Nemours, to the west of Oran, 1409 miles. The estimated cost of construction is 4055 million francs for the eastern railway, 4185 million francs for the central, and 3180 million francs for the western railway. These figures can obviously only be taken for comparison, as the report leaves open to further investigation a great deal that may modify considerably the estimates. Moreover,



ROUTE OF THE PROPOSED TRANS-SAHARAN RAILWAY

Niger. Between them there are immense regions of sand hills through which a railway cannot be constructed. Subsequent surveys were undertaken to define routes that would avoid these obstacles, and several official missions were sent out in 1928 and 1929 to investigate possible routes in the eastern section from Biskra, in the centre from Affreville, on the Algiers-Oran line, and in the west from Oran and passing through Morocco. Monsieur Maître-Devallon excludes the proposed central and eastern routes on the ground that the crossing of the Atlas Mountains offers too many difficulties, involving cuttings and bridges and viaducts that would necessitate considerable labour, and the enterprise would be far too costly and would delay the construction of the railway for several years. Therefore, the *Organisme d'Etudes du Transsaharien* has adopted the western route from Oran, where there already exists a railway to Bou Arfa, which will constitute the first section of the proposed line. From Bou Arfa, the railway will traverse vast plains with an almost continuous down gradient to Central Sahara. The only obstacle towards Colomb-Béchar is a gorge, 40 m. deep, which will have to be crossed by a viaduct 350 m. long. The route continues through flat country to the oasis of Ougarta, and then along a narrow valley between small mountain ranges, and finally over higher ground which will have to be negotiated by cuttings. After this, the route is flat as far as the bed of the Saoura, which runs on an average only once in three years. The Saoura will be crossed by a bridge, 150 m. long. So far there are oases that can be connected up with the railway by roads. The route offers no difficulty to Adrar, which is the centre of a district with a population of 20,000, and there the station will be one of the most important on the line. The existing motor car route is then followed by a continuous down gradient to Reggan. This is the last oasis on the border of an absolutely waterless

they represent only a part of the total expenditure, in view of the necessity of replacing some of the metre-gauge lines in North Africa.

Owing to the refusal of the West African Government to authorise the employment of black labour in the Sahara, where the climate is unsuitable for it, the railway would have to be constructed from the northern end with Arab labour from the south of Morocco, and work could only be carried on for about 200 days during the year—that is to say, nothing could be done during the summer months. It is estimated that under these conditions the western railway would be completed in eight years, while the central railway could be not built in less than ten years, and the eastern line in less than fifteen years, mainly on account of the difficulty of procuring labour for the two latter routes.

The method proposed for laying the line in the desert is to send forward a technical staff with motor cars and wireless emitter to stake out the line, followed immediately by a gang of men to prepare a motor road alongside the track. Then would come a gang to lay out the track and make temporary embankments where necessary—particularly where dry river beds have to be crossed—which will be replaced by permanent constructions when the line is so far advanced that the necessary material can be brought by rail. This gang will be followed by another to riddle and prepare the ballast and level the track. Another gang will lay the ballast and lengths of rails and sleepers with machines already employed elsewhere for the purpose. Finally, a gang will follow by rail to complete the work begun by the first gang, and will build stations and arrange for the water supply. It is expected to construct the line at the rate of a mile a day with rather less than 1000 men. While the Trans-Saharan Railway is being constructed, railway work will be carried on in the Sudan to complete the system, and negotiations are to be entered into with

the British and Belgian Governments for extensions to the Gold Coast and Katanga. The idea is to develop the railway into a trans-African line from Oran to the Cape.

The report deals fully with the commercial possibilities of the railway, based upon the economic development of the West and Equatorial African colonies, with the aid of new traffic facilities, and while the figures given are imposing, they would be less favourable if limited to the traffic actually available and the probable normal rate of increase in the future. It is claimed that the cost of carrying goods by rail will not be higher than shipping freights, and that they will be carried more quickly. Generally, time is not an important factor in the transport of colonial produce, while for passengers there are few who would venture to cross the Sahara during the four or five summer months. The competition of motor cars is disposed of by the logical conclusion that the roads across the desert can never be more than tracks that are liable to deterioration, and that consequently such vehicles cannot be depended upon to carry heavy loads. Nevertheless, the report states that motor car traffic will develop with the railway.

The Radio Research Board.

THE report of the Radio Research Board for the period ending December 31st, 1930, was issued last Monday, and in order that we might see the experimental work now in actual progress we were invited to inspect the laboratories at Slough and Teddington on Friday last week. For the most part the work at Slough is carried out in small huts on an extensive site remote from any source of interference, whilst that at Teddington is done in a hut and other buildings associated with the National Physical Laboratory. Since the Board was established, apparatus and methods capable of yielding reliable and consistent results have been worked out for the study of the fundamental problems connected with the propagation of waves, the nature and origin of atmospherics, and radio direction finding. Marked progress has also been made in the improvement of methods for the measurement of electrical quantities at high frequency.

Fundamental research forms an important part of the Board's work, although in certain cases priority is given to experiments which may lead to results that may have immediate practical application. The solution of many problems presented to the Board is of interest to one or more Government Departments or branches of the wireless industry. By its terms of reference, items of this nature can be included in the Board's programme of research where adequate provision is not otherwise available. Financial arrangements have been made for more intimate collaboration between the Post Office and the Department of Scientific and Industrial Research through the Radio Research Board, and under these arrangements the services of the Radio Research organisation will be made available to a greater extent for exploring new ideas and new principles in radio developments of special interest to the Post Office. When desired, moreover, the knowledge and experience of the Board's staff will be available for the assistance of the Post Office in solving practical difficulties and arrangements will be made for the carrying out of any necessary experimental work to enable such assistance to be given. Careful consideration has recently been given to the question of speeding up the Board's investigations, and as a first step in this direction arrangements have been made to extend the scope of the observations on atmospherics, carried out with the co-operation of the Meteorological Office at its station at Leuchars, Fifeshire, by equipping a small out-station at Leuchars to work in conjunction with the Radio Research Station at Slough on atmospherics and the propagation of waves. Close collaboration was maintained during 1930 with the Radio Research Boards appointed in Australia and New Zealand by their respective Governments, and arrangements have been made for the early exchange of information concerning the results of work undertaken by the three Boards.

The Board's work is too extensive and too involved to be dealt with in detail here. Those who are interested in research of this nature should study the Report, which contains 90 pages of highly instructive matter. A few of the outstanding features of the work may, however, be mentioned. Special attention is being paid to the study of waves below 10 m., with a view to testing their communication properties. For the study of the ionisation of the atmosphere and its effects on the propagation of waves, extensive use has been made of the frequency change method developed by Professor Appleton. By means of a small continuous change of transmitter wave length, a succession of maxima and minima interference between ground waves and waves deviated by the upper atmosphere are produced at the receiving station, and by using loop and antenna receiving systems in several different ways, from a comparison of the interference "fringe" amplitudes, it has been possible to estimate the relative intensities of the ground and atmospheric waves, as well as the angle of incidence of the latter at the ground.

A comparison of the phase differences between the two sets of waves as deduced from the interference "fringes" recorded with different types of aerial systems has yielded information relating to the polarisation of downcoming waves. In all such investigations the number of "fringes" produced by a known wave length change has been found, even when the determination of that number was not the primary object of the experiment. In this way the equivalent path difference for the ground and atmospheric wave tracks has been calculated, and from this the equivalent height of the ionised layer has been deduced. Whilst in the past it was thought that there was only one ionised layer, investigations point to the existence of three. The region of ionisation which normally reflects long waves and normally deflects broadcasting waves is known as the region E, whilst hypothetical reflecting layers above and below this region are known as the regions F and D respectively. A complete account of the experi-

mental work based on the frequency change method has been presented in three papers communicated to the Royal Society by Professor Appleton.

The first of these papers dealt with the evidence collected from the lengthy series of observations carried out on wave lengths of the order of 400 m. at the Peterborough radio research station, which has now been closed down, and served as an introduction to the two other papers, which dealt mainly with the simultaneous reception of downcoming waves at several receiving stations and with the use of shorter wave lengths. The equivalent path of the atmospheric waves is obtained in any one case by counting the number of interference maxima and minima—number of fringes—obtained in any one frequency change, dividing this number by the frequency change in cycles per second and multiplying the result by the velocity of light, when the equivalent height of the layer may be deduced by simple triangulation. It has been observed that the fringe system frequently shows the presence of subsidiary "fringes" imposed on the main fringes, thus indicating the existence of atmospheric rays of greater equivalent path than the main fringes.

At the present time a considerable amount of work is being carried out on waves below 50 m. One of the most important matters in connection with the Heaviside layer, about which there is incomplete evidence, is that relating to the minimum wave length which is reflected or refracted by it, a problem which is linked up with skip distance, with the problem of diffuse *versus* specular reflection by the layers and with Strömer's theory of long delay echoes. The frequency change method mentioned provides a means of obtaining information bearing on all these points. Results on short wave lengths are being steadily accumulated and have already produced evidence relating to the influence of magnetic storms on the ionised layer. It has been found, for example, that on the occasion of a magnetic storm the ionisation at the height of about 120 kiloms. is frequently sufficient to reflect 50 m. waves which normally penetrate at vertical incidence to a very much greater height, thus indicating a marked increase in ionisation from the normal value. The ultimate object of the present studies of the effect of the ionisation of the atmosphere on the propagation of waves has now definitely emerged as being the quantitative determination of the mean distribution of ionisation at different levels in the atmosphere, and experiments now in progress point to the possibility of realising this object. When reliable figures of the mean ionisation density at different heights have been obtained, it will be possible to evaluate the mathematical formulæ representing the processes by which waves of various frequencies are propagated and to check the various theories of wave propagation.

On behalf of the National Physical Laboratory work on the study of aerials has been continued and a graphical method has been developed for finding the magnitude and phase of the electrical field in the immediate neighbourhood of an aerial with a known distribution of current. The phenomenon known as "aerial shadow" has also been investigated by measuring at different points the variation in signal strength, caused by the interposition of a receiving aerial between the local transmitter and the points at which the measurements were made. The method mentioned of calculating the electric field has been employed to furnish a satisfactory theoretical explanation of the results obtained, and the investigation is likely to be of value in the design of reflector systems of beam stations.

In connection with direction-finding, the Board has done useful work in the way of modifying the Adcock system. It is well known that the variable night error met with when using all types of closed loop direction-finders are due to the action of the horizontally polarised component of downcoming waves. Experiments with a special Adcock aerial system employing four vertical dipoles and used with an ordinary radiogoniometer showed that the system was practically free from night error, and this result was attributable to the fact that by making all connections to the centre of the dipoles the horizontal members of the system were arranged so that no E.M.F. was induced in the system by a horizontal electric force. The system, however, depended for its success on the suspension of the hut containing the operator and apparatus at a height of about 20ft. above the ground, and in view of the inconvenience of this arrangement, the research work has been directed to the realisation of an Adcock direction-finder that can be operated in a hut erected at ground level. An improved system of coupling the four receiving aerials to the central radiogoniometer by a series of high-frequency transformers has been developed. The system in its improved form was described on April 2nd, 1930, in a paper read before the Wireless Section of the Institution of Electrical Engineers by Mr. R. H. Barfield, who explained that balancing condensers are inserted in the earth lead to compensate for the lowering of the hut. A direction-finder for use on wave lengths between 10 m. and 5 m. is being developed for use in the study of ultra short waves, and in this connection it has been necessary to extend the study of open wire screens employed to reduce antenna effect. A direct-reading, instantaneous direction-finder employing the cathode ray oscillograph is also in the course of development.

Results obtained with the rotating loop beacon erected at Orfordness for use by ships have been analysed for the Board of Trade and have been published. In connection with this work an automatic recorder for use in checking bearings from a rotating beacon has been constructed. Reports received from mariners indicated a general desire to be able to receive bearings at distances at which night errors might arise with a beacon employing an ordinary rotating frame, and an investigation was therefore begun to discover whether the Adcock aerial system could be used satisfactorily in the production of a rotating beacon. The Adcock beacon which was erected at the National Physical Laboratory was unfortunately destroyed by fire in June, 1930, but sufficient observations had been carried out to indicate that the system could probably be applied to a beacon transmitter of commercial size.

If space permitted much might be written about the Board's investigations on atmospherics. With the aid of the new cathode ray oscillograph developed by Baron Manfred von Ardenne it has been possible to photograph the wave forms of atmospherics previously observed visually, and it is satisfactory to note that so far the general

nature of the forms recorded photographically is in agreement with the results of previous visual observations. The network of simple pen-writing recorders situated at Slough, Lerwick, Aboukir and Bangalore, which were employed for observations on the main direction of arrival of atmospherics, was maintained in operation until the end of 1928. While the results with these instruments gave indications of an orderly progression of a single dominant source of atmospherics across the world under solar control, the very wide polar curve of the instruments and the ambiguity of sense in the recorded bearings presented very great difficulties in the interpretation of the results. But a recorder has now been designed in which the "resolving power" in respect of simultaneous streams of atmospherics arriving from different directions is very greatly increased, and it is proposed when opportunity arises to proceed with the construction of these new recorders for issue to suitable observing stations in this country and overseas.

Simultaneous observations on individual atmospherics with the cathode ray direction finder have been continued, and whilst the results have shown frequent correlations with meteorological data in some cases no correlation could be traced. Nevertheless, the results are considered to be sufficiently favourable to justify the extension of the period of observation and an improvement in the triangulation system for observing distant sources. The scheme of using Fultograph picture transmissions for recording the range of atmospherics is yielding satisfactory results, and up to date they show broadly that a very great preponderance of atmospherics are received nearly simultaneously at all the observing stations scattered over the British Isles and Europe where the receiver sensitivity is sufficient to reveal them.

At the National Physical Laboratory work on the development of radio frequency standards has been continued. Much research has been carried out on the use of tuning forks and quartz crystals for controlling frequency. Two tuning forks forming the National Physical Laboratory standard for radio frequency have been remounted in an enclosure in which constant pressure and temperature are maintained, and with continuity and constancy of the supply voltage to the forks a constancy of frequency at any instant to one part in one million is contemplated. Experiments are also being made with a quartz oscillator for a standard frequency of 1000 cycles per second as an independent alternative to the tuning fork. As the Schering high-frequency bridge now appears to be practically perfect, no further work on its development is proposed, but considerable attention has been paid during the past year to the improvement of methods of measuring currents at high frequencies.

The Radio Research Board's Report is published at 2s. and is obtainable in London at H.M. Stationery Office, Adastral House, Kingsway, W.C. 2.

SIXTY YEARS AGO.

IN our issue of November 10th, 1871, there was an interesting leading article entitled "Celestial Engineering." There were, we remarked, very few intelligent individuals in this country who were not aware that the inhabitants of the Celestial Empire—otherwise China—were an extremely ingenious and industrious people. It was, we said, just as certain, however, that accurate information concerning the progress recently made by the Chinese in the arts and sciences was confined to a very few. We therefore proceeded to show that advices, which had recently come to our notice, showed that the Chinese were determined that their nation should not be left behind in the great race for improvement. They had recently made great strides towards perfection in the construction of all the implements and munitions of warfare. At Shanghai, a large naval arsenal, known as the "Kiangnan Naval Yard and Arsenal," in which many Europeans were employed in directing and instructing Chinese artificers and engineering pupils, had been created. In that establishment the Government had, during the two preceding years, built and successfully launched five gunboats—one with paddles and four with screws—having a gross measurement of 3500 tons and propelled by engines of 550 nominal collective horse-power. That alone, we commented, was "a great feat for a nation still looked upon as nearly barbarous by only too many in Europe"; but it was by no means the whole of the Yard's activities. There was far advanced towards completion a "fine screw frigate of 2700 tons burthen and 400 horse-power," while the keel of a similar vessel had been laid. These vessels were each to carry twenty-eight 40 lb. and two 100 lb. guns, all of wrought iron, which were then in course of manufacture at the Arsenal, as were also the engines for driving the boats, several dredgers, and a large dry dock. The manufacture of Martini-Henry rifles was also being carried out on a large scale under the guidance of a staff of officers sent out from our own Enfield Factory. . . . In discussing the foregoing and other advances in the introduction of European manufacturing methods into China, we made the following prophecy: "It is quite possible that China may yet play a very important part in the affairs of the world. Nothing stood so much in the way of her progress as the prejudices of the people. The wars which forced her to open some of her ports to the 'barbarian' English conferred the greatest possible benefits upon her. Through these ports the nation acquired information that never could have been obtained under the old exclusive rule. The ingenious Chinese have not been slow to profit by this, and when we bear in mind the indomitable patience of the people, their intense thirst for learning, and the imitative skill which, as displayed by them, has almost passed into a proverb, it becomes difficult, if not impossible, to fix a limit to the material progress which the nation may make within the next few years."

THE first section of the Bermuda Railways, described in our issue of September 25th and October 2nd, was opened for public traffic on Sunday, November 1st. It is expected that the whole line will be completed by December.

The Commercial Motor Transport Exhibition at Olympia.

No. I.

THE Tenth International Commercial Motor Transport Exhibition, which opened at Olympia yesterday, Thursday, November 5th, and will remain open until Saturday, November 14th, has been arranged by the Society of Motor Manufacturers and Traders, Ltd., and is one of the most complete and extensive exhibitions of its kind held during recent years. Among the features of particular interest to our readers we may mention the new and modified designs of chassis for heavy road vehicles which have followed as a direct result of the Ministry of Transport's regulations with regard to the loading and limiting dimensions of such vehicles. Designers have sought to embody new features within the fixed limits for overall dimensions of length and width, ground clearance and height, particularly for single and double-deck omnibuses. Again, the Ministry of Transport braking regulations have caused the introduction of new brake arrangements, and an effort has been made to reduce stresses on working parts without increasing weights by the better disposition of the materials employed, and the free use of alloy steels and the lighter alloys.

Another feature of this year's Exhibition is the greatly increased number of heavy-oil compression-ignition engines, a type of motor which is rapidly taking a leading place in the development of the modern road transport vehicle. We are pleased to record a much larger number of British-designed engines, several of which mark a definite forward step.

The evolution of the heavy road vehicle, both internal combustion and steam, has been greatly helped by the intensive research which has been done on the production of pneumatic tires for commercial vehicles, some of which are now designed to withstand very heavy loading. Such tires appear this year on steam wagons and tractors and on nearly all the other road transport vehicles, while the recent "Micheline" vehicle in France, which utilises pneumatic tires for railway coaches, must not be overlooked as a possible future development. Progress in tire design has been greatly helped by the experience gained with very high speed racing cars, which has, perhaps, affected the commercial vehicle more than any other type. Alongside this trend may be noted the recent progress made in moving track vehicles, which, in the past, have been mainly developed for military purposes, but will in the future certainly play their part in land transport, particularly in those countries in which good roads are not always available.

The leading exhibits shown at Olympia are worthy in every sense of the high standard set by British motor manufacturers, and it is hoped that the industry will benefit greatly by the Exhibition. In what follows we give a description of some of the principal exhibits, which has been compiled from material placed at our disposal by the various firms. As far as possible we confine ourselves to exhibits which show the new developments in design above referred to.

JOHN I. THORNYCROFT AND CO., LTD.

Among the many exhibits staged by John I. Thornycroft and Co., Ltd., of London and Basingstoke, which include vans, lorries and omnibuses, is a new type of compression-ignition heavy-oil engine generally similar to that described and illustrated in our issue of October 23rd, but without a reversing gear. From these exhibits we have chosen for special description a newly designed chassis for double-decked passenger omnibuses, which we recently inspected at Basingstoke. The chassis has been built to accommodate a covered double-deck omnibus of standard design, carrying fifty to fifty-two passengers in addition to the driver and conductor, the gross load not exceeding 6 tons 3 cwt., or 13,780 lb. It has been designed to give the absolute minimum height of platform obtainable under present regulations, with a proper margin for tire wear, and the smallest diameter wheels. Advantage has been taken of new materials, such as the light magnesium alloys, and high-grade heat-treated alloy steels.

The outstanding features are the front and back axles, which are shown in Figs. 2 and 3 opposite, and which, we are informed, are the subject of patent applications. A general view of the completed chassis is given in Fig. 9 on page 492. The wheels are of the detachable disc pattern with Dunlop 36in. by 8in. pneumatic tires in front and twin 34in. by 7in. twin types at the rear. As will be seen from our illustrations, the side members of the frame are of deep section, the frame depth being

such that, while giving the height of body required in modern vehicles, there is an ample margin of safety from the underside of the frame to the ground. The tubular cross members are of large diameter and are so fixed as to give the requisite rigidity to the whole construction. The intermediate bearing of the propeller shaft is carried by a plate cross member, while the front cross member is of square tubular section and is placed conveniently for supporting the engine. At the back of the chassis the drop extension is bolted on separately so that the height can be varied in order to suit different entrances for double and single-deck omnibuses.

The front axle, shown in Fig. 2 opposite, has been specially designed to meet the heavy horizontal forces as well as vertical loads, which are imposed by modern systems of braking. Such an axle must resist large torsional stresses, and in the usual H section axle body any mere stiffening between the pivot pin and the spring anchorage adds weight without giving the desired result. The new Thornycroft axle has a box section form of body running right through from steering pivot to steering pivot, and is built up of alloy steel pressings with ends of alloy steel stampings, the whole being electrically welded together. The axle arms are of a more or less conventional design, with the bearings on each stub axle spaced as far as possible apart, in order to reduce the load on them when the vehicle is cornering.

Front wheel brakes of the maximum possible capacity, having regard to the limitations of wheel rim size, are fitted. By using a floating cam arrangement, practically all jamming pressure has been removed from the bearing, which supports the cam end of the shaft when the brake is applied. The result of this, it is claimed, is to free the operating

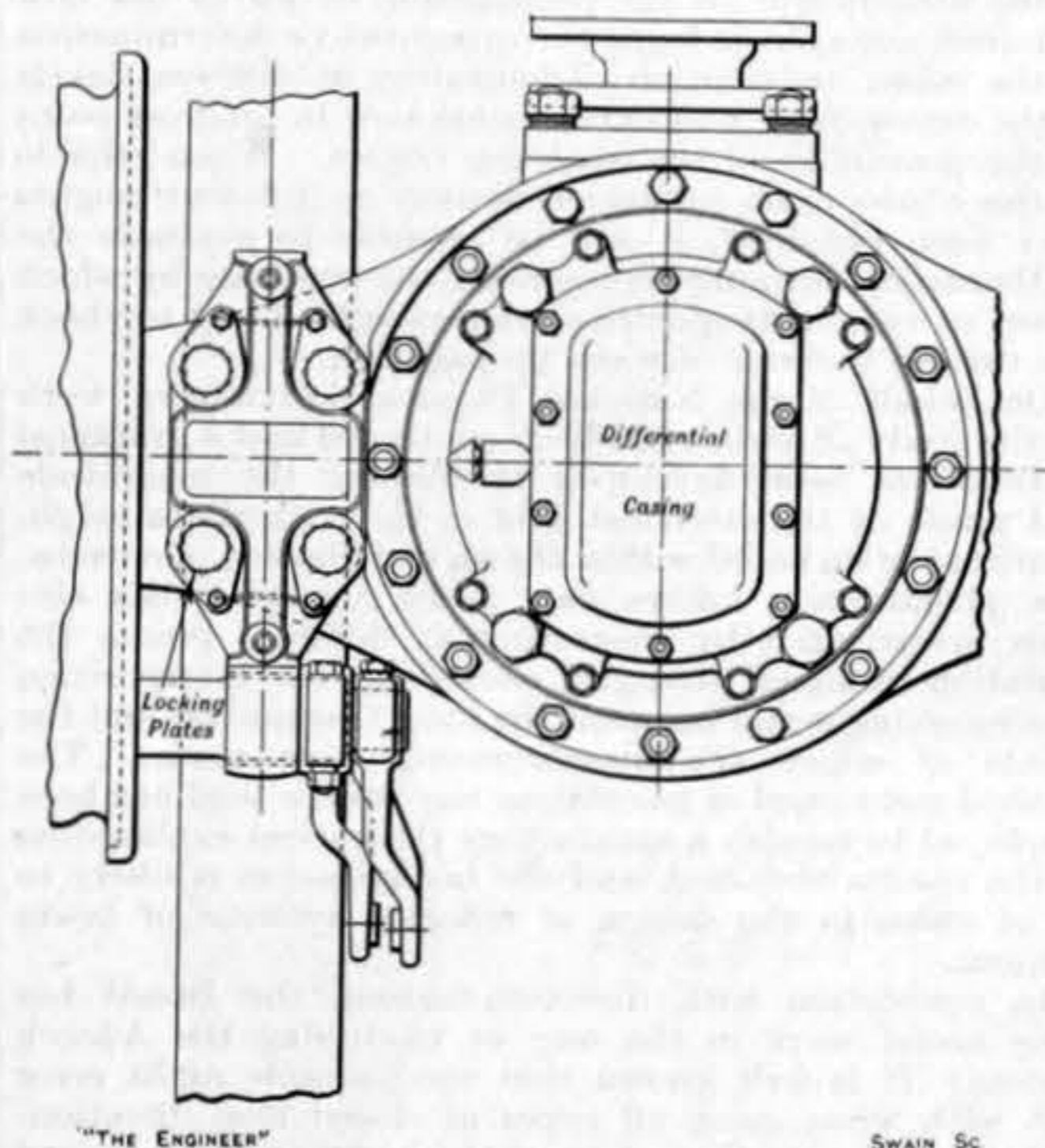


FIG. 1—SPRING ASSEMBLY AND DIFFERENTIAL

shaft from the heavy bearing pressures which would otherwise prevent the full power of the operating mechanism from becoming effective on the brake shoes. By the means employed, the same pressure can be obtained on the brake shoes with considerably less torque applied to the brake cam shaft. These advantages have been obtained whilst still retaining the conventional form of internal caliper two-shoe brake construction, which is familiar to, and therefore liked by, most operators.

The rear axle, a section through which is given in Fig. 3, opposite, is a completely new unit designed throughout to make the best of the limitations laid down by modern conditions. It is of the semi-floating type, as, owing to the high speed at which modern passenger vehicles travel and negotiate corners and bends, it is only by utilising the distance apart of the bearings on the live axles in a semi-floating axle that the bearings can, the makers claim, be made to stand up to modern conditions. In this design, the live axles are considerably larger than those fitted on any other similar vehicles and are hollow. Hence, they are about 50 per cent. stronger than the older type axles, but no heavier.

The worm shaft, shown to the right of Fig. 3, has also been treated in the same manner, and made of large diameter and hollow, giving great rigidity.

In conjunction with these hollow shafts the firm has adopted a new method of fixing the wheel hubs and driving flanges, which is shown to the left in Fig. 3. The ends of the shafts are turned parallel with a shoulder, thus making absolutely certain that driving couplings, &c., come up to the required point. The couplings are ground internally to give the desired pressure when fitted on the shaft, and circular grooves are broached inside them with corresponding semi-circular grooves hobbled in the shaft. Accurate round keys, eight in number, are then fitted, and the couplings pressed on the shaft. This method of fixing has been running under extreme conditions in various positions in Thornycroft chassis for some years, both overseas and at home, and as a result of such tests it has now been made standard practice. One great advantage which is claimed for this system as against the con-

ventional spline is that there are no sharp concave corners. Such corners, as is well known, are a great source of weakness, both on account of high local stress and also from their liability to develop cracks in hardening or heat treatment.

The weight on the live axle is supported by large diameter self-aligning double roller bearings. The brakes in the back axle are wide and particularly rigid in construction, and are so supported that the brake cams can move freely.

The axle casing itself is of hollow rectangular section, which possesses an advantage over the more usual circular section, in that it can be made stronger for a given vertical depth. In this way it has been possible to keep the vertical depth of the axle down to the absolute minimum so as to enable a lower floor line to be obtained in conjunction with great strength of axle body.

The worm gear and differential are offset from the centre line, as is usual in the modern type of passenger chassis, but the design of this part incorporates several improvements. The worm gear is mounted in such a manner that whilst the centres are small rigidity of construction has not been sacrificed. The whole of the worm casing is a unit made of a high-quality light alloy, and is bolted into the banjo axle casing. This particular construction enables the bearing caps, which, in the conventional design are separate units, to be combined in one piece so that they give each other mutual support and also makes it possible to have the whole of the worm casing, instead of the bottom cover only, made in a light alloy.

A very large amount of oil is carried in the worm casing, and a large cooling effect is obtained owing to the construction. As previously mentioned, the worm shaft is hollow of large diameter, and therefore very stiff. The worm wheel is also of massive section, as will be seen from our drawing. It is attached to a spherical differential casing, which form has been adopted on account of its great strength, the whole of the differential forming a particularly fine piece of design.

The arrangement of springs is an interesting feature. Although the worm drive has been offset in the axle, room has been found between the offset axle and the wheels for a spring of greater width than has hitherto been found possible, while leaving a proper clearance between the tires and the spring. The springs are made up of leaves 4in. wide instead of the usual maximum of 3½in. In order to enable this width to be fitted a change in construction was found necessary. The normal spring anchorage consists of four large diameter bolts of sufficient power to both anchor the springs and to resist the added stress caused by the spring tension in the area between the bolts. In order to take care of the stress set up by the flexing of the spring during movement on the road the spring is cramped up in a detachable stamped alloy steel spring box, the box itself being held to the axle by four alloy steel bolts. These bolts are therefore not called upon to sustain the large stress variations, which are incidental to ordinary spring bolts, and can also be so arranged as to take up considerably less room than bolts as fitted in the normal design. This is clearly shown in Fig. 2 and Fig. 1, the latter view clearly indicating the arrangement of the spring box alongside the differential casing and the locking plates for the bolts. Another novel feature we noted was the spring ends. The top leaf and the third leaf are carried over and under the eye of the suspension, which is incorporated in the second leaf, the two ends being connected by a clip, a form of construction giving added support to the spring. The leaf locating lugs and the wedge piece in the spring box are shown on the drawing of the spring assembly in Fig. 2. A useful provision in the chassis is the concentration of the grease gun connections to all parts at two points at either side of the chassis, which are brought out to the full chassis width and are covered with a rotating brass plate.

Space will only enable us to deal quite briefly with the propelling drive and the engine. The transmission shaft is furnished with a flexible coupling of a new type with two discs of flexible material on either side of the driving and driven spider. This coupling is placed next the gear-box, and in this position it gives very smooth running. The after portion of the propeller shaft is carried by two universal joints enclosed in metal covers.

The gear-box and change speed gear is of the straightforward type, with very large diameter shafts and bearings, and gear changing is quite a simple and light operation. The following gear ratios have been adopted:—Fourth, 1:1; third, 1.52:1; second, 2.40:1; first, 4.48:1; and reverse, 5.48:1. The clutch also is new in design and is furnished with easy lubrication. In Fig. 4 opposite we show two sectional views of the engine, which is the outcome of research work at Basingstoke, carried out with a view to evolving a trouble-free motor, with simple maintenance requirements. It is of the six-cylinder overhead valve pattern, with a bore of 4½in., or 111 mm., and a stroke of 5½in., or 133 mm. It has a designed output of 85 to 98 horse-power and a Treasury rating of 45.9 horse-power, the cubic capacity being 474 cubic inches, or 7759 c.c. The overhead valve arrangement gives ease for valve grinding or decarbonisation, and a spare head with ground-in valves can be fitted without having to adjust the timing mechanism. All the auxiliary units which

THORNYCROFT OMNIBUS CHASSIS—AXLES AND ENGINE

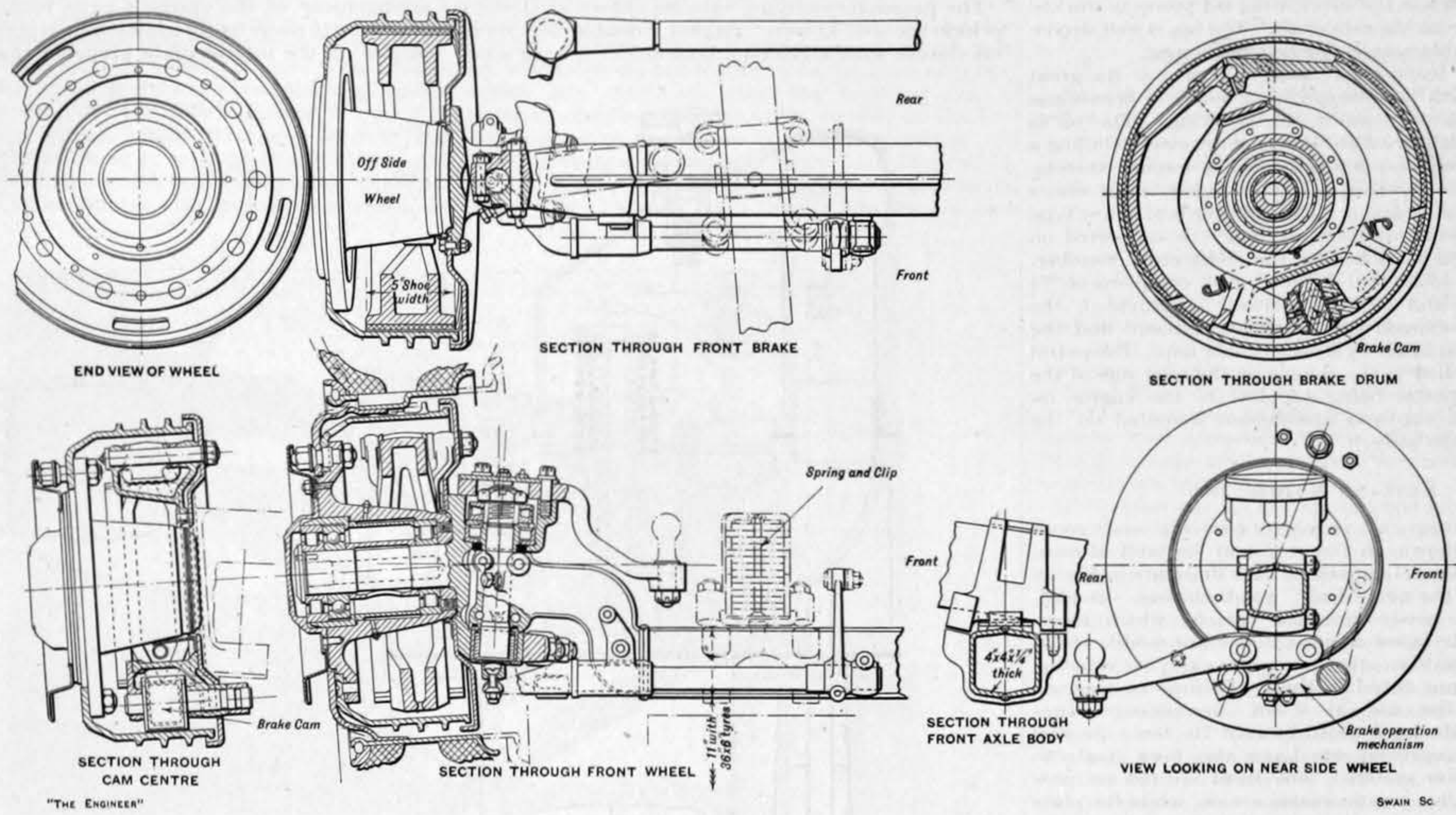


FIG. 2—DETAILS OF FRONT AXLE

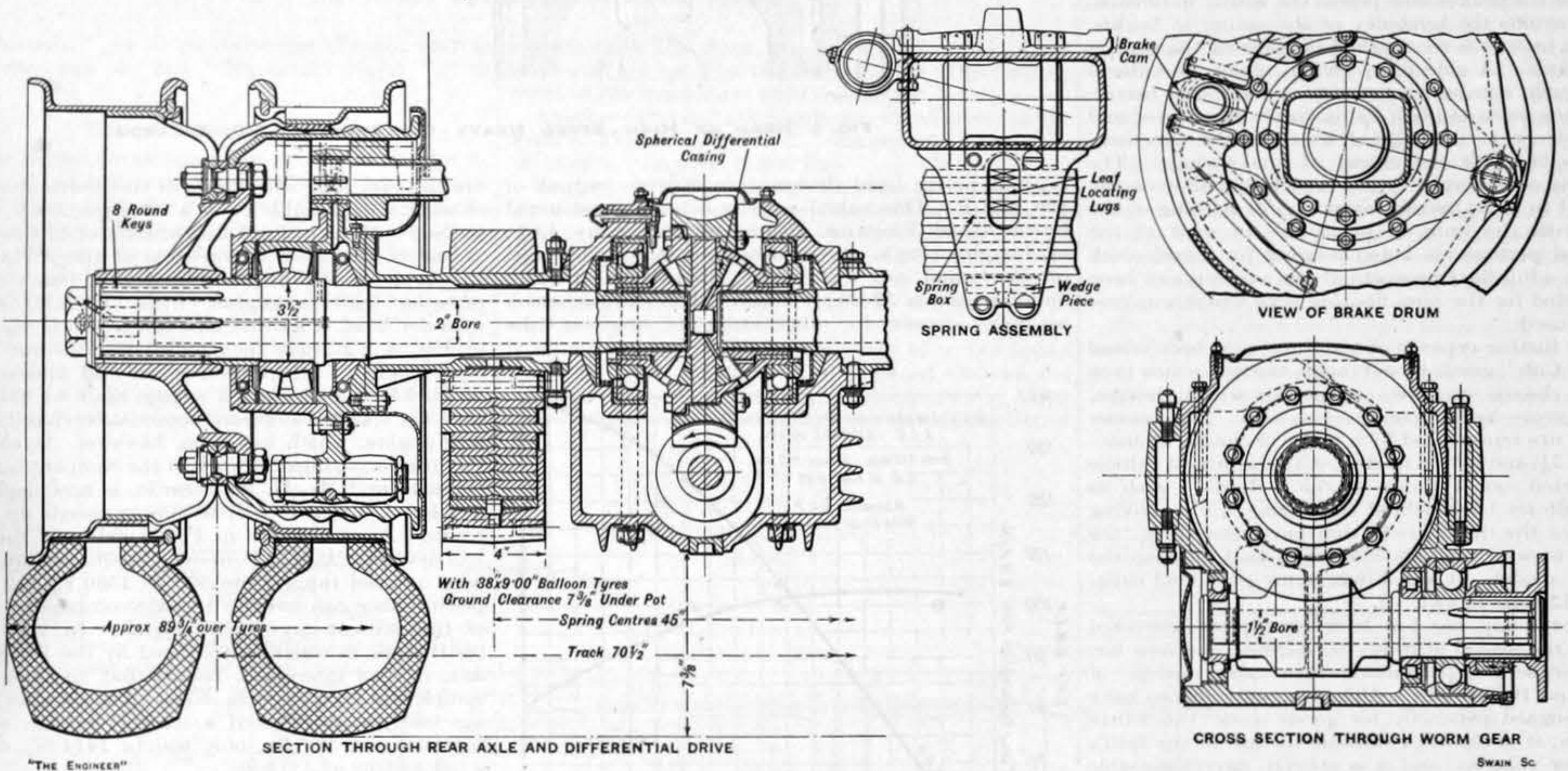


FIG. 3—DETAILS OF BACK AXLE

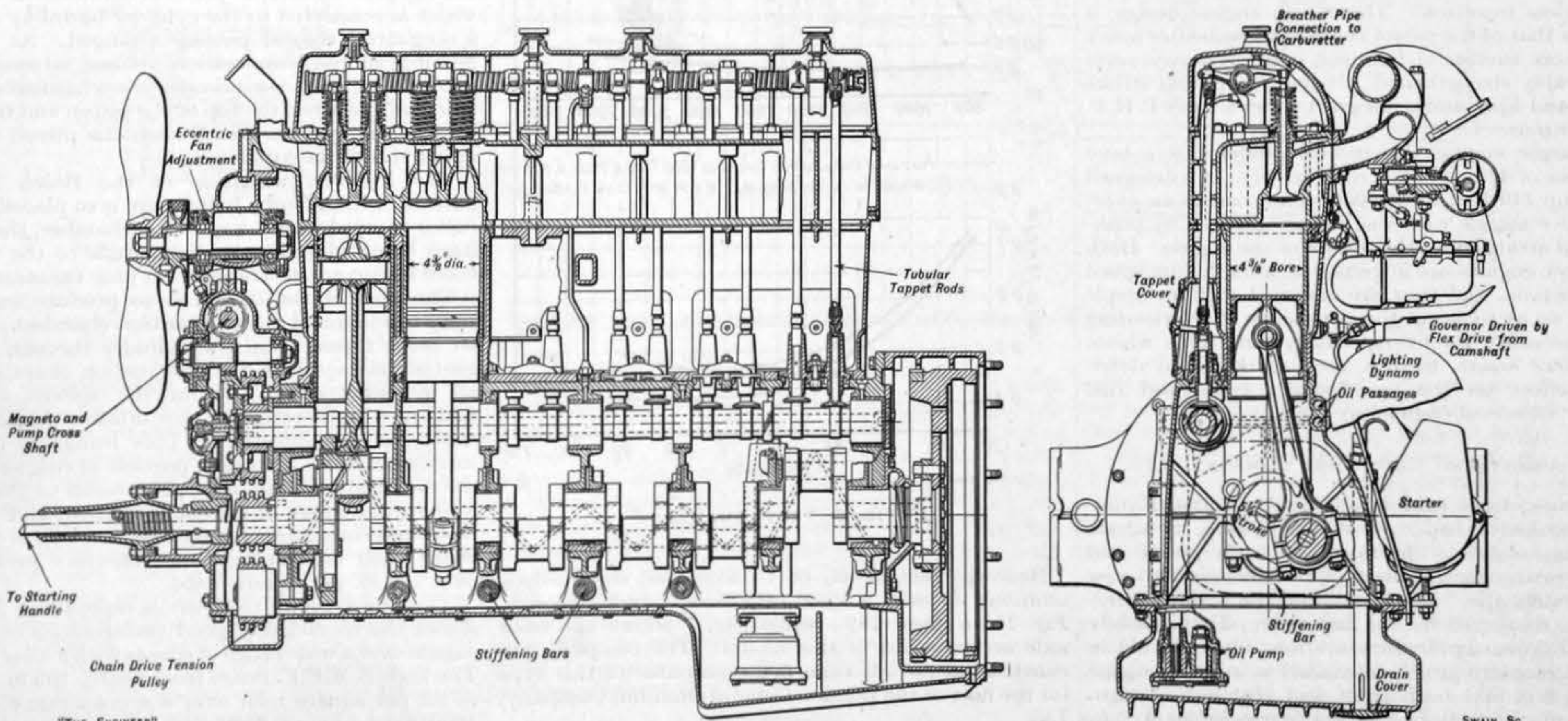


FIG. 4—SIX-CYLINDER PETROL ENGINE

require attention are attached to the near side of the engine, leaving the off side clear for a passenger chassis of the forward control type. The water pump and the magneto are driven by an accessible front cross shaft, while the lubricating oil pump is worked by gearing from the cam shaft. The fan is belt driven with adjustable centres for belt tensioning.

A special feature of the crank case is its great rigidity, which is obtained by a series of transverse stiffening bars, shown in our drawing. The oil is passed through two dirt collecting devices, including a magneto filter, and is also cooled in circuit, thereby allowing a fairly thin oil to be used, with easier starting in cold weather. The radiator is of a new type of quite pleasing appearance, and it is supported on rubber buffers attached to the front cross member. A floating dashboard with a full complement of instruments and lighting controls is provided, the connection between the floating dashboard and the radiator being made by a neat rubber flap. The petrol tank is attached to the chassis on the near side of the frame, the petrol being supplied to the engine by means of an auto-vac attachment mounted on the near side of the body.

LEYLAND MOTORS, LTD.

A wide range of passenger-carrying and goods vehicles is shown on the stand of Leyland Motors, Ltd., of Leyland, Lancashire. We illustrate in Fig. 10 on page 492 the new "Cub" goods chassis. In addition to the newly designed vehicle, which incorporates all the latest designs, important modifications have been made to other passenger-carrying vehicles. The new frame fitted to these machines is designed to permit the use of 9.0in. low-pressure tires well within the legal width limit of 7ft. 6in. Several additional improvements have also been made to the suspension system. The front springs are now set so as to give greater castor action, while the plate stress has been reduced by the anchoring of the spring at its front end and its shackling at the rear; the application of the brakes now places the spring in tension, and so avoids the tendency of the spring to buckle. Another feature is the method of securing the springs to the axle. A side plate fixing, which provides a very much sturdier construction than the better-known top plate and bolt fixing, has been adopted and its construction is designed to allow the necessary freedom of plate movement of the springs. The mounting of the brake drums is such that they can be removed so as to permit inspection or relining of the shoes with the hubs in position. In view of the increased permissible laden weights for double-deck vehicles, a full-floating worm-driven axle has now been substituted for the semi-floating type which was previously used.

Three further types of chassis have now been added to the "Cub" goods model range, the first a side type control chassis and two others six-wheel designs, with a gross load capacity of 4 tons. The heavier vehicles are represented by a range of chassis embracing 4, 6, 7½, and 9½-ton models, with the largest vehicle a bonneted model known as the "Rhino," with its front axle set back behind the engine. The driving axle is of the double-reduction bevel gear type, the gearing of which is very similar to that used on the "Bull" model. It has a maximum gross load capacity of 12 tons 10 cwt.

The company has for some time past interested itself in the design of heavy oil engines, and now has in experimental production two new models of 8-litre and 10-litre size. Although both engines have been designed primarily for goods work, the 8-litre engine is, it is claimed, suitable for use in the firm's passenger vehicles, and it is strictly interchangeable in the chassis with the firm's standard petrol engine. Both engines are of the compression-ignition type, with airless injection. The 8-litre engine design is based on that of the petrol engine and embodies many of its more successful features, with necessary parts considerably strengthened. It has a bore and stroke of 4½in. and 5½in. and is designed to develop 90 B.H.P. at 2000 r.p.m.

The larger engine, the 10-litre model, has a bore and stroke of 4¾in. and 6in. respectively. It is designed to develop 110 B.H.P. at 2000 r.p.m., and is an overhead valve engine with the valves operated by push-rods, and arranged on the offside of the engine. Both of the new engines are governed at a maximum speed of 2000 r.p.m., and they are designed with an ample capacity so as to avoid the possibility of overloading or the necessity for overspeeding, conditions which, the makers assert, have a very marked and detrimental effect on the maintenance costs and fuel economy of an oil-engined vehicle.

THE ASSOCIATED EQUIPMENT COMPANY, LTD.

A feature of the exhibits of the Associated Equipment Company, Ltd., of Windmill-lane, Southall, Middlesex, is the wide range of both goods and passenger-carrying vehicles. These include two new goods models, the "Matador" and the "Mandator," which are displayed for the first time. They embody all the improvements which are now incorporated in the most recently produced models as regards engine and gear-box and both front and rear axle design. The first unit is equipped with a four-cylinder A.E.C. 80 B.H.P., 2400 r.p.m. engine, and the second with a 120 B.H.P. engine running at the same speed. The

firm is also showing all types of vehicles which have been introduced during the last two years, including the high-duty "Mammoth Major," 120 B.H.P., 12-ton lorry.

The passenger-carrying vehicles shown at Olympia include the well-known "Regent" double-deck omnibus chassis with a 110 mm. bore engine having a new

increased stability with a frame width of only 5ft. The three servo-motor operated brakes give a total braking area of 875 square inches, which is distributed over twenty brake shoes, while a special arrangement of the spring torque blade allows the rear axles to move freely while eliminating any extreme angles on the intermediate propeller shaft couplings

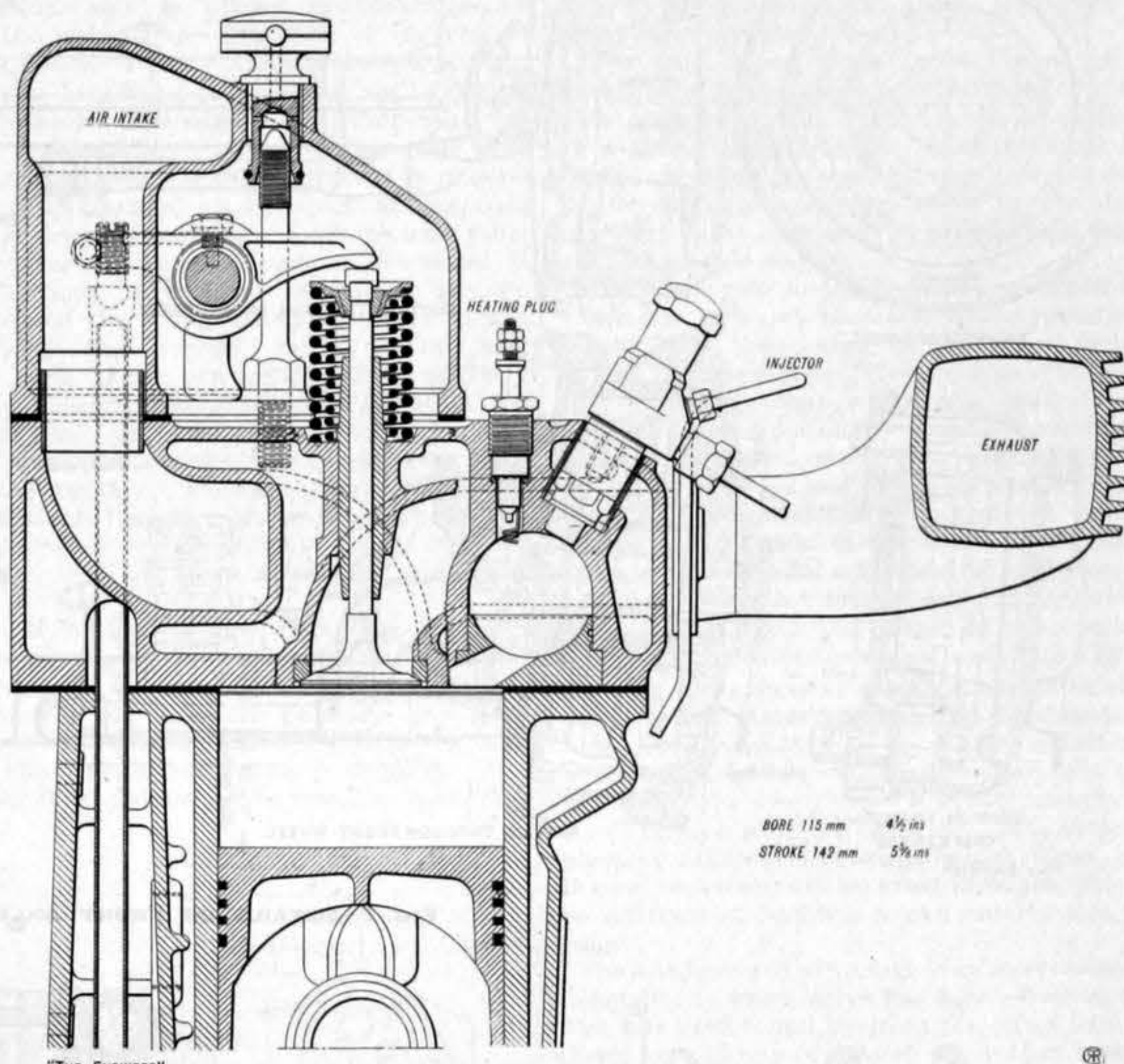


FIG. 5-HEAD OF HIGH-SPEED HEAVY-OIL ENGINE-A.E.C.-RICARDO

type of power head designed to give an output of 120 B.H.P. This vehicle carries a body constructed by the Brush Electrical Engineering Company, Ltd., of Loughborough. Two other models to be seen on the stand are a "Regal" single-deck 32-seater omnibus and a 32-seater coach. The exhibit which we have chosen for illustration is, however, the

On the very long wheel base of this particular type of chassis, it is possible to fit a 72-seater body, and yet to keep within the legal weight limit of 12 tons.

One of the great attractions of the A.E.C. stand will undoubtedly be the new A.E.C. heavy-oil compression ignition engine, with an A.E.C.-Ricardo cylinder head, a section through which is reproduced in Fig. 5. It may be recalled that in our issue of November 7th last we described and illustrated the 95 B.H.P. high-speed oil engine built by the A.E.C. with an "Acro" auxiliary combustion chamber. The new engine, which has been, however, developed by the joint experimental work of the company's research engineer and Mr. H. R. Ricardo, is now designed to develop 130 B.H.P. and to run at speeds up to 3000 r.p.m. As the curves in Fig. 6 indicate, the engine will develop a B.M.E.P. of over 100 lb. per square inch over a speed range from 500 to 1500 r.p.m., and its performance can now be directly compared with that of the present-day petrol engine. In view of the restrictions in weight introduced by the Road Traffic Act, it is of interest to record that the new engine, complete with its fly-wheel and all accessories, including two generators and a starting motor, weighing together over 200 lb., only weighs 1414 lb., or it has a net weight of 1214 lb.

As our drawing indicates, the new cylinder head is arranged to contain a spherical combustion chamber, which is connected to the cylinder barrel by means of a tangential conical passage arranged. As much as possible of the compression volume is contained in this sphere, only the necessary mechanical clearance being left between the top of the piston and the underface of the cylinder head when the piston is at the upper end of its stroke.

The injector, which is of the Bosch standard pattern, with a Bosch fuel pump, is so placed that the fuel is sprayed into the spherical chamber, the injector itself being placed at a slight angle to the vertical; there is also an electric heating plug for starting.

The idea of the design is to produce an orderly swirl of the air in the combustion chamber. The air, on being forced from the cylinder through the tangential passage into the combustion chamber, takes up a rotary action within the sphere, and thus flows at a rapid rate past the injector nozzle during the period of injection. This brings a continual supply of fresh air to each particle of fuel as it enters the combustion chamber. As a result of this action, a high percentage of the air is utilised, and the combustion is complete. A very clear exhaust is obtained, even when developing mean effective pressures of over 100 lb. per square inch.

The upper group test curves reproduced in Fig. 6 shows the remarkably good performance of the new engine over a wide range of speeds with a clear exhaust. The high B.M.E.P. range from nearly 103 lb. down to 85 lb. per square inch over a special range of about 1000 r.p.m. up to 2400 r.p.m. is noteworthy, while the three fuel consumption curves at speeds of 1000, 1500, and 2200 r.p.m. respectively, reproduced in the

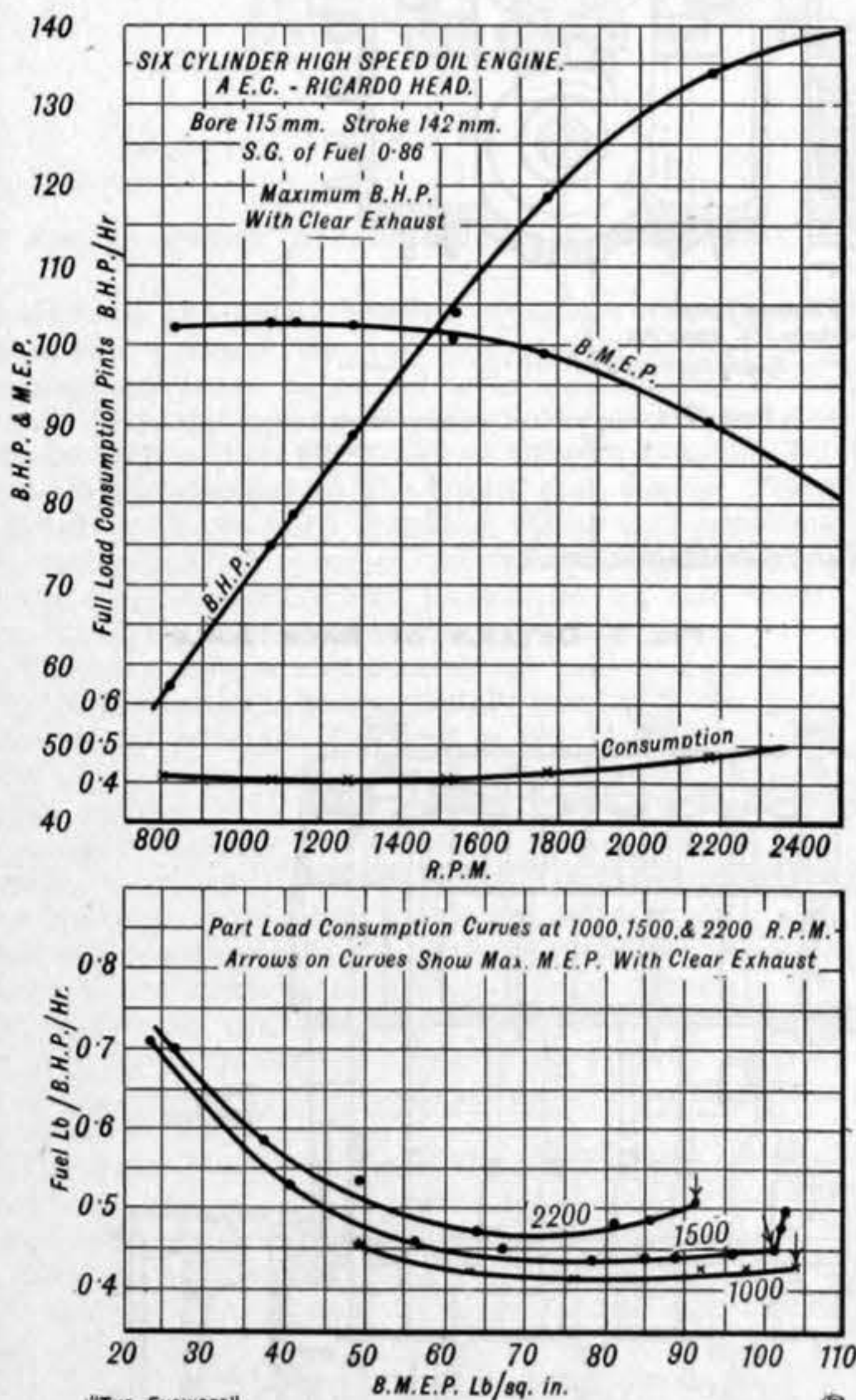


FIG. 6-TEST CURVES

"Renown" six-wheel, 60 to 65-seater, double-deck omnibus chassis, a view of which is reproduced in Fig. 11 on page 492; while Fig. 7 shows the back axle arrangement of this model. The company has constructed no less than 500 omnibuses of this type for the fleet of the London General Omnibus Company, Ltd.

Special points of the chassis are the use of single springs on either side, and single-tired wheels giving

lower part of our drawing, show a practically constant fuel consumption over a range of B.M.E.P. extending from 60 lb. to 100 lb. per square inch.

The outstanding feature of the engine is the fuel economy obtained. The consumptions of oil in actual service taken from some sixty vehicles fitted with high-speed oil engines, now shows from 75 to 95 per cent. improvement over those obtained with similar vehicles running under the same conditions, but using petrol. In ton-miles per gallon, figures of over 170 have been achieved, whilst instances of over 150 ton-miles per gallon as an average over a distance of 10,000 miles have been on certain occasions recorded.

The new oil engine is also shown incorporated in

The drawing Fig. 8, above referred to, shows the Hardy four-wheel drive four-cylinder model which has a designed carrying capacity of 4 tons. A four-cylinder A.E.C. engine is fitted with a unit type gear-box which, together with the reducing gear-box, increases the total number of speeds to eight forward and two reverse. Both the front and the rear axles are worm driven, but the drive to the front axle only comes into operation when the reducing gear is engaged, and then automatically, so that on the four low gear ratios the vehicle is four-wheel driven. At 2000 r.p.m. the road speeds range from 26.4 m.p.h. to 3.2 m.p.h., the corresponding overall gear ratios being 8.25 : 1 and 67.3 : 1. Single 36in. by 8in. tires

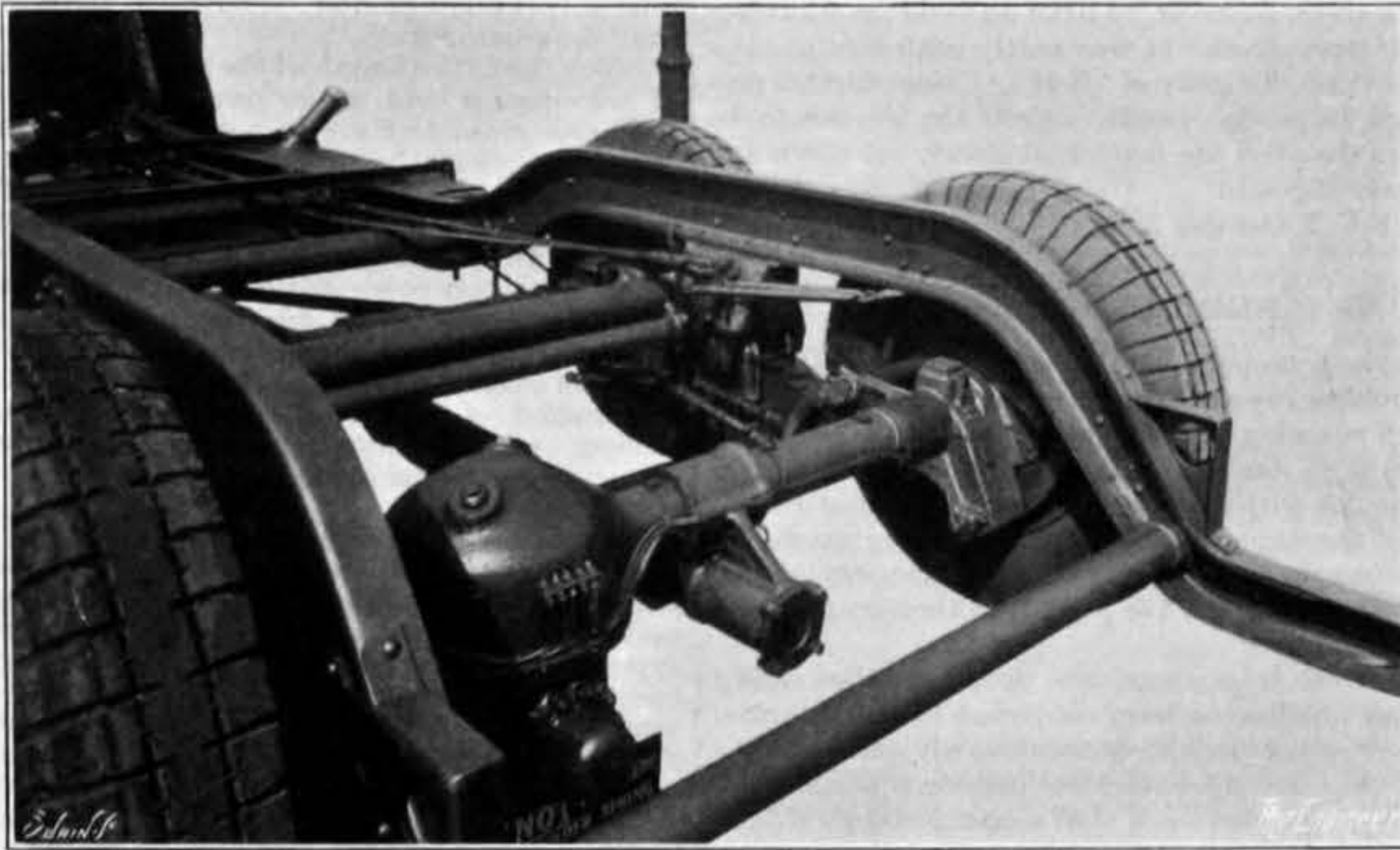


FIG. 7—SIX-WHEEL CHASSIS REAR AXLES—A.E.C.

the "Renown" six-wheel passenger chassis, and as a separate unit on the "Mammoth Major" float lorry.

HARDY MOTORS, LTD.

A new British invention which will be of interest to all users of heavy motor transport is exhibited on the stand of Hardy Motors, Ltd., which firm is allied to the Associated Equipment Company, Ltd., of Southall, whose exhibits we have just described. It is known as the Hardy patented auxiliary front wheel drive and is incorporated in all vehicles made by that company.

The object of the invention is to give additional tractive effort and power to a lorry and so enable it to negotiate soft ground and bad roads when necessary, or to climb steep hills with heavy loads. It

are fitted on the front wheels and twin tires of the same size are used on the rear wheels. The tractive effort of the machine is 6200 lb.

Another exhibit is the Hardy six-wheel drive tractor with a 124 B.H.P. A.E.C. engine and a tractive effort of a little over 17,000 lb.

On page 492, Fig. 12, we illustrate the company's latest model six-wheel drive chassis designed to carry 8 tons either on normal roads or across country. It is also intended to haul a trailer and is fitted with the latest type A.E.C. high-speed six-cylinder 130 H.P. oil engine. A main gear-box of the unit type with a single-plate clutch is provided, and the drive is taken by a short propeller shaft to a two-speed auxiliary gear-box which is so designed that on the direct drive only the rear bogie is driven, while, when the low range of gears is engaged, the front wheel drive

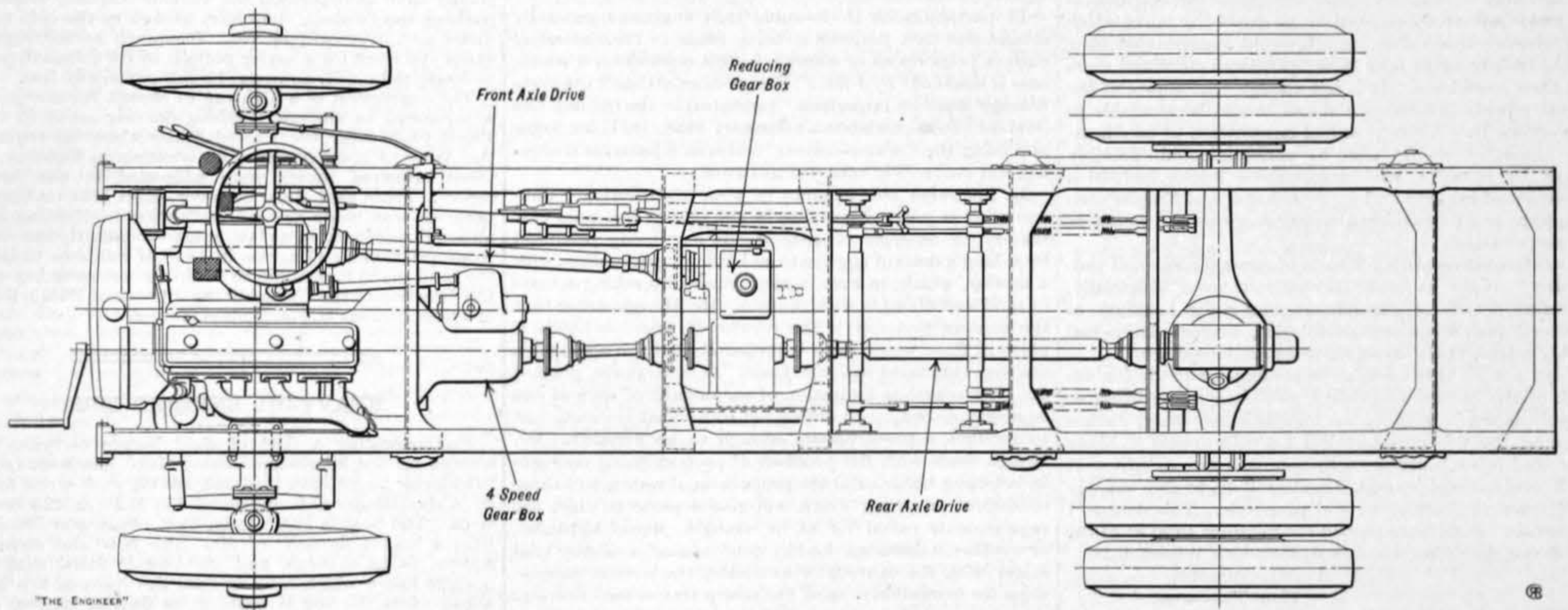


FIG. 8—CHASSIS WITH AUXILIARY FRONT-WHEEL DRIVE—HARDY

consists of a combination of extra low gears with an all-wheel drive. In actual practice it is not used when driving over good roads at high speed, because then the vehicle operates as a standard A.E.C. chassis. When, however, bad roads or steep hills are encountered the driver engages an extra low gear ratio which automatically engages the drive to the front wheels and makes them power driven. All driving stresses are distributed over both axles, which greatly reduces the strain on the chassis, and soft ground and bad obstacles are easily negotiated. The arrangement of the drive is illustrated in Fig. 8. The value of such a principle is most important when a vehicle has to operate under varied road conditions, as the load that can be taken is always limited to that amount which can be carried over the worst section, regardless of however good the rest of the road may be.

comes into operation. The rear bogie, which is worm driven, is newly designed and it is mounted on two springs only. The front axle, which is also worm driven, is built up of a solid forged casing, with worm-driven differential assembly, generally similar to that on the rear axles, the drive being taken to the front wheels through universally jointed shafts. The two ranges of gears provide eight forward speeds, with overall ratios varying from 8.25 to 1 to 67.3 to 1, and road speeds at 2000 r.p.m. from 28.4 to 3.5 m.p.h. The driver's position is alongside the engine, and the body space is 19ft. 8in.; 38in. by 9in. single tires are fitted throughout and the vehicle has a designed tractive effort of 8900 lb.

(To be continued.)

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

THE STANDARD OF WAGES.

SIR,—A valuable suggestion is contained in the letter which you print from Mr. R. Gaudin (October 30th), that our commercial and financial problems ought to be studied in the methodical manner in which an engineer studies an engineering problem. Neglect of this precaution is everywhere conspicuous.

A leading example of the planning of a country's future is to be seen in the Nile Valley. A series of irrigation proposals have shown us that hydraulic engineers can allow for political considerations, reducing them to a variable not more inconstant than the weather, and can also make good their claim to the immediate and close attention of politicians.

Is the Nile too simple to present an analogy? I doubt it. Our commerce follows, metaphorically, four main streams, with interactions between the second and third, but, to a large extent, separate—agriculture, shipping, minerals, and textiles.

Fifty years ago we had an inherited prejudice against interference with trade by governments. It was recognised that unfettered competition inflicts great hardships, yet it was believed that competition promotes efficiency. Phrases introduced by Charles Darwin about "the struggle for existence" and "the survival of the fittest" and "the extinction of the less improved" were accepted as applicable, by analogy, to commerce. (Egypt was then in the "basin irrigation" stage, and in a sad mess at that.)

Since the European War, our experiences of Government interference have done nothing to create confidence. We have an immense capacity for production, coupled with an immense failure to distribute either labour or the products of labour where they are wanted. What are the best instruments hitherto invented for moving those things of a few simple kinds which are wanted in large quantities? The answer is evident—ships and railway trucks. Our successive Governments have wilfully penalised the owners and users of ships and railways, and have poured out money like water for constructing motor tracks which can only distribute luxuries, and cannot carry the weights and quantities of materials and commodities required for common use.

Again, what are the most important of our industries? Since we live on an island, food production and shipping. Now, more than a million new dwelling-houses have been built in England since the European War, partly or wholly at Government expense, and hardly one of those houses is so situated that it could be used by any farm worker, or any waterside worker.

The recital of such Government follies could be amplified indefinitely. Looked at from the reverse side, they are, in a way, hopeful, since they show how great are the improvements which can be introduced so soon as men with the training and habit of mind of practical engineers

take our problems in hand. The stresses of commerce are not more unknown than the stresses dealt with in the construction of the Sydney Harbour Bridge.

It is quite unnecessary to suppose that the American doctrine of high wages has been discredited. So soon as distribution and local production of local needs can be brought to an equal efficiency compared with centralised production, there is no reason why the wage-earner should not have as much of what he wants as the man in a good salaried position gets to-day. Our standard of living need not remain below that of most European countries, and in passing I would like to attack the fallacy that French or Italian workmen live a rougher life than English workmen. The English workman and his family are, as a rule, worse housed and worse fed.

Currency is a matter of convenience. The precious metals are usually convenient for currency, because gold,

and in less degree silver and copper, apart from other qualities, are pleasant to look at, and people who have secured their own livelihood, if they still have some spare energy, will always everywhere exert themselves to obtain decorative materials. But, if gold is going to fluctuate widely between scarcity and comparative abundance, gold ceases to be any better than diamonds for currency purposes, and any enduring substance in wide demand becomes equally or more convenient. It is possible that such a substance might be one of the standard qualities of iron, as suggested by the late Sir Joseph Calvert, of Middlesbrough.

E. PEASE.

Middlesbrough, November 3rd.

BOILER TUBE EXPANSION.

SIR,—I read in a recent Board of Trade report that an accident happened to a comparatively old water-tube boiler on account of "a shortening of the effective length of the tube due to excessive curvature arising from working conditions. The resistance of the expanded end in the header was not sufficient to prevent its withdrawal."

Does not this statement represent a serious indictment of the broad principles of our boiler designers, and leave one with the idea that water-tube boilers are still unmechanical arrangements?

Thornycrofts started with the assumption that it was necessary to make the tubes of a boiler curly, so that they could accommodate themselves to expansion and contraction. Yarrows and others said make the tubes straight and fix them into the drums so strongly that they will not pull out, and, incidentally, secure the advantage of being able to look down the length of a tube to see that it is in proper order. Then, that matter was rather important, as boilers were often fed with impure water and frequent scaling was imperative.

Now, however, with good feed water the convenience of a straight tube, as regards cleaning, has been minimised, but the risks of mechanical failure have been increased by higher pressures and temperatures.

Boiler tubes are habitually expanded and bell-mouthed in plates and headers with the object of holding them in place, but those operations must, obviously, stress the material beyond the elastic limit and there is no possibility, as things stand at present, of normalising the metal again after the tubes have been put in place. The tubes must, palpably, be weakened locally by the processes of expansion and belling, so they must, in general, be made stronger than is necessary to withstand the ordinary working conditions, while the plate also is stressed.

Such thoughts are, of course, elementary, but the design and manufacture of boilers persists on the same general lines as those of thirty years ago. Is it not time that some attention was given to a more comprehensive consideration of the attachment of one part of a boiler to another?

London, November 3rd.

FUMAROBLE.

INDUSTRIAL PEACE.

SIR,—Now that this country has acquired a new horizon in the landscape of political, Imperial and economic vision, it is to be earnestly desired that such an horizon may also dawn upon industry.

Much may be done by those who guide the destinies of our great industrial corporations to dispel the mists which may obscure this vision, and I would suggest that they should endeavour to take their operatives more and more into their confidence. It is not enough that copies of the annual reports and balance sheets should be available to all workers, but, where possible, information of an educative character should also be communicated, possibly month by month; such information might include a barometer of imports and exports, home and Empire consumption, and a considered commentary on the causes of the rise or fall.

A statement regarding "costs of management and production" might be made annually or even biannually, providing details of expenditure under the headings of directors' fees, management salaries, average individual weekly wages, State taxation, rates and insurance.

I am not on this occasion appealing for funds for the work of the Industrial Peace Union—my name being so actively taken in vain by the energetic Secretary, Arthur Bowman, for this purpose—but I would appeal to those interested in such problems to approach him as editor of the Union's official journal, *The New Way*, to give voice in the journal to their views and proposals. This course, I am certain, would have earned the vigorous support of the founder of the union, the late J. Havelock Wilson, C.H.

V. A. MALCOLMSON,

Hon. Treasurer,

Industrial Peace Union of the British Empire.
November 3rd.

"THE TRAGEDY OF 'R 101.'"

SIR,—Your reviewer of my "Tragedy of 'R 101'" describes me as "a well-known and self-avowed opponent of the airship in general." I should like to take the opportunity to correct this impression.

It is quite true that I have consistently opposed participation of the Government in a highly speculative commercial enterprise, also that I am of opinion that the rigid airship can never be a commercial proposition for passenger carrying purposes. Further, it is true that, since I had opportunity, in 1927, to discuss the ideas and ideals which formed the bases of the construction of "R 100" and "R 101," I objected to the basis of design of each of these ships.

It is far from true, however, that I am "a self-avowed opponent of the airship in general." I stated, as long ago as 1927, that I believed that the "Graf Zeppelin" would

be a technical success. I have also stated, in writing, that I believed that the new American ships would be technically successful. The designs of these ships are the result of sound evolutionary progress in ideas and practical development. The "R 100" and "R 101" were enormous experiments based on principles which I have criticised as unsound.

May I say that I should not be at all surprised to see the rigid airship playing a useful part in modern civilisation, not as a passenger carrier, but as a craft designed and intended solely for the carriage of a limited weight of high-speed mail?

Nothing would give me greater pleasure than to cooperate with rigid airship enthusiasts in exploring the possibilities of developing small fast rigid airships, capable of carrying from 2 to 5 tons of special mail over long distances, such ships, however, to have no facilities whatever for carrying passengers. It was partly with this in view that I wrote "The Tragedy of 'R 101,'" since further progress cannot be made soundly unless the lessons to be learned from disasters are first of all clearly set down and then properly digested.

E. F. SPANNER.

London, E.C. 3, October 29th.

RIMMING STEEL.

SIR,—At the bottom of page 369 of your issue of October 9th, in a footnote, is the expression of a wish that a clear definition of rimming steel might be had.

This steel is so named from the fact that when cast in open-top moulds without covers it begins freezing around the edges of the exposed surface, this freezing extending slowly out into the centre in much the same way that a small pond freezes around the edges and then out into the centre.

Rimming steel is distinguished from so-called killed steel through not having been subjected to the action of aluminium or other deoxidiser customarily put into the ladle or mould. Its characteristics include a deep-seated condition of blow-holes, such that a heavy, tough skin is available. It is particularly useful for steel sheets, especially those employed in the automobile industry.

It has been found possible so to control this action of rimming and its coincident location of the blow-holes as to place the latter on almost any desired point beneath the surface of the ingot, and thus obtain such qualities in the resulting steel as may be desired. There is a continual evolution of gas from an ingot so cast, resulting in a small fireworks display, somewhat of the geyser type. For this reason the ingot is particularly clear of pipe, although the immediate portion at the top becomes somewhat spongy.

This is pretty much a popular description of what the term means, but I hope you will find it useful.

SIDNEY G. KOON.

New York, October 23rd.

MODERN CONCRETE.

SIR,—There will be many readers of *THE ENGINEER* who hope that expert replies will be forthcoming to the questions raised in a letter in your issue of October 30th signed "Concrete."

In particular, it is desirable that engineers generally should feel that progress is being made in the control of correct proportions of water. In this connection a strong case is made out by John F. Hough in an article "Concrete Storage Must be Imperious," published in the *Oil and Gas Journal* (Tulsa, Oklahoma), January 29th, 1931, for fixing and using the "water-cement" ratio as a basis for designing and controlling concrete mixtures.

In line with the remarks of your contributor "Concrete" it is pointed out that in the past it has been customary to conceive of concrete as something produced by taking a mass of aggregate and filling its interstices with a mortar, which, in turn, was produced by taking a mass of sand and filling it with cement. Mr. Hough states that the modern principle is the reverse of this. A batch of paste of fixed water ratio is prepared, and the aggregates are then combined with the paste. It is, however, pointed out that complete hydration of an amount of cement can be accomplished by an amount of water that is insufficient to produce a paste plastic enough to be handled. Mr. Hough deals with the problem of proportioning concrete by selecting beforehand the proportion of water, and those conditions of curing which will give a paste to meet the requirements called for as to strength, liquid tightness, or weather resistance; and by determining on site by trial mixes with the aggregates available, the correct proportions for workability, using the slump test as the criterion.

A. C. VIVIAN.

Potters Bar, Middlesex, November 3rd.

The Mount Vernon Memorial Highway.

A ROADWAY, planned as the most advanced example of modern highway construction in the United States, and to be called the Mount Vernon Memorial Highway, is being built between Washington and the ancestral home of George Washington. It is to constitute a memorial to the first President of the United States and Generalissimo of the American Revolutionary Army, and it will be dedicated in April, 1932, that year marking the bicentennial celebration of his birth.

Over virtually its entire length of 15½ miles, the road skirts the Potomac River, passing through country which is rich in historic memories of Washington, and while special attention has been given to engineering and construction features, no less emphasis has been placed upon the scenic

advantages which the route will provide. Slightly more than one-sixth of the entire length of the highway, or 2½ miles, has been constructed over hydraulic fills. Millions of cubic yards of material were pumped into place and special engineering features have been incorporated into the design of the road as it passes over those stretches to counteract any settling that may result in the future. These "fills" were constructed by the Corps of Engineers of the United States Army, at a cost of approximately 1,300,000 dollars, after a tender amounting to about 1,900,000 dollars had been rejected. The United States Bureau of Public Roads is in charge of the construction work on the highway.

While the road surface is only 40ft. wide, the right of way that has been acquired by the Government extends in many places 400ft. from the centre of the thoroughfare. This depth was, it was considered, needed to provide proper surroundings and, incidentally, to prevent the erection of unsightly buildings and advertising signs which would spoil the scenic effects.

Along the entire length of the road, there is to be a series of over-passes and under-passes, which will virtually eliminate cross traffic. In sections in which residential developments in the neighbourhood give promise of the origin of a fair volume of traffic, parallel roads on one or both sides of the highway will collect that traffic and lead it to certain points for access to the main traffic route. These collection roads are designed to prevent inflowing cars from entering the highway at frequent and short intervals and thereby disrupting the main flow of vehicles. The over and under bridges along the route have all been constructed of reinforced concrete, excepting one steel railway bridge. In constructing the pavement two materials are being used, Portland cement concrete and bituminous concrete.

Along the route, where the scenery might prompt the traveller to stop, provision has been made for cars to be parked. At some of these points islands will separate the parking space from the main artery, while at others the expedient of adding extra width of continuous road surface has been resorted to. Omnibus stops have also been arranged for by widening the roadway at certain points. To accommodate motorists at the Mount Vernon terminus, parking space for some 350 private cars and 60 omnibuses will be provided, the two areas being separate. The traffic is reversed at the terminus by means of a circular parkway, from which lead several lateral roads, alongside which parking space is available. The land at the terminus has been laid out with a view to shielding the standing cars from sight and so as to produce a park-like appearance. To accommodate any overflow traffic on special days, an emergency parking area has been acquired which will accommodate 1500 cars.

While engineers from the Bureau of Public Roads at present do not envisage any need in the near future of widening the roadway, which will accommodate four lanes of traffic, over most of its length the width may be increased if necessary without extensive operations.

Plans for the celebration of the bicentennial of the birth of George Washington have been in progress for a number of years. The entire year of 1932 will be devoted to the celebration, which will be national in scope. Many visitors from all states of the Union, as well as from all parts of the world, are expected to be attracted to Washington throughout the year. The dedication of the highway will take place at a time when thousands of visitors will be in the national capital, and it is expected that from the beginning the road will have a heavy volume of traffic. It is to carry that volume of traffic with both the utmost speed and safety that engineers from the Bureau of Public Roads have incorporated the various omnibus stops and parking spaces along the route, as well as the side roads, under and over bridges, &c. Inasmuch as the highway skirts the river for a major portion of its distance, points of cross traffic will, however, be comparatively few.

The conception of a highway to Mount Vernon built as a memorial to George Washington originated in 1886. Three years later the United States Congress requested the Army to make a survey for a memorial highway, and three principal routes were suggested in the Army's report. From that time, however, until 1928 no tangible progress was made toward realisation of the memorial, although sentiment in its favour kept constantly increasing. Appropriation by Congress in 1928 of funds to construct the road made it possible to begin the undertaking under the direction of the United States Bureau of Public Roads, of which Thomas H. MacDonald is chief.

HEAVY-OIL ENGINED TUG.

FOR operating a fleet of steel barges carrying bulk cement on the Mississippi River, there has been built a twin-screw tunnel-hull towboat, having each screw driven by a six-cylinder C.I. engine of 350 H.P. at 225 revolutions. The boat is 124ft. long, 26ft. beam, and 7ft. deep, with a loaded draught of 5ft. The bow and stern are square, as in a barge, and the bow is fitted with four upright knees which bear against the stern of the barge ahead when the tug is pushing its fleet of barges, as is usual in river service. At the stern the hull is shaped to allow easy flow of water to and from the propellers, which operate in tunnels of rectangular section, which provide a solid column of water and eliminate much of the swirling action of water in rounded or arched tunnels. Compressed air engines operate the deck capstans and other auxiliary apparatus, while an hydraulic-pneumatic steering system handles the rudders, which can be operated independently, like the screws, to assist in steering and manoeuvring. A single funnel contains the exhaust silencers for the main and auxiliary engines. Each main engine is of the vertical, six-cylinder, four-cycle, solid-injection, directly-reversible type, having cylinders of 14in. diameter and 18in. stroke. The thrust bearings are of the Kingsbury type. Clutches operated by compressed air form the couplings between the engine and propeller shafts. The four-bladed cast steel propellers are 6ft. diameter and 5½ft. pitch, revolving inboard at the top for movement ahead. The line shafts are 8in. in diameter and tail shafts 8½in. Control of the engines is effected by a hydro-pneumatic device, operated by a single lever. Besides regulating the engine speed, and the reversing, it actuates the brake on the fly-wheel.

Railway and Road Matters.

THE train ferry of the Great Eastern Train Ferries, Ltd., between Harwich and Calais, mentioned herein on April 10th last, was to be brought into use yesterday—Thursday, November 5th.

THERE are eleven railway directors in the new House of Commons. There are three on the London, Midland and Scottish, Great Western, and Southern respectively; one on the London and North-Eastern; and one on the Northern Counties Committee.

It is difficult to understand why, in these days of reduced traffic, the loading of goods trains should show a decrease, and why, again, the number of empty wagons on a train should be higher. One would have expected that efforts would have been made to secure more economical working. These are, however, facts recorded in the Railway Returns for 1930. Compared with 1929 the average number of wagons on a train decreased from 34.49 to 34.14; the proportion of loaded to total wagon miles fell from 67.23 per cent. to 66.91 per cent., and the average wagon load for all descriptions of traffic decreased from 5.65 tons to 5.59 tons.

It is with profound regret that we have to record the death on October 23rd of Lieut.-Colonel H. F. Stephens, a regret that arises from the loss of a capable railway engineer and a splendid companion, and of whom we, who knew him intimately, remarked that his object in life appeared to be to show hospitality to his friends. Added to this, there was the sorrow that his long illness kept him from business, and all that that meant. Colonel Stephens was associated in the promotion, construction, and administration of several light railways, whose cause he successfully championed when the Railways Act, 1921, was passing through Parliament.

WHILST it may be very unpleasant to passengers to have to sit, as happened recently, for half an hour, particularly if in a tunnel, in a train, the engine or electric motor of which had failed, they may have the satisfaction of knowing that a good deal of the time is being spent in putting into effect precautions for their safety. When a train comes to a stand under such conditions, the guard must proceed forward and learn what has happened and discuss what steps are to be taken. He must then go back and protect his train by putting detonators on the line, and then proceed to the signal-box in the rear to obtain assistance in the shape of another engine. When the latter arrives the guard must accompany it to the standing train, which may be pushed forward. If it happens that the engine of the first train cannot move the relief engine must draw the rest of the train back, and, in anticipation of that, the guard would have obtained from the signalman a "Wrong Line Order," authorising the return movement on the wrong line. Alternatively, relief may be more quickly obtained from the signal-box in advance. In that event the guard would go back to protect his train and the fireman would go forward. The relief engine, in that case, would be accompanied by the fireman, but he must not return without a "Wrong Line Order" to set back on the facing road.

AN inquiry upon the cause of the fatal collision of May 27th at Fakenham, L. and N.E.R., was held by Lieut.-Colonel Anderson, but his report has only recently been issued, the delay obviously being the result of a difficulty in determining whether a defect in some facing points was due to an intermittent electrical fault or to an obstruction in the switches. It may be remembered that, as related herein on June 5th last, an up train stood in a bay and a down train should have passed it—the line being single—by running along the main line. The facing points that had led the up train from the main lines into the bay could not afterwards be restored to the normal position, and, unfortunately, the driver of the down train ignored the "danger" indication of the main line signal and passed into the bay, colliding with the standing train. One passenger was killed. The points in question are 415 yards from the signal-box, and are therefore actuated by what is known as a long-distance, low-voltage, battery-fed point mechanism, which is controlled by a track circuit 140 yards long. There was no evidence or sign of an obstruction in the switches, and as there had been eight reports that month of a defect in the track circuit, and one at the points, it would seem that an intermittent electrical fault had prevented the points from being put back. Subsequent investigations negative this assumption, and Colonel Anderson concludes that "the theory of an obstruction seems, therefore, the more probable of the two."

It was sixty years on November 1st since the Regulation of Railways Act, 1871, was brought into use. It was the sequel to the report of a Select Committee of the House of Commons which was appointed in April, 1870, to inquire into the law of compensation, as applied to railway companies, and also to inquire whether any and what precautions ought to be adopted by railway companies with a view to the prevention of accidents. Singular to relate, that report had only seven lines on the latter subject, and therein it recommended to the careful consideration of railway boards the evidence it had received in favour of the block and interlocking systems and of continuous brakes. The Act of 1871, however, did nothing as to these things; moreover, they were not made compulsory until 1889. What the Act did was to extend the powers, given to the Board of Trade, under the Act of 1842, to inspect new railways, to "the opening of any additional line of railway, deviation line, station, junction, or crossing on the level, which forms a portion of or is directly connected with a railway on which passengers are conveyed." The law as to reporting accidents was considerably extended and standardised; moreover, reports were required of failures of equipment, track, &c. The latter class was covered by paragraph 4 of Sec. 6, which required reports of "any accident of a kind not comprised in the foregoing descriptions, but which is of such a kind as to have caused, or to be likely to cause, loss of life or personal injury, and which may be specified in that behalf by any order to be made from time to time by the Board of Trade." Another point achieved was that inquiries into accidents were made legal. Although the inspecting officers had been holding such inquiries from the year—1840—of their own appointment to inspect railways, those investigations were not legal until the Act of 1871.

Notes and Memoranda.

SOYA beans have been successfully grown for many years in Ontario, but no mills have yet been erected for the expression of the oil.

EIGHT TONS of powder were used to blast away "Cape Horn," a bluff that had to be removed in the construction of the Six Companies' Railroad in connection with the building of the Hoover dam in America. As a result of this single blast 276,000 cubic yards of rock were displaced.

WITHIN 50 miles of Michipicoten Harbour on Lake Superior there are several iron pyrite deposits—all close to the Algoma Central and Hudson Bay Railway—the sulphur content of which varies from 30 per cent. to 45 or 48 per cent. In the aggregate, there are millions of tons of such material.

A CONTINUOUS non-stop run of two months' duration with a small six-cylinder, four-cycle, high-speed, airless-injection oil engine, was recently made at the Finnieston Engine Works of Harland and Wolff, Ltd. When the engine was opened up after the run, wear and tear were found to be exceptionally small.

A NOTEWORTHY cargo has just been discharged at Manchester. It comprises 2500 tons of pig aluminium shipped from Port Alfred, Canada, for the Northern Aluminium Company. The ore for this metal was mined in British Guiana, taken to Canada for reduction, and will be rolled into sheet at Banbury, England.

THERE is an interesting short article in the *American Machinist* for October 31st which describes the process of polishing non-metallic articles by tumbling them in a mixture of bone and wood chips with a small amount of abrasive material and grease. It appears that buffalo bone and lignum vitae are the best materials.

A HYDRO-ELECTRIC power station of unusual type has been constructed at Kremnitz, near Pressburg, Czechoslovakia. In an abandoned coal mine, says the *Engineering News-Record*, two turbines of 3600 H.P. each have been set up 800ft. below the surface and a small river has been diverted into the mine to supply the generators. The water passes off from the mine through caves and underground passages.

ACCORDING to an estimate of the Russian technologist, S. Sauersteig, of Moscow, the magnesite deposits in the Urals contain some 40 million tons of mineral, as compared with the 100 million tons accepted as the extent of the reserves in Austria. Far more important, however, are the deposits in Manchuria, which have hardly been touched as yet, and which are estimated to contain enormous quantities of the mineral.

FORESTERS of Finland have developed a method whereby, from the plants that naturally spring up and flourish on a given area, they can predict the type of forest that will grow on the area, and even make some approximation to the yield that may be expected from the mature forest. Investigations along similar lines have been conducted by the Forest Service of the Department of the Interior, Canada, with a strong probability that such a method can be developed for the forests of the Dominion.

ENGINEERS are reinforcing the foundations of the New Old South Church, Copley-square, Boston, the tower of which inclines toward the south-west about 35in. The inclination has, says the *Engineering News-Record*, been increasing at the rate of an inch a year for the past few years, and it is the hope of the engineers not only to stop this continuous inclination, but to bring the tower back absolutely to plumb. The church is built on wooden piles on a filled-in area, in which the tide ebbed and flowed up to about 1870. The church was erected in 1875.

ORDINARY "permalloy," the alloy of iron with 78.5 per cent. of nickel, is specially suitable for D.C. circuits. For A.C. circuits a higher electrical resistance is desirable to minimise eddy current losses, and in the *Bell Laboratories Record*, September, G. W. Elmen gives an account of work done on similar alloys in which part of the iron is replaced with chromium or molybdenum. Both these elements increase the resistivity, and with 3.8 per cent. peaks are obtained in the curve of initial permeability, which, in the case of molybdenum, actually rises above that for the original alloy. Above a flux density of about 2000, however, the plain nickel-iron alloy is the more permeable. This latter alloy also suffers from the disadvantage that, in addition to an annealing treatment at about 950 deg. Cent., further heat-treatment at 600 deg. Cent., followed by rapid cooling, is necessary if the full magnetic qualities are to be developed. With some of the newer alloys the original annealing is unnecessary, and slower rates of cooling give the highest values of the permeability. It is of interest that the addition of a non-magnetic metal such as molybdenum may, in certain circumstances, render a magnetic alloy still more magnetic.

WHAT is claimed to be one of the greatest door-to-door transport feats ever undertaken has been arranged by the L.N.E.R. in co-operation with the Great Eastern Train Ferry Company and Schenkers, Ltd., continental forwarding agents. The Metropolitan-Vickers Electrical Company, Ltd., secured some time ago an order for 1300 tons of electrical equipment for the Hungarian State Railways. Most of this equipment is now complete and arrangements have been made to convey it in through wagons for the whole distance of 1200 miles from Manchester to Budapest via the L.N.E.R. and the Harwich-Zeebrugge train ferry. Engineers of the railway company will accompany each wagon from Manchester to Zeebrugge to ensure everything being in perfect order when the wagons are handed over to the Belgian railways. The machinery to be conveyed includes eight transformers, each weighing 26½ tons; sixteen switches, each weighing 7½ tons; 330 tons of switchgear, and thirty-six electric motors, each weighing 20 tons. The use of containers for the conveyance of the smaller parts has effected a saving in packing costs of about £2 a ton, and was largely instrumental in securing the traffic to the train ferry route against competitive sea routes via Trieste. The Hungarian railways wish to receive the equipment piecemeal as their electrification scheme progresses, and the wagons will therefore be despatched at intervals over a period of three years.

Miscellanea.

THE land under cultivation for sugar beet in Southern Alberta has increased from 4000 acres in 1926 to 12,000 acres at the present time.

A GAS and coke-making works with a capacity of 1,000,000 cubic feet a day is to be put up to supply Fort William and Port Arthur, Ontario.

A RECENT inquiry from Rangoon for a replace component has revealed the fact that a Marshall 8 N.H.P. portable steam engine, No. 6490, supplied by the Gainsborough firm in 1879, is still working out there.

TRAMCARS passing over the Dorchester Bridge, recently built by the Canadian National Railways, will be rendered almost silent by an insulation of several inches of cork, which will be placed under the asphalt between the lines.

A FACTORY for the manufacture of steel window sashes has been established in Toronto, Canada, by Beacon Windows, Ltd., associated with John Thompson, Ltd., of Wolverhampton. The rolled sections are being imported from England.

ACCORDING to the *Bulletin* of the Hydro-electric Power Commission of Ontario, creosoted wood poles can be successfully painted if they are given a priming coat of aluminium paint. The aluminium is said to cost no more than the colour paint.

AN instrument for measuring the actual metacentric height of a vessel has been invented by the assistant chief surveyor of the American Bureau of Shipping. It appears that the instrument includes a gyroscope and a pendulum, which are used to measure the angle of roll.

THE Council of the Senate of Cambridge University has recommended that the Goldsmiths' Readership in Metallurgy be discontinued and that a Goldsmiths' Professorship in Metallurgy be established. The Goldsmiths' Company has assented to the proposal.

THE new Canadian coastguard cutter, "Adversus," was launched at Orilla, Ontario, on September 23rd. She is the second coastguard cutter of her size to be launched in Canada, and was built at the Ditchburn shipyards. She is 117ft. overall, with a beam of 19ft.

THE construction of a fixed dam at Montgomery Island in the Ohio River, about 31½ miles below Pittsburgh, Pa., at an estimated cost of 6,000,000 dollars, to replace three movable dams, has been authorised by the United States War Department. The new dam will have roller gates and double-lock chambers.

THE third autumn research meeting of the Institution of Gas Engineers opened in London on Tuesday last, when ten research and education reports dealing with the technical and educational work of the gas industry were presented and discussed, before a gathering of five hundred gas engineers from all parts of the country.

THE Prime Minister of Northern Ireland, Lord Craigavon, announced in a recent speech that, in order to encourage the "Come to Ulster" movement, the Government was now prepared to grant free sites to manufacturers not already established. Further, it was urging Ulster municipalities to excuse rates for some years to give the new industries every opportunity to gain a sure footing.

NEARLY twenty entries have already been received for the run for veteran cars from London to Brighton which the R.A.C. is organising on November 15th next. They include a L'ion Bollée which was built thirty-five years ago; an 1897 Vipen, which lay buried at the foot of Hindhead for over twenty years. There is also a steam car which was built in 1904, which runs at a working pressure of 600 lb. per square inch. The run is limited to cars built in 1904 or earlier.

At a meeting of the steel structural industry, held on October 30th, at the Grosvenor Hotel, it was unanimously decided to form a new organisation called the National Federation of Bridge and Structural Engineers. Mr. James Halliday, of Francis Morton and Co., Ltd., was elected the first chairman, and Mr. E. A. Willson, of Archibald D. Dawnay and Sons, Ltd., was elected vice-chairman. The secretary of the National Federation is Mr. C. J. Kavanagh, Artillery House, Artillery-row, S.W. 1.

IN an address before the Institution of Civil Engineers, Yorkshire Association, on Thursday, October 29th, Mr. R. Alan Thwaites, chairman, said "that although legislation could, to some extent, help to establish the status of the qualified engineer by attaching to him some form of label to enable him to be readily distinguished from those who are unqualified, yet, in the ultimate outcome, it is mainly a matter for the engineer himself, by displaying outstanding ability in the performance of his daily task, and in his handling of public affairs, to merit that high status which will assuredly not long be withheld."

No figures as to the increased cost of digging the Wellington-street tunnel under the Lachine Canal at Montreal will, says the *Canadian Engineer*, be given until the Council receives the figures from the executive. It is understood that the contractors have run into quicksand, which will add considerably to the original estimate of 2,800,000 dollars. This contract was given without calling for tenders on a cost plus basis. At some places solid formation could not be found at a depth of 37ft. Drills dropped completely out of sight, employees declared. The contractors, it was said, had taken the contract with such eventualities in view.

THE annual report of Bradford Electricity Committee on the work of the Electricity Department for the year ended October, 1931, states that, notwithstanding the difficult times through which the city has been passing, consequent upon trade depression, the work of the Department has been attended with what, under the conditions, must be regarded as satisfactory results; the net decrease in energy sold was 177,109 units. The decrease of units sold for motive power was 4,619,076, and bulk supplies decreased by 5768, but increases in other classes of supply, including an increase for domestic supplies on the special rate—amounting to 2,147,174 units—reduced the net decrease to the figure above mentioned.

COMMERCIAL MOTOR VEHICLES AT OLYMPIA

(For description see page 487.)

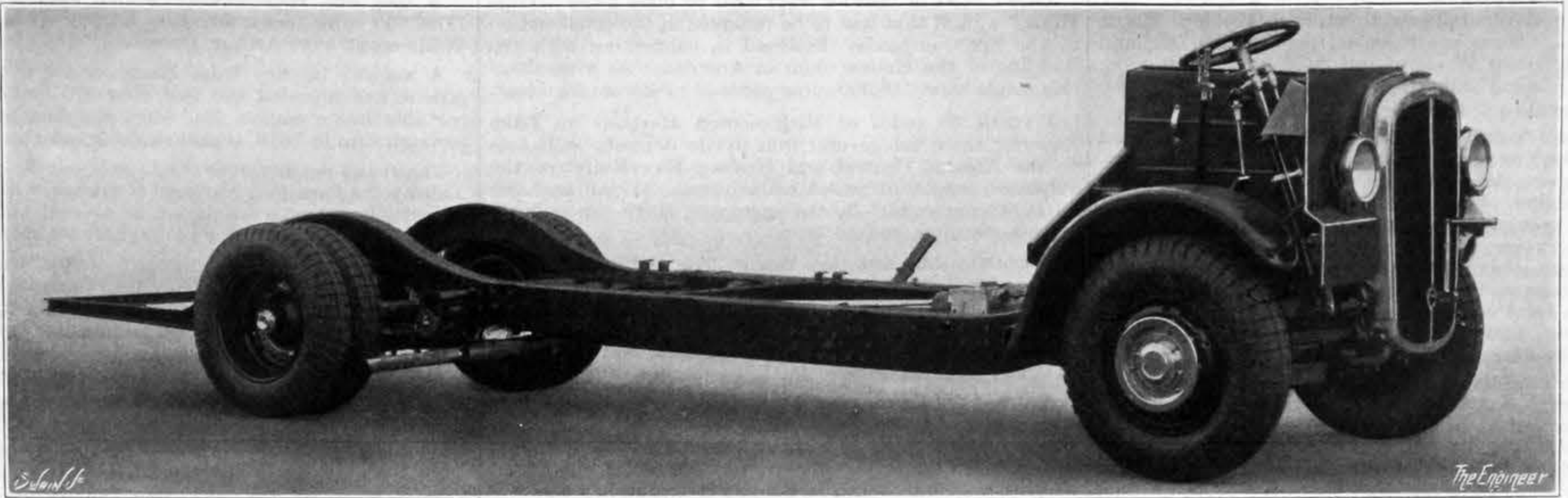


FIG. 9—DOUBLE-DECK OMNIBUS CHASSIS—THORNYCROFT

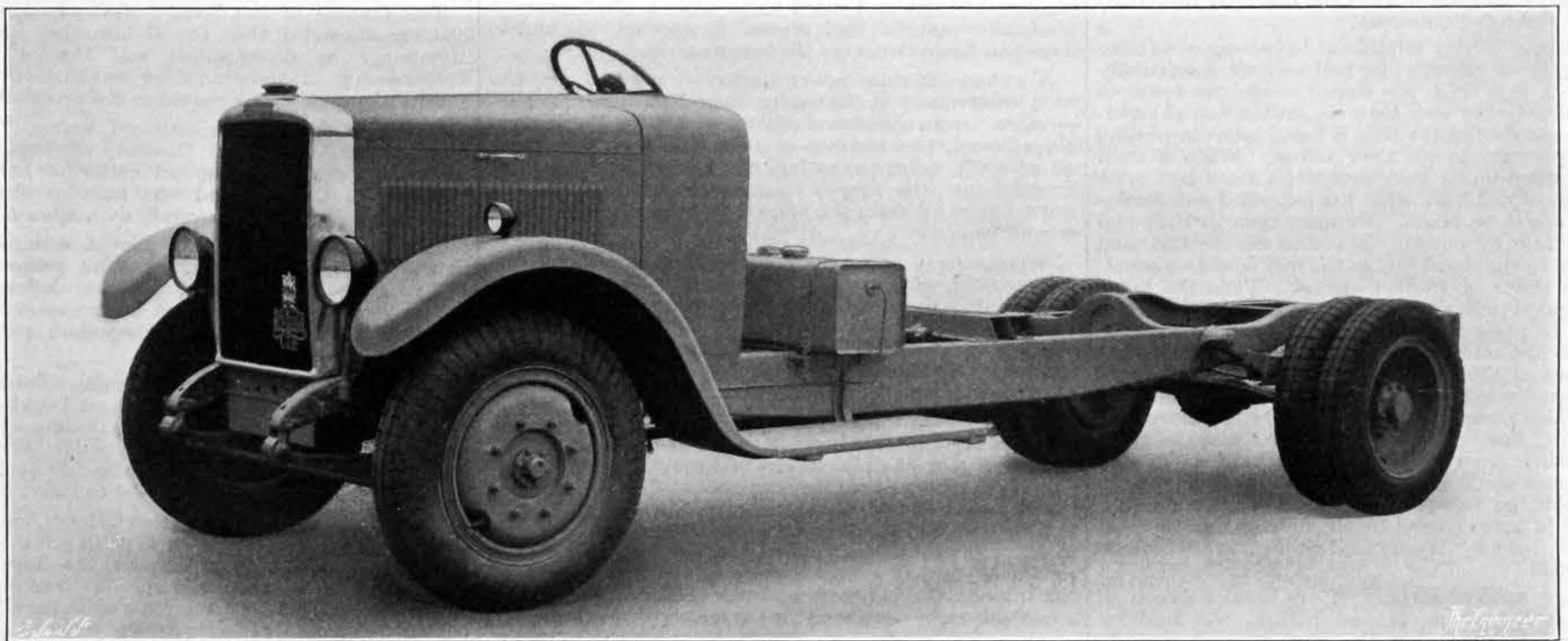


FIG. 10—GOODS WAGON CHASSIS—LEYLAND

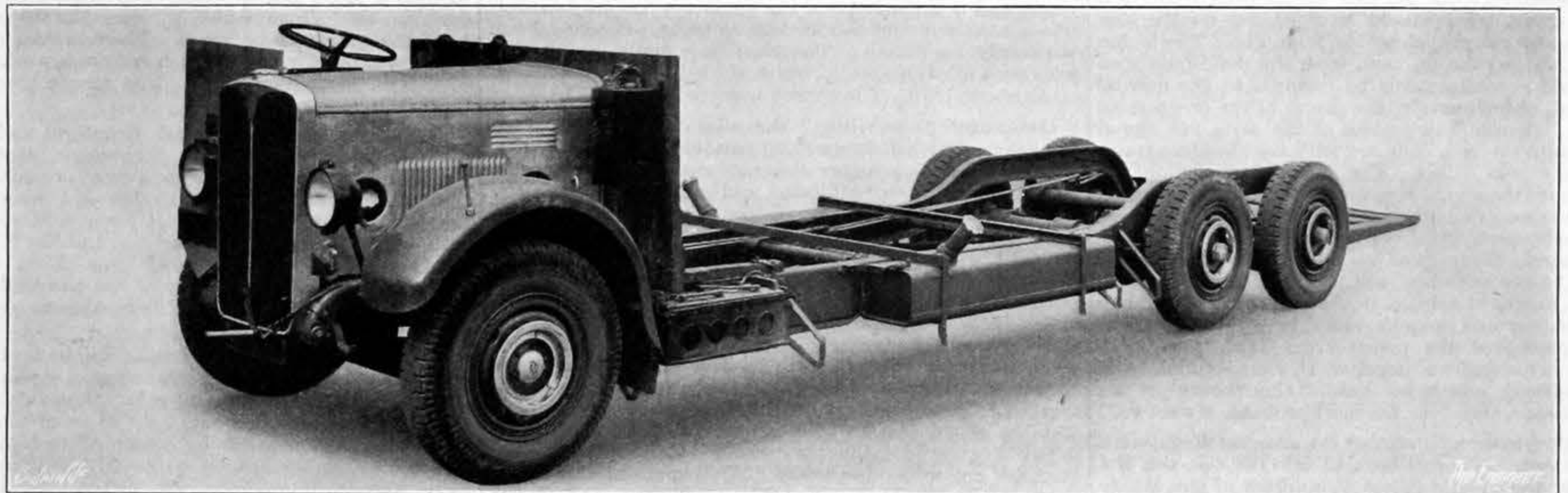


FIG. 11—SIX-WHEEL OMNIBUS CHASSIS—A.E.C.

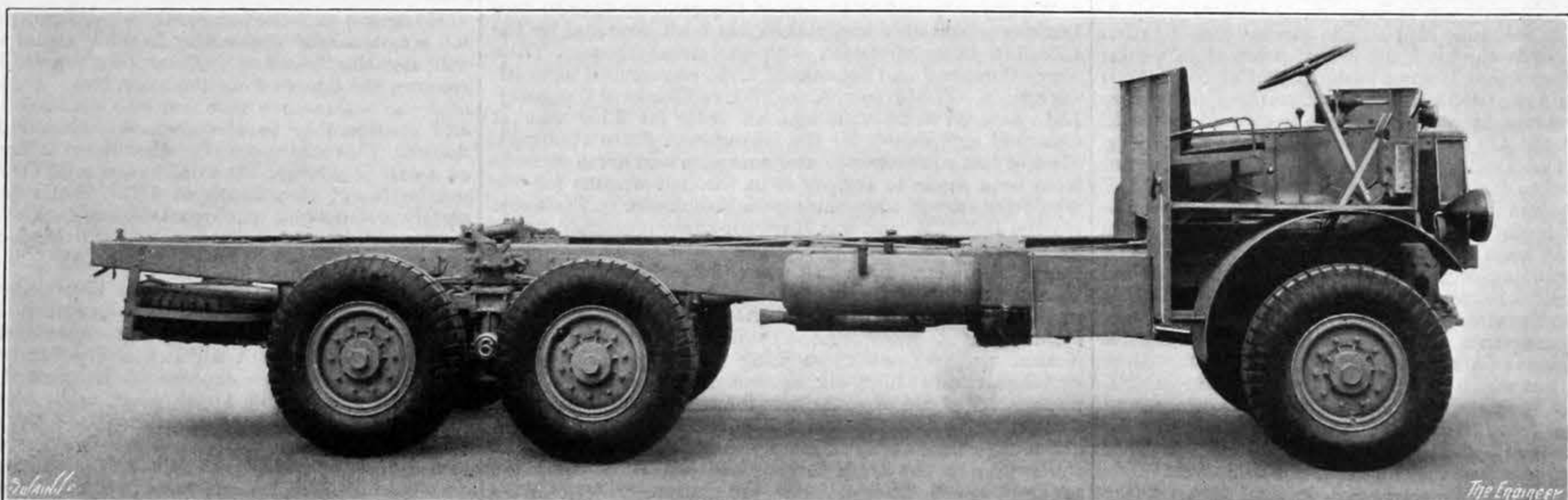


FIG. 12—SIX-WHEEL DRIVE CHASSIS—HARDY MOTORS

The Engineer

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NOVEMBER 6, 1931.

The Pound Abroad.

THE temporary suspension of the gold standard was an event of which the full significance was not easily grasped by the ordinary citizen. He had no doubt that something important had happened, but was more inclined to wait and see what the effect would be than to put his trust in that section of the daily Press which preached that the relinquishment of a gold basis for our currency would put an end to all our financial troubles. The immediate effect was the reduction of the purchasing power of the pound abroad to something like four-fifths of its previous value. The English firms which had to procure francs, dollars, or what not to settle bills abroad found themselves faced with a payment in their own currency of about 20 per cent. more than they had bargained for. There was nothing very pleasant in that, and no more comfort was to be derived from the converse fact that a foreigner who owed a debt in sterling could settle it with a 20 per cent. discount for himself. Of the confusion and hardships which such a sudden change of values caused in respect of existing contracts we need not speak. The trouble, moreover, was not confined to British dealings alone, for the universal confidence in sterling had caused it to be frequently chosen as a means of payment between merchants in neutral countries. One party to a contract would make a handsome extra profit by no merit of his own, while the other was forced to bear a loss for which he was in no way responsible. These were the immediate and obvious results of the depreciation of British currency. They could, however, only be temporary because the situation would liquidate itself on the expiry of existing agreements, and could have no influence on future business beyond the effects of the serious shock to confidence.

A question of much greater importance is the effect of a depreciated currency on the economic welfare of the country, and, in particular, upon its export trade. Every price quoted in pounds sterling

to the foreigner is now 20 per cent. cheaper to him than it would have been a month or so ago. So far as export trade is concerned, therefore, it is as if the cost of production had been reduced by 20 per cent. in a night, and to this extent the international competitive position of our manufacturers is strengthened. This is the point of view which caused a great deal of ill-informed jubilation when the gold standard was suspended. It is well, therefore, to examine it a little closely. In the first place, it is evident that nothing really did happen on September 21st to reduce manufacturing costs in any way whatever. Taxation, wages, salaries, and transport were unchanged, and there was no greater efficiency of machinery or labour than the day before. What, then, did occur on that day to enable a British merchant to sell goods in Paris, for example, for 100f. instead of maintaining his previous price of 124f.? He was certainly able to do so with an equal apparent profit to himself, but is his increased competitive power any real advantage to himself or the nation? This is the question which demands very close attention. The insistence on the fact that we must increase our exports if we are to regain prosperity tends to obscure the truth about an export trade. There is nothing good in exporting for the sake of exporting, otherwise we could become wealthy, and could solve the unemployment problem at the same time by manufacturing to the limit of our capacity and dumping the products into the sea. Exportation, in itself, is, in fact, merely the sending of wealth out of the country, and it has no other object than the creation of credits abroad which can be realised directly or indirectly in the form of desirable imports, or can be invested. With the pound at its gold value, the export of a machine worth £1000 to France created a credit of 124,000f., and goods or other wealth to that amount could be obtained for it. At present, the same machine will only create a credit for about 100,000f., the difference being obviously to the advantage of the purchaser, and not to that of the seller. Unless the country, therefore, increases its exports in proportion to the depreciation in sterling, it will be in a worse position than before as regards real income. That is a vital point to bear in mind. The stimulation given to the export trade by the depreciation in currency is, indeed, an heroic tonic. If anyone doubts what lies at the end of the road, he should remember the conditions which currency depreciation has led to in continental countries. In Germany exports were stimulated to such an extent by the depreciation of the mark that had not the Government taken the strongest measures the country would have been absolutely ruined by its export trade. The export of goods of all kinds had, indeed, to be forbidden, except by special and practically unobtainable licence. The control of exportation had to be carried to such an extent that outgoing trains were boarded before arrival at the frontiers by officials who simply confiscated, without either receipt or payment, everything new that they could find in the luggage of passengers. The country was in danger of being stripped of everything portable by buyers who, for a few shillings, guilders, or dollars, could purchase almost anything they wanted. In France and Belgium, where depreciation of the currency never attained the same degree as in Germany, controlling interests in industrial concerns could be obtained so cheaply by foreigners that many of the largest undertakings had to defend themselves by issuing special shares to their own nationals, with multiple voting powers.

No country which has experienced the effects of the depreciation of its currency would willingly see another depreciation, in spite of the burst of fictitious prosperity which it caused in the export and manufacturing trades. To Great Britain, as a creditor nation, the depreciation of sterling is a serious direct loss, apart altogether from current trade. It was useless to regret the temporary abandonment of the gold standard, once circumstances had rendered it inevitable, but it would be more than foolish to regard it as fortunate. If the stimulus to export trade and the simultaneous stimulus to home trade by the indirect protection of the home markets does effectively reduce the cost of production, good will come out of evil. But to imagine that the refusal of our foreign customers to give more than 16s. worth of gold, credit, or goods in return for a sovereign's worth of exports is in any way a relief from the alleged "burden of the gold standard" is the purest folly. We need to encourage exports as a means to an end, namely, the creation of foreign credits, and this end has been made the more difficult to achieve in exact proportion to the lessened external value of our currency. The maintenance of our

export trade at a high level is now more essential than ever, and it is fortunate that there are signs of a revival of industry apart from those due directly to the fall in the value of the pound.

Geared Locomotives.

TOOTHED gearing played an important part in the early history of steam locomotives. Richard Trevithick, the true and first inventor of the railway locomotive, used it for speed reduction and wheel coupling in his Gateshead engine of 1805; Blenkinsop employed it for speed reduction and adhesion; Stephenson used it for coupling; Hedley had it in "Puffing Billy." Long after the direct drive had driven it out of British practice it was still employed by American inventors. Peter Cooper's "Tom Thumb" of 1829 used a vertical engine geared to the driving wheels. "James I.," that extraordinary locomotive with a candle-extinguisher boiler built for the Mount Clare competition in 1831, had a pair of gear wheels perched on the top of a triangular frame above a vertical cylinder; Ezra Childs sent a geared turbine locomotive to the same trials; the celebrated Ross Winans eight-wheeler of 1843 had a horizontal cylinder driving the leading axle through multiplying gear. When the "Rocket" carried off the prize at Rainhill in 1829, gearing had already quite disappeared from English practice, and the vertical engine was beginning to drop from its upright to a recumbent position. The cylinders of the "Rocket" were soon brought down almost to the horizontal, and with the coming in 1830 of the "Planet," with its horizontal cylinders under the smoke-box, the type which has remained to this day as the standard in all parts of the world was established.

In the United Kingdom there was no need to depart from the general characteristics of a design which had proved itself suitable for all railway conditions, and when British makers sent engines overseas they used the same drawings as for the home railways. In America, however, special problems had often to be faced. Locomotives were required to work in lumber and mining camps under adverse conditions. The road was bad, the gradients were severe, the curves were sharp, the treatment was rough, but the speed of progression was slow. For these conditions the beautiful English locomotives were not well fitted, and American inventors busied themselves about departures from the normal, particularly the geared type, which, with its relatively small and light engine capable of developing through the reduction gear a large tractive effort, presented obvious merits. In order to meet the problem of small radius curves, articulation was introduced and for it the geared type has peculiar advantages, for it makes possible the replacement of flexible steam pipes by universally jointed shafting—an easier problem. As early as 1838 an engine called the "Neath Abbey" was fitted with gear, and since 1880 America has developed several geared types, amongst them all the best known being the "Shay," though the "Climax," the "Baldwin" and the "Heisler" are fairly extensively employed. In the "Shay" design the engine is vertical and is generally placed on the right side of the engine just in front of the cab. It rotates an external shaft which may run the whole length of the locomotive and tender, and drive all the axles by bevel reducing gear. In all the other designs the driving shaft is central. In the "Climax" it is driven by a cross-shaft, with a crank at each end, the cylinders being placed one on each side of the boiler; the "Baldwin" arrangement is similar, but the cylinders are in the usual position and the cross-shaft takes the place of the driving axle. In the "Heisler" design the transverse shaft is omitted, a crank or cranks being formed in the central portion of the longitudinal shaft. The cylinders form a vee under the boiler barrel and connect direct on to the crank. All the American designs employ bevel pinions and wheels, but in an English design, which we illustrate on another page to-day, worms and wheels are used with manifest advantage. Recent improvements in worm gearing have brought it up to an efficiency as good as that of the best spur gear, and probably materially higher than the bevel pairs used in the American engines, which are exposed to dirt and dust and other adverse conditions. With worm gear completely enclosed and running in oil makers will now guarantee an efficiency above 97 per cent. Loss of power in transmission is therefore no longer a serious matter. Apart from its use in articulated locomotives, gearing has been revived in ordinary locomotives for two reasons. First,

to make use of high-speed, high-pressure, engines or turbines, as in the "Winterthur" and "Ljungstrom" types respectively, and for speed control in oil-engined types. For the latter purpose it has only given satisfaction in small sizes, but in the Swedish steam turbine locomotives it is reported to be quite satisfactory.

From this brief review of the situation, it will be seen that there is in existence a good deal of experience with gearing for locomotives, and the question must arise in the mind whether there is any probability of its extension for main line engines working under normal conditions. Not many years ago the answer would have been a categorical negative. The only locomotive gear of which engineers had any wide experience was that used for traction engines and road rollers. It was inefficient and noisy and quite hopeless for the transmission of large powers. But vast strides have been made since the motor car, the electric tram and locomotive, and the geared turbine obliged metallurgists and machine tool makers to devote a great deal of time, money and energy to the problems of toothed wheels. It may be said with confidence that suitable and efficient gears could now be produced. Noisiness and inefficiency need no longer stand in the way of the geared locomotive, if not for express, at least for goods services. In certain cases, where great adhesion with low axle weight was required, we can imagine that it might be employed with advantage, as it makes it relatively easy to drive all wheels, including those of the tender. Yet it is probable that the familiar argument will continue against any material departure from the normal designs of locomotives. The Stephenson arrangement has held its position all through these long years of progress on account of its simplicity. In a little more than twenty-five years the steam locomotive of Trevithick and Hedley shed all its complications and was left with nothing but the essentials, all acting in the most direct way. So it has remained to this day, despite the addition of accessories. It owes its long life and continued success, despite its relatively low thermal efficiency, to this beautiful simplicity, and any change from the normal arrangement would only be tolerable if it could offer some advantage that could far outweigh those which would have to be sacrificed. For this reason we deem it unlikely that the geared type will ever make progress, save for special purposes and special conditions, but for those purposes it has attractions to which the mechanical engineer cannot be blind.

The Tidal Thames.*

No. I.

By long-established custom the President has been permitted to choose the subject of his address, and it is usual for him to deal with matters with which he has been intimately associated. It is my intention to follow this precedent and to take as my subject "The Tidal Thames." It is a subject so full of historical and engineering interest that the main difficulty which presents itself is to determine correctly what should be omitted. I have divided this address into the following sections:—Historical, River Walls, Foreshores, Dredging, Tidal Data, Fresh Water Flow, Docks, Bridges, Tunnels, Weirs, and Riverside Industries.

HISTORICAL.

The river Thames rises at Thames Head in the Cotswold Hills, in the county of Wiltshire, about 161 miles above London Bridge. The tidal influence extends only as far westward at the present time as Teddington Weir, but in earlier times it probably extended as far up the river as Staines.

The authority of the Corporation was long and often disputed by the Lord High Admiral of England and the Constable of the Tower, until the decision of a Court of Justice and the confirmatory Charters of James I. settled the conservatorship of the Thames on the Corporation of London. The Lord Mayor enforced his powers by water bailiffs until the year 1771, when a Committee of the Corporation took over the duties.

The conservancy of the river was under the jurisdiction of a Committee of the Corporation until 1857, but from the year 1836 its constitution and administration were the subjects of repeated public inquiry, and in 1857 recourse was had to legislation, when a new Board of Conservancy was created and named "The Conservators of the River Thames." The constitution of the Conservancy Board was varied in 1864, and again varied in 1866, when its jurisdiction was extended to include the whole of the Upper

Thames as far as Cricklade, which had for many years been under the administration of the Upper Navigation Commissioners.

By the Act of 1908 the Port of London Authority was constituted, and by that Act, which came into force on March 31st, 1909, the river was divided into two sections: the upper section above the landward limit—about 265 yards below Teddington Lock—remaining under the jurisdiction of the Conservators, and the lower section came under the jurisdiction of the Authority, which at the same time was empowered to take over the several dock undertakings.

RIVER WALLS.

One of the greatest and most important works undertaken for the improvement of the river was the construction of the river walls or embankments which enclose the large extent of marsh lands on either side. History seems uncertain as to when or by whom they were constructed. Some authorities contend that they were constructed by the Romans; others that they were the work of the ancient Britons under Roman superintendence; but there is strong evidence that they were not constructed earlier than the reign of Henry II. (1154–1189). The confining of the river within the limits of the embankments has been of immense benefit to the tidal flow, owing to the improved alignment of the currents and the increased scour created by the addition of the very large quantity of water which would otherwise have spread out over the marshes.

The earliest record of the appointment of Commissioners to supervise the breached walls or embankments and to report on their condition is dated March, 1380, following the inundation in 1376, when some acres of land belonging to Barking Abbey were completely submerged and put out of cultivation. At first only three Commissioners, termed "Sewers," were appointed, but in 1385 a fresh body of nine "Sewers" replaced them. These appointments were made by the King's Council, but in 1427 an Act was passed, under which the Chancellor nominated Commissioners, and the Commissioners appointed bailiffs, collectors, treasurers and superintendents.

The duty of safeguarding the low-lying portions of London was by the Metropolis Management (Thames Prevention of Floods) Amendment Act, 1879, placed upon the Metropolitan Board of Works, and subsequently, under the Local Government Board Act, 1888, upon the London County Council.

After the passing of the Metropolis Management (Thames Prevention of Floods) Amendment Act, 1879, the Metropolitan Board of Works, in August, 1880, made it compulsory for all owners of properties within the County of London to raise and maintain the defence works to the level of 5ft. above Trinity High Water; but, following the high tide which occurred on the afternoon of January 8th, 1881, when the height at Westminster, according to the records of the London County Council, was 5ft. above Trinity High Water, the Metropolitan Board of Works decided that the flood protection works should be raised to 5ft. 6in. above Trinity High Water. An exceptionally high tide occurred again on January 7th, 1928, reaching to a height of 5ft. 9in. above Trinity High Water at London Bridge; and a conference was summoned on January 16th, at the instance of the Prime Minister, "to review the situation and to settle what action can and should be taken to obviate any recurrence of such loss of life and widespread damage as resulted from the recent disaster." A Committee of Investigation was formed, representative of the several interested authorities, and as a result the London County Council at their meeting on March 18th, 1930, decided that the flood protection works within the County of London should be raised to varying heights. A system of flood warnings has also been instituted, to be given by telephone from Southend Pier when the level of the water reaches Trinity High Water mark at that point.

In April, 1931, the Minister of Health and the Minister of Agriculture and Fisheries appointed a Committee to consider the present organisation for the prevention of damage by floods in the tidal portion of the Thames, and to make recommendations as to the further measures, if any, that may be necessary, as to the authority or authorities to which the duty of carrying out any such measures should be entrusted, and as to the basis on which the cost should be distributed.

FORESHORES.

Before the time of Queen Elizabeth no suggestion was made that the Crown was entitled by reason of the prerogative to the foreshore of the kingdom generally; but shortly after her accession claim was made for the Crown, not only to the foreshore as between high and low-water mark, but to every piece of land which had at any time been subject to the flux and reflux of the sea.

King James I., early in his reign, perceived that defects in the titles of owners of land might be exploited with considerable profit to himself, and he accordingly issued a general Commission of Inquiry concerning concealments and defective titles, and gave power to his Commissioners to compound with the owners of such lands for the defect of their titles and authorised the Commissioners "for ready money to be paid in hand" to bargain and sell the King's interest to the owners in such possessions the titles

* The Institution of Civil Engineers. Presidential address, delivered by Sir Cyril Reginald Sutton Kirkpatrick, November 3rd, 1931.—Abridged.

to which were conceived to be insufficient or doubtful. Under these Commissions, which were renewed from time to time, the Commissioners drove a thriving business for the King.

After the passing of the Crown Lands Management Act, 1829, the Commissioners of Woods and Forests began actively to revive the claims of the Crown to foreshore which had practically lain dormant for upwards of a century.

In 1844 the Attorney-General filed an information in Chancery against the Corporation of London in respect of the proprietary rights over the foreshores of the Thames. The case dragged on until December 18th, 1856, when an agreement was come to and an arrangement was subsequently made between the Corporation and the Crown by which a grant was made on March 1st, 1857, of all the estate and interest of the Crown in the bed and soil of the Thames within the flux and reflux of the tide, and all encroachments, embankments and enclosures therefrom and thereupon, except in front of or adjacent to any Crown or Government property. This agreement and grant were confirmed by the Thames Conservancy Act, 1857, in consideration of a payment to the Commissioners of Woods and Forests of £5000, and a third of the proceeds of all sales and grants of foreshore thereafter to be made.

DREDGING.

Until 1857 the dredging of the navigable channels was undertaken by the City Corporation, and it would appear that any such dredging was carried out by the ballast men by arrangement with the Corporation, such, for instance, as the removal of the very large and extensive shoal which grew up in the river, to the grave detriment of the navigation, consequent upon the breach in the river embankment at Dagenham in 1707. It was reported by the Lord Mayor in 1713 in respect of this shoal "that although many thousands of tons have been taken up yearly by the ballast men, yet the shoal daily increases."

As the draught of shipping increased, complaints as to the deficiency of depth in the channels became frequent, and in 1889 a complaint was addressed to the Conservators. As the complaints from shipowners and others interested in the navigation continued, the Board of Trade on November 9th, 1894, appointed a Commission, referred to as the Lower Navigation Commission. The Commissioners were the late Sir John Wolfe Barry, K.C.B., past-President Inst. C.E., the late Vice-Admiral Sir George Nares, K.C.B., and the late Mr. George Fosbery Lyster, M. Inst. C.E.

The Commissioners, in their report dated March 25th, 1896, stated that the improved condition of the Thames since 1883 was undoubtedly encouraging, and that they thought that the carrying out of the limited programme of the Conservators could not fail to have some effect in increasing the velocity of the tidal wave and the quantity of water entering and leaving the river. They, however, concurred with the view put forward by the shipowners and others that much public advantage would be gained if a navigable depth of about 30ft., suitable for the vessels of the deepest draught, were afforded at least up to Gravesend or even, if possible, to the Albert Docks.

The total quantity of material removed from the river by the Conservators during the period of thirty-one years, from 1878 to 1909, was 11,144,156 cubic yards, as measured in the hoppers. A cubic yard of Thames mud as dredged in Barking Reach has been found to weigh 2380 lb., and the wet material to contain 47.01 per cent. of water. The quantity of material removed by the Conservators would, therefore, represent approximately 5,905,000 cubic yards as an improvement in the tidal capacity of the river.

is now carried out as required to maintain the depths, except for the section of the river from the Royal Albert Docks to Cold Harbour Point, where the Port Authority have authorised the channel to be maintained to a depth of 27ft. The total quantity of material removed from the river channels by the Authority to the end of the year 1930 was 41,768,747 cubic yards, as measured in the hoppers.

Closely connected with the dredging for the deepening of the channels is the subject of dredging for ballast. By the Lastage and Ballastage Act of 1843, the sole right of supplying ballast to vessels was confirmed to the Corporation of Trinity House for a period of twenty-one years. In the Report of the Select Committee on Thames Conservancy in 1863 it is stated that the ballastage of the Thames is by an ancient charter and recent legislation vested exclusively in the Trinity House, and that in the year 1861 there was shipped in the Port of London as ballast 202,915 tons of chalk and 565,700 tons of shingle, in all 768,615 tons of material. The ballast Act expired in 1866, and owing to the adverse report of the Select Committee on the management of the monopoly, and the dearth and badness of the quality of the ballast supplied, the Act was not renewed, and the raising of ballast ceased to be an exclusive privilege of the Trinity House. Owing to the introduction of water ballast during the nineteenth century, the dredging of ballast from the Thames for the use of vessels became no longer necessary. The Conservators, under their Act of 1864, were empowered to dredge for ballast; but the quantity raised is not known. These powers are now vested in the Port of London Authority.

TIDAL DATA.

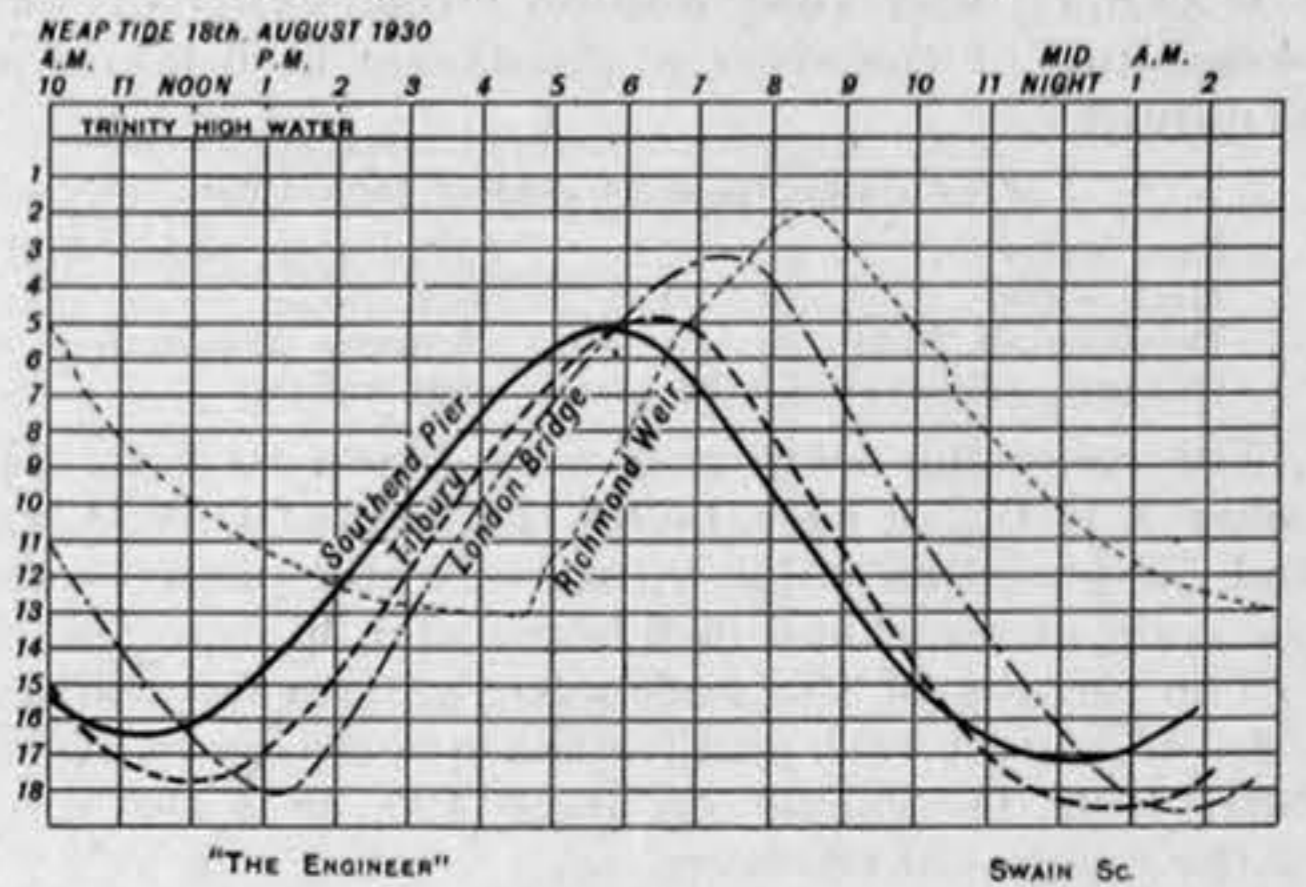
The tidal portion of the river Thames proper may be said to end at a line drawn from Southend Pier to the end of the Isle of Grain, where the estuary of the Thames may be said to begin and where it receives the water from the river Medway. The estuary of the Thames may be said to extend eastward to the meridian of the Kentish Knock light vessel, its northern boundary being the coast of Essex and its southern boundary the coast of Kent. The area is upwards of 1000 square miles, and contains numerous sandbanks between which are the several navigation channels leading to the river.

A comparison of the tidal capacity in cubic yards of the river proper between the westward limit at Teddington and the eastward limit as defined above, for the years 1908 and 1925, covering a period of seventeen years, is as under:—

	1908.	1925.	Improvement.
	Cubic yards.	Cubic yards.	Cubic yards.
Below L.W.O.S.T.			
Teddington to London Bridge ..	8,427,000	9,119,000	692,000
London Bridge to Albert Dock ..	28,176,000	30,982,000	2,806,000
Albert Dock to Gravesend ..	148,206,000	159,773,000	11,567,000
Gravesend to Southend ..	581,297,000	586,405,000	5,108,000
Above L.W.O.S.T.			
Teddington to London Bridge ..	33,466,000	33,798,000	332,000
London Bridge to Albert Dock ..	49,128,000	49,906,000	778,000
Albert Dock to Gravesend ..	140,291,000	142,952,000	2,661,000
Gravesend to Southend ..	575,646,000	584,152,000	8,507,000
Total ..	1,564,636,000	1,597,087,000	32,451,000

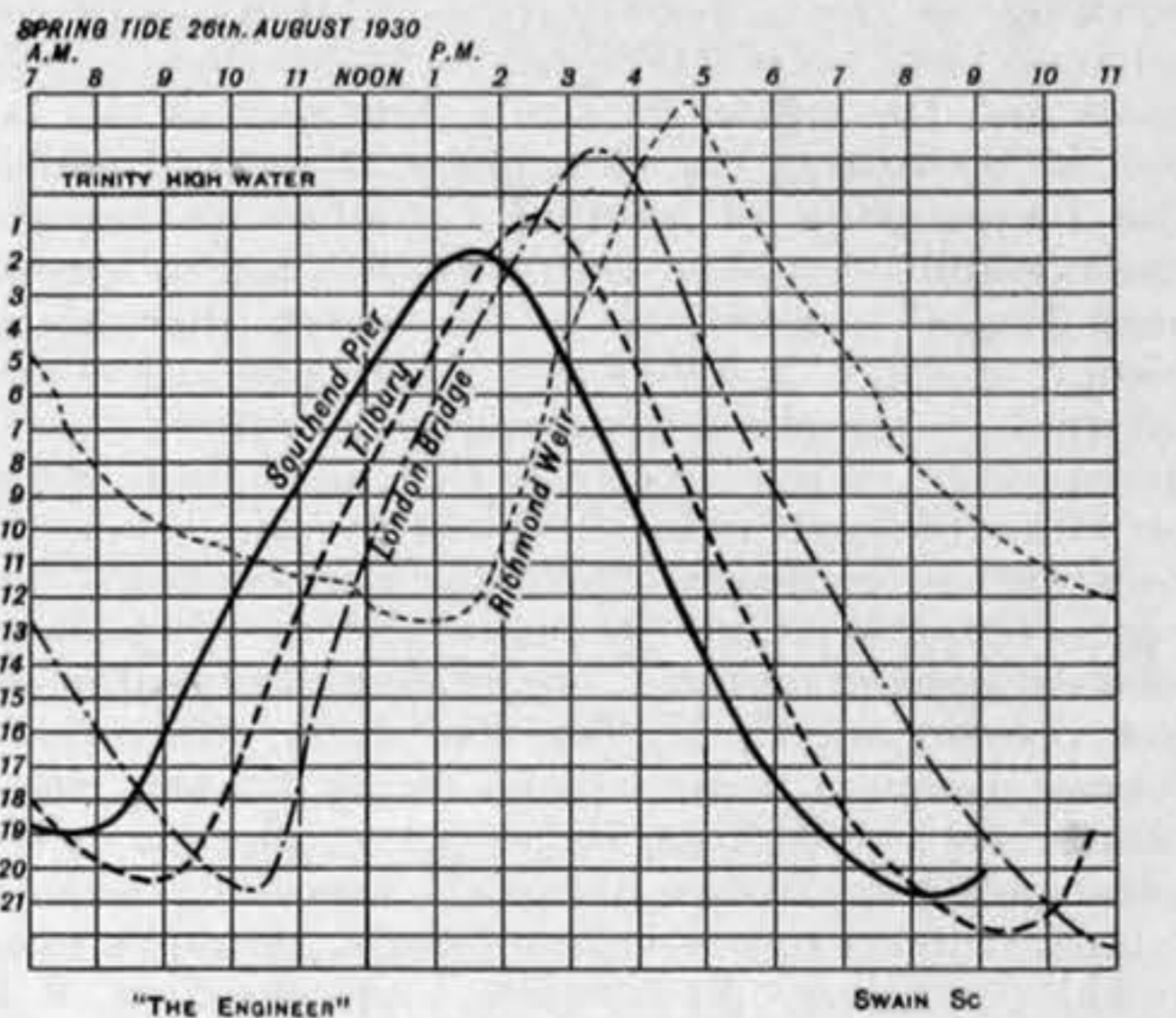
A provision was inserted in the Act of 1800 for the construction of the London Docks that the low-water

cut and made by our direction in a certain post fixed at or near, the Hermitage Dock, and 17ft. 11in. below the level of a certain other line cut and made by our direction in a certain other post fixed between the Bell Dock and Wapping Old Stairs, and 18ft. 3in. below the level of a certain other line cut and made by our direction in a certain other post fixed at or near Shadwell Dock; and, inasmuch as the said marks are now made on Wooden Posts, we recommend that Stone Piers, properly marked according to the said

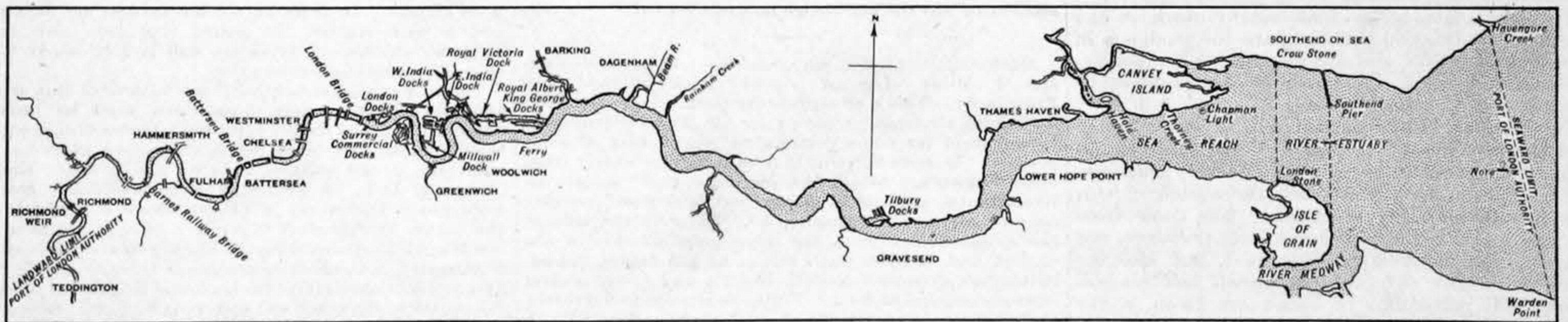


levels, be substituted in lieu thereof at any time thereafter."

It is enacted by Section 309 of the Port of London (Consolidation) Act, 1920, that "The high water of ordinary spring tides at one mile below London Bridge shall be taken as level with the mark fixed by the late Captain Huddart in the year one thousand eight hundred upon the Hermitage entrance lock to the London Docks commonly called 'Trinity Standard.' The high water of ordinary spring tides at other places shall correspond with the above, allowing for the difference of flow at each particular place." This section was no doubt inserted in the Act



of 1920 to preserve the datum fixed in 1800 of Trinity High Water or "Trinity Standard," and it would perhaps have been better if the section had been redrawn to convey that express purpose, because that datum does not, at the present time, represent the level of high water of ordinary spring tides at 1 mile below London Bridge. After the Ordnance Survey levelling had been completed, Commander Burstal found that the lower edge of the stone at the Hermitage entrance lock was 12.53ft. above Ordnance Datum, and this height is accepted by Staff-Commander T. H. Tizard in his "Notes on the Tidal Datums and Levels of the Thames River and Estuary," published in 1891. Trinity High Water level is, however, generally accepted upon the river as being 12.50ft. above Ordnance Datum.



MAP OF TIDAL PORTION OF RIVER THAMES

The dredging of the river was taken over by the Port Authority on April 1st, 1909, and a programme was authorised as follows:—

	Statute miles.	Width.	Depth.
		Feet.	Feet.
London Bridge to Greenland Dock	3½	400-500	14-16
Greenland Dock to Royal Albert Dock	7	600	20
Royal Albert Dock to Cold Harbour Point	6½	600	30
Cold Harbour Point to Gravesend	9½	1000	30
Gravesend to the Nore Lightship	20½	1000	30

This programme has been completed, and dredging

mark should be determined and certified by two of the Elder Brethren of Trinity House within three months of the passing of the Act. At a Court of the Corporation of Trinity House, held on August 7th, 1800, a committee, consisting of Captains Calvert, Brown, Easterby, Joseph Cotton, Huddart, Chapman, and such other members as might desire to attend, was appointed to ascertain the level of low-water mark at the Hermitage Dock, Bell Dock and Shadwell Dock; and at a board meeting held on September 4th, 1800, Captains Brown, Huddart and Chapman presented a report from the Committee as follows:—

"We have, by a careful examination of the rise and fall of the tides determined the line, or height, of low-water mark, to be 17ft. 10in. below the level of a line

The following tidal data have been deduced from the most recent records of the automatic tide gauges. The levels are referred to Trinity Standard:—

	Highest recorded tide, 7th Jan., 1928.	H.W. O.S.T.	H.W. O.N.T.	L.W. O.N.T.	L.W. O.S.T.
	Ft. in.	Ft. in.	Ft. in.	Ft. in.	Ft. in.
Southend Pier ..	+2 6	-1 8	-5 1	-16 10	-18 10
Tilbury ..	+3 9½	-0 8½	-4 4½	-17 8	-20 0
Royal Albert Dock ..	+5 1	+0 5	-3 1½	-17 8	-20 0
London Bridge ..	+5 9	+1 4	-2 8½	-18 5½	-20 2½
Richmond Lock ..	+6 1¼	+3 0	-0 10½	-12 0*	-12 0*

* Summer level.

The calculated tidal flow at the cross section at Southend on the line of the eastern extremity of the river Thames proper, as previously defined, was:—

For the Spring Flood on August 26th, 1930.

Low water	19ft. 1½in. below T.H.W.
High water	1ft. 8in. "
Duration of flood	5 hours 56 minutes "
Quantity of water in cubic yards	710 million

The following spring ebb went down to 20ft. 10½in. below T.H.W., or 2ft. ½in. below the level of L.W.O.S.T., and 768½ million cubic yards of water passed out of the river at Southend in 6 hours and 52 minutes:—

For the Neap Flood on August 18th, 1930.

Low water	16ft. 4½in. below T.H.W.
High water	5ft. 2in. "
Duration of flood	6 hours 20 minutes "
Quantity of water in cubic yards	509 million

The following neap ebb went down to 17ft. 2½in. below T.H.W., or 4½in. below the level of L.W.O.N.T., and 538½ million cubic yards of water passed out of the river at Southend in 6 hours and 36 minutes.

The records of the automatic gauges for the neap tide on August 18th and for the spring tide on August 26th, 1930, are shown on page 495, as is also a plan of the reaches of the river.

(To be continued.)

Literature.

Creep of Metals. By H. J. TAPSELL. Oxford University Press. 1931. Price 30s. net.

THE study of the creep of metals under constant stress has received during the last ten years a very considerable amount of attention, and the phenomenon has come to be recognised as an important determining factor in the success or failure of many types of plant working at high temperatures. Many ambitious schemes have been attempted for the carbonisation of coals and the cracking of oils, but success has been denied because of the slow creep of metal vessels at the temperature of working. Failure to recognise the possibility of slow distortion has led to losses of considerable magnitudes. The lower thermal efficiency of steam engines and steam turbines than of internal combustion engines has caused serious attempts to be made to raise the upper limit of temperature of such plants, which, as the lower temperature is generally fixed by the cooling water, necessitates a high temperature in superheater elements and cylinders. The raising of pressures does not present anything like the same difficulties as raising temperatures, which, owing to the risk of small creeps continuing for very long periods at comparatively low stresses in metals, especially when the temperatures exceed certain limits, presents exceptional problems. A complete understanding of the phenomenon of creep is of the greatest importance, therefore, in relationship to many industrial problems, and particularly in connection with the attempts to utilise more economically the fuel supplies of the world.

Following the important pioneer work of Chevenard, Dickenson and Lea, experimenters in many lands have made attempts to determine what Lea called "the limiting creep stress," or else the stress at which the rate of creep is not greater than some defined quantity at a given time after the application of the load, and a very considerable bibliography has grown up in a few years. Steel makers have recognised the great importance of the phenomenon and have endeavoured, with considerable success, to produce steels not necessarily of greater strength than the well-known steels when tested in the usual way, but which at temperatures above, say, 450 deg. Cent., should more effectively resist creep. The fundamental work in the laboratories has given reliable data for guidance in the design of plants, and has also helped the makers of steels and other alloys in the development of metals to meet particular needs.

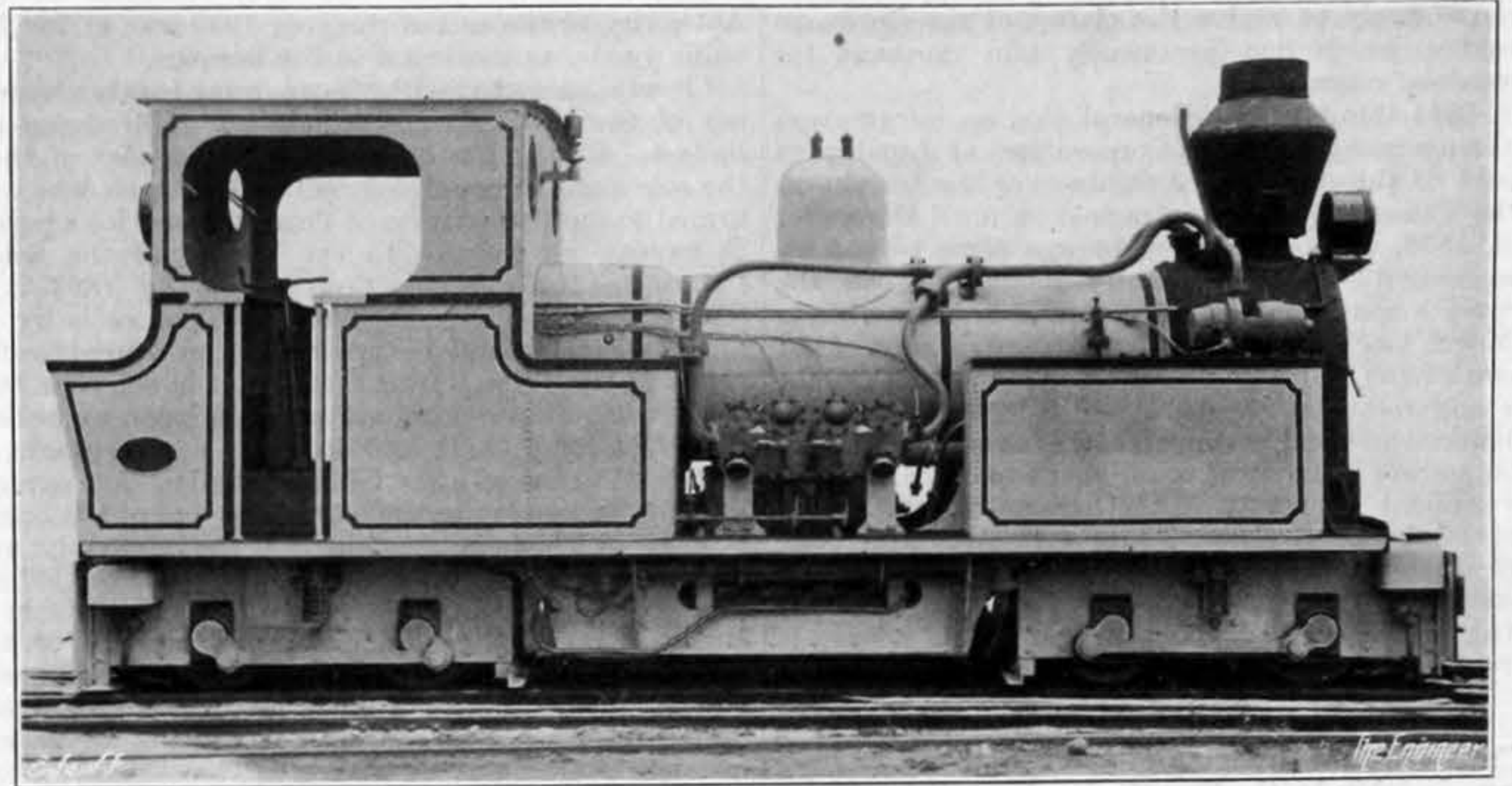
The National Physical Laboratory early recognised the very great importance of the subject, and during the last seven or eight years a very considerable volume of work, for which the author of this work has been chiefly responsible, has come from that institution. He is well qualified, therefore, not only to describe the apparatus used, but also the important results obtained by himself and his colleagues, full particulars of which are given in the book. The work of others is also carefully described, and the volume supplies a real need in describing the technique of various workers, and in giving a very complete summary of the data available. The author also points out the need for and the directions in which further work should be attempted. He has collected all the available knowledge of a subject of great importance, and has added a bibliography, thus making a volume which should prove of real service to designers and all engaged in or contemplating experimental work in connection with this difficult and interesting subject. The book is well arranged, clearly written, and the illustrations are good.

SHORT NOTICES.

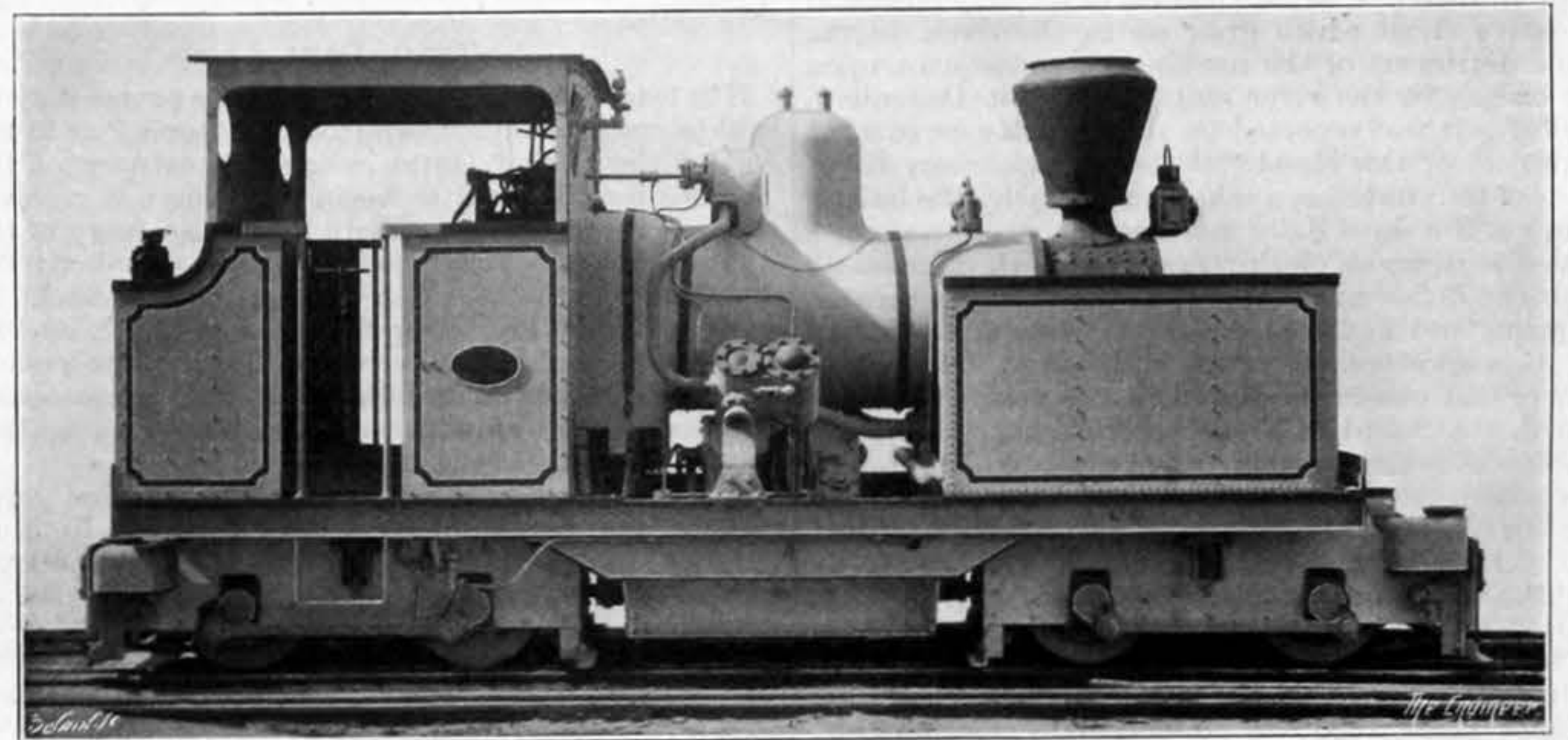
Direct-current Machine Design. By A. W. Hirst. London: Blackie and Son, Ltd. Price 10s.—So many books have been written on the design of D.C. generators

NARROW-GAUGE GEARED ARTICULATED LOCOMOTIVES

AVONSIDE ENGINE COMPANY, LTD., BRISTOL, ENGINEERS



FOUR-CYLINDER LOCOMOTIVE



TWO-CYLINDER LOCOMOTIVE

and motors that any addition to this class of literature may seem uncalled for, especially as the tendency is to abolish D.C. supplies. The reasons the author gives for producing the book are that for certain purposes D.C. machines will always be required, and that hitherto books on the design of these machines have not met the requirements of those who do not intend to specialise in the subject. For such students most of the standard works on design are considered to contain too much detail for their purpose and are in consequence too expensive. By confining himself to design and omitting the elementary matter usually to be found in text-books on electrical technology the author has succeeded in producing a relatively small and cheap volume which should meet the requirements of students who are anxious to acquire a general knowledge of dynamo and motor design. The book is confined to the design of shunt and compound machines of normal or enclosed ventilated construction, having a temperature rise in accordance with B.S.S. Nos. 168 and 169. At the end of some of the chapters examples are set to enable the student to test the knowledge he has acquired.

Electricity for Coal-mining Students. By J. Stevenson and W. Miller. London: Crosby Lockwood and Son. Price 7s. 6d.—This is an elementary book, specially written for mining students, preparing for the Mines Department examination for colliery managers' certificates of competency. In some respects it does not differ widely from other elementary text-books, for it naturally deals with fundamental principles, Ohms law, series and parallel circuits, alternating currents, &c. Later in the volume the authors enter upon the more practical side of the subject and consider such things as generators, cables, switchgear, generator control, motors, and motor control instruments, and so forth. The book is quite well written, and all the diagrams are simple, and easily understood. A noteworthy feature of the book is that it contains a considerable number of exercises relating to the various branches of the work covered, and each question is accompanied by the correct answer. Altogether, the requirements of the mining student are well met.

BOOKS RECEIVED.

Elastic Arch Bridges. By C. B. McCullough and E. S. Thayer. London: Chapman and Hall, Ltd., 11, Henrietta-street, W.C. 2. Price 30s. net.

Automotive Repair. Vol. II. For Electrical Service Men. Second edition. By J. C. Wright. London: Chapman and Hall, Ltd., 11, Henrietta-street, W.C. 2. Price 18s. net.

Problems in Thermodynamics and Steam Power Plant Engineering. By E. A. Fessenden and T. G. Estep. London: Chapman and Hall, Ltd., 11, Henrietta-street, W.C. 2. Price 7s. 3d. net.

Geared Articulated Locomotives.

THERE have been many designs for geared locomotives, chiefly for narrow-gauge and mountain railways, but hitherto they have never succeeded in establishing themselves for other duties, despite certain obvious advantages. In recent years the desire to use the steam turbine has revived the interest in them, and we have seen such examples as the Ljungstrom, the Zoelly, the Reid, and others. But even with the great advance that has been made in gear design, materials, and manufacture, none of them have had the slightest appreciable effect upon the output of locomotives of the normal type.

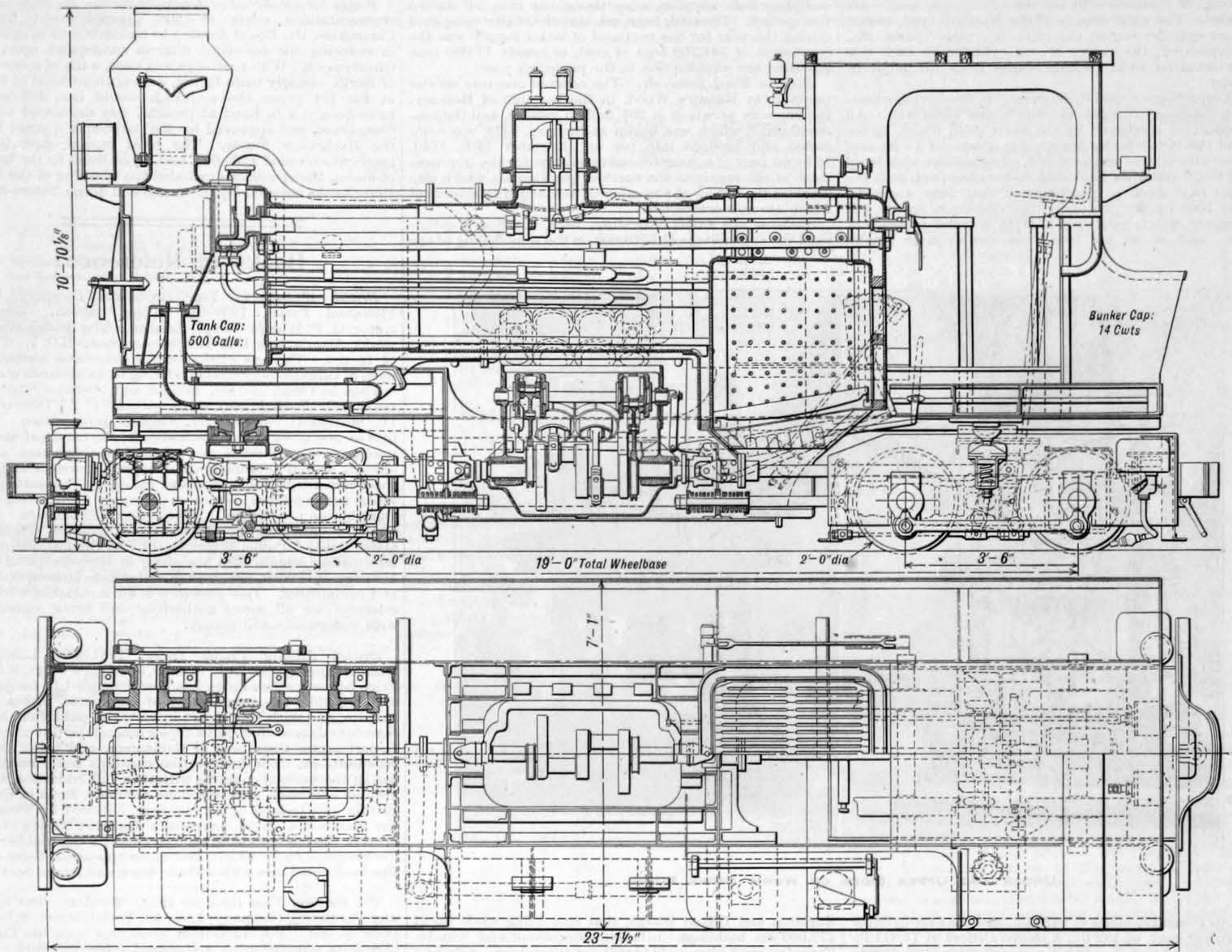
But whilst the advantages of the geared type, with a high-speed engine of relatively light weight, have not been sufficiently great to outbalance the simplicity of the direct drive for normal engines, the position is not quite the same when we come to the considerations of articulated engines. In them all the advantages are increased and in such engines the geared type has made more progress, and several types are still largely employed in America for special services.

The two engines which form the subject of this article and the accompanying illustrations may be broadly described as of the Heisler type, but whereas in that engine bevel pinions and large bevel wheels are used for the reduction, in the engines made by the Avonside Engine Company, Ltd., of Bristol, a worm reduction gear is employed. The worm is placed above the wheel and enables the driving shaft to run in a straight line from the crank axle, thus obviating the angling of the shaft which is necessary in the Heisler design, in order to enable it to pass over the inner axle of the bogie and be directed towards the centre of the outer and driven axle. The vee engine, placed under the barrel of the boiler, is common to both, but the Avonside engine employs a simpler valve gear, the arrangement of which is well shown in one of our drawings.

In our issue of August 29th, 1930, we described an articulated locomotive driven by a heavy-oil engine, which was made by the Avonside Engine Company, Ltd., for plantation work in Natal. It was a double bogie engine, the outer wheels of both bogies being driven by a longitudinal shaft with worm and wheels from a centrally placed oil engine. The success achieved by that locomotive in service has led to the new design, with steam engines capable of exerting more power than the oil engine. One of the new locomotives has two, and the other—see drawing—four cylinders. The gauge is 2ft. 0½in. and in both cases the fixed wheel base of the bogies is 3ft. 6in., but the total wheel base is 16ft. 6in. in the two-cylinder and 19ft. in the four-cylinder design. The cylinders in all cases are 6½in. by 8in., and piston valves of the "Wota" type are used. They are, as will be seen from the drawing, of exceptionally large size for the cylinders, being, in fact, 4in. in diameter. With a stroke of 2½in.,

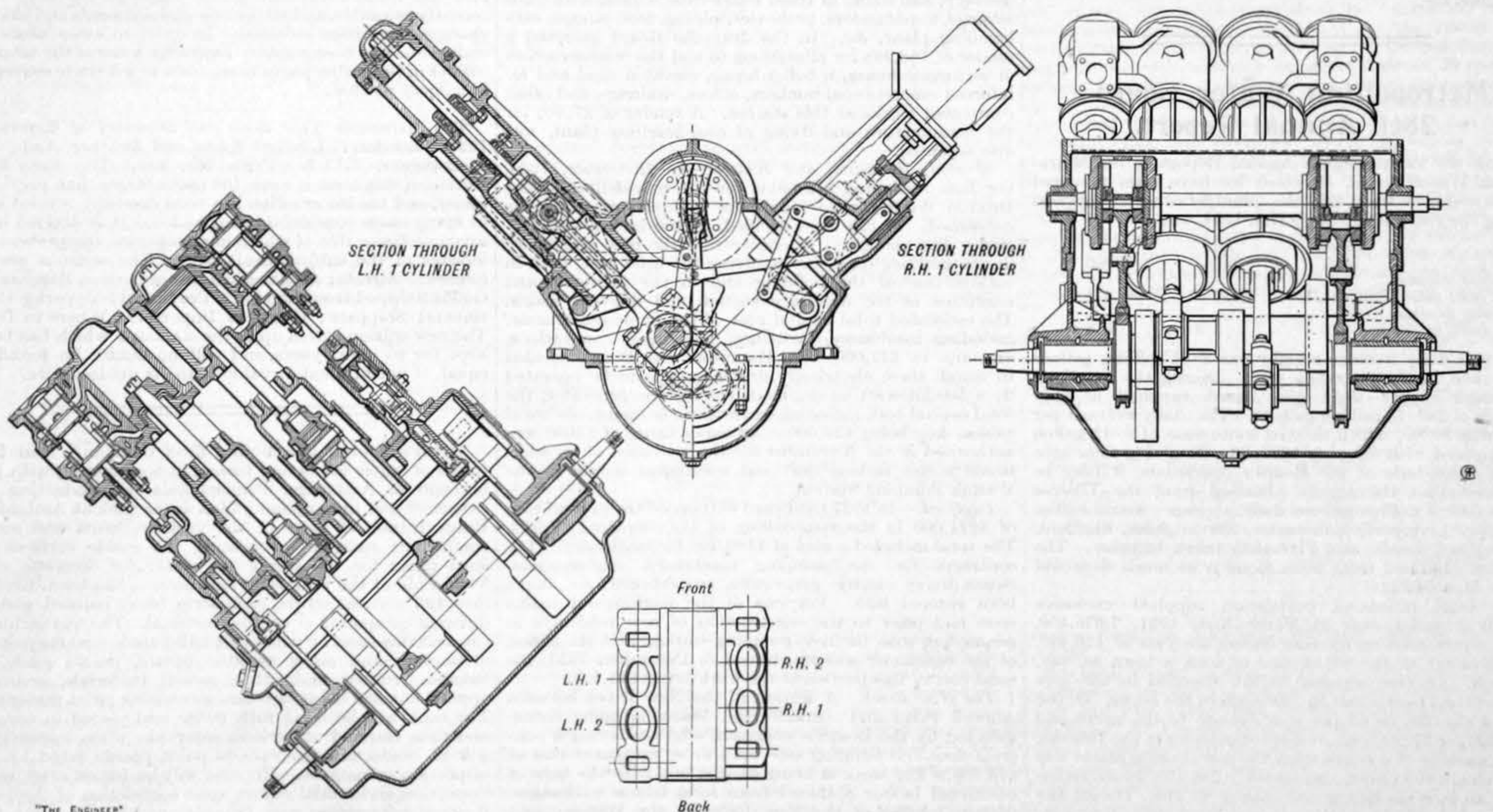
FOUR-CYLINDER GEARED ARTICULATED LOCOMOTIVE

THE AVONSIDE ENGINE COMPANY, LTD., FISHPONDS, BRISTOL, ENGINEERS



"THE ENGINEER"

®



"THE ENGINEER"

SECTIONS THROUGH FOUR-CYLINDER ENGINE

a port area of 5.76 square inches is obtained, and a ratio between cylinder volume, in cubic feet, and port area in square inches of about 1 to 38 is secured, in place of the usual 1 to 150. This is necessary to allow the engines to run at a high speed—600 to 800 r.p.m., without excessive wire-drawing, and with reasonable steam velocity through the ports. The large port area, however, causes an increased clearance, and, in consequence, the full gear cut off has been restricted to a little under 70 per cent., small auxiliary notches being cut in the main ports to facilitate starting. Four cut-off positions—70, 50, 30, and 20 per cent.—are provided. The valve gear is of the Marshall type, and in the four-cylinder engine the cylinders, valve chests, &c., are duplicated, the valves of one cylinder on each side being actuated from rocking shafts from the adjacent cylinder.

The same bogie is used throughout. It has driving wheels 2ft. in diameter, coupled by rods in the usual way. All the reduction is effected by the worm gear, which, in the case of the two-cylinder engine, has a ratio of 7 : 20, and in the four-cylinder engine 6 : 17. Locomotive speeds up to 15 to 20 miles an hour had to be visualised, and the engines have been so proportioned that they might be run at 1000 r.p.m. Normally, the maximum speeds will not exceed 600 to 800 r.p.m. With a boiler pressure of 200 lb., and at 80 per cent., the two-cylinder engine

for unfiltered water possessed by the Board at the end of the year was :—

Positions of reservoirs.	No.	Area in acres.	Capacity in mill. galls.
Thames Valley	32	1749.5	14,017.5
Lee Valley	17	955.0	5,639.5
Totals	49	2704.5	19,657.0

Taking the supply of 1930-31 as a basis of calculation, the grand total represented a storage sufficient for 70.7 days, including bulk supplies, even though no rain fell during that period. The coal, coke, oil, and electricity consumed during the year for the purposes of water supply was the equivalent of 184,700 tons of coal, or nearly 17,000 tons less than the consumption in the preceding year.

Bishops Wood Reservoir.—The covered concrete service reservoir at Bishop's Wood, in the borough of Hornsey, the capacity of which is 20½ million gallons, and the construction of which was begun in January, 1928, was completed and brought into use on December 15th, 1930. It forms part of a comprehensive scheme for the improvement of the supply to the north of the Thames, which also includes the laying of a number of new aqueducts, most of which are now completed.

Surbiton and Ditton.—In July, 1929, the Board authorised the expenditure of £220,000 on the remodelling of the

Mains.—The Report also contains particulars of work in connection with the laying of new mains, including those between Kempton and Hampton; at North Hill, Hornsey; Tottenham and Edmonton; between the Great West Road and Syon Lane; in Hendon and Ealing; between the Kingston Hill and the Putney Heath Reservoirs; in Greenwich and Woolwich; Chelsfield and Shoreham; Chislehurst and Orpington; Foot's Cray; between Eltham and Woolwich; Esher and the Dittons and Surbiton; and Merton.

Works for the Relief of Unemployment.—In response to representations made by the Unemployment Grants Committee, the Board decided to endeavour to co-operate in reducing the prevalent distress consequent upon unemployment. With that object in view, a list of a number of works—mostly main laying, among them some of those in the list given above—which would not, ordinarily, have been put in hand at present, was submitted to the Committee, and approved for the purpose of a grant from the Exchequer Funds. The total capital expenditure involved exceeded £260,000, and, in addition to the laying of mains, the operations included the wharfing of the New River banks between Rye Common and Seven Sisters-road.

Books of Reference

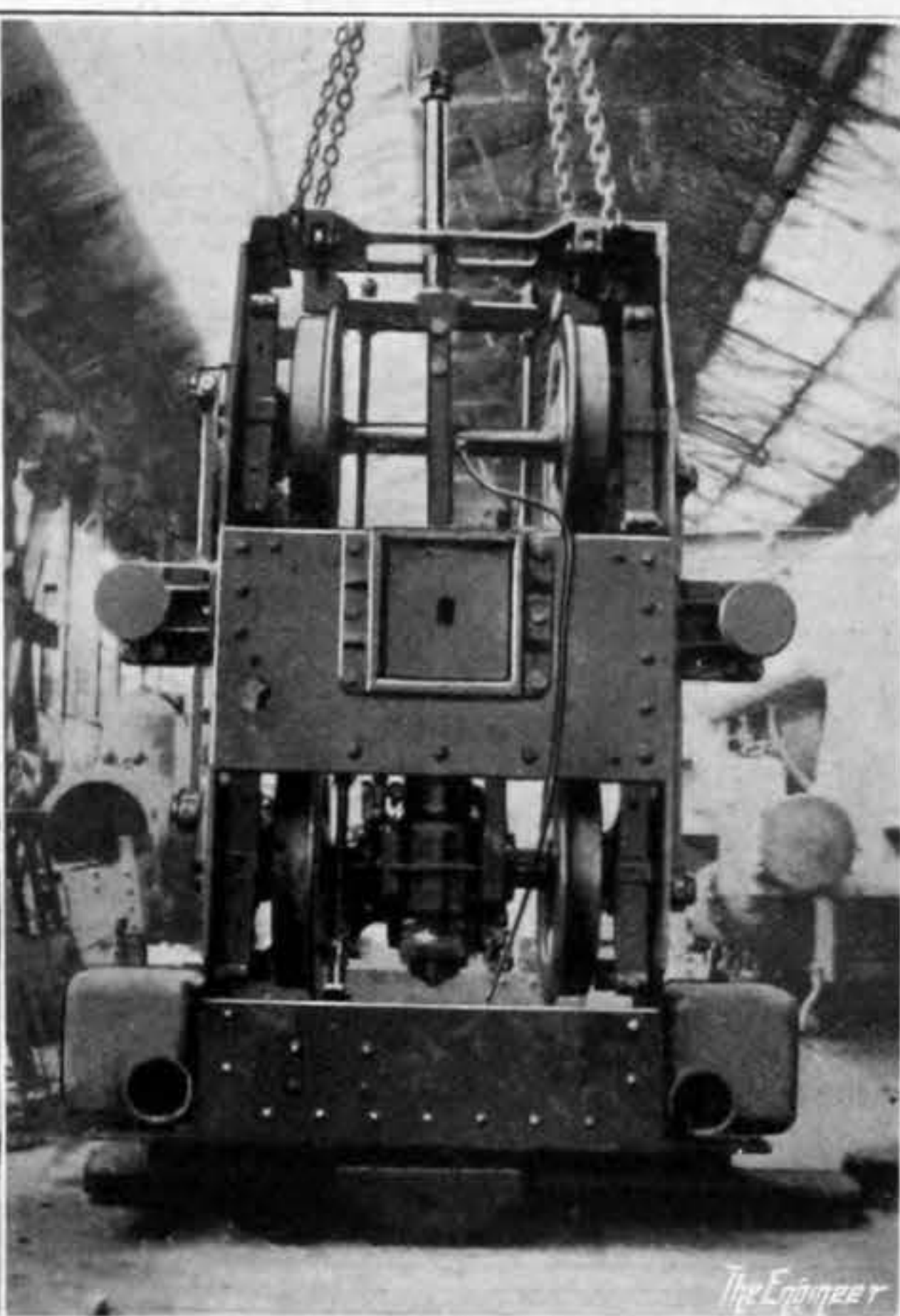
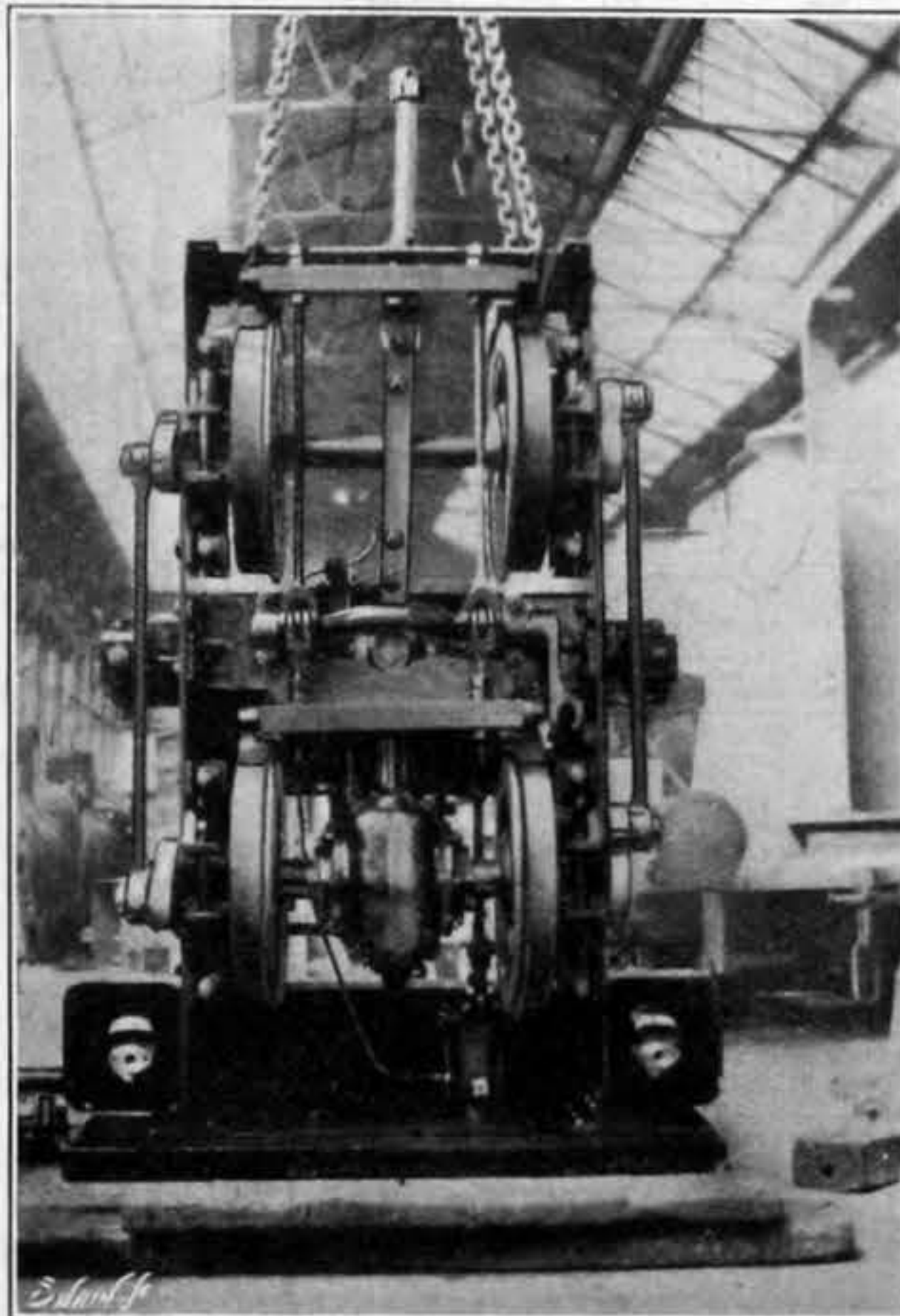
British Waterworks Year Book and Directory, with Statistical Tables, 1930-31. Third edition. General editor, G. P. Warner Terry. London: The British Waterworks Association, 173, Rosebery-avenue, E.C.1. Price £1 1s. net.—The new edition of this year book contains a mass of valuable information relating to waterworks undertakings in Great Britain, Ireland and overseas. Its 422 pages are divided into three sections: I., Directory; II., Statistical Tables; III., General Information. The first section gives in alphabetical order the names of undertakings with particulars as to date of establishment, chief officials, special Acts and limits of supply, sources of supply, the character of the water and charges. The statistical tables are as follows:—Sources of Supply; Filtration and Distribution; Supply; Estimated Population and Supply; Analysis of Accounts; Domestic Charges; Meter Rents; Public Water Rates. In the miscellaneous information section lists are given of the officials of the Ministry of Health, members of water associations, boards and committees. This directory is an invaluable work of reference for all water authorities and firms connected with waterworks and supply.

British Empire Trades Index, 1931-32. London: Business Directories, Ltd., 8 and 9, Johnson's-court, E.C.4. Price 5s. net.—This index has been compiled to facilitate and expedite the interchange of commerce within the Empire, and with this object in view the publishers have distributed some 25,000 free copies among the Government Departments, Chambers of Commerce, and other trade organisations. The first section contains trade headings listing the various concerns with their full addresses, telegraphic addresses, and telephone numbers, firms in Great Britain and Ireland appearing first, followed by those in the Dominions. Next comes an alphabetical index of the firms in the trade section, each having the key numbers of the headings under which their name appears in Section 1. The book concludes with a Trade Mark and Brand Section.

The Railway Year Book for 1931. London: The Railway Publishing Company, Ltd., 33, Tothill-street, S.W.1. Price 5s. net.—For thirty-four years this book has maintained its reputation as a standard reference work, and with each edition its usefulness increases. The new volume includes a number of fresh features, among which is a table giving particulars of the electrification of steam railways throughout the world, and a list of the world's longest railway tunnels. The articles relating to the various railways have been extensively revised, additional information has been incorporated, the statistics are the most recently available, and all the new appointments and official changes have been included. In order to assist users an endeavour has been made to rearrange some of the tabular matter in the earlier pages to conform to a definite sequence of subject matter.

The Mercantile Year Book and Directory of Exporters, 1931. London: Lindley Jones and Brother, Ltd., 32, Bishopsgate, E.C.2. Price 20s. net.—The forty-fifth edition of this book is some 100 pages larger than previous issues, and the information has been carefully revised and in many cases considerably expanded. It is divided into seven sections, five of which have separate comprehensive indexes of the subject dealt with. The sections are as follows:—Streets; Alphabetical List of London Merchants; Goods Shipped from London; Provincial Shippers; Continental Shippers; Overseas Importers; Where to Buy. The new edition is well up to the standard which has been kept for so many years, and will, no doubt, be found of equal, if not of greater, value than its predecessors.

THE Pittsburgh Des Moines Steel Company, manufacturers of water tanks and towers in conjunction with the borough of Ambridge, Pennsylvania, is conducting an extensive test in a million gallon water tank at Ambridge, Pennsylvania, of most of the various paints and other compounds suitable for coating the inside surfaces of steel tanks for the storage of water for domestic use. The inside of the tank shell and bottom has been divided into 196 vertical strips, each strip being painted with a different compound or coating material. The test includes the usual lead and oil paints, asphalt paints, coal tar paints, aluminium and other metallic paints, paints made of bakelite, rubber and other special materials, enamels applied hot and many new and interesting paint materials. The tank will be filled with water and placed in service and then emptied at periodic intervals, when inspections will be made and the various paint panels rated by an inspection committee. Reports will be issued after each inspection and a final report upon completion of the test. Further information may be obtained by addressing the Pittsburgh Des Moines Steel Company, Neville Island Post Office, Pittsburgh, Pennsylvania.



UNDER AND UPPER SIDES OF WORM DRIVE BOGIE

develops a tractive effort of 6438 lb., and the four-cylinder with 80 per cent. of 185 lb., a tractive effort of 11,811 lb. The smaller engine is without a superheater, and weighs in working order 16 tons. The larger engine has a superheater of 69.7 square feet, and weighs 23 tons. Minimum curves of 60ft. radius can be taken by the larger and 50ft. radius by the smaller engine.

The illustrations, particularly the drawings, show the general arrangement so clearly that further description is not called for.

Metropolitan Water Board: 28th Annual Report.

FROM the twenty-eighth Annual Report of the Metropolitan Water Board, of which we have been favoured with a copy, we learn that the quantity of water supplied during the year ended March 31st, 1931, was—

	Direct area.	In bulk.	Total.
Total volume (mil. galls.)	100,411.8	1,059.3	101,471.1
Daily average (mill. galls.)	275.1	2.9	278.0

The total daily average supply was 2.81 million gallons more than in the preceding year. During the month of maximum supply—July—the Board supplied a daily average of 299.73 million gallons. The daily average per head was 36.09, which showed a decrease of 0.32 gallon as compared with the year 1929-30. As giving some idea of the magnitude of the Board's operations, it may be explained that the supply obtained from the Thames alone—167.5 million gallons daily average—would suffice to supply Liverpool, Manchester, Birmingham, Sheffield, Nottingham, Leeds, and Plymouth taken together. The quantity obtained from wells alone is as much as would supply Manchester.

The total estimated population supplied—exclusive of bulk supplies—was at March 31st, 1931, 7,675,459, which represented an increase during the year of 126,480, or equivalent to the population of such a town as, say, Norwich. Of the increase, 69,751 occurred in the area north of the Thames and 56,729 south of the River. Of the total, 4,834,932, or 63 per cent., reside to the north and 2,840,527, or 37 per cent., reside to the south of the Thames.

The number of services from the distribution mains was at the end of the year under review 1,286,198, which represented an increase during the year of 23,270. During the same period 22,250 additional inhabited buildings were supplied with water.

The amount of storage and subsidence reservoir capacity

Surbiton and Ditton Works, that sum being made up of £72,000 on buildings, including alterations and foundations for machinery; £118,000 for machinery, including boilers, engines, and coal-handling plant; and £30,000 for mains, culverts, &c. In March, 1930, a tender of £48,980 for the manufacture, delivery, and erection of four steam turbines with centrifugal pumps and two electrical generators was accepted. In May of the same year a tender of £29,825 was accepted for the manufacture, delivery, and fixing of three water-tube boilers, with their settings, superheaters, preheater, piping, feed pumps, ash-handling plant, &c. In the July the Board accepted a tender of £68,988 for alterations to and the reconstruction of an engine-house, a boiler-house, elevated steel and reinforced concrete coal bunkers, offices, drainage, and other contingent works at this station. A tender of £7290, for the manufacture and fixing of coal-handling plant, was also accepted.

Brixton, Hampton, and Walton.—In December, 1930, the Board adopted a scheme for the remodelling of the Brixton Works, in so far as the pumping machinery is concerned. It has been decided, in the interests of efficiency and economy, to concentrate the new machinery in one building on a site involving the least cost, both in construction of the building and in the provision and alteration of the necessary suction and delivery mains. The estimated total capital cost of the approved scheme, including machinery, buildings, and main connections, amounts to £77,000. At Hampton, the Board decided to install three electrically driven pumps to be operated by a 500-kilowatt oil engine driven electric generator, the total capital cost, including connections to mains, electrical cables, &c., being £20,000. An expenditure of £7000 was authorised in the November for the provision of an additional steam turbine unit and contingent works at the Walton Pumping Station.

Deptford.—In 1927 the Board authorised the expenditure of £221,000 in the remodelling of the Deptford Works. The total included a sum of £109,000 for machinery. The contracts for the pumping machinery, engine-house, steam-driven electric generators, switchboard, &c., have been entered into. Portions of the working-out mains were laid prior to the construction of new roadways in connection with the new pumping station, and the laying of the remainder was sanctioned in December, 1930, the total cost of this portion of the work being £14,500.

The New River.—A section of the New River between Amwell Pond and Amwell Hill, Ware, is being reconstructed by the Board's workmen, who are laying a concrete floor and building side walls at an estimated cost of £15,700. The work is being carried out with the help of additional labour obtained from local labour exchanges. Certain lengths of the New River in the Hornsey and Ware sections have also been improved by the provision of timber wharfing, the estimated cost being £4200.

The Progress of the National Power Scheme.

ELECTRICAL development in Great Britain, in common with other countries, has been adversely affected by the world economic crisis, and a certain slowing down has taken place in the rate of expansion in electricity consumption. The fact, however, that in many ways the country was under-developed and had still considerable leeway to make good, no matter how severe the industrial depression,

which Great Britain has been divided for the purpose of the scheme; secondly, the standardisation of frequency phase, involving new or modified generating plant and consumers' apparatus in non-standard areas; thirdly, the determination of agreements regarding tariffs between the Board and authorised undertakers supplied from the national transmission system.

If we take the first phase, we find that by the end of 1930 nine schemes covering 76.7 per cent. of the area of Great Britain, 98.2 per cent. of the population, and 99.5 per cent. of the output of authorised undertakers, had been served by the Electricity Commission, that eight

conversion in addition to actual negotiation with land-owners for such wayleaves. At the end of September, 1931, good progress had been made both in primary and in secondary lines. During those nine months, wayleaves covering 832 miles of primary lines operating at 132,000 volts and 304 miles of secondary lines operating at lower voltages, or the total of 1136 miles, had been obtained. In a number of areas, notably Central Scotland, North-East England, Mid-East England, Central England, East England, and, to all intents and purposes, North-West England, negotiations were almost complete. In South-East England, which presented special difficulties

TABLE I.—Electricity Schemes.

Schemes Adopted	Date of receipt from Electricity Commissioners.	Date of adoption by Central Electricity Board.	Square miles (land and inland water).	Per cent. of Great Britain.	As extracted from Registrar-General's Provisional Reports on 1931 Census.	Per cent. of Great Britain.	Existing generating stations owned by authorised supply authorities in area as at December 31st, 1930.		Electricity generated during year ended December 31st, 1930.		Number of selected stations.	
							Nos.	Per cent. of totals.	Millions of units.	Per cent. of totals.	Exist-ing.	New.
<i>Schemes Adopted</i> —												
Central Scotland Elec. Scheme, 1927	12/4/27	29/6/27	4,980	5.6	3,785,035	8.4	28	957.1	8.8	10	2	
South-East England Elec. Scheme, 1927	29/9/27	15/2/28	8,828	10.0	12,518,955	28.0	116	3,231.6	29.6	31	4	
Central England Elec. Scheme, 1928	14/3/28	22/5/28	7,311	8.3	5,603,139	12.5	49	1,497.7	13.7	19	1	
North-West England and North Wales Elec. Scheme, 1928	16/6/28	12/10/28	9,082	10.3	7,130,798	15.9	78	2,114.5	19.4	27	2	
Mid-East England Elec. Scheme, 1929	31/12/28	19/3/29	7,546	8.6	4,914,063	11.0	44	1,244.2	11.4	16	—	
North-East England Elec. Scheme, 1929	13/6/29	22/1/30	5,049	5.7	2,700,589	6.0	20	822.0	7.5	6	—	
South-West England and South Wales Elec. Scheme, 1930	30/12/29	23/5/30	17,090	19.4	6,297,700	14.1	123	771.3	7.1	7	2	
East England Elec. Scheme, 1930	31/3/30	31/7/30	3,438	3.9	782,687	1.7	12	69.2	0.6	2	—	
South Scotland Elec. Scheme, 1930	8/12/30	31/7/31	4,308	4.9	251,702	0.6	4	10.7	0.1	1	5	
Totals, Schemes adopted	—	—	67,632	76.7	43,984,668	98.2	474	10,718.3	98.2	119	16	
<i>Remaining Areas</i> —												
North Scotland	—	—	20,509	23.3	805,817	1.8	21	198.3	1.8	—	—	
GREAT BRITAIN	—	—	88,141	100.0	44,790,485	100.0	495	10,916.6	100.0	—	—	

has served to protect it from a definite recession in power production. In 1931 Great Britain was the one industrial country to show a definite increase in the generation of electricity. A great part of this result has been due to the adoption of progressive promotional schemes by authorised undertakers, notably in the domestic field, and also to the rapid industrialisation, based on electricity, which has been so marked a characteristic of economic progress in South-East England. In some ways the

schemes had already been adopted by the Board; whilst the ninth, namely, that referring to South Scotland, was finally adopted, after much negotiation, on July 31st, 1931. The last remaining area, the North of Scotland, was still being surveyed by the Electricity Commission, and it had not yet been received by the Board. To all intents and purposes, therefore, the whole of the country had been mapped out, and it was possible by the middle of the year to see the country as a single unit, with a programme of

owing to the enormous congestion of population round London and to the great number of housing estates which have come into existence, and are being developed, more than 80 per cent. of all wayleaves required had been obtained. Progress in South-West England is so rapid that, by the early spring of 1932, it may be expected that there also negotiations will be completed. At the end of September, 1931, 1730 miles of transmission lines had been erected with a corresponding number of substations, an increase of 913 miles since December, 1930. Primary lines accounted for 1363 miles, and secondary for 367. Examination of Table II. shows that a number of areas were approaching completion in addition to Central Scotland, notably North-East England and Mid-East England. It was estimated that at the end of December, 1931, a total of 2100 miles would be erected, an increase of 1200 miles during the year, while 3246 miles of wayleaves would be negotiated, representing an increase of 1500 miles, and it was estimated that, by the end of 1932 or the beginning of 1933, the construction period would come to an end.

TABLE II.—Progress Made in the Construction of the "Grid" in the First Three Quarters of 1931.

Scheme area.	Approximate total mileage of routes.	At December 30th, 1930.	At September 30th, 1931.	Total towers erected (miles) at September 30th, 1931.	Lines in operation.	
					Route miles.	Circuit miles.
<i>(i.) Primary Lines—</i>						
Central Scotland	240.6	240.6	240.6	240.6	240.6	296.5
North-East England	91.3	70.0	91.3	82.9	—	—
North-West England	313.0	231.2	299.7	140.8	—	—
Mid-East England	322.7	198.8	319.3	251.3	—	—
Central England	395.5	320.4	392.6	286.1	76.1	83.9
East England	138.1	14.3	137.1	40.4	—	—
South-East England	520.5	301.9	442.3	307.7	149.1	159.3
South-West England	647.0	14.0	299.8	13.7	—	—
Totals	2668.7	1391.2	2222.7	1363.5	465.8	539.7
<i>(ii.) Secondary Lines—</i>						
Central Scotland	19.7	—	18.1	0.4	—	—
North-East England	89.6	30.2	84.8	36.7	—	—
North-West England	263.8	129.0	177.8	100.6	72.9	135.6
Mid-East England	201.1	97.6	191.5	117.9	39.9	39.9
Central England	18.0	17.8	17.9	17.9	15.7	31.3
East England	24.0	—	7.5	—	—	—
South-East England	209.9	71.9	146.4	80.2	67.4	109.8
South-West England	110.0	8.5	15.2	13.2	8.6	17.2
Totals	925.1	355.0	659.2	366.9	204.5	333.8
Grand totals	3593.8	1746.2	2881.9	1730.4	670.3	873.5

interruption in electricity demand has facilitated the work of the Central Electricity Board, since it was not called upon to accelerate unduly construction programmes in any one part of the country, and has been able to maintain a fairly exact balance between the areas comprising the whole of the national power system.

It will be remembered that the purpose of the Central Electricity Board is to co-ordinate the production of electricity in Great Britain in a number of selected highly

development covering the next ten years. The position is shown clearly on Table I., where it will be seen that the most important areas are South-East England, North-West England, Central England, and Mid-East England, all of them comprising the greater bulk of the principal industries of this country. It will also be seen that 119 stations had been selected and provision had been made for sixteen new stations, chief among them being Battersea and Fulham in London, with an ultimate capacity of about

The second and parallel phase in the Board's activities covers the standardisation of frequency. Under the Electricity (Supply) Act of 1926, authorised undertakers operating non-standard systems would be entitled to convert those systems, including consumers' apparatus to the standard frequency, the capital cost of such conversion being met by the Board. The interest on the capital and the sinking fund charges were to be met, however, by a levy on the entire electricity supply industry and transmitted to the Board by the Electricity Commission, the body responsible for carrying out such a levy. The areas affected were the West of Scotland, North-East England and Central England. In the West of Scotland at the end of September, 1931, more than half of the expenditure required in connection with standardisation had been sanctioned by the Board; in North-East England about 40 per cent., in Central England about 33 per cent., and in other areas between 30 and 40 per cent., the total expenditure sanctioned amounting to slightly more than £7,000,000, the half of this figure being represented by North-East England alone. It has been estimated that this work will be completed in about two years' time. The total expenditure incurred by the Board, inclusive of standardisation of frequency, can be given as about £28,000,000, the statistics covering construction programmes alone, without reference to standardisation being given in Table III. It will be seen in this table that South-East England alone represents 36 per cent. and is easily the most important area, followed at some considerable distance by North-West England,

TABLE III.—Total Value of Contracts Entered Into by Scheme Areas in Great Britain as at August 31st, 1931.

Contracts entered into for	Central Scotland.	South-East England.	Central England.	North-West England and North Wales.	Mid-East England.	North-East England.	South-West England and South Wales.	East England.	Totals.
Principal main transmission lines	£ 664,996	£ 1,990,601	£ 990,216	£ 1,018,417	£ 801,383	£ 601,635	£ 1,165,323	£ 303,883	£ 7,536,454
Lower voltage transmission lines	6,105	2,231,698	52,274	414,333	394,017	177,490	61,092	—	3,337,009
Principal transforming stations	994,203	1,837,079	1,224,573	1,367,579	874,396	425,350	838,097	139,858	7,701,135
Lower voltage transforming stations	—	1,082,951	17,206	198,887	222,968	14,011	26,253	6,007	1,568,283
Other works	89,106	226,245	123,868	65,250	61,518	27,210	827	15,300	609,324
Totals	1,754,410	7,368,574	2,408,137	3,064,466	2,354,282	1,245,696	2,091,592	465,048	20,752,205

efficient generating stations, to interlink those generating stations by main transmission lines, operating at 132,000 volts, to establish subsidiary lines at 33,000 volts, to serve important points of distribution, to standardise the frequency of generation at A.C. 50 cycles, and to effect through this work of co-ordination a reduction in the costs of electricity with the widest possible dissemination of such economies as translated into the prices charged by authorised distributors. One can distinguish perhaps three phases in the work of the Board. First, the wayleave and construction phase, when the main and secondary transmission systems were being erected in the ten areas into

400,000 kilowatts each, Clarence Dock in Liverpool, with a similar capacity, and Sir John North at Swansea in South Wales, estimated to house about 120,000 kilowatts. The principal difficulty confronting the programme of construction was the necessity to obtain wayleaves very often against the most determined opposition, since public opinion in Great Britain has, even now, not reached the stage where it recognises electrical development as essential to the prosperity of the country, and is prone to take alarm at any new scheme of a public nature affecting what is known as landscape amenities. The Board has had to carry out the work of initiation and

Central England, Mid-East England and South-West England. The third phase, namely, negotiations with authorised undertakers, has not yet reached the stage where one can select any area other than Central Scotland for special attention. In Central Scotland, as already stated, a "grid" tariff has been introduced, but negotiations with authorised distributors are not yet completed. In all other areas without exception, agreements, largely of a provisional nature, have been made with isolated undertakers without any tariff being yet introduced for an entire area. It may be possible to arrange such a tariff

for South-East England during 1932. On the whole, the progress made by the Central Electricity Board in 1931 has been definitely ahead of programme and it has been attended by few technical difficulties.

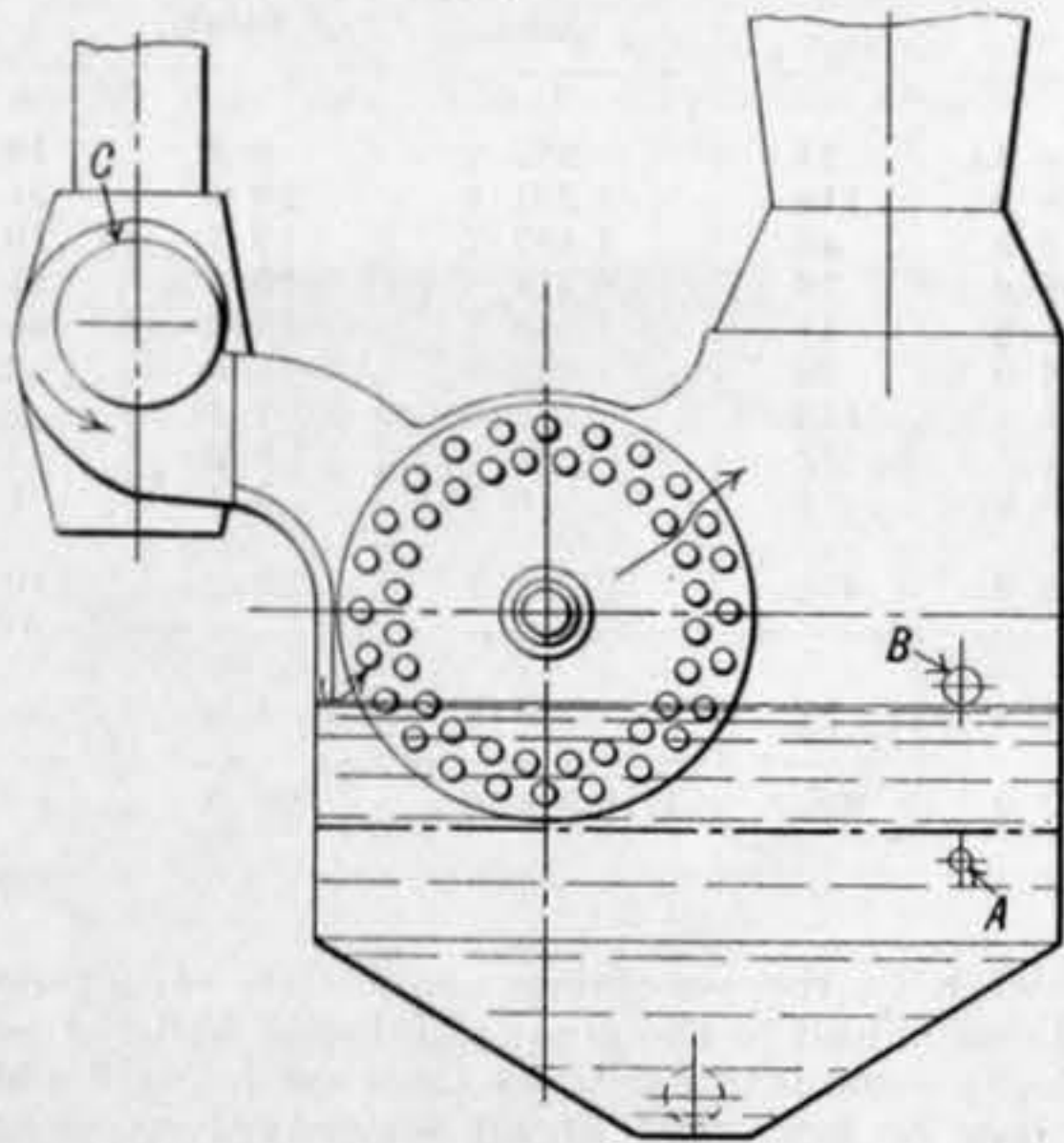
Gas Washers for Electric Power Stations.

By JOHN B. C. KERSHAW, F.I.C., F. Inst. Fuel.

SUPPLEMENTING an article which appeared in THE ENGINEER of May 8th, 1931, particulars are now given of two gas washers which are in use at the Central electric power station for the région Valenciennes-Anzin, in the Département du Nord, France, the results obtained with which are stated to have been entirely satisfactory. It is claimed that a distinct difference is noticeable in the appearance of the gases passing out of the smoke

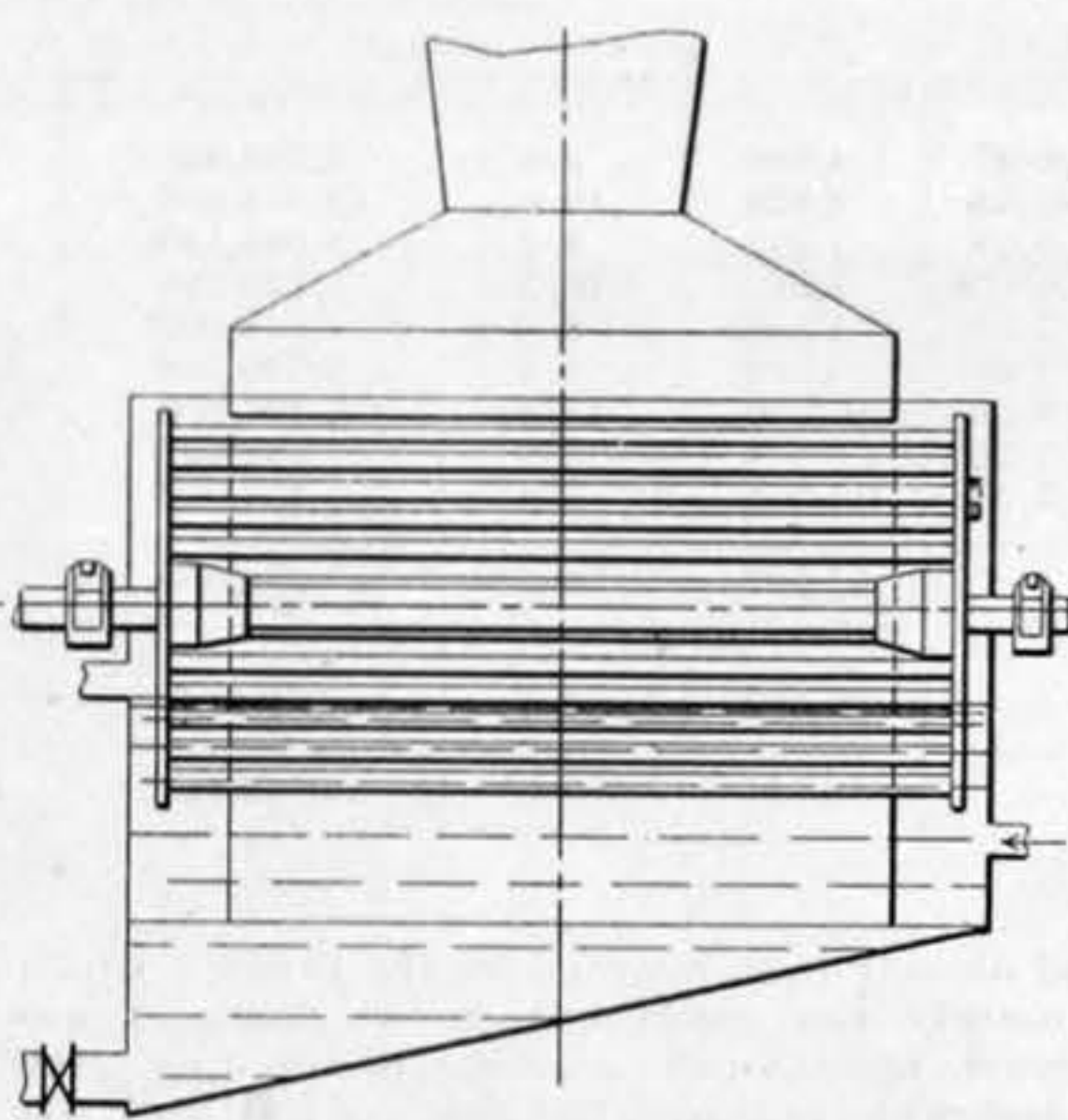
to the bars of the cage, and the solid and gaseous impurities which are caught by the wet bars are then transferred to the wash water in the tank, as the cage revolves. The solid particles of matter settle by gravity and the sludge is removed periodically by opening the run-off cock, shown in the drawing at the lower portion of the tank. A constant level of water is maintained by arranging for a regular feed by the inlet pipe shown at A in Fig. 1, and by the overflow pipe at B, but the amount of fresh water required is small, for little is removed with the sludge, and what is required is chiefly to make up for the moisture carried away by the washed gases. At intervals the water in the wash tank is renewed, and the solution containing the whole of the sulphur acids may either be concentrated for recovery of the acid, or may be treated with an alkali in order to obtain the acids in the form of a neutral salt. This type of washer, therefore, is very well adapted for recovering the sulphur of the coal in some more useful form, such as sodium sulphite or sodium hyposulphite, rather than as the customary worthless salt, calcium sulphate.

In order to increase the effectiveness of the squirrel-



"THE ENGINEER"

FIG. 1—SQUIRREL CAGE GAS WASHER



®

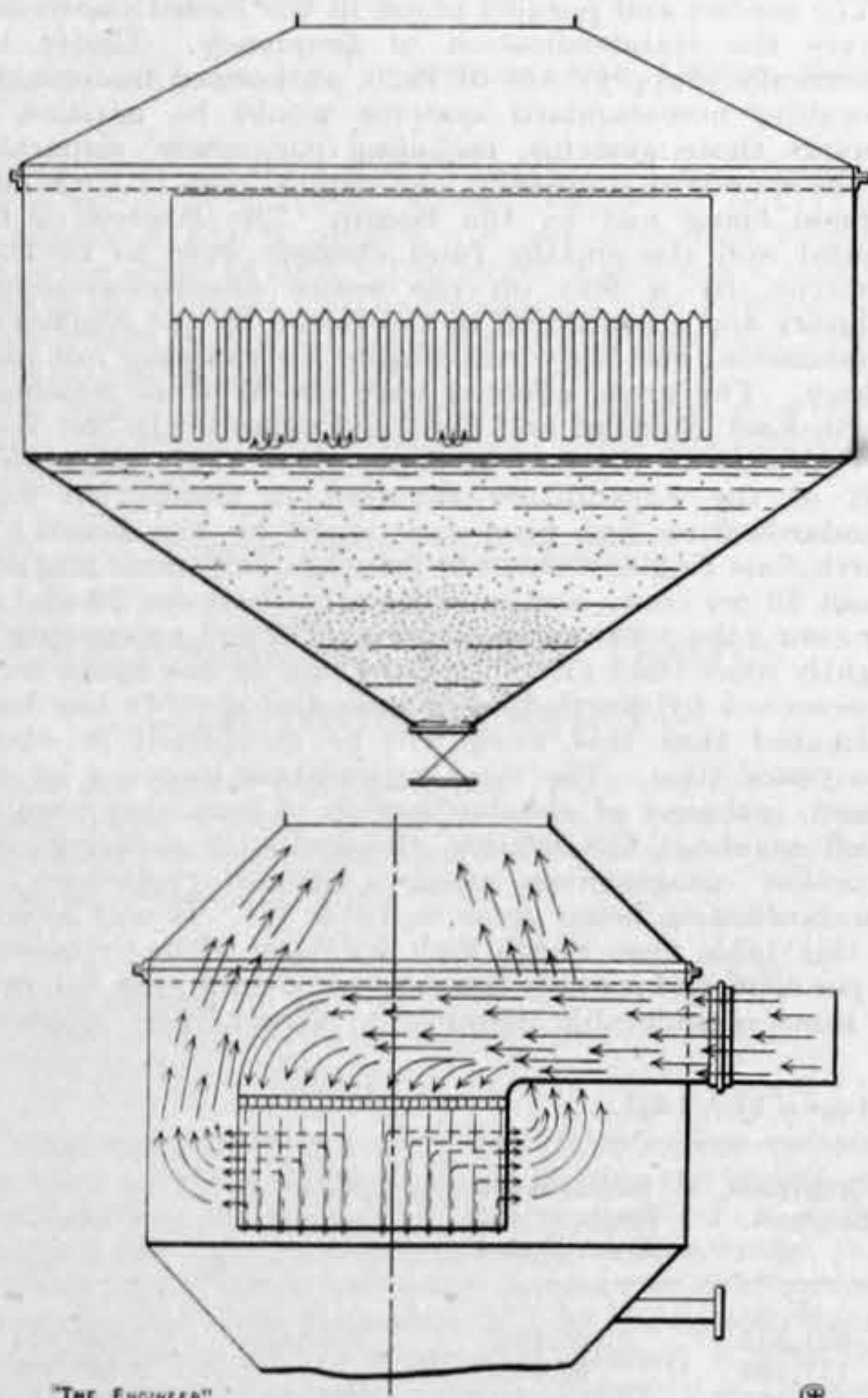
stacks of the power station at Lourches, when the washers are in operation, and at a distance of between 700 and 1000 yards from the chimney the gases are practically invisible.

These washers are of very simple and inexpensive construction, but the leading motive of the engineers concerned in their development was to design a form which would require only a small amount of water for its operation. A further advantage of the new type of washer is that the capital outlay required is small. The cost of a washer, having a capacity sufficient to deal with the gases from a boiler with 400 square metres (4300 square

cage washer at Lourches, a deflecting fan C is placed in the gas delivery flue, in order to direct the flow of gas downwards upon the surface of the water. This leads to removal of the coarser dust particles before the gas comes into contact with the bars of the revolving cage. Corrosion difficulties are overcome either by covering the bars and ends of the cage with sheet lead, or by making use of twisted strands of asbestos in place of metal, for the construction of the cage. Such twisted asbestos strands retain the dust particles better than thin bars of metal, but they ought to be coated with asphalt or tar before use, and both the end plates of the cage and the inner surface of the containing vessel must also be coated with tar in order to prevent corrosion by the acid liquid and gases. This type of washer has now been in use at Lourches for a considerable period, with successful results, and, when desired, its efficiency can be raised by use of a second or third unit, without increasing very seriously the amount of water required to operate it.

Another simple and inexpensive washer which has also been developed and experimented with at Lourches is illustrated in Fig. 2. It consists of a series of flat-shaped tuyeres or blowers, which direct the dust-laden gases at a high velocity directly upon the surface of water contained in the lower portion of the washer. These streams of gas are only 15 mm. to 20 mm. in thickness, and on this account the distance between the lower openings of the tuyeres and the water surface can be reduced to a very small amount without causing turbulence of the water. The uptakes of the apparatus which carry the gases away have double the linear dimensions of the tuyeres, and the gas, therefore, expands considerably and is greatly reduced in velocity before it leaves the washer. This expansion and cooling aids the separation of the dust and other solid impurities of the waste gases.

This, the Haveaux washer, like the Gires squirrel-cage washer, can be operated with a very small supply of water, and it is possible to obtain a fairly concentrated solution of the sulphur acids in the wash water before the latter is removed for treatment. Very little moisture is carried away by the escaping gases, even when the tuyeres are brought within close distance of the surface of the wash water; but it is necessary to maintain a constant level of water in the tank, and the sludge must be removed at intervals by the vent cock shown at the bottom of the diagram.



"THE ENGINEER"

FIG. 2—HAVEAUX GAS WASHER

feet) of internal heating surface, is under 20,000f., including all the necessary alterations to the structure and piping of the boiler-house.

The Squirrel-cage Washer.—A washer, designed by Monsieur P. Gires, the chief engineer of the electric power station at Lourches, was described by the designer in a paper read before the local Electrical Engineering Society, at Lieges, in June last year. It consists of a double squirrel-cage mounted on a horizontal axis in a chamber containing the wash water in such a position that the waste gases are compelled to travel over its bars before they can escape to the chimney. The cage is slowly rotated with its lower part dipping into the water. The arrows in Fig. 1 show the path of the waste gas through the apparatus. A very intimate and close contact is obtained, between the escaping gases and the water, which clings

who are reported to have perfected a process by which ordinary muskeg litter is transformed into a fine quality of insulation material. Experimental work is stated to have advanced sufficiently for the new product to be presented to the building industry. The Carlson process consists of mixing the vegetation with water and boiling, after which it is churned and finds its way to the presses, to emerge as the new building insulation in sheets of various lengths and sizes adaptable to use in building. It is stated that tests have shown that the insulation will not burn unless subjected to a temperature higher than 392 deg. Fah.

New Link in Trans-Canada Telephone.

A new link was forged recently in the proposed trans-Canada telephone system, when Montreal and Winnipeg were brought into direct voice contact over the circuit wires of the Bell Telephone Company and the Manitoba Government Telephone System that will compose the third loop in the all-Canadian chain of talking channels, which is expected to connect Halifax with Vancouver by the end of this year.

British Coal Imports.

Up to the middle of July, British anthracite coal imports through the port of Montreal were over 53,000 tons ahead of last season, the total up to that time being 290,000 tons. With 15,783 tons of German hard coal landed on the harbour wharves since the opening of navigation, the grand total of anthracite brought across the Atlantic was 306,063 tons, or 11,090 more than in the corresponding period of last year. June was a big month in the movement of British coal to Canada, no less than 123,968 tons having been imported in that period, as compared with 80,856 tons in June last year.

Big Fertiliser Plant.

The new superphosphate fertiliser unit at Hamilton, Ontario, of the Groselli Chemical Company, a subsidiary of Canadian Industries, Ltd., has just been put into operation. The annual capacity of the new unit will be 75,000 tons of 16 per cent. superphosphate, stated to be of a new free-flowing type manufactured by a new process.

Control of Radio Broadcasting.

A recent decision of the Supreme Court gives the Dominion exclusive control of radio broadcasting throughout the country. The Dominion has been exercising this control for some years, but its authority was questioned by the province of Quebec, supported by the provinces of Ontario and New Brunswick. The Supreme Court decision gives the Dominion complete jurisdiction on the ground of "convenience amounting to necessity." It is likely that an appeal against the finding will be made to the Privy Council.

Benzine from Turner Valley Gas.

Turner Valley, Alberta, which now yields in the neighbourhood of 1,500,000 barrels of naphtha yearly, may also produce a like amount of benzine in the same period, according to Dr. D. H. Boomer, of the University of Alberta, if experiments carried out at the Institute of Technology, Calgary, prove successful.

Proposed New Fraser River Bridge.

A combined railway and vehicular traffic bridge across the Fraser River, in British Columbia, immediately east of Port Mann, on a direct line of communication between Vancouver and the south, is proposed by the Fraser River Bridge Company. A double-deck steel structure, with a span of 1000ft. across deep water, and the necessary approaches on each side, is suggested. Present plans call for three lines of vehicular traffic on the upper deck, and the suggestion has been put forward that the Canadian National Railways should solve its problem of a permanent entry into Vancouver by using the lower deck.

Progress on Montreal Termini.

With less than a year's work done on the Canadian National Railway terminus scheme at Montreal, a good showing has already been made. Several of the minor unit parts of the undertaking have been finished for some time; others are nearing completion, and the major parts are well under way. In the excavation for the station site, it is estimated that 1,200,000 cubic yards of material will be taken out. At the time of writing—the middle of August—660,000 cubic yards had been removed. The foundations of the four-track vertical lift bridge to be constructed over the Lachine Canal are completed, and the most troublesome part of the work on the undertaking has been surmounted.

English Syndicate to Work Gold Claims.

The decision of the Amisk Gold Syndicate to construct a 100-ton mill to work gold claims in the Amisk Lake—formerly Beaver Lake—area of the Province of Saskatchewan, marks the introduction of English capital into Saskatchewan's north. Investigations extending over several months have determined the syndicate to make a substantial investment in the area, and machinery for the mill, to be erected this autumn, will, it is reported, be shipped from England.

Vancouver Opens New Air Port.

The first unit of Vancouver's new municipal air port on Sea Island, which provides facilities for both land and sea planes, was officially opened towards the end of July. The air port site occupies 469 acres on the south side of the island, which is at the mouth of the North Arm of the Fraser River, and provides ample space for the future development of this important air terminus. Present development includes the administration building, one land plane and one sea plane hangar, and east-west and north-south runways.

Canadian Engineering News.

Copper Refinery Starts Operations.

A NEW page in the history of Montreal's industrial development was opened recently when operations were officially started in the new 3,000,000-dollar copper refinery of the Canadian Copper Refiners, Ltd., in Montreal East. The plant covers an area of more than 275,000 square feet, and houses all the complicated apparatus necessary to refine the raw material, and separate the copper from the silver found in the same ore. With a capacity of about 75,000 tons of copper a year and about 720,000 oz. of silver a year, it ranks as an important industry, and has an employment capacity of 300.

New Insulation Material.

Commercial utilisation of muskeg vegetation, plentiful enough in Northern Alberta, is seen as an immediate probability following the development of a new building insulator called "Mosstex," by two Edmonton men, J. Victor Carlson, and his son Arthur V. Carlson,

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Hope Renewed.

THERE is an improved activity in various fields of Midland and Staffordshire industry, and it would appear that the trade tide has turned. The way is now clear for the country to go ahead with its reconstruction schemes, and with hope renewed, zeal and energy have been redoubled in an effort to get the trade ship well under weigh. Optimism has been increased by the numerous inquiries which have come in during the past week. Many of these relate to supplies of manufacturers, such as the Midland—and particularly the Birmingham—district specialises in, and some of which have hitherto been unable to compete in the export markets with similar goods made in other countries. Already encouraging orders are accruing. This movement, together with the active steps being taken to strengthen stocks, alike of raw materials and manufactures, has necessitated the engaging of additional hands at many of the factories, foundries, mills, and workshops in this district. The improvement in business, though not so spectacular as the daily Press would have us to believe, is, nevertheless, real and encouraging, and embraces alike the heavy and the lighter trades. Iron and steel sales are better, the engineering trades, heavy and light, are slightly more active; foundries are turning out more castings; while reports from the steel sheet mills, the hardware and hollowware and the metalware factories all encourage optimism. Confidence in the future is fast returning, and as far as this district is concerned, it probably only requires the pronouncement of the new Government's policy on tariffs to herald a new era of prosperity for the Midlands and Staffordshire. Producers and consumers are expecting a gradual, if not rapid, restoration to the flourishing conditions of old times, and it is to be hoped they will not be disappointed. They are certainly prepared to do all in their power to bring about such a desirable state of affairs, and I am convinced that the necessary energy and enterprise are not lacking.

Factory Sites Wanted in Birmingham.

With these indications of a revival in trade, Birmingham bids fair to become an even larger manufacturing centre than it is to-day. Within the past few weeks inquiries have been received by the City Information Bureau from fifteen English firms for factory sites in Birmingham, a number of which are from local manufacturers desirous of securing larger premises. It is not only from home sources, however, that inquiries are to hand. The interest that foreign firms are taking in Birmingham as a suitable centre for the manufacture of goods in this country is shown by the fact that fourteen continental and American firms are contemplating opening works in the city. Among the countries represented, definite applications to the Bureau for premises and sites have been received from France, Germany, and Holland, while there have been tentative inquiries from the United States, Sweden, and Belgium. Four foreign firms have actually acquired factories in Birmingham during the past few weeks.

Greater Use of Metallurgists.

Pleas for the greater use of metallurgists in industry, and for co-ordination amongst the different branches of metallurgy, were made in Birmingham on Saturday last at the annual dinner of the Co-ordinating Committee representing the Staffordshire Iron and Steel Institute, the Birmingham Metallurgical Society, and the local section of the Institute of Metals. The Lord Mayor of Birmingham (Alderman W. W. Saunders), having reminded them that Birmingham made its reputation as a centre of hardware manufacture, said the science of metallurgy was a vital part of the hardware industry, and the work of the metallurgical chemist was one of the great rocks on which the industry was constituted. The metallurgical experts were the men behind the scenes, but their work was of the greatest importance. Mr. W. F. Brazener, Chairman of the Committee, complained that frequently industrialists in that and other cities did not make sufficient use of their metallurgists. They were regarded more or less as doctors or dentists, and were applied to when things were getting desperate. As the industries of Birmingham were built up mainly on metal products, everyone would see that the metallurgist ought to be called in or ought to be on the spot to advise and control the operations in connection with metals. Mr. Seligman, in making an appeal for co-ordination, said that with a little hard thinking now and a little activity in the future, they could get between them one central organisation which would control all those activities which were for the benefit of them all. So they would bring about order where there was now confusion, increase the service of metallurgy and decrease the burdens of the metallurgist.

Production Engineers.

Sir Herbert Austin, speaking as President at the annual dinner of the Institute of Production Engineers in Birmingham on Saturday last, expressed the view that it would be a good thing if they could conveniently and without too much delay, lay down the limitations and the necessary activities of a production engineer. We were becoming more specialised every year, and it was a great advantage to specialise in a particular branch of engineering. He believed the success of the production engineer was going to be very largely in proportion to his satisfactory relations with the other branches of the business. Successful contact between the production engineer and the designer and the sales manager did not only mean personal contact in their particular works, but it meant their keeping in touch as an institution with the other institutions that controlled the destinies of the designer or the salesman, and discussing with them each other's difficulties. There was no doubt, said Sir Herbert, that the production engineer was going to be a very necessary factor in future manufacture. He advised the Insti-

tution to keep the membership as high in quality as possible.

Coventry Engineering.

Coventry engineering industries are becoming increasingly busy, and manufacturers in practically all branches of trade in the city are optimistic as to the future. Automobile engineers report that inquiries and orders are coming in briskly, both on home and export account, and sheet metal works and automobile accessory producers are experiencing greater calls from the parent industry. The electrical trades are favourably placed, while tool makers maintain a reasonably high rate of output. On the whole, the outlook for Coventry industries is considered to be bright.

Coventry Works Fire.

A destructive fire occurred at the automobile engineering works of Riley (Coventry), Ltd., on the 30th ult. The repairs and service departments and departmental offices were severely damaged, and a number of cars destroyed. Fortunately, the fire was prevented from spreading, and the production departments were saved. The damage is estimated roughly at £10,000. The fact that the production shops were not involved means much to Coventry, for the works, which employ many hands, are working at high pressure. Production has not been interrupted, and the repair and service work has been transferred to another section of the factory.

Raw Iron Prices.

The action of the Central Pig Iron Producers' Association in reaffirming recent selling rates has encouraged the market in the belief that producers hold the opinion that trade development should be encouraged by keeping prices down. Recent increases in blast-furnace production costs, combined with an improved demand, might easily have led smelters to a very different decision. Indeed, recent inquiries for supplies of pig iron over long periods suggested that some buyers anticipated a rise in values. The producers refusal to do business, led one to believe that they also contemplated better prices. The policy of the Association is commended on 'Change in Birmingham, and business this week has proceeded as in recent weeks, and was of an encouraging nature. Consumers show a greater readiness to specify deliveries against existing contracts which in many cases cover their requirements to the end of the year. Offers of contracts for the first quarter of next year at an advance of half a crown on present prices have not been readily taken up. Furnacemen generally are not prepared to commit themselves into 1932. Derbyshire, North Staffordshire, and Northamptonshire furnaces are fairly well engaged, and sales of odd lots are being made at the official minimum selling rates, as follow:—Northamptonshire forge, £2 17s. 6d.; No. 1 foundry, £3 5s. 6d.; No. 2, £3 4s. 6d.; No. 3, £3 2s. 6d.; No. 4, £3 1s. 6d.; Derbyshire forge, £3 1s.; No. 1 foundry, £3 9s.; No. 3, £3 8s.; No. 3, £3 6s.; No. 4, £3 5s.—delivered at stations in the Black Country and subject to rebate.

Steel.

Steel works have booked more business than of late, and although this applies particularly to semi-finished material and the smaller sizes of finished bars and sections, it is also true to a smaller extent as regards heavy material. Structural steel has been sold on a larger scale, but satisfactory specifications are not coming in. There is slightly more work in the heavy engineering and the jobbing foundries in this area, while the brisker conditions noted in recent weeks in the light castings trade are maintained. Values are unchanged, being in accordance with the list set out by the Steelmasters' Association. Boiler plates, which are not subject to control, are £8 17s. 6d. per ton. In the half-products department local steelmasters have secured some business as a result of the difficulty of dealing with continental firms. Foreign trade is virtually at a standstill, except for spot lots that continue to be offered for prompt delivery, subject to transport facilities. Native producers quote small re-rolled bars £6 17s. 6d. to £7, and all-British bars up to £7 10s. Billets sell at last week's figure of £5 5s. to £5 10s., while Staffordshire hoops make £9 10s.

Finished Iron.

The finished iron trade of South Staffordshire remains outside the small buying movement noticeable in other branches of the market, but the strip mills have certainly more to do than they had a few weeks ago, and manufacturers take a more hopeful view. Iron strip may be obtained at £10 10s. to £10 12s. 6d. per ton. Marked bar prices are unchanged at £12 per ton, and makers would welcome an improvement in business. The position in the Crown and common bar branches is unaltered and unsatisfactory, the latter, despite the fact that continental business is almost at a standstill. There have been a few sales on a sterling basis, though there would appear to be a wide variation in quotations. The threat of a tariff is keeping customers off the market. Complications may arise in regard to buying and selling, and the average buyer does not want to be involved.

Galvanised Sheets.

The minimum price acceptable for 24 gauge galvanised corrugated sheets has fallen by a further half-crown to £9 10s. Only substantial orders would be taken at this rate, other business being subject to the higher quotation of £9 12s. 6d. and £9 15s. Mills are moderately well employed, but are prepared to sacrifice a little to enable them to run their plants to capacity. There has been some increase of business in tin-plates in this district on the week. Quotations range from 14s. to 14s. 6d.

Steel Scrap.

Steel scrap is a very difficult market. Prices appreciated a short time ago, but users are not prepared to pay the higher scale, except for delivery six months or so ahead, on the assumption that by then there will have

been a general advance in prices of scrap metal. Orders for prompt delivery are very scarce.

Unemployment.

The unemployment figures for the Midland area continue to decline and the increased activity of recent weeks, as shown by the reabsorption of labour into industry, compares very favourably with the betterment going on in other parts of the country. The most recent decline is one of 10,712, bringing the total for the district down to 369,958. Of these, 271,190 are wholly unemployed, and of the grand total, 262,220 are male adults. The Birmingham figures now stand at 69,642, Coventry 13,198, Nottingham 14,870, Walsall 10,038, Wolverhampton 15,821, Leicester 12,199, and Derby 10,487. In the Stoke-on-Trent area there has been a rise on the week of 160; Oldbury also is in a slightly worse position than it was.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

"Bull" Points.

It is now possible to point definitely in several directions to a gradual improvement in Lancashire engineering. The biggest actual contract announced during the past week has, of course, been that placed by the Central Electricity Board with British Insulated Cables, Ltd., Prescott, for £337,000 worth of transmission line material. Certain textile machinery manufacturers in the county have better order books, and these have been reflected in more than one instance in departments reverting to full-time working after varying periods of inactivity. In one case a firm of loom makers is reported to have gone on to full-time with about two-thirds of its normal staff, after being on short-time for nearly six years. Locomotive builders generally are no better situated, although one local firm in this branch has secured an Indian order for locomotive boilers, and an inquiry from Ireland is also being dealt with. A number of machine tool makers are better placed, and further improvement is expected. A director of one of the leading concerns in the machine tool trade is anticipating a busier time coming along during the next few months than they have experienced for several years. A South African order for railway wheels and axles has been secured by a Trafford Park concern, and marked activity is reported among Lancashire engineering firms producing heavy-oil engines and motor vehicles that are being equipped with them. Finally, it may be stated that this district has hopes of securing substantial orders from China for textile and other types of industrial plant.

An Industry of Promise.

The Imperial Fruit Show, which opened at the City Exhibition Hall, Manchester, last Friday, and the fifth annual convention of the National Food Canning Council held in connection therewith, have between them served to focus attention on a little-known branch of Lancashire engineering which seems to offer prospects of substantial development. Canneries in this country have grown from about six in 1925 to forty-one at the present time, and the total capital invested in these now amounts to about £4,250,000. Mather and Platt, Ltd., engineers, of Newton Heath, Manchester, who are said to be the biggest manufacturers of canning machinery in the country, have played a prominent part in this development, and are likely to continue to do so in view of the extensions to capacity that are planned by existing canneries and the new canning factories that are contemplated. Mr. H. W. Packer, secretary of the Food Canning Council, stated this week that Manchester is likely to become the manufacturing centre for canning machinery, not only for Great Britain but for the rest of the Empire. American plant, so far as canneries in this country are concerned, has been virtually displaced by British. Delegates to the Canning Conference visited the works of Messrs. Mather and Platt on Wednesday of this week.

Manchester-Budapest.

The first consignment of heavy electrical plant which the Metropolitan-Vickers Electrical Company, Trafford Park, Manchester, are making for the Hungarian State Railways, left here last week on its direct journey, via the Harwich-Zeebrugge train ferry, to Budapest, and thus inaugurated a new era in international railway transport. The contract covers a total of about 1400 tons of plant, including transformers, switchgear, and motors, and further consignments for the 1200-mile "door-to-door" journey will be made at intervals.

Road and Bridge Expenditure.

Lancashire Highways and Bridges Committee in a report to be presented to the County Council on Thursday of this week recommend that on schemes involving the widening of existing roads only the work necessary to put the roads in safe condition shall be proceeded with. Other plans are postponed, and altogether substantial economies on road and bridge expenditure are to be effected.

Personal.

Mr. W. A. Dearden, engineer and manager of the Johnstone Corporation gasworks, has been appointed to succeed Mr. G. Dixon, who has accepted the post of gas engineer at Nottingham, as manager of the Lancaster Corporation gas undertaking. Mr. T. W. Hall, of 7, Green-leach-lane, Worsley, late with the Stafford Coal and Iron Company, Stoke-on-Trent, has joined the firm of R. G. Stone and Co., London, as selling agent for Shelton pig iron in the Lancashire, Yorkshire, and Cheshire area.

Non-ferrous Metals.

After the previous week's halt in non-ferrous metals, there has been a further upward movement in all

sections during the past week. There has been a certain amount of fluctuation in the case of tin, and the highest point touched has not been maintained. On the other hand, the opening days of the present week saw a recovery from the closing price last week-end, and prices finished up about £2 higher on balance. Prospects for tin consumption in this country are not unsatisfactory, and, notwithstanding the fact that there is no indication at the moment of the United States demand picking up, a rather "bullish" view of the statistical position is being taken. No decision has yet been reached in America by the conference which has been considering the problem of reducing the production of copper. A fairly active demand for the metal, both here and in America, was succeeded later in the week by appreciably quieter conditions. Neither these nor the present uncertain outlook have brought down quotations for standard, which is dearer by about 5s. a ton. The biggest relative increase has been in lead, which has moved up to the extent of 10s. a ton. This has been due less to any pressure of demand than to the fact that supplies of the metal at the moment are comparatively limited. Inquiry for spelter has only been moderate, but the Cartel's decision to curtail output further has stiffened values by about 7s. 6d. a ton.

Iron and Steel.

The movement of foundry iron in Lancashire is developing satisfactorily so far as actual consumption is concerned, and altogether deliveries are heavier than they were less than two months ago. Forward buying interest in the metal seems to be concentrating now on the first three months of next year, and Midland makers are willing now to book over that period at to-day's prices. Already, a number of the better-situated foundries have covered their requirements thus far. For delivery in the Manchester district, Staffordshire, Derbyshire, and Cleveland brands of pig iron are maintained at 67s. per ton, with Northamptonshire at 65s. 6d., Scottish makes at about 87s., and West Coast hematite at 81s. Lancashire bar iron is in moderate request at £9 15s. per ton for Crown quality material and £8 5s. for seconds. Rollers of constructional steel continue to complain of the poor demand locally, and except for a fair movement of special alloy varieties, there has not been much improvement in steel generally, recent business having been limited to relatively small tonnages of plates and bars. Large bars are quoted at £9 7s. 6d. per ton, small re-rolled sorts at about £7, sections at £8 7s. 6d., joists at £8 15s., acid and basic boiler plates at up to £8 17s. 6d., and tank plates at £8 17s. 6d.

BARROW-IN-FURNACE.

Hematite.

There is not the same number of orders being placed with North-Western iron producers, but that fact need not cause any apprehension, for in most cases buyers have assured their supplies for some time ahead. It has been stated that the stocks, which had accumulated to over 150,000 tons during the slack period, had been cleared, but that is not correct. Stocks still exist. Some of the material, it is true, is awaiting orders for delivery, but there is a certain tonnage still unsold. If there had been an entire clearance the Ulverston Works, which had a big stock on hand before damping down, would have restarted by now. It will not be long before they do, for they have already received a fairly big cargo of foreign ore. With the steel departments temporarily idle at Workington there is more iron available from that district. The local iron ore trade is increasing, but there is still any amount of room for improvement. More furnaces may go in later, and that will improve business. The steel market is dull. Workington has not sufficient work to keep on continually on rails, sleepers, and fish-plates. Barrow rail mills are still working. Hoops and small sections are experiencing a fair trade.

SHEFFIELD.

(From our own Correspondent.)

Signs of Progress.

THE trade situation in Sheffield appears to be improving, but the progress so far is not marked, and it would, perhaps, be hardly correct to say that the tide has definitely turned yet. However, the signs are there, and they are inspiring confidence in the future. Apart from actual trade advances, there are one or two indications which give hope. One of these is the re-creation in the markets of the world, as a result of the General Election, of confidence in the financial stability of Great Britain. The Secretary of the Chamber of Commerce points out that this confidence is one of the most important factors on which our trade depends. A resumption of buying may be expected, and, as the world is understocked with goods at present that resumption should be of benefit to Sheffield, which, as the result of reorganisation and reduction of production costs, is in a favourable position to take full advantage of the changed situation. The Chamber has received inquiries from overseas firms which wish to represent British industries, since they believe that Sheffield's competitive powers have been increased as a result of the difference in the exchanges. Inquiries have also come from firms abroad which are considering the possibility of erecting works in this country for the manufacture of commodities which, up to the present, have been imported. It is assumed that this is being done in anticipation that steps will be taken by the new Government to balance the country's trade account by some restriction of imports. The Chamber is compiling a list of Sheffield firms which have works or sites to dispose of, and it has also appointed a very strong committee to deal with any questions that may arise out of possible changes in the country's fiscal system.

Condition of the Works.

Steel consumers are showing their confidence by giving orders to cover future requirements, and, in consequence, the tonnage of billets and similar material

now on the books of local steel firms is larger than it has been for a long period. Inquiries are also more numerous than usual. There is no improvement to report in the heavy engineering, railway or shipbuilding steel departments. The demand for stainless and kindred steels, although it has kept up to a large volume, has tended to fall off lately, but is now recovering. The requirements of the automobile builders remain at about recent levels. In the lighter steel branches, a better tone characterises the export side, as overseas buyers can now obtain these materials at a reduction of about 20 per cent. compared with the days when we were on the gold standard. The tool makers are expecting to reap a good profit from the altered value of sterling as it is likely to make imported tools dearer. A good trade in American and German tools is done in this country, and it is thought that a lot of this trade will now be diverted to home producers.

Some Orders.

A few contracts of interest have been announced during the past week. The Union of South Africa Railways and Harbours Department has ordered wagon axles from Brown Bayley's Steel Works, Ltd., Sheffield, and from John Baker and Bessemer, Ltd., Rotherham. Orders for tool steel required by the Egyptian State Railways have been placed with Arthur Balfour and Co., Ltd., Thos. Firth and John Brown, Ltd., and Samuel Osborn and Co., Ltd., all of Sheffield. Robert Jenkins and Co., Ltd., of Rotherham, have received an order from Boots Ltd. for stainless steel and mild steel vessels, of a total value of nearly £12,000.

A Disappointing Report.

The very adverse conditions with which Sheffield trade has had to contend during the past twelve months have been shown by many company reports, and are again emphasised by the report of Samuel Osborn and Co., Ltd., for the year ended July 31st. The directors state that the depression experienced during the latter part of the previous financial year was accentuated during the whole of the period under review. Competition was keener than ever, and many orders were obtainable only at unremunerative prices. The profit was only £2461, as against £35,291 for the year 1929-30, and £44,301 for 1928-9. No ordinary dividend is recommended, as compared with 7 per cent. in each of the last two years. A balance of £10,069 is carried forward.

Umbrella Frames in Demand.

At Stocksbridge, near Sheffield, are the works of S. Fox and Co., Ltd.—one of the constituent firms of United Steels, Ltd.—which, although they have for many years held a leading position in the heavy steel industry, have a still older reputation as the original home of the steel umbrella frame. Mr. Samuel Fox was the first manufacturer in the country to employ steel wire for these frames, which were previously made of whale-bone. As a result of some specialised advertising, this branch of Messrs. Fox's business is at present enjoying great activity. Production has been increased by 100 per cent., and in some sections of the plant by as much as 400 per cent. The plant, which is being extended, is running overtime, and has prospects of maintaining full time throughout next year. The wire is rolled and drawn from steel melted at the Stocksbridge works.

Cotton Progress.

Sheffield, as the producer of steel for all kinds of machinery, is interested in the progress of any industry, and is therefore pleased to hear of improvement in the cotton trade at mills in the Peak district, not far from the city. The Cotton Doubling Mills, of Litton, near Tideswell, which have been closed for over twelve months, have been reopened on full time, and orders on hand will necessitate the working of two shifts per day for three months. The neighbouring Cressbrook mill, which has been working short time for over two years, has also been placed on full time. Both these mills are owned by Matthew Dickie and Co., Ltd.

Cutlery and Plate.

Although the usual Christmas season rush of orders has not developed, and the general condition of these trades is one of quietude, there is more doing than there was a month ago. Last week's returns of unemployment in the city showed a fall of 1068—although the total is still the staggering one of 56,317—and this decrease was attributed, in part, to improvement in the cutlery trade. The special Christmas export demand has finished, but now that the General Election is out of the way, more orders are expected from home distributors. There is an improvement in the scissors branch. This trade suffered from German competition when the Safeguarding Duty on cutlery was allowed to lapse, but it is now recovering at the expense of that country, as the low rate of exchange makes German scissors nearly as expensive as those of Sheffield. For the same reason sales of safety razor blades are increasing, and the trade in German blades has fallen very greatly. There is a great deal of price-cutting in the cutlery trade, and much of the work done is unremunerative. For the time of the year, demand for silver ware continues poor. The increased price of silver is being reflected in higher costs of making sterling silver goods, and of electro-plating, but the prices of spoon and fork blanks have not yet gone up, in spite of the heavy advances in nickel and copper.

NORTH OF ENGLAND.

(From our own Correspondent.)

More Work for North-East.

INDUSTRIAL prospects in the North of England are distinctly brighter. The change for the better in the iron and steel trades is reflected to some extent in the slight increase of exports. At the moment the total volume of trade passing is not heavy, but a very hopeful

tone pervades all sections of the market, and steady expansion of inquiry is noticeable. Prospects are also more encouraging in the shipbuilding and marine engineering industries. This week William Gray and Co., Ltd., of West Hartlepool, have booked another order for a 9000-ton steamer for J. and C. Harrison and Co., of London. This makes three vessels of the same deadweight tonnage, which Messrs. Gray have on their books for the London firm, and brings the total number of vessels which the West Hartlepool firm has on order up to six, with an aggregate deadweight tonnage of about 53,000 tons. Two of the vessels are under construction at the present time, and the prospect for the coming winter for shipyard workers in the Hartlepoons is decidedly brighter than that of a year ago. In each case the propelling and other machinery will be constructed by the Central Marine Engine Works, West Hartlepool. Contracts have been awarded by the L.N.E.R. Company to Smith, Patterson and Co., of Blydon, for 1000 tons of cast iron chairs, and to the Anderston Foundry Company, Port Clarence, Middlesbrough, for 500 tons of similar material. These orders are in connection with renewal and maintenance of permanent way on the L.N.E.R.

Iron and Steel Exports Higher.

Although it was only at the end of September that Britain went off the gold standard, the effect on Cleveland's export trade in iron and steel is already noticeable. During the past month the total tonnage shipped was 45,447 tons, compared with 36,821 tons in the previous month. Though the increase is not large, it is anticipated that shipments will continue to expand, as orders already booked and others in prospect are due for delivery. The pig iron shipments have been more immediately responsive to the altered conditions. These total 15,901 tons, which is the highest figure recorded since October of last year. The coastwise shipments, which reached 8336 tons, fell 101 tons short of the previous best this year—in June last—and the delivery of 5549 tons of pig iron to Scotland is the heaviest since last November. Despatches of pig iron to foreign ports advanced from 3831 tons in September to 7515 tons in October, and included 2450 tons to Denmark, 1630 tons to Germany, 700 tons to Italy, 542 tons to Norway, 430 tons to China and Japan, 506 tons to Holland, and 449 tons to Belgium. The manufactured iron and steel shipments advanced from 26,367 tons to 29,546 tons, a decline in the coastwise shipments from 14,531 tons to 9249 tons being more than counterbalanced by an increase in the exports overseas from 11,636 tons to 20,297 tons. Of this latter figure, 11,668 tons went to South and East African ports, and 1234 tons to India and Ceylon, while a shipment of 1425 tons to Canada is believed to be the forerunner of more trade with the Dominion.

Imports Down.

The imports of iron and steel last month to the Tees amounted to 15,036 tons, compared with 15,592 tons in September and 21,182 tons in October last year. The heaviest decline was in pig iron at 636 tons, compared with 1675 tons in September, and 5594 tons in October last year. Imports for the twelve months ended October 31st from overseas and coastwise reached 171,740 tons, comprising 25,660 tons of pig iron, 125,373 tons of crude steel bars, billets, blooms, and slabs, and 20,707 tons of plates, bars, angles, rails, sheets, and joists. For the corresponding period a year ago the unloadings were 158,190 tons, comprising 17,262 tons of pig iron, 106,176 tons of crude sheet bars, &c., and 34,752 tons of plates, bars, angles, &c., and for the twelve months just prior to the war imports totalled 54,564 tons, comprising 1427 tons of pig iron, 33,655 tons of crude sheet bars, &c., and 19,482 tons of plates, bars, &c.

Cleveland Iron Trade.

No substantial expansion of business can yet be reported in the Cleveland pig iron trade. More inquiries are circulating, and it is believed that industrial needs are on a heavier scale, but new orders mature slowly. However, ironmasters are well able to wait, and there is every confidence that the position will continue to improve. This improvement is not being jeopardised by an advance in prices, and though costs of production are high, ironmasters are still accepting business at the fixed minimum rates. No. 1 Cleveland foundry iron is 61s.; No. 3 G.M.B., 58s. 6d.; No. 4 foundry, 57s. 6d.; and No. 4 forge, 57s.

Hematite Pig Iron.

Conditions in the East Coast hematite pig iron trade are gradually changing for the better. Stocks at makers' yards are still inconveniently large, but are decreasing at a gratifying rate. Output is shortly to be enlarged by an additional furnace going into blast. Ordinary qualities are put at 66s., but buyers claim they can buy at rather less.

Iron-making Materials.

There is little or no demand for foreign ore, but sellers' prices tend to advance, and 17s. 6d. c.i.f. Tees is now quoted for best Rubio. The coke trade is dull, and good blast-furnace qualities are offered at 17s. to 17s. 6d. delivered at the works.

Manufactured Iron and Steel.

Business expands slowly in the manufactured iron and steel trade, and producers would welcome a freer flow of specifications. The sheet trade is quieter, and galvanised sheets, 24 gauge, have receded to £9 15s. All other quotations are unchanged.

The Coal Trade.

The Northern coal trade position is somewhat disappointing, and the prospects for the month much below normal anticipation. There is an absence of inquiry, and nearly all the collieries are looking for trade. Some producers have sold a fair amount of output over the early part of next year on the basis of minimum prices, and others have refrained from doing so in anticipation of

prices rising. Time alone will show which of the two policies was the better. In the past it has often proved to be a wise course to take business up to a certain amount when it is offered, and so ensure steady working to a definite extent, keeping in hand a reserve of output for any appreciation in the market that may take place. The risk of not booking business is that there may be little of it to get when the day of urgent need is at hand. At the moment, the pits are working well on old contracts, but they require immediately more orders for almost every class of fuel. Home trade is quiet, and there is very little inquiry from abroad. The spurt in business a month ago has spent itself, and sellers are keenly on the look-out for customers. At the present rates of exchange British coals abroad are nearer to the prices of competitors than they have ever been, but stocks are so heavy in continental countries that demand has not had a chance to assert itself. Northumberland steam coals are now readily available for any date of shipment, and prices are in buyers' favour at 13s. 6d. to 13s. 9d., as compared with 14s. 3d. a week ago. Sellers find it difficult to attract buyers, even at the lower values. Tyne prime and Durham prime steams are quoted unchanged, but all are in need of trade. Prices remain respectively at 13s. and 15s. Small steam coals are abundant at 8s. 6d. Durham gas coals are inactive, and the pits producing them, like those yielding steams are working largely on business obtained some weeks ago. Best qualities offer at 14s. 6d. to 14s. 9d., and secondary at 13s. 6d. Durham coking unscreened and small are plentiful at 13s. to 13s. 6d., and inquiry is meagre. Unscreened bunkers move slowly, best being steady at 13s. 6d. to 14s., and seconds 13s. to 13s. 3d. Gas coke is in moderate supply, and quoted steadily at 19s. Patent oven coke is slow trade, and under ample stocks prices rule easy at 16s. 6d. to 17s.

SCOTLAND.

(From our own Correspondent.)

Shipbuilding.

The shipbuilding output from Clyde yards during the month of October only amounted to three vessels of 5849 tons aggregate, a total which speaks eloquently of the small amount of work on hand in those yards. Nevertheless, the output was noteworthy in that it included the "Dubrovnik," constructed for the Yugoslav Navy, the largest and fastest flotilla leader built in this country. This vessel has a displacement of 2400 tons and is designed to attain a speed of at least 37 knots. So far as new contracts are concerned, October has been one of the best months this year. Messrs. Lithgows, of Port-Glasgow, are to build a cargo vessel of 9100 tons for Messrs. J. and C. Harrison, London; Alex. Stephen and Sons, Ltd., of Govan, a cargo steamer of 8000 tons for French owners, and D. and W. Henderson and Co., Ltd., of Partick, a cargo steamer of 6800 tons for Messrs. H. Hogarth and Sons, of Glasgow. Then Harland and Wolff, Ltd., are to build for the L.M.S. Railway a sister ship to the Clyde pleasure steamer "Duchess of Montrose." This vessel will be built at Govan. The inquiry for new tonnage, mainly for cargo vessels, has improved a little during the past few weeks.

Steel.

There is as yet no change in the position of the steel industry. Plants continue to run slowly, the total output being only about 30 per cent. of the capacity. Heavy material is poorly specified and other classes are only slightly better off. Makers, however, hope for better demands from shipbuilders. The improvement in sheets is maintained. Several good orders for black and light galvanised sheets have been secured, and one firm, at least, in the West of Scotland, has its rolling mills working on full time. Tubes are comparatively quiet, but it is reported that one firm has received an important order for pipes for Africa.

Iron.

Wrought iron makers have been busy of late on orders for skelp for Canada, but that business is practically over for this season. Bar iron and re-rolled steel are very quiet. The latter is still quoted £6 10s. per ton, home or export.

Pig Iron.

It was expected that pig iron would benefit from the depreciation of sterling, but, up to date, no advantage is noticeable. Only three furnaces are in blast and supplies are still ample. During the week 1200 tons were unloaded at Bowling from Millom and Barrow, while shipments amounted to 564 tons (479 tons foreign), compared with 521 tons (485 tons foreign) in the same week last year.

Contract for Aberdeen.

In face of very keen competition, John M. Henderson and Co., Ltd., Aberdeen, have secured an order for three travelling cranes and auxiliaries from the North-Western Railway Company, Lahore, India. The total weight of the three cranes and auxiliaries amounts to almost 140 tons.

Scrap.

The advance in scrap is fully maintained, cast iron machinery being still quoted 52s. 6d. and heavy steel 40s. per ton.

Coal.

Owing, in a measure, to the instability of sterling and increased competition from Poland, the export demand for Scottish coal has again dropped to comparatively small quantities for immediate shipment. In the export market the only outstanding feature is the strength of treble nuts, especially in Fifeshire. Double nuts are fairly steady, but singles are most irregular and pearls plentiful. Home demands are better and round fuels in most districts benefit to some extent. Lanarkshire splints and ells are

steady, Lothian's steams are fairly well placed, and third-class Fifeshire steams are improving. The recent demand for first-class Fifeshire steams has fallen off, and these can now be secured through second-hands at less than colliery prices.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

The Coal Trade.

SHIPMENT of coal and coke from the ports in this Channel under the control of the Great Western Railway Company last week were not quite up to the level of the previous week. The total was 438,180 tons, as against 453,065 tons, while the figure for the corresponding period of last year was 509,953 tons. It is questionable whether the shipments for this week will mark any improvement, as tonnage is being delayed by bad weather, and furthermore, chartering operations have recently fallen off. At the end of last week the number of idle tipping appliances at the various docks was thirty-eight, and there were only three steamers waiting to berth, while on Monday the number of idle tips was reduced to twenty-four, but a day later the total was back over thirty, though it should be pointed out that so far as the number of steamers actually loading was concerned the position was fairly satisfactory. The immediate outlook, however, cannot be said to be cheering, as it is very singular that since the General Election the inquiry from abroad for coals has unquestionably fallen off appreciably. The opinion was expressed in this column that there was likely to be a pause in operations, but it must be said that it has come as a surprise that there should be such a perceptible drying up of business for early shipment. The market, however, is accustomed to things going contrary to expectations, though the slackening in the demand is very disappointing and may be only temporary. As a set-off to this it is consoling that contract business is still proceeding. Some of this is over next year, and does not appear on the market, as it used to do in former years; but in the case of the Portuguese State Railways it is officially announced that they have bought 125,000 tons of smalls to be delivered between now and March. This contract has been placed with three firms, viz., 50,000 tons with Pyman, Watson and Co., Ltd., to be delivered at Lisbon; 35,000 tons with R. and H. J. Rea, Ltd., to be delivered at Barreiro, Lisbon; and 40,000 tons with Gueret, Llewellyn and Merrett, Ltd., for delivery at Oporto.

Coals for France.

Reference was made last week to the fact that it was the intention of the French Government to curtail further the importation of coals, and to limit as from the beginning of this month the quantity to be permitted to enter the country to the average of the three years 1928, 1929 and 1930 less 25 per cent., but before the week was out the news was received that the decision to cut down imports was altered, and that the basis was to remain at 20 per cent. less than the average of the years above-mentioned. It is understood that this is to operate for the current month, but it is not improbable that there will be no change this year. Another matter affecting shipments to France concerns the administration of the licensing system. It will be recalled that there was a movement on foot for the procedure to be altered in respect of the granting of licences, and instead of this being in the hands of the French importers and agents of exporters on this side it was proposed that this country should be placed in the same position as Germany, Belgium, Holland and Poland, and that the licensing should be in the hands of the British Central Coal Council. It was maintained by the coalowning interests that this would have the effect of bringing to this country its full quota, whereas in the past it is contended that imports of coal from this country to France have fallen to a greater extent than those from other countries. Last week, however, there was a conference in London between representatives of the Central Council of Coalowners and the Coal Exporters' Federation of Great Britain, and although no official information was given of the proceedings, it was learned that the decision was reached that temporarily, at any rate, there should be no change in the existing system, but a strong memorandum is being addressed to the French importers and the Coal Exporters' Federation that if they want to maintain the present system then steps must be adopted which will ensure that the full quota of the French coal trade is obtained by this country.

Tin-plate, Steel and Iron Items.

South Wales tin-plate employers have voluntarily decided to increase the *ex gratia* bonus payment made to the lower-paid workmen from 5 per cent. to 7½ per cent. for the quarter commencing November 1st and ending on February 6th. This is consequent upon the fall to zero in the sliding scale which governs wages. Before the end of this week No. 2 blast-furnace at the Dowlais Works, Cardiff, will have been set in operation, and towards the end of this month another furnace at the Briton Ferry Works, belonging to the British (Guest, Keen, Baldwins) Iron and Steel Company, Ltd., will have been blown in. There is certainly more activity in the industrial line in this area. Five of the sheet mills at Messrs. Gilbertson's works, Pontardawe, are to be re-started on Monday next after being at a standstill for over a year, while the Glantawe Tin-plate Works belonging to the same firm will resume operations next week. The report is current that there is a prospect of the Blaenavon coke ovens and blast-furnaces making a re-start shortly, but nothing official so far is forthcoming. These works have been idle since the 1926 strike. There is a good chance of the Pontyclun and Llanharry Iron Ore Works re-starting in about a fortnight. When working full time they employed about 700 men. The s.s. "Novian" sails from Swansea this week with the largest general cargo that has been despatched from this port to Canada for very many years, if indeed it is not a record cargo. She is taking between 5000 and 6000 tons of tin-plates, black plates, galvanised sheets and steel plates for constructional work. This is the last steamer sailing direct to Montreal to discharge. The feature of the import

trade of this district during the past week or so is the quantity of partly manufactured iron and steel goods which has come from the Continent, principally from Belgium. The total for last week was 35,020 tons, which compares with 18,298 tons for the corresponding period of last year. The quantity is much in excess of the average for several years past. In fact, it was only equalled in the early part of 1927.

Current Business.

The tone of the steam coal market is quiet, especially for prompt shipment, though dry coals are firm compared with other descriptions. Dry qualities can command 3d. to 6d. per ton above the schedule, but all other coals can be secured without difficulty at the minima. Anthracite coals continue to be well booked and are very busy getting off the last shipments this season to Canada. Patent fuel continues to be rather on the quiet side, but coke is moving off more freely. Pitwood remains without feature at 24s. 6d. to 25s.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

MR. A. LEGGETT has been appointed a director and chairman of E. R. and F. Turner, Ltd., Ipswich, in succession to the late Mr. Pierson Turner.

MR. J. H. B. FORSTER and Mr. Ralph Freeman, of Sir Douglas Fox and Partners, have joined the board of the South Durham Steel and Iron Company, Ltd., and Cargo Fleet Iron Company, Ltd., members of the Furness group of steel and iron companies.

MR. DAVID SMITH asks us to announce that he is severing his connection, as manager of the Machine Tool and Small Tool Department, with T. C. Jones and Co., Ltd., of Wood-lane, London, W. 2, and is starting business on his own account as manufacturers' agent at 84, Temple Fortune-lane, Golders Green, London, N.W. 11. Telephone, Speedwell 6092.

CONTRACTS.

HARLAND AND WOLFF, Ltd. have in hand an order for the Bank of England. It comprises five sets of 520-kW heavy oil engine-driven generating sets and two sets of 40 kW.

THE VISCO ENGINEERING COMPANY, Ltd., of 162, Grosvenor-road, London, S.W. 1, has received an order for twenty-nine of its Visco air filters with a total capacity of over 350,000 cubic feet of air per minute, to be installed in one building in London. It is believed that it is the largest air filter installation ever ordered for, or installed in, one building in this country.

LA SOCIÉTÉ D'EXPLOITATION DES PROCÉDÉS DABEG, of Paris, asks us to announce that it has received from La Compagnie des Chemins de Fer de l'Est an order for forty sets of Dabeg automatic brake gear for fitting on new bogie coaches. The company also informs us that les Chemins de Fer de la Ceinture de Paris have decided to equip with the Dabeg apparatus twenty-five guards' vans which are at present being constructed.

THE PARSONS OIL ENGINE COMPANY, Ltd., of Southampton, has recently received orders for (a) a 100 B.H.P. petrol engine for Rangiora Power Station, New Zealand; (b) four petrol engines, 42 H.P., for aerodrome fire plants; (c) two paraffin Board of Trade 30-kW emergency sets for the new Southern Railway boat "Isle of Sark"; (d) one 4-kW similar paraffin Board of Trade emergency set for a new L.M.S. boat and one 12-kW similar set for t.s. "Paris"; (e) one 20-kW emergency set for a vessel for foreign owners; and (f) one 10 H.P. petrol standby set for overseas.

HENRY SIMON AND Co., Ltd., of Cheadle Heath, near Manchester, have received from the Leith Harbour and Docks Commissioners the order for the machinery and equipment for a new concrete granary, with a total storage capacity of 25,000 tons of grain, which is to be built at the Imperial Dock, Leith, to replace the grain warehouse that was destroyed by fire in January, 1930. The order comprises the whole of the conveying, elevating, and weighing machinery, the necessary electrical equipment, electrical grain temperature indicating apparatus, and a complete dust collecting plant. The whole of the machinery will be operated by electric motors.

TANGYES LTD., of Birmingham, has recently received orders for (a) horizontal duplex pumping machinery for Burnley, Lancs.; (b) a treble-ram pump and oil engine for a water company in Kent; (c) two four-stage turbine pumps driven by two wood-fuel suction gas engines, and two oil engines, auxiliary pumps, &c., for South Africa; (d) five vertical oil engine-driven bore-hole pumps; (e) two 84 B.H.P. oil engine generating sets complete for a South of England stone company; (f) two electrically driven reciprocating pumping sets for the Croydon Corporation; (g) two large oil engines for North Africa; (h) twelve oil engines for India; (i) a railway in India for an axle journal lathe, &c.

THE INSTITUTION OF MECHANICAL ENGINEERS' AWARDS.—The Council of the Institution of Mechanical Engineers has made the following awards for papers read before Graduates' Sections during the session 1930-31:—(1) £6, E. E. Griffiths (graduate): "The Factors Influencing the Design of Normalising Furnaces" read at a graduates' and students' meeting of the South Wales Branch on November 25th, 1930; (2) £4, W. L. Beby (student): "Material Handling in a Mass Production Factory," read at a meeting of the Graduates' Section, Midland Branch; (3) £2, C. H. Russell (student): "Modern Machine Tools," read at a meeting of the Graduates' Section, London, on November 24th, 1930; £2, A. E. Hamblin (graduate): "The Mass Production of Tin Containers," read at a meeting of the Graduates' Section, London, on October 20th, 1930.

CANNERS' MACHINERY.—The fifth annual convention of the National Food Canning Council was held in Manchester this week in conjunction with the Imperial Fruit Show. One of the principal activities of this Council is to encourage the manufacture of specialised and improved machinery for the canning industry in Great Britain. Lancashire is making an endeavour to attract this growing industry, and one important firm of engineers—Mather and Platt, Ltd.—has taken up the manufacture of this class of machinery on a considerable scale. Visitors to the convention had an opportunity of inspecting Mather and Platt's works at Newton Heath on Wednesday last, and a complete range of appliances was seen in operation. They included pea viners, washers and separators, graders and blanchers; can-filling machines, cookers and coolers, exhausters, cooking retorts, &c. At a luncheon given at the works, Mr. Loris E. Mather, chairman of the company, said that although this new branch of manufacture had made good strides, the value of the canning machinery output was as yet only one-fiftieth of that of the entire works, but he anticipated that it would not be long before the canning branch had an output comparable with those of the electrical, mechanical, textile, and fire departments. It would appear to us that there is considerable scope in this connection, for hitherto British engineers have been singularly slow to realise the great possibilities of business with the canning industry, the machinery for which has had to be purchased either from the United States or Germany.

French Engineering Notes.

(From our own Correspondent in Paris.)

Marine Exhibition.

THE annual Salon Nautique in Paris has shown that French engine builders are making progress in the construction of solid injection engines, which, for the first time, overshadowed everything else, even for small powers. There is a great field for such engines for fishing boats and canal barges, which are still supplied mainly by foreign makers, though home firms are likely to increase their participation in the trade, principally with engines built under licence from well-known foreign builders. The Ruston-Hornsby engines are being built by a French company which showed one of its own make, in addition to more powerful marine engines imported from England. Fishing boats offer by far the largest opening for business, though, for reasons of economy, the boats are nearly always under-powered and the installations often primitive. Now that those drawbacks are recognised, there is hope that owners of fishing boats will be more amenable to the counsels of experts who install engines that are sufficiently powerful and thoroughly reliable. In the case of canal barges, there is less resistance to progress in power equipment, for the reason, probably, that the canals form part of an international system, and, as French barges navigate on Belgian canals, their owners are disposed to follow what has become a general practice in the installation of engines on them. For that reason, also, Belgian makers of heavy-oil and solid-injection engines supply a large part of the French requirements. In view of these trade possibilities, the foreign participation in the Show was large, and, in addition to two or three British makers of engines and boats, there were exhibitors from Belgium, Sweden, Germany and the United States, though the American contribution consisted mainly of small petrol outboard engine equipments. Bollinders, Sulzer and Als-Thom exhibited marine engines of about 500 horse-power. At the other end of the scale, Lorraine showed small solid-injection engines of 6 horse-power. Petrol marine engines, except the smallest sizes, seem to be disappearing. Renault, nevertheless, showed petrol engines in addition to mechanical injection engines. The growing use of solid-injection engines for marine and other purposes is encouraged by the reduction of import duties on fuel oils, which has appreciably increased the economy of these power units. Little advance has been made with reversible engines, except for high powers, and the use of reversing gears is general. They are all of the satellite type with expanding clutch, many of them being of one German make.

The Super-liner.

The Compagnie Générale Transatlantique has made known some details of the new liner which was put on the stocks early in the year at Saint-Nazaire. It will have a length of 311 m., a beam of 35.9 m. and a depth of 28 m. With normal load it will draw 11.16 m. of water. The electric propelling machinery will develop up to 160,000 horse-power, as compared with the 64,000 horse-power of the "Ile de France." It will be able to carry 2500 passengers, and it is stated that the journey between Havre and New York will be accomplished in less than five days. There is no French port at present capable of receiving such a ship, and the entrance to the port of Havre will have to be widened and deepened and the port itself dredged.

Motor Traffic.

Amongst the many congresses held in Paris is one devoted to the safety of automobile traffic, and that just held covered the various aspects of road and car construction, but attention was given more particularly to road users and to the means that should be employed to reduce the risk of accidents. Drivers themselves are held to be mainly responsible for accidents, because the system of examination for driving licences in this country implies that, if they have a knowledge of the mechanical parts of driving, they may safely handle a car, whereas, without physical fitness, many drivers are a danger to themselves and to others. The system of granting licences as the result of a short driving test was regarded as useless. The value of a psychological test is shown by the results obtained with drivers of omnibuses and tramways in Paris, who have to undergo an elaborate psycho-technical examination when all their actions and nervous sensations while operating the driving gear on a platform in front of a screen showing traffic are faithfully recorded. They also have to undergo periodical examinations in order to ascertain if they remain fit. Since this system of testing was employed, the number of omnibuses in Paris has doubled, but there has only been a slight percentage of increase in the number of accidents, despite an increasingly difficult traffic, while the number of accidents due to ordinary motor car traffic has grown proportionately with the number of cars on the road. It was suggested at the congress that this psycho-technical examination should be made in every case in which a driver is responsible for an accident and that his driving licence should be cancelled in the event of the examination showing him to be unfit. The effect of local efforts to educate the public and road users was declared to have been good. In the Department of the Sarthe, the local authorities had, by this means, reduced the number of motor accidents by one half, and it was concluded that local efforts to educate road users, an elimination of unfit drivers, and an adequate police patrol should be sufficiently effective to ensure the safety of road traffic.

Trade Protection.

Manufacturers in this country now find that the changed conditions of trade have rendered them more susceptible to foreign competition than those elsewhere, and that, while their own costs are unchanged, they are helpless against the importation of goods which, they aver, are sold at prices that are only possible by reason of special advantages offered to foreign exporters. As compensating tariffs have proved to be ineffective against dumping, the Government is being asked to apply to all manufactures the system of import restrictions which is already enforced in the case of certain agricultural produce and coal.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

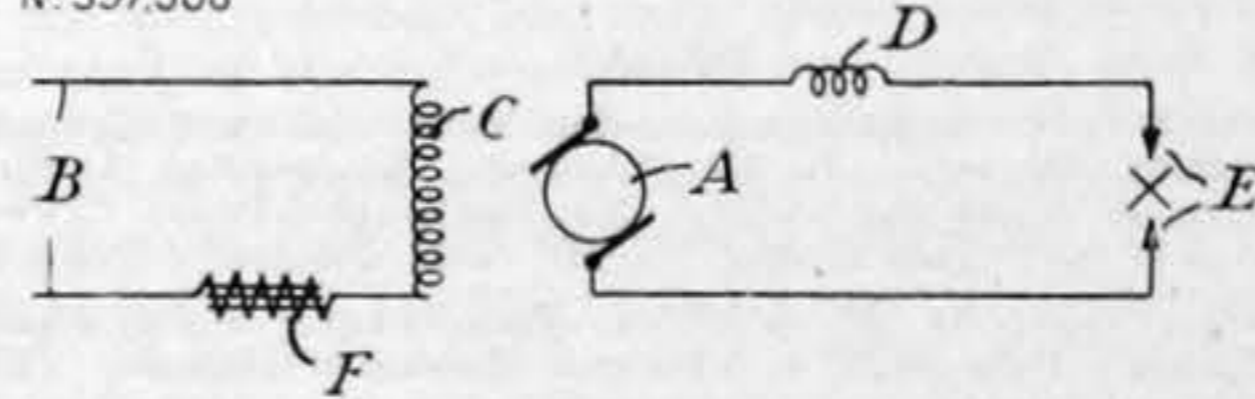
The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

DYNAMOS AND MOTORS.

357,308. July 8th, 1930.—DIRECT ELECTRIC CURRENT ARC WELDING APPARATUS, John Bentley Hansell, of 121, Eccles Old-road, Pendleton, Manchester; and Associated Electrical Industries, Ltd., of Crown House, Aldwych, Westminster.

This invention relates to direct electric current arc welding apparatus of the kind in which a D.C. generator is provided with a separately excited field winding and an opposing field winding connected in series with the armature and the arc welding terminals, the object being that the voltage of the generator shall rise when the current in the armature circuit falls and vice versa. With this arrangement, however, the change in voltage of the generator is comparatively slow owing to the transformer action between the series and separately excited field windings. The separately excited field winding behaves as a coil in a circuit closed through an impedance and tends to suppress any change in flux in the pole pieces of the generator. If the current from

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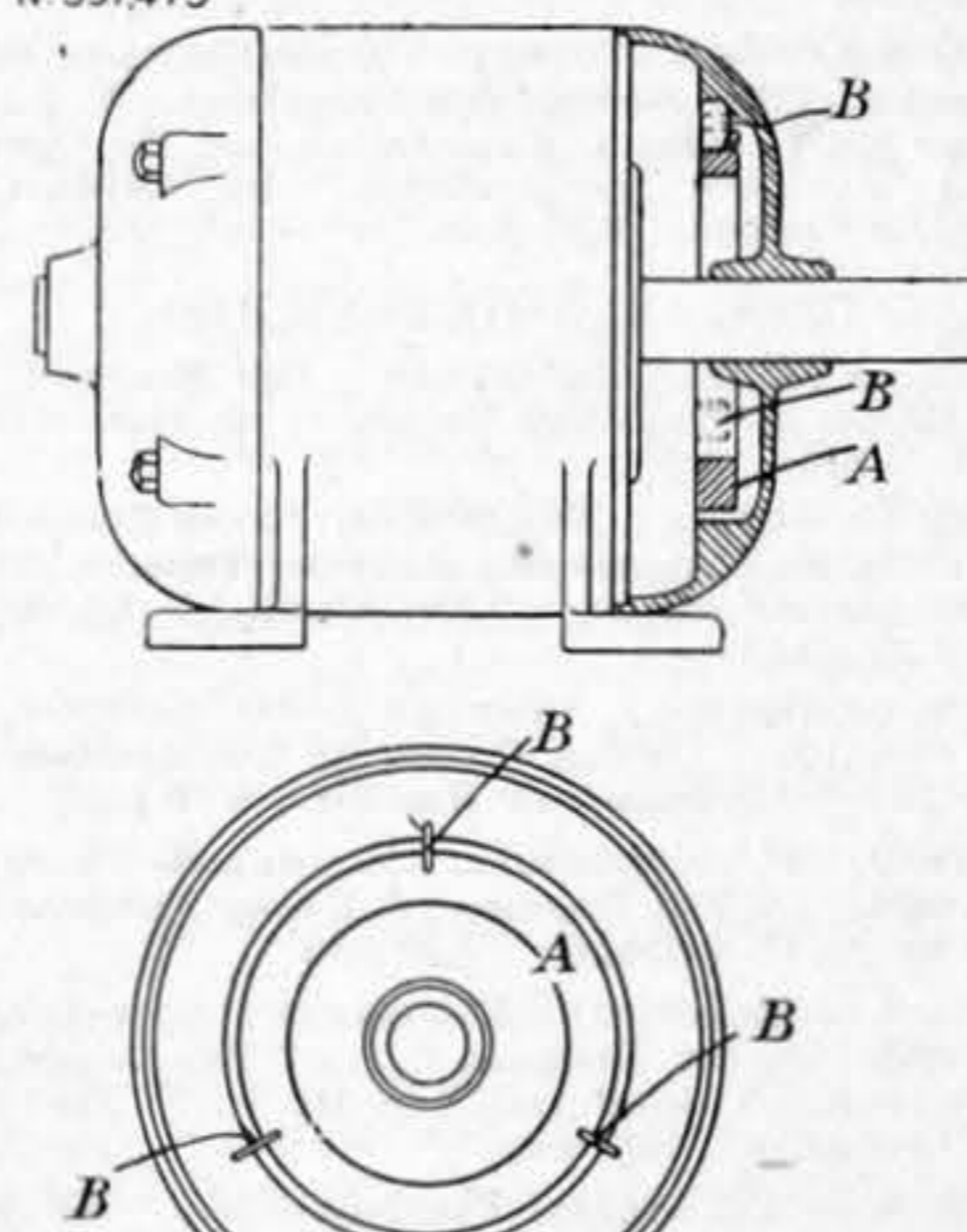


the series field winding is reduced, for instance, the current in the separately excited field winding will also diminish and the flux will not immediately change. The separately excited field current and field flux will then gradually rise until this field current attains its original value. According to the invention, a D.C. generator A is excited from a current source B and is provided with a separately excited field winding C and also an opposing field winding D connected in series with the armature of the generator A and the arc welding terminals E. A choke coil F is connected in the exciting circuit in series with the field winding C and in some cases an air gap is provided in the magnetic circuit of the choke coil. The rate of rise in voltage of the generator can be controlled by using tapings on the choke coil or by adjustment of the air gap. In some cases, by suitably proportioning the coil F, the choke coil usually provided in the arc welding circuit for stabilising the circuit when small changes occur in the arc conditions may be dispensed with.—September 24th, 1931.

357,475. February 24th, 1931.—DYNAMO-ELECTRIC MACHINES, The British Thomson-Houston Company, Ltd., of Crown House, Aldwych, London, W.C. 2.

The object of this invention is to provide a simple vibration absorbing device for a dynamo-electric machine subject to vibration about its axis of rotation owing to a pulsating torque as met with in a single-phase motor. In a motor of this type the torque pulsates so as to produce considerable vibration of the stationary member. This vibration is greatly reduced, in accordance with the invention, by supporting a weight on the stationary member by springs and proportioning the weight and the springs so that they have a natural period of vibration corresponding in frequency with the vibration of the stationary member of the motor. This may be accomplished by various

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arrangements of parts, but it is preferred to provide an annular weight A arranged inside of one of the end covers and coaxial with the shaft. The weight is secured in the end cover by radially arranged flat springs B, which are secured in radial slots formed in the cover and in the weight respectively. The springs are therefore resilient to circumferential vibrations of the weight A, but rigidly resist movement of the weight in any other direction. The weights and the strength of the springs are made so that the natural period of vibration of the weight and the springs is the same in frequency as the vibration of the stationary member due to the pulsating torque of the motor. By this construction the vibration of the motor is substantially eliminated without the necessity of providing any resilient supports for the motor or its bearings.—September 24th, 1931.

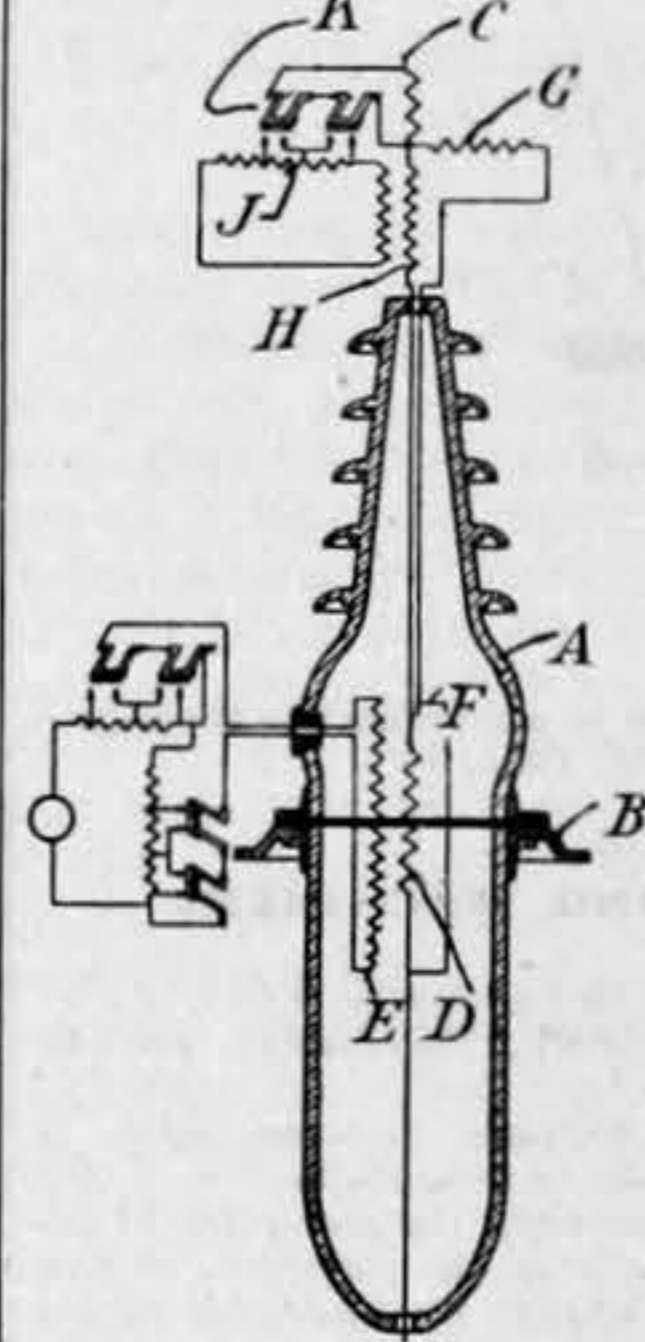
TRANSFORMERS AND CONVERTERS.

357,082. May 6th, 1930.—CURRENT TRANSFORMERS, William Warren Triggs, of the firm of Marks and Clerk, 57 and 58, Lincoln's Inn-fields, London, W.C. 2.

This invention relates to current transformers for diverting relatively small amounts of energy from high-potential con-

ductors and especially to current transformers mounted in high-potential bushings. One object of the invention is to provide improved means for regulating the ratio of transformation in the current transformer. Another object is to provide improved and economical means for maintaining a substantially constant transformation ratio for a given range of current passing through the bushing. A is a bushing insulator supported on a flange B. The conductor C passes through the bushing and is insulated from the flange B. Within the bushing is the primary winding D and the secondary winding E of a current transformer. The conductor F shunting the primary winding is connected to the incoming lead C through an impedance G. In series with the primary winding is an impedance H. Where the cross section of the iron in the current transformer is rather small or worked at a high flux density, the saturation of the core tends to change the ratio between the current in the windings D and E as the current in the winding D changes. For many purposes it is desirable to maintain a constant ratio between the current in the conductor C and the current in the secondary E throughout

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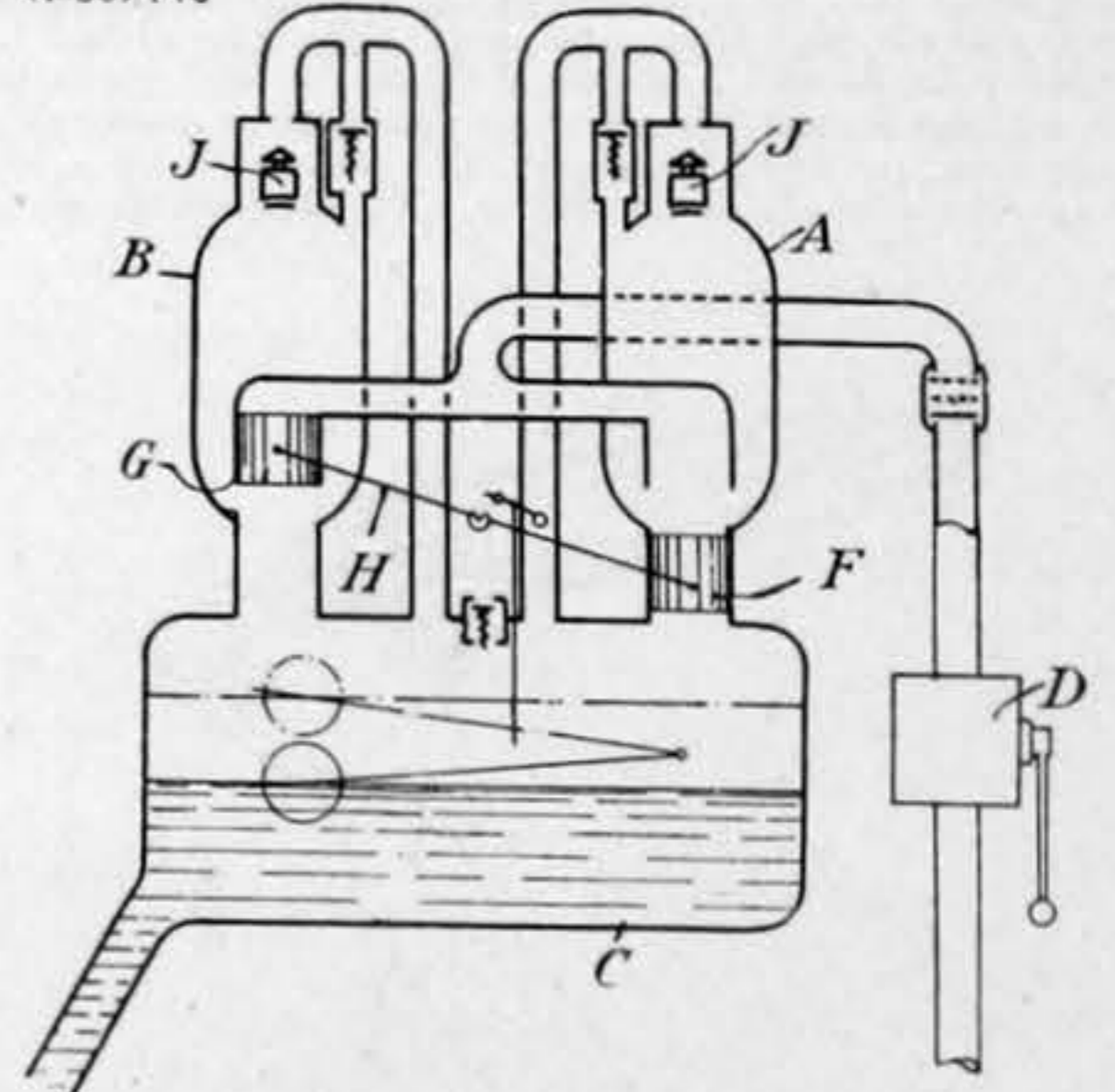
a particular range of current value in the conductor C. This is accomplished by controlling the current in the primary winding D by changing the proportion of the total current in the conductor C which is caused to flow through the winding D. Where it is desired to boost the current in the secondary E to maintain a constant ratio as the current in the conductor C increases, this may be done by increasing the proportion of the main current flowing in the primary D. The proportion of the current in the primary D is controlled by changing the relative values of the impedances G and H as the current increases in the conductor C. One way of accomplishing this result is by the use of an air core reactance for the impedance G or a metal core reactance, the core of which does not become saturated as the current increases. If at the same time H is provided with an iron core, which becomes saturated as the current increases, it will be apparent that the ratio between the impedances G and H will be increased with the increase in current, and the relative portion of the current flowing through the primary D will be correspondingly increased. The impedance H may consist of a current transformer having a resistance J in its secondary circuit. The current transformer H can have a magnetic circuit which becomes saturated as the current increases so that a relatively larger portion of the current will flow through the winding D as the current in the conductor C increases, thus compensating for the leakage of magnetic flux in the current transformer D E and maintaining a substantially constant ratio between the current in the conductor C and the current in the secondary E. The impedance H may be in the form of a current transformer as described or may simply be a reactance coil having a core which becomes saturated as the current increases. When a current transformer is used for this purpose its reactance may be readily adjusted by changing the resistance J in the secondary circuit. Thermal relays K are shown arranged to cut out successive portions of the resistance J as the current increases and thus reduce the reactance H. Thermal relays may be used for varying the impedance in the branches of the secondary circuit as well as the primary.—September 7th, 1931.

MEASURING AND TESTING INSTRUMENTS.

357,440. December 13th, 1930.—LIQUID METERS, A. Lanzer, Corseaux-Vevey, Switzerland.

This liquid meter is said to prevent intentional or accidental fraud. It comprises two measuring vessels A and B, which are mounted on a discharge tank C. The liquid is supplied by the pump D and is delivered to the measuring vessels by the branch pipe shown. The orifices of the branch pipes and those connecting the measuring vessels with the tank are controlled by the piston valves F G, which are slung on an articulated lever H, is furnished with a spring at the articulation. Each of the air

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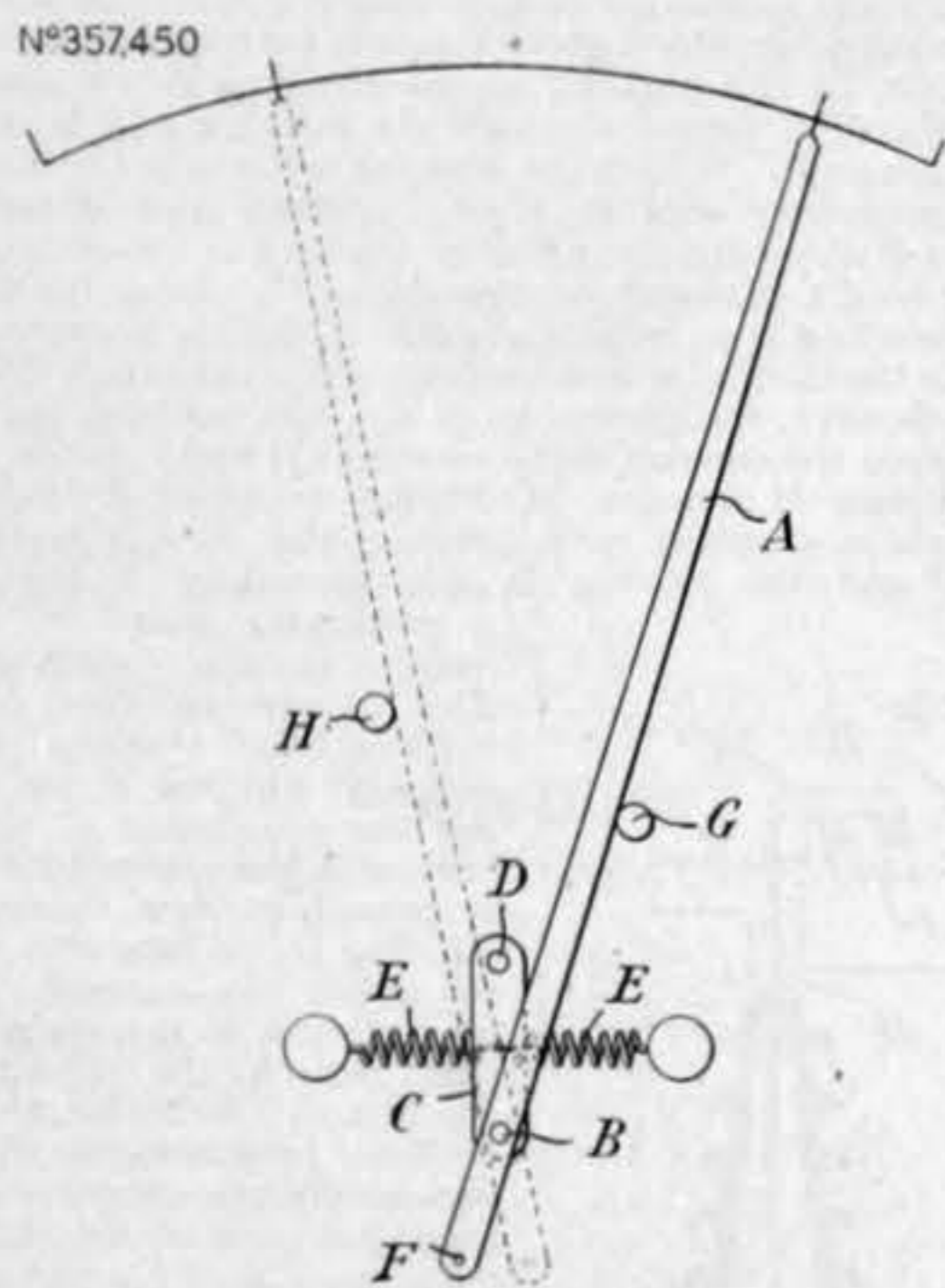


vessels is provided with a float valve J. In operation, with the parts in the position shown in the drawing, liquid is pumped into the vessel A until its float valve J closes. There then accumulates a pressure above the valve G, which is pushed down and puts the spring at the articulation of the lever H in stress. When the valve G passes its seating there is a release of pressure, and the valve F quickly reverses for the emptying of the chamber A, while B is closed for refilling. The specification explains several safeguards on the exact working of the apparatus.—September 24th, 1931.

357,450. December 24th, 1930.—POINTERS FOR INDICATING AND RECORDING INSTRUMENTS, The Cambridge Instrument Company, Ltd., Chesterton-road, Cambridge, C. H. Mason, and W. J. Stallan.

This invention is concerned with a system of linkage which will give an open scale during part of the movement of a pointer, and a much closer scale at the extremities. The pointer A is pivoted at B on the link C, which, in turn, is pivoted at D. The link C is held in mid-position by the springs E E. The pointer is operated by any instrument at the heel F. Fixed abutments are arranged at G and H. It will be seen that through

the mid part of the movement of the pointer the magnification is large, but when it touches either of the abutments the ratio is greatly reduced. At the ends of the swing the link C is, of

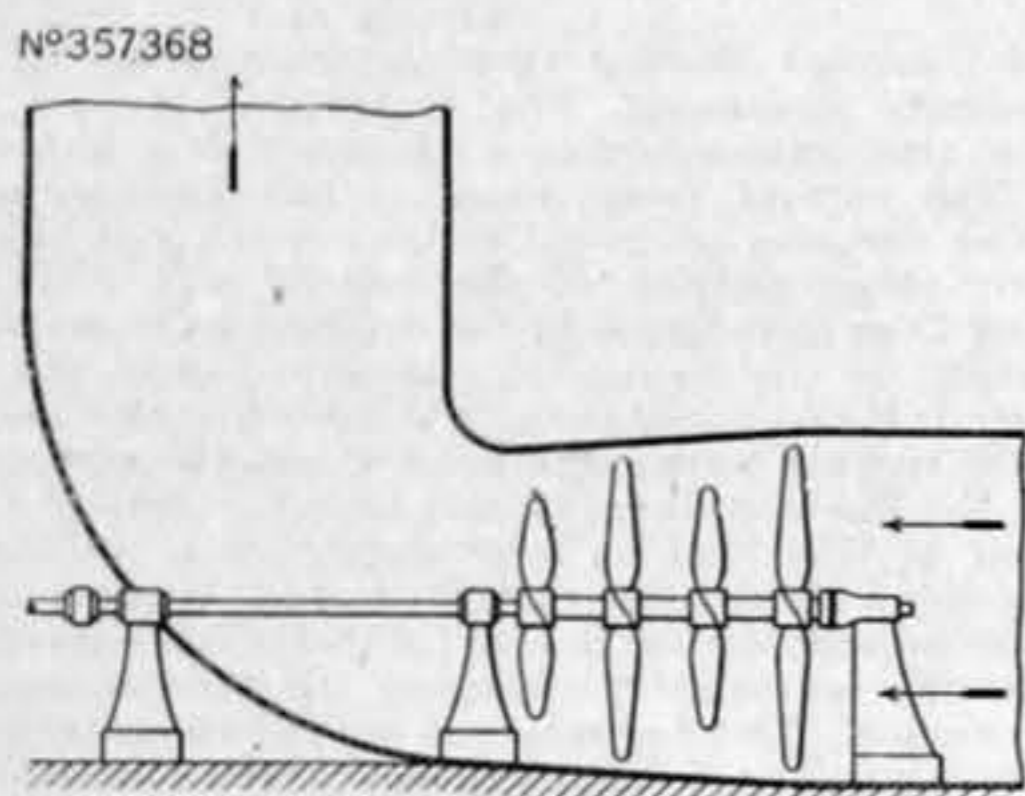


course, allowed by the springs to rock to accommodate the movement of the pivot B.—September 24th, 1931.

PUMPING AND BLOWING MACHINERY.

357,368. September 19th, 1930.—MULTI-STAGE FANS, A. V. Roe and Co., Ltd., Newton Heath, Manchester, and H. Rogerson.

It is stipulated that for the purpose in view, such as mine ventilation, the propellers of the fan should be "mounted one behind the other upon a common shaft, the face pitch of the several screws or propellers increasing in the direction of flow of the air, whilst their diameters gradually decrease, the tunnel

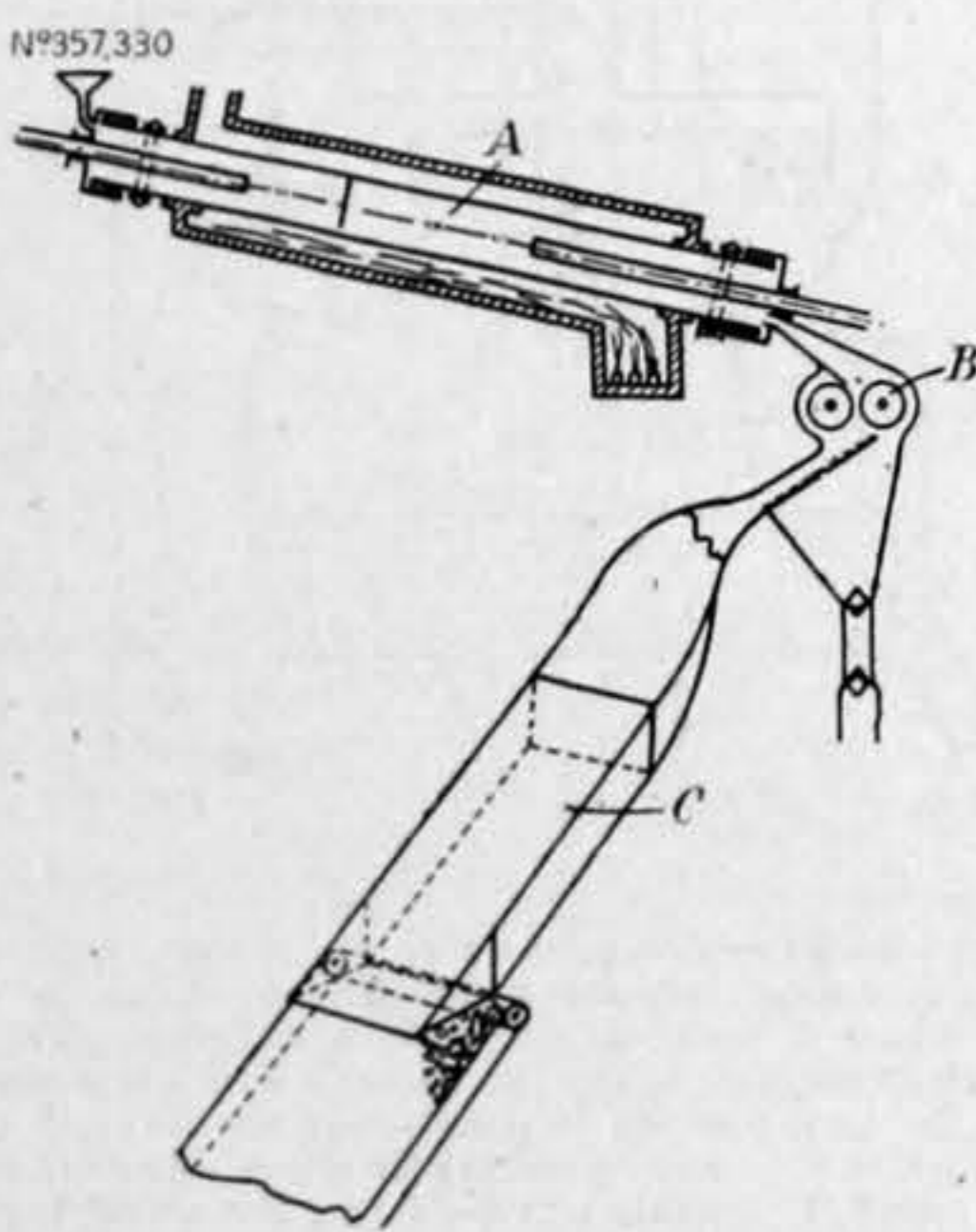


containing the screws or propellers having a taper to correspond with the gradual diminution of the air screw diameter." It is claimed that whilst the velocity of the air is gradually increased, as it passes through the fan, its pressure is not greatly altered, so that stream-line flow results, which facilitates the reduction of the power required to drive the fan as compared with the usual form of multi-stage fan of the same pitch.—September 24th, 1931.

MISCELLANEOUS.

357,330. July 30th, 1930.—BRIQUETTING COAL, H. Hardy, 107, Rue du Charbonnage, Anderlues, Belgium.

This invention relates to the manufacture of briquettes and agglomerated bodies from coal subject to pasty fusion, the invention consisting in subjecting the coal, in a granular or divided state, to a heat treatment, at a temperature between 350 deg. and 500 deg. Cent., according to the kind of coal used, until the coal particles assume a more or less globular or spheroidal shape, each globule being inwardly of a reticular or cellular structure filled with gas and surrounded by a closed or unapertured envelope or casing. To obtain this globular



condition it is necessary that the heating should be uniform, so that the temperature in the interior of each particle is substantially the same as the temperature on the surface, and as the temperature is progressively increased the different constituent parts of the coal undergo first a softening, then a liquefying, then a vaporisation, each of these stages taking place simultaneously on the exterior and in the interior of each particle. All that liquefies on the surface can freely separate by simple evaporation or gasification, whilst all that liquefies in the interior of each particle, on the other hand, is physically shut in and consequently causes swelling of the particles. The coal particles when in this globular condition lend themselves, owing to the chemical decomposition which takes place, to the

production of briquettes or agglomerated bodies without the use of tar or binding material, the globules being first cooled and moistened with water, and then, after being kneaded or mixed, transformed into briquettes by the application of pressure. It is the object of the present invention to simplify the above process, and the invention consists in compressing the segregated globular bodies in a press, to convert them into agglomerated balls or briquettes, as soon as they issue from the oven. It is essential that the temperature to which the coal is submitted does not exceed certain limits, depending on the nature of the coal, otherwise the globules will burst and be converted into semi-coke, each particle, whilst maintaining a more or less spheroidal form, merely consisting of a hollow empty shell formed with apertures or holes. These coke particles are, of course, useless for the production of agglomerated balls or briquettes without binding material. It will be seen that the material when brought into a globular condition can be treated as a mixture of tar and coal for the production of agglomerates; that is to say, that when humidified, kneaded in the hot state, and pressed, it can give balls or briquettes. The primary process is carried out in the rotary kiln A, the product is kneaded into balls in the machine B, and, if desired, a secondary distillation is carried out in the roaster C.—September 24th, 1931.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Tuesday of the week preceding the meetings. In all cases the TIME and PLACE at which the meeting is to be held should be clearly stated.

TO-DAY.

INSTITUTE OF ELECTRICAL ENGINEERS: NORTH-EASTERN STUDENTS' SECTION.—In the Electrical Engineering Lecture Theatre at Armstrong College, Newcastle-upon-Tyne. "Four Months in the United States," by Mr. G. D. Clothier. 7.15 p.m.

INSTITUTE OF MECHANICAL ENGINEERS.—Storey's-gate, St. James's Park, S.W. 1. Thomas Hawksley Lecture, "The Mechanical Aspects of Electricity," by Mr. Llewellyn B. Atkinson. 6 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, S.W. 1. "The Cooling of the Crude-Oil Engine," by Mr. A. P. Quarrell. 7.30 p.m.

PHYSICAL SOCIETY.—At the Imperial College of Science, Imperial Institute-road, South Kensington, S.W. 7. Presidential address, "The Expanding Universe," by Sir Arthur Eddington, F.R.S. 5 p.m.

RAILWAY CLUB.—57, Fetter-lane, London, E.C. 4. "The Callender and Oban Railway," by Mr. H. A. Vallance. 7.30 p.m.

SATURDAY, NOVEMBER 7TH.

INSTITUTE OF BRITISH FOUNDRYMEN: LANCASHIRE BRANCH.—In the College of Technology, Sackville-street, Manchester. "Production of Castings in a Modern Malleable Iron Foundry," by Mr. H. J. Beck. 4 p.m.

INSTITUTE OF MECHANICAL ENGINEERS: GRADUATES' SECTION.—Storey's-gate, St. James's Park, Westminster, S.W. 1. Debate, "That a College Education is Desirable in the Training of a Mechanical Engineer." 6.45 p.m.

MONDAY, NOVEMBER 9TH.

INSTITUTE OF METALS: SCOTTISH LOCAL SECTION.—In the Rooms of the Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank-crescent, Glasgow. "Experiences with some Electric Furnaces for Melting Copper and Copper Alloys," by Mr. W. L. Govier. 7.30 p.m.

INSTITUTE OF TRANSPORT.—At the Institution of Electrical Engineers, Victoria Embankment, W.C. 2. Annual general meeting. Paper, "The Influence of Transport on Regional Planning," by Mr. J. Paterson. 5.30 p.m.

NATIONAL INSTITUTE OF INDUSTRIAL PSYCHOLOGY.—At the Royal Society of Arts, John-street, Adelphi, W.C. 2. "Recent Research into the Causes of Industrial Accidents," by Mr. Eric Farmer. 6 p.m.

ROYAL AERONAUTICAL SOCIETY.—In the Gaumont Film Company's Theatre, Film House, Wardour-street, W. 1. "Aeroplanes as an Aid to Mineral Exploration and the Operation of Aircraft in Sub-zero Temperatures," by Captain W. J. McDonough, of Canada. 6.30 p.m.

TUESDAY, NOVEMBER 10TH.

INSTITUTE OF MARINE ENGINEERS.—The Minories, London, E.C. 3. "Effects of Propelling Machinery on Hull Structures," by Mr. J. L. Adam. 6 p.m.

INSTITUTE OF METALS: NORTH-EAST COAST LOCAL SECTION.—In the Electrical Engineering Lecture Theatre, Armstrong College, Newcastle-upon-Tyne. "Die Casting," by Mr. A. H. Munday. 7.30 p.m.

INSTITUTE OF METALS: SWANSEA LOCAL SECTION.—At the Y.M.C.A., Swansea. "Some Causes of Unsoundness in Non-ferrous Alloys," by Professor D. Hanson. 6.15 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—King's Head Hotel, Coventry. "The Training of Young Automobile Engineers," by Mr. B. G. Robbins. 7.30 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS: SCOTTISH CENTRE.—39, Elmbank-crescent, Glasgow, C. 2. "The Design of a Distribution System in a Rural Area," by Mr. E. W. Dickinson and Mr. H. W. Grimmit. 7.30 p.m.

INSTITUTION OF PETROLEUM TECHNOLOGISTS.—At the House of the Royal Society of Arts, John-street, Adelphi, W.C. 2. "The Dilution Theory of Detonation," by Mr. I. A. J. Duff. 5.30 p.m.

INSTITUTION OF WELDING ENGINEERS, LTD.: NORTH-WESTERN BRANCH.—At the College of Technology, Manchester. "Carbon Arc Welding," by Mr. A. Y. Stirrat. 7.30 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, Piccadilly, W. 1. "Combustion of Gases," by Mr. G. I. Finch. 5.15 p.m.

SHEFFIELD METALLURGICAL ASSOCIATION.—198, West-street, Sheffield. "Methods of the Determination of Physical Properties of Steel," by Mr. J. Woolman. 7.30 p.m.

WEDNESDAY, NOVEMBER 11TH.

INSTITUTION OF ENGINEERING INSPECTION.—In the Rooms of the Royal Society of Arts, John-street, Adelphi, W.C. 2. "Mechanical Testing of Materials," by Dr. G. H. Gulliver. 5.30 p.m.

INSTITUTION OF LOCOMOTIVE ENGINEERS: BIRMINGHAM CENTRE.—In Room 178 of the Queen's Hotel, Birmingham. "Location and Acquisition of Natural Water Reserves," by Mr. C. C. Cowling. 6.45 p.m.

THURSDAY, NOVEMBER 12TH.

BOROUGH POLYTECHNIC.—Borough-road, S.E. 1. Annual Prize Distribution, by Professor C. E. Inglis. 7.30 p.m.

FARADAY SOCIETY.—In the Rooms of the Chemical Society. Discussion on "The Oxidation of Fuel Vapours in Air." 8 p.m.

INSTITUTE OF BRITISH FOUNDRYMEN: LANCASHIRE BRANCH, BURNLEY SECTION.—In the Lecture Room of the Municipal College, Ormerod-road, Burnley. Mr. W. Barnes, of Burnley, and others, will read a series of ten-minute papers. 7.15 p.m.

INSTITUTE OF MARINE ENGINEERS.—The Minories, London, E.C. 3. Films, "The Manufacture of the 'Royal Scot' Locomotives" and "The Leipzig Technical Fair." 7 p.m.

INSTITUTE OF METALS.—At the Royal School of Mines, South Kensington, S.W. 7. "Some Recent Advances in Rolling Plant," by Dr. W. J. P. Rohn. 8 p.m.

INSTITUTE OF METALS: BIRMINGHAM LOCAL SECTION.—In the Chamber of Commerce, New-street, Birmingham. Open discussion, "Mechanical Testing," opened by Mr. W. A. Benton. 7 p.m.

INSTITUTION OF STRUCTURAL ENGINEERS.—10, Upper Belgrave-street, S.W. 1. "Portland Cement," by Mr. H. Gutteridge. 6.30 p.m.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS: TEES-SIDE BRANCH.—In the Cleveland Scientific and Technical Institution, Corporation-road, Middlesbrough. "Electric Grid Change-over," by Mr. S. Burns. 7.30 p.m.

SCIENCE MUSEUM.—Exhibition-road, South Kensington, S.W. 7. Modern glasses, "Sheet and Plate Glass," by Mr. R. F. Taylor. 4.45 p.m.

FRIDAY, NOVEMBER 13TH.

CHEMICAL ENGINEERING GROUP.—Burlington House, Piccadilly, W. 1. "Platinum," by Mr. Donald McDonald. 8 p.m.

INSTITUTE OF METALS: SHEFFIELD LOCAL SECTION.—In the Non-ferrous Section of the Applied Science Department of the University, St. George's-square, Sheffield. "Engineering Silver Solders," by Mr. E. A. Smith. 7.30 p.m.

INSTITUTION OF WELDING ENGINEERS.—At the Chamber of Commerce, 95, New-street, Birmingham. "Some Details of the Progress Reached in Forge and other Welding in Boiler Works Practice," by Messrs. E. W. Thompson and A. Jeavons. 7 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, S.W. 1. Annual general meeting. 7.30 p.m.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—At the Mining Institute, Newcastle-upon-Tyne. "The Care and Maintenance of the Industrial Steam Locomotive," by Mr. J. W. Hobson. 6 p.m.

MONDAY, NOVEMBER 16TH.

NATIONAL INSTITUTE OF INDUSTRIAL PSYCHOLOGY.—At the Royal Society of Arts, John-street, Adelphi, W.C. 2. "Recent Research into the Causes of Industrial Accidents," by Mr. Eric Farmer. 6 p.m.

TUESDAY, NOVEMBER 17TH.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Seagrave Club, Queen-street, Wolverhampton. "The Training of Young Automobile Engineers," by Mr. B. G. Robbins. 7.30 p.m.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, London, W.C. 2. Special meeting. "The Pressure Cable—An Advance in the Construction of High-voltage Cable Installations," by Messrs. M. Hachstadter, W. Vogel and E. Bowden. 8 p.m.

WEDNESDAY, NOVEMBER 18TH.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Metropole Hotel, King-street, Leeds. "The Training of Young Automobile Engineers," by Mr. B. G. Robbins. 7.15 p.m.

FRIDAY, NOVEMBER 20TH.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, St. James's Park, Westminster, S.W. 1. Sixth Report of the Marine Oil Engine Trials Committee, to be presented by Eng. Vice-Admiral Sir George G. Goodwin. 6 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, S.W. 1. "Modern Pressed Brick Manufacture," by Mr. H. G. Brown. 7.30 p.m.

MONDAY, NOVEMBER 23RD.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, London, W.C. 2. Howard Lecture, "Diesel Engines, I.," by Mr. H. R. Ricardo, F.R.S. 8 p.m.

TUESDAY, NOVEMBER 24TH.

INSTITUTION OF ELECTRICAL ENGINEERS: SCOTTISH CENTRE.—At the Grosvenor Restaurant, Gordon-street, Glasgow. Annual dinner. 6.30 p.m. for 7 p.m.

INSTITUTE OF MARINE ENGINEERS.—The Minories, London, E.C. 3. "The Work of Akroyd Stuart and the Development of the Oil Engine in which it is Carried On," Akroyd Stuart Award, 1931, paper, by Mr. Alan E. L. Chorlton. 6 p.m.

SHEFFIELD METALLURGICAL ASSOCIATION.—198, West-street, Sheffield. "Works Progress," by Mr. H. T. Hildage. 7.30 p.m.

WEDNESDAY, NOVEMBER 25TH.

INSTITUTION OF AUTOMOBILE ENGINEERS.—At the Engineers' Club, Albert-square, Manchester. "The Training of Young Automobile Engineers," by Mr. B. G. Robbins. 7 p.m.

NEWCOMEN SOCIETY.—The Annual General Meeting in the Hall of the Chartered Institute of Patent Agents, 1, Staple Inn-buildings, W.C. 2. Annual General Meeting. "Men of Straw: An Account of Surviving Straw Handicraft," with a practical demonstration, by Mr. T. B. Hennell. 5.30 p.m.

THURSDAY, NOVEMBER 26TH.

INSTITUTE OF METALS: BIRMINGHAM LOCAL SECTION.—In the Chamber of Commerce, New-street, Birmingham. "The Casting of Tough Pitch Copper," by Mr. W. F. Brazener. 7 p.m.

FRIDAY, NOVEMBER 27TH.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, Westminster, S.W. 1. "Progress in the Design and Construction of Static Transformers," by Mr. D. W. McJanet. 7.30 p.m.

MONDAY, NOVEMBER 30TH.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, London, W.C. 2. Howard Lecture, "Diesel Engines, II.," by Mr. H. R. Ricardo, F.R.S. 8 p.m.

WEDNESDAY, DECEMBER 2ND.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, London, W.C. 2. "The Development of Lighthouses," by Mr. D. Alan Stevenson. 8 p.m.

MONDAY, DECEMBER 7TH.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, London, W.C. 2. Howard Lecture, "Diesel Engines, III.," by Mr. H. R. Ricardo, F.R.S. 8 p.m.

WEDNESDAY, DECEMBER 9TH.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, London, W.C. 2. Trueman Wood Lecture, "Roads and Road Transport," by Sir Henry Maybury, G.B.E. 8.30 p.m.