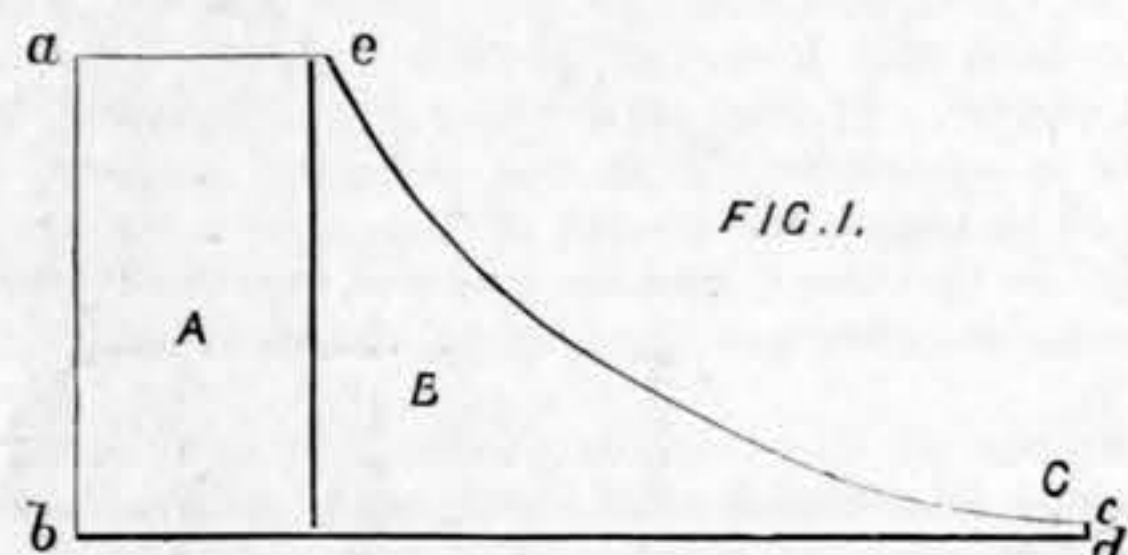


# THE INFLUENCE OF THE INDICATOR DIAGRAM ON THE DESIGN OF VALVE GEAR.

VOLUMES have been written on the influence of valve gear on the indicator diagram, but the story of the influence of the diagram on valve gear has yet to be told. The effect of each on the other has been about the same, in one sense. In another, the diagram has played a far more important part. Indeed to it in the main may be ascribed the origin of scores of patents which cumber the shelves of the Patent-office library. We think we shall be under the mark if we say that there are more than one hundred recognised systems of steam distribution at work now in this country, Europe, and the United States. The efficiency of the greater number is about the same, while the superiority of any one of the others over its fellows mainly exists in the brain of the inventor, and nowhere else. It is not to be denied that by the adoption of various types of valve gear in pursuit of a fancied advantage, expense has been incurred, failures have been risked and ensued, and wholly unnecessary trouble heaped on the steam user. It seems, we may add, that a word of warning is wanted just now more than ever, because there is a strong temptation to follow economy in electric light machinery along devious and intricate paths best left unexplored by those to whom a breakdown is a consummate misfortune. For writing thus we shall probably be told that we entirely under-estimate the value of correct distribution, to which possible argument we reply that we are quite familiar with all that can be proved on paper concerning the importance of obtaining diagrams as nearly as can be perfect; but that in the first place, these theoretical results are not invariably realised in practice, and that, even if they were, they may be purchased at far too high a price.

The ideal single-cylinder diagram is something like Fig. 1. It consists of a rectangle A, and a space B enclosed between the base line and a hyperbolic curve. The end at C is cut off sharply by the sudden opening of the exhaust port. The admission portion of the stroke is represented by the rectangle A, the expansion



portion being the space B. It will be noticed, in the first place, that there are four sharp corners at *a b c d*, and something very closely approaching to a corner at *e*. We may for the moment subordinate *c d*. The pursuit of the two corners *a b* and the acute angle *e* is mainly responsible for the multitude of valve gears. It is an article of faith with most steam users to say nothing of nearly all engineers, that the presence of these sharp corners is essential to economy. We believe it can be shown that this belief has no foundation of proof supplied by practice; but we reserve this point for the moment.

We have said that the curve from *e* to C is commonly regarded as a hyperbola. It could, however, only be this if the fluid expanding was a perfect gas working isothermally. The curve of expanding steam is something very different in theory. Its precise character has, however, not yet been settled by the physicist. We need not trouble ourselves with this, however. In practice the curve is very generally for the greater part of its length a close approximation to a hyperbola, this result being brought about by re-evaporation in the cylinder, which fattens the diagram. It is not, however, so much with the diagram as it is that we have to do, as with the diagram as it is intended to be by inventors of valve gears. So much premised, we are in a position to consider what is the nature of the problem which the inventor tries to solve.

Let us begin with the base line *b d*. This is to be straight from end to end. It will of necessity lie a little above the atmospheric line in a non-condensing engine; a little above the line of absolute vacuum in a condensing engine. No valve gear can better it in this respect. To get the corner *b*, the exhaust port must remain open to the very end of the stroke. It must then shut suddenly; and, as suddenly, the steam-admission valve must open. The inventor will very soon find that it is impossible to perform both operations almost simultaneously with a single valve, unless the engine runs at very slow speed. Consequently he has recourse to two valves—one for admission and another for exhaust. Here we must, in a manner, digress for a moment in order to point out that a separate exhaust valve is often used for reasons only indirectly connected with the corner *b*. Returning now, we have next to consider the line *a b*. This is straight and vertical. As the piston is almost at rest when this line is being formed, it follows that a comparatively small area of port opening will suffice to give it. The case is entirely different with *a e*. In order that the line may be quite horizontal, it is clear that, not only must the port opening be ample, but that there must be such an excess of steam-chest pressure prevailing that steam will rush through the port fast enough to maintain that steady full pressure on which the squareness of the corner *a* and the horizontality of the line *a e* depend for their existence. And here it will be in place to say that disappointment in getting the corner and the line as intended is very often due not to the shortcomings of the valve gear, but to too small a steam pipe or some other unperceived agency which reduces the valve-chest pressure. Our readers will find it not a little instructive to take a few diagrams from a valve chest; or even to fit it with a pressure gauge, and watch the performance of the hand on the dial.

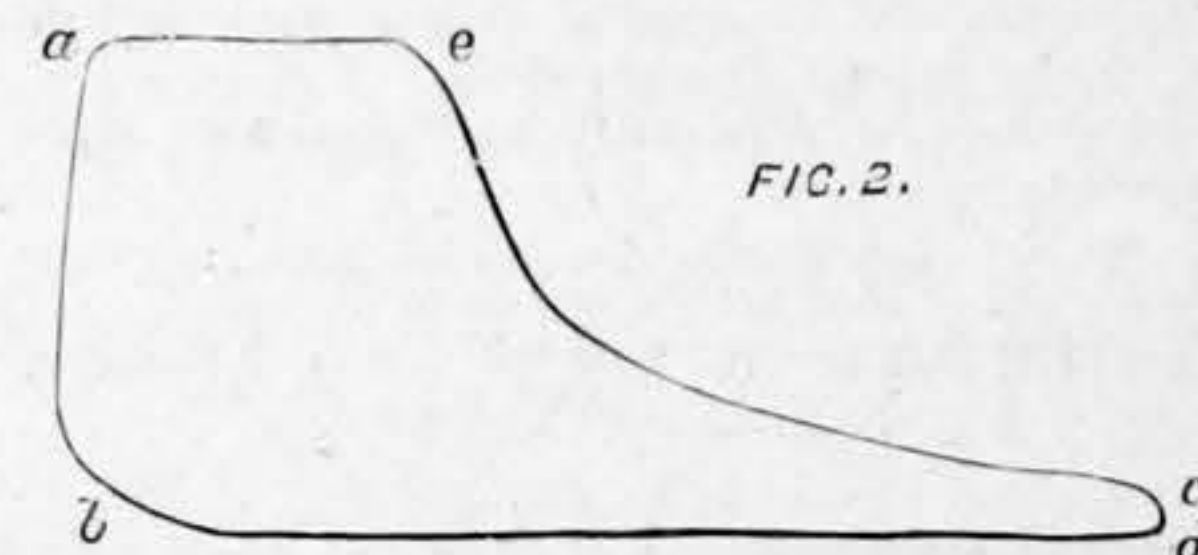
Eager as inventors have been to secure the two corners *a* and *b* and the straight line *a e*, that eagerness has been as nothing compared with the energy which urges them to get an acute angle at *e*. The Corliss trip gear, for example, and the great host of its congeners, have all resulted from the demand for a sharp cut-off. To the purist in diagrams, nothing is more offensive than a rounded union between the straight line and the beginning of the expansion curve. The difficulty of getting this rapidly augments with the speed of the engine. Let us, to make this clear, suppose that when the piston had reached the point *e* it stopped until the steam admission valve had closed. It is clear that, so long as it was not allowed to move again until the valve was quite shut, the leisurely closing of the valve, however indolent, would have no effect whatever on the union of the curve and the straight line. The drawing of the curve could not begin until the piston started. On the other hand, if the piston moved continuously and very quickly while the valve closed slowly, the complete closing might not take place until the stroke was nearly ended, and the result would be that a large proportion of the stroke would be done with falling pressure and wire-drawing through the admission port. From which considerations it is properly deduced that the faster the engine runs the quicker must be the closing of the steam valve. What this means, put into a very few figures, we shall now set forth.

We take the case of an engine running at the now-a-days moderate speed of 120 revolutions per minute—a fairly large engine, let us suppose, driving a dynamo. Each revolution will be made in half a second, each stroke in a quarter of a second. Let us suppose that the piston speed is 720 ft. per minute, the stroke being 3 ft. Let the cut-off take place at one-fourth of the stroke. The velocity of the piston will be then, roughly, about the average, its precise value depending partly on the length of the connecting-rod. Now, 720 ft. per minute is 12 ft. per second, or 144 in. If it is decided that the valve shall move from full open to completely shut while the piston moves 1 in., then the operation must take place in the 144th part of a second. If we permit the piston to run 2 in., then the time allowed for closing will be doubled, and so on. To get an absolutely perfect expansion curve, and a perfect union between the expansion curve and the pressure line *a e*, the valve should close so quickly that the piston could not move any appreciable distance whatever while the closing was going on. This is impossible, and the utmost that inventors can achieve is to hasten the closing to the utmost. The broad mechanical result is that the valve must be first snatched open, and then caused to shut with a jerk, conditions which are obviously mechanically wrong. It is because of the practical impossibility of getting an automatic high-speed trip gear to work that so many attempts have been made to produce a positive trip gear; up to the present with a success which depends for its completeness on the sense in which the words "high speed" are used. A good illustration of the difficulties to be overcome is supplied by the fact that double-spring grip Inglis-Corliss trip gear cannot be used at a high speed, the inertia and vibration of the springs preventing certainty in their closing action. They have not time, indeed, to get a fair grip of the tongue pieces by which they pull the valve open. It forms no part of our present purpose to criticise valve gear; but we may say here that the shorter the stroke of the moving parts of the trip gear, whatever it is, the better is the chance of success, and on the Continent gear is used which permits of considerably higher speeds being attained than are possible with the old Corliss gear.

It would greatly extend the range of this article were we to go into the question of the relative merits of different types of valve gear, not as steam distributors, but as mechanical contrivances more or less liable to break down. It is clear, we think, that for electric light work above all others, there are certain paramount considerations which overrule everything. The first is that the valve gear shall have the minimum number of parts and joints, because each of these is a thing that may, by its failure, lead to the stoppage of the whole machine. Not long since we saw a French engine in the valve gear of which we counted twenty-two joints, all to be lubricated and watched. The diagram was very good. Our readers will, however, we believe, quite agree with us that no merit in the diagram would compensate for the impropriety of employing twenty-two joints per cylinder to distribute the steam. Yet, if we go into some modern engine-houses in this country, we shall see valve gear which is hardly less complex and profuse in quantity. It is provided to get a good diagram mainly, but no doubt partly to isolate the engines made by one firm from those made by other firms. We have nothing, however, to do with this latter fact. We believe that the pursuit of square corners has, as we have said, induced the use of complicated valve gear, delicate in its action, easily put out of order, costly to make and maintain, beautiful in its finish, and on the whole a mistake from first to last; and we hold this view because there is abundant reason for saying that much more simple gear will give results which, in economy of fuel, can hardly be distinguished from the results obtained by complex gear, and in other respects is in every conceivable way better.

In Fig. 2 we have a diagram theoretically imperfect, and yet so far good that the difference in the consumption of steam per horse per hour between it and an engine giving a square-cornered diagram would be almost inappreciable at the end of the year in its effect on coal bills. Here there are practically no sharp corners; yet it would be very difficult to say how such a diagram represents imperfect or wasteful use of steam in any appreciable practical way. It is impossible to prove that the round corner at *e* means half-a-pound more steam per horse per hour. It does not happen to be a real diagram, but it is such as may be had with no more complication than is represented by a gridiron cut-off slide riding on the back of a main slide. Let us consider the so-called defects of the diagram a little in detail.

In the first place, we have a curve at *b* instead of a square corner. Now engineers, at all events, have made up their minds that, whatever theory may denote, there is a good deal to be said in favour of a rounded compression corner. Rankine advocated compression up to the initial pressure, as getting rid of clearance; but we have learned a good many things since Rankine wrote. There are some curious and not as yet explained phenomena about compression. For example, compression appears to be required to bring out the advantage of jacketing, at all events in compound engines running at moderate speeds. Whenever we find an engine doing about as well without steam in the jackets as with it, it will be observed that the compression curve is very small. The corner *a* is square enough. It is very easy to get this with almost



any valve gear; but *e* is quite rounded off, because the valve takes some time to close, and the steam must be worked wire-drawn to a small extent. Can it be shown that the loss so incurred is worth what is entailed, first, by running the engine at a speed sufficiently slow to get a trip gear to work with certainty; or, secondly, by the complication and risk of a breakdown, entailed by the use of all such gear in high speed engines? We think not. The truth can, however, best be arrived at by taking what facts do and do not teach.

In a recent impression will be found a very valuable tabular statement compiled by Mr. Bryan Donkin, setting forth the economical efficiency of several engines, all typical of the most advanced practice. The performance of all these engines is excellent, but some are better than others. Does the fact prove that the superexcellence of some is due wholly to great merits of their valve gear? We venture to think that no one will be rash enough to attempt to maintain such a theory. Here, however, we must, to protect ourselves, point out that we are not in any way taking into consideration the effect of small clearance spaces, short ports, the utility of separate exhaust valves in keeping admission ports hot, the effect of the arrangement of the valves on cylinder drainage, or such like matters. We are dealing now solely with the influence of square corners in the diagram on the use made of the steam in the cylinder. We have, it is true, no diagrams from these engines; but none the less it is clear that economy has been sought with success, not so much in the arrangements for distributing the steam as in those for keeping it hot while at work. That is, indeed, the condition above and beyond all others essential to economy.

But again let us turn to the marine engine. If we exclude a few exceptional mill engines, mostly of foreign make, it is not too much to say that the modern marine engine is the most economical steam engine in the world; and yet trip gear is unknown at sea, and square corners are impossible in the diagrams, because the valves are invariably sliding valves, worked by the link motion. Here it may be urged that the economy is due to the use of three cylinders; but the compound marine engine is not so very far behind the triple-expansion engine, and we have yet to learn that any mill engines have greatly beaten the best type of compound marine engine. When they have done so, it is not, we venture to say, because of square corners in the indicator card, but because of the use of re-heating or some similar detail, and this holds true of compound mill engines with Corliss gear to both cylinders. We may add that instances are within our own knowledge where such engines manage to consume as much as 25 lb. to 28 lb. of steam per horse-power per hour. But let us push the argument a little further.

Marine engines will, no doubt, give a horse-power for between 13 lb. and 14 lb. of steam per hour, representing, say, 1.75 lb. of coal per horse per hour. Now, in a triple engine, the power is got pretty equally from each of the cylinders. If, then, we take only the power developed in the first cylinder, we have a fuel consumption of  $3 \times 1.75 \text{ lb.} = 5.25 \text{ lb.}$  of steam per horse per hour. The same for all three. Now it is in the first cylinder alone that a sharp cut-off takes place, and the diagram is practically free from wire-drawing. In both the other cylinders we have virtually an enormous clearance and continual wire-drawing, the pressure falling continuously the whole way from admission to exhaust. But it is not clear that the steam is used to just a great practical advantage, whatever theory may say, in the intermediate cylinder, at all events, as it is in the high-pressure cylinder. For the low-pressure cylinder it may be claimed that it has the benefit of the vacuum. It is at least certain that each of them gives out approximately the same power for the same weight of steam. Indeed, the intermediate-pressure cylinder gets much less steam than the high-pressure cylinder.

It would extend this article beyond reasonable limits were we to push the argument further. We may sum up our contention in a few words. It is that a great deal of ingenuity has been misdirected and much money wasted in the effort to obtain an indicator diagram of a particular type. The object is not worth the cost. The difference in the consumption of steam per horse per hour, particularly in compound engines, between the engine giving the ideal diagram and one with rounded corners is, within limits, practically nil. It will, we hope, be fully understood that we draw a very well-defined distinction between a proper card and the very imperfect diagram which seems to content some steam users. In a word, we do not ignore the teachings of common sense. We may

add our conviction that not a few of our readers will endorse our statement that some of the worst engines made, especially in the United States, secure a sale solely on the fancied merits of a square-cornered diagram, and even that is not universally genuine. The true secret of economy lies not in trip gear, although that is good enough in its way, but in fairly high pressures and large ranges of expansion in hot cylinders. But we cannot too strongly enforce the lesson that wet steam will baffle all attempts to keep down coal bills, no matter what the shape of the indicator may be.

For large engines running at speeds up to about 100 revolutions per minute, gear of the Corliss type possesses several advantages which have nothing to do with the shape of the diagram. Principal among these is the ease with which such gear can be controlled by a governor. An interesting article might be written upon the influence of the rotary governor on the design of valve gears. But the matter has no relation to the subject we have been discussing.

## THE STRENGTH OF SPARS AND RIGGING OF SAILING VESSELS.

No. III.

FROM the considerations already put forth, it will be seen that if a wedged mast be increased in diameter, the stiffness may become too great, and if it be reduced in diameter, the thickness of the plating will have to be increased to give the necessary strength, but in that case the weight is increased, and consequently the strains. There is, therefore, for each case a diameter giving the maximum amount of strength with the minimum amount of material. It may be determined by a trial-and-error process.

There can be no downward forces acting on the lower mast head, and it is entirely free to resist the transverse bending thrown upon it by the topmast and the forces at the lower mast cap. The support at the topmast hounds will be seen from the table given in a previous article to be largely in excess of that at the lower mast cap. The stay at the latter place will, therefore, need support from the lower shrouds through the mast head.

Assuming the mast head bent to a stress of five tons per square inch at its lower part, we may find the force which would do this if applied at the mast cap from

$$P = \frac{p I}{l y} = \frac{5 \times 2700}{15 \times 12 \times 13} = 5.7 \text{ tons.}$$

This part of the applied force at the cap would, therefore, be transmitted to the lower hounds, and the stress on the lower shrouds would be

$$11.1 \times \frac{16.6}{10.9} = 16.7 \text{ per cent.}$$

of the ultimate strength.

The forces at the cap will be  $9.3 - 5.7 = 3.6$  tons, to be supported by the cap backstay. The stress on this stay will, therefore, be—

$$70 \times \frac{3.6}{9.3} = 27 \text{ per cent.}$$

of the ultimate strength.

Assuming in the same way a stress of five tons per square inch on the lower part of the topmast head, it will be able to take 2.2 tons of the load on the topmast cap backstay, and thus to increase the stress on the topmast backstays from 15.9 to 27.5 per cent. of the ultimate strength, and to reduce the stress on the topmast cap backstay from 57 to 31.4 per cent. of the ultimate strength.

The stresses on the stays will, under these circumstances, be as given in the above-mentioned table in the column headed "corrected tension, percentage of ultimate strength of stay." The bending stresses on the topmast, the topgallant and royal masts, will be comparatively small, owing to the greater flexibility of these spars as compared with the short mast heads.

The stresses due to the downward forces on the topmast may be calculated from

$$p = \frac{P}{A} + \frac{P l^2}{125 I}$$

where  $P$  is the sum of the vertical forces, including the weight component,  $l$  the length from lower cap to topmast hounds,  $A$  the sectional area, and  $I$  the moment of inertia of the section of the topmast. Taking the case where only the lower topsails are set, we have

$$p = \frac{68.3}{26.5} + \frac{68.3 \times 27^2}{125 \times 1030}$$

$$= 2.58 + .39 = 2.97 \text{ tons per square inch,}$$

which leaves about the same margin for bending stresses as in the case of the lower mast. The stresses at the topgallant and royal mast ought, when calculated in the same way, to have the same margin for bending stresses.

The higher we go up the more elastic become the supports, or the larger the deflections, which would be required in order that the stays may support the forces. But at the same time the spars become more flexible, and can admit of these increased deflections with even less stresses than in the case of the lower mast. The higher, therefore, the position of the stay, the greater will be the percentage of the total force which it will take, and the smaller that which the mast takes.

Above the lower hounds the stresses will practically be the same, whether the mast is wedged or not, because, although the relatively small difference in the deflections at the hounds when the mast is wedged and when it is not is important, as far as the stresses on the comparatively short and stiff lower mast are concerned, it is of very little moment in comparison with the much larger deflections of the masts above.

One of the most common damages to spars is the failure of the topmast. This may be due to inefficient support from the stays, but is more probably due to insufficiency of strength to resist the downward forces. In the latter

case the best method to add to the strength is by increasing the thickness of the plating or by fitting angles. If angles are fitted, then it is better to fit four smaller ones than two larger ones, because not only is the strength more uniformly distributed, but the actual strength is increased thereby.

The butt attachment is in all spars of the greatest importance, being in the direct line of practically the whole of the stresses thrown upon the spar, and the butt being a large percentage of the total girth. The edge connection between the plates is less important.

The bowsprit may be taken as a mast, the lateral forces on which are very small, and the rolling strains on which are practically nil. Its own weight becomes more important, in so far as it acts more nearly perpendicular to the centre line of the spar. The greatest strains thrown upon a bowsprit are, however, those due to the tensions on the foremast stays. These will tend to bend the bowsprit upwards in the middle line plane of the vessel. The strains on these stays may be estimated by assuming the sails on the foremast caught aback, and taking the vessel to be pitching with a period and maximum angle of displacement somewhat less than those assumed for rolling. It will easily be seen that for a given strain on the forestays the corresponding strains on the bobstay and jibstay will be very much greater, owing to the very much smaller spread of the latter stays with reference to the bowsprit and jib-boom. As the bowsprit cannot, just as the masts could not, take any appreciable part of the forces, it is necessary that the stays below should be very strong, and as the bowsprit cannot deflect to any great extent without severe strains, it is necessary that the stays below it should also be very stiff, as they should for a given pull give a small extension. It is, therefore, desirable that these stays should be made of solid iron or steel bars fitted so as to be bearing hard at both ends. In considering the support which stays afford to masts, it has been assumed that there is no initial tension on the rigging. Usually there will probably not be any appreciable amount of permanent tension on the stays, due to the setting up of the rigging. If, however, there is then its effect will be to reduce the deflections by an amount corresponding to the collective initial tension on the stays. This is equivalent to increasing the stiffness of the rigging. Wherever stiffness is wanted, it is, therefore, advantageous to have permanent setting-up strains, and the lower the stays are fitted the harder they ought to be set up.

### YARDS.

The forces which act on a yard are more difficult to determine than those acting on a mast; but, on the other hand, if once determined, the distribution of the stresses is much simpler. The wind pressure acting perpendicular to the plane of the yards is easily determined. The actual tension on the sail is, however, much greater than this force. Let the angle which the sail at the yards makes with the plane of the yards be  $\psi$ —see Fig. 6—and the total tension on the sail at the yard  $W$ , then the component perpendicular to the plane of the yards will be  $W \sin \psi$ , and that parallel to the mast  $W \cos \psi$ . The forces due to the weights and rolling reactions may also be resolved perpendicular to the plane of the yards and parallel to the mast. The yard is supported at the centre, and the tension of the sail may be supposed to be uniformly distributed over the length of the yard, though it will probably be somewhat greater towards the ends. The distribution of weight along the yard is capable of exact determination. For yards of the ordinary form, the centre of gravity of the half length of the yard is at a distance of 18 per cent. of the total length of the yard from the centre.

Let the normal pressure of the wind on the sail be  $S$ , and the length of the yard  $l$ , then the moment about the centre of the yard of the component perpendicular to the plane of the yard will be:—

$$\frac{s}{4} \times \frac{l}{4} = \frac{s l}{16}$$

The moment of the force parallel to the mast will be:—

$$\frac{s}{4} \times \cot \psi \times \frac{l}{4} = \frac{s l}{16} \cot \psi.$$

The corresponding moments for the weight will, if  $w$  is the weight of the whole yard, be:—

$$\frac{w}{2} \sin \theta \times .18 l$$

$$\text{and } \frac{w}{2} \cos \theta \times .18 l$$

where  $\theta$  is the angle of inclination of the vessel.

For the rolling reaction the moment perpendicular to the plane of the yards is:—

$$\frac{w}{2} c \times .18 l$$

where  $c$  is a constant dependent on the period, angle of roll, and height of yard above centre of gravity of ship.

There are no rolling reactions parallel to the mast. In the example taken the royal yard was 52 ft. in length, and weighed with sail and fittings .7 tons. It was when hoisted 157 ft. above the centre of gravity of the ship. The angle of inclination of the vessel may be taken as 15 deg., the angle which the yards make with the middle line plane 24 deg.; the angle which the sails make with the plane of the yards 15 deg., and the coefficient for the rolling reactions .00142.

The moments of the forces perpendicular to the plane of the yards are, therefore, as follows, viz.:—

$$\text{Wind pressure } \frac{.7}{4 \cos 24 \text{ deg.}} \times \frac{52}{4} = 2.5 \text{ foot-tons}$$

$$\text{Rolling reactions } \frac{.7}{2} \times .00142 \times 157 \text{ ft.}$$

$$\times \cos 24 \text{ deg.} \times .18 \times 52 = .7 \text{ foot-tons}$$

$$\text{Weight } \frac{.7}{2} \times \sin 15 \text{ deg.} \times .18 \times 52 = .8 \text{ foot-tons}$$

$$\text{Total } 4.0 \text{ foot-tons}$$

$$\begin{aligned} \text{The moment of the forces parallel to the mast are} \\ \text{Wind pressure } \frac{.7}{4 \cos 24 \text{ deg.}} \cot 15 \text{ deg.} \times \frac{52}{4} = \\ 9.4 \text{ foot-tons} \end{aligned}$$

$$\text{Weight } \frac{.7}{2} \cos 15 \text{ deg.} \times .18 \times 52 = 5.0 \text{ foot-tons}$$

$$\text{Total } 12.4 \text{ foot-tons}$$

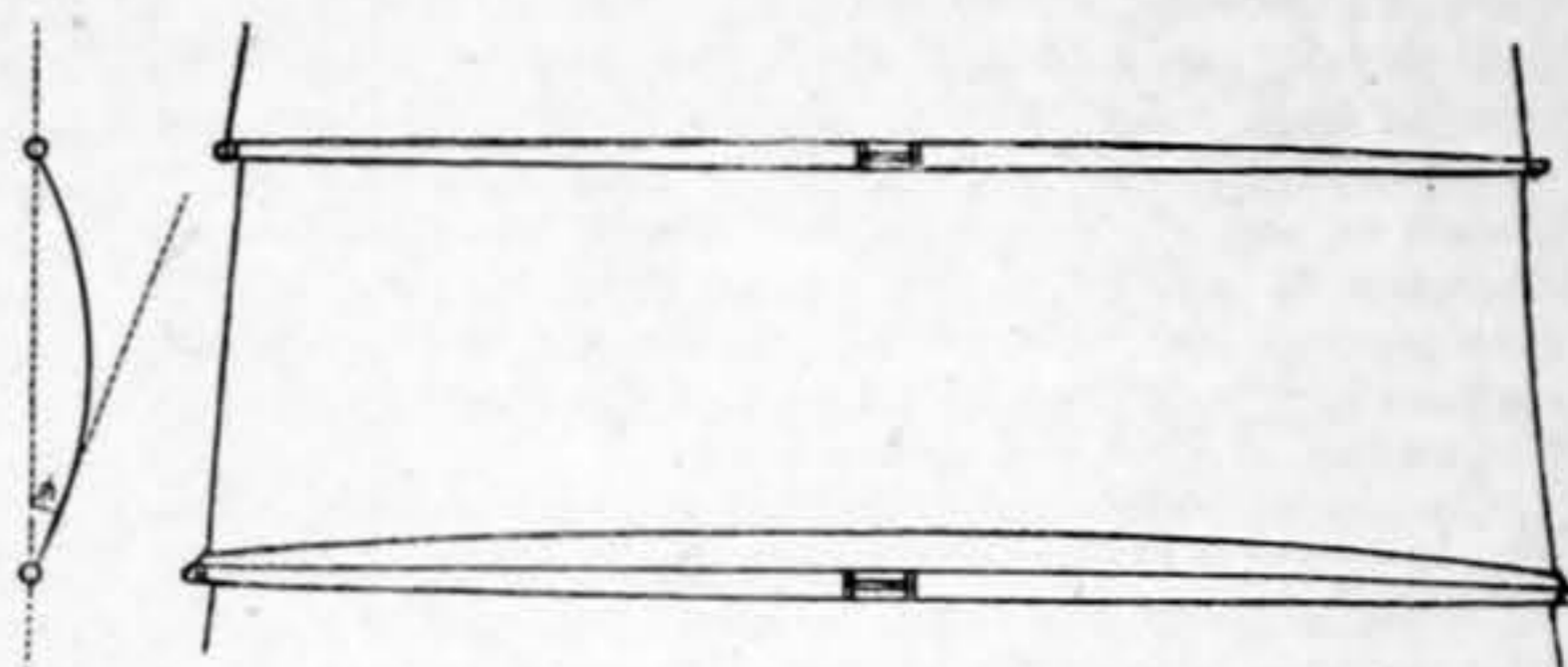
The resultant is therefore

$$R = \sqrt{4.0^2 + 12.4^2} = 13 \text{ foot-tons} \\ = 156 \text{ inch-tons.}$$

The moment of resistance of the yard was 30.5 inch<sup>4</sup>. The stress is therefore

$$p = \frac{156}{30.5} = 5.1 \text{ tons per square inch.}$$

The above moments are based on the assumption that the yard receives no support from the braces. Some support will be afforded in this way, but it can only be a very small amount, as the braces are nearly perpendicular to the direction of the forces. If, however, a lower yard had been taken, then it might be considerably assisted by the sail above it being set, as that would



tend to raise the ends of the yard below. The most severe case will, however, always be that where no sail is set above. If the yard ends are supported by stays to the mast above, then the bending moment will be reduced to about one-fourth of the above for the forces parallel to the mast, and the place of maximum stress will be near the centre of gravity of the half length of the yard.

The sum of the various forces may be taken to be uniformly distributed over the length of the yard. The bending moment at any place of the yard will, therefore, vary as the square of the distance from the end of the arm. The thickness of the plating of the yard may be taken to vary as the diameter, in which case the moment of resistance will vary as the cube of the diameter. For a constant stress along the yard the diameter should, therefore, vary as the two-thirds power of the distance from the yard end. If the yards were made to this contour, then there would be a sudden change in the curvature at the middle, which, for practical reasons, would be undesirable. Nor can the ends of the yards be made of so small a diameter as the above considerations would lead to.

Gaffs and booms may be treated as yards supported at two or more places, and the bending stresses calculated accordingly. In the case of the boom, the tension on the sail will, however, act against the weight of the boom instead of with it.

### MATERIAL.

It has so far been assumed that all the material of the spars and rigging has been steel. In the example taken we may assume the diameters of the spars to be the same, whether they are made of steel or wood. In that case the ratio between the sectional areas of steel and wood spars would be .07, and the ratio between the respective moments of inertia and the moments of resistance .13. The weight of steel is about twelve times the weight of the wood of which spars are made. The weight of steel spar will, therefore, be  $.07 \times 12 = .84$  times the weight of a wood one.

The steel will stand about ten times the amount of stress the wood can bear. The strength of a steel spar is, therefore, 1.30 times that of a wood one.

The modulus of elasticity for steel is about 23.7 times that of wood used for spars. The stiffness of a steel spar is, therefore,  $.13 \times 23.7 = 3.1$  times that of a wood one.

The resilience of a spar is the work done in straining it to its breaking point or to a certain percentage of the

breaking stress. It will be measured by  $\frac{p^2 I}{E y^2}$ , where  $p$

is a given percentage of the ultimate strength,  $E$  the modulus of elasticity,  $I$  the moment of inertia, and  $y$  the half diameter of the spar. The ratio between the resiliences of a steel and wood spar will, therefore, be

$$\frac{10^2 \times .13}{23.7} = .55.$$

For the same diameter the resilience of the wood spar is, therefore, the greater.

For the same strength a steel wire rope will weigh about 42 per cent. of the weight of a hemp rope, and the diameter or circumference will only be one-third that of a hemp rope.

The following table gives a comparison between the various elements for steel and wood spars, and for hemp and steel wire ropes. The results are averages, and will vary with variations in the quality of the wood or hemp, or with the construction of the steel spars and ropes. In each case the quantities stated are assumed to be unity for wood and hemp, so that the figures represent really the ratio between the quantities for steel and the corresponding quantities for wood or hemp.

The weight of the spars was shown to be the most important item amongst the causes of the strains on the masts, because not only does it add itself to the straining forces, but the rolling reactions will be increased in pro-

portion to the increase in the weight. It is usually desirable to save as much material as possible for the sake of economy, but when the weight of the structure itself causes much greater strains than the other applied forces it has to support, the reduction in the weight of the material is most important for the efficiency of the structure. Everything which tends to saving of top-weight tends, therefore, to the improvement of the support for the sails. It will be seen from the table below that for the same diameter of the spar there will be a saving of about 11 per cent. in weight if steel is substituted for wood, and this saving will be accompanied by an increase of 30 per cent. in the strength against cross bending. Further, by substituting steel wire ropes for hemp ones, there will be a saving of 58 per cent. in the weight of the rigging, for the same strength. This shows the great advantage of adopting steel both for spars and standing rigging. Steel has, however, its disadvantages.

Spar.—Ratio of Steel to Wood.

Diameter.	Sectional area.	Moment of resistance.	Moment of inertia.	Weight per unit volume.	Ultimate stress.	Modulus of elasticity.	Diameter.	Weight.	Strength.	Stiffness.	Resilience.
D.	A.	I <sub>g</sub> .	I.	P.	p.	E.	D.	A.P.	I <sub>g</sub> p.	I E.	$\frac{p^2 I}{q^2 E}$
1.00	.07	.13	.13	12	10	23.7	1.00	.84	1.30	3.1	.55
							1.09	1.00	1.67	4.4	.65
							.92	.77	1.00	2.2	.46
							.75	.48	.55	1.0	.31
							1.35	1.53	3.22	10.3	1.00

Ropes.—Ratio of Steel to Hemp.

Circumference.	Sectional area.	Weight per unit volume.	Ultimate stress.	Modulus of elasticity.	Circumference.	Weight.	Strength.	Stiffness.	Resilience.
C.	A.	P.	p.	E.	C.	A.P.	A p.	A E.	$\frac{1}{A E}$
.33	.109	3.85	9.20	45	.33	.42	1.00	4.9	.20

It is desirable that the rigging shall take practically all the transverse forces. To do so it ought to be stiff as compared with the mast, or to require a very large force to extend it a given amount. Steel wire ropes are seen to be about 4.9 times as stiff as hemp ropes, so that so far steel is again preferable to hemp. It will, however, be seen that, both for the same diameter, for the same weight, and for the same strength, the stiffness of the steel mast is in excess of the wood one. The wood mast would therefore be preferable, in so far as it would with the same rigging leave the greater part of the work to the stays, whereas the steel spar would, on the other hand, take a larger proportion of the transverse forces, and might with yielding stays take more than it could support. As the stiffness of the spars is increased by the substitution of steel for wood, it is desirable that the stays should at the same time be made stiffer, and steel ones are therefore preferable to hemp ones when steel masts are adopted, even if they were not so from other considerations.

Suddenly-applied forces, such as might be caused by the impetus of the wind, must within a short space of time strain the structure from a minimum, say, zero, up to a maximum, say, a certain percentage of the breaking stress. The effect of the impulse will be partly spent in doing this work. It is therefore desirable not only that the structure should have a certain amount of strength, but also that it should be able to yield to a large extent before breaking; in other words, that it should have a certain amount of resilience. In this it will be seen that both the steel spars and the steel rigging are deficient. The resilience of a steel spar being, for the same diameter, only about one-half that of a wood one, and the resilience of steel wire ropes about one-fifth that of hemp ones. Against suddenly-applied forces the wood and hemp have therefore the advantage.

Other metals than steel might be employed for spars. Those of less specific gravity, like aluminium, would offer greater chances of improving the structure than the heavier ones with high tensile strength; because the thickness could then be increased, thereby adding to the resistance to crippling, without increasing the weight.

For the same angle of inclination of the vessel, the moment of the wind forces will, for similar ships, vary as the fourth power of the dimensions. The moment of the weights will also vary as the fourth power of the dimensions, as will the moment of the reactions due to rolling, if we assume the same angle of roll. The strength of the spars will vary as third power of their linear dimensions. The stress on the spars will therefore be increased as the vessels become larger. As the various forces are increased as the third power, and the strength of the stays as the second power of the linear dimensions, it follows that the stress on the stays is also increased in the larger vessel. As by far the greater part of the stress is due to the weight of the material itself, it follows that any increase in the scantlings adds considerably to the straining forces. There is, therefore, for each material a limit to the size of spar which can be made of it. When this limit is reached, then any increase in the strength by means of increased scantlings is impossible, and it becomes necessary to find a new material which will give greater strength in proportion to the weight. This limit is for steel spars in the very largest sailing vessels not so very far off, as will be seen from the large proportion the stress due to the weight bears to the total stress in the vessel taken as an example. The appropriateness of

adopting steel instead of wood as the material for the largest vessels will be apparent from the above, as this material will admit of greater strength for the same weight, or of less weight for the same strength.

The flexibility of the spars and the extensibility of the stays are measured respectively by the ratio between the deflection and the length of the spar, and the ratio between the extension and the length of the stays, both of which ratios will vary as the linear dimensions of the structure. The deflections and extensions themselves will vary as the square of the dimensions. The resilience is half the product of the deflection and the force. In proportion to the applied forces the resilience will, therefore, vary as the square of the linear dimensions of the structure, or the larger vessel will possess considerably more resilience than the smaller one. This, again, goes to show that wood and hemp are more suitable than steel for the spars and rigging of small vessels. These materials will in the small vessels provide the resilience, which in the larger vessels is found in the structure itself.

The fact that the stresses on spars increase so rapidly with the dimensions, and that additional scantlings do not necessarily materially improve the strength, explains the many failures of masts and rigging when the size of sailing vessels was rapidly being increased. It was not so much by adding material that these vessels, spars and rigging were improved, as by careful attention to the details of the structure and to the lessening of the straining forces by reducing the stiffness of the vessel, and by removing unnecessary top weights. A very great deal depends on little details. In a ship's hull a few loose rivets, or even large partial destruction of the structure, does not or may not materially affect its efficiency as a whole. With the rigging structure it is different. The faulty fitting of a chain plate, the snapping of an eyebolt, or the uneven setting up of a few stays, may cause the complete collapse of spars and stays.

Even when all details are perfect, when the dimensions of the spars and rigging are ample and properly proportioned, when the stiffness is gradually reduced from the deck to the truck, when there is sufficient resistance to meet the ordinary impulses of the wind, and when all is as near perfection as it is possible for the constructor to make it, even then failures may happen. The builder has done his part, but it remains with the stevedore and the captain of the vessel to do their part. It was seen that any alteration in metacentric height affected the rolling reactions. The stevedore has it in his power to alter this quantity to the extent of 100 per cent. or more, thereby increasing or decreasing the rolling reactions in the same proportion. The captain has it in his power to carry the sails in any sort of wind, and to let the vessel fall off from the wind and roll with the waves under the most trying conditions. It is evident, therefore, that a vessel may be dismasted over and over again without the slightest fault in the structure. It is impossible to construct masts and rigging which will resist any wind forces or any rolling reactions. The shipbuilder can only provide a structure which is strong and efficient under ordinary circumstances, and it is for the stevedore and the captain, so far as it lies within their power to do so, to see that these average working conditions are never exceeded.

## THE EARLY RAILWAYS OF SURREY.

### No. II.—THE CROYDON, MERSTHAM, AND GODSTONE IRON RAILWAY.

WHEN the Surrey Iron Railway had got well started and was far advanced towards completion, it seemed fit that steps should be taken for carrying it another stage on the way to Portsmouth. At a meeting held at Wandsworth, June 3rd, 1802, Mr. George Tritton in the chair, it was unanimously resolved that a subscription should be entered into to defray the expense of a survey for this object. Messrs. Samuel Jones and George Wildgoose were engaged to do this, and to prepare plans, sections, and a book of reference, according to the Standing Orders of Parliament, under the direction of Mr. William Jessop. At a further meeting on October 7th, Jessop and his son Josias were appointed engineers, and Jessop's report, dated that day from the London Coffee-house, was read. He approved of the route surveyed, with a small exception, and considered the line from Croydon to Reigate by Merstham would pay for itself by the traffic in lime and "fire-stone" from the quarries at the latter place. Notices were given the month before of intention to apply for power to make a line, though an extensive loop from near Purley round by Caterham to Godstone Green was given up. In spite of great opposition from the advocates of an extension of the Croydon Canal, who were headed by Lord Gwydir, and had gained over John Rennie to their side, the railway party won the day, the Croydon, Merstham, and Godstone Iron Railway Company being incorporated on May 17th, 1803, with power to make "an inclined plane or railway for the passage of wagons," from Pitlake Meadow at Croydon to the town of Reigate, with a branch from Merstham to or near Godstone Green. Jessop's estimate of the cost was only £52,347, but the capital authorised was £60,000, with power to raise £30,000 more if necessary. The total length of the system sanctioned by this Act would have been about 15½ miles, but £45,500 was all the Company was able to raise, which only sufficed to get it to Merstham limestone quarries. Neither Reigate, which would have been on the way to Portsmouth, nor Godstone Green, where there were splendid quarries of free-stone, was ever reached. As in the case of the older line, the works were carried out with considerable promptitude, considering their rather heavy nature. On July 24th, 1805, the line was opened for traffic so far as it ever got, a distance of about 8½ miles. A long account of the proceedings may be found in the *Morning Chronicle* of July 27th, 1805, which also describes the foundation of the railway as composed of "white chalk and flints pounded, watered, and rolled, with a small sprinkling of gravel on the top," and holds it forth for the benefit of the commissioners of the roads near London. The account is under the title of "Extraordinary Feat of a Draught Horse." Mr. Banks, it seems, laid a wager that a horse could take twelve wagons loaded with stone, a gross

weight of 36 tons, unassisted, along the railway towards Croydon. This it easily did, going six miles in 101 minutes, starting afresh four times. Having won his bet, Banks directed four more loaded wagons to be attached, and finally fifty workmen got upon the train, the same horse continuing to draw the whole lot. On being carefully weighed at Croydon the total load was found to be 55 tons 6¼ cwt., a fact which excited almost as much wonder and admiration as did the Rainhill trials of locomotives so many years later. As the line fell 1 in 120 the whole way, and was, no doubt, in excellent order, there is nothing really very surprising in the feat. Probably the train would have gone to Croydon just as well without a horse at all.

The Committee, or Board of Directors, as it would now be called, of the C.M. and G.I.R., consisted of thirty-four members, twenty-six of whom had been on that of the Surrey Iron Railway two years before. Several London bankers, Col. Hylton Jolliffe, M.P., of Merstham House, owner of the quarries, and the Rev. William John Jolliffe were on the new Committee, but not on that of the older line. The Jolliffes exercised an important influence upon the fortunes of both tramways during many years, as will be shown later on. The proprietary of these lines was, to a large extent, the same.

The Croydon terminus of the Merstham line was, of course, that of the Surrey Iron Railway, a little to the north of the parish church, about the Gun Tavern yard. Part of the property of Ellis Davis's almshouses was taken, then the line ran round at the east end of the church through some bleaching grounds which had lately formed part of the gardens of the old Palace of the Archbishops of Canterbury. Portions of the Palace were also taken, though a good deal of it still remains. It then ran along the present Southbridge-road, coming up with the Brighton-road behind the Blue Anchor Inn. Continuing through Haling Park, it took a course now marked by a back lane behind the long row of houses just beyond the Park. Passing just below St. Augustine's Church, its site beyond has lately been built over, but opposite the Windsor Castle Inn the course of the line begins to be clearly marked by a line of rough posts and wire fencing. This continues a considerable distance, during which it may be plainly seen from the Brighton Railway, passing a large chalk quarry on the way. Very slowly the line diverges to the westward of the high road, rising also with a steady and uniform gradient, said to have been, and appearing to be, 1 in 120. Near the cross roads at Purley, opposite the church, some villas stand on the site, and then the road to Russell Hill Schools crosses it. The raised horse tracks and a few sleeper holes full of grass may yet be seen along here. Just beyond comes a genuine little bit of embankment, much grown over with grass and bushes. After this is a long stretch of ploughed land, on which the course of the old line may be faintly traced. Still slowly diverging and rising, it has been cut through at Smitham Bottom by the Chipstead Valley Railway. Immediately after this is a large piece of embankment, curving a little to the left. On the top of this the holes where the stone blocks rested are very plainly to be seen, especially in what we should call the up line. In fact, it is the only place on either of the Surrey trams where they can be well traced. The embankment is about 20ft. high where it ends on the north side of the road from Coulsdon to Epsom, but is only 18ft. wide on the top. The outer blocks were therefore extremely near the edge. Apparently the rails were laid to break joints, though this may not have been the practice generally. Formerly an arch existed across the road here, but it was pulled down as too small when the tramway went out of use. An isolated bit of embankment, on the south side of the road, was till lately very perfect, made of chalk, but has mostly been carted away. After a short break beyond, another piece is visible in the farmyard of Cane Hill Asylum, after which the route of the line is lost in the Asylum grounds, but becomes visible beyond at the edge of a plantation on the hillside. Its average distance from the Brighton road is about a quarter of a mile, though much less between Croydon and Purley. Approaching the high road at Hooley-lane cross roads, it ran on the east side of Stoney Cottage. Some blocks may be seen here in a rough wall, but for the space of nearly 1½ miles further no trace of the line remains, for the reason that its site is now partly occupied by the highway, which was thrown westwards upon it when the London and Brighton Railway was made in 1838-41, and partly by that railway itself or its spoil-banks. The Croydon and Reigate highway, or Brighton road, was formed in 1806-8, and passed under the tramway by an arch about half a mile south of the cross roads just mentioned. It is the mile beyond this which is now the railway, or obliterated by the huge chalk mounds thrown up in making it. When the tram reappears it is at a branch road leading off to Chaldon. Here it was in a shallow cutting which immediately adjoins the Brighton road on its eastern side. One of the original bridges, of genuine canal type, carries the branch road over the excavation. The spoil banks partly fill it in on the north side, and it has had to be secured with wall plates, and one parapet has been rebuilt. The lower part of the semicircular arch is of the local limestone to the springing, all the rest of the bridge being red brick. The outer faces have a perceptible batter, and are 16½ft. apart at the springing line, leaving the roadway between parapets about 13ft. wide. Underneath the span on the ground line is 17ft., and the headway about 10ft. The span seems small for a double line of 5ft. gauge and 5ft. intermediate space, but as the wagons were also 5ft. wide, there would be about a foot clearance on either side. Some 200 yards farther on there is another bridge Fig. 3, of precisely similar size and type, carrying a lane leading to a farmhouse. The cutting here is deeper, and water accumulates in it after wet weather. It resembles a grassy lane, 18ft. wide at the bottom. No traces of the sleeper sites remain. Soon the filled-in place of an occupation bridge in the fields is reached, and then, re-curving towards the road, the cutting becomes planted with trees. At about five furlongs from the last bridge a third one is met with, connecting the road with the fields beyond. This bridge is somewhat different from the others, the sides being formed with flints in two panels with limestone between, and sloping back considerably to the springing line. This has two or three courses of stone, the arch being turned in brick. The width and span are the same as in the former cases, but the headway is greater and the parapet walls longer and, as will be seen from Fig. 4, very much splayed or curved. In a little way the plantation ends, the line comes level with the road, and has a few cottages on its site. It then passed over the south end of Merstham Tunnel, and pursued a south-easterly course behind the Jolliffe Arms. Half a mile or so from the tunnel the line ended at Merstham limestone quarries.

This half mile may be regarded as the stump of the unfinished Godstone Green branch, as the main line would have gone down the hill and round to the south-west, had it been taken any further. Some tipping frames remained at the

## EARLY SURREY RAILWAY BRIDGES



Fig. 3—RAILWAY BRIDGE NEAR CHIPSTEAD, 1805



Fig. 4—OLD TRAM-ROAD BRIDGE NEAR MERSTHAM

quarries for many years after the line was closed, but have long disappeared.

In 1806 another effort was made to complete the scheme sanctioned three years before. An Act of July 3rd gave the Company power to raise the balance of the £90,000, virtually in any way it could. Several accounts give the capital after this as £65,000, but as no further extension of the line took place, it would seem that the money, if really raised, went to pay off debts. With a branch of a quarter of a mile into a quarry near Purley, the system was nine miles long, equal to £7220 per mile, or, say, £7000 without rolling stock. Considering the nature of the works, it could hardly have cost less.

As regards dividends, the Merstham line was but little more successful than the Surrey Iron Railway. In 1822, however, some shares were sold, which were described as paying 1 per cent. per annum, and there is even some reason to think that upon one occasion no less than 2 per cent. was divided. Still, the returns were undoubtedly very small and irregular, and the line was justly considered a financial failure.

The same scale of rates and tolls obtained as on the Wandsworth line, except that no rate for coal by the chaldron appears, but only by the ton. This might be 4d. per mile, and except, perhaps, a little manure, was probably the only article of back-carriage. Depôts for manure might be established at various points, and lords of the manor and landowners could set up wharves for their convenience, but where any of the intermediate stations were, or whether there were any, we have no knowledge. There were probably a few occupation level crossings, where the gates were normally kept closed against the railway, as the wagoners were expected to be their own gate-men, but owners and occupiers of lands traversed could let their servants and cattle go freely about on the line, provided they did not damage it or obstruct the traffic. The Company could, seemingly, charge what it liked for small parcels not over 500 lb. in weight, provided it notified such charges at the wharves and toll-houses, and could exact wharfage for goods left more than twenty-four hours. Level crossings had to be paved with "Purbeck squares" for two yards on each side, flush with the top of the flanges of the rails.

The Croydon Canal turning out a failure, and being hopelessly unable to get any nearer to Portsmouth, in 1811 established a connecting line between its wharf—the site of which is now partly occupied by West Croydon Station—and the Surrey trams at their yard or depôt nearly half a mile off. The line went along what is now Tamworth-road, with a considerable fall and curve all the way. At the canal basin was a windlass, by which the wagons and trucks were drawn up the last few yards on to the wharf and unloaded into barges, which usually brought back coal direct from the ships.

The connection, in all probability, proved profitable to the Merstham line, though most likely it rather injured the Surrey Iron Railway. It plainly gave the Croydon, Merstham, and Godstone Company an alternative route to London, and for heavy goods intended for shipment was certainly better than the Wandsworth route. A good deal of stone used to be sent down from Merstham at one time, the deposits of "fire-stone" in particular being in great demand for constructing ovens and furnaces. There was also some traffic, at any rate about 1820, in stone from Worth, near Crawley, about twelve miles south of Merstham. Most likely the stone trucks went on by road and rail straight through from Worth to Croydon. Fuller's earth, too, is found in considerable quantity about Redhill and Nutfield, near Merstham, and formed one of the chief articles of traffic. Being largely used in the clothing trades of the West and North, it would go to Wandsworth for transport up the river, and on by the canals. Lime, however, was the staple, and to this day Merstham grey-stone lime can hold its own with any. In the time of the old tramway, inland carriage from long distances was almost prohibitory, so that to get lime in London from within twenty miles was a great point.

About the year 1807 Mr. Banks and the Rev. W. J. Jolliffe entered into partnership as building contractors on the large scale, and soon attained the highest position in that line of business. Favoured by the Rennies, they undertook the execution of many of their greatest works, and constructed, notably, Waterloo, London, and Southwark bridges, except the ironwork of the latter. In these works they employed Merstham lime, and, in fact, practically controlled the traffic on both the Surrey trams. There seems little doubt that they were the contractors to whom the tolls were periodically leased. All over the country the great works of Jolliffe and Banks extended, they built with a solidity and excellence worthy of the ancient Egyptians, and almost seemed to emulate their enduring monuments. Both partners amassed enormous fortunes. Latterly they lived near each other in Tilgate Forest, Sussex, not far from the Worth stone quarries, which were, no doubt, developed by them. Banks, who was knighted by George IV., is said to have been quite a self-made man, in fact, some

accounts say he worked as a navvy at the construction of the Merstham line. This is probably wrong, however. His tomb in Chipstead Churchyard looks down upon the deserted cutting of the ancient plate-way. There is a fine portrait of him in the Guildhall Art Gallery. In 1833 the partnership was dissolved, and the Merstham tram, which was said, from the point of view of those days, to have "done a pretty good trade for twenty years," probably suffered in consequence.

Although the London and Portsmouth canal schemes of 1801 came to little, and an extension of the Croydon Canal to the latter place in 1804 was defeated by the millowners, the project was long kept on foot, and latterly tended to combine with, instead of opposing, the railways which had already got nearly a fourth of the distance. John Rennie the elder was again the leader, and in 1810 presented plans for the Grand Southern Canal from the Medway Navigation at Tunbridge to Portsmouth, utilising a portion of the river Arun, and including "a cut or canal from the Iron Railways at Merstham" to the main line of navigation at a farm in Burstow parish, Surrey. The plan, however, was defeated in the session of the following year. Nothing daunted, a fresh scheme, backed by the Jolliffes, Barclays, and Trittons, on the railway side, and the Duke of Norfolk as to the land-owning interest, was brought out in January, 1812, for a canal from Merstham through Horsham to the projected

was in possession of the Brighton Company, which soon after desired tenders, by November 8th, for purchasing the "iron trams" or rails, then lying either on the old line or contiguous to the turnpike road. Claims on the Merstham Company had to be sent in to Mr. B. C. Luttly, the clerk, at Wandsworth, by November 24th. Finally, by a short Act, passed July 1st, 1839, the Croydon, Merstham, and Godstone Iron Railway Company was dissolved, and ceased to exist as from the date of the Act.

From 1803 to 1826 the yearly General Assembly of this line took place at the King's Arms Inn, at Croydon, and from 1827 to 1829, and 1831 to 1834 at the Greyhound, in the same town. In 1830, however, and the last five years to 1839 inclusive, the George and Vulture, in George-yard, between Lombard-street and Cornhill, was the place selected. With the exception of the first and last meetings, which were on June 7th, the first Tuesday in May was the day, and 11 o'clock the hour, of these interesting gatherings. Unfortunately, no account of the proceedings at any of them seems accessible. All the establishments just mentioned still remain.

The photographs both of this line and the Surrey Iron Railway are by Mr. W. Ash, 50, South-street, Wandsworth.



WILLIAM JESSOP

Wey and Arun Canal at Newbridge, but a petition to Parliament was all it came to. Six years later it was attempted to be revived, with, if possible, less result still.

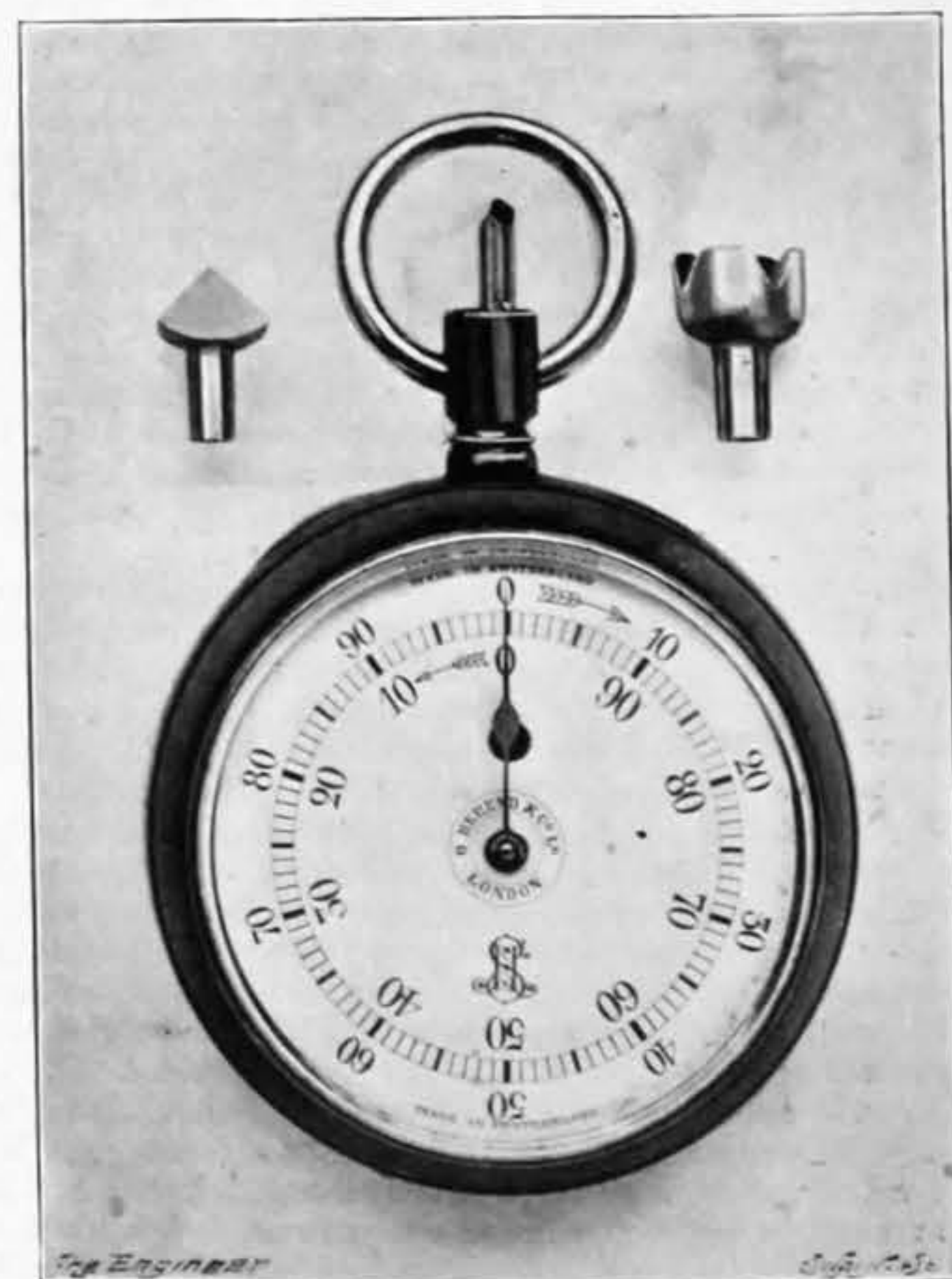
Early in 1825 appeared the prospectus of the Surrey, Sussex, and Hants Railroad Company, whose object was to unite some of the south coast ports with Brighton, and go thence to London. As horse power was to be used unless something better was discovered, and as Sir Edward Banks and four of the Jolliffes were on the board, the line would, no doubt, have utilised the C.M. and G.I.R.; but the project came to naught.

The rails were similar to those of the Surrey Iron Railway. One which we have seen, perfect all but part of the flange, is 36in. long, 4in. wide on the tread, with the flange 3in. high in the middle. On the bottom are two parallel ridges, one under the outer edge, the other in the centre, 27in. in length. The outside of the tread has at the left the letters, facing towards the flange, Ry. Co., and at the right-hand corner C.M. & G., so that the inscription would read continuously from one rail to the next. The other rail has one end broken off, but is plain underneath; both are only ½in. thick. This last is probably one of the original rails, the former being a renewal.

The Act of July 15th, 1837, incorporating the London and Brighton Railway Company, authorised it to purchase "the whole of the said Iron Railway from Croydon to Merstham." The matter being referred to arbitration, the sum of £9614 was accepted, although £42,000 was at first asked. As the tolls of the tramway had been advertised to let for three years from January 1st, 1837, this event would seem to have been somewhat unexpected. By September, 1838, the line

## REVOLUTION COUNTER.

WE illustrate a neat form of revolution counter which O. Berend and Co., Limited, are just bringing out. It has been designed with a view to meeting the requirements of consulting engineers for a handy instrument which can be carried without inconvenience in the pocket. This counter closely resembles rather a large-sized watch. The case is oxidised. The spindle projects through the boss of the ring, and a point and hollow bit are provided. A scratch on the side of the spindle indicates the position of the driving pin, on to which a slot in the bits has to slide. In this respect the counter is



POCKET SPEED COUNTER

open to improvement, as both the pin and scratch are too small to see clearly in a dark engine-room. Why should not a square or oval spindle be used? The marking of the dial follows the design adopted in other forms of counters made by the same makers. There are two sets of figures reading clockwise and anti-clockwise; one set is in red, the other in black, and a little signal disc, which is either red or black, depending on the direction of rotation of the spindle, shows which set of figures is to be used. This is a capital arrangement. The hands are set back to zero by opening the back of the case and turning a thumbscrew. The counter, which is of Swiss manufacture, appears to be excellently made.

## ELSWICK NAVAL MOUNTINGS.

No. I.

It is only occasionally that an opportunity occurs of obtaining trustworthy descriptions of the best designs in gun

readers to grasp more fully the mountings described, and in answer to a special request made, Sir Andrew Noble kindly sanctioned the supply of drawings differing from those in the paper referred to, in the fact that reference letters and names of the members of each design are

best gun mountings were apt to resemble those they had seen at home very closely. The Rendel heavy gun mountings many years ago, and subsequently the remarkable small and compact Vavasseur mountings, in which the recoil of the gun was controlled as it had never been done before, only need to be mentioned to remind professional readers of the truth of what we have said. To these we may add one equally well known, but to which attention is called, as it may have escaped the notice it deserves. Elswick first brought forward quick-firing guns, and in 1886 30-pounders were already made by them.

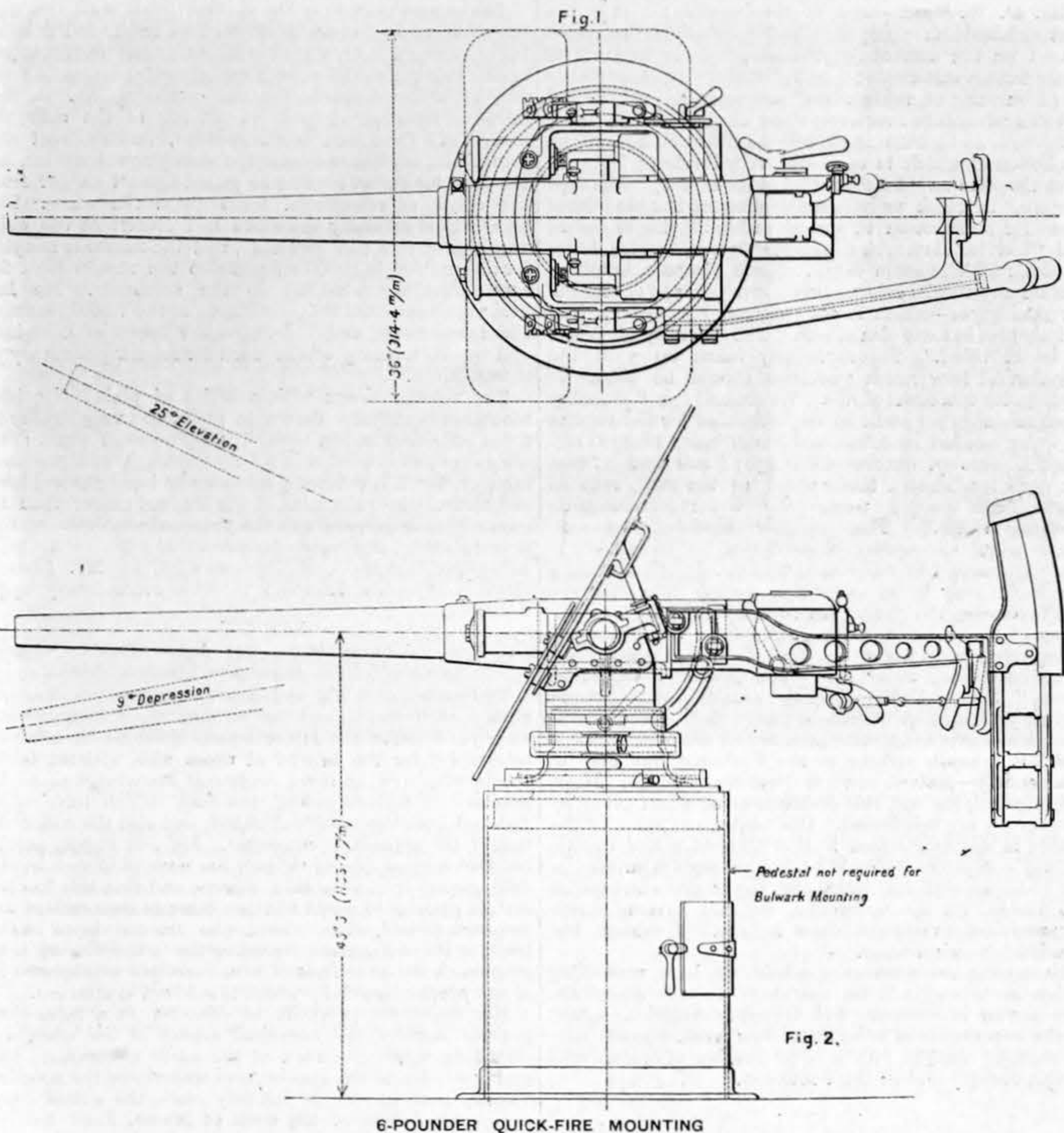
In 1890 the Navy had so completely adopted quick-firing guns, that while the Nile and Trafalgar, launched in 1888, had armaments containing 4.7in. quick-firing pieces, the Ramilles class had 6in. quick-firing guns discharging 100 lb. projectiles; while the lists of 1890 show that the French navy had as yet only 65 mm. (2.57in.) pieces discharging 8½ lb. projectiles, as in the Carnot armament, and Germany had 10.5 cm. (4.13in.) guns in the Brandenburg class. The advantage secured by Elswick was not confined to priority of date, and the feature to which attention is specially called is the application of the sights to the portion of the carriage which did not recoil, so that the eye could be kept on the line of sight without disturbance—a principle which is clearly recognised now, but which was so slowly perceived that it was carried out in very few quick-firing mountings exhibited at the World's Fair in Chicago in 1893.

Sir Andrew Noble's paper having been printed in the Proceedings of the Institution of Naval Architects, the present object is to notice more particularly the mountings dealt with in it. Figs. 1 and 2 and a photograph on page 62 show an improved mounting which first came in about 1887 for three and six-pounder quick-firing guns, superseding the "crinoline" or "elastic" stands. The gun here recoils in the line of fire, and proved itself very successful on trial at Portsmouth, and was adopted in our own and many other navies. The photograph shows the fixed ammunition. The shoulder-piece pistol grip, &c., are seen in Fig. 2 and the photograph. These guns are now principally used in tops and in the armaments of destroyers.

Figs. 3 and 4 and a photograph on page 63 give the 3in. 12-pounder quick-firing gun on the pedestal mounting introduced in 1890. It will be seen that the piece is fixed in a cradle carrying a buffer fixed beneath the piece moving with it in elevation, and providing for recoil in direction parallel to its own axis. The carriage is of forged steel, in the form of a Y, having a long shank which fits into the pedestal and forms the pivot. The whole weight is taken on the end of the pivot, and the mounting can be trained with ease by a few pounds applied at the shoulder piece. The pedestal is very solid, is of forged steel, and affords excellent protection to the pivot; the base is also small, and there being no rollers or roller paths, the deck may be considerably distorted without interfering with the working of the piece. In unprotected positions it is specially desirable to diminish and simplify any portion of the mounting likely to be struck in action. The shield is 3in. thick, balanced and attached to the carriage by flexible stays—see Fig. 3—so arranged that if the shield be struck the stays yield so that a very reduced shock is transmitted to the carriage. This mounting was the first to be fitted with the drum and bar sight—see Figs. 3 and 4 and photograph, page 63. In 1891 an experimental mounting of this type, somewhat resembling that in the photograph on p. 64, but without the shield, was made for a 4.7in. gun, with 3in. shield and sloping roof with yielding stays. It was attacked in a comparative trial with a piece on a centre pivot roller-path mounting, in which a 3in. shield formed an integral portion of the mounting, which had as well an outer shield 1½in. thick. The latter mounting was disabled after two rounds—one from a 3-pounder and one from a 6-pounder. This trial showed that steel castings, although giving excellent tests, could not withstand a severe blow from a projectile. The pedestal mounting received twelve rounds before it was disabled—four from a 3-pounder, six from a 6-pounder, and two from a 4.7in. gun, and it would not then have been disabled had the pedestal been made, as they are now, of forged steel. In the experimental mounting the pedestal was of steel plate and angle; the last projectile fired penetrated the pedestal and jammed the pivot. Even then the damage was not serious, and could have been remedied in a few hours. With this exception, the mounting was as good as ever. This type of mounting for guns up to 6in. calibre is now almost universal in our own and many other services.

The photograph on page 64 shows the 4.7in. quick-firing gun on pedestal mounting, as used in our own and other services in secondary armaments of battleships, such as the Barfleur, and in principal armaments of cruisers.

NAVAL ENGINEER APPOINTMENTS.—The following appointments have been made at the Admiralty:—Fleet Engineers: H. S. Rashbrook, to the Wildfire, for the Edinburgh, appointment to the Champion cancelled; R. Harding, to the Vernon, additional, for the torpedo boats and such tenders as have no engineer officers attached to them. Staff Engineers: J. A. H. Hicks, to the Duke of Wellington, additional, for the Cressy; T. C. E. Hughes, to the Duke of Wellington, additional, for the Hecla. Chief Engineer: W. J. Anderson, to the Duke of Wellington, additional, for the Gladiator. Engineers: F. Pring, to the Duke of Wellington, for the Glory, and W. J. Leighton, to the Research. Acting Engineer: F. Guyer, to the Wildfire, for general duties in Sheerness Dockyard Reserve. Probationary Assistant Engineers: G. W. Mathew, to the Devastation; J. E. G. Cunningham, to the Vivid, additional, for the Ocean; A. O. Wood, to the Vivid, additional, for the Ocean; H. V. Gordon, to the Majestic; E. B. Scott, to the Diadem. Artificer Engineers: John Guthrie, Eugene Mundy Baker, and Joseph R. Drake, all to the Pembroke; Geo. Dewey, Nathaniel E. Blake, Charles H. Hotston, Frank Mill, O. H. Nayler, Frederick D. Morgan, Archibald P. Norris, John Cook, and Geo. Betteridge, all to the Duke of Wellington; Amos Nicholls, to the Vivid; all supernumerary. Reserve Artificer Engineer: Alex. H. McTear, to the Rambler.

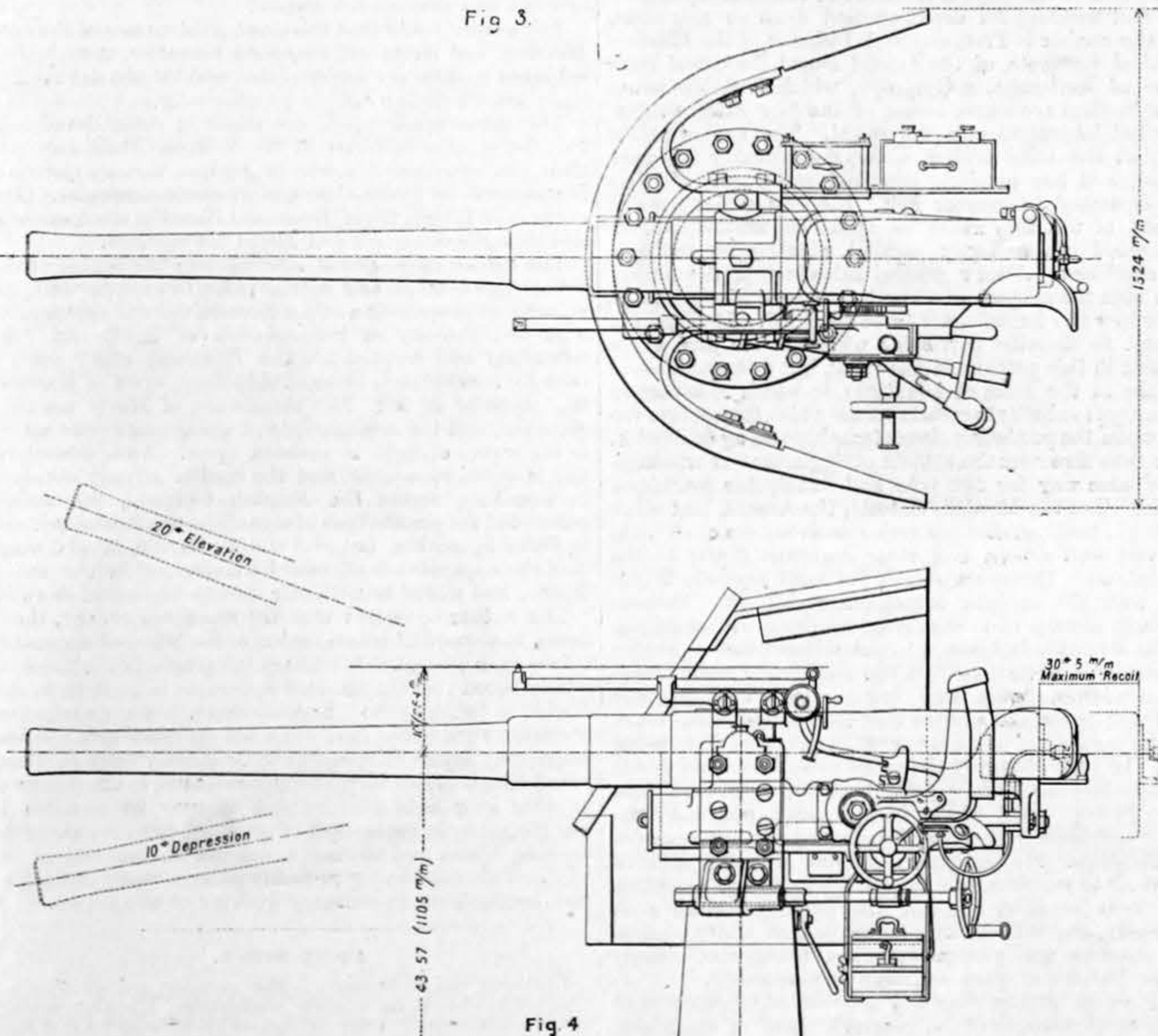


6-POUNDER QUICK-FIRE MOUNTING

mountings, for reasons which need not now be discussed. Consequently, Sir Andrew Noble's paper, read before the Institution of Naval Architects last year, furnished an

inserted, and to these photographs are added. Special stress is also laid on Elswick mountings, because Elswick has taken the lead in a remarkable way in this branch of

Fig. 3.



PEDESTAL MOUNTING, 12-POUNDER QUICK-FIRE GUN

opportunity which could not be allowed to pass without an effort to turn it to account. It was desirable, also, if possible, to add to it such information as would enable

war material. British officers, when attending foreign trials, have remarked that whatever new features or special developments of excellence might appear, the

## LITERATURE.

*Waterworks for Small Cities and Towns.* By JOHN GOODELL. New York: *The Engineering Record*. 1899.

THIS forms one of the *Engineering Record* series of works on engineering subjects. Its aim is to meet the desire shown in many letters received by our valuable contemporary for such information, and we are expressly told that the book contains no new theories, nor any references to methods of construction or design which have not proved satisfactory in use. As an offset to this, however, it is claimed that there will be found in its pages "considerable information never before collected in a single volume, and troublesome to obtain elsewhere." Further than this the work is intended to be of value to waterworks' trustees as well as superintendents and engineers; hence, a great deal of attention is paid to some details which technically-educated officials may consider very elementary. One notices, all through the book, descriptions of subjects of minor importance, which would be incomprehensible but for this explanation. A noticeable feature is the number of quotations from engineers—American and others. Whole pages are sometimes filled with such quotations, some of them emanating from men of high standing in the engineering world, and nearly all of them being well-chosen.

These quotations are largely relied upon, and in one place we read that they "give such explicit information on the subject of earths that little further comment is necessary." The subjects under discussion had been the proper material to use for earth dams. The opinions expressed are almost wholly in favour of gravel—i.e., a combination of small stones, sand, and loam, or gravel mixed with a small proportion of clay, in preference to clay alone. As a standard for practical purposes, one of the authorities recommends one cubic yard of coarse gravel, 0.33 yard of fine gravel, 0.15 yard of sand, and 0.2 yard of clay.

The use of too much water is deprecated in the formation of an earthen embankment. It is pointed out that its employment is perfectly natural from a contractor's point of view, because the liberal use of water will apparently make a very tight bank with the minimum expenditure of labour and time. With most materials employed in the construction of such works, however, there is a strong probability of "chinking" of the bank as the surplus water dries out, if an excessive amount is used. As to the actual method of forming the embankments themselves, especially those containing gravel, it is recommended that the layers of material should be thin, that they should be rolled dry in the first instance, then sprinkled with water and rolled again for a short time, and then that a final wetting should be given first before the next layer is applied. Dams and weirs are dealt with at some length, dimensioned sketches of existing constructions being given. Some twenty pages are devoted to masonry dams. Here we notice that the author has simply taken existing works as his starting point. Descriptions of portions of various dams are given and ample quotations made from various authors. The information is well put together, but lacks detail. In fact, as a whole, this statement may be applied to the whole volume.

An interesting chapter is that entitled "Special Features of River and Pond Supplies." Here we have a discussion of the motion set up in ponds and lakes by changes of temperature, whereby the top layers of water are made to change places with those below. Mr. Desmond Fitzgerald is quoted to explain what this entails, and we are told how that lakes, with any considerable amount of organic matter, and also deep artificial reservoirs where the original ground surface has not been properly stripped, have two great "overturnings" each year. These occur in spring and in autumn, the lower layers of water, which are quiescent during the period when there is comparative stagnation owing to small temperature changes, gradually collect all the organic matter from the upper layers, and decay goes on until all the oxygen is used up. When the "overturning" comes all this bad water is brought up to the surface, and infusoria and diatoms, obtaining a fresh supply of oxygen, grown in enormous numbers. In consequence, it is well to take water from the top of such reservoirs during the periods of stagnation, and, of course, it is of importance to see well to the stripping of the sides and bottoms of a projected reservoir. We are told, however, that many engineers are "disposed to sneer at the idea of the necessity of removing all the organic matter from the bottom and sides of the valley which is to form a storage basin for domestic supply." The worst odours in drinking waters are due to floating microscopic organisms. These are alluded to in this chapter, and a list of such organisms with the particular odours attaching to them is given. It is taken from Mr. G. C. Whipple's "Microscopy of Drinking Water." "It will take a biologist," we are told, "but a short time to determine which species is responsible for any given case" of bad odours. "Unfortunately, it is not such a simple matter to devise a satisfactory remedy, and in the present state of knowledge on the subject no general advice of any value can be offered."

The author next proceeds to discuss in order:—"Ground Water Supplies"; "Springs"; "Open Wells"; "Driven Wells"; and "Deep and Artesian Wells." Here we are given extracts from the specifications of different engineers, and the general outlines of the different kinds of wells are discussed. In one place we read—the author is describing "driven wells."—"Finally, Mr. J. L. Norton modified the American driven-well practice for military purposes, and his apparatus was used so successfully during that campaign—the British Abyssinian campaign in 1867—that driven wells using small tubes are frequently called Abyssinian wells in Great Britain and on the Continent." Numerous descriptions, not in most

cases very detailed, are given of different kinds of wells in America, on the Continent, and in England.

Pumps and pumping stations are next dealt with. This portion of the work requires no special mention, except perhaps in so far as it contains an interesting chapter on the air lift pump. One authority quoted—Mr. D. W. Mead—says of this system: "It is the best combination pumping appliance which has been placed on the market for obtaining a large quantity of water from a small hole;" and further, "In cases where it is a question of volume and not economy, the air lift has this advantage over everything else . . . ."

There is an interesting chapter on filtration and filters, the action of which is described very lucidly. Then we have chapters on "Intakes and Intake Pipes," "The Pipe System," in which we have descriptions of flexible jointed pipes for submersion in water, and the laying of these; and "Service Reservoirs and Standpipes," which latter are dealt with in some detail. None of these, however, contain any special information—save perhaps of some of the standpipes—which is not common knowledge. The last chapter but one deals with "The Quantity of Water to be Provided." This is largely taken up with the question of how much provision should be made for coping with outbreaks of fire. We are told that "probably more mistakes are made in the estimates for the volume of water needed by towns and small cities than in any other feature of waterworks design;" and further, that "a good fire stream takes water at the same rate as about 6000 people using the water for domestic purposes alone." This chapter contains one sentence which is worthy of quotation at length. "It has been learned by experience that the draught during a few hours may be at twice the average daily rate *per capita* during the year. On Monday mornings, for instance, when washing is done, and late in the afternoons of hot days, when lawns are sprinkled, there is an excessive demand for water, for which provision should be made." The last chapter deals with the management and general upkeep of waterworks. Here there is discussed at some length the question of checking waste—which is so much greater in the United States than in this country—meters, and the cleaning of mains. Here, too, electrolysis and the destruction of water pipes by this agency are mentioned. One statement made by the author in this connection is that tramways and electric railway companies "should be just as much interested as the water departments in keeping the return currents on the tracks, for the wandering electricity means waste of power, and consequent loss of income." Evidently Mr. Goodell is no electrician.

Reviewing the work as a whole, we have something which in its way will be useful in several directions. The author is evidently well versed in American waterworks practice, and, in addition, has made himself conversant, by reading, with a large number of waterworks in this country and on the Continent.

*Die Ankerwicklungen und Ankerkonstruktionen der Gleichstrom-Dynamomaschinen.* Von E. ARNOLD. Berlin: Julius Springer. 1899. Dritte Auflage.

THIS work consists of a very thorough and detailed description of the various methods of armature construction and winding for direct-current dynamo machines, and the author is Professor and Director of the Electro-technical Institute of the Grand Ducal Technical High School of Karlsruhe, in Germany, which doubtless many of our readers are aware is one of the best fitted electro-technical laboratories in the world. The author points out that the third edition differs considerably from the second, and has received essential additions. He has also described in greater detail his own series parallel method of winding, which he states has almost entirely superseded the ordinary parallel winding for multiple pole machines. After a general introduction the author deals with the subject of closed armature windings, and shows how the formulæ are to be obtained. He does not attempt to describe particular windings for any given machine in this portion of the work, but deduces general formulæ in the form of equations, in which it is merely necessary to substitute certain values which themselves depend upon the particular class of machine being dealt with.

He then discusses the subject of ring armature windings in the same way for two-pole and multipolar machines, and describes the Morden-Victoria, the Arnold, and other windings; both parallel and series methods are dealt with, and very well drawn and clear diagrams illustrate the descriptions. Drum-armatures are next treated, beginning with the earliest arrangement by von Hefner-Altenack, and the various subsequent forms are described. Special attention is devoted to the author's series parallel winding, and he states that large multipolar drum armature machines should have bar windings and not wire windings; it may so happen that the current is too small and the number of turns too great to allow of bars being used. In such a case, if the usual calculations for series windings be tried, it may prove that the number of bars and collector strips would be too small, and then the author considers that his series parallel winding removes all difficulties. He also points out that it is very difficult and at all times uncertain to build multipolar machines with loop winding, so that the machines shall work faultlessly, and it frequently happens that while a particular machine will give good results, another of exactly similar design will spark and heat very seriously.

The cause of the difficulty referred to appears to be the unusual strength of the magnetic field of the poles, which may be produced by the eccentric position of the armature, by want of homogeneity in the steel, by unequal size of the poles, unequal strength of the lines of force, or through unequal turns upon the limbs of the magnets. The author subsequently deals with the calculation of self-induction in tunnel armatures, and the armature reactions in special windings. The systems of winding designed by Swinburne, Brown, Brown-Morden, and Sayers, are very fully and carefully described, and illus-

trated by very clear diagrams. Open windings are dealt with in a separate section, and the author clearly explains why the small number of coils is advantageous in the case of armatures used for arc lighting, as the pulsations tend to render the arc lamp mechanism more sensitive than it otherwise would be.

The second portion of the volume deals with the construction of the armature framework itself, and detailed illustrations are given of various forms of armature bodies with the different methods of constructing the ribs or other supports for the windings, the devices adopted for securing positive driving of the coils, the forms of Paccinotti teeth grooves, tunnels and slot armatures, details concerning the stamping of the discs, and the best means of binding to guard against danger from the effect of centrifugal force upon the wires. The author then carefully describes and illustrates the chief varieties of collector segments, and the methods adopted for fixing them in position, and also the means used for connecting the windings to the segments. He has evidently compared the advantages of the varied forms of end connections, and illustrates the types of template and special forming blocks used for securing accuracy in manufacture.

The volume closes with a series of plates of actual machines beautifully drawn to scale, and very similar to those published in Mr. Gisbert Kapp's recent work. The whole subject is treated in a very thorough and practical manner, but it is evidently intended to instil general laws and formulæ into the mind of the student rather than to enable him to grapple with the practical problems of the drawing-office, and we recommend this work to be read in conjunction with the recent work by Mr. Fisher-Hinnen, as each will act as a valuable commentary upon the other.

*La Telegraph sans Fils.* Par ANDRE BROCA. Paris: Gauthier-Villars, Imprimeur-Libraire. 1899.

THE author of this work is a Professor of Physics at the College of Medicine, and has written the volume with a view to describe the latest results obtained in wireless telegraphy for the benefit of those who, without being specialists, have so much technical knowledge as to be desirous of understanding the laws which have been deduced from the results obtained, and also the construction of the apparatus employed. He very rightly points out that a great deal of rubbish has been published in the daily papers by unscientific writers, and that this has led certain persons to doubt whether there is any truth in the recorded results, while others, who are convinced of the truth of the statements regarding the possibility of telegraphing without the use of wires, are still uninformed as to the precise means by which this result is attained.

He, therefore, proceeds to describe in a somewhat popular manner the historical aspect of the question, sketching lightly the work of the early electricians, and giving an idea of the general laws underlying the subject. Rapidly passing over the last fifty years, the author gives a general notion of the work of Morse, Lord Kelvin, Hertz, Maxwell, Blondlot, Lodge, and others. He says that he has not attempted to follow strict chronological sequences, but has described certain experiments of Blondlot before those of Hertz because they mark the almost imperceptible transition from telegraphy by means of wires and wireless telegraphy.

The author holds that the three great names of Fresnel, Maxwell, and Hertz will be joined hereafter, though they belonged to different nationalities, and his aim has been to make known their works in popular form.

The Morse apparatus is described in some detail, and also the syphon recorder of Sir William Thomson, and then the attempt is made to explain various electrical phenomena by hydrostatic and dynamic analogies. The exciters of Lodge, Righi, Bose, and Blondlot are described, and then the discoveries of Hertz are reached.

The author pays special attention to the design of the coherer, and takes also special pains to explain that the velocity of propagation of an electric wave is comparable with the velocity of transmission of light. At high potentials and frequencies the electrical effect upon a metallic conductor is at most skin deep, even if it enters the material at all. The researches of Hertz are then sketched, and the resemblance of electro-magnetic waves to the waves of light is insisted upon. After describing the Marconi apparatus, and the results already obtained in signalling across the English Channel, the author points out the possibilities of signalling to ships at sea and to trains in motion, but also alludes to the disadvantage that the apparatus is affected by electricity in the atmosphere, and would be perfectly useless in case of storms.

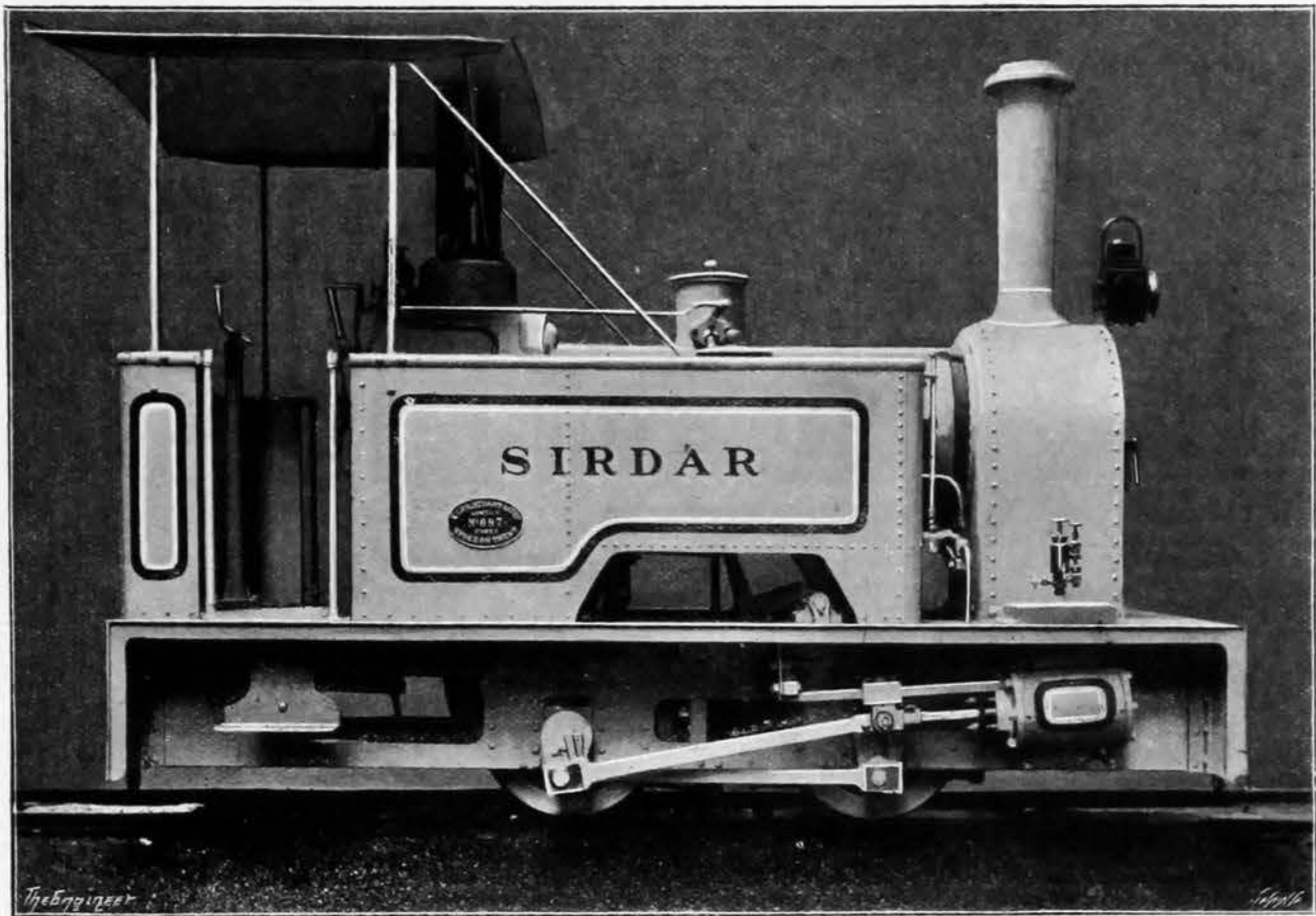
The author considers that for distances of, say, thirty miles, the speed of transmission of the Marconi apparatus is less than that of the ordinary telegraph, but it must be remembered that the Marconi apparatus is quite new, and doubtless subject to improvement. In conclusion, the author considers that while the application of wireless telegraphy appears at present to be strictly limited, it may afford means of considerable improvement, in the service of existing long lines of telegraph it may be possible to use Hertzian waves instead of ordinary currents along the existing wires, and to use a coherer at the end of the wire. This might very probably remove many difficulties now encountered in ordinary working of telegraphs.

## SHORT NOTICE.

*Telephones and Microphones: How to make and use them.* A practical hand-book for amateur electricians. London: Dawbarn and Ward, Limited. Price 6d. net.—This little book forms No. 4 of the "Model Engineer Series," and much of the matter contained in it has already appeared in the columns of the *Model Engineer and Amateur Electrician*. In its present form the information has been collected and revised so as to bring the subject into one volume. It is intended for the guidance of the amateur electrician who wishes to make and fix his own telephones. There is abundance of instruction in this respect, and one is told most clearly how to construct telephones of different kinds from the simplest to the most complicated. The illustrations are clear, and give just the information required, and they are quite easy to follow. Altogether it is a useful little book for the amateur worker.

SIEGE TRAIN LOCOMOTIVE

KERR, STUART, AND CO., LIMITED, STOKE, ENGINEERS



SIEGE TRAIN FOR THE WAR.

WE are enabled to illustrate the trucks and locomotives forming the siege train which was supplied to the War-office by Kerr, Stuart, and Co., Limited, last November. It will be remembered that a very smart piece of work was done in connection with this train, to which it may be interesting to recall to our readers' memory. The inquiry reached the firm's London office on Monday, November 13th. Practically nothing required was actually complete at the date of the inquiry. The order for two narrow-gauge locomotives, five miles of straight and one mile of curved railway, with steel sleepers, &c., thirty sets of points and crossings, two sets of

and were in such a condition that they could be despatched without delay.

All the points and crossings were manufactured in the time at the company's works, and the mile of curved railway was bent to template, there being no less than three different curvatures. The company had in stock all of the channel irons required for the construction of the four-wheeled wagons and a few chilled cast iron wheels. Some of the channels for the bogie wagons were also in stock. The balance of these was obtained from a merchant's stock in Liverpool. Owing to fog during Saturday and Sunday, November 18th and 19th, these got delayed en route to the company's works at Stoke, and the North Staffordshire Railway took special

the 22nd—a week later—after having been run for two days in presence of War-office authorities. Some of the men engaged on this part of the order voluntarily worked for three days and three nights without stopping. The tests included running the locomotives on a special railway curved to 60ft. radius, with full steam pressure. The War-office also insisted on a hydraulic pressure test of the boilers of 280 lb. on the square inch—the general working pressure being only 140 lb. We are informed that they were gauged during this test, and showed little deflection and absolutely no permanent set when the pressure was removed. We are enabled to give a photograph of one of the engines. They were intended, as already mentioned, for the Egyptian Government, and, of course, permission had to be obtained to divert them. The class of locomotive is exactly the same as has been supplied in considerable numbers, not only to the Egyptian Government, but also to those of the Cape and Russia. Details of the locomotives are as follows:—The cylinders are 6in. in diameter, and have a 10in. stroke. The gauge is 2ft. The diameter of the wheels, of which there are four, all coupled, is 24in., and the wheel base is 3ft. 6in. The diameter of the axles is 3½in., and the journals are 3½in. by 5in. There are thirty-six 1½in. tubes in the boiler, and the fire-box is of copper. There are 83.5 square feet of heating surface in the tubes, and 16.5 square feet in the fire-box, making a total of 100 square feet. The grate area is 3.33 square feet. There are water tanks at the sides coming nearly to the top of the boiler. These hold 90 gallons. The weight when empty is 5 tons 10 cwt., and when in working order 6 tons 12 cwt. The cylinders are placed outside, and there is a light metal awning over the driving platform. Most fortunately this type of locomotive is one which has lately been ordered in considerable numbers for constructional work abroad, and in consequence of this nearly all the parts were in a more or less forward condition. Even allowing for this, however, it was a wonderful piece of work to get them out in the time.

Fig. 1 shows the four-wheeled wagons. They had a platform 11ft. by 4ft. 10in. The wheel base was 5ft. 6in., and the wheels 16in. in diameter. They carried 3½ tons. They were fitted with a brake on one wheel.

Fig. 2 shows the bogie wagons. These were 16ft. long inside the end posts and 4ft. wide overall. They are to carry six tons, and will be used for the transport of guns. One wheel of each bogie is braked. The wagons are in reality simply flat-platformed trucks limited to 4ft. wide, so as to accommodate the gun carriages, and provided with removable check posts. It was necessary that the platforms should be no more than 4ft. wide, so that gun carriages could be placed on them, the wheels of these hanging down on either side. The makers knew that the platforms must only be 4ft. wide, but, being unaware at the time the order was given for what purpose the wagons were going to be used, they had put the sockets for the check posts outside of the wagon frames. When the War-office officials came to inspect the work this was at once discovered and orders given for the sockets to be put on the inside of the channels. Naturally this alteration took some little time, and rendered it all the more remarkable that the order was executed within the prescribed limits.

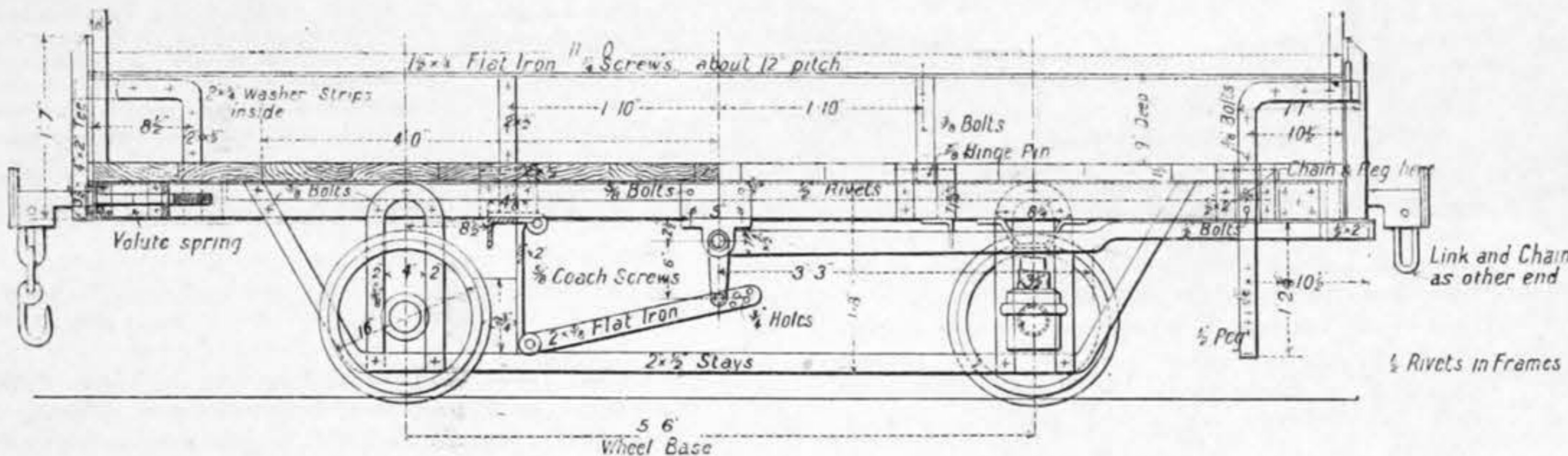
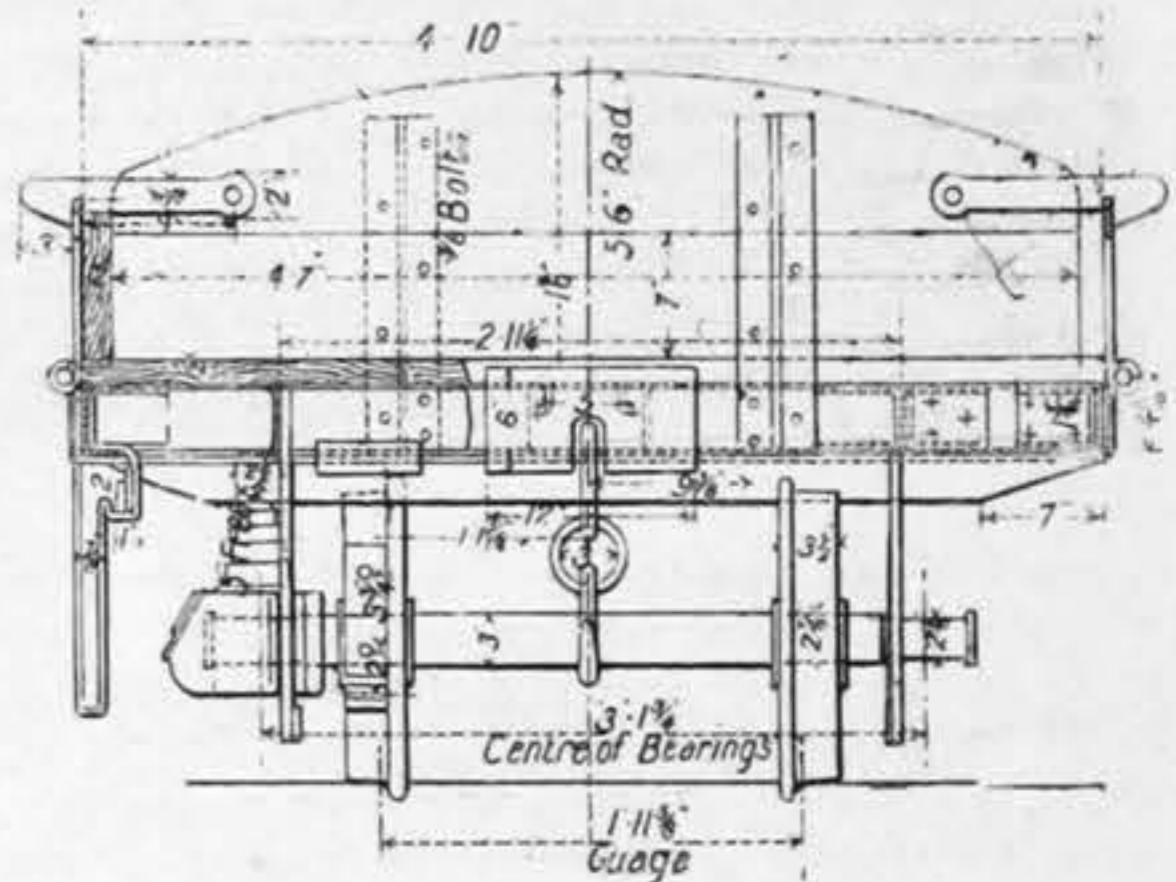


Fig. 1—3½-TON FOUR WHEELED WAGON



diamond crossover roads, twenty-four four-wheeled wagons to carry 3½ tons each, fifteen bogie wagons to carry six tons each, and two six-ton bogie brake wagons, was given on Saturday, November 18th, to the company's head office in London, and the majority of the work, including both locomotives, was inspected and passed by the War-office on the Wednesday following, November 22nd, four days later, including the Sunday. The remainder was completed and despatched well within the contract period, which was ten working days.

pains by making inquiries along the line to find them and take them on to Stoke. The springs were manufactured at Sheffield and the chilled cast iron wheels in Edinburgh. At each place the firm had a representative, who, as and when the material was completed, despatched it by passenger train to the works. Special trucks were attached to passenger express trains for the purpose. There was also a representative in Liverpool arranging for the reception and loading of the finished material on board the ship which was to convey

In addition to the foregoing there were also two 6-ton bogie brake wagons. These were provided with a brake to each of the eight wheels; and with regard to brakes we may mention that only after the order was given was the exact form of brake to be used decided upon. Naturally under these circumstances all the brakes had to be manufactured throughout and stock articles could not be resorted to. The brakes are applied by means of hand wheels at the end of the wagons. The bogie brake wagons were of similar

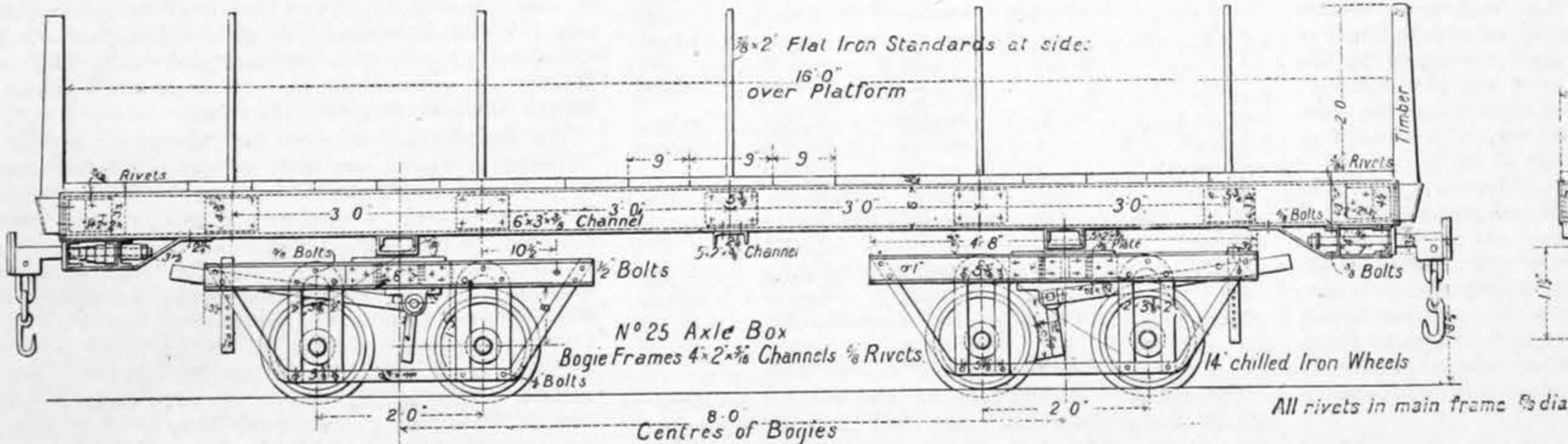
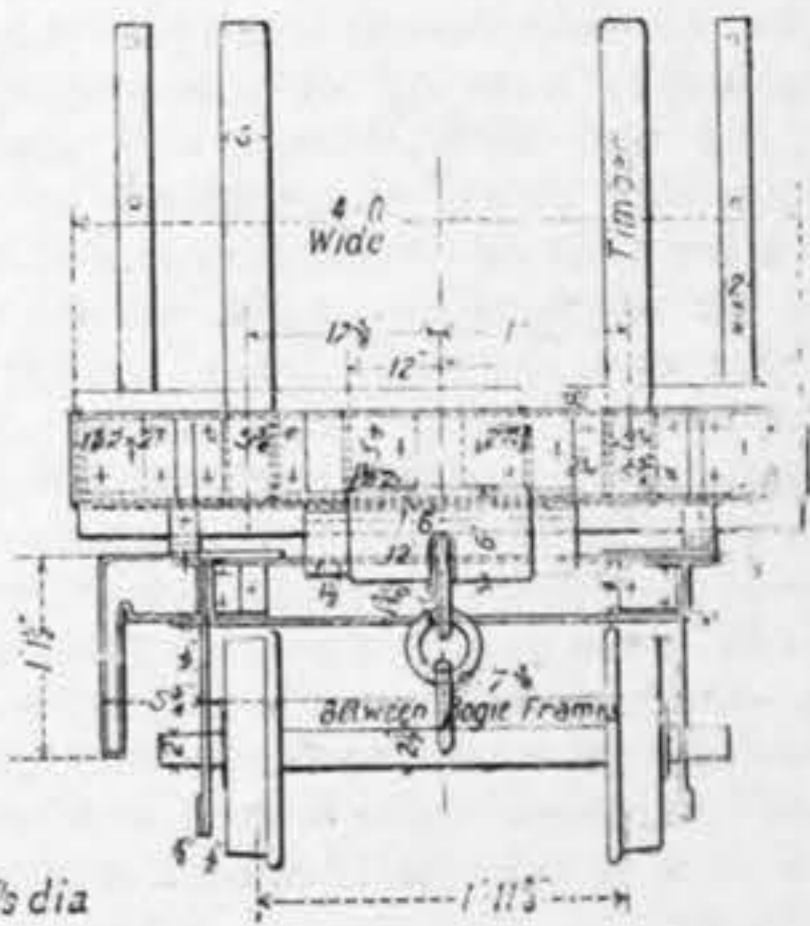


Fig. 2—6-TON BOGIE WAGON



This was a remarkably short space of time, and we have investigated the matter in order to find out how it was managed, making a special journey to the company's works at Stoke for the purpose. As soon as the inquiry was received the company satisfied itself that such material as it had not got in stock could be at once procured from other firms. It was in an excellent position to carry out such an order. Besides the work which it carries out itself, it has large contracts on hand with other firms. These, by arrangement with its clients, who co-operated in a most laudable manner, it was arranged might be drawn upon. For instance, the rails and sleepers sent out were manufactured at Mosbay,

it to Cape Town. Kerr, Stuart, and Co. are loud in their praises, not only of the North Staffordshire Railway Company, but of all the sub-contractors, for the whole-hearted manner in which they all dealt with the work.

The locomotives sent, of which there were two, were originally destined for the Egyptian Government, and had been on order some little time. They were, however, not in a very advanced state. The frame plates, although in stock when the inquiry was received, had not been treated by the firm in any way. On November 15th, however, in anticipation of the order being given, the work of erection was commenced. They were actually despatched from the works on

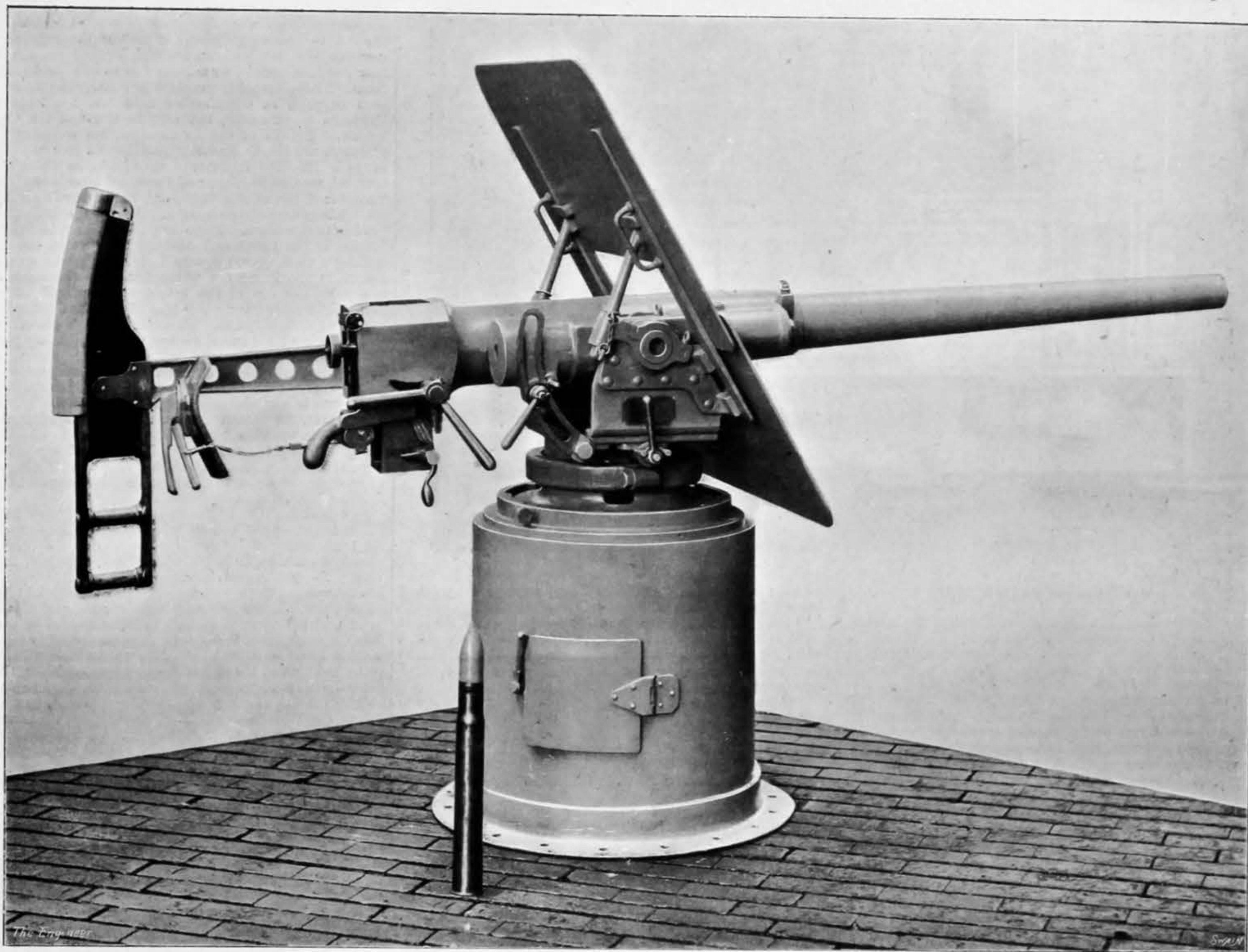
design to the foregoing bogie wagons, and are presumably meant for the same purpose, as here again the check posts are not put outside the frame work.

The rails supplied are of the Vignolles section, and weigh 20 lb. per yard. They are in 21ft. lengths. The sleepers are of channelled steel of trough section, the underside of the tops being provided with a thickening piece in the centre. For the fixing of the rails two tongues are punched at either end of the sleepers where the rails are to come. These are so arranged that the tongues will project over the base of the rail on each side when this is placed in position. Keying is performed by means of small steel wedges.

6-POUNDER QUICK-FIRE MOUNTING

SIR W. G. ARMSTRONG, WHITWORTH AND CO., LIMITED, NEWCASTLE-UPON-TYNE, ENGINEERS

(For description see page 59)



SHIPBUILDING AND MARINE ENGINEERING DURING 1899. No. 1.

THE statistics of tonnage built or building embodied in the elaborately compiled statements presented by certain enterprising daily newspapers at the end of each year are beyond question highly interesting, but the accuracy of the figures—notwithstanding that they are the outcome of information obtained at some pains and considerable expense, no doubt, from shipbuilders themselves—and more especially the accuracy of the deductions made and the comparisons drawn therefrom by the compilers, leave a good deal to be desired, by the professional reader at all events.

Tonnage is a term with such plurality of meaning that thorough uniformity in its use can scarcely be expected in returns obtained from such a large and more or less irresponsible number of informants as the builders of craft, big and little, rough and fine, embraced in the conveniently broad and general term shipping tonnage. Year after year discrepancies and exaggerations, unintentional or designed—which, of course, the newspaper compiler can scarcely be expected to rectify or even challenge—are made, and these invariably take the direction of magnifying the work of particular firms and districts. These errors, though not always allowed to pass—our shipping contemporary *Fairplay*, for example, this year, as in some previous years, directing attention to them—are too complex or too immaterial for professionally interested and initiated readers to attempt setting right, and, of course, it never occurs to the “man in the street” to question these statistics and comments of his favourite newspaper.

Nor is it our purpose in what follows to undertake the onerous and, after all, perhaps needless task of criticising and revising such statements. Our object in referring to the matter at all is to make clear that, while availing ourselves of the returns thus enterprisingly got together by papers like the *Newcastle Chronicle* and the *Glasgow Herald*, it is idle to affect an accuracy which takes account of fractions of a ton in 6000-ton vessels, and of every little smack and sailing boat turned out, many of which have been taken cognisance of in order, apparently, to swell the grand aggregate to the utmost. The figures hereafter given are not presented as accurate to half a ton or a ton, and the deductions drawn are based not so much on single or particular instances as on broad general facts. Our account, too, will have less to do with the volume of tonnage produced by individual firms or dis-

tricts than with the outstanding technical features of the noteworthy productions of the year.

As regards the volume of work accomplished, the year 1899 is ahead of all preceding years since shipbuilding became an industry. This is certainly so as regards the United Kingdom, and it applies also to most, if not all, of the foreign countries where shipbuilding on any considerable scale is carried on. Dealing, meantime, only with the United Kingdom, the following table gives in round figures the output of the several districts, including out-lying ports; also alongside, for comparison, the output for the year previous. In almost every case, it will be noticed, there has been an increased output from the districts, and thus 1899, in particular instances as well as in aggregate result, has been the “best on record.”

	Output, 1899.		Output, 1898.		Output increase.
	Vessels.	Tons.	Vessels.	Tons.	
Clyde...	280	491,000	...	466,800	24,200
Tyne...	120	308,000	...	307,300	700
Wear...	75	268,500	...	263,000	5,500
Tees...	50	144,000	...	146,500	—
Hartlepoons...	40	139,500	...	119,000	20,500
Inland...	21	131,500	...	121,300	10,200
Dockyards...	7	69,100	...	73,000	—
Humber...	157	32,300	...	33,800	—
Thames...	138	21,200	...	38,300	—
Tay...	19	18,000	...	14,300	3,700
Firth...	30	15,600	...	26,600	—
Mersey...	42	13,500	...	4,020	9,480
Dee...	28	12,000	...	7,450	4,550
Other ports...	114	66,800	...	40,000	26,800
	1120	1,731,000		1,661,350	

The relative importance of the several districts is readily seen from the table, but a few explanatory remarks are necessary regarding the figures. Sail tonnage in the ordinarily accepted sense of the term is at present *non est* in British shipbuilding activity. At least few, if any, ocean-going sailing vessels were built in Britain during 1899, although a number of vessels of moderate size are now on hand in Scottish districts. It is misleading, therefore, to find “sail tonnage” bulking very largely indeed in the builders’ returns. What is so named for want of any other convenient classification really consists for the most part of such-like craft as barges, lighters, pontoons, &c.—craft, in fact, not mechanically propelled—and also of coasting smacks, yachts, and small sailing boats. In our table all have, for convenience, been classified under steam tonnage, and although this does not very materially affect the tonnage figures, it is otherwise with those referring to the number of

vessels. Deductions might, in fact, be drawn from the two series of figures, as to the average size of steamships built in the several districts, which would be quite misleading. Thus: On the Clyde itself—the premier river and the recognised home of specialised shipbuilding—as many as forty of the 280 vessels in the table, consisted of craft neither designed to be directly propelled by mechanical means nor yet by “the unbought wind,” but many of which were yet entitled to be considered as contributing to mercantile shipping. These comprised for most part capacious barges for river carriage purposes by steam towage in foreign countries. Of the 138 vessels with which the Thames is credited, no fewer than 117 were steel and iron barges or lighters, one firm turning out 58 and another 48 of such craft. Important enough, certainly, but not to be classified with sail tonnage, strictly speaking, any more than with steam tonnage. Of the 157 vessels turned out on the Humber, 44 in the same way were barge lighters and keels, and on the Mersey 26 out of the 42 vessels produced comprised barges, ketches, luggers, and sloops.

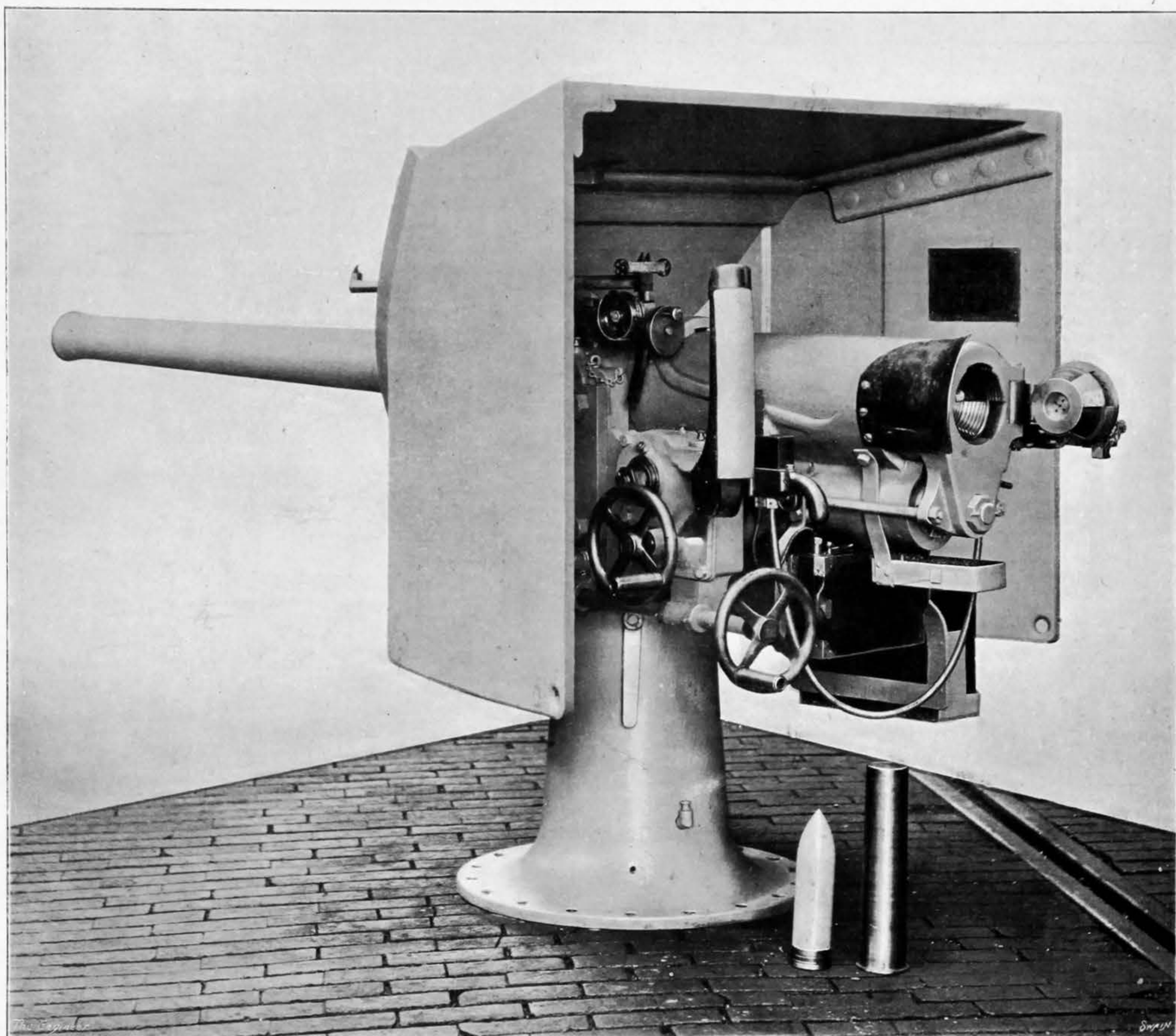
The tonnage output given for the various districts also includes, of course, the work produced for our own and other navies, and it should be remarked that “tonnage” in respect of such work means “displacement” tons, or tons weight, as distinguished from customs measure tons of 100 cubic feet capacity in the case of merchant shipping. On the Clyde, naval work amounted to 42,100 displacement tons spread over nine vessels. On the Tyne, naval work amounted to 30,120, made up by eight vessels. On the Thames it reached 3200 tons, made up almost wholly by high-speed torpedo boat destroyers; and on the Mersey naval work amounted to 8640 tons, made up by three vessels. Adding these contributory items to the work given in the table as having been turned out by the dockyards, we have a grand total of 138,560 tons of warship work for our own and other navies—equivalent to 8 per cent. of the total tonnage produced.

With respect to the number of firms contributing to the output of the respective centres, the Clyde total represents—leaving small firms out of account—the work of forty-four firms. The Tyne output represents the work of fourteen firms, the Wear thirteen firms, and the Tees and Hartlepoons together nine firms. Not so many years ago it was the custom to pit the whole group of North-East Coast rivers against the Clyde in making comparisons as to the measure of activity and success attained in turning out ship tonnage during any year.

## 12-POUNDER QUICK-FIRE GUN ON PEDESTAL MOUNTING

SIR W. G. ARMSTRONG, WHITWORTH AND CO., LIMITED, NEWCASTLE-UPON-TYNE, ENGINEERS

(For description see page 59)



On this occasion, and for several years past, the Tyne itself forms no insignificant competitor of the Clyde, while the combined efforts of the three North-East Coast rivers, comprising thirty-six firms, results in 860,000 tons being produced; a very striking performance compared with that of the Clyde—491,000 tons by forty-four firms. Tonnage is, of course, but a rough, if not misleading, measure of the work involved, and of the value of the product concerned. There is no gainsaying that the Clyde figure represents, in these respects, quite as much, if not more, than the combined outcome of North-East Coast activity. In spite of the gradually encroaching advances of Tyne builders into the domain of high-class and elaborately-fitted mail boats, dredging, and telegraph-laying steamers, &c.—so long and so justly considered Clyde specialities—and notwithstanding the high renown of several Tyne firms in naval production, the Scottish river still holds the palm for the volume of its output of highly specialised and intricately fitted shipping “tonnage.” Of the 240 steamers which mainly constituted the Clyde output, 24 were twin-screw steamers, nine were war vessels, 12 were dredgers of various types, sand pump as well as hopper, eight were hopper barges, eight were paddle steamers, seven were stern-wheelers, 27 were trawlers, liners, and carriers, 12 were steam yachts and launches, while at least 20 were steamships of the mail and passenger-carrying type, ranging in tonnage from 14,000 to 3300 tons. That other districts are now sharing, however, in the high-class work formerly almost wholly overtaken by the Clyde is undoubted. Evidencing this, we need only mention the Cunard liner *Invernia*, launched on the Tyne some months ago; her sister ship the *Saxonia*, launched on the Clyde later; and later still, the *Saxon* for the Union Company, at Belfast. The launch of these vessels in the respective districts at or near the end of the year 1899 fitly brought to a close a year of shipbuilding records of various kinds, which indeed began with the launch of the White Star leviathan *Oceanic*—the vessel of the century.

## PROPOSED ELECTRICAL SUPPLY COMPANY FOR SOUTH WALES.

AMONG the Electrical Supply Bills before Parliament during the coming session will be the “South Wales Electrical Power Distribution Company.” The promoters of this company have just issued what is called a “Statement for the Information of Local Authorities,” and it sets out what the proposals of the company are. The capital of the company is to be £1,000,000, divided into £750,000 of ordinary share capital, and £250,000 of debenture capital. Power is sought to construct three electrical generating stations, one at Neath, one at Pontypridd, and one at Pontypool. From these supply centres the company proposes to spread out an extensive system of electrical mains for the supply of electricity to anyone who wishes to use it throughout the whole of the county of Glamorgan, and so much of Monmouthshire as lies to the west of the river Usk. This area contains 1050 square miles, and contains collieries, steel works, tin-plate and copper works, stone quarries, railways, tramways, engineering and ship repairing works, and factories of all kinds. It is argued that electricity is coming into almost universal use in manufacturing, engineering, and other works on the Continent and in America; that hence, these works effect great economies in their manufacture; that the works of South Wales are in competition with these foreign manufacturers, and are suffering, and may suffer still more in the future, for lack of the “electrical facilities which their rivals enjoy.” Furthermore we are informed that there are “certain chemical and other industries for which South Wales possesses every other advantage, but which cannot be carried on for lack of cheap electrical facilities.” At the present time only 16½ square miles of this area of 1050 square miles is supplied with electricity. It is urged that there will be a further facility to the public, in that electric tramways may be run in those districts which otherwise, owing to unequal traffic conditions, could not economically run tramways. All the local authority would have to do would be to lay rails, &c., and buy current by meter as and when it was required. This would prevent having large generating plant comparatively idle for the best part of the week and only busy on market days. Electricity would also be available for lighting power in villages and country houses. The company evidently has

high aspirations, as it aims at the prevention of the denudation of villages of their population and the overcrowding of towns, for it is argued that if workmen can have power to work with they will remain in the villages. The small-power users in the country will be able to buy power as cheaply as they could buy it in towns, and this, it is hoped, will enable them to manufacture “nearly as cheaply as the large steam-power works and mills.” It is also anticipated that farmers will use electric power for many agricultural purposes. Certainly the promoters are very sanguine in their anticipations, and have drawn attention to every possible small consumer. The average price per Board of Trade unit at present ruling in South Wales is about 5d. The maximum which the new company would be allowed to charge would be 4d. per unit for an intermittent supply, and 2d. per unit for a regular supply. “It is probable that the actual charge would be much less.” We are told now that in America and on the Continent current is supplied to large consumers for trade purposes at as low as ½d. per unit in some cases. The average price taken over a large number of cases is ½d. This would mean, say, anything up to £10 per annum for a horse-power, instead of from £15 to £20 per annum.

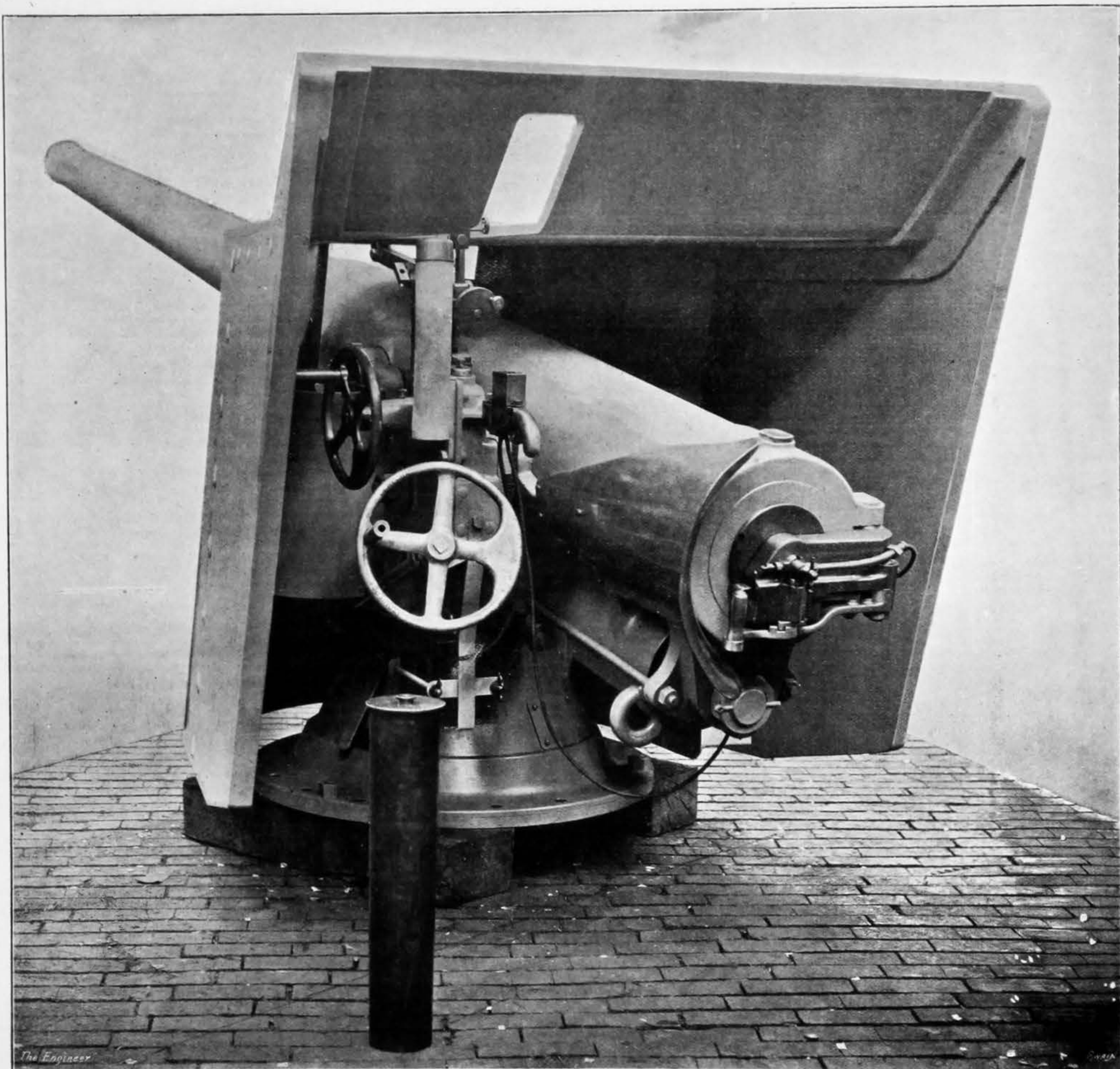
The company does not seek a monopoly. It would be hardly likely to get it if it did, seeing that there are existing electrical interests in its area. It does not seek to supply electricity within an already authorised area save to “wholesale consumers,” and a wholesale consumer is one who undertakes to take not less than 20,000 Board of Trade units per annum. It will be endeavoured to persuade local authorities to lay distribution mains, and take electricity from the new company in bulk. “There is ample room both for the company and also for the lighting businesses of the local authorities, and neither need interfere with the other.” Of course, this is the same cry as has been raised by large supply companies before, and some of them have not lived through the ordeal of a parliamentary committee.

This particular company differs very little from those which have gone before. The cheapness in production is to be due to close proximity to collieries and to “the diversity of the needs arising in a large community of consumers, which diversity is found to average the consumption of power at a high ratio throughout the twenty-four hours.” Exactly

## 4.7 IN. QUICK-FIRE GUN ON PEDESTAL MOUNTING

SIR W. G. ARMSTRONG, WHITWORTH, AND CO., LIMITED, NEWCASTLE-ON-TYNE, ENGINEERS

(For description see page 59)



this argument has been put forward before, and in all probability it is correct, but the company may find it not quite so correct as it evidently hopes it will be. It is probably quite true that there will be a large day load, but it is almost equally probable that there will be the same evening peak which there is now, and this will necessitate a large reserve of power which will be idle during most of the twenty-four hours. In the evenings of winter, for example, there will be all the trains and light railways—if there are any—running. The factories—if they are found to take to electric power—will all be running at their full with power and light; and then there will be the company's other lighting business, to which it is certain to aspire. The argument is that all the various and different directions in which electricity will be supplied will average one another, and that there will be an almost even output. Of course, as we say, this may be found to be so, but we very much doubt if it will be—at all events, to the extent foreshadowed.

The "statement" concludes with an appeal to "every person holding office, either on a Town Council, Urban District Council, Parish Council, or as a magistrate, in South Wales," to support the work, and to further it by their aid, and several directions are given in which this can be done.

Of course, this is a clever move on the part of the proposers, who foresee trouble on the part of such persons and bodies, and who have therefore endeavoured to take the bull by the horns and persuade these officials that the company will actually benefit the places which they represent.

A NEW telegraph line between Madras and Calcutta has now been practically completed, says *Indian Engineering*. Copper conductors are used entirely for the new line, so as to increase its working capacity. The route chosen is *via* Dhoud and Mannad. A third line will also be constructed to connect up Bombay to these lines. The copper wires along the new route are supported on oil insulators, so as to minimise the effect of the saline atmosphere along the coast.

## THE MANCHESTER ASSOCIATION OF ENGINEERS.

MR. HENRY HODGSON, the newly-elected President of the Manchester Association of Engineers, delivered his inaugural address to the members on Saturday last, taking for his subject "Our Position as Engineers." The question, he said, to which he wished to draw attention was, whether in the race for the world's mechanical requirements we were holding our own, and, if so, were we likely to continue to hold our own. He was no pessimist, but he was of opinion that the conditions of production would have to undergo considerable modification if we were to continue to occupy the foremost place in the rank of the mechanical producers of the world. One of the modifications required had reference to the relations between capital and labour; these ought under no circumstances to be antagonistic. Although at present there was no open display, an undercurrent of antagonism existed which prevented workmen from doing all in their power to advance the interests of the employers, which in the long run were also the interests of the workmen themselves. Piecework, if it could be put on an equitable basis, and so formulated as to meet all cases, seemed to him to promise a good measure of success, and in such work as lent itself to a fixed basis of prices had proved fairly successful; but there was a fly in the amber in this case. A rate was fixed for the production of a certain piece of work; the workman laid himself out to do his best, and in the course of time became very expert, and earned a considerable sum weekly. Someone suddenly discovered this, and on the ground that he was earning too much, the price was cut down, the effect of which was to prevent the man using his best endeavours in the future. There was another aspect of piecework, which, so far as he could judge, must militate against the system. This was a want of elasticity to meet the varying prices of the article manufactured. It appeared to him that in the case of such manufactures as admitted of being worked on the piecework principle, the price paid for production should be governed directly by the price obtainable in the open market for the sale of the article. Some system more comprehensive than piecework would, however, sooner or later, have to be adopted, and a system of industrial partnership seemed to be a solution of the problem. In this partnership capital should have some fixed minimum rate of interest, and the workman a fixed minimum rate

of wages, the profits resulting, after these had been met, being divided equally, or in some other proportion, between the two. This scheme might answer if profits were always certain, but the difficulty in that respect would be met by not dividing all the profits when made, but keeping in hand some proportion to build up a reserve fund from which the minimum interest on capital would be made a certainty in the time of the lean years. The workman's wages having been paid weekly, he would have nothing to receive at the end of the term unless profits had been made, and he was inclined to believe that the incentive given by this method would be such as to ensure the desired result. This idea might be deemed Utopian, and it might be said it had been tried and failed; but he believed the tendency of the times in several directions was to bring it within the range of practical politics, and, at any rate, the rudiments of such a scheme were in successful operation in the manufactured iron and steel trades in some districts. Mr. Hodgson then proceeded to deal with the increase of foreign competition in various branches of engineering. In the locomotive building trade, he remarked, they were all aware that a number of important orders had been recently placed in America, owing, it was said, to the inability of English firms to undertake the required delivery. With regard to stationary engines, they all remembered what took place recently at Glasgow, where, out of a requirement for four large engines for tramway traction, two were ordered in America. Russia, which used to be our best customer for steam engines, now sent the largest proportion of its orders for stationary engines to one firm in Switzerland. Our supremacy in the shipbuilding and marine engine building trades was also being assailed. In conclusion, Mr. Hodgson remarked that when the present abnormal demand was over, and the world settled down to a scramble for work, then would come the testing time; the competition would not be confined to ourselves, and unless we took steps to place ourselves in a better position to meet the outsider, he was afraid we should in the end come off very badly.

THE traction engines with Sir Redvers Buller's force in Natal are said to be doing excellent work, hauling the heavy wagons out of holes and swamps with the utmost ease.

## RAILWAY MATTERS.

ALL the London and North-Western Railway lines leading out of Crewe to the North are being widened, and three new bridges will have to be erected.

A DEPUTATION from the Leeds Corporation inspected the Sheffield Electric Tramway system this week, travelling over the completed section, inspecting the power house, and visiting the car shed, &c.

THE Secretary of State for the Colonies has appointed Mr. F. Bedford-Glasier general manager of the Sierra Leone Government Railway. This railway is the only British railway that is open for traffic in West Africa.

THE first work of extending the London, Brighton, and South Coast Railway Company's terminus at Victoria has been commenced by the closing of the Grosvenor Hotel, which the company purchased for £240,000.

THE northern express from St. Petersburg to Ostend in connection with the boat service to London ran off the rails on Thursday morning, the 11th inst., as it was entering the railway station at Brussels. The locomotive and tender were overturned and three passengers slightly bruised.

THE declared value of locomotives exported from this country last year was £1,468,467; in 1898 the value was £1,483,600, and in 1894 £750,039. So that in the last five years the value has about doubled, and no doubt would have been higher had not the builders been already very busy on home orders.

THE railway accidents in the United States in November numbered 266, of which 122 were collisions, and 137 derailments. Fifty-six persons were killed, and 204 injured. A general classification shows that 11 were due to defects of road, 52 to defective equipment, 53 to negligence in operating, 10 to unforeseen obstructions, and 140 were "unexplained."

THE death is announced of Dr. Edward H. Williams, of the Baldwin Locomotive Works. He was formerly manager of the Pennsylvania Railroad, an appointment which he gave up in 1870 to become a partner in the above works. Dr. Williams was 75 years of age, and was widely known by his many philanthropic works in the United States.

THE light railway movement at Aberdare was summarily ended last week. At the inquiry an objection was lodged which was decided to be fatal, namely, that the application of the promoters dealt with an area entirely within the district of one sanitary authority. The application was opposed by the district council, the Taff Vale Railway, and others.

THE Great Northern Railroad of the United States is introducing a system of profit sharing with their employes next month. It is stated that the management has decided to recommend to the stockholders a plan for a distribution of a large block of the company's shares among the men who have been in the service of the company for a certain number of years.

At Pontypridd last week the proposed light railway for the Rhondda was the subject of public inquiry. The opposition was strong, and amongst others the Taff Vale Railway urged the great expenditure that had been incurred to meet public needs. Over a million and a-half passengers were carried at Pontypridd annually, and over a million at Porth. Examination postponed *sine die*.

OPERATIONS in connection with the extension of the Glasgow and South-Western Railway from North Johnstone to Dalry will shortly be commenced. The new railway will relieve the great pressure of passenger and goods traffic on the main line. At present the stations are situated at some distance from the centres of population; but on the formation of the new line they will be provided with more convenient travelling facilities.

At Laxey, in the Isle of Man, a place famous hitherto for its ancient water-wheel, there has just been completed a hydraulic plant for working the electric railway between Douglas and Ramsey during the winter months. The principal advantage in connection with the use of hydraulic power at Laxey is that it enables the entire steam plant to be shut down for about seven months in the year, during which time the pressure of traffic is at a minimum.

As an apt illustration of the soundness of the views we expressed last week concerning the value of fire-box surface, we may cite a recent performance of Mr. D. Drummond's engine No. 719, fitted with water-tubes in the fire-box. The engine recently took the South African express weighing 390 tons without passengers or luggage from Waterloo to Southampton in five minutes less than the booked time. The engine never lacked steam of full pressure the whole way.

As evidence of the tendency towards heavier locomotives and longer trains used on American railways during recent years, some interesting figures have been published regarding the weights of engines turned out by the Brooks Locomotive Works in the years 1891 and 1899. The average weight of the engines built in the former year was 82½ tons, and in the latter 121 tons. The figures are based on an output of 226 and 300 locomotives respectively. The weights given are those of engine and tender in working order.

A FEW months ago we published a letter which gave details concerning the routes likely to be taken by the projected line of railway that will bring the railway system of European Russia into direct communication with Russian Central Asia. It is now announced that the sum of 100 million roubles will be required for the construction of the line in question. The Imperial Council discussed recently the Budget of Extraordinary Expenses, and a vote of ten million roubles was then granted to the Ministry of Ways and Communications for use during this year. The length of the projected railway will be 2000 versts, or about 1335 miles.

THE Light Railway Commissioners held an inquiry last week at Cheltenham into the application of a contractor, supported by the Town Council, to construct a line two and three-quarter miles long through the streets of the borough. The scheme is to connect the local railway stations with the summit of the Cotswold Hills, a distance of six miles, thereby opening up the rural districts at present untouched by any line. The scheme in its complete form was before the Commissioners a year ago; but successful objection was raised to its passage through a particular street. An alternative route was now proposed, and no serious objection was taken. The line will be worked on the electric overhead trolley system.

THE Midland Railway Company is seeking powers to raise £2,400,000 additional share and loan capital, of which £600,000 may be raised by the issue of debenture stock, and £1,800,000 by the issue of new preferred converted ordinary stock, and new deferred converted ordinary stock, or of Midland Railway 2½ per cent. perpetual preference stock. Amongst the general purposes of the company for which the new capital is sought is included the widening in Derbyshire, for a distance of three miles and three furlongs, from Chinley to New Mills. This widening of the Dore and Chinley line naturally follows the company's widening of its main line between Sheffield and Dore, for the completion of which they are seeking further time, viz., to extend for three years from June, 1900.

## NOTES AND MEMORANDA.

THERE were 954 ships, of 267,642 gross tons, built in the United States last year. Of this number 421 were steamships of 160,132 tons gross.

STEEL, as a shipbuilding material, was used in the United Kingdom during the past year to the extent of 98·8 per cent. The amount of iron used was only 1·1 per cent.

THE Admiralty have appointed a civilian expert at Plymouth to give a number of naval medical officers in the Royal Naval Hospital a course of instruction in the use of the Röntgen rays in surgical cases.

THE largest steamers which were launched in the United Kingdom during last year are the following:—Oceanic, 17,274 tons gross; Ivernia, 13,900; Minneapolis, 13,750; Saxon, 12,970; Saxonia, 12,750; Persic, 11,973.

FROM the returns compiled by Lloyd's Register of Shipping, it appears that, excluding warships, there were 538 vessels, of 1,306,751 tons gross, under construction in the United Kingdom at the close of the quarter ended 31st December last. This total shows a reduction of 95,000 tons, compared with the same date in 1898.

THE amount of copper produced in the United States last year—estimating the output of December—was 264,600 tons. This amount includes the copper in sulphate, and shows an increase over the production of 1898 by about 10·5 per cent. This production is about 65 per cent. of the total output of copper in the world.

DURING 1899, exclusive of warships, 726 vessels of 1,416,791 tons gross, viz., 714 steamers of 1,414,774 tons and 12 sailing vessels of 2017 tons, were launched in the United Kingdom. The warships launched at both Government and private yards amount to 35 of 168,590 tons displacement. The total output of the United Kingdom for the year were, therefore, 761 vessels of 1,585,381 tons.

ACCORDING to the annual statement regarding the shipbuilding trades published by Lloyd's Register the tonnage of vessels—exclusive of warships—launched in the United Kingdom during 1899 was greater by 49,000 tons in that year than in 1898, and exceeded by 464,000 tons the output of 1897. As regards war vessels the figures for 1899, which exceed those for 1897 by 73,000 tons, are less than those for 1898 by 23,000 tons.

ACCORDING to the report on the condition of the metropolitan water supply during the month of September last by the water examiner appointed under the Metropolitan Water Act, 1871, the average daily supply from the Thames was 143,035,685 gallons; from the Lea, 20,190,011 gallons; from springs and wells, 60,150,551 gallons; from ponds at Hampstead and Highgate, 1912 gallons. The daily total was 223,378,159 gallons for a population estimated at 5,989,033, representing a daily consumption per head of 37·30 gallons.

DURING last year the three leading German shipbuilding firms have been very busy on vessels for foreign Powers. According to the Berlin correspondent of the *Times*, these firms have been engaged in building three armoured and four torpedo cruisers as well as four torpedo boat destroyers for the Russian Government. Eight small torpedo boats have been supplied to Japan, and the Vulcan yard last year built the Yakumo, a cruiser of 9850 tons displacement, for that Power. The Schichau yard is building torpedo cruisers for Italy. The Tamoyo, a torpedo cruiser of 1080 tons displacement, has been built for the Brazilian Government in the Germania yard at Kiel.

A SWING bridge operated by electricity has been erected across the River Charles in the United States, and connects Boston and Charlestown. The bridge, with approaches, is 1920ft. long, and the width 100ft. The revolving central section is 240ft. long, and weighs 1200 tons. When turning it is supported on 70 steel wheels, 26in. in diameter, which run on a track 54ft. diameter. The plant for operating this portion of the bridge is contained in a chamber below, and the motive mechanism consists of two 28 horse-power motors placed outside the power-house, one on each side and above the circular track. They are connected to this by means of bevel gearing and vertical shafts, so as to equalise the moving power.

At a recent meeting of the Committee on Black Smoke, in Glasgow, the sanitary inspector submitted diagrams showing the results of the mechanical improvements for the prevention of black smoke, adopted by certain firms. During the month of November, 74 inspections were made of boilers and furnaces, and 135 observations were taken of chimneys; 18 warning notices were issued to defaulters, giving them one month wherein to effect the necessary improvements. During the month 77 prosecutions were taken against offenders, and seven convictions obtained. Since the work was taken over by the sanitary department, 17 firms have made alterations and improvements in their plant, five are burning better fuel than formerly, and six have discharged incompetent firemen.

A GOVERNMENT return, showing the number of fatal accidents and deaths in and about the mines and quarries of the United Kingdom last year, has just been issued. There were 863 separate fatal accidents, involving 910 deaths, in mines of coal, fire-clay, stratified ironstone, and shale, as compared with 828 accidents and 908 deaths in the previous year. Of these, 424 accidents and 433 deaths were due to explosions of firedamp or coal dust, the remainder of the total being caused by accidents in shafts, on the surface, and in connection with the underground machinery and workings. In other mines not included in the preceding there were 47 separate fatal accidents involving 56 deaths, against 31 accidents and 333 deaths in 1898. The deaths caused by accidents in quarries numbered 117, a decrease of 17 compared with the total of the previous year.

THE United States Lighthouse Board is experimenting with a megaphone and a siren whistle at the Falkner's Island lighthouse station. The megaphone, according to the *Engineering News*, is 17ft. long and 7ft. in diameter at the mouth, and stands upon a circular platform 28ft. in diameter, upon which it revolves. When the tube is due north of any vessel the ship will hear the north signal—a short, a long, and a short blast. If it is due west of a ship the vessel will hear three short blasts, and so on, with a different combination of long and short blasts for each of the eight points of the compass. The signals are fifteen seconds apart, and the apparatus makes a complete revolution in two minutes. All the sounds indicating the various directions are regularly classified, the western being longer than the eastern signals, and those indicating south being shorter than those for signalling north.

THE eminent surgeon Sir William MacCormac, has written to the *Lancet* from the seat of war in South Africa giving his experiences of wounds made by the Mauser bullet. It appears that this missile bores a small, clean hole right through the part, and the aperture of exit can hardly, if at all, be distinguished from that of entrance. The wounds are on the whole aseptic, and heal rapidly under a simple antiseptic dressing. Sir William gives numerous instances of the comparatively simple nature of the wounds which have come under his notice. In one case where the bullet must have pierced the stomach no symptoms of such injury were noticeable, the patient taking food as usual. Even when perforating the lungs only a small amount of hæmorrhage appears to be produced, and again when a comminuted fracture of a bone of a limb has been produced complete consolidation of the broken bone may result, though the fracture was necessarily compound.

## MISCELLANEA.

THE Chicago Main Drainage Canal was opened on January 2nd, by turning into it the waters of the Chicago River.

THE new United States battleships Kearsarge and Kentucky are to be placed in commission at an early date.

THE Admiralty have ordered a third-class cruiser to be laid down in Devonport dockyard forthwith. She will be 310ft. long, have a speed of twenty knots, and be armed with sixteen quick-firing and two Maxim guns.

It is stated that the Niagara Falls Power Company has petitioned the Treasury Department of the United States to levy a tariff on current generated in Canada and transmitted across the border into the States. This course is being taken in order that the Ontario Power Company shall not compete in the United States with the petitioning concern.

THE report of the Registrar-General on the public health states that the deaths registered last week in thirty-three great towns of England and Wales corresponded to an annual rate of 29·1 per 1000 of their aggregate population, which is estimated at 11,610,296 persons in the middle of this year. Croydon had the highest death-rate, namely, 37·4 per 1000, and Cardiff the lowest, namely, 16·1 per 1000.

THERE is an outcry in Paris against the behaviour of the drivers of motor carriages, who appear from all accounts to have a supreme disregard for all rules of the road. Some time ago officials were appointed to "keep an eye" on automobilists, but they do not seem to have met with much success, probably because they have to depend upon their limbs to catch the offenders. It seems likely that more rigorous steps will shortly be taken to limit the legal speed of these vehicles.

An evening paper calls attention to the dangerous practice which is common in this country of leaving horses unattended on the public highways. Always a risky proceeding, both for the horse and the public, it is now more than ever to be deprecated, on account of the presence on the roads of what our contemporary calls the "panting motor car." If horses are to be left unattended some means should be adopted to prevent them breaking away when startled.

It is satisfactory to note from the information collected from the tables of trade disputes in 1899 published in the *Labour Gazette* that last year was freer from important disputes than any year in recent times. The number of workpeople affected by disputes in 1899 was about 2·1 per cent. of the total number employed. The percentage was 5·5 in mining and quarrying, 4·9 in textile trade, 3·6 in building, 1·9 in metal, engineering, and shipbuilding, and less than 0·5 in other trades.

LAST Tuesday the Belfast Harbour Commissioners granted the firm of Harland and Wolff a thirty-one years' lease of their present holding and of all additional ground required for purposes of extension. As a result the removal of part of this firm's works, of which rumours have for some time been current, will not now be necessary. The Commissioners have, it is said, also decided to build new graving docks suitable for warships, on conditions mutually agreed upon by the above firm and themselves.

THE President of the Board of Trade on Wednesday received a deputation of residents in Marylebone on the subject of the defective supply of electric lighting in that parish by the Metropolitan Electric Supply Company. Mr. Ritchie said the grievance of the consumers had been thoroughly made out. The company was liable for breach of contract with their customers, but the only legal remedy was that of summoning the company before a magistrate, and getting them mulcted in penalties. He hoped the deputation would do some good by having ventilated the subject.

AMONGST the killed of the garrison at Ladysmith is Lieutenant John Pakeman, a native of Derby, and grandson of the late Mr. Pakeman, who was head of an important department of the Midland Railway. His father was also connected with the Midland line. John Pakeman was educated at Christ's Hospital, and on leaving school entered one of the Midland Railway departments. But he soon threw up his appointment, and enlisted in the Royal Dragoons. He left this regiment to join the Imperial Light Horse, with which body he was serving when he met his death.

THE *Times*, which is usually so well informed in technical matters, contained on Tuesday last a paragraph headed "New Bridge for the Tugela," which is not quite accurate in all its details. We read that the bridge "was to be of Siemens-Martin steel, 105ft. long, 16ft. 6in. wide, and weighing 750 tons." As will be seen from our description on page 71, this is only one of seven spans, each of them 105ft. long, five being for the Tugela Bridge and two for the bridge at Frere. Moreover, the span weighed 105 tons, and not 750 tons, which is rather greater than the weight of the whole seven spans.

FROM a report recently made by Preece and Cardew on the cost of lighting railway carriages by electricity, it appears that the total annual cost per coach would be £13 16s. 6d., based on the cost of fitting and running 400 coaches with an average of twelve lamps of 8-candle power per coach. The total capital outlay for lighting this number of coaches is estimated at £32,000. These figures somewhat exceed those contained in a report on the subject by Mr. W. Worby Beaumont some months ago, and show that the capital outlay would be about 50 per cent. higher than for compressed oil gas for equally effective lighting, while the gas would cost about 25 per cent. less for supply and maintenance.

OWING to the growth of the incandescent system of gas lighting in Germany, proposals have been made to reduce greatly the candle power of the gas provided, with a view to cheapening its production. At Magdeburg, says the *American Manufacturer*, the question has been seriously debated as to whether it would not be well to reduce the candle power from fourteen, its present value, to ten, and finally to eight. Experiments show that when used with an incandescent mantle, the poor gas has in certain cases given even more light than the rich. Thus, in one series of tests, a burner of this type was supplied with gas ranging in candle power from fifteen to two, and the latter actually gave the best light. Probably it contained a considerable amount of hydrogen. With the recent improvements in water-gas manufacture, a gas rich in this constituent can now be very cheaply produced.

At the Westminster Palace Hotel on Tuesday, a conference was held of coalowners and representatives of the Miners' Federation with reference to an agreement entered into provisionally on December 7th last at a meeting of the Conciliation Board, which recommended a continuance of the Board from January 1st—the date of the expiration of the previous agreement—for a further three years, the maximum rate of wages to be raised to 60 per cent. above the 1888 standard; should this be accepted, an additional 5 per cent. to be granted from the first making-up day to be paid on the next making-up day. This proposal, which brings up wages 45 per cent. above the 1888 standard, was accepted by all except the Lancashire miners. Hence the present conference. As a result of the conference, it was agreed that the owners throughout the Federation area be recommended to advance the rate of wages 5 per cent. on the 1888 standard to surface labour engaged on the pits, banks, and screens manipulating the coal. The new standard is to take effect from the first making-up in January.

# SPAN OF THE NEW BRIDGE OVER THE TUGELA RIVER

THE PATENT SHAFT AND AXLE TREE COMPANY, LIMITED, WEDNESBURY, ENGINEERS

(For description see page 71)



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 Letters relating to Advertisements and the Publishing Department of the Paper are to be addressed to the Publisher, Mr. Sydney White; all other letters to be addressed to the Editor of THE ENGINEER.  
 Telegraphic Address, "ENGINEER NEWSPAPER, LONDON."

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\* LATEST TYPES OF THE BRITISH FLEET.—Our two-page coloured supplement, representing H.M. ships Formidable, Drake, and Albatross, may be had, printed on superior paper, upon a roller, price 1s., by post 1s. 1d.  
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TO CORRESPONDENTS.

\* In order to avoid trouble and confusion we find it necessary to inform correspondents that letters of inquiry addressed to the public, and intended for insertion in this column, must in all cases be accompanied by a large envelope legibly directed by the writer to himself, and stamped, in order that answers received by us may be forwarded to their destination. No notice can be taken of communications which do not comply with these instructions.  
 \* All letters intended for insertion in THE ENGINEER, or containing questions, should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.  
 \* We cannot undertake to return drawings or manuscripts; we must, therefore, request correspondents to keep copies.

REPLIES.

D. D. (Leicester).—The apparatus was described in our issue of the 10th February, 1899. The maker is H. W. Neild, of Victor Works, 89, Blackheath-road, London, S.E.  
 EXCALIBUR.—When you are ready we shall be happy to make the facts known. You are for the moment only one of a great many who have more or less recently invented rifle shields.  
 A CORRESPONDENT.—It would be impossible to give all the rules concerning ships' boats here. You can obtain a copy of the rules, "Merchant Shipping (Life-saving Appliances)," from the Marine Department of the Board of Trade. The air chambers in a lifeboat must contain one cubic foot of air for every ten cubic feet of boat capacity, and one person shall be allowed for every ten feet of capacity.  
 H. M.—Land and buildings with fixtures attached, and which cannot be separated from the security, are proper subjects for a mortgage. Loose chattels, such as those you mention, which a mortgage would have power to sever and sell separately, ought to be included in a bill of sale. Occasionally difficulty arises in determining what may be included in the mortgage and what must go into a registered bill of sale. You would do wisely to consult your solicitor.

MEETINGS NEXT WEEK.

LIVERPOOL ENGINEERING SOCIETY.—Wednesday, January 24th. Paper, "Defects in Iron Castings," by Mr. David Brown.  
 THE INSTITUTION OF JUNIOR ENGINEERS.—Saturday, January 27th, at 6.30 for 7 p.m., at the Westminster Palace Hotel, Fifteenth Anniversary Dinner.  
 CLEVELAND INSTITUTION OF ENGINEERS.—Monday, January 22nd, at 7.30 p.m. Paper, "The Pneumatic Pyrometer with Autographic Recorder," by Mr. E. A. Uehling, Middlesbrough.  
 THE INSTITUTION OF MECHANICAL ENGINEERS.—Friday, January 26th, at 8 p.m. Paper, "Water Meters of the Present Day, with Special Reference to Small Flows and Waste in Dribbles," by Mr. William Schönheyder, Member, of London.  
 THE INSTITUTION OF CIVIL ENGINEERS.—Tuesday, January 23rd, at 8 p.m. Ordinary meeting. Paper, "Swing Bridges over the River Weaver at Northwich," by Mr. J. A. Saner, M. Inst. C.E.—Friday, January 26th, at 8 p.m. Students' Meeting. Paper, "The Simplon Tunnel," by Mr. C. B. Fox, Stud. Inst. C.E.  
 THE INSTITUTION OF ELECTRICAL ENGINEERS.—Thursday, January 25th, at 8 p.m., at the Institution of Civil Engineers, 25, Great George-street, Westminster, S.W. Adjourned discussion on the Report of the Institution's Visit to Switzerland. Paper, "An Electrolytic Centrifugal Process for the Production of Copper Tubes," by Mr. Sherard Cowper-Coles, Member.  
 SOCIETY OF ARTS.—Monday, January 22nd, at 8 p.m. Cantor Lectures. Four Lectures on "The Nature and Yield of Metalliferous Deposits," by Mr. Bennett H. Brough. Lecture I: Deposits in which ores of the useful metals are met with—Beds, veins, and masses—Classification of ore deposits—Methods of mining formerly employed—Recent improvements.—Wednesday, January 24th, at 8 p.m. Ordinary Meeting. Paper, "Local Government and its Relation to Parish Water Supply and Sewerage," by Mr. W. O. E. Meade-King, M. Inst. C.E.

THE ENGINEER.

JANUARY 19, 1900.

FRENCH SHIPBUILDING.

ONCE again the French naval programme has shifted, and now—provided always that a fresh programme is not evolved between the time that these lines are written and their appearance in print—the pretty theories of a *guerre de course* are at a discount. The battle squadron is, for the instant, the order of the day, and ten battleships, together with ten large armoured cruisers, are spoken of; while the building of two out of those nine submarines that figure in the last parliamentary return is postponed to the *Ewigkeit*, and generally the "new school" has been repulsed. As for the submarines, the countermanding of the two latest is, perhaps, hardly a question of schools, since their particular type-ship, the Narval, does not appear to come up to requirements. She is said, in fine, to exhibit a tendency to float bottom upwards—a state of things that "is expected to interfere with the comfort of her crew, and to hamper her docility," all of which we are quite prepared to believe, given the truth of the reported instability. Experiments with such comparatively unknown factors as submarine boats are, however, one thing; the proposed construction of fighting ships upon accepted models, another. It is this last that we propose to examine.  
 First, as to cause. Hitherto the French programme has been governed by that of Great Britain, and the opponents of big ships have always pointed out that if France lays down a battleship extra, this country replies with a couple. Therefore, they have argued, it is useless to build battleships with which to fight perfidious Albion. "Fast cruisers" has been the watchwords of this party, and for a year or two its influence has been visible in French shipbuilding. Craft like the Guichen, Chateaufort, and others, very swift and very lightly armed, have been built specially for that form of piracy known as the *guerre de course*. After embarking upon this programme, some one in authority seems to have started thinking; and the wisdom of building "a multitude of swift cruisers"—about three is the present total of the multitude—got called into question. Swift the Guichen undoubtedly is, but everything is sacrificed to speed and coal, so that one of our second-class cruisers could, in vulgar parlance, knock her into a cocked hat inside a few minutes. The result of these deliberations was that the Guichen idea was abandoned, an armed liner being every whit as suitable for piratical purposes. Thereupon armoured cruisers were laid down; vessels able to tackle our protected cruisers without much risk, but—except on paper—slower than the Guichen type. To these we have replied with the Cressy class and others, and on this particular line things seem to have crystallised—the Guichen folly is not likely to be repeated. Indeed, the French are now con-

tinually asking themselves why, having evolved such a really splendid type as the Dupuy de Lôme, they ever started building anything else. Expense, and the desire of each Minister of Marine to be original, seem to be the two chief reasons why. However, at present the ship-building barometer is at "set fair" in the Dupuy de Lôme direction. A third reason may be casually alluded to. Great Britain never built any "reply" to the Dupuy de Lôme. In the innocence of their hearts the French administration of the period assumed that we recognised some cardinal defect in that ship, and here was an additional argument in favour of something more cheap and showy. Actually our neglect of the Dupuy de Lôme idea should rather be attributed to oversight on the part of past British Admiralties, and the fact that our people, too, were at that time very eager to find something cheap and showy. The Dupuy de Lôme is not a new ship, her armour is by no means of the latest patent; yet, seeing the angle at which it is inclined, we much doubt whether anything under a big gun could get through it. And we incline to fancy that the Dupuy de Lôme could stand up to our Cressy better than the far more modern Dupetit-Thouars.

So much for France's cruiser programme; we now come to the battleships. These, we think, owe the idea of their inception to Germany—it has dawned upon the French that England is not the only country with a navy, and that while the problem of the best kind of fleet to render safe a policy of pin-pricks has been under discussion, the German navy has been creeping up. Already, in case of a Franco-German war, Germany could defeat the French Northern Squadron and blockade the Channel coasts till reinforcements arrived from the Mediterranean. If Germany's programme be left unanswered, then that Power will be well ahead of France on the sea. At present, taking vessels of the first and second battle rank, Germany has five completed—the four Brandenbergs and the Kaiser Friedrich der Dritte. Against these France has the Brennus, Bouvet, Jauréguiberry, Charles Martel, Massena, Carnot, Charlemagne, and Gaulois—eight ships, five of which belong to the Mediterranean. True, France has the four Jénappes type, and the Courbet and Dévastation re-armed—or about to be—as well as some other vessels, such as the Magenta, Formidable, and Baudin, of doubtful fighting value, and which Germany has ships to meet. Half of these, again, are at Toulon, and altogether Germany would be in a fairly good position to make things unpleasant.

Of the ships being completed, Germany has one, the Kaiser Wilhelm der Zweite, while France has the St. Louis, Suffren, and Henri Quatre—this last quite a second-class ship. This more than preserves the balance, perhaps, but it does little else. In the matter of battleships building France has one other, the Iena, in hand. Germany has about half a dozen. This spells a probable clear superiority for Germany in the near future, unless Russia helped France, and Russia has not much with which to help despite the parliamentary return. If, therefore, France is not prepared to concede naval superiority to Germany she must begin to build battleships at once, for—neglecting the new programme—Germany, as she is, stands to get ahead of her old rival, and to be able comfortably to beat her in detail. And since it is hardly conceivable that France will permit this, we may look during the next few months to hear a good deal more about the "glorious mastodons," and a good deal less about the "brave sous-marins." While these last have been winning imaginary future victories over perfidious Albion, Germany has plodded along and mended her weak spot in the war of 1870-71. The *guerre de course* ideal, like several other of her ideals, seems likely to cost France pretty dear. Luckily for her, she seems to have awakened just in time; and if the new programme is carried out she will still remain an important naval Power.

AN AMERICAN LABOUR STRUGGLE.

AN account of one of the most remarkable struggles between capital and labour which has ever come to our ears forms the subject of an article in the current number of the *Engineering Magazine*. It is written by one of the persons directly interested, Mr. H. M. Norris, of the Bickford Drill and Tool Company, at whose works in Cincinnati the trouble arose. We must be content merely to outline the full history which Mr. Norris has written. The dispute was brought about by the introduction of the premium system of paying for labour, and as the plan is not very well known in this country a few introductory words about it may not be out of place. The premium system was invented some fifteen years ago by a Mr. Halsey, and has been successfully used by a number of American firms. Its object is to increase the output of machines by encouraging the individual workman. An estimate is made from existing data of the average time occupied in the machining of any particular piece of work. This average is called the time limit. And as long as the workman does not exceed this figure he gets paid at the current fixed rate of wages. But if, on the other hand, he accomplishes the work in less time, he is paid a percentage on each hour or part of an hour that he is under the limit. There is, it will be seen, absolutely nothing which can be construed as disadvantageous to the workman. With average industry he gets the full wages at which he is engaged, and by taking more pains or developing greater skill he is able to gain a premium.  
 In the majority of the establishments where the system has been tried the workmen have been open-eyed to their own interest, and have gladly embraced the chance of earning larger wages. But at the Bickford Drill and Tool Company's works they were blind to the advantages, and, as the tale unfolds, the company was obliged to withdraw the scheme. The story is worth following with some little care. Feeling that the men would find some difficulty in distinguishing between the premium plan and piecework, Mr. Norris introduced the system with the greatest care and tact. He began on one

of the oldest hands and explained the principle of the arrangement to him, and by degrees spoke to others about it till most of the leading hands were working under it. He then thought the time was ripe to introduce it generally, and had the necessary time cards printed. On the back of these a brief outline of the system and the conditions were printed. One or two quotations may be made with advantage. "A time limit once fixed will not be changed, except through the introduction of new methods of doing the work, so there need be no fear of earning too much money. Those who earn the most will be worth the most." "Premiums will not be paid on any work that is not completed to the entire satisfaction of the foreman. Every workman must satisfy himself before commencing a piece of work that it will finish to the required size. All premiums will be paid on the first regular pay day following the completion of the work upon which they were earned." The conditions, it will be seen, were put plainly and honestly before the men, and there was no suggestion by the men—so far as the story goes—of any unfairness on the part of the employers. For a short time the plan seemed to be working well, but one day a man came with a claim that a mistake had been made in the time limit on some wall radial arms. He had, he admitted, gained a premium of 1.40 dols., but thought he should have received more; his contention being that a man who saved an hour should be paid for the entire hour—"piecework was better than the premium plan, but he did not want either of them, and would sooner go on as he had been doing before the innovation." It was pointed out to him that he need not take the extra money, there was nothing compulsory in it, but he remained unsatisfied, and the trouble began. Time, instead of decreasing, began to go up, and at last, in order to make an example, the worst offender was dismissed, several others left in sympathy. The firm made an endeavour to restore peace, but as the men insisted on the reinstatement of the discharged workman and the firm refused to allow him to return, the matter ultimately came into the hands of the International Association of Machinists of Cincinnati, and after this association—a similar institution, apparently, to any one of our unions—had vainly endeavoured so secure the man's return, the strike collapsed and the others went back to work. On the next pay day Mr. Norris went to several of the men and said, "There is a premium due from last week; would you like it enclosed in your envelope?" and in each case the answer was "No." Loth to give up the plan, an attempt was made to convince Mr. Seigreat—the agent of the Association of Machinists—that it did not infringe on any of the rules of the union. He confused it with piecework, and refused to be convinced. As some of his remarks give the key to the men's attitude it will be as well to quote them. "He persisted in confounding the premium plan with that of piecework and other systems, classing together and pronouncing as bad all methods tending towards increasing a workman's output. He declared them to be simply a scheme of the employer to augment his bank account at the ultimate expense of the working man. He said he believed all such systems worked injury to both the employé and the employer—to the former by engendering a feeling of rivalry and discord among the men, and to the latter, by compelling him to accept inferior work." The difference between the premium plan and piece-work was explained by Mr. Norris. It was shown that under the latter "the wage cost per piece of merchandise remains the same, no matter how great the increase in output of the workman; hence, if the piece prices are fixed too high, the manufacturer must either cut them or continue to pay extravagantly for his work;" but "under the premium plan half the saving in wages goes to the workman and half to the employers, rendering a cut unnecessary, even though the time limit should prove considerably higher than necessary." Later, the grand master of the International Association of Machinists confirmed Mr. Seigreat's view. In his opinion labour could derive no benefit from the scheme. He took the position that if work was done in less time, the output would be greater than the firm could dispose of, and the number of hands would be reduced till the output was reduced to the original amount.

Although Mr. Norris's story is not yet complete, we have enough before us to show plainly the attitude of the American workmen to progress. It is an attitude which we imagine will astonish not a few people in this country. Rightly or wrongly, many of us have been under the impression that the Yankee artisan was particularly wide awake to his own interests. We have always supposed that what unions there were rather encouraged individual enterprise than choked it, and that in all works a healthy rivalry existed. We have even been told by American writers that the success of American methods is due to the encouragement which is held out to and accepted by American workmen. We have been informed that this is particularly the case with machine tools. That the development of this particular branch of engineering across the water was directly attributable to the interest which the mechanics took in discovering means of reducing time, and comparisons unfavourable to the English workmen have been drawn with no little frequency.

Presumably the men of Cincinnati are not as those of other cities. They are under the thumb of a union which is at least as stern and impartial in crushing the individual as any of our similar British institutions, and seem quite as anxious to prevent the natural development of industries as any European people for the last two centuries. The men's position has been clearly defined by both their representatives, and it must be said in fairness to them that they have adhered manfully to their opinion in face of evident disadvantages. They have laid down a principle which may be read in a very few words. Increased output means decreased occupation. The more work that one man can do the less the number of men required. It would serve no useful purpose to point out again the shortsightedness of this policy.

It has been drummed again and again into the ears of the workman, but he is none the wiser. History does not appeal to him in the way that a deduction from apparently plain and straightforward facts does. A foot-note to Mr. Norris's article contains the observation that "theory takes account of all the conditions that can be discovered and calculated; practice deals with all the conditions there are." Can we do better than recommend workmen the world over to digest that observation well? Theory thus defined is the rock they split on. Considering only such facts as they with biased eyes can see, and calculating only from the data immediately under their hands, they have formulated a principle which leaves out of account a most important factor. Would they but take the trouble to study past records, they would find it difficult to find a single case in which the means of increasing production have led to a permanent reduction of the number of persons employed. As we all know, in the majority of cases increased output, by whatever means brought about, has been followed by an increased demand, and consequent increase in the size of factories.

#### THE FEDERATED MINERS IN SOUTH WALES.

THE meetings of the Miners' Federation at Cardiff concluded on Friday last week, too late for more than a summary reference in these columns; and the secrecy in which the proceedings were, for the most part, conducted, made anything like an intelligible account of the deliberations impossible at the time. Friday was an open day, and so was the forenoon portion of Wednesday; but the remainder of the four days' session was practically held in closed caucus fashion, which the best friends of the colliery population regard as a tactical mistake. It was not only a tactical mistake; it was an error in policy attended by sundry unfortunate and mischievous consequences. There was a Presidential address after all, but it was thrown over to the second day, and instead of being an "opening" statement, it fell into the category of the thin slice of beef within an old Vauxhall sandwich. It was placed before the public as the unconsidered trifle which they were to be permitted to digest or discard as they chose. That is the worst of these semi-public gatherings. One expects a free and frank exposition of the grievances, of the position, and of the remedies suggested by the representatives of nearly half a million of the active mining community. We are only allowed to know half that goes on; and conjecture, however shrewd, as regards the other half is as apt as otherwise to distort the nature of the proposals the speakers are dealing with *in camera*. It is clear enough that we were right in describing the assemblage of the Federation in the South Wales coalfield as a distinct and defiant challenge, the very gauge of battle, to the advocates of the Sliding Scale system of wage adjustment. It stands to reason also that by the sheer preponderance of opinion, converted or coerced, the Sliding Scale arrangement is now to be regarded as in its moribund days. Some are for its immediate extinction; but they are manifestly in the minority. The bulk of the South Wales miners have declared themselves in favour of denouncing the Five Years' Agreement in as legal a fashion as time and chance allow. But there is scarcely mention of this contingency in Mr. Pickard's deferred address, or in the "official" reports of the discussions, and all that is communicated on a vital issue is at extra-official luncheons, or the itinerant district gatherings which alone represent the ancient missionary spirit of the Miners' Federation of Great Britain. Mr. Pickard's postponed speech, nevertheless, commands notice, and the remark must be made by way of preface that in his observations *ex cathedra* he was more sensible, more moderate, than in the free-and-easy speeches he made on sundry platforms in condemnation of the South Wales Sliding Scale and its supporters. The Sliding Scale system is not a fetish. There may be idealism, but not necessarily perfection, in the phrase, or the mechanism it describes. It has, however, served the purposes of an exceptional district like South Wales since 1875—since 1879 on the present standard—and there needs to be some proof better than that presented by Mr. Pickard why a Wages Board would be a superior institution to create in its place.

It marked a new era in South Wales, and in the history of the organisation, said Mr. Pickard, that the members of the Federation should be able to meet in Cardiff; to meet with the consciousness that South Wales was with them; and to know that Welshmen had proved such "good fighters" during the long strike of 1898. The "whole country," he declared, sympathised with them when they were put in a corner, and were struggling to disentrammel themselves from the fetters of the Sliding Scale. "Sliding Scales, it would on all hands be admitted, were made to enable commercial men to run the show easily, so that whether prices advanced or fell, these men made their contracts fit in to secure profits all the year round. In times of adversity, as in times of prosperity, the lawyers had always work before them; they were always secure of their payments, and the men of the sixpenny dividends came in last. The coal merchants, with rare exceptions, were the people who could live better and longer under Sliding Scales than either the colliery owner or the workmen." Then followed an echo of the insidious teachings of Mr. D. A. Thomas, M.P., and one or two other men among the "Outlanders" of the Coal-owners' Association. "In good times, as in bad times," said Mr. Pickard, "coal was sold at a profit. The coal-owners said that the middlemen swallowed the profits. If that was so, then they, as workmen, must do all they could to oust the middleman from his position. South Wales was now an integral part of the Miners' Federation. Having come to this point, it remained for them to determine how this new relationship was to obtain for them—the colliers—anything more than the bare necessities of life." Here came the word of promise

to the ear, and there is no need prematurely to criticise the value of the promissory note. "As far as South Wales was concerned, there could be no question as to the benefits which the Federation could confer upon its mining population. Thanks to the 30 per cent. minimum in the Federation area, the workmen had obtained about £6,000,000 year by year more in wages than they could have obtained if that minimum had been altered as the percentages ran between 1871 and 1874. Taking the last ten years, the workmen had secured, owing to this minimum, about £60,000,000 extra in wages, and even though in ordinary circumstances the owners would have declared themselves unable to pay it, now when the 45 per cent. had been obtained, it would mean to every man in the Federation at least about 9s. per week, or nearly £9,000,000 per annum; and this without taking South Wales, or Durham, or Northumberland into calculation. Was not that result worth the effort, and more especially as it was procured in a quiet and ordinary way?" The moral of it all, according to Mr. Pickard, is that these results have been achieved by methods—"quiet and ordinary," possibly—but quite contrary to the peaceful and automatic processes of the Sliding Scale based upon average selling prices *f.o.b.* But what about the Conciliation Board of Wages? The trade reports in *THE ENGINEER* have explained the character of the work such boards have done in the North, even the North of Mr. Keir Hardie, or the more easterly North of Fife and Clackmannan. What is it that Mr. Pickard has to say as to the applicability of the Wages Board in South Wales as a substitute for or an amendment of the Sliding Scale? "Some people," he went on to say, "complained that the Conciliation Board drove men out of the organisations, and that there was nothing left to fight for. . . . If the Board of Conciliation ruled the standard rate of wages, the local unions at home must look after the fluctuating work in the pits, because it was the little fox which stole away the grapes. Let them be well warned that it was their unity which consolidated their power. Without aggressive Unionism, with the force of individualism behind it, the members could make no headway, either locally or in the general field of action."

It is not worth while to follow Mr. Pickard through his comments upon the Compensation Act, for we are all familiar with the deficiencies and perplexities of that unfortunate measure; or in his strictures on the apathy of both political parties as regards the Mines Regulation Amendment Bill; or in his dexterous skating over thin ice in urging still the idea of an eight hours day from bank to bank. Mr. Pickard himself was explicit enough, and we are free to say that he has no opinions that he need conceal. But hereanent subject after subject, and the very subjects we all feel concerned in, were relegated to the mystery of the closed chamber. It was only on this day week, at the concluding meeting, that the veil was withdrawn on a spectacle of a divided camp over one of the most stalwart proposals, one could fairly call one of the most truculent, proceeding from the Presidential chair. It related to the eight hours working day from bank to bank, an absolute impossibility in South Wales until the men make some concession in the direction of working three shifts in the twenty-four hours. There appears to have been a conflict of opinion at one of the earlier closed meetings over the Federation proposal for an amendment of the Compensation Act: that, namely, for a compulsory minimum payment for injury within three days of the accident, and before the facts could be inquired into, or the collier's share of responsibility ascertained. The Welshmen objected to this as too exacting, and incidentally it was stated that the Act had so far worked well for the Welsh miners, most of the claims having been settled without passing through the Court. The more important schism, however, appeared on the motion that this Conference should continue with unabated vigour to agitate for a legal eight hours' day "from bank to bank." A Scotch delegate confessed that in this matter they had not made the progress they looked for; they were more hopeful seven or eight years ago; and he supposed none of them was sanguine enough to think that in the next year or two the measure would be carried into law. A Merthyr delegate said his branch had at last withdrawn their opposition to the "bank to bank" limit; but it was evident that he did not speak for the whole of the Welsh colliers. The President ultimately evaded the difficulty by remarking that an amendment to one clause would probably lead to the shelving of the whole question, and at his suggestion the original motion and amendment were withdrawn.

#### THE DYNAMICABLES.

SOME eighteen years ago, when electrical engineering was in the earliest stages in this country, a small society was formed, which included in its ranks all the leading electricians and electrical engineers of the day. The first title of the society was "The Electric Arc Angels," but this was almost immediately altered to "The Dynamicables." The society was in no sense public. The members met and dined together at varying intervals. There were no speeches made, no toasts drunk, but after dinner some member started a subject for discussion—electrical, or mechanical, or physical—and information was interchanged. After a few years, the Institution of Electrical Engineers superseded the Dynamicables, and the society ceased to exist. By happy thought, it occurred to Mr. C. W. Biggs—one of the first of the Dynamicables—to get up a dinner at which should be assembled all possible surviving members of the society. The dinner took place at the Whitehall Club on Wednesday night, and about five-and-twenty members, including not a few leading men in the profession, were present. Major Crompton was in the chair, supported by Mr. Alexander Siemens, Professor Perry, and Mr. MacFarlane Gray. Although it was against the rules to make speeches, the occasion was seized to bid Major Crompton and the band of fifty volunteer electrical engineers who accompany him to the Cape, God-speed. Major Crompton, in a brief reply, explained how it came to pass that he was leaving England for South Africa. After the melancholy death of Dr. Hopkinson, Major Crompton was asked to take over

command of the corps of Volunteer Electrical Engineers. He did so with some reluctance professionally, but he had gone on in the hope that some better man than himself would take his responsible post. No one had stepped forward, and so it had come to pass that he had had to pick from some two hundred and fifty men fifty for special service. They were all good men—men who sacrificed much, who gave up appointments, relinquished business, risked their future prospects, and were ready to imperil their lives in their country's cause. He was proud to lead such men, and yet sad that the need for their services should have arisen. Their work in South Africa would consist in making themselves generally useful. Telegraphing, electric lighting, and signalling would occupy them. Much use would be made of traction engines, and Messrs. Aveling and McLaren had worked day and night to provide plant. The detachment went fully determined to do their duty, come what would. In very touching words he thanked his friends for their good wishes, and trusted that the day was not distant when they would meet again rejoicing. The dinner was in every respect a success, and it is possible will be the first of a series.

#### PEACE AT THE PITS.

ANOTHER guarantee for peace in the coalfield for a further period of three years was given in London on Tuesday, when the Coal Conciliation Board met, after a lapse of several weeks, to consider the wages question throughout the area covered by the Miners' Federation. An arrangement has been come to whereby the last obstacle in the way of amicable working in the British coalfield for the next three years is certain to be cleared. That obstacle was the 5 per cent. advance for surface men. The resolutions passed cover three points. The first sets forth that in consideration of the agreement for a continuance of the Conciliation Board from the 1st of January, 1901, for a further period of three years at the present minimum and increased maximum to 60 per cent., the present rate of wages to underground labour will be increased from the first making-up day in January by 5 per cent. on the standard. The second resolution provides that for a further period of three years from the first making-up day of January, 1901, the rate of wages is not to be below 30 per cent. above the standard rate of 1888, the present minimum, and not more than 60 per cent. above the standard rate of 1888. The third resolution, which is the sequel to the other two, provides that during the period of three years from January, 1901, the rate of wages for underground labour is to be determined by the Conciliation Board within the limits mentioned in the foregoing resolutions. The decision to recommend a 5 per cent. advance to the wages of the surfacemen was come to unanimously; but this could not take the form of a definite resolution, as the Conciliation Board has no power to enforce an arrangement in the mine which they can only recommend to the owners in the various districts. The resolutions which have been arrived at, and the recommendation added thereto, may be taken as indicative of general confidence in the continued prosperity of the coal trade for several years to come. The present prices for the various kinds of coal justify the abnormally high wages which have now been fixed upon; but should there come a reaction in trade, which many competent judges anticipate within the period mentioned by the new arrangement, there could scarcely fail to be a recrudescence of trouble in the coalfield which would require all the diplomacy of coalowners' and miners' agents to get over.

#### THE ROYAL YACHT.

THE unfortunate mishap at the undoeking of the new Royal Yacht at Pembroke has given rise to a good deal of speculation. We may, or may not, ever know the whole truth of the matter. Probably we never shall. The Pembroke correspondent of the *Naval and Military Record* tells us that:—"According to the account given by eye-witnesses the ship, which was previously resting safely on the keel blocks supported by numerous breast shores, gave three lurches immediately after she floated. The rising tide lifted her off the blocks, thus relieving her of the shores. Instantly that occurred she gave a slight list to port, then fell back slightly to starboard, hung there momentarily, and again heeled to port. The starboard shores fell out while those on the port side jammed as they fell between the side of the dock and the ship's side, and assisted to force the keel away from the line of blocks towards the opposite side of the dock. She ultimately steadied herself at between 22½ deg. and 25 deg. from an upright position, but the opinion is generally held that if the bow had not come in contact with the upper end of the dock, the counter being brought up on the caisson and the port bilge on the keel blocks, the ship would have continued to fall until her masts reached the roof and walls of the adjacent armour-plating shop, or came against the dock side." There seems to be no doubt that the ship was, like several Atlantic and Australian liners, what sailors call "tender," and sensitive to the addition of extra weight on one side or the other. But it does not, therefore, follow that she will be unstable when she has all her coal, water, and stores aboard, to say nothing of water-ballast. There are experts who predict that in sea-going trim she will prove a perfectly safe and stable vessel. But until those responsible for her are a trifle more communicative, opinion can be but speculation.

#### LONDON STREET TRAFFIC.

Now that the London County Council is taking energetic measures to improve the appearance of our streets and is endeavouring to meet the ever-increasing traffic in London, appears to be a fit time for calling attention to a serious evil, and one which, strangely enough, appears to have been almost overlooked. We refer to the heavy wagon traffic which takes place between Ludgate-hill and Charing-cross. The whole district is comparatively hilly, and it is not an uncommon sight to see a lorry heavily weighted stuck half-way up Fleet-street, or more frequently upon any of the numerous streets which lead from the Embankment to the higher level. The stoppage of one such large wagon in the main thoroughfare is enough seriously to disturb nearly a mile of traffic, and although widening the streets might mitigate, it will hardly remove the evil. It has occurred to us that if some means of assisting heavy carts from the Embankment to Fleet-street and the Strand—or even along these roads themselves—could be introduced, much wearing out of patience and of horseflesh would be obviated. Such a means is at hand. The pressure mains of the London Hydraulic Power Company are laid under Fleet-street and the Strand, and there could be but little difficulty and expense in erecting small hydraulic bollards or

capstans at the corners of several of the steeper streets to help horses by means of towing ropes. For this purpose a clear space of about one cubic yard under the pavement would have to be found, and we believe this could easily be done. The bollards themselves would occupy no more room than the corner posts which are erected already at many places, in fact they might be so constructed as to take the place of these posts. The system would be inexpensive, and the use of the bollards might be paid for by the users, or provided by the City free of charge. In either case the key for supplying the pressure might be in the possession of either the policeman on point duty, or might be kept in some shop close by.

#### VICKERS-MAXIM QUICK-FIRING GUN.

It is interesting to compare the equipment of the Vickers-Maxim quick-firing field battery, supplied to the City of London Volunteers, with the service equipment, making allowance for the different character of the pieces. The calibre is 75 mm.—2.57 in.—the gun being the same as that supplied for the armament of the Nile boats in the last Soudan campaign. The ammunition is "fixed," the projectile and charge being inserted by means of a brass case with central fire. The carriage is fitted with spring buffers, the gun barrel recoiling about a foot in a jacket carrying the trunnions, the trail has a form of spade to check recoil, and there are brakes which can be applied to the wheels. The recoil is by these means so completely controlled that the gunner who lays the piece is able to remain seated on a seat on the trail. Four projectiles are supplied—shrapnel with time and percussion fuze, common shell, ring shell with percussion fuze, the weight of each being 12½ lb., and lastly, case shot. The last is said to be efficient up to 300 or 400 yards; the shrapnel time fuze provides for 5000 yards, up to which the gun is sighted. The muzzle velocity is 1575 foot-seconds.

#### BOOKS RECEIVED.

*Report by the Chief Labour Correspondent of the Board of Trade on Trade Unions in 1898, with Comparative Statistics for 1892-1897.* London: Eyre and Spottiswoode, 1899. Price 1s. 6d.

*Indicator Diagrams: A Treatise on the Use of the Indicator and its Application to the Steam Engine.* By W. W. F. Pullen. Manchester: The Scientific Publishing Company, Limited. Price 6s. net.

*Gedenkboek van het Koninklijk van Ingenieurs 1847-1897. Mémoires publiés à l'occasion du cinquantième de l'Institut Royal des Ingénieurs Néerlandais, 1847-1897.* La Haye: Van Langenhuisen Frères, 1899.

*A Rudimentary Treatise on Coal and Coal Mining.* By the late Sir Warrington W. Smyth, M.A., F.R.S. Eighth edition. Revised and extended by T. Forster Brown. London: Crosby Lockwood and Son, 1900. Price 3s. 6d.

*Rules for Railway Location and Construction of the Northern Pacific Railway Company.* By E. H. McHenry, M. Am. Soc. C.E., chief engineer. New York: Engineering News Publishing Company, 1899. Price 50 cents.

*Pyrography and Wood Roasting.* By Thos. Bolas, F.C.S., F.I.C., and Chas. Godfrey Leland, M.A., &c. Being No. 9 of the "Useful Arts and Handicraft Series." Edited by H. Snowden Ward. London: Dawbarn and Ward, Limited. Price 6d. net.

*Lockwood's Builders', Architects', Contractors', and Engineers' Price Book for 1900.* Edited by Francis T. W. Miller. With a Supplement containing the London Building Acts, 1894 and 1898. London: Crosby Lockwood and Son, 1900. Price 4s.

*Bent Iron or Strip Work.* By Geo. Day, F.R.M.S., and Chas. Godfrey Leland, M.A., F.R.S.L., &c. Being No. 8 of "Useful Arts and Handicraft Series." Edited by H. Snowden Ward. London: Dawbarn and Ward, Limited. Price 6d. net.

*The Interaction of Wheel and Rail, and its Effect on the Motion and the Resistance of Vehicles in Trains. From the German of Baddeker.* By A. Bewley, Ex. Eng. P.W.D., India. Madras: Printed at the Lawrence Asylum Press, by H. Plumbe, superintendent, 1899.

*The Law of Mines and Minerals, with an Appendix of Mining Precedents, fully Annotated with References to the Text, and a Glossary of English Mining Terms by the late Wm. Bainbridge, F.G.S.* The fifth edition. By Archd. Brown. London: Butterworth and Co. 1900. Price £2 2s.

*Lubrication and Lubricants: A Treatise on the Theory and Practice of Lubrication, and on the Nature, Properties, and Testing of Lubricants.* By Leonard Archbutt, F.I.C., F.C.S., and R. Mountford Deeley, M. I. Mech. E., F.G.S. London: Chas. Griffin and Co., Limited, 1900. Price 21s.

*Kinematics of Machinery. A brief Treatise on Constrained Motions of Machine Elements.* By John H. Barr, M.S., M.M.E. With over 200 figures. First edition. Third thousand. New York: John Wiley and Sons. London: Chapman and Hall, Limited, 1899. Price 2 50 dols.

*The Engineering Works of the Kistna Delta: A Descriptive and Historical Account.* Compiled for the Madras Government by George T. Walsh, M. Inst. C.E., Chief Engineer for Irrigation, Madras (retired). In two volumes. Vols. i. and ii. Madras: Printed and published by the Superintendent, Government Press, 1899.

**SINGULAR ACCIDENT ON ELECTRIC TRAMWAYS.**—A curious accident happened to the Sheffield Electric Tramway system on Monday. Pierce flames were observed to issue from the electric switchbox at the bottom of West-street. Instantly the tram service on all the city routes was stopped, causing much surprise and alarm. The fire brigade were called out, but they could do nothing. The flames from the switchbox, which had frightened the assembled crowd, who drew back fearing an explosion, ceased immediately the current was cut off, and the brigade did not linger to contend with the smoke which poured from the box, bearing with it a strong bituminous smell. An examination showed that in some way at present unknown the insulation surrounding the conductor in one of the underground cables had become defective, and had caught fire from the electric sparks. This insulation, being composed of bituminous material, burned rapidly. The defective part was close to the switchbox, and only a short length of it was burned, the damage being repaired in about half an hour. Before this could be done, however, it was necessary to cut the section beneath the switchbox. These boxes hold the cables which convey the current from the power station, and by switches in the boxes the electricity is carried up the street standards on to the trolley wires. The boxes are a quarter of a mile apart, and the current can easily be taken along the trolley wires for that or a greater distance. It is to secure equality of pressure that the wires are fed from the boxes at intervals, but when the accident occurred the feeding power of the switchboxes was dispensed with. The insulation which occurs in the trolley wires opposite every switchbox was bridged over by Corporation workmen standing on a tower car, and the current was carried over the wire until the switchbox further on was reached, when the feeders then came into operation.

#### COLOURS OF HEATED STEEL CORRESPONDING TO DIFFERENT DEGREES OF TEMPERATURES.\*

By MAUNSEL WHITE, and F. W. TAYLOR, Bethlehem, Pa.

THERE is, perhaps, nothing more indefinite in the industrial treatment of steel, than the so-called colour temperatures, and as they are daily used by thousands of steel workers, it would seem that a few notes on the subject would prove of general interest.

The temperatures corresponding to the colours commonly used to express different heats, as published in various text-books, hand-books, &c., are so widely different as given by different authorities, it is impossible to draw any definite or reliable conclusion. The main trouble seems to have been in the defective apparatus used for determining the higher temperatures. The introduction of the Le Chatelier pyrometer within the last few years has placed in the hands of the scientific investigator an instrument of extreme delicacy and accuracy, which has enabled him to determine the temperatures through the whole practical range of influence, and led to the establishment of new melting and freezing points of various metals and salts, which are now accepted as the standard in all scientific investigation. There has not, however, been published any results with the Le Chatelier pyrometer seeking to establish a correspondence of temperatures with colour heats.

The first work done in this line, of which we are aware, is that of Dr. H. M. Howe, some eight or nine years ago. His results, however, have not been published, and with his kind permission we are enabled to give them here:—

	Degrees Cent.	Degrees Fah.
Dull red .. .. .	625 to 550 .. .. .	1022 to 1157
Full cherry .. .. .	700 .. .. .	1292
Light red .. .. .	850 .. .. .	1562
Full yellow .. .. .	950 to 1000 .. .. .	1742 to 1832
Light yellow .. .. .	1050 .. .. .	1922
Very light yellow .. .. .	1100 .. .. .	2012
White .. .. .	1150 .. .. .	2102

The nomenclature used for colour heats differs with different operators, but in our investigation we have adopted that which seems more nearly to represent the actual colour corresponding to the heat sought to be represented. We have found that different observers have quite a different eye for colour, which leads to quite a range of temperatures covering the same colour. Further, we have found that the quality or intensity of light in which colour heats are observed—that is, a bright sunny day, or cloudy day, or the time of day, such as morning, afternoon, or evening, with their varying light—influence to a greater or less degree the determination of temperatures by eye.

After many tests with the Le Chatelier pyrometer, and different skilled observers working in all kinds of intensity of light, we have adopted the following nomenclature of colour scale with the corresponding determined values in degrees Fah., as best suited to the ordinary conditions met with in the majority of smith shops:—

	Degrees.
Dark blood red, black red .. .. .	900
Dark red, blood red, low red .. .. .	1050
Dark cherry red .. .. .	1175
Medium cherry red .. .. .	1250
Cherry, full red .. .. .	1375
Light cherry, bright cherry, scaling heat,† light red .. .. .	1550
Salmon, orange, free scaling heat .. .. .	1650
Light salmon, light orange .. .. .	1725
Yellow .. .. .	1825
Light yellow .. .. .	1975
White .. .. .	2200

With the advancing knowledge of, and interest in, the heat treatment of steel, the foregoing notes, it is hoped, may prove of some value to those engaged in the handling of steel at various temperatures, and lead to further and wider discussion of the subject, with a view to the better understanding and more accurate knowledge of the correct temperatures. The importance of knowing with close approximation the temperatures used in the treatment of steel cannot be over-estimated, as it holds out the surest promise of success in obtaining desired results.

This demand for more accurate temperatures must eventually lead to the use of accurate pyrometric instruments; but at present the only available instruments do not lend themselves readily to ordinary uses, and the eye of the operator must be largely depended upon; therefore, the training of the eye, by observing accurately determined temperatures, will prove of much material assistance in the regulation of temperatures which cannot be otherwise controlled.

**TRAIN SERVICE TO AND FROM PARIS.**—The South-Eastern and Chatham Railway announce that on and from the 15th January certain alterations and improvements will be made in the services to and from Paris, *via* Dover-Calais and Folkestone-Boulogne, which will be appreciated, more especially in view of the forthcoming Paris Exhibition. The Northern of France Railway Company has for some time past been building new rolling stock for use on its international express trains. The carriages are of the most modern corridor bogie type, with lavatory accommodation. A sufficient number of these vehicles has now been completed, to enable the 9.0, 10.0, and 11.0 a.m. services from London and the corresponding return services from Paris to be exclusively composed of these new carriages between Calais and Boulogne and Paris, and it will arrive five minutes earlier than at present, and *vice versa*. The 9.0 a.m. morning service will also have a restaurant car added between Calais and Paris, and the departure from Paris will be made at 9.30 instead of 9.0 a.m., arriving in London as at present. The afternoon service, *via* Boulogne, now leaving Paris at 3.45 p.m. will be timed to leave at 3.30 p.m., and on and from February 1st this service will be due to arrive at Charing Cross 17 minutes earlier than at present, viz., at 11.15 p.m.

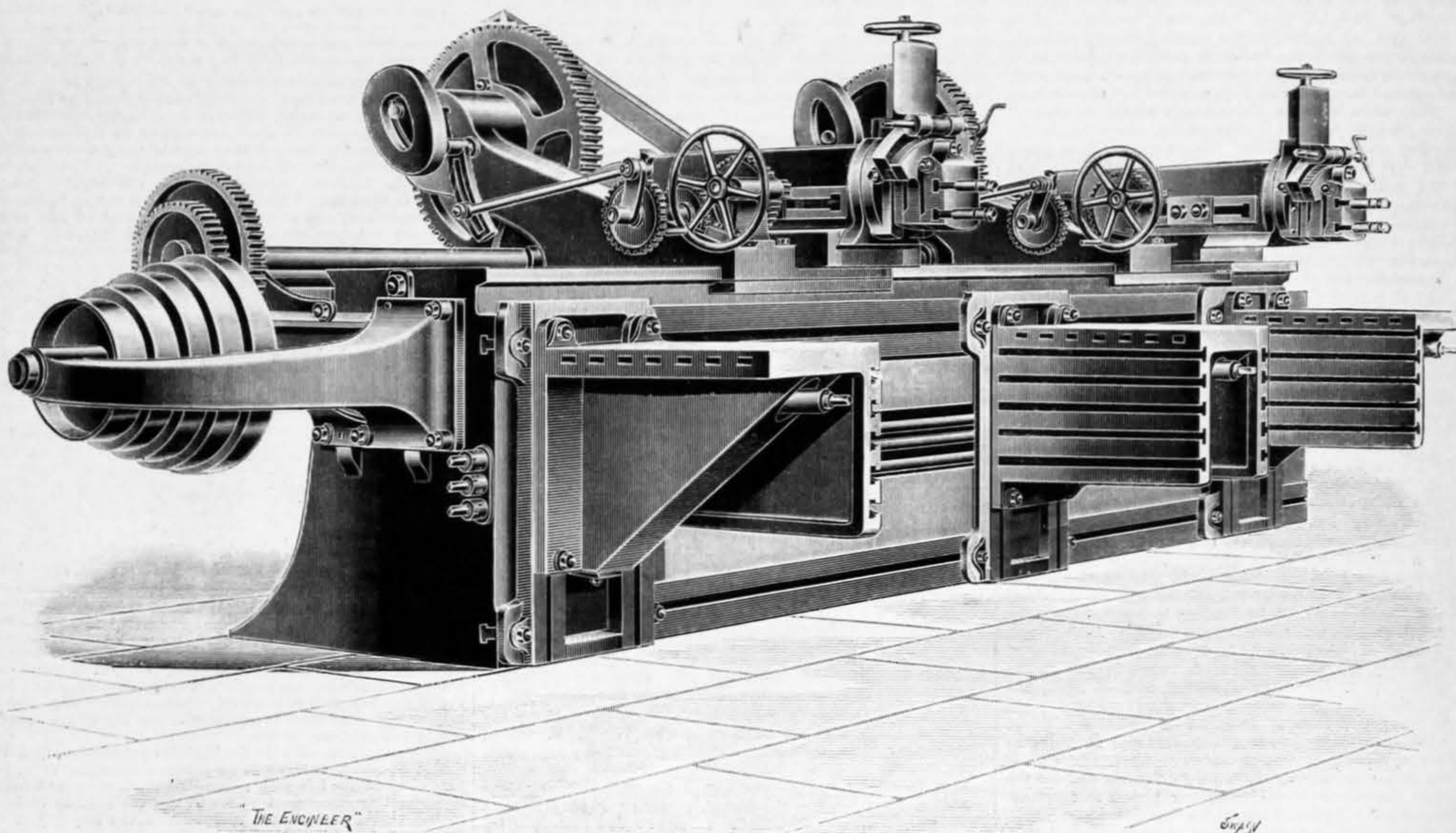
**ANNUAL DINNER OF OLD STUDENTS OF THE ROYAL SCHOOL OF MINES.**—Mr. H. G. Graves finding it necessary to retire from the honorary secretaryship of the Old Students' Dinner, a position which he has filled with such ability and success for eight years, it is thought that, over and above the recognition of Mr. Graves' work by his nomination as chairman of the forthcoming annual dinner, the eminent services which he has rendered to the Old Students deserve some further mark of acknowledgment. It is proposed, therefore, to present him with a loving cup with a suitable inscription, accompanied by an album containing the signatures of the subscribers, without mention of the amount subscribed. The following gentlemen have formed themselves into a Committee to promote this object:—H. Bauerman, chairman of the dinner, 1892; Bennett H. Brough, chairman, 1894; A. G. Charleton, chairman, 1896; Francis Fladgate, Registrar of the Royal School of Mines; W. H. Greenwood, chairman, 1895; W. Gowland, chairman, 1893; F. W. Harbord, chairman, 1899; F. E. Harman, chairman, 1884; H. W. Hughes, chairman, 1898; T. K. Rose, chairman, 1897. Subscriptions should be sent to Mr. F. Fladgate, Royal College of Science, South Kensington, or to Mr. Hngh C. McNeill, hon. sec. of the Dinner Committee, 29, North Villas, Camden-square, London, N.W., not later than January 15th, 1900, in order that the presentation may take place at the Royal School of Mines dinner on January 26th, 1900.

\* American Society of Mechanical Engineers.

† Heat at which scale forms and adheres, &c., does not fall away from the piece when allowed to cool in air.

## 32IN. DOUBLE-HEADED SHAPING MACHINE

LOUDON BROTHERS, GLASGOW, ENGINEERS

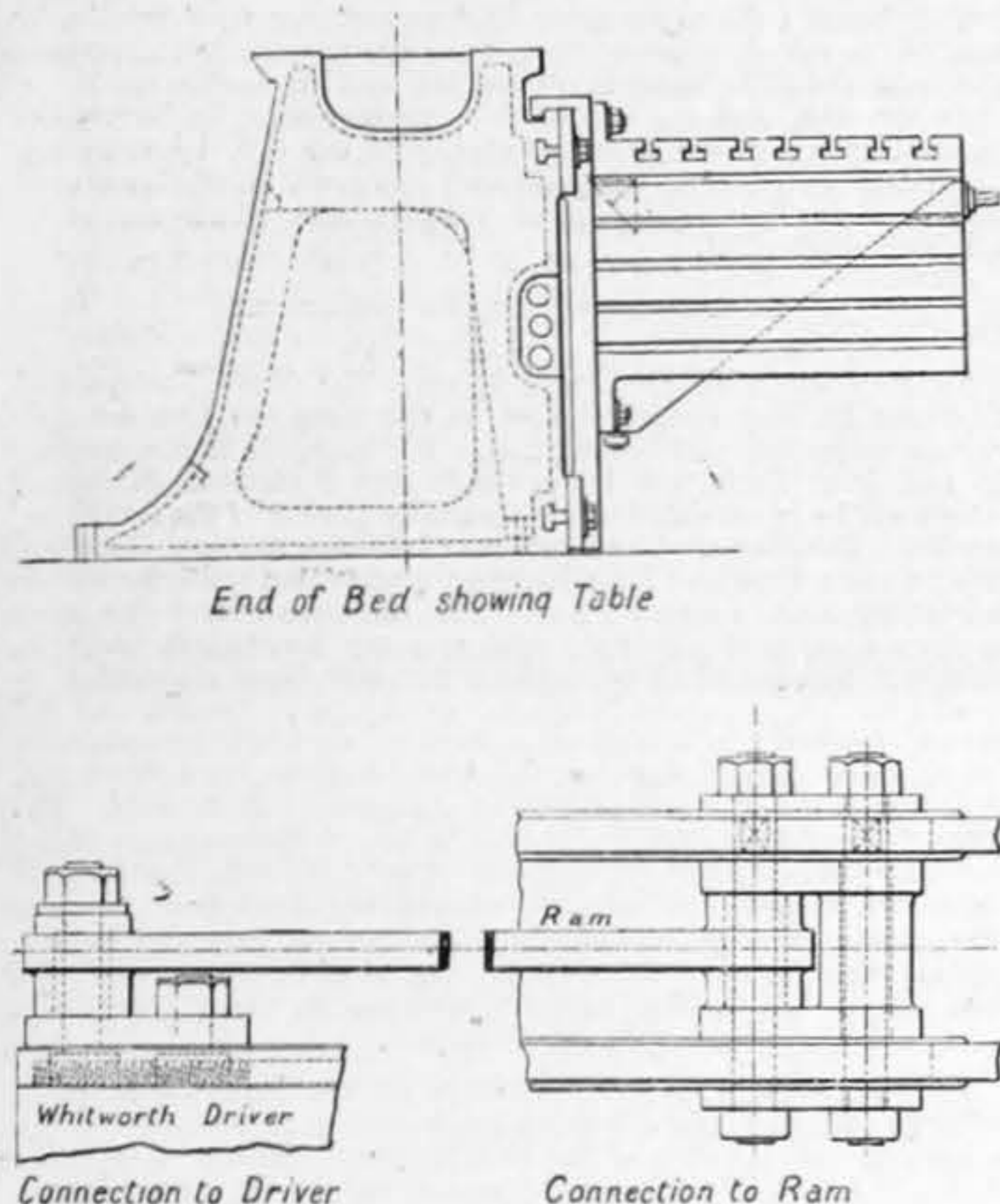


## SHAPING MACHINE.

At a time when we hear more than enough of the invasion of English markets by foreign engineers, it is pleasant to know that there are still fields in which the old-time reputation of the British machine tool maker still lives. We have recently received from Loudon Brothers, of Glasgow, a photograph and some drawings of a double-headed shaping machine constructed by them for the Creusot Works. The photograph and the drawings we reproduce on this page. The bed of this fine machine is 20ft. long, and the base is broadened out so as to give great rigidity. Its exact form is seen best in Fig. 1. There are two heads which are entirely independent, being driven by separate gearing at opposite ends of the machine. The gearing consists of a five-step cone and a double-spur gear, giving in all ten speeds to each head. The power is transmitted through two long shafts

angular and vertical adjustment. The worm segment can be used for cutting internal curves. An automatic feed can be applied to the vertical adjustment when required. There are three tables, the form of which is seen in the engraving and in Fig. 1. They are carried on plates hung on the front

boilers is 125 lb., and the full working load is 300 indicated horse-power, the emergency load nearly reaching 2000 indicated horse-power. Superheated steam is employed, a superheater of special form being placed between the two cylinders. The speed when fully loaded is 120, and when light 122 revolutions per minute. The engine has been designed and its manufacture and erection supervised by Mr. J. F. Marshall, of John Fowler and Co., Limited, and it certainly does both him and the makers a large amount of credit. On the occasion of our visit we watched the plant at work for nearly two hours. During this period it worked with hardly a sound. It had been started to work just when its erection was completed, and had run almost continuously ever since, and was, a week ago, doing some twenty-one hours' work a day and driving the whole of the electric tramways in the town, the original machinery being used as standby, and one boiler having been laid off. The valve gear is positive action Corliss without trip of any kind, and the governor is extremely sensitive, and, moreover, fitted with multiplying gear, so that its governing action on the expansion valves is instantaneous. Often and often while we were watching it large increases or decreases of the load, amounting on occasions to from 800 to 1000 horse-power were suddenly thrown on or off in accordance with the exigencies of the traffic. The engine in each case responded without a sound, and while we were observing the tachometer there was never a greater variation of speed than 2 per cent. By listening alone one could not possibly tell that the load was not quite constant, but when closely observed the clean action of the governor could be appreciated. The engine is running jet condensing, the pumps being worked by a bell crank driven off the tail end of the low-pressure piston-rod. The boiler steam passes through the jacket and cylinder covers before it reaches the interior of the high-pressure cylinder. Thence it traverses a superheater supplied with live steam from the boiler, and is then led to the low-pressure cylinder, which is jacketed in its sides and covers. The result is that the steam remains dry right up to the time when it is finally exhausted. An indicator cock on the low-pressure cylinder gave us an opportunity of observing this for ourselves. The steam here was absolutely dry, and there was no water of any kind. In addition to the governor already mentioned there are two further safety governors, one mechanical and one magnetic, to close the main stop valve should the speed or voltage for any reason exceed a specified maximum. In a future edition we hope to give detailed drawings and description of this fine engine.



Figs. 1 and 2—BED AND DRIVING GEAR

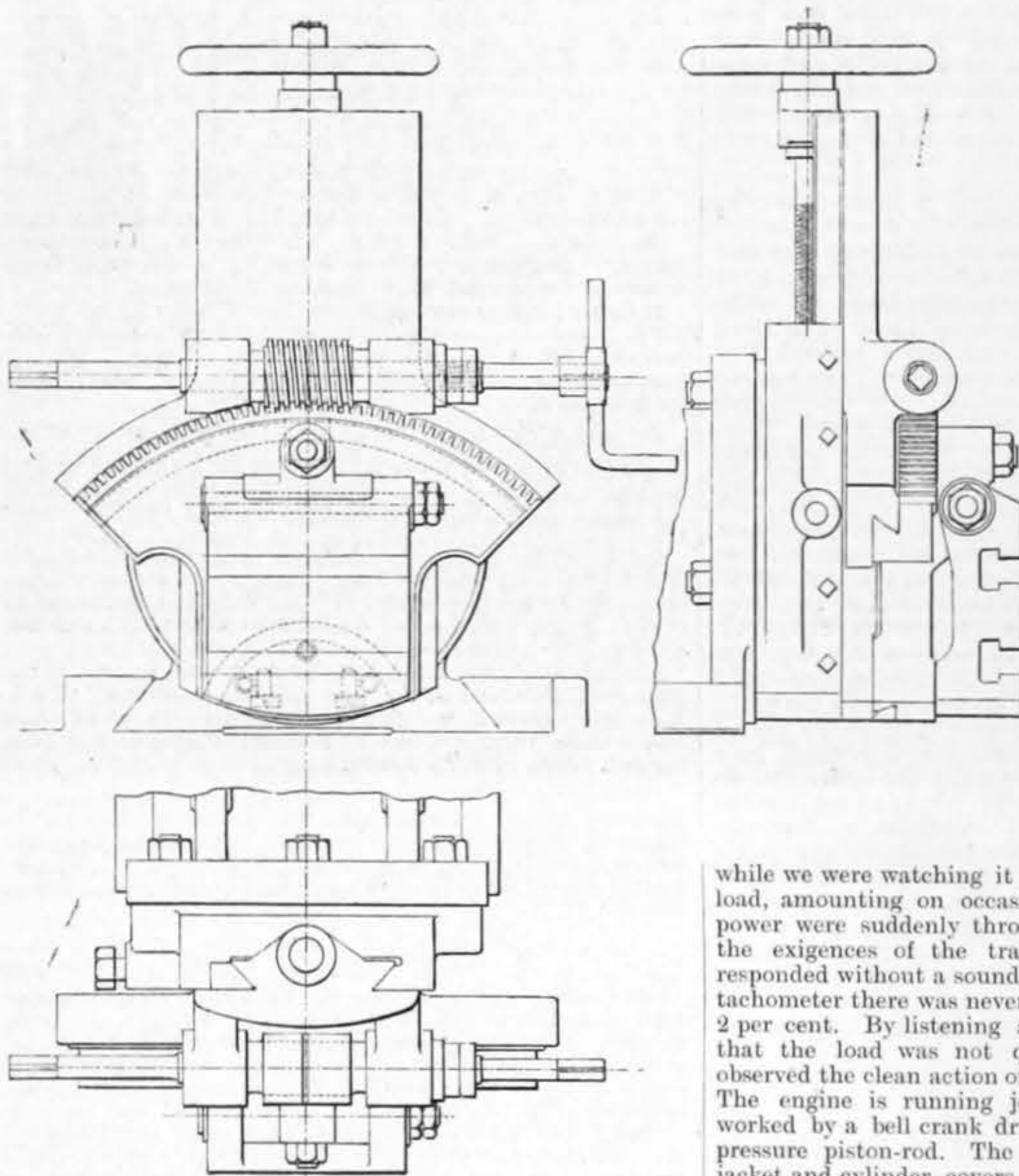


Fig. 3—DETAILS OF HEAD

of the bed, and are moved horizontally by screws fixed in the bed—see Fig. 1—and vertically by bevel wheels and screws fixed in the plates.

## NEW TRAMWAY GENERATOR AT LEEDS.

SOME three weeks ago the Leeds Corporation started their new additional generating plant for the electrical tramways. We have had an opportunity of seeing this at work. The dynamo is multipolar, and has been manufactured by Greenwood and Batley. The engine has been supplied by John Fowler and Co., Limited, and is of the horizontal cross compound type. The cylinders are 29in. and 55in. in diameter, with a stroke of 32in. The steam pressure at the

while we were watching it large increases or decreases of the load, amounting on occasions to from 800 to 1000 horse-power were suddenly thrown on or off in accordance with the exigencies of the traffic. The engine in each case responded without a sound, and while we were observing the tachometer there was never a greater variation of speed than 2 per cent. By listening alone one could not possibly tell that the load was not quite constant, but when closely observed the clean action of the governor could be appreciated. The engine is running jet condensing, the pumps being worked by a bell crank driven off the tail end of the low-pressure piston-rod. The boiler steam passes through the jacket and cylinder covers before it reaches the interior of the high-pressure cylinder. Thence it traverses a superheater supplied with live steam from the boiler, and is then led to the low-pressure cylinder, which is jacketed in its sides and covers. The result is that the steam remains dry right up to the time when it is finally exhausted. An indicator cock on the low-pressure cylinder gave us an opportunity of observing this for ourselves. The steam here was absolutely dry, and there was no water of any kind. In addition to the governor already mentioned there are two further safety governors, one mechanical and one magnetic, to close the main stop valve should the speed or voltage for any reason exceed a specified maximum. In a future edition we hope to give detailed drawings and description of this fine engine.

A NUMBER of signalmen and torpedo-men of the Channel Fleet have joined temporarily the Vernon Torpedo School at Portsmouth for instruction in wireless telegraphy. This system is to be installed on the *Majestic*, *Magnificent*, *Hannibal*, and *Jupiter*, belonging to the Channel Squadron.

which run the entire length of the bed, and on each of which there slides a wheel keyed by a feather which drives large wheels fixed at the backs of the heads. Another screw is used for traversing the heads along the bed. This screw is fixed, and nuts fitted in the heads, and rotated by hand wheels through gearing cause the movement of the heads. A system of cams and ratchet wheels can also drive this gearing to give the feed; the amounts are  $\frac{1}{8}$ in.,  $\frac{1}{16}$ in.,  $\frac{1}{32}$ in., and  $\frac{1}{64}$ in. per stroke of ram. One of the heads is illustrated in Fig. 3, in which part of the ram is also shown. Attention may be directed to the broad wearing surfaces of all the parts. The rams are centrally driven—a distinct advantage—by a Whitworth two-to-one quick-return motion. The arrangement is illustrated in the upper part of Fig. 2. They have a stroke of 32in. The connecting-rods are exactly behind the centre of the tool slides, and are firmly fixed to the driving discs and rams by two  $1\frac{1}{2}$  bolts at each end. The adjustment is made by hand. The tool slides themselves are of cast iron, but the tool holders or clappers are of steel; they have

## TUGELA RIVER NEW BRIDGE—END VIEW OF SPAN

THE PATENT SHAFT AND AXLETREE COMPANY, LIMITED, WEDNESBURY, ENGINEERS



## THE NEW COLENZO AND FRERE BRIDGES.

OUR readers will remember that during the military operations in Natal the bridges over the Tugela River at Colenso and over the river at Frere have been destroyed by the Boers. With wonderful promptitude the Natal Government at once decided not only to give the order for the reinstatement of both these bridges, but to make the new structures of a stronger and heavier type than the wrecked bridges, so that they could withstand the heavier weight of modern and increased traffic. Drawings for such bridges were fortunately in existence, and it remained only to entrust the manufacturer with their construction. With this object tenders were invited, both in this country and in America, and in the result the order for the work was given to the Patent Shaft and Axletree Company, of Wednesbury. This firm undertook to deliver the first shipment of one span in six weeks from the date of the order. The order was given on the 21st of December last, at a most inconvenient time, seeing how near it was to the Christmas holidays. The first span was, as a fact, finished last Saturday, the 13th inst., and deducting Christmas and Boxing days, and three Sundays, the work had actually occupied nineteen working days.

Our illustrations above and on page 66 show side and end views of this one span, the photographs having been taken on Monday afternoon last, just after the structure had been taken over by the Natal Government officials. It will be observed that it had been entirely erected in the company's works. This, of course, represents time, several days at all events, and, as a comparison, we may mention that not only was this not done by the makers of the Atbara Bridge, but that the edges of the plates composing this bridge were not planed or finished. The planing involved in the span of the Tugela Bridge was no less than 7500ft. run. Moreover, this span, as will be the

case with the whole of both bridges, was also painted with Docker's special "Hermator" oxide paint.

There are to be in all seven spans of 105ft. long each. Five of these spans are for the bridge at Colenso, the remaining two are for the river at Frere. Each span will weigh some 105 tons, exclusive of rivets, and there are 69,000 rivet holes to be drilled in each span. Siemens-Martin steel, manufactured at the company's works, is used throughout. In an early issue we hope to give drawings of one of the spans, and shall then enter more minutely into detail than in the present instance. We may say here, however, that the bridges are both identical, saving in the number of spans, that they are 16ft. wide, and are intended to accommodate one line of 3ft. 6in. gauge, with space for pedestrians or horse traffic.

It will be interesting to go somewhat deeply into the manner in which the work has been carried out in such an extraordinarily expeditious manner. We were enabled to gather the following information when we inspected the first span on Monday last:—The order was received at 9 a.m. on December 21st. By 5 p.m. the same day a considerable quantity of material—some 100 tons—had been rolled at the company's works, tested and approved by the Natal Government engineer, and some of the plates were actually on the planing machines. About 100 men and boys have been continuously at work on the order, but though these have worked late, there has practically been no night work. The quickness with which the first span was completed, and the remainder of the work taken in hand—for two spans are now completed and work begun on the third, fourth, and fifth spans, while the whole of the material for the seven spans is rolled, cut to size, tested, and approved—is the result, so we are informed by the company's officials, of the manner in which the workmen have responded to the call made upon them. Every man and boy, from the manager of the bridges department, Mr. Knowles, downwards, having done everything in his power to

further the work. Nothing beyond ingots was in stock when the order was received. The firm had made the original Colenso and Frere bridges in 1877, but the new bridges are, as already mentioned, of different pattern. Hence new templates had to be made, and the men in the template department voluntarily worked right through Christmas. The company is certainly to be congratulated on the promptitude with which the work has been completed, and on having such a staff of workpeople as to render this possible.

## DOCKYARD NOTES.

THE Shikishima, having completed for sea at Southampton, has returned to Portsmouth, reaching Spithead last Saturday afternoon. After doing her final steam, gunnery, and torpedo trials, she will come into harbour, coal, and leave for Japan next week. Her gunnery and torpedo trials are evoking great interest amongst Japanese naval officers, and practically all of them from the other ships now building in this country are at Portsmouth this week.

THE new French naval programme includes the building of ten first-class battleships and ten big armoured cruisers. Work upon the two latest submarines—Narval type—is suspended at present.

THE Dutch naval programme for 1900 provides for building two more second-class cruisers of the Gelderland type. A ten years' programme has been put forward, which includes three improved Evertsens, five of the Koningen Regentes type, and three small monitors armed with 8in. guns in

turrets, three other monitors—these we have heard of before—seven cruisers—Gelderland type—twenty one first-class torpedo boats, twelve small torpedo boats, and fourteen gunboats for the Dutch East Indies.

THE needs of the American navy have been summed up as follows:—For coast defence, 46 monitors, 34 coast defence battleships, 32 cruisers, 26 destroyers, 74 torpedo boats, and 50 submarines. For other purposes, 24 first-class battleships, 50 armoured cruisers, 20 protected cruisers, 26 gunboats, and 84 destroyers—altogether a large order and a tolerably expensive one.

By the time these lines are in print the long-delayed Pandora will have been floated out at Portsmouth, and hopes are locally entertained that she will be ready for her trials by the summer of 1903.

THE Admiralty have ordered the Drake to be expedited and launched as quickly as possible, a course against which the authorities at Pembroke dockyard are said to be protesting, as experience has shown that to launch ships in an early stage at that yard eventually delays them, owing to the difficulty in armouring them afloat. Rapid completion of ships is not, however, the forte of the present Admiralty, to get them into the water as quickly as possible—save always in the case of the Pandora at Portsmouth—is the thing they like. It swells the total of "ships launched and completing," and serves to impress the nation. Hanky-panky has not yet quite retired from Whitehall and Spring-gardens.

QUITE a number of newspapers now contains letters advocating armour-protected troops—a question to which THE ENGINEER has already referred. The prime difficulty, as we have pointed out, is how to transport the armour. A report—to which, however, we hardly feel disposed to attach much credence—is going round to the effect that Russia—which generally sees the newest thing—is questioning the advisability of armouring sailors serving the guns of such ships as the *Rosia*. The idea is that small particles of shell and burning powder could thus be kept out, at the cost of a slightly reduced rate of fire perhaps. The moral effect would be great, no doubt, as 3-pounder and 1-pounder shells would thus be discounted unless they actually hit a man. In the old days our knights in armour used to go afloat; it will be curious if the ancient idea of armouring the hull—for this idea is old as the hills—is supplemented by the armoured men of old time. Should the ship sink, of course they will drown; but so probably will everyone else in the ship that goes down. In a modern naval battle it is absolutely certain that there will be no rescue of the drowning. It will be quite impossible.

THE cruiser *Pique* is to be commissioned at Devonport on the 15th of February for service on the China station. At Chatham the *Blenheim* is being brought forward for service.

THE new destroyer *Electra*—from Clydebank—has successfully passed her official trials at Portsmouth.

THE *Kent*—of the 9800 tons Essex class—will be "laid down" at Portsmouth on February 1st. At Devonport a third-class cruiser of an improved *Pelorus* type is to be laid down at once. At Sheerness two sloops, the *Espiegle* and *Fantome*, are to be commenced. They will be twin-screw, of 1075 tons, 185ft. long by 30ft. broad, and armed with six 4in. quick-firers. They will, of course, have no fighting value, being intended for "police duty."

THE French cruiser *Tage* is being "transformed" again. This time it is to remove all the woodwork, an operation that has necessitated pulling her to pieces almost. She is to be re-boilered and re-engined, so that coupling this with a previous re-construction, she will nearly approach the proverbial Irishman's gun. Little of the original *Tage* save the shell can now remain. The ship and her engines were fully illustrated in THE ENGINEER some years ago.

THE current *Le Yacht* contains a photograph of the Russian gunboat *Giliak*, with a descriptive article that follows tolerably closely one that we gave in this column some weeks ago. There is also an article on French cruisers, and an article concerning the American submarine boat *Argonaut*.

## GUNS FOR THE WAR.

WE wish to correct a mistake which crept into our description of "Guns of Position, and Siege Guns for the War," January 5th, page 6.

By a slip the gun in Figs. 1 and 2 was called 4.7in. instead of 5in., and this was carried into the text. As correctly stated in the article on "War Material," page 21, the 5in. gun is mounted on the 40-pounder carriage, and the 4.7in. on that of the 6in. howitzer, and the cuts are correctly drawn for this.

## TENDERS.

### PEMBROKE DOCK.

For the following materials and works, for the drainage of Pembroke Dock—northern outfall—for the Pembroke Town Council, viz., 750 yards run 2ft. 6in. cast iron outlet pipes, 840 yards run 7ft. by 6ft. storage culvert, 450 yards run 3ft. 6in. by 2ft. 4in. brick sewer, 8500 yards run earthenware pipe sewers or thereabouts, together with manholes and other contingent works, and the erection of a pumping station with engines, pumps, and rising main complete. Beesley, Son, and Nichols are the engineers for this work.

	£	s.	d.
Pethwick Bros., Plymouth	35,725	0	0
E. Powell, Pontypidd	31,960	0	0
B. Cooke and Co., Westminster	31,583	0	0
Geo. Osenton, Westerham	30,567	0	0
W. L. Meredith, Gloucester	30,053	2	9
Thos. Taylor, Pontypidd	29,902	15	9
J. and T. Binns, Portlisshead	29,750	0	0
F. G. Bugbird, Penygroes	29,500	0	0
James Dickson, St. Albans	28,871	0	0
Wm. Underwood and Brother, Dukinfield (accepted)	28,300	0	0

## LETTERS TO THE EDITOR.

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

### WEAPONS AND WARFARE.

SIR,—The flood of criticism, which threatens to swamp the English Government, the English War-office, and the English army, appears to me to be unreal, frothy, and lacking in usefulness. Possibly I shall not do better than some of those whom I presume to answer; yet I fancy that what I have to say may possess such small value as may be claimed for that which has not been said before, and is intended at least to direct thought into a new channel.

Nothing seems to me to be easier than to sit in a chair and dictate to a typewriter that which comes uppermost in a mind astonished by the sequence of events unanticipated, and outside the limited experience of the author. That which seems to come uppermost in Fleet-street is the notion that our generals ought to have known all and everything about Boers, their weapons of war, and their methods of fighting; and it has been argued, even by the more temperate, that however ignorant we might be about Boer guns, we ought to have thoroughly understood what our own guns can and cannot do. Now much of this seems to me to be nonsense; and it is written because the writers have not taken thought. They may rest certain that there is a cause for everything, and they ought to have sought out this cause, and not finding it, foreborne to animadvert. No doubt all the facts will be made known by-and-by, and criticism should for the moment be confined to such acts, operations, deeds, failures, and successes as are understood, and the purport, method, and result of which are fully comprehended.

To illustrate my meaning, I will take the question of the merits of our larger weapons of war. We have sent guns to do some particular work, and the guns have not done it. Had we any possible means of knowing beforehand whether they would or would not? The answer must be that the effects of shell fire, for example, on the ground occupied by the Boers must be a matter of conjecture, simply because this is the first time shells have been tried under the special conditions. I am sure you would not care to cumber your space with all that might be said on this point. The experience acquired in India and elsewhere may be cited; but my answer is that all experience of that kind is just as likely to be misleading as leading. It is a recognised fact that even apparently minute differences in the character of the ground which it is attempted to clear by shell fire, will so modify the effects that they may mean failure or success to the people using the shells. Again, we have rifle fire. About the effects and power of that, again, next to nothing is known. In the first place, target firing only teaches one thing. The shooting at dummy men teaches another thing. Neither teach us anything of what the rifle will do in a sharp action. For the very reprehensible and unpleasant practice of "sniping" a Bisley experience is valuable. For the rest let me quote a few words from Charles Lever's "Charles O'Malley." O'Malley was going to fight a duel, and his second asked him what kind of shot he was. "I can break the stem of a wineglass at fifteen paces," was the reply. "That is all very fine," said the second, "but the wineglass had not a pistol in its hand." All which means that men are certain to become excited in battle, and that under the conditions old "Brown Bess," if only she had been a breechloader, would have beaten the best small bore of the present day.

Next we are told that our sham fights must have taught us much. That is quite possible; but they did not and could not teach us to fight the Boers. None of these sham things take count of the man behind the gun. From first to last the war is being fought with untried weapons, so far as active, special, real fighting is involved, under wholly novel conditions, and no one knows more about the matter than our own officers and soldiers. Whenever the Germans and the French fight with smokeless powder, lyddite, and quick-fire guns, they will find themselves in just the same plight, except in so far as they profit by our South African lessons.

The main object I have in view, Sir, in asking for space in your correspondence columns, is to call attention to a fact which is, perhaps, well known, but never insisted on, and usually overlooked. I mean the great truth that the value of all weapons of war, and methods of fighting, depend entirely on their adaptation to their environment. We can no more make a special system succeed under adverse conditions than we can grow bananas on a Lothian farm, or fatten prize oxen in Klondyke. It is not necessary to cite examples. The history of all wars—that is to say, the history of the world—is full of them. That army will succeed that best complies with the conditions dictated by the environment. It is, of course, possible to starve out an army or wear it away by a natural process of attrition; but such process does not represent a military, or, perhaps, I ought to say, a fighting success.

Now the success of the Boers so far has been wholly due to their intense adaptation to their environment. They are not, in the proper sense of the word, soldiers at all. They have no drill worth the name. A Boer army is a collection of undisciplined fighting men. Given an open country, and I have not the smallest doubt that a moderate English army would sweep them off the face of the earth. But Tommy Atkins is by no means suitable to the environment of the South African broken country. There was a time when poor Tommy would have gone to fight the Boers with a stiff leather stock round his neck, and a knapsack like a small chest of drawers on his back. We have got the better of all that. But a great deal still remains to be done to fit him for his environment. The "hardy mountaineer" is a stock phrase, and we are told in history over and over again how this same hardy mountaineer has beaten the best troops in the world. He has done so because he was adapted to his environment, and the troops were not. A striking example of the influence of environment fully recognised and potentially operative, is supplied by the Navy. Jack is perfectly adapted to his work; and as his environment in a manner changes from day to day, and place to place, climate, motion, nothing constant; so we see how wonderfully well he "adapts himself," to use another stock phrase, "to his surroundings." That is the reason that Jack has been so useful already in this war.

Now, it seems to me that much of the criticism which I call unintelligent, springs out of an overlooking of the truths I have endeavoured to state. We have put armies in the field which are in no way adapted at first to their environment. But no one is to blame for this. We have no other armies to use; nor do I suppose for a moment that the newspaper men who now bang their desks with their fists, and call all their gods to witness that the War-office is run by imbeciles, had the smallest idea that the troops which filled our great transports would be unsuitable; if they thought so, they kept their thoughts to themselves.

The leader writer who now denounces everyone and everything either knew the facts long ago, or he did not. If he did, why has he held his tongue? If he did not, why denounce the War-office? It will not do to defend him on the plea that it was not his business to know. That is a line of defence which no contributor to a daily paper will accept for a moment. He will tell you that it is his business to know everything. But this is a digression, useless enough perhaps, yet reminding.

What we have obviously been doing for the last hundred days or so is to adapt our methods of fighting to the environment. We have been learning. We have had certain costly lessons. All teaching, even that of the Board School, is terribly expensive. The world has learned for the first time what the modern quick-fire weapon, large or small, can do, and, what is more to the point, what it cannot do. We have three classes of artillery—to wit, Horse Artillery, very light and mobile; Field Artillery, more weighty and powerful, and slower in its movements; and guns of position, of which the 4.7in. is a type. One result of this war will be, I think, an energetic attempt to produce a 4.7in. gun which

can be moved with reasonable alacrity. Wire may yet do much in the direction not now dreamed of. I am certain that changes will be made in shells—possibly in the direction of ensuring that, no matter how they are fired, they will burst.

But I fancy the principal change that will be brought about will be the formation of armies suitable to their environment, and not moulded on one pattern. The great defect of the War-office has been, I think, the endeavour to mould all our soldiers on the same pattern. There has been a certain amount of diversity, but it comes more by chance than good guidance. No doubt for several years to come we shall have to maintain a standing army in South Africa. That army ought to be modelled on lines quite different from those hitherto recognised as orthodox, to the exclusion of all others, in Pall Mall. Far be it from me, a civil engineer, to hint, even in a sentence, what the War-office's great men ought to do. But I shall be much surprised if Roberts and Kitchener do not come back full of excellent ideas based on facts; and it must not be forgotten that not the men alone, but the weapons of war, must be carefully adapted to the environment. If the country is so difficult that a big gun cannot travel on its own fighting carriage, then let it be provided with a travelling carriage as well. Marryat tells us in one of his novels how in a certain siege it became all-important to get a 9 lb. ship's gun up to the top of a steep hill commanding the town. The soldiers could not do it. But a sailor suggested that the gun should be packed with tow into a large hoghead, well hooped, and that this hoghead should be parbuckled up the hill. This was done, and the place surrendered. Jack adapted the gun to its environment. The flying bridges put up by our Royal Engineers are excellent illustrations of what I mean. Another is supplied by the Indian screw guns. These are not made in two pieces the better to kill men, but in order that they may be taken up the mountains where the men to be killed fight.

To conclude this too long letter. Let me repeat that the reason why we have so long been unsuccessful is not the fault of officers or men, but the unfitness of our armies at the outset to the environment. Even if the War-office had known all the conditions, there was no help, because it had to send the troops it had got. It is more than doubtful if more could have been done with them than was done at the time.

Bismarck is credited with saying that for England to fight Germany would be like a whale fighting with a lion, and someone else has said that the only reason why we could not help the Greeks in their war with Turkey was that we could not send an ironclad up country. We have been in very much the same position with the Boers; our armies have been as unfit for operation on the veldt as an ironclad would be for putting down a border fray. But the time lost at Ladysmith has not been wasted. French has taught us a lesson. Our "surprises" and "accidents" have been lessons, not defeats; we learn slowly but surely, and the War-office already begins to recognise the value of those incomparable light horsemen supplied by our Colonies—troops in perfect accord with their environment. The lesson taught will not be without value, and I shall be greatly astonished if one of the first results of the war is not a new departure in the mobile artillery, which constitutes our most important weapon of war.

January 15th.

A MAN IN THE STRAND.

### LOCOMOTIVE MILEAGE.

SIR,—In a recent letter on locomotive work in England and America I ventured to challenge your calculation on the cost of American locomotives per mile run, and to point out that American locomotives habitually made a mileage four or five times that usual in this country. In the "Proceedings" of the Western Railway Club for November last, I have just come upon some figures which may be of interest to your readers. Engine mileage per month of various engines is given as follows:—7688, 7228, 7316, 6014, 5648, 5702, 9657, and 10,170 miles. One speaker mentioned that two engines were doing the work recently done by four; another said that thirty-seven engines were doing the work for which fifty-two had formerly been employed. That English engines also can run 8000 miles a month continuously has been sufficiently proved by Mr. Webb with the "Charles Dickens," but "Charles Dickens" has, as far as I know, no imitators.

18, St. James's-place, S.W.

W. M. ACWORTH.

January 13th.

[Mr. Acworth's criticisms lose all force, because he does not give the faintest notion of what he means by train miles. Before any useful deduction can be drawn, it is essential that there shall be a common basis of definition. We are afraid Mr. Acworth has not got sufficient data before him to state with any degree of accuracy the mileage run by engines in this country, as the profitable train miles only appear in the reports. This last half-year the London and North-Western engine mileage has been over thirty-eight millions. Nearly all the main line passenger engines are double-manned, including the whole of the four cylinder engines, and some of these engines are running over 8000 miles a month, which we think will compare very favourably with American engines or those of any other country.—ED. E.]

### THE SURREY IRON RAILWAY.

SIR,—Mr. Arthur Kinder is evidently unaware that there were two tramways worked in connection with each other, but separate concerns all the same.

The Surrey Iron Railway could not possibly have gone to Coulsdon lineworks, as it only ran from Wandsworth to Croydon. Another line ran from Croydon to Merstham chalk pits and lineworks through a cutting, and it is doubtless that Mr. Kinder remembers. Both railways were double lines throughout. I venture to doubt if Coulsdon lineworks were ever connected with the old tram, which is on a much higher level at the other side of the valley.

It is stated that the tram crossed the Brighton road by an arch, at about 16½ miles from London. Possibly a level crossing was substituted after a time by altering the road or railway, or both.

6, Rawlings-street, Chelsea, S.W.

January 15th.

W. B. PALEY.

### CAMBERED PISTON-RODS.

SIR,—We read in your newspaper of January 12th the description of a 2000 indicated horse-power compound mill engine, and take liberty of begging you to notice that in 1892 we took a patent for such a disposition of piston-rods. But we bend them in such a manner that they are straight when running.

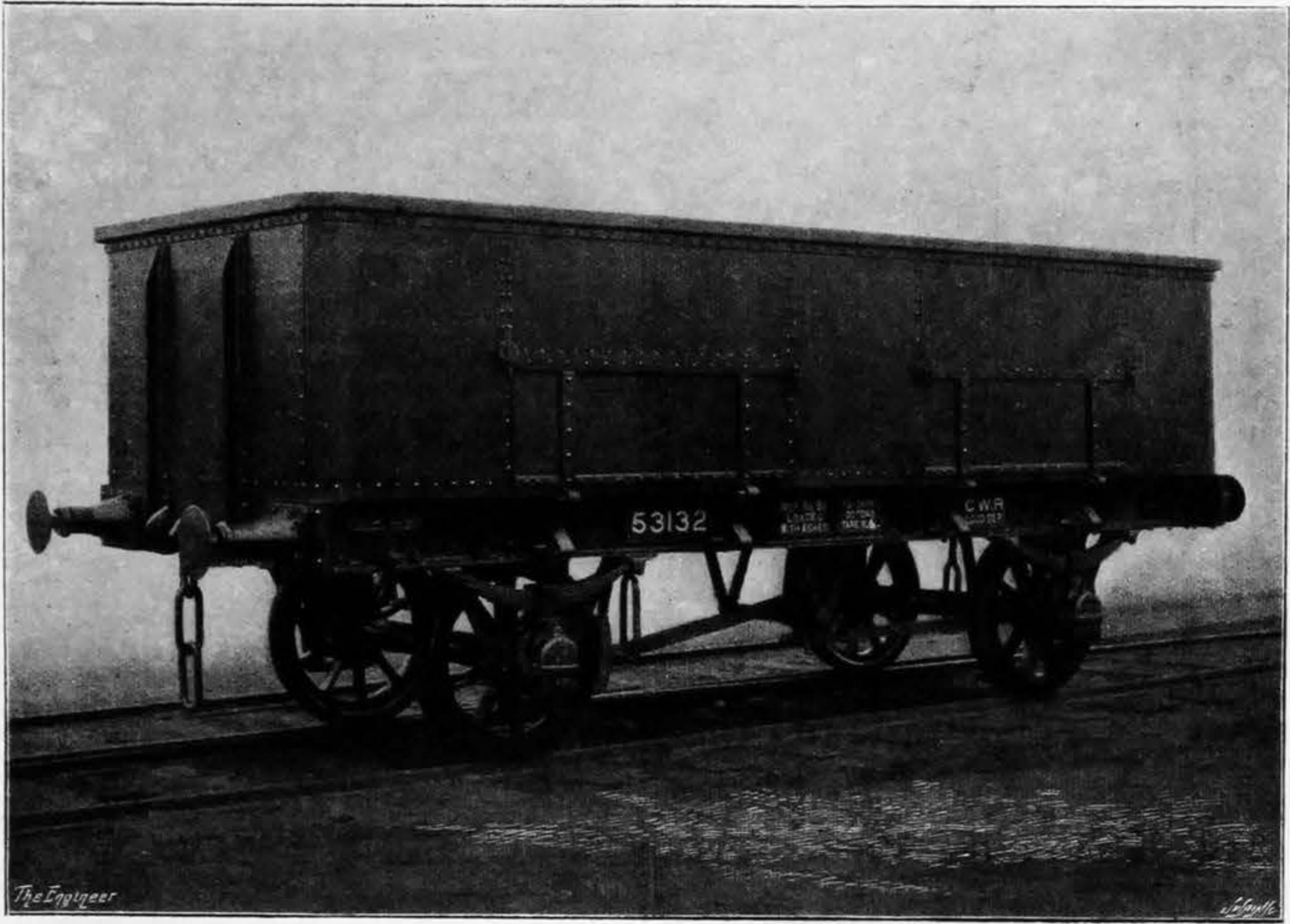
Chaussée de Mons, 95, Anderlecht,

Bruxelles, January 16th.

H. BOLLINCKX.

THE Bill which has been deposited for next session by the Metropolitan District Railway Company, amongst other objects seeks powers to work by electricity certain railways owned or used by it. For this purpose it is proposed to erect a generating station near Lots-road, Chelsea, and to lay cables from the generating station to the railway of the company at West Brompton and Earl's-court stations. The company ask for permissive power to work by electrical power the traffic on their existing railways, or any of them, and on the City lines and extensions railways of the company and the Metropolitan Company, and on any railways of the Metropolitan Company which the company are authorised or empowered to run over. It is, however, provided that these powers shall in no way prejudice the right of the Metropolitan Company to run over the Inner Circle Railway.

TWENTY-TON COAL WAGON, GREAT WESTERN RAILWAY



TWENTY-TON COAL WAGON.

We said in a recent impression that the Great Western Railway Company was trying some 20-ton coal wagons. Special attention is being devoted to this subject now, and by the courtesy of Mr. Dean we are enabled to give an illustration of one of these wagons. The following tabular statement supplies all the dimensions:—

Body—	
Length in clear	19ft. 11½in.
Width in clear	7ft. 1½in.
Depth in clear	4ft.
Thickness of side plates	¾in.
Thickness of floor plates	1in.
Doors	3ft. 2½in. x 2ft.
Number of doors	four
Frame—	
Length over headstocks	20ft.
Width over headstocks	7ft. 9in.
Wheel base	12ft.
Sole bars	Channel section 12in. x 3½in. x ½in.
Headstocks	12in. x 3½in. x ½in.
Cross bearers	12in. x 3½in. x ½in.
Longitudinals	9in. x 3in. x ½in.
Diagonals	9in. x 3in. x ½in.
Wheels and axles—	
Diameter of wheels	3ft. 1in.
Journals	10in. x 5in.
Wheel seat	6½in.
Middle of axle	6in.
Axle centres	6ft. 6in.
Springs—	
Length of spring	3ft. 7in.
Number of plates	six
Size of plates	4in. x ½in.
Camber	5in.
Axle-boxes	G.W.R. standard O.K. oil axle-box
Brake	Thomas' patent either-side brake

CONTRACT OPEN.

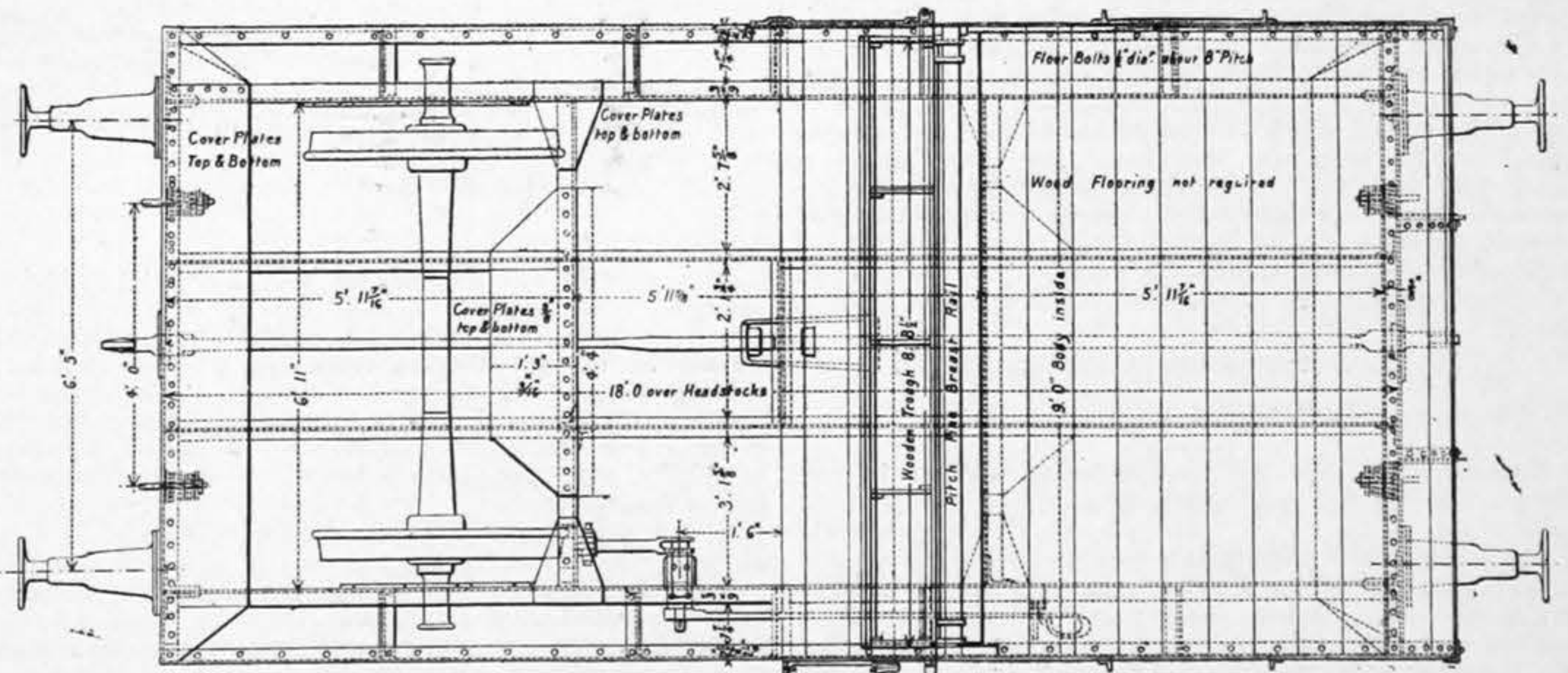
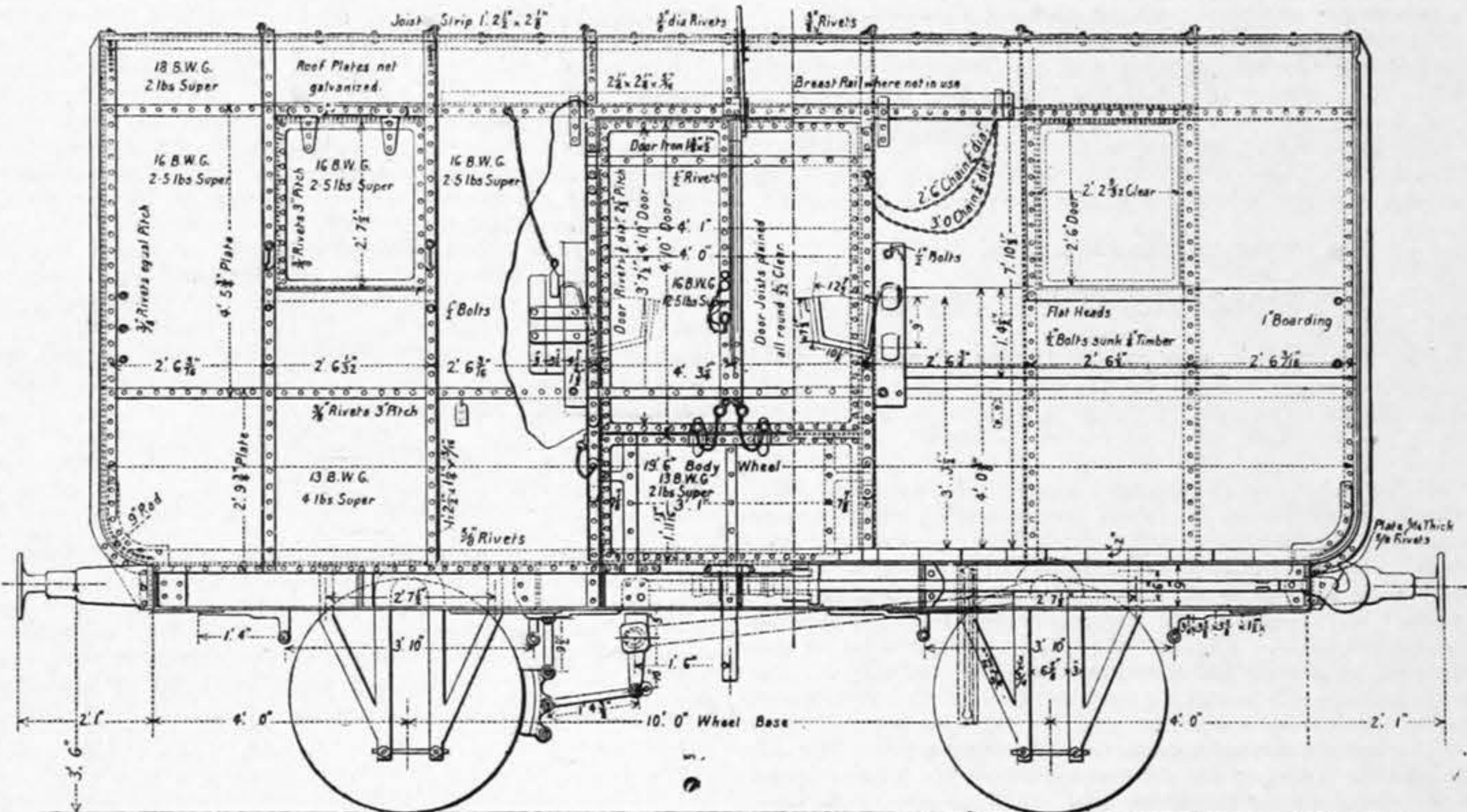
INDIAN STATE RAILWAYS.

THE Secretary of State for India in Council is advertising for tenders for the following:—Two hundred covered goods wagons with wheels and axles, axle-boxes, and springs complete; woodwork, axle-box brasses, and leather shields are not to be supplied. Alternative-covered goods wagons, similar to the above, with wheels and axles, axle-boxes, and springs complete, but with pressed steel underframes. Firms tendering are to submit with their tender a drawing of the frame they propose to supply for the North-Western Railway 5ft. 6in. gauge. Sixteen covered goods wagons with wheels and axles and springs; woodwork, axle-boxes, and brasses, horse wagon fittings, side brake, top door fastening on roof, and flap door spring not to be supplied. These are for the Ghaziabad Moradabad Railway, 5ft. 6in. gauge. All fastenings, bolts and nuts, rivets, washers, &c., for erecting in India, together with an allowance of 20 per cent. extra for waste, to be included in contract. Basic Bessemer steel is not to be used under any circumstances. All draw-bars, with hook and nuts complete, cradles, safety chains, with their hooks, eye bolts, and nuts complete, couplings complete, and coupling shackles and pins, are to be made of best Yorkshire iron. No iron or steel of foreign manufacture is to be used. The contractor is to name in his tender the firms from whom he proposes to order the axles, tires, axle-boxes, springs, and Yorkshire iron.

The roof sheets of the covered wagons are to weigh before galvanising not less than 1½ lb. per square foot, and after galvanising not less than 30 oz. per square foot, and are to be corrugated after they are galvanised. The steel of which the axles and tires are made must be made by the open-hearth acid process, from the purest brands of English hematite or Swedish iron, and not more than 30 per cent. of scrap steel must be used in its manufacture. The ingots may be clogged down before being forged into finished axles.

The wrought iron wheel bodies are to be made of Kirtley's rolled spokes and rims; the spokes are to be welded up in one mass at the boss, and a circular washer of wrought iron solidly welded on each side. The axles chosen for testing are to be placed in bearings 3ft. 6in. apart on a solid foundation weighing at least ten tons, and must sustain without fracture ten blows from a 20-cwt. "tup" falling from a height of 30ft.,

the axle being reversed after the first blow, and then after every second blow. The tires chosen for testing are to be placed in a running position, with the tread resting on a solid metal foundation, and a weight of 20 cwt. will be allowed to fall freely on the tread from heights of 10ft. and upwards, until the deflection of the tire amounts to one-sixth of the internal diameter. The tested tire must show no signs of failure under this test. On complete analysis the carbon



must not exceed .65 per cent., or be less than .55 per cent. The phosphorus (exclusive of arsenic) and the sulphur must not be present in greater proportions than .035 per cent. each, arsenic must not exceed .02 per cent. The manganese must not exceed .75 per cent., and the silicon must not exceed .35 per cent. Should the analysis show carbon, silicon, phosphorus, sulphur, arsenic or manganese in the steel in excess of these maxima, the whole batch will be rejected. The wheels are not to be pressed on their axles except in the presence of the inspector, and in all cases the wheels are to require a pressure of not less than 60 tons or more than 70 tons to force them on the axles. The wheels

are not to be pressed on at night. The remainder of the specification is as usual. Tenders are to be in by 2 p.m. on Tuesday, 23rd January, 1900, marked "Tender for Wagons."

NAVAL WORK OF THE ELSWICK SHIPYARD IN 1899.

In our *résumé* of the naval work in English shipyards and engine factories in 1899, given in our issue of December 29th ult., we were unable for the moment to give that effected by Sir W. G. Armstrong, Whitworth, and Co., at the well-known works at Elswick. We now have pleasure in supplying the omission.

Of the vessels completed out of hand during the past year there were the two first-class armoured cruisers, Asama and Tokiwa, built for the Imperial Japanese Government; they are each of 9700 tons displacement, fitted with twin-screw triple-expansion engines of 20,000 indicated horse-power, and cylindrical boilers by Humphrys, Tennant, and Co., of Deptford, and attained a speed of 23 knots. The two second-class protected cruisers, Hai Tien and Hai Chi, built for the Imperial Chinese Government, each having a displacement of 4500 tons, fitted with twin-screw triple-expansion engines of 17,000 indicated horse-power, and eight cylindrical boilers by Hawthorn, Leslie, and Co., of Newcastle. These vessels on trial realised a speed of 24 knots.

For the Royal Portuguese Government there was built and completed the second-class protected 22-knot cruiser Don Carlos 1st, a vessel of 4280 tons displacement, fitted by the firm last mentioned with triple-expansion twin-screw engines of 12,500 indicated horse-power and water-tube boilers of the Yarrow type; and for the Chilean Government the training ship General Baquedano, of 2300 tons displacement, having single-screw six-cylinder triple-expansion engines of 1500 indicated horse-power and Belleville water-tube boilers, also fitted by Hawthorn, Leslie, and Co. This vessel is fully equipped and rigged as a sailing ship.

There are also undergoing their steam trials the following vessels, built at the Elswick Works:—The United States cruiser Albany, of 3440 tons displacement, with triple-expansion twin-screw engines and cylindrical boilers of 7500 indicated horse-power, by Hawthorn, Leslie, and Co., to drive the vessel at 20 knots an hour; and two torpedo boat destroyers, one engined by the Wallsend Slipway and Engineering Co., with engines of the usual "destroyer" type; and the other by Parsons Marine Steam Turbine Co., with their compound turbine motors; the former vessel being expected to attain a speed of 30 knots, and the latter 35 knots an hour.

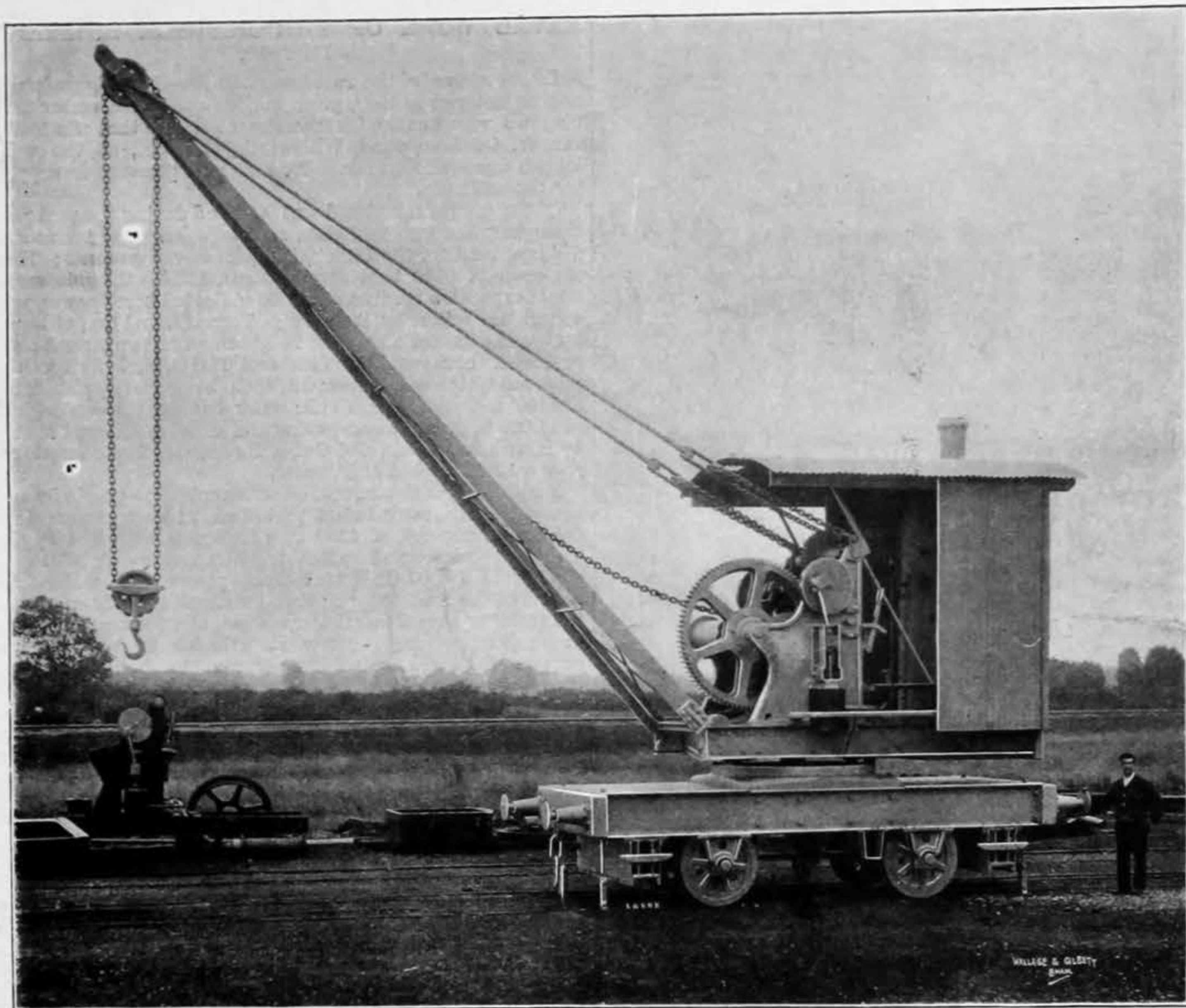
Five other large vessels are in hand at the Elswick Works, viz.:—The battleship Hatsuse, for the Imperial Japanese Government, which is of 15,000 tons displacement, to be fitted with twin-screw triple-expansion engines and Belleville boilers of 14,500 indicated horse-power, by Humphrys,

Tennant, and Co. This vessel is launched, and is now receiving her machinery and being fitted out for sea. The Idzumo and Iwate, first-class armoured cruisers for the Japanese Government, are each of 9800 tons displacement, have the same type and power of engines and boilers as the battleship Hatsuse, just mentioned, and supplied by the same firm. The Idzumo is launched and now receiving her machinery and being equipped for sea, and the Iwate is on the stocks, and ready to receive her armour.

There are also in course of construction at Elswick two Norwegian armour-clads, to be named the Norge and Eidsvold, intended for coast defence ships; the former is framed

## LOCOMOTIVE STEAM CRANE

BEDFORD ENGINEERING CO., BEDFORD, ENGINEERS



and plated, and the latter partially plated. They are each of 3850 tons displacement, and will be engined by Hawthorn, Leslie, and Co. with twin-screw engines of 4500 indicated horse-power, and boilers of the modified Yarrow type.

In common with all other firms in the United Kingdom engaged in the shipbuilding and marine engineering industries, the business of Sir W. G. Armstrong, Whitworth and Co., during the past year was much interfered with by the difficulty in obtaining material, and certain classes of labour. Apart from these delays, it will be seen from the foregoing record of work accomplished, that fair progress was made.

## LOCOMOTIVE STEAM CRANE.

We give on this page an illustration of a steam crane, involving many modern improvements, which has recently been built for the London and South-Western Railway Company by the Bedford Engineering Company, of Bedford, from their newest 10-ton patterns. The carriage is of steel, carrying a centre casting and having the axle and other brackets bolted to it. The steel-tired travelling wheels are 3ft. diameter, mounted upon 6 $\frac{1}{2}$ in. axles, and provided with steel bevel gear for driving both axles. Buffer beams and spring buffers, with draw-hooks and chains, are fitted, and the cross girders are arranged for housing when not required for maximum loads. The revolving bed is constructed of steel girders, supporting the necessary transoms for carrying four anti-friction rollers and for the reception of the forged steel post, which is 11in. diameter and 7ft. 8in. long, bored through the centre for the passage of the travelling shaft. The side cheeks are bolted to the girders, and connected by a transome which receives the top of the post. All motions for hoisting, slewing, derricking, and travelling are taken direct from the crank shaft, no second-motion shaft being used. Both the hoisting and derrick barrels are loose upon their shafts, and the latter are fixed between the side cheeks so as to act as stays. All gearing is of ample strength for the work required, as an example of which it may be stated that the hoisting wheel is 24in. pitch, 54in. wide, bored 13 $\frac{1}{2}$ in., and bolted on to a 14in. barrel. The crane has ample bearing surfaces where necessary, and is provided with efficient means of lubrication. It will easily lift its maximum load at the rate of 60ft. per minute, and travel at the rate of five miles an hour. The total weight of the crane, without fuel or water, is thirty tons.

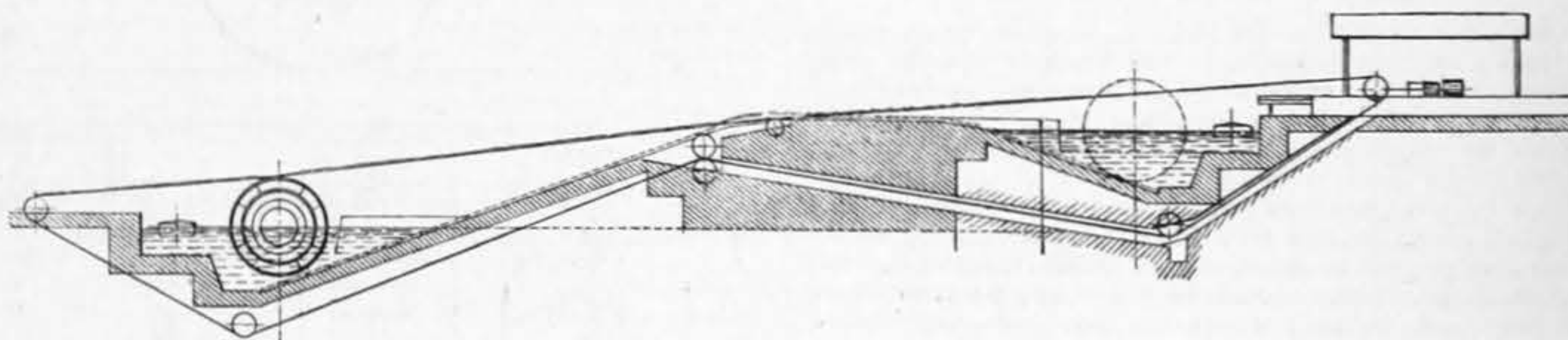
## ENGINEERS AND CHINA.

ENGINEERS in the chief manufacturing centres of Great Britain have good reason to hope for increased orders in the near future from China. The official report which the Chinese minister to this country is commissioned to present to the Emperor as the result of the industrial tour upon which the minister has recently been engaged, is almost certain to be progressive in its recommendations; and that the Emperor is getting more and more favourable to Western commercial methods is very evident from the startling public announcement which Sir Chihchen Lofengluh was able to make a few days ago, to the effect that it has been definitely decided to establish in China a number of chambers of commerce upon similar lines to the English chambers. Such a step cannot fail to foster internal commerce and add to China's material prosperity, with the probable result of increasing Chinese requirements for the assistance which in so many ways English engineers are so able and willing to afford. Our machinery shipments to China are already increasing; during the past year the British shipments of textile machinery to that country—including Hongkong—attained a value of as much as £190,261, as against £116,741 in the previous year, or an improvement of £73,520. The

new total was also better than 1897 by £47,874. It is a pity that the Board of Trade returns do not specify China among the markets to which the various other classes of machinery are sent, including mining, agricultural, and other sorts. This remark applies also to steam engines. China is becoming more and more important to English machinists and engine builders, and monthly statistics showing how the trade is progressing would be very welcome. It speaks well for increased railway enterprise in the Celestial Empire that our steel rail exports have increased in value from £66,351 in 1897 to £72,778 in 1898, and to £82,389 in 1899. China's requirements in bar, angle, bolt, and rod iron rose in value from £34,716 in 1898 to £67,923 in 1899. Last year took as much as £129,039 worth of "old iron and steel for re-manufacture," which was rather less than in the preceding year, but nearly £40,000 better than in 1897. Clearly China is a market well worth cultivating, and British manufacturers have acted wisely in giving the Chinese minister a hearty welcome at their various works.

## A NOVEL CANAL LIFT.

A DESCRIPTION of a proposed canal lift was recently presented to the Austrian Society of Engineers by Prof. Czischek and Herr Tentschert. The idea at the base of this novel arrangement will be readily understood from the diagrams given below. The two levels of the canal are connected by an inclined plane built up of masonry. Four parallel rails are laid up this plane. A long circular



steel drum, open at both ends, rests on these rails, and has the ends of two ropes attached to it, at two or more points. The ropes are laid as shown round guide pulleys and on to a windlass. When the drum is in the position shown in the engraving, the upper rope is wound up on it, whilst the lower rope is unwound. By pulling on the upper rope the drum is caused to revolve and rolls up the plane. A system of weights, which roll down a tunnel parallel to the face of the inclined plane, and is connected by other ropes with the drum, effect a balance. The drum, as we have said, is open at both ends, but it is partly closed by an annular ring, so that it will in any position hold an amount of water sufficient to float a barge. It is obvious that the ingress and egress of the latter is very easily effected, and the system under certain conditions might prove feasible, but, as a rule, in such cases as it would be fitted to deal with, locks would be more cheaply installed and more simply worked.

## THE INSTITUTION OF CIVIL ENGINEERS.

## THE PURIFICATION OF WATER.

At the ordinary meeting on Tuesday, January 9th, Mr. Charles Hawksley, vice-president, in the chair, two papers were read. The first, on "The Purification of Water after its Use in Manufactories," by Reginald A. Tatton, M. Inst. C.E., dealt with the seriously polluted condition of the rivers in the Mersey and Irwell watershed, which had for many years been the subject of complaint. Although in some instances works for the treat-

ment of sewage and trade waste had been constructed, the matter had not been taken in hand seriously until the formation of the Mersey and Irwell Joint Rivers Committee in 1891. This authority, which consisted of twenty-four members, representing the County Councils of Lancashire and Cheshire, and the county boroughs in the watershed, was constituted under a Provisional Order of the Local Government Board to enforce the powers of the Rivers Pollution (Prevention) Act, 1876, the application of the Board being supported by the manufacturers, who urged that the work should be taken in hand by a representative central authority, so as to ensure to them uniformity of treatment. In addition to the Act of 1876 the Joint Committee obtained further parliamentary powers in 1892. The author gave tables showing the number of manufactories in each industry from which waste waters of a polluting character were discharged, and a comparison between the number of purification works constructed in 1893 and at the present time. A special description was given of the works at three manufactories where the trade waste was efficiently treated, together with the cost of the works and the annual cost of treatment, and the paper was accompanied by plans and sections of these works. The manufactories referred to were those of R. Clay and Sons, Kelsall and Kemp, and Syddall Bros. R. Clay and Sons carried on the process of ordinary bleaching, dyeing, and finishing, and the works for purifying the trade waste consisted of precipitation tanks and filters, sludge tanks, presses, &c. The volume of water at times amounted to 500,000 gallons per day; it was treated with lime and "iron alum" and settled in tanks in which most of the suspended solids were intercepted; from these tanks the water was pumped to a second series of tanks for further precipitation, and the clear liquor was finally passed through cinder filters to the stream.

Kelsall and Kemp were woollen manufacturers, dyers, and finishers. The trade waste was of a very polluting character owing to the amount of soap used in the scouring processes, and the grease extracted from the wool. The waste containing the grease, &c., was kept separate from the dye-water in the mill, so that it might be treated by itself. It was pumped into a series of three tanks, in which the solids were precipitated by lime and ferric chloride, the clear liquor passing forward through a second series of tanks and filters into the stream; the sludge was discharged on to filters composed of cocoanut matting, and after it had dried sufficiently it was pressed and the oil extracted. The dye-water from the mill, to which was added the clear liquor from the grease tanks when they were being drawn off for cleaning, was settled in a series of tanks, and filtered. The volume of water dealt with was 180,000 gallons per day. Messrs. Syddall Bros. carried on the processes of calico printing, dyeing, and bleaching, and the pollution was caused by alizarine, logwood, and other dyes, soap, starch, &c. The total volume of the trade waste amounted to about 70,000 gallons per day; the water from the various departments was collected to a well, whence it was pumped to the purification works, which consisted of a central settling-tank and two precipitation tanks, used alternately, each of the latter holding a 2 $\frac{1}{2}$  days' supply; iron alum was used as precipitant. The sludge was drawn from the settling and precipitation tanks into a well, and was thence pumped to a sludge-drying area. The water from the precipitation tanks was finally filtered through fine ashes. A description was given of the methods adopted at another printworks in the watershed, where the waste waters from the logwood, indigo, and soap were severally subjected to a preliminary treatment before being sent forward to the precipitation tanks. In the case of the logwood the object of this preliminary treatment was to reduce the cost of treatment in the tanks, as it was found that the concentrated logwood liquor was more easily dealt with by itself than when mixed with other waste. The indigo and soap-recovery plants were remunerative, and should be adopted at all works where possible. This method of treating the different polluting matters separately should receive special attention, as being undoubtedly the most economical and efficient. In addition to the detailed description of the works mentioned above, suggestions were given as to the methods of treatment which should be adopted at bleach works, paper works, tanners' and fellmongers' works, breweries, collieries, and chemical works. The polluting waters from bleach works might be treated by precipitation in tanks similar to those of Messrs. Syddall, and, if convenient, it was advisable to separate the final wash water, to reduce the volume, as that water was usually pure enough to be discharged direct into the stream. The water from the keirs, being highly concentrated, should be collected in a separate tank and discharged gradually into the remainder of the water for treatment. The materials used in paper works varied so much that it was impossible to describe a typical purification plant; if esparto grass or straw was used evaporators should be put down, and the soda ash recovered, the wash water being precipitated in tanks. Precipitation tanks were also required at mills where rags, hemp, &c., were used. The more extended use of wood pulp had materially reduced the pollution. The polluted water from tanneries, fellmongeries, and breweries should, if possible, after preliminary treatment, be admitted into the sewers, but if this was impossible, efficient precipitation tanks, followed by filtration or land treatment, were necessary. The second paper, on "Experiments on the Purification of Waste Water from Factories," by W. O. E. Meade-King, M. Inst.

C.E., was an account of experiments made with a view to arrive at a simple and efficient means of dealing with foul waters after their use in manufactories. Many processes already existed by which these waste waters could be dealt with, and doubtless there were those who would find nothing new in the treatment recommended; but the position of a manufacturer was very different from that of a local authority, who, on being called upon to carry out works for sewage purification, could obtain sanction to a loan for the purpose, the repayment of which was extended over a considerable number of years; whereas the individual could obtain no such sanction, but could be called upon to carry out such works at his own expense. It was therefore an important matter that the most simple process obtainable should be discovered, and it was hoped, if the paper taught nothing new, it would at any rate cause ventilation of the subject, and so be the indirect means of attaining the object in view. It was hoped that comments would be made on the use of salt water as an addition to certain precipitants for the purpose of causing rapid precipitation. The author was not aware that any such treatment had been previously tried; and it was such a simple expedient that, even if it proved a failure when tried on a large scale, its trial could have no injurious effect either on the works or the pockets of the manufacturers. Rapid filtration was considered an essential point owing to the probability of there being only a very limited area in which to put down purification works, and the experiment showed that this could be obtained by having three or four mediums—all of the simplest description—with a space of a few inches between each, so that the liquid, instead of being held up in the filter, had practically a free passage; at the same time it was aerated and was acted upon by the mediums sufficiently to turn out an effluent to all appearance clean and pure, and free from smell.

## METHODS OF COALING SHIPS AT SEA

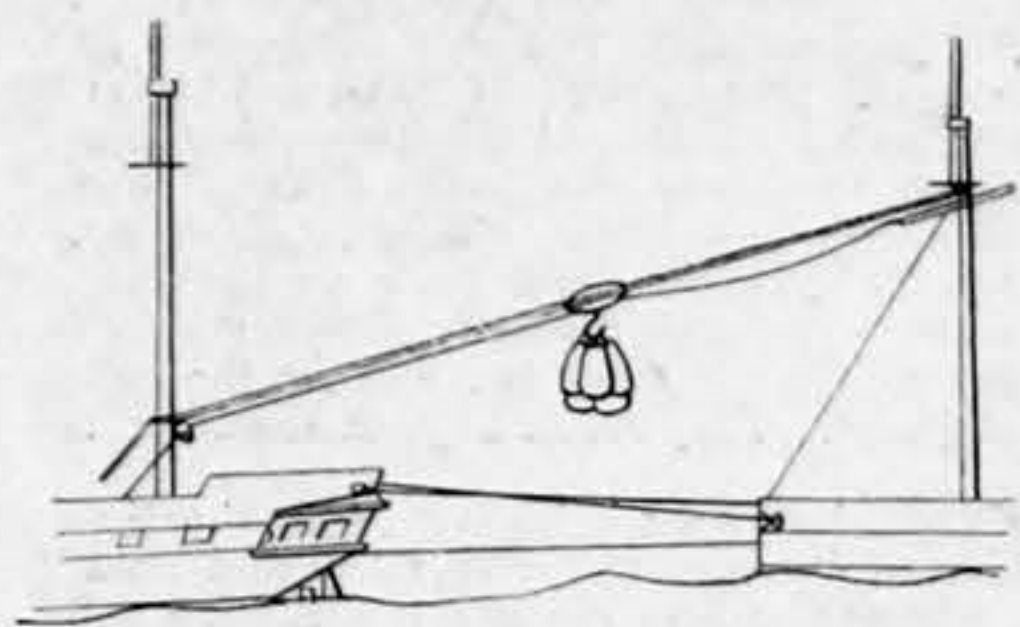


Fig. 1. Lieut. Bell's Plan 1887.

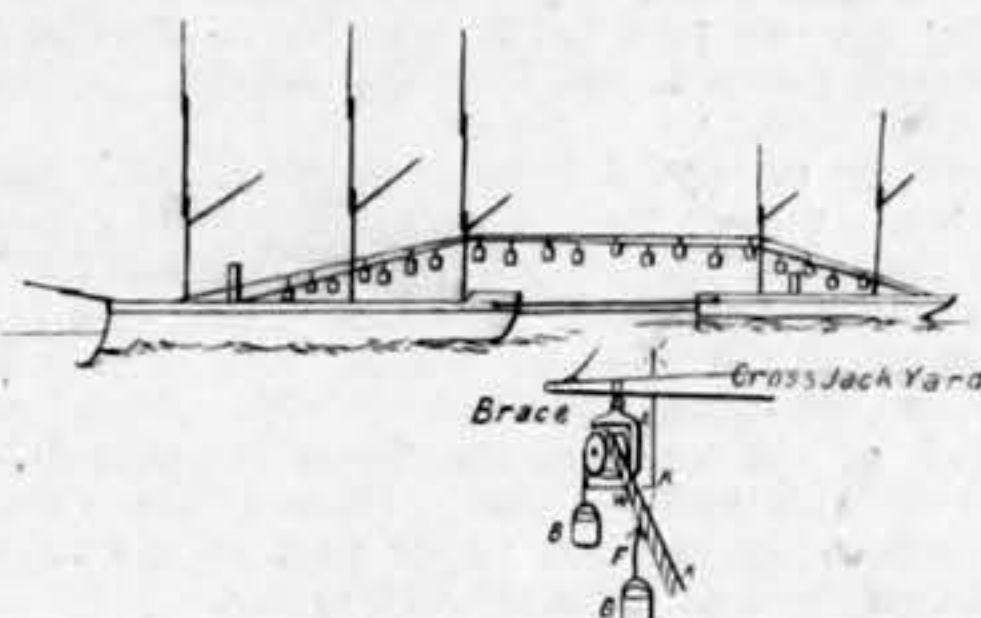


Fig. 2. Lieut. Tupper's Plan 1887.

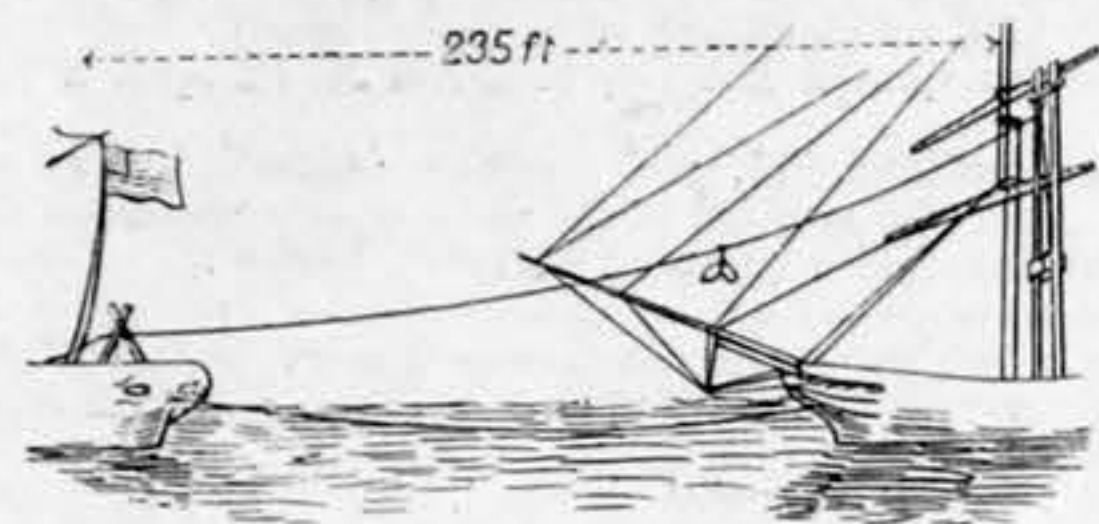


Fig. 3. Philip Low's Plan 1893.

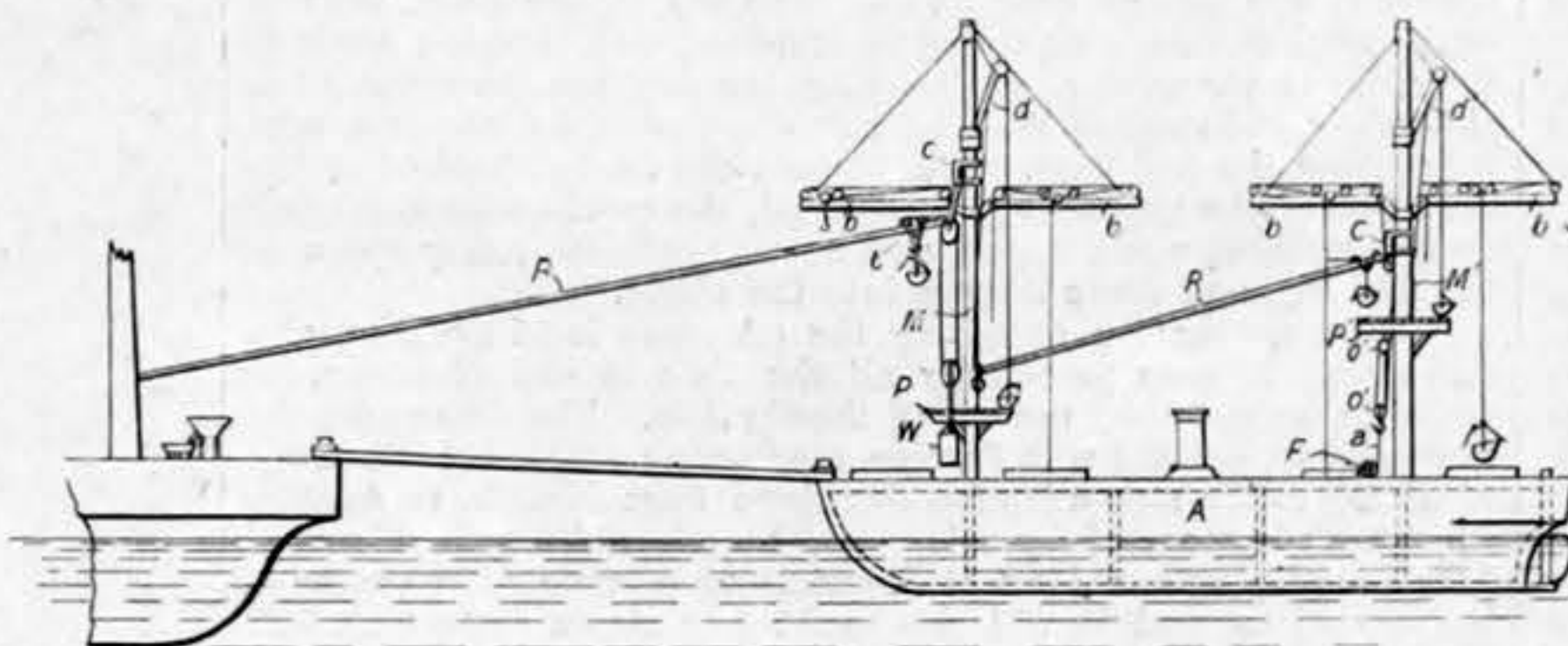


Fig. 4. The Wash Plan 1889.

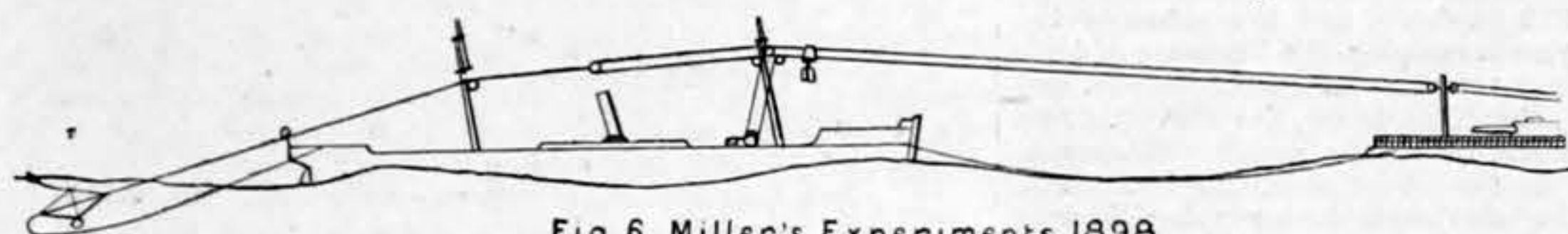


Fig. 6. Miller's Experiments 1898.

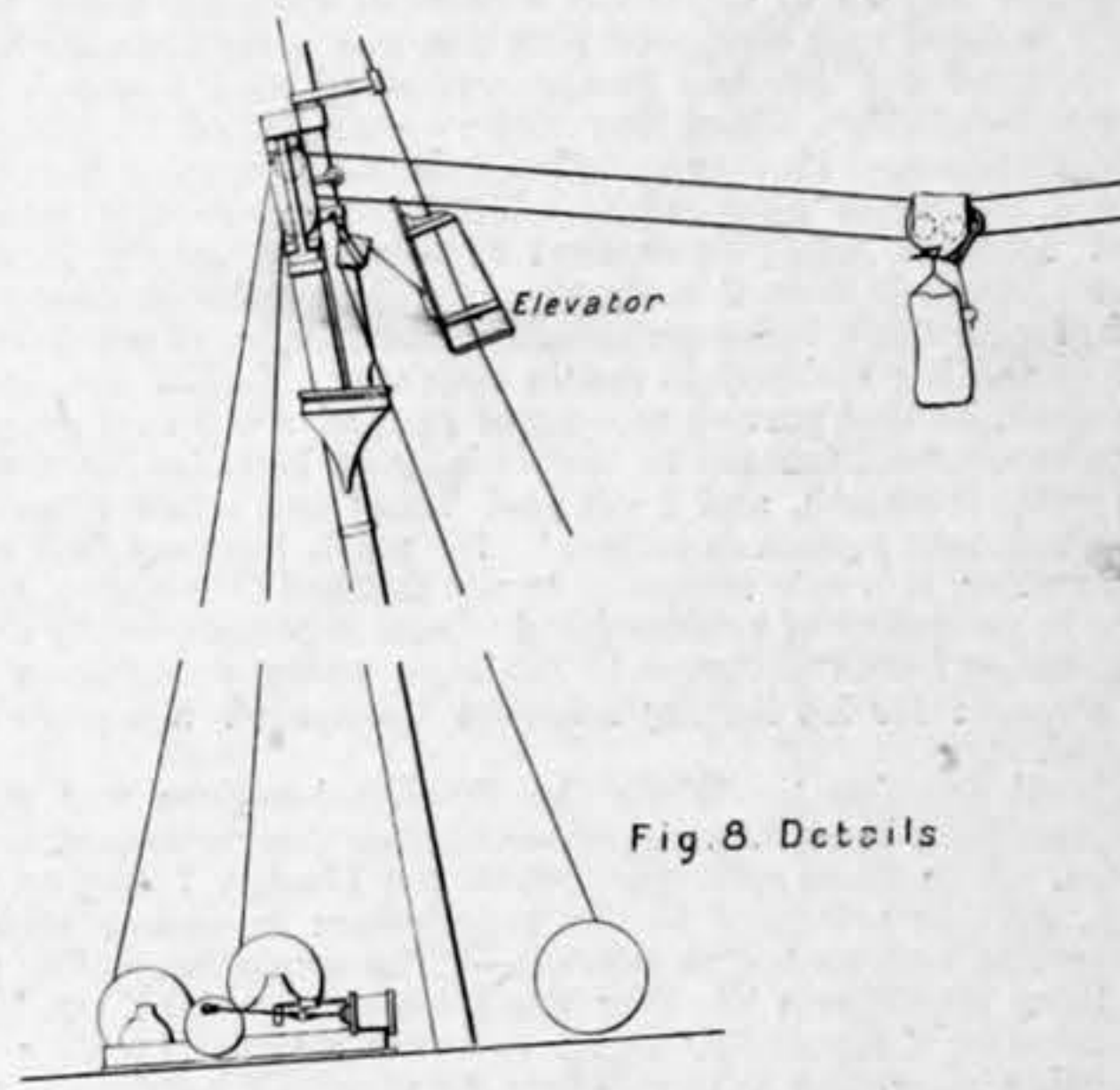


Fig. 8. Details

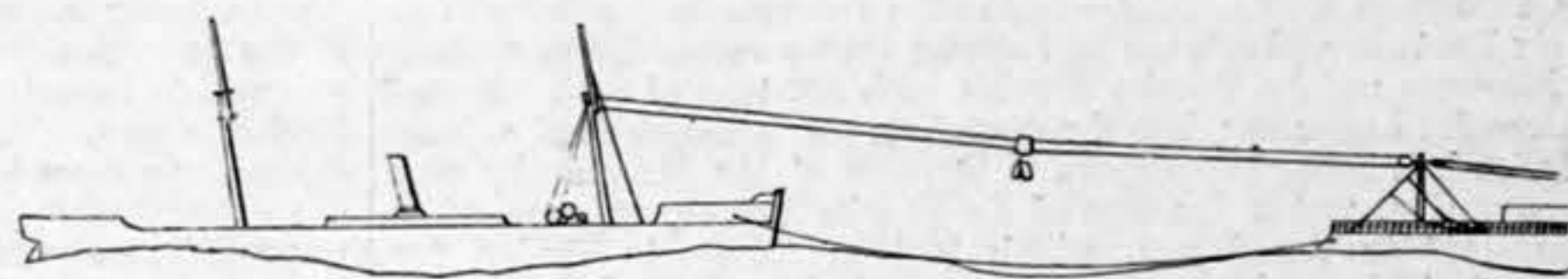


Fig. 7. Miller Conveyor 1899

## COALING VESSELS AT SEA.\*

A PAPER entitled "Coaling Ships in Squadron on the Open Sea" was delivered by Lieutenant R. S. Lowry, R.N., before the Royal United Service Institution, London, April 13th, 1893. In Lieut. Lowry's plan, special coal boxes or boats holding about a ton of coal were proposed to be carried by a collier and passed from that to the warship by lines, hoisted on deck, emptied, and returned. These boxes contained an air-tight chamber so as to float. The plan was fully discussed, and was evidently not considered practicable. Four years later a paper entitled "Coaling Ships of War at Sea" was read before the same Institution, by Lieutenant C. E. Bell, R.N. This paper was quite fully discussed by Admiral Boys, the late Vice-Admiral Colomb, Commander Campbell, Captains Fitzgerald and Henderson, and others.

Lieutenant Bell gives a quotation from Captain Scott, which forms his excuse for putting his views before the Institution as follows:—"I think, moreover, that you require, if you have groups of squadrons, some equal coaling power or means of coaling at sea which we have not yet hit upon." And then says:—"I feel sure that all officers will agree with me that coaling from broadside at sea is impossible, except in very calm weather, and even then it is attended with great risk to both men and material employed." And "I am sure I am supported in such belief, by all who have considered the subject, that the only way by which the various difficulties and dangers of coaling at sea can be overcome and the work carried out successfully with the least possible delay, and absence of danger to men and material, is by coaling from bow to stern." Also, "I do not make any claim to originality; in fact, I believe the same idea has occurred to many officers who have given any consideration to the subject, and, in fact, on submitting a sketch of the present plan to Sir J. H. Cammerell a short time ago, he then told me it had suggested itself to him some years back, and he believed it to be the only way it could be done."

**Bell's requirement.**—Lieutenant Bell says, "Any satisfactory plan of coaling at sea must satisfy the following requirements:—(1) Rapidity. (2) Safety. (3) Ability for the ships engaged in the operation to proceed with the minimum diminution of speed. These three requirements are absolutely essential to the success of any plan, but there are others of no little importance. (4) Necessity of keeping coal dry. (5) Minimum of labour to be employed. (6) Little cost for material necessitated."

**Lieutenant Bell's plan.**—The plan suggested by Lieutenant Bell is that shown in Fig. 1, in which it will be seen that he first took the collier in tow of the warship, and then added an inclined and elevated cable attached low down to the after mast of the warship and to the top of the foremast of the collier. On this elevated line a truck or carriage was employed capable of running along this line. Two ropes are shown, one fastened to the rear, and one to the front of this truck, leading the one to the warship and the other to the collier, so that the bags of coal secured to the truck can be drawn over to the warship, and the empty truck hauled back to the collier. The hawsers he showed crossed from the "stern pipes of the ship of war to the bow ports, hawse ports, or other convenient places of the coal ship." He proposed to carry five bags at a time, carrying about 220 lb. of coal per bag. The bags were to be hoisted, by some arrangement not shown from the deck of the collier, to the suspended cable, and there attached by a man stationed on the foreyard for that purpose. With this plan he proposed to satisfy all the requirements which he had laid out—namely, rapidity, safety, &c. While he refers to the fact that his appliance costs but a trifle, he adds the following:—"I would at the same time insist that no expense should be considered too great to carry out this most important, I may say all-important, operation in those cases where it may be essential to the success or safety of any ship or ships of the Navy, or any expedition they may be engaged in."

**Discussion of Lieutenant Bell's plan.**—The discussion that followed was properly very severe on Lieutenant Bell's plan, for, as it will be observed, there were no means provided for maintaining a uniform tension on this elevated and suspended wire, and if the vessels so rigged were pitching ever so little, either one of two things would occur, and probably both after a short time. By the ships pitching towards each other the coal bags would be likely to be dropped into the sea, and by pitching away from each other, either the foremast of the collier would be unshipped or the suspended cable snapped. Commander Campbell said:—"I do not agree with him, but I admire his principle, and I sincerely hope this paper may help to give another blow to the 'happy-go-lucky system,' and assist us in bringing about that systematic organisation of every detail for which the Navy is now crying with one voice, and which is now happily receiving the special attention of our rulers." Lieutenant Tupper said, among other things:—"I think the practice of coaling ships, both at sea and in harbour, ought to be made just as much a drill and evolution as are many other operations which have to be performed." The chairman of

the meeting, Admiral Boys, said in relation to Bell's plan:—"But if those ships should get in any seaway whatever, the operation, I believe, must break down. As to blockading, if we are to blockade, the practice of coaling at sea by boats or otherwise will occasionally be adopted."

**Lieutenant Tupper's plan.**—Lieutenant R. G. O. Tupper, R.N., submitted a different plan for coaling vessels at sea, as shown in Fig. 2. His plan provided an endless rope, starting from the stern of the collier in bow of the warship, passing over an elevated support on the foreyard, thence to the after mast of the warship, and thence to the forepart of the warship. This endless rope was to have buckets of coal secured to it at frequent intervals, the whole operated by a capstan, and the coal in that way passed from one ship to another. This plan was, of course, subjected to the same criticisms as that of Lieutenant Bell's, namely, that in any seaway whatsoever the cable would either be dropped into the sea by excessive slack or snapped by pitching in the reverse direction. He continued, however, by saying:—"I think vessels performing the duties of colliers, store ships, transports in a fleet, should be large and of the highest speed, and armed with quick-firing and machine guns, so that they might be utilised as scouts for the fleets and in the capture of the enemies' commercial fleets when not actually employed in the operation of transmitting the supplies they contain to the ships of the fleet to which they may be attached."

**The Low plan.**—The Hon. Philip B. Low secured a patent, July 10th, 1893, on a plan practically the same as that of Lieutenant Bell, described in his paper six years earlier, but with the addition of a counterweight secured to the end of an elevated carrying cable, Fig. 3. This counterweight was arranged to maintain a constant tension, and consequently a constant deflection on the suspended cable, regardless of the motion of the ships. The use of a counterweight to maintain a constant tension on a suspended wire rope has successfully been employed in wire rope tramways. His plan was tested by the Navy Department in October, 1893. The test took place on board the U.S.S. San Francisco and the U.S.S. Kearsarge. The distance from the shears of the cruisers to the upright poles on the collier was about 235ft., so that the distance between the vessels was something less than 200ft. The transporting cable, or the transmission wire, as the inventor called it, was secured to the deck of the San Francisco, supported by a pair of shear poles at the stern, then run on an incline to a gin block near the foremast of the Kearsarge, which played the part of the collier, at an elevation of about 32ft. above the point of suspension on the San Francisco. This gave an air-line inclination from the points of support of about 8 deg. to the horizontal. After the cable was rendered about the gin block it was bent backwards, and on the end was secured a counterweight about 1600 lb. weight. The bags of coal weighed nearly 200 lb., and the time required to travel from the pole head on the collier to the shear pole on warship was about 14 sec. The time of hoisting and sending over ten bags of coal was about 20 min., giving the rate of about 2 to 2½ tons per hour. The Board of Naval Officers were instructed to report upon the trial, and their official report was that in rough weather the apparatus would not be of great value in transferring coal from one vessel to another. The apparatus was reported to have worked well; but as the sea was calm, it was impossible to tell what would have been the effect in a moderate sea. As the sea becomes heavier, the distance between ships would have to be increased for safety, and there would have to be a corresponding increase in the height of the gin block, in order that a proper inclination could be given to the connecting rope. Presuming that the distance between ships be increased to 300ft., the same angle of inclination preserved, and the same height of shear poles on the warship, then the gin block on the collier would have to be located 70ft. above the deck of the collier. Seventy feet above the deck of the collier would take one to the truck of the foremast of the U.S.S. collier Saturn. It is clear that to attempt to attach bags of coal at such a height as that above the deck would be difficult, if not impracticable, especially in a rolling sea. Even then the capacity, whatever it might have been at 200ft., must be something less at 300ft. distance between the ships. In order, therefore, to increase the capacity of this device, it would be necessary to increase the load; but as it will be noticed that with a 200 lb. load a 1600 lb. counterweight was employed, a 400 lb. load would require a 3200 lb. counterweight, and a 600 lb. load a 4800 lb. counterweight, and so on. The element of danger to the ship in carrying any such counterweight would seem to need consideration. If the tow-line should snap, this weight would be pulled up to the gin block, and then something would give away, and the dropping counterweight would do great damage.

**The John E. Walsh plan.**—Fig. 4 illustrates a plan patented by John E. Walsh, of New York. The cable R, attached at one end to the towing boat, inclines upward and bends over a pulley block O, near the head of the foremast, thence bends under the pulley block O, carrying a counterweight W. The rope is bent many times, and must therefore carry a very large counterweight to sustain the requisite tension in the rope R. The objections which

have been offered by the author to Low's inclined cable and counterweight apply equally well to the Walsh plan. The figure also illustrates overhead derricks for hoisting the load out of both hatches to platforms on the masts, the platform on the mainmast being somewhat higher than that on the foremast, and an auxiliary inclined cable between the masts adapted to carry the coal forward. The author believes that any hoisting device of this kind elevated to any height will be impracticable in a rolling sea. If the load is to be hoisted at all on ships at sea, it should certainly be steadied between guides.

**Lieutenant Niblack's paper.**—Lieutenant A. P. Niblack, in a paper on "Coal Bunkers and Coaling Ships," read before the Society of Naval Architects and Marine Engineers in 1893, presented a most complete argument for the necessity of rapid coaling as a factor in efficiency, and he gives considerable data on the rapidity with which the ships then built in the United States navy could be coaled in harbour. He says:—"Our crack ship, the San Francisco, could only take coal in at Sandy Point at the rate of ten tons per hour, and ordinarily she takes three days, working hard, to fill up. Efficiency in ship's crew must be supplemented by the best mechanical arrangement practicable, and the ship must be both able to go anywhere and stay there." "Coal supply and rapid coaling are very important factors in efficiency, not only in emergency, but in time of peace, for the time spent in coaling ship is time wasted." He then gives the rates representing an average of three or more good actual performances of each ship, and shows that the Chicago, the Charleston, and the Newark coaled at the rate of thirty tons per hour. He quotes from the English manoeuvres, giving the average of the Thunderer at 17½, and of the Anson at 51.6 tons per hour, the latter using the Temperley transporter—see Fig. 5. Recently English ships coaling in a harbour being completely surrounded by colliers and working Temperley transporters and whips combined, have coaled 150 tons per hour. It seems to the writer very apparent that the United States navy needs not only an appliance for coaling at sea, but also a far better means than at present employed for coaling in harbour. At the present time the United States navy owns but one Temperley transporter, the device which the British Navy has used with so much success and has so extensively adopted using now nearly 200. This transporter was fitted to the collier Saturn during the late war, but does not know if it was ever used, or whether any report was ever made upon it.

Lieut. Niblack's paper appealed for larger coal capacity and greater facility for getting the coal into storage. Naval Constructor Francis T. Bowles, United States navy, said, in reference to Lieut. Niblack's plan, as follows:—"I have no doubt that it would add at least 20 per cent. to the cost of the vessel, and the proportion of cost as a vessel grows larger would increase, because the larger the ship the greater the amount of space and weight every one thinks he ought to be allowed to dispose of."

**Difficulties of coaling at sea during the Spanish-American war of 1898.**—Touching upon the difficulties which were experienced by the United States vessels during the Spanish-American War, the author quotes some paragraphs which appeared in the daily Press while the conflict was being waged. The *Commercial Advertiser*, on June 26th, 1898, published a diary of their correspondent located on board the United States battleship Iowa, and only that part is quoted from which has reference to the coaling problem:—

"June 7th, 1898. . . . The collier Justine is alongside, and we started in coaling. The Justine has not the coaling capacity of the Merimac, but she is a fine steamer, very strongly built. In a seaway this is a great advantage, for though we gave her some pretty hard knocks, no holes were punched in her side. Since she comes right alongside our armour belt, she can be the only sufferer. She is also very convenient to coal from. Working three forward hatches, we are able to take aboard very easily 260 tons before supper time."

"June 8th, 1898. Much to our disappointment we found that we cannot get the Justine again to-day, as she was ordered over to the Brooklyn, and we had to content ourselves with the Sterling, and to our sorrow. We had every fender out possible, big rope fellows, too, that will stand any amount of knocking, but no sooner had the Sterling come alongside than she came up heavily against our ash chute and opened a hole in her side. There was nothing to do but send the carpenter's gang aboard and shove her off for repairs. Every one is disgusted with the Sterling for having sides like paper."

"June 11th, 1898. We tried to coal again from the Justine to-day. Made all preparations, and even started sending the coal aboard, but, before we got more than a dozen bags on, the ships knocked together again so badly that we had to cast the collier off and give it up again. It is most aggravating, for now we must clean up the ship, only to start in coaling again on Monday."

Thus it will be seen that coaling was begun on the 7th, and on the 8th, 9th, 10th, and 11th, practically no coaling was accomplished, although each and every day they needed coal, and were desirous of having it. It may be interesting to know that this same collier Justine, after discharging a single cargo of coal, was returned to Newport News and laid up a long time for repairs, the bill for which exceeded 4000 dols.

It is generally conceded that Cervera's defeat was due directly

\* A paper by Mr. Spencer Miller, presented at the annual meeting of the American Society of Naval Architects and Marine Engineers.

to the fact of being out of coal and provisions, and he thereby sought the harbour of Santiago de Cuba to fill his bunkers. It is also a fact that had he been as speedy about coaling after he had arrived he probably could have escaped from the harbour, because the American vessels were also short of coal, as will appear from the messages exchanged between Admiral Sampson and Commodore Schley and the Navy Department, as they appeared in the report of Captain Crowninshield, Chief of Bureau of Navigation. The following message was sent from Commodore Schley to Admiral Sampson:—"Arrived May 21st off Cienfuegos. . . . Expect difficulty here will be to coal from colliers in constant heavy swell. Other problem easy compared with this one so far from the base." On the same day Admiral Sampson received this despatch from Commodore Schley, dated May 24th:—"Coaling off Cienfuegos is very uncertain. Having ascertained that the Spanish fleet is not here, I will move eastward to-morrow, communicating with you from Nicholas Mole; on account of short coal supply in ships, cannot blockade them if in Santiago. I shall proceed to-morrow, 25th, for Santiago, being embarrassed, however, by Texas' short coal supply and her inability to coal in open sea. I shall not be able to remain off that port on account of general short coal supply of squadron, so will proceed to the vicinity of Nicholas Mole, where the water is smooth, and I can coal Texas and other ships with what coal may remain in collier." So much has been said about this matter, it is only necessary to say that had Commodore Schley been in possession of colliers fitted to coal at sea, especially during his journey from Cienfuegos to Santiago, there would have been no occasion for his leaving Santiago unguarded a day after his arrival.

*French experiments.*—While the Spanish-American war was in progress the French were experimenting on this problem of coaling at sea. The Paris correspondent of the London Times, on July 28th, said, in reference to the experiments in coaling with the Temperley transporter, as follows:—"The second interesting point in these manoeuvres has been the attempt to coal at sea. This experiment, if successful, would necessarily have led to a considerable innovation in naval plans, for it would have induced the authorities to send out under the protection of men-of-war floating depôts which would follow the fleets destined to fight in distant waters, and to supply them with coal. The Japon, a collier, 3000 tons, furnished with a crane—Temperley transporter—while steaming six knots in a rough sea and strong breeze succeeded in coaling the Marecau and La Touche Treville with 200 tons of coal. It was a successful beginning, but the operation was not continued as long as desired, it being interrupted in the case of the Marecau by way of precaution, and in the case of La Touche Treville on account of an accident to the Japon, which had to return to Toulon for repairs." This problem does not seem to have been fully solved, as proved by the damage sustained by the Japon. The French Admiralty "is confident of a decisive result, for it has just decided that the Japon is to remain permanently attached to the Mediterranean reserve squadron. This solution will naturally have important consequences, one of the first being eventually the complete re-victualling of ships in motion, or at any rate out at sea. There is no doubt, indeed, that, the question being thus raised for all navies of the world, it will be solved. We may even go further. If all the nations could have not merely coaling stations but complete re-victualling stations always at hand, victualling on the voyage would be neither necessary nor useful. This, however, is impossible, even for the richest and best equipped Powers, especially now-a-days, when colonising nations may be drawn into action in far distant regions. It may therefore be supposed that the problem to be laid down will be coaling and re-victualling in motion." "This is the question now before all the great navies, and as such experiments cannot be made in the dark, it is certain that all nations will almost simultaneously have the necessary apparatus for enabling ships to be supplied at sea, so that they can be sent to the greatest distance without running short, at the moment of combat, of either food or coal."

*Coal supply: Vice-Admiral Colomb, R.N.*—A number of interesting reviews of the Spanish-American war were made by foreign naval officers. One of the most interesting touching the subject of coal supply was written by the late Vice-Admiral P. H. Colomb, R.N., in *Cassier's Magazine*, published August, 1898, entitled "Coal Supply, Speed, Guns, and Torpedoes in Marine Naval War." Among other things under the head of coal supply, Vice-Admiral Colomb said:—"We get speed and certainty for voyages made under steam, and the full advantages are reaped in peace time, because coal supply can be exactly arranged for and calculated according to the work required of it, for that can be known, but for the warships in war no such special arrangements and calculations are possible. Coal supply can be treated only generally before war breaks out. No one can say beforehand whether it has been advantageously or economically allotted."

Becoming interested in this question in 1893, the author proposed at that time to stretch an elevated cable from the stern of the warship to the bow of the collier in tow, one to be securely fastened to the warship and the other end wound around the compensating engine, similar to the steam towing machines. The load running on this cable was to be conveyed over by an endless rope. It was expected that the compensating engine would keep an equal strain on this elevated line irrespective of the pitch of the vessels so connected. In March, 1898, Lieutenant J. J. Woodward, Naval Constructor, located at Newport News, Va., invited plans and prices on a device containing much the same general ideas. A few weeks later—April—a plan was sent to Mr. Woodward, and he in turn transmitted it, with favourable recommendations, through the Chief Constructor, to the Secretary of the Navy. It was not, however, until August of the same year that any understanding was had with the Navy Department whereby the work of construction could be begun. The plan, considerably modified, was submitted to a Board of Naval Officers, consisting of Rear-Admiral Ramsay, president, Thomas Williamson, chief engineer, and Z. L. Tanner, commander, and they consider the device "feasible in moderate weather." Thereupon the Department contracted with the Lidgerwood Manufacturing Company, of New York City, U.S.A., to have the apparatus installed on board the collier Marcellus. So much time was lost in negotiations, however, that before the work of construction was begun the war came to an end.

*The author's experiments.*—October 15th, the author performed an experiment in New York harbour with a tug, towing a sloop, using a quarter-sized model. Shear poles were mounted on the tug, and blocks on the mast of the sloop, the distance between points of support being 100ft. An endless rope was employed, being used in accordance with the plan shown in Fig. 6. A movable sheave in the bight of the cable aft the mast was held taut by a line connecting it with a sea anchor or towing cone dragged in the sea behind the sloop. By this plan it will be observed that the tug towed the sea anchor as well as the sloop, the latter merely supporting the rope as it passed over. A carriage gripped to the upper part and provided with wheels to roll on the lower part served to carry the bags of coal over from sloop to tug. As the experiment was performed in a storm, no photographs were taken. The storm was so severe that the sloop shipped water over the bow, and both boats rolled and pitched very badly. In spite of this, however, the bags of coal were conveyed across the space as though the sea was smooth; the sea anchor serving to perfectly act as a compensator, maintaining a constant tension on the endless conveying cable. If such a plan were adopted, the sea anchor would have to be selected in accordance with the speed of towing; the greater the speed the smaller the cone required.

#### DESCRIPTION OF THE MILLER CONVEYOR ON THE U.S.S. MARCELLUS.

(1) It is proposed, with this device, for the warship to take the collier in tow, or the collier to tow the warship, leaving the distance between ships about 300ft.; this method of securing boats at sea is recognised as being safe.

(2) The warship to receive the coal will erect a pair of shear

poles on its deck, which, secured by guys, will support a sheave wheel and a chute to receive the load.

(3) The collier is provided with a specially-contrived engine located aft the foremast, having two winding drums. A steel cable,  $\frac{1}{2}$  in. diameter, leads from one drum to the top of the foremast, over a sheave, thence to the sheave on the warship, back to another sheave on the top of the foremast, thence to the other drum. This engine gives a reciprocating motion to the conveying rope, paying out one part under tension; a carriage secured to one of the parts passes to and from the warship, its load clearing the water intervening.

(4) A carriage of special form is provided with wheels which roll on the lower part to the conveying cable, and grip slightly but sufficiently the upper part of the cable. This carriage will carry bags of coal 700 lb. to 1000 lb. The load is held by a hook pivoted at the bottom of the carriage, which hook is held by a latch. When the carriage comes in contact with the rubber buffer on the sheave block at the warship, this latch is pressed in, thereby releasing the hook and its load. Should the carriage strike heavily at either terminus the upper part of the cable will slip through the grip and no damage will be done.

(5) As soon as the bags are dropped, the direction of the rope is reversed, and the carriage returned to the collier. During the transit of the load an elevator car descends to the deck, bags of coal placed thereon, suspended from a bale, and elevated again to the stops on the guides, so that when the carriage has returned to the collier, the pointed hook finds its way under the bale or hanger supporting the coal bags. The instant the load is hooked on the direction of the ropes is again reversed, the carriage takes its load from the elevator and transfers it across the intervening space to the warship, and drops it again into the chute.

(6) The engine for operating the conveyor is of peculiar construction. It runs practically all the time in one direction, its speed being varied by the use of the throttle. The drum near the foremast is provided with friction mechanism so that it is capable of giving to the rope a tension anywhere from 1000 lb. to 4000 lb. This drum is operated by a lever. The other drum is of special form, employing two dry metallic surfaces in contact. This drum is adjusted so that it will slip under any strain exceeding, say, 3000 lb. It may be adjusted while the operation is going on, the tension being increased if the load sags too much, and diminished if the deflection is unnecessarily small. The forward drum will be referred to hereafter as the 4000 lb. drum, and the other as the 3000 lb. drum. When the engine is running, the tendency of both drums is to draw both parts in, one to the extent of 4000 lb. and the other 3000 lb. The effect, therefore, is for the 4000 lb. drum to prevail and overhaul the 3000 lb. resistance, and it is this resistance that sustains the load in its transit between the two boats. Through the co-operation of the two drums the conveying distance between the two boats is compensated for, and a practically uniform tension sustained during the transit of the load. If the points of support on the two ships approach each other—during the transit of the load—the effect will be that the drum pulling 4000 lb. will take up the slack so produced, and the 3000 lb. drum will temporarily cease slipping, or at least the slip will be reduced. If now the boats pull apart, the 3000 lb. drum will simply slip the faster. All that is necessary, therefore, in the operation of this machine is to see to it that the speed of transit is in excess of double the speed at which the two boats come together.

(7) After the load is dumped at the warship the operator of the engine releases the friction lever on the 4000 lb. drum, thus reducing the tension on the lower part to some point considerably below 3000 lb., whereupon the 3000 lb. drum acts to haul in rope, and thus returns the carriage to the collier.

(8) The speed of conveying is about 1000 per minute, consequently the load will be taken from the collier and deposited in the warship in about twenty seconds.

(9) Attention is called to the fact that the total tension on these two parts of rope will never exceed, say 8000 lb.; furthermore, should the ships pull away from each other and the tow-line part, the only effect will be to unwind the rope from one of the drums, its end falling into the water, whereupon the other drum will wind in the other end of the rope and recover the carriage attached thereto. The drum used for operating the conveyor also serves to wind up and store the cable when the collier is not coaling at sea.

As this paper goes to press, the collier Marcellus is fitted with this device, consequently any further description of it will be deferred until the meeting of the Society, when the author will be in a better position to give illustrations and descriptions of the machine as it will be tried at sea.

#### ALMANACS, CALENDARS, &c.

We have to thank the Campbell Gas Engine Company, Limited, for an exceedingly neat pocket calendar and diary. A feature of it is a railway accident insurance policy for £500 on the first page. A pocket for stamps, &c., is formed in the cover.

Mr. Percy J. Neate, of Rochester, has brought out a wall calendar, much on the same lines as last year. It is nicely got up in black ink on a white card, the result being a pleasing contrast with some of the highly coloured and ornamented calendars which are usually considered attractive.

Peckett and Sons, of the Atlas Locomotive Works, Bristol, have issued a wall calendar of handsome appearance, and having monthly "tear-off" slips. As usual, the calendar is ornamented by an excellent photographic reproduction of one of their recently-constructed locomotives, a six-wheels coupled saddle tank engine, with 18 in. cylinders, and weighing 50 tons. On the back of the calendar there is given a large amount of useful information.

The Hunslet Engine Works, Leeds, are issuing a neat wall calendar of the monthly "tear-off" type.

#### CATALOGUES.

Westinghouse Electric Company, Limited, Norfolk-street, Strand. Circular No. 1010. Self-cooling transformers.

Burnham, Williams, and Co., Baldwin Locomotive Works, Philadelphia. This is a copy of the monthly booklet issued from these works, giving illustrations and particulars of the locomotives recently constructed.

The Horseley Company, Limited, Tipton, Staffordshire. Illustrated description of the works, together with information regarding work executed by the company. The printing and illustrations are of the highest standard.

Robert Boyle and Son, Limited, Holborn-viaduct, London. New illustrated catalogue. This book is in reality something more than a mere description of this firm's specialities; it forms an artistic practical treatise, in which is demonstrated how efficient ventilation can be successfully achieved by a natural agency and without complex mechanical arrangements.

ACCORDING to the monthly report on the state of the skilled labour market published by the Labour Department of the Board of Trade, the general state of employment continued good in December, and the percentage of unemployed members returned by 44 trade unions lower than at any similar period of the year since 1889. In the 123 trade unions making returns, with an aggregate membership of 511,181, 12,664—or 2.5 per cent.—were reported as unemployed at the end of December, compared with 2.2 in November, and with 2.9 per cent. in the 118 unions, with a membership of 470,391, from which returns were received for December, 1898.

#### THE IRON, COAL, AND GENERAL TRADES OF BIRMINGHAM, WOLVERHAMPTON, AND OTHER DISTRICTS.

(From our own Correspondent.)

GREAT activity prevails at all the works, and the upward tendency of prices continues. Galvanised corrugated sheets were quoted on "Change in Birmingham this—Thursday—afternoon £15 for 24 w.g., f.o.b. Liverpool. The demand for Natal and Cape Colony is greatly increasing, owing to the immigration of refugees from the Transvaal and Free State, and from Great Britain. Owing to the crowded condition of Cape Town, Durban, and other South African towns, temporary structures have to be erected for housing the population, so that corrugated roofing sheets are in heavy demand. Black sheets are advanced 5s., making the minimum price £11 5s. for 24 gauge. They are in large demand for use by the galvanisers.

Hoops and all classes of strip are in large out-turn at satisfactory prices, and the demand is excellent. The Hoop and Thin Strip Association have advanced prices 10s. per ton, making the basis price £11 for 20 gauge, with the usual extras. Some makers, however, state that they are securing 7s. 6d. to 10s. more than this basis price. Cut lengths are, as usual, 5s. extra. The Association of Hinge Strip Manufacturers have reduced discounts 2½ per cent., which is equivalent to a net rise of 5 to 10 per cent. Gas strip is advanced to £10, and bedstead strip in cut lengths is £11 5s. Steel strip is also quoted £11 5s., or a rise of £2 upon a few months back.

Marked bars continue £11, and common unmarked bars are quoted £10. A further meeting of the small rounds section of the Unmarked Bar Association has been held to consider the question of extras, and although no official change has been made in the present position, yet several of the members have declared their intention of forcing the 10s. extra upon  $\frac{1}{2}$  in. gauge, and with other sizes accordingly.

Steel of all kinds is in great demand. Steel rounds realise £10 15s. to £11, delivered in South Staffordshire. Best cold-rolled and close-annealed steel sheets for working up purposes are quoted £13 for singles by Staffordshire makers. Serviceable steel sheets for tin-plate making are being sent here from Wales at about £12 for 24 gauge, delivery Midland stations, which is an advance of about 30s. upon three months ago. Midland tin-plate makers quote tinned sheets £29 per ton for coke singles, and £30 10s. for coke doubles; with £31 for charcoal singles, and £32 10s. for charcoal doubles. The next bi-monthly average selling price in the Midland iron trade is expected to be declared about a week hence, and is pretty sure to show a further advance.

Pig iron is quoted:—Staffordshire cinder forge, 72s. 6d. to 73s.; part-mine, 75s.; all-mine, 77s. 6d. to 82s. 6d.; best, 90s. to 92s. 6d.; cold-blast, 120s. to 127s. 6d. Midland sorts are in great request, the output being hardly sufficient to meet the requirements of consumers. Northamptonshire and Leicestershire sorts are quoted 73s. to 75s., and Derbyshire 74s. to 76s. These high prices are largely due to the advanced rates for cokes. Derbyshire coke has been advanced to 30s. per ton at the ovens, and Durham and Welsh coke is quoted 40s., delivered into this district. Pig iron is being imported from other districts to a considerable extent, to make up for local shortness of supply. Coal also is decidedly dearer than recently. Some of the coalowners are making increased charges for the use of wagons, and are abolishing the custom of giving extra weight, so that manufacturing as well as domestic sorts are from 2s. to 2s. 6d. dearer than a few months ago, and this, of course, increases the cost of iron.

The brass and copper industries appear to be in a sound, if not very active, condition. In a few cases manufacturers are making for stock, but there is no dearth of consumptive demand, at all events for goods of the cheaper descriptions. But copper goods are not selling so freely, as public confidence in the stability of the metal has been somewhat rudely shaken by recent fluctuations.

In the Birmingham metal-working industries there are some large contracts under execution for municipalities, local authorities, and railway companies in various parts of the country. In the export department shipments have been interfered with of late by the scarcity of freightage, owing to the large number of merchant vessels required by the Government for transport purposes. There are consequently a good many unexecuted orders and cargoes awaiting shipment for various colonial and foreign markets, which will swell the returns of future months. The most urgent orders at present are those arising out of the war, on the execution of which some of our manufacturers are engaged almost night and day.

In the machinery branches in the Birmingham district there is steady, if not full, employment, but there is not the pressure of demand which was experienced last summer, and many engineers and machinists could do with additional orders. Structural engineers, however, continue very busy, and report contracts which, in many cases, will carry them through the greater part of the year. They complain, however, that prices are not what they ought to be relatively to the cost of labour, fuel, and steel. But this is, doubtless, an evil which will correct itself with the abatement of competition, as orders accumulate in manufacturers' books.

Makers of springs and axles report business active, both for home and export, and this fact, taken in connection with the recent rises in metal and fuel, has prompted them to declare another advance of prices equivalent to from 7½ per cent. to 10 per cent. During the past twelve months the Axlemakers' Association has reduced discounts by 10 per cent., which is equivalent to an advance of net prices to from 30 per cent. to 40 per cent.

There are loud complaints by Birmingham merchants of the wanton injury inflicted on British commerce with Brazil by the new Customs regulations of that country, and especially the prohibition of the distinctive English labels by which our goods have hitherto been identified, and the duplication of invoices, of which one has to remain in the possession of the Consulate—thus divulging trade secrets and prices to trade competitors. The Chamber of Commerce have decided to address the Foreign-office on the subject, and to invite the co-operation of other Chambers in obtaining a reform of these obnoxious rules.

#### NOTES FROM LANCASHIRE.

(From our own Correspondents.)

*Manchester.*—In the iron trade of this district there is a continued slow, but steady recovery from the unsettlement caused by the collapse of warrants with the close of last year. Buyers, however, are still to a large extent holding back, but as week by week the speculative brands of pig iron go on hardening, confidence is gradually returning, and there is now a general conviction that for a considerable time to come low prices are not at all probable, but that the movement of the market is more likely to be in a still further upward direction. In fact, apart from the large requirements for actual consumption, in which there is no falling off, and which in themselves are sufficient to give exceptional strength to the market, the fuel question is also an important factor in governing the situation, and the large advance during the present week on all descriptions of fuel throughout Lancashire cannot fail to have its effect on all branches of the iron trade. With the increased cost of production, lowness of stocks, and both makers and manufacturers heavily sold over a considerable period, there would certainly seem to be a prospect of high-priced material for some time to come.

The Manchester iron market on Tuesday was fully attended, with more inquiry stirring, but no appreciably increased weight of buying generally. In pig iron the position is again stronger, and there is less underselling by merchants. For local and district brands makers are exceedingly firm at their full quotations, and delivered Manchester, No. 3 foundry Lancashire is quoted 80s. 6d., less

2½; Lincolnshire, 75s. 6d. to 76s. net; and Derbyshire about 80s. net cash, with forge qualities, delivered Warrington, 74s. 2d. to 74s. 8d. net cash for Lincolnshire, and 76s. to 76s. 6d., less 2½, for Lancashire. Current quotations for Middlesbrough in the open market are about 1s. 6d. per ton higher than last week's rates, merchants asking 76s. 10d. net by rail Manchester, with 78s. 4d. quoted by makers. There has also been a similar advance in Scotch iron, Eglinton and Glengarnock being quoted by merchants about 80s. 6d. to 81s. net cash, delivered Manchester docks, with makers' prices about 2s. above these figures. American pig iron, delivered Manchester docks, is about 77s. 6d. to 78s. net cash.

Perhaps not quite so much business is being booked by finished iron makers at the advanced rates, but they continue indifferent about new orders for the time being, and they are asking a further premium upon present prices where they have any special lots they can offer for immediate delivery. For Lancashire bars the list basis is £10, but £10 5s. is being got for prompt delivery. North Staffordshire bars remain nominally at £10, but makers decline to accept business except at quite 5s. above this figure. In goods a steady demand is reported at the full rates of £10 7s. 6d. for random to £10 12s. 6d. for special cut lengths, delivered Manchester district, and 2s. 6d. less for shipment. Sheets are now quoted £11 to £11 5s. delivered here. Nut and bolt makers have not yet followed the upward move in finished iron by any further advance in their list rates, but for long forward delivery they are quoting higher prices.

In the steel trade the position becomes steadily stronger, with generally a fairly good business reported. For hematite makers' quotations remain firm at 89s. 6d. to 93s., less 2½, but the upward tendency in warrants will no doubt tend to harden makers' prices. For billets £7 10s. is the minimum quotation, with local makers having little or nothing to offer. Local made steel bars have in some instances been raised 10s. per ton, but generally quotations still range from £9 up to £9 15s. Hoops are firm at £10 10s., with boiler plates ranging from £9 10s. to £9 15s. delivered Manchester district.

Machine tool makers continue to report a slackening off in the weight of new work coming forward, and in many cases they are now finishing orders more rapidly than these are being replaced, but the prevalent opinion is that a good deal of new work is just now simply being held back. Other branches, such as boiler-making, stationary and locomotive engine building, and the general engineering trades, are all exceedingly busy, whilst the extreme pressure of work throughout all sections of electrical engineering is more than maintained. The usual monthly returns of the leading workmen's unions show little material change in the position. The Amalgamated reports a temporary increase in the donation list, which is about 2½ per cent. of the total membership, and a little over 2 per cent. locally, but this is fully accounted for by suspensions due to holidays, and other special causes. The Steam Engine Makers' Society returns show a further reduction in the unemployed list, only ½ per cent. of the total roll being on donation, with practically a clear book in the Manchester district. The United Machine Workers' Association has under 2 per cent. of the membership on benefit, with about the same proportion in most of the Lancashire engineering centres. Returns from branches as to the state of trade continue of a satisfactory nature.

Some improvements in miners' safety lamps were brought before the Manchester Geological Society at their meeting on Friday last, by Mr. J. G. Patterson, representative of Baxendale and Co., the makers. Amongst these improvements is a special arrangement—Patterson's patent—for preventing lamps going down into the pit without gauzes, to the imminent danger of life and property. In this arrangement the gauze is provided with a ring which forms a seat for the glass, so that in the event of the gauze or gauzes not being in their place, the glass, on being put in the lamp, will fall to the bottom, thus revealing to the lamp man that something is not in its place. In fact, with this device it is impossible to put a lamp together unless it is a complete safety lamp.

The forty-fourth annual report of the Council of the Manchester Association of Engineers, which was read and adopted at a meeting of the society held on Saturday last, shows that one honorary life, 22 honorary, and 27 ordinary members were added to the roll during 1899, and after taking into account the loss by death, resignation, &c., the total number on the roll is now 453, as against 416 a year back, there being 28 honorary life, 165 honorary, and 260 ordinary members. The financial statement shows a balance to the credit of the Association, after paying all accounts due up to December 31st, of £4488, as against £4224 twelve months ago, representing a surplus of £263 on the year's working.

Last week I referred to the probability of a further upward move in coal prices. This has now been fully borne out, and at an earlier date than was generally anticipated. On Friday last at a meeting of the West Lancashire Coal Sales Association, it was decided to advance best Wigan Arley coals 1s. 3d., and all other descriptions of fuel 1s. 8d. per ton. On the following Tuesday, the leading Manchester colliery concerns decided upon an all-round advance of 10d. per ton in the immediate neighbourhood of Manchester and Salford, with advances in outside districts ranging from 1s. 3d. to 1s. 8d., according to circumstances. For house-fire coal the advance in prices will bring pit quotations in West Lancashire to 14s. 6d. and 15s. best qualities of Arley, 13s. to 13s. 6d. common Arley and Pemberton 4ft., and 12s. to 12s. 6d. common house coal, with pit prices in the Manchester district for corresponding qualities of coal about 5d. to 10d. per ton above these figures. For all other descriptions of fuel suitable for iron-making, steam, and general manufacturing purposes, the demand continues considerably in excess of the supplies offering in the market, and the advanced rates bring pit quotations about on a level with the special prices that were previously being got in the open market. The general average prices at the pit mouth may now be given as about 12s. to 12s. 6d. steam and forge coals, 9s. 6d. to 10s. medium qualities of engine fuel, and 10s. 6d. up to 11s. for the very best qualities. Shipping prices are even higher than inland quotations, and for ordinary qualities of steam coal 15s. is the general figure that is now being readily got for delivery at the High Level, Liverpool, or the Garston docks.

The further advance in prices has been brought about by the continued scarcity of all descriptions of fuel except house-fire qualities, and the great pressure of demand for iron-making, steam, and general manufacturing purposes, and also for shipment. The scarcity of supplies has to a large extent been caused by the restriction of the output, which during the past six months, at the pits generally throughout Lancashire, has been quite 10 per cent. below the average "get;" and with the additional advance in wages that has now been conceded, a still further reduction of the output is regarded as not at all improbable.

The upward move in the price of coal is in some instances being accompanied by a corresponding advance in coke; but this is by no means general, and average quotations at the ovens remain at about 23s. to 23s. 6d. for furnace qualities, up to 30s. for the best foundry sorts.

**Barrow.**—There is a very full and a very active trade in hematite pig iron, and, although makers' prices remain unchanged for mixed Bessemer numbers at 77s. to 80s. per ton f.o.b., they have very little iron to sell, and many of them can readily get 82s. 6d. for good brands at reasonably forward delivery. The market shows indications of expansion, and the probabilities are that, although the demand at the moment is fuller than the supply, a still brisker demand will soon be experienced. Warrant iron has improved in price to 75s. 6d. net cash sellers, 75s. 5d. buyers.

Some large parcels of warrant iron have been cleared from the Barrow stores during the week, and the total for the district shows a shrinkage of 6095 tons. There is now in warrant stores 192,530 tons, or a decrease since the beginning of the year of 5317 tons. Forty-seven furnaces are in blast, as compared with forty-one in the corresponding week of last year.

Iron ore is in very full and very steady demand, and good

ordinary sorts are at 14s. to 15s. net at mines, with best at 18s. and 20s. The price of Spanish ores delivered is steady at 19s. and 20s. per ton, and very large imports are coming to hand.

The steel trade is brisk in every department, and makers find themselves not only well off for orders, but in receipt of very full inquiries for forward deliveries. Heavy rails are at £7 per ton firm, and ship plates are still at £8, with any amount of orders offering. There is a good business doing in every department of the steel trade, and prospects are very bright all round.

Shipbuilders and marine engineers are very busily employed, and are devoting special energies in pushing forward the large amount of Admiralty work in hand.

Coal is dearer, at 17s. delivered for good steam coal, and 36s. for Durham coke delivered.

Shipping is very busily employed, and exports are very large, especially of pig iron. Last week 17,080 tons of pig iron and 5847 tons of steel were exported from West Coast ports, being an increase of 10,425 tons of pig iron, and 1749 tons of steel as compared with the corresponding week of last year. The total exports this year have been 45,680 tons of pig iron and 16,684 tons of steel, showing an increase on the corresponding period of last year of 23,736 tons of pig iron, and a decrease of 5604 tons of steel.

## THE SHEFFIELD DISTRICT.

(From our own Correspondent.)

THE prolonged congestion of the railway lines is now being rapidly cleared, and the inconvenience, where it has not been entirely done away with, has been greatly lessened, and we are within measurable distance of the coal trade resuming its proper condition. There is no falling off, however, in the high price paid for coal in any of the qualities. The weather has been so damp, with occasional cold snaps, that household fuel has been firmly maintained, and is still called for in excess of the output. Markets have been so completely depleted of stocks during the Christmas holidays that there is a general request from all directions for further supplies. The demand for London, the Eastern Counties, and the home districts is equally urgent, and as forward selling has been exceptionally active, there is very little coal to dispose of in the open market. The prices mentioned last week—14s., 15s., and 16s. per ton at the pit—have been readily given in cases of pressing necessity. Generally, however, best Silkestones are ranging from 12s. 6d. to 13s. 6d. per ton; Barnsley house, 12s. to 12s. 6d. per ton; second qualities being obtainable at 10s. to 11s. per ton.

In the steam coal trade there is still a large demand, and the tendency of stocks to accumulate during the first month of the year is altogether absent this season. All qualities of hard coal are called for on inland account. For heavy weights the figures range from 10s. 6d. to 11s. per ton, but the rates for smaller quantities are quoted from 13s. to 15s. The gas companies are as urgently in need of supplies as ever. In many cases the difficulties of public lighting are by no means lessened, and the situation can scarcely be improved until the days are much longer than they are now. Engine fuel has never been in greater request than now, as may be gathered from the current rates, viz., nuts, 9s. 6d. to 10s. 6d. per ton; screened slack, from 7s. 6d. per ton; pit slack, from 6s. per ton, while even higher prices are paid by those whose needs are exceptionally urgent. The situation in coke remains unchanged, rates ranging from 18s. 6d. to 22s. 6d. per ton.

In the Sheffield district the price of bar iron has been advanced another 10s. per ton, the quotation for bar iron being now from £11 per ton upwards.

Every branch of the iron trade is full of work, and a similar remark applies to railway material in all its departments. The output could be increased if the raw material were obtainable more promptly and in adequate weights. Wagon and carriage builders report that full employment is being found for all their men. Nuts, bolts, and similar goods have again gone up in price. In the beginning of December contracts were taken at £3 per ton advance on the quotations of December, 1898. Another 30s. per ton has been added since then. A feature of the military material trade is the large demand at present for lyddite and shrapnel shells on Government account. Makers are keeping their machinery running night and day, the Government requiring immediate delivery. It is not unnatural that one should hear a revival of the old complaint that the Government did not give out orders several years ago, when costly plant and skilled artificers were idle for months at a time. Now orders are being placed very heavily, and the authorities cannot get all they need. Manufacturers of heavy gun forgings are also busy on Government account, heavy shaftings and castings for marine purposes being likewise freely ordered.

In the wire mills activity universally prevails, best steel wire for the production of pit haulage and similar ropes being particularly in request. This trade was a good deal cut into some years ago by the Swedish firms who began to roll wire at home instead of sending their steel over here to be prepared, but in spite of the Swedish competition, there is sufficient work both for home and foreign markets to keep the plant fully engaged.

All the leading firms engaged in the tool trades are full of work, a feature of the orders on the books being the demand for the home market. The Government have recently been placing large orders for steel spring bands, and are now inviting tenders for close upon 300,000 files required in the various departments of the arsenals. The file trade generally is in a good state, although manufacturers complain that they are unable to obtain advances in prices to recoup them for the higher rates charged for raw material. It is noteworthy that the use of machinery in the file trade is still steadily increasing; in fact, were it not for the machines the requirements of the world would not be met.

## NORTH OF ENGLAND.

(From our own Correspondent.)

A STEADY improvement must be reported in the iron and allied trades this week—an improvement which has been in progress since the year commenced—and the tone of business in consequence is cheerful, with consumers much more disposed to operate than the sellers. Actual transactions completed have been comparatively few in number this week, but that is owing to the indifference of producers rather than to any backwardness of the buyers, indeed, if the latter had their way a large business would have been done. As a matter of fact, it seems to be the general belief that higher prices will rule, and, therefore, while consumers show considerable anxiety to purchase, sellers—both makers and merchants—are inclined to hold back, as they are likely to do better by waiting. The situation is generally very favourable to sellers. This is the quietest period of the year, when usually prices decline and stocks increase, but now prices are on the upward tack, and demand is so pressing that stocks are being reduced even in the public warrant stores.

The scarcity of pig iron is indicated by the complaints that consumers still make as to the difficulty of getting what satisfies their needs. At this time of the year under ordinary circumstances there is no difficulty, for the output exceeds the requirements. When, therefore, there is a short supply in the middle of winter naturally the makers expect that the business will be exceedingly favourable for them in the spring, and they are very sanguine. What is a most satisfactory feature of the current upward movement is that speculative operations have played but a small part in bringing it about; it has been induced by an increase of really *bona fide* business, and this is the more likely to be maintained. Inquiries for iron for spring delivery are coming forward freely, especially from the Continent, and the prospects of active trade for that season are altogether encouraging.

Makers adhere yet to 70s. per ton as the price of No. 3 Cleveland G.M.B. pig iron—a figure which they have quoted since the

early part of December, and below which they have not done business, except under special circumstances. Second hands have during the interval been selling at times considerably under this price, even as low as 64s. 6d.; but that did not affect makers, who were never so well off as regards orders. The price of pig iron in merchants' hands has been steadily rising this month, 1s. 6d. per ton having been added this week, bringing the figure for No. 3 up to 69s., which is only 1s. below makers' iron, and 4s. 6d. more than the price ruling a little before Christmas. Cleveland warrants have also been considerably lower than the prices quoted either by makers or merchants, but that circumstance has had little influence on the latter. Buyers have not manifested any great inclination to take warrants, even though they have been so much cheaper than makers' iron, either in first or second brands. This appears to be because the choice of brands in the public stores has become somewhat limited. Thus, when makers were quoting 70s. for No. 3, and merchants 67s. 6d., Cleveland warrants could be bought at 66s. 9d. On Tuesday, merchants raised their price to 69s., but warrants were obtainable at 67s. 9d., but on Wednesday they were raised to 68s. 7d. For a long time now warrants have been at lower prices than makers' iron, and though the stock of the former has gone down considerably, it might have been expected to have decreased to a greater extent.

Cleveland iron is relatively a good deal dearer than Scotch, and this has caused a heavy reduction in the shipments from the Tees to Grangemouth, so much so that this month they are little more than half the quantity reported in the corresponding month of last year—up to the 16th they were 17,437 tons, as compared with 31,262 tons in January, 1899. This is to be expected when it is borne in mind that Cleveland warrants were at one time this week only 3½d. per ton below Scotch, whereas the usual difference is 4s. to 5s., that being what it costs to deliver Cleveland iron to the Glasgow founder on the same terms as Scotch iron. Under present circumstances the Scotch consumer has to pay a good deal more for Cleveland iron than his Scotch costs him, and naturally he is cutting down his consumption of the former as much as possible.

No. 4 Cleveland pig iron and all descriptions of forge iron are quoted and sold at 68s., and are not very easily obtainable, as the supply is even shorter than that of No. 3. Some firms have realised 68s. 6d. for grey forge, for the delivery of which there is great pressure.

Hematite pig iron is very scarce in this district, the production being short of requirements, while makers, it is asserted, have no stocks, and the stock in the public stores has dwindled to about 7650 tons, a very insignificant quantity with a make of 1,200,000 tons per annum of this description of iron, and considering that within the last few years a stock of over 100,000 tons was reported. Relatively better prices are ruling for East Coast than for West Coast hematite warrants, 79s. being the figure for the former and between 75s. and 76s. for the latter. But the situation in this district is so much better, for, against a stock here of 7700 tons, the West Coast has one approaching 200,000 tons, and that with a make under 900,000 tons per annum. The producers in this district ask, and will not take less than, 80s. per ton for mixed numbers of East Coast hematite pig iron, and some quote 82s. 6d. Rubio ore is somewhat cheaper than it has been for some time past, owing to the fall in freights, which is usual at the close of the Baltic season, many of the steamers trading with the Baltic ports in the season being put into the Bilbao ore trade when it is over. The rates of freight have declined 1s. 3d. per ton from Bilbao, but ore has not fallen that much in price, 6d. being the outside, for 20s. 6d. delivered at the wharves in this district is obtainable.

Pig iron exports from the Cleveland district this month are rather quiet, but are much better to the Continent than are usual in January. The total quantity shipped up to Wednesday night was 47,729 tons, as compared with 53,913 tons last month, and 61,426 tons in January, 1899. The stock of Cleveland pig iron in Connal's stores on the 17th was 65,875 tons, a decrease for the month of 4748 tons, and of hematite 7653 tons were held, decrease for month 1850 tons.

The 37th annual report of C. E. Muller and Co., Middlesbrough, contains some important statistics relative to the ore and iron industries, especially the former. It is shown that out of the 7,055,178 tons of iron and manganese ores imported into Great Britain in 1899, no less than 6,186,022 tons came from Spain, these being much larger quantities than were reported in 1898. The Bilbao district last year exported 5,864,174 tons of iron ore, against 4,633,241 tons in 1898. The North-East ports of England imported 2,456,513 tons of foreign iron ores, as compared with 2,266,600 tons in 1898. It is also shown that the North-East of England exported last year two-thirds of all the pig iron sent from the United Kingdom.

The manufactured iron and steel industries continue extremely brisk, and where works are not running to their fullest capacity it is because of short supplies of materials, particularly of fuel. This fuel question has become a serious one for manufacturers, because not only are the supplies short and irregular, but prices have gone up heavily. Notwithstanding this, manufacturers in this district have not followed the example of those in the Midlands and Scotland in regard to advancing prices; indeed, they have not altered their quotations for several weeks past, though there is no lack of work, and a good many orders have to be refused. Common iron bars are quoted at £8 15s.; best bars, £9 5s.; double best bars, £10 5s.; iron and steel ship plates, £8; steel boiler plates, £9 5s.; iron and steel ship angles, £7 15s.; steel sheets, singles, £10 7s. 6d. black, and £14 15s. galvanised; puddled bars, £5 15s. per ton, all less 2½ per cent. f.o.t., except puddled bars, which are net. Heavy steel rails are firm at £7 net, and steel railway sleepers £8 10s. net.

The officials and workmen at the Stockton Malleable Iron and Steel Works of the South Durham Steel and Iron Company, Limited, on Tuesday made a handsome presentation to Mr. Douglas Upton, who is retiring from the general managership of the works, which he has held since 1891. The winding up of the Stockton Malleable Iron Company, which sold its works to the South Durham Steel Company, has now been completed, and the liquidators have intimated that the shareholders will get a little over par value for their £100 shares. Shortly before the sale they were quoted at £30 each.

This week the officials of the North-Eastern Railway Company have been conferring with the representatives of various grades of their men on the subject of hours and wages. It is not expected that the business will be got through before next week, and it has been arranged that no information relative to the negotiations shall be made public before the close.

The coal trade of this district has never been in such a brisk condition for the last quarter of a century as it is now; indeed, it is questionable whether the demand ever so far exceeded the supply. Consumers in all branches of industry complain of the difficulty in getting fuel, and prices are being rushed up at a great rate, being now in some cases double those quoted last year, this being most apparent in the retail house coal trade. Sellers seem to be able to get almost whatever they like to ask, for there is something approaching a famine in the trade, and consumers want the coals at any price. For best steam coals 20s. per ton f.o.b. has been quoted, and for steam smalls 11s., while best gas coals have risen to 19s. f.o.b. The coalmasters are securing relatively better prices for coal than for coke, and the difficulty of getting the latter is increased. For foundry coke for export 32s. 6d. to 34s. per ton f.o.b. has been paid, and for blast furnace coke 25s. 6d. at the furnaces is the least that will be taken for ordinary qualities.

## NOTES FROM SCOTLAND.

(From our own Correspondent.)

THERE has been a gradual improvement in the Glasgow pig iron warrant market this week, so far as prices are concerned. The

volume of business was small, especially in the earlier part of the week; the values moved steadily upward. There was later a considerable demand for warrants from outside quarters, London being reported as a good purchaser. This latter fact caused quite a cheerful tone in business, and prices jumped up when the report came on 'Change, nearly 1s. per ton in the case of Scotch iron. Business has been done in Scotch warrants from 67s. 5d. to 69s. cash, and 67s. 10d. to 69s. 5d. one month. There has been very little doing in Cleveland warrants, in which sales were reported from 67s. 1½d. to 67s. 9d. cash, and 67s. 7½d. to 68s. 3d. one month. Cumberland hematite warrants have sold from 74s. 6d. to 75s. 9d. cash, and 74s. 11d. to 76s. 4½d. one month.

The furnaces that were put out of blast before the holidays are now all in operation, and there are 83 blowing in Scotland, compared with 75 last week and 82 at this time last year. Of the total 40 are making hematite, 38 ordinary, and five basic iron.

The demand for makers' iron has now resumed its former state of activity. It is true that there has only been a moderate amount of iron purchased by consumers in the open market, but heavy deliveries are now being made by makers and merchants. The stock of pig iron in Connal and Co.'s Glasgow stores shows a reduction for the past week of 3749 tons, and the reduction since the beginning of the year is now 7203 tons.

Prices of makers' iron are firm as follows:—Govan, f.o.b. at Glasgow, No. 1, is quoted 70s.; No. 3, 69s.; Carnbroe and Wishaw, Nos. 1, 78s. 6d.; Nos. 3, 75s. 6d.; Clyde and Calder, Nos. 1, 82s. 6d.; Nos. 3, 77s. 6d.; Gartsherrie, No. 1, 82s. 6d.; No. 3, 77s.; Summerlee, No. 1, 86s.; No. 3, 80s.; Coltness, No. 1, 87s. 6d.; No. 3, 78s.; Glengarnock at Ardrossan, No. 1, 82s. 6d.; No. 3, 77s. 6d.; Eglinton at Ardrossan or Troon and Dalmellington at Ayr, Nos. 1, 77s.; Nos. 3, 74s. 6d.; Shotts at Leith, No. 1, 85s.; No. 3, 78s. 6d.; Carron at Grangemouth, No. 1, 85s.; No. 3, 78s. 6d. per ton.

There is a large and steady consumption of hematite pig iron at the steelworks, and the prices of Scotch-made hematite, after having touched 80s. per ton, are now improving. Merchants quote for this class of iron 81s. for delivery in railway trucks at the steelworks. Fair supplies of ore are being obtained, but it is not expected that prices will be lower for Spanish ore for some time.

The shipments of pig iron from Scottish ports in the past week have been 8613 tons, compared with 5244 in the corresponding week of last year. There was despatched to the United States 150 tons, South America 10, India 10, Australia 660, France 420, Italy 114, Germany 180, Holland 551, China and Japan 100, other countries 30, the coastwise shipments being 6388 compared with 3726 tons in the same week of 1899.

The finished iron and steel works are now for the most part in full employment. In some cases the full starting of work was delayed beyond what has been usual at this season by a scarcity of coals. This difficulty is now being gradually removed, so far as the supply is concerned, although very high rates are being charged for the fuel. The makers of finished iron quote rivet and angle iron and common bars, £9 5s., and best bars, £9 15s. delivered free at the ship at Glasgow net cash. Steel is very firm, and a very large amount of material has been booked for delivery over a great part of the present year.

The coal trade is still hampered with difficulties of transit, which keep back supplies from consumers, but it is expected that these will be gradually overcome, and that before long the trade will have resumed something like its normal condition. At some of the ports the pressure for shipment has eased off considerably, while in other cases coals cannot be got forward in sufficiently large quantities to meet the demand. The home trade is engaging the attention of coal masters very much at present, as the domestic consumer is ready to pay proportionately higher prices than can be obtained in connection with the shipping business. The prices of coals are nominally the same as those quoted last week.

## WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

THE rough weather of late, preventing the arrival of tonnage, has had some effect in lessening the excitement in the coal trade, but as the conditions remain which led to the boom, this may be considered as only temporary, and the upward course of things will be resumed. It was reported on 'Change this week that all the large colliery firms have full stems on their books for this month's loading, and this fact exceeds in value a page of speculation. Fortunately, too, labour questions are easy, and in the principal districts the output promises to be large, even if not quite up to the demand. In the Swansea Valley complaints are strong of a limited supply, and of almost phenomenally high prices. At Pontardawe, Hedley's Colliery, the colliers, 400 to 500, came out on Monday. Efforts are being made to bring about, if possible, an amicable settlement.

A slightly easier demand for steam coal was the most notable feature at the early part of the week, followed by perceptible improvement later. Best steam smalls maintained their remarkable position, as will be seen by latest quotations, and best and second-best house were in active request. So, too, the semi-bituminous coals of Monmouthshire, all in connection with Cardiff shipments. Newport has had a busy week, sending off a good general export, with large tonnage to Malta and Azores. In all, Newport despatched close upon 70,000 tons foreign, and 18,095 tons coastwise. Swansea had a good average export: 46,415 tons, and nearly 8000 tons patent fuel. Swansea local coal supplies are quite inadequate to meet the demands of its various industries, and short supplies have told seriously in many instances.

Latest Cardiff prices are as follows:—Best steam coal, 27s. 6d. to 30s.; seconds, 25s. to 26s.; drys, 23s. to 24s.; special smalls, 16s. 6d. to 17s.; seconds, 15s. to 15s. 6d.; drys, 13s. 9d. to 14s. 6d.; best Monmouthshire, large, 23s. to 24s.; seconds, 21s. to 21s. 6d.; Cardiff shipment; best house coal, 25s. to 26s.; No. 3 Rhondda, 23s. to 23s. 6d.; brush, 18s. 6d. to 19s. 6d.; small, 16s. to 16s. 6d.; No. 2 Rhondda, large, 18s. 6d. to 19s. 6d.; through and through, 15s. to 15s. 6d.; small, 13s. 6d. to 14s. Patent fuel, 22s. 6d. to 23s.; coke, furnace, 25s. to 26s.; good foundry, 28s. to 30s.; special foundry, 35s. to 36s. An average inquiry is stated on 'Change to characterise both patent fuel and coke.

The Government Annual Mining report shows a loss of 175 lives during the year in mining operations in Wales, a large proportion of which were due to falls of sides and roof.

The Ynyshir Steam Coal Company has acquired, and taken over from January 1st, the Ynyshir House Coal Company, formerly belonging to Mr. Thos. Jones.

A new colliery is to be started at Brynethin, and a movement is on foot for starting the Brynethin pits. Certain shares in the minerals underlying the Forest, and now worked by the Nixon Company, are being placed on the market, with the notification of royalties. First, a dead rent of £89 10s., then 7d. for every ton of large coal, 3½d. small, 6d. ironstone, and 3d. fire-clay.

I am glad to report that the Wynnstey colliers, Ruabon, whose notices expired on Saturday, have withdrawn them for a fortnight, to enable their representatives to effect a settlement if possible.

All districts are sharing in the prosperity in coal. Newport, Mon., broke its record in coal shipments last year, and the iron ore imports were greater than they have been for the past eight years. In the Forest of Dean the improvement in price and demand has benefited the collier in ratio. Last week there was an advance of 2s. per ton, and a concession to the men of 10 per cent.

This week, in the Cardiff district, some large Admiralty orders were placed. The total was about 90,000 tons, and the delivery from present date to June. Prices f.o.b. range from 24s. 9d. to 25s. This is higher than the strike prices of '98, which in May

were 23s. to 23s. 6d. best steam. The last Admiralty contracts, placed three months ago, ranged from 18s. to 19s. The present contracts have been divided as follows: Dowlais, 10,000 tons; Cyfarthfa, 6000 tons; Ynyshir, 6000 tons; Hills, Plymouth, 20,000 tons; per Adams and Wilson, Ferndale, 5000 tons; Albion, 6000 tons; Penrhwykiber, 15,000 tons; Nixon, 5000 tons; Burnyeat Brown, 5000 tons; Powell Duffryn, 15,000 tons.

It was stated on 'Change, Cardiff, mid-week, that all firms who quoted above the figures I have named were excluded.

Swansea coal prices this week are not freely quoted. They are very high, and forward sales have been declined at present figures:—Anthracite, 15s. 6d. to 16s.; seconds, 14s. 6d. to 15s. 6d.; ordinary, 11s. 6d. to 12s. 6d.; small rubble culm, 8s. 6d. to 9s. Steam, best, according to arrangement; seconds, 21s. to 21s. 6d.; bunkers, 17s. to 18s. 6d.; small, 12s. 6d. to 13s. 6d., all delivered f.o.b. Swansea, cash 30 days less 2½. Patent fuel, 18s. to 20s. Coke: Furnace, 29s.; best foundry, 30s. to 35s. Iron ore: Tafna, 20s.; Rubio, 21s. Pitwood, 19s. to 19s. 6d., into trucks. In the Newport, Mon., and Cardiff districts the prices of Cillb are as follows:—Rubio, 20s. 6d. to 21s.; Tafna, 19s. to 20s., c.i.b.

Iron ore has continued to come in freely principally from Bilbao, but of late the Dowlais Company has been importing also from Paraguelos, and Cyfarthfa from Almeria. It is expected that imports from the latter will increase, especially if the old scare is revived that the North of Spain resources are lessening. The drain is evidently great. Swansea imported 5126 tons last week, Briton Ferry 1500 tons, Blaenavon, Ebbw Vale, Cyfarthfa, and Dowlais considerable quantities. Amongst the imports of the week have been bar iron for Newport from Workington, pig iron from Barrow and other quarters totalling over 1000 tons to Swansea. I am glad also to note increased quantities of spiegel even from Mostyn to Ebbw Vale and Dowlais. Great tracts of manganese ore from Harlech to Barmouth will probably find a destination southward ere long by the Cambrian Railway.

Next month a quantity of blast furnace and colliery plant will be disposed of by auction at Abernant, Aberdare.

The war threatens to more seriously affect the steel works than was at first generally supposed. Considerable numbers of men are in various militia regiments, and as these are called in the strain will be great. The tendency of this may be expected to direct attention more strongly than ever to mechanical and other appliances. The latest, in the form of the Bolton stoker, now on trial at Dowlais, will relieve twenty men.

The Birmingham quarterly meeting gave a spurt to prices, and a further advance of 5s. to 7s. 6d. per ton in finished iron and steel was confirmed. This had been previously secured. On 'Change, Swansea, mid-week, there was a good deal of animation. It was reported that pig iron had shown a distinct revival. In Scotch there has been an advance of 1s. 5d.; in Middlesbrough, 1s. 4½d.; in hematite, 1s. 3½d. It was reported that there had been an extraordinary decrease in stocks, 3949 tons in Scotch, 2919 tons in Cleveland, and 6154 tons hematite; total 13,022 tons on the week. Market stated to be stronger than at any time during the past six months. Supplies of tin-plate bars short, and seriously affecting tin-plate mills. I give quotations with the proviso that they are nominal, and subject to moderate alteration. Coal is so abnormally high and scarce, and block tin has again advanced to £5 per ton. Forward sales have been declined at present quotations. Pig iron, Glasgow warrants, 67s. 9½d. to 68s., cash; Middlesbrough No. 3, 67s. 9d.; other numbers in proportion. Hematite warrants, 75s. 5d. for mixed numbers, f.o.b. Cumberland, according to brand. Welsh hematite, 85s.; Welsh bars, £9 5s. to £9 10s.; angles at usual extras. Sheets, iron, and steel, £11 5s. at works. Steel rails, heavy, £7 10s. to £7 15s.; light, £8 10s. to £8 15s.; sleepers according to section and specification. Bessemer steel: tin-plate bars, £7 5s.; Siemens, best, £7 7s. 6d. to £7 10s.

Tin-plates: Bessemer steel cokes, 16s. to 16s. 3d.; Siemens, coke finish, 16s. 3d. to 16s. 6d.; ternes, per double box, 28 by 20 c., 30s., 31s., to 34s.; best charcoal, 16s. 6d. to 17s. 6d. Big sheets for galvanising, 6ft. by 3ft. by 30 g., per ton f.o.t., £14 10s. to £15 10s.; finished black plate, £12 15s. to £13 10s.; Canadas, £10 15s. to £11 10s.; galvanised sheets, 24 g., £15 to £15 10s. Copper: Chili bars, £70 15s. to £70 12s. 6d. Block tin, £116 10s. to £117. Spelter, £20 7s. 6d. Lead, £16 15s.

There was a large shipment of tin-plate last week—92,735 boxes—receipt from works 64,539 boxes. Stock is down to 169,638. Short supplies of coal and bars have seriously affected make of the eight furnaces in Morriston, five only were at work. Serious breakages affected Foxhole, and from the same cause in the Briton Ferry district make was greatly reduced. Foundries in the Swansea Valley are working overtime. Mannesmann Works going well, also furnaces adjoining. Gloucester sheds very busy.

There was a meeting of the Tin-plate Conciliation Board in Swansea on Tuesday, but the business was not of an important character. A demand for a 15 per cent. advance for steelworkers was adjourned. Minor disciplinary disputes were arranged, and action taken to maintain friendly relations between the managers, superintendents, and men.

Aberystwith, unlike other places of the Welsh coast, is raising objections to receive more guns for defence.

A very successful machinery trial of the new Royal Yacht took place this week at Pembroke Dock.

It is reported at Milford Haven this week that the training ship for boys now at Cork Harbour will be transferred to Milford. Much difficulty is experienced in getting boys from the South of Ireland, and the advantages of the Welsh coast and the interest of Welsh boys in seafaring are admitted.

I have referred of late to the agitation amongst the railway men belonging to the Taff Vale, Cardiff, Rhymney, and Barry. The climax would now appear to be at hand. At the last meeting—Sunday—it was decided to hand in notices at the expiration of seven days if employers refuse to meet a deputation of the men to confer on wage questions. A strong wish is expressed all over the district that peaceful measures will prevail, even if deferred to the last moment. Action is evidently timed to take place when the whole of the Welsh industries are in fullest activity, and if persevered in must bring about complete stagnation. Railways have much to contend against at present, increased cost, coal, rails, &c., and lessened revenue. I believe that the difficulty will be tidied over. The concession of a meeting, and explanation of the trying position of railways at present, should impress the more reasonable of the men.

## NOTES FROM GERMANY.

(From our own Correspondent.)

FAVOURABLE accounts are given concerning employment in the various iron-producing districts, and inquiry is still exceptionally good in almost all departments.

Pig iron is in pressing demand, and the output readily purchased by manufacturers, who continue to be vigorously engaged, and are therefore most anxious to secure all they can get in raw material.

Last week's business on the Silesian iron market was, in some branches, more lively than before the holidays, and there is a brisk, healthy tone prevailing. Heavy plates and merchant bars appear to be in rising demand. The business done on foreign account is limited, and much weaker than in summer.

Coal and coke are in large request. Total shipments during December last year were, for the Ruhr district, 3,392,280 t., against 3,779,770 t.; for the Saar district, 553,670 t., against 580,250 t.; for Silesia, 1,329,080 t., against 1,480,880 t.; and for the three districts together, 5,275,030 t., against 5,840,900 t. for the same month in 1898. The decrease in output was 10·3 per cent. for the Ruhr district, 4·6 per cent. for the Saar district, 10·2 per cent. for Silesia, and 9·7 per cent. for the three districts together. Total deliveries of coal and coke in the past year were, for the Ruhr district, 45,614,240 t., against 42,932,300 t.; for

Silesia, 16,806,530 t., against 15,909,990 t.; for the Saar district 6,917,510 t., against 6,709,120 t.; and for the three districts together, 69,338,280 t., against 65,551,410 t. in the year before. Increase in output was accordingly 6·2 per cent. for the Ruhr district, 5·6 per cent. for Silesia, 3·2 per cent. for the Saar district, and 5·8 per cent. for the three districts together.

The following figures, given by the *Rheinisch-Westphalische Zeitung*, show imports in English coal to Hamburg to have been in 1899, from Durham and Northumberland, 1,235,354 t., against 1,022,243 t. in 1898; from the Midlands, 491,949 t., against 440,123 t.; Scotland, 576,767 t., against 541,885 t.; Wales, 110,325 t., against 39,325 t. Coke: 5762 t., against 11,524 t.; total import thus amounting to 2,420,157 t., against 2,055,100 t. From Westphalia 1,645,805 t. coal were sent to Hamburg, against 1,652,154 t. in 1898. In December last year import in coal from Durham and Northumberland was 88,294 t., against 97,791 t. in 1898; Midlands, 39,644 t., against 49,440 t.; Scotland, 47,226 t., against 54,618 t.; Wales, 7457 t., against 6646 t.; total import amounting to 182,661 t., against 209,465 t. From Westphalia 113,183 t., against 128,908 t., were sent to Hamburg in December last, total supplies thus amounting to 295,844 t., against 338,373 t. in 1898.

The business done on the iron market in Austria-Hungary is of the most limited description, and entirely of the hand-to-mouth sort. All through last year Austrian ironmasters have been, on the whole, but moderately engaged, and quotations have shown a tendency to weakness. Fortunately, export has been improving, especially in bars, plates, and girders; and though this was caused by the Austrian prices being lower than those in other countries, still the orders thus secured have done a good deal to keep the works going regularly. At the same time, imports in iron and steel to Austria-Hungary were very low on account of the pressing demand for all sorts of iron which was felt in other countries, and so the majority of the Austrian shops were fairly well engaged during the greater part of the year. The business in scythes has been anything but satisfactory, partly on account of an unfavourable harvest, and also because foreign competition was very keen and successful.

Though demand and inquiry have been moderate when compared to the last quarter, the Belgian iron market has yet been showing remarkable firmness upon the week, and prices are all well maintained. Quotations in the first of January were as follows:—Luxemburg foundry pig, No. 3, 110f.; ditto, forge pig, 100f.; basic, 110f. per ton. Merchant bars, No. 2, 225f. to 230f.; No. 3, 230f. to 235f. p.t.; for home consumption, No. 2, for export, realises 215f. to 225f. p.t.; No. 3, 220f. to 230f. p.t. Inland quotation for girders is 205f.; angles, 235f.; iron-plates, No. 2, 225f.; No. 3, 240f.; sheets, 250f. steel rails for export, 160f. p.t. Production of pig iron in Belgium during the month of December last year is officially stated to have been 104,780 t., 28,055 t. being forge pig, 9145 t. foundry pig, and 67,580 t. basic. Total output of pig iron in Belgium was nearly 25 per cent. higher than in 1898, being 1,219,690 t. for 1899, and 982,748 t. for the year before.

The Belgian coal trade is very active, and quotations remain exceptionally high; the opinion prevails that for spring orders 21f. to 22f. p.t. will be quoted for engine coal, and 25f. to 27f. p.t. for best steam coal. Small coal fetched 15f. to 18f. p.t. last week. In November last year exports in artificial coal from Belgium amounted to 44,840 t., against 51,019 t. for the same month in the previous year, while from January to November in the year now past export was 488,480 t., against 610,960 t. in the same period the year before.

The following figures, given by the *Rheinisch-Westphalian Gazette*, show the production of iron and steel in Sweden to have been, during the first nine months of last year, as under:—

	1899. Tons.	1898. Tons.
Pig iron . . . . .	381,730	400,400
Malleable iron . . . . .	14,700	142,000
Bessemer ingots . . . . .	71,200	79,000
Martin ingots . . . . .	120,100	114,000
	587,730 tons.	735,000 tons.

## THE NEWPORT HARBOUR COMMISSIONERS' WEEKLY TRADE REPORT.

STEAM coal keeps in good demand, and prices for all descriptions are very firm. House coal in good request, and prices have a strong upward tendency. Tin and copper both higher than last week's quotations. Exports for week ending January 12th, 1900, were:—Coal, foreign, 69,361 tons; coastwise, 18,095 tons. Patent fuel, 1200 tons. Imports for week ending 16th inst. were:—Iron ore, 4470 tons; pig iron, 510 tons; bars, 220 tons; cement, 160 tons; pitwood, 4712 loads.

Coal:—Best steam, 23s. to 24s.; seconds, 21s. to 22s.; house coal, best, 20s.; deck screenings, 16s.; colliery, small, 15s. to 15s. 6d.; smiths' coal, 13s. to 13s. 6d. Pig iron:—Scotch warrants, 60s. 1d.; hematite warrants, 75s. 11d. f.o.b. Cumberland; Middlesbrough, No. 3, 68s. 1d. prompt. Iron ore:—Rubio, 20s. 6d. to 21s.; Tafna, 19s. 6d. to 20s. Steel rails, heavy sections, £7 10s. to £7 15s.; light ditto, £8 10s. to £8 15s. f.o.b.; Bessemer steel tin-plate bars, £7; Siemens steel tin-plate bars, £7 2s. 6d., all delivered in the district, cash. Tin-plates:—Bessemer steel, coke, 15s. 9d. to 16s.; Siemens, coke finish, 16s. to 16s. 3d. Pitwood, 17s. to 17s. 6d.

London Exchange telegram:—Copper, £70 10s.; Straits tin, £116 10s. Freights firm.

THE PREVENTION OF RAILWAY ACCIDENTS.—A test of the Laffas system for preventing railway accidents took place at Barry on Tuesday last. The testing train consisted of an engine and nine coaches, weighing altogether about 160 tons. The trials appear to have met with a good deal of success. The Board of Trade representative will probably visit Barry next week to test the system.

TRADE AND BUSINESS ANNOUNCEMENTS.—Mr. Emile Cloes, civil engineer and representative for Belgian works, 122, Cannon-street, London, E.C., has retired from business, and has transferred his agencies to Mr. Adolphe Corin, who will carry on business at the same address under his own name.—Mr. Edward Lomer, 12, St. Mary Axe, has been appointed agent in this country of the Accumulator Works (Accumulatoren Fabrik A.G.), of Berlin and Hagen, Westphalia.—Mr. Jno. Stevenson, Middlesbrough, has taken his son, Mr. Joseph Shaw Stevenson, into partnership.

GEORGE FURNES.—The death is announced of Mr. Geo. Furness, a well-known contractor for public works of the old school. Mr. Furness commenced business about 1841, his first contracts being for the construction of railways in the Midlands. Subsequently he transferred his energies to France, where he was associated in important railway contracts with the late Mr. Thomas Brassey, father of Lord Brassey. Upon his return to England he constructed railways in most of the Midland, Western, and Southern counties, having at the same time very heavy contracts abroad. In London he constructed the northern outfall sewer, the reservoirs in connection therewith—the combined works forming an important feature to the present main drainage system of London—and the Thames Embankment from Westminster Bridge to the east end of Somerset House. The tenders for these undertakings in London approached one and a-half million sterling. The last railway built by Mr. Furness in England was the extension of the South-Eastern to Port Victoria.

## AMERICAN NOTES.

(From our own Correspondent.)

NEW YORK, January 3rd.

THE most important factor in the iron and steel industry to-day is the prospective railroad requirement for 1900. Over 4500 miles were built in the United States during the past year. The estimates as to construction this year differ very widely. Much depends upon the condition of the money market, and as to this it is possible to speak only in general terms. Congress is legislating in a manner which promises to remove all elements of uncertainty from the pathway of financiers. To all appearances there is an abundant supply of money, subject, however, to occasional twists given to the market by speculators in Wall-street. Government has taken steps, however, by which the Internal Revenue receipts will not be tied up in banks, but will remain in circulation. Three-fourths of the railroad building last year was done by way of extending existing lines. Some of the building to be done this year will consist of entirely new lines, or new lines connecting existing systems. In Canada 470 miles of road were built, and in Mexico 255 miles last year. The State of Iowa took the lead with 552 miles. A great increase in mileage will take place throughout the western and south-western States. Considerable railroad building will also be done in the far North-West and in British America. Prices for railroad material rule high, and to all appearances there will be very little, if any, decline. The reason for this is that requirements are so heavy, mills are sold so far ahead, so many new enterprises are coming to the surface that manufacturers of rail equipment, locomotives, and cars, see no occasion for showing any leniency to the companies. Pig iron production is close on to 300,000 tons per week. Every effort is being exerted to push the construction of furnaces, rolling mills, the enlargement of foundries, and the expansion of capacity in every direction involving the consumption of iron and steel. The greatest activity lies in the expansion of plate mill capacity and the building of new mills. Two or three of these are about producing material, and this fact accounts in part for the decline in plate in large quantity. The leading bridge builders are making up their prospective requirements for the third quarter of the year. If prices are suitable they will place orders in the latter part of this month. Included in these probable requirements are some orders from Europe and Asia, the extent of which is unknown at this time.

The manufacturers of iron and steel in this city said last Saturday that they were warranted in the belief that the requirements for the third and fourth quarters of the year would largely be placed during the first quarter. If so, they say that means a rush of business unprecedented in the annals of the iron and steel trade, but they decline to speak as to the probability of any weakening in prices. Such talk as this is only heard among buyers, whose wish is father to the thought. Manufacturers themselves see no reason for any weakness, and, on the contrary, state that everything points to even stronger quotations. It is, however, the general belief that iron and steel quotations have reached the highest probable level. Several very important improvements will shortly be inaugurated in this city, involving the construction of one or more tunnels, one or more bridges, and the radical improvement of our rapid transport system, including the use of electricity instead of steam. The contemplated expenditures will reach between 30,000,000 dols. and 40,000,000 dols., and it is the intention to rush the work through as rapidly as possible. There is nothing new in the Lake Superior ore situation beyond the fact that extraordinary activity prevails in the manufacture of equipment for the quicker handling of ore from the mines to the furnaces. It is also intimated that a great deal of new ore territory will be defined early in the spring, but the deposits are much more extensive than have been supposed. It has been believed for years past that the limits of the ore deposits were pretty definitely ascertained. This is probably the case, still there may be small outlying fields of value.

## ENGINEERING NOTES FROM SOUTH AFRICA.

(From our own Correspondent.)

IMPORTANT as was the part attributed to artillery by the prophets before the Boer war began, few could have expected to find it dominate the position so completely. On the whole, the burghers' rifle shooting has not turned out so deadly as it was represented, but with the aid of their heavy modern guns, their entrenched positions on the rugged kopjes of Northern Natal, have become almost impregnable. Several months ago, in Johannesburg, one of the chief officers of the Staats Artillerie assured me, "We are not afraid of the resources of the British Empire, and we mean to fight. We shall get into Natal and take up our positions, and we shall laugh at the resources of the British Empire." This sounded at the moment like the customary Pretorian "bluff," but subsequent events have at least given it a certain measure of justification. The ordinary type of British field artillery does not appear to be powerful enough for dealing with an enemy who will not quit his entrenchments under any conditions, and who is supported by far heavier guns than any we can bring against him. The fact is that the Boer, fighting with the assistance of continental experts and with the best continental war material, represents an entirely different level of guerilla warfare to that of the Indian frontier tribes. Regular siege guns seem to be required to dislodge him from his positions, and upon the artillery officers will be thrown the principal brunt of the attack. Pending the arrival of more guns, therefore, there is likely to be a protracted lull in the campaign.

A good deal of interest has been excited in South Africa by the report that the amalgamation of the two mail steamship companies has been decided on. This interest centres almost entirely upon the possibilities of improvement in speed and comfort of service, and of reduction in freights, which may result from the change. A

little consideration, however, would show that the proposal, if effected, is not likely to introduce any alteration in these respects. For a long while past the competition between the two mail lines has been purely nominal, and they have practically agreed to divide the traffic. One proof of this is in the absolute identity of their shipbuilding policy. Within the past few years both fleets have been practically re-modelled on the same general lines. The Kinfauns and Kildonan Castles are very well matched by the Norman and Briton, and a similar comparison may be drawn with the two companies' new intermediate vessels. Amalgamation would, therefore, simply mean administrative economy, and would certainly lead to no revolution in the class of steamships engaged in the Cape passenger service. There is, indeed, very little to complain of in the present facilities, and many people prefer a seventeen-knot steamer to the tearing greyhounds of the Western Ocean. No doubt fares and freights are high; but then it must be remembered that there is practically no return cargo from South Africa, and the homeward voyage has frequently to be made with empty holds. The last monthly Cape trade returns are very illustrative of this latter fact. Now that the war has stopped the export of gold and diamonds, the value of the exports has dropped from about a million and a-half to under £600,000. By the way, the steamship companies must have done very well out of the war, not only by the letting of transports, but also by the carrying of the large crowd of British refugees from the Transvaal.

I have not seen it mentioned that the home-made carriage for the 4.7in. naval gun enables that piece to be drawn by eighteen men—the customary crew for a 12-pounder.

## COAL MINING IN SOUTH RUSSIA.

MR. JOSEPH CRANKSHAW, F.G.S., read before the members of the Manchester Geological Society recently, a paper on "Coal Mining in South Russia," dealing chiefly with the coal mines of the Jusovo district, which is the centre of the bituminous coalfield of the Donetz basin. The whole of the district was, he said, overlaid with an alluvial deposit of gravel and sand, from 40ft. to 120ft. in thickness, beneath which the coal seam outcropped. The seams were at a high inclination near the surface, being at an angle of 18 deg., but they became much flatter to the deep, and at about 400 yards they were in some places only 4 deg. to 5 deg. Few of the pits were more than 200 yards deep; they were rectangular in shape, and about 13ft. 6in. by 5ft., lined with timber, with one or two partitions. The conductors were of wood, and most of the cages provided with safety catches called "parachutes." The men, however, generally ascended and descended by "ladders." The winding engines were mostly of the type used in England for underground haulage, and were used at pits with an output of 200 to 1000 tons per week; but one colliery was winding 1000 tons a day from one of their pits, for which they had a pair of engines made by Messrs. Walker, of Wigan, with 42in. cylinder and 7ft. stroke. The workable seams in the district varied in thickness from 72in. to 15in., but the average was about 24in. The coal was generally of a good appearance, light in weight, with a fibrous fracture, and was described as "fatty" coal. Some of the seams yielded a high percentage of gas, but they were also rather high in sulphur, ranging from 0.77 to 2.5 per cent. The system of working was mostly pillar and stall. A large proportion of slack was produced, but this did not seem to be of much importance, as the same price was got for the coal, independently of size. The cost of getting and carting was equal to 58s. 4d. to 69s. 4d. per ton, put in railway trucks. The selling price of the coal was equal to 8s. 1d. to 11s. 8d. per ton at the time of his visit, and had gone up considerably since. The average profit was quite 4s. per ton. At the present moment every encouragement was being given to Englishmen and English capital.

In answer to questions from members, Mr. Crankshaw said none of the coal was shipped; the collieries could not raise enough for the manufacturers in their own country. The coal belonged to the middle or lower measures, but not the millstone grit, although the limestone came immediately up to the coal measures in some parts.

## LAUNCHES AND TRIAL TRIPS.

NORTHLANDS, steel screw steamer; built by, Wm. Gray and Co., Limited; to the order of, Jones and Hallett; dimensions, 329ft., 46ft., 23ft. 6in.; engines, triple-expansion, 23in., 36in., 62in., by 39in., pressure, 160 lb.; constructed by, Central Marine Engine Works; trial trip, January 10th.

MACEDONIA, steel screw steamer; built by, Craig, Taylor, and Co., Stockton; to the order of, A. C. de Freitas and Co., of Hamburg; dimensions, 274ft., 35ft., and 23ft. 8in. moulded; engines, triple-expansion, 22in., 35in., and 59in., by 39in. stroke, pressure, 160lb.; constructed by, Thomas Richardson and Son, Limited; trial trip, January 13th; 12½ knots.

AQUA, steel screw steamer; built by, Ropner and Sons, Stockton-on-Tees; to the order of, Sir Christopher Furness, for Newman and Dale, of London; dimensions, 325ft., 48ft., and 24ft. 3in. moulded; to carry, 5200 tons deadweight; engines, triple-expansion, about 1100 I.H.P., pressure, 160 lb.; constructed by, Blair and Co., Limited; launch, January 16th.

ZINNIA, steel screw steamer, spar deck; built by, Tyne Iron Shipbuilding Company; to the order of, Stag Line, Limited; dimensions, 345ft., 46ft., 28ft.; engines, triple-expansion, 23in., 38½in., 64in., by 42in., pressure, 180 lb.; constructed by, North-Eastern Marine Engineering Company; launch, January 16th.

VAUXHALL, steel screw steamer; built by, Irvine's Shipbuilding and Dry Docks Company, Limited; to the order of, West Hartlepool Steam Navigation Company; dimensions, 352ft., 48ft., 27½ft.; to carry, 8000 tons (measurement); engines, triple-expansion, 25in., 40in., 66in., by 45in.; pressure, 160 lb.; constructed by, Sir Christopher Furness, Westgarth, and Co., Limited; launch, January 17th.

## THE PATENT JOURNAL.

Condensed from "The Illustrated Official Journal of Patents."

## Application for Letters Patent.

When inventions have been "communicated" the name and address of the communicating party are printed in italics.

5th January, 1900.

529. ASSISTING THE PROPULSION OF CYCLES, G. B. H. Austin, London.
330. TRANSMITTING MOTION IN TRACTION ENGINES, J. Marshall, London.
331. CASTING METALS, H. Edmunds, London.
332. MANUFACTURING LEAD TUBING, H. Edmunds, London.
333. COIN-FREED APPARATUS, A. M. Argles, London.
334. GAS GOVERNORS, S. Chandler, jun., J. Chandler, and Kirkham, Hulett, and Chandler, London.
335. ELIMINATING IMPURITIES FROM METALLIC SOLUTIONS, G. E. and A. R. Davis, London.
336. ADDING MACHINES, W. Heintz, London.
337. BOTTLES, R. Thompson, London.
338. KILNS FOR FIRING CERAMIC WARE, C. Czerny and C. Schimp, London.
339. TENTS, E. L. Munson, London.
340. PRINTING MACHINES, J. R. Corbin, London.
341. ART OF PRINTING, J. R. Corbin, London.
342. PRINTING MACHINES, J. R. Corbin, London.
343. NUT LOCKS, O. O'Sullivan and E. G. Boardman, London.
344. ORDONANCE, C. A. Jensen.—(E. W. Anderson, United States.)
345. WOOD-TURNING APPARATUS, &c., J. Howard, London.
346. BRAKES, E. Wits, London.
347. CONSTRUCTION OF VEHICLES, R. George, sen., London.
348. LAUNDRY APPLIANCES FOR PETTICOATS, E. Graddoff, London.
349. EXTRACTS FOR MAKING BEVERAGES, R. J. White, London.

6th January, 1900.

350. APPARATUS FOR PHYSICAL EXERCISE, J. Robinson, Ipswich.
351. RIMS OF CARRIAGE WHEELS, &c., R. H. Smith, London.
352. ACETYLENE GAS LAMPS, A. D. Platt, Dublin.
353. CUTTING ROLLED "TOBACCO PLUG," C. H. Andrew, Manchester.
354. INJECTORS, T. H. White, Manchester.
355. DISTILLATION OF SHALE COAL, A. Ramage, Glasgow.
356. TREATING WASTE PRODUCTS, A. Ferguson, Glasgow.
357. PORTABLE CABINETS FOR BATHS, S. Morrison, Glasgow.
358. BILLIARD CUES, W. Warburton and R. Theaker, Sheffield.
359. BEVEL PROTRACTOR, A. B. and H. B. Barlow, Manchester.
360. REBOUNDABLE ARMOUR PLATE, J. Morrison, Durham.
361. DOUBLE LINK DETACHABLE CHAIN, A. H. McNaught, Ayr.
362. MACHINE FOR CUTTING CLOTH, W. A. McWilliam, London.
363. AUTOMATIC COUPLINGS, H. S. Frampton, London.
364. VALVE, C. H. Bryant and O. Fraenkl, London.
365. FURNACE FOR MELTING METALLIC PRECIPITATES, A. James, London.
366. GENERATING ACETYLENE GAS, M. Lieske, London.
367. ADJUSTING ELECTRIC-LIGHT SHADES, M. A. and H. Crankshaw, London.
368. LAMP BURNERS, J. Pepper, Sheffield.
369. COMPRESSORS FOR REFRIGERATING MACHINES, H. Renno, London.
370. REFRIGERATORS, &c., H. Renno, London.
371. MANUFACTURE OF GRAPHITED CARBON, F. Schmidt, London.
372. WINDING THREAD, J. Drummen, London.
373. SEWING-MACHINE NEEDLES, G. J. and P. Queck, London.
374. APPARATUS FOR FILTERING OIL, J. and J. R. Smith, Keighley.
375. RANGE FINDERS, A. A. Common, London.
376. SAFETY DEVICE FOR BROOCHES, E. Porter, London.
377. SAVING VESSELS AT SEA, E. Edwards, London.
378. MANUFACTURE OF GLASS ARTICLES, A. Berenberg and O. Hellstern, London.
379. COLOURS UPON THREADS, O. Hoffmann, London.
380. DENTISTS' SPITTOONS, A. Fogg, London.
381. TOOL FOR CLOTH MAT MAKING, J. Hewins and C. Hardy, London.
382. CUTTING BREAD, G. W. E. Kemball, Liverpool.
383. GRINDING MACHINES, W. P. Thompson.—(M. W. Nevens, C. J., G. M., G. C., and O. C. Luther, United States.)
384. RECEPTACLE FOR LIQUOR, T. Pusch, London.
385. SPINNING COTTON, W. A. Phillips, London.
386. PULVERISERS, H. Arledter, London.
387. PUMPS, O. Beckmann, London.
388. ACETYLENE LAMPS, S. J. Earl, London.
389. CYCLES, G. C. Marks.—(H. Treppeau and C. Lagarde, France.)
390. DRIVING GEAR OF CHAINLESS BICYCLES, G. C. Marks.—(H. Treppeau and C. Lagarde, France.)
391. PNEUMATIC TIRES, M. J. Badet, London.
392. SHEATHS FOR SPINDLES OF SPINNING MACHINES, R. N. Aubele, London.
393. MEANS OF WORKING METALS, J. D. Mattison, London.
394. SHIELD FOR MILITARY PURPOSES, C. Thompson, London.
395. PRODUCING MULTIPLE PICTURES, W. Caelius, London.
396. METERS, M. Behrendt, London.
397. SWIMMING GLOVE, Emerich of Varga and D. Zilahi, London.
398. COVER FASTENINGS FOR BOTTLES, I. P. Doolittle, London.
399. TELEPHONE CALL STATIONS, A. and E. Chabaud, London.
400. LAMPS, C. A. Lee, London.

8th January, 1900.

401. ANGULAR SOCKET, H. MacKintosh, Inverness.
402. LAMPS FOR LIGHTING STREETS, H. F. Joel, Forest Gate, Essex.
403. MACHINES FOR CUTTING STONE, &c., S. Holgate, Altham.
404. PILLARS FOR BEDSTEADS, R. P. Taunton, Birmingham.
405. MUSICAL INSTRUMENTS, &c., S. Howard, Manchester.
406. PHOTOGRAPHIC CAMERAS, S. D. McKeller, Manchester.
407. PROPPELLING CYCLES, A. Nightingale and C. Arnold, Wolverhampton.
408. RETORTS FOR DISTILLING SHALE, J. Beveridge and The Linlithgow Oil Company, Limited, Glasgow.
409. MOULDING BOTTLE STOPPERS, A. B. McLean, Leeds.
410. APPARATUS FOR PRODUCING GAS, E. J. Duff, Glasgow.
411. AUTOMATICALLY FEEDING BOILERS, F. Schoeneberger, Bradford.
412. FLASHLIGHT APPARATUS, O. Giese, Glasgow.
413. ARRESTING THE MOTION OF VESSELS, H. Simpson, Liverpool.
414. FIXINGS FOR FITTED WOODWORK, A. J. Norris, London.
415. SETTING SAWS, D. Wright, Manchester.
416. RECORDING VOTES AT MEETINGS, H. Riley, London.
417. ARMoured ROAD CARRIAGES, T. and H. Fenwick, London.
418. BEDSTEADS, L. Dutriez, London.

419. WATER LEVEL INDICATORS, W. E. Pott, Sutton, Surrey.
420. ELECTRIC ARC LAMPS, H. Premer, Barmen, Germany.
421. MAKING SOAP BUBBLES, G. Krafft, Barmen, Germany.
422. APPLIANCE FOR USE IN DRAWING, J. A. Jones, London.
423. RECEPTACLE FOR HOLDING ARTICLES, T. H. Percival, London.
424. DRILLING MACHINE, M. C. Jackson, J. McDonough, and A. J. Clark, London.
425. BRUSHES, H. C. Woodworth and B. G. Spiller, London.
426. APPARATUS FOR ELEVATING MATERIALS, J. Fishburn, London.
427. ENAMELLING PROCESS, S. S. Bromhead.—(C. H. Waterman, United States.)
428. FASTENINGS FOR SHIRT FRONTS, &c., J. Rahm, London.
429. BOOTS, J. J. Hartopp, London.
430. PURIFYING TURPENTINE OR PINE OIL, G. Weber, London.
431. FRET SAWS, F. Beck, London.
432. EXHIBITING PHOTOGRAPHS, J. A. Prestwich, London.
433. AUTOMATIC MIXING MILLS, A. and A. Simon, London.
434. TELEPHONES, A. S. Bowley, London.
435. LOCKING DOORS, F. T. Hollins and H. C. T. Amendt, London.
436. FILES, K. Faber, London.
437. VEHICLE BRAKE, J. Dulait and C. V. Berghe, London.
438. COIN-FREED DELIVERY APPARATUS, F. E. Fensom, London.
439. MANUAL COAL-MINING MACHINES, H. Ebert, London.
440. ELECTRICAL SOCKETS, L. M. Chapman and J. M. Gelatt, London.
441. SAFETY VALVES, J. W. MacKenzie.—(F. Schreidt, United States.)
442. SOLDERING IRON, C. Shields, London.
443. LAND ROLLERS, J. W. Newman and E. C. Roberts, London.
444. BRACES OR BIT STOCKS, W. L. Baumgardner, London.
445. PUMP, E. de G. Whomes, London.
446. COMBINATION TOOL FOR USE OF ENGINEERS, E. Jones, London.
447. PROTECTOR FOR HAT OR BONNET PIN, R. Chidley, London.
448. ATTACHMENTS FOR HOUSEMAIDS' PAILS, R. Chidley, London.
449. STOVES, H. Cole, A. H. Waters, and H. Lowe, Birmingham.
450. STEAM-PRESSURE PUMPS, J. E. L. Ogden, London.
451. REGULATING THE SUPPLY OF AIR, F. Pinther, London.
452. WASHING PLATES, DISHES, &c., A. M. Mills, London.
453. COOKING UTENSILS, C. N. Hodgson, London.
454. CLIP FOR SECURING CYCLE PUMPS, J. Williams, London.
455. INKSTAND, H. R. Mutant, London.
456. STOPPERS FOR RECEPTACLES, A. W. Howarth, London.
457. PARCEL CARRIER, F. W. Schroeder and P. W. Moran, London.
458. TRAIN SIGNALLING, F. W. Schroeder and P. W. Moran, London.
459. SPINNING AND BLEACHING MATERIALS, R. Brandts, London.
460. CYCLISTS' REPAIR REQUISITES, &c., H. Berbyn, London.
461. BAG, E. Nolzen, London.
462. COIN-ACTUATED VENDING MACHINES, R. Kann, London.
463. ELECTRICAL SWITCHES, W. L. Wise.—(The Aktien Gesellschaft Elektricitätswerke vorm O. L. Kummer and Co., Germany.)
464. HEATING FURNACES, W. C. Macey, Kingston-on-Thames.
465. SECURING TRACES TO THILLS, P. R. J. Willis.—(A. A. Arthur, United States.)
466. FACILITATING THE ESCAPE OF GAS, W. J. Wells and Allan and Adamson, Ltd., London.
467. FITTINGS FOR ELECTRIC LIGHT, B. M. Fletcher, London.
468. SADDLES, J. Scott, London.
469. GLASS CUTTERS, B. J. R. Mills.—(C. Dugon, France.)
470. PHOTOGRAPHIC REDUCING AGENTS, B. J. B. Mills.—(La Société Anonyme des Plaque et Papiers photographiques, A. Lumière et ses fils, France.)
471. AIR CARBURATORS, C. D. Abel.—(La Société Anonyme des Anciens Etablissements Panhard et Levaasor, France.)
472. OBTAINING ZINC FROM ORES, G. Harrison.—(Messrs. C. Casoretti and F. Birtani, Italy.)
473. BORING MACHINE, W. H. Gaylord and F. Eitapene, London.
474. RAIL JOINTS, E. Ling and C. F. Liegwarth, London.
475. LIGHT-EXTINGUISHING CANDLESTICKS, J. Murdoch, London.
476. MEANS OF HEATING OF STEAM BOILERS, E. Gobbe, London.
477. LIGHT-PROJECTING GLASS, G. Moffat and E. J. Dobbins, London.
478. TELESCOPES, J. W. W. Baker, London.
479. UTILISING HEAT, R. C. Parsons and R. Belfield, London.
480. CLUTCH MECHANISM, R. Tingey and Milner Safe Company, Ltd., Liverpool.
481. APPARATUS FOR PLAYING A GAME, J. von Rutkowski, Birmingham.
482. PRINTING MUSIC TYPOGRAPHICALLY, W. H. Lack, London.
483. TREATMENT OF COMPLEX ORES, F. Ellershausen, London.
484. APPLIANCES FOR SAVING LIFE, G. A. Logsdail, London.
485. SELF-BINDING HARVESTERS, L. M. Jones, C. McLeod, and F. D. Mercer, London.
486. TEXTILE MATERIAL-TREATING APPARATUS, R. Weiss, London.

9th January, 1900.

487. BAND-SAW MECHANISM, J. W. King, London.
488. TURNSTILE, J. H. Winson and F. B. Tussaud, London.
489. LOCATING EARTH CONTACTS, M. J. Myers, London.
490. CUTTING PRESSES, J. A. Keay and The British United Shoe Machinery Company, Ltd., Leicester.
491. PETROLEUM MOTORS, R. Lucas, Forest Row, Sussex.
492. TROUSER STRETCHERS, A. Doman, Dudley.
493. HYDRAULIC VALVE GEARS, R. Middleton, Leeds.
494. SELF-COLLAPSIBLE SEATS FOR SHOPS, M. Owens, Dublin.
495. SINGLE-TRIGGER DOUBLE-BARREL GUNS, W. Baker, Birmingham.
496. RETAINING IN PLACE PINS AND STUDS, A. G. Strong, Bristol.
497. SASH LOCKS FOR WINDOWS, H. C. Price, Birmingham.
498. TURNING MACHINERY SPINDLES, G. Hayhurst, Bury, Lancs.
499. ATTACHING FABRICS TO THEIR FRAMES, W. H. Davis, Birmingham.
500. COUPLINGS FOR RAILWAY WAGONS, J. Mallon, Manchester.
501. FABRIC PRINTING, J. Galbraith and W. McW. Petrie, Glasgow.
502. WINDING YARN, J. T. Haworth, T. C. Usher, and A. E. Hodgson, Halifax.
503. HOT-WATER BOILERS, &c., J. W. Sutcliffe, H. Bottomley, and Hartley and Sugden, Limited, Halifax.
504. HOISTS CONTROLLED BY FRICTION, E. J. Smallcombe, Manchester.

505. HAIR-CLIPPING MACHINES, &c., J. Dunnachie, Glasgow.
506. KITCHEN RANGES, J. Thompson, Newcastle-on-Tyne.
507. BELLS, A. Clarke, Birmingham.
508. TILE, W. W. Gravill, Leeds.
509. DYING YARN, J. Major and T. J. Wood, Manchester.
510. SPEED GEAR for ROAD VEHICLES, R. F. Hall, Birmingham.
511. BURNERS, S. B. Moss, London.
512. WATCHES, J. A. Lund, London.
513. TUBE CLEANERS, W. S. Elliott, London.
514. WEFT WINDING of LOOMS, J. A., and H. Ryo, London.
515. DRAUGHT EXCLUDER, F. Johnson, London.
516. ELECTRIC SWITCH, J. Vesely, London.
517. CYCLE STANDS, E. Mettes, London.
518. SECTIONAL BOOKCASES, F. Macey, London.
519. LOCK-NUTS for BOLTS, J. Parbel and H. Meissner, London.
520. MAKING SAND MOULDS for CASTINGS, H. E. Pridmore, London.
521. FELT REFINING MACHINES, P. F. Comstock and A. Hedbavny, London.
522. FOLDED JOINTS for SHEET METAL, T. L. Carbone, London.
523. SOLDERING APPARATUS, T. L. Carbone, London.
524. ELECTRICAL RESISTANCES, E. A. Goddin and J. T. Armstrong, London.
525. STAMPING METAL, A. J. Boulton.—(R. Krockner and A. Hahn, Austria.)
526. MOTOR MECHANISM for VEHICLES, K. Schiller, London.
527. PNEUMATIC TIRES for WHEELS, J. Despaiguet, London.
528. WHISTLES, G. J. Couchois, London.
529. BACK PROTECTORS for BED-PANS, C. Traubaud, London.
530. CHLOROCARBONIC ETHERS, H. E. Newton.—(Farbenfabriken vormals F. Bayer and Co., Germany.)
531. CIGAR MACHINES, P. A. Newton.—(The American Cigar Machinery Company, United States.)
532. PRINTING MACHINERY, H. E. Newton.—(R. Hoe, United States.)
533. CARPENTERS' SET SQUARE, A. C. Smith, London.
534. REFRIGERATORS, E. G. Behrend, London.
535. CYCLISTS TOOL BAGS, A. E. Lowenthal and A. G. Walker, Birmingham.
536. MILITARY SHIELD, E. J. Dyer, London.
537. STOPPING ENGINES, J. J. Kaye, London.
538. CARTRIDGES, C. A. Bailey and E. S. Coe, London.
539. ZINC BLOCKS to PREVENT CORROSION, G. C. H. Prost and J. S. Clausen, London.
540. CAKE FORMERS for OIL MILLS, W. P. Thompson.—(The Meridian Machinery Company, United States.)
541. AIR and GAS ENGINES, J. W. Eisenuth, Liverpool.
542. COMPRESSOR for MAKING CUPELS, A. C. Calkins, Liverpool.
543. WASHING and DISINFECTING CLOTHES, H. Tipper and A. McAllister, Manchester.
544. TILTING APPLIANCES for WAGONS, W. H. Pheysey, Birmingham.
545. EXPLOSIVE ENGINES, A. F. Spooner.—(R. Feraud, France.)
546. DRIVING GEAR for MOTOR CARS, A. F. Spooner.—(R. Feraud, France.)
547. PROCESS of MAGNETIC SEPARATION, C. Q. Payne, London.
548. TIME INDICATORS, I. F. Phelps, London.
549. JAR FASTENERS, R. H. Hamer, London.
550. TREATMENT of SEWAGE EFFLUENT, R. F. W. Smith and The Pioneer Investment Trust, Limited, London.
551. RAILROAD CONSTRUCTION, F. Hackmann, C. Christodoro, and E. Baasen, London.
552. CEMENT FURNACES, E. Gobbe, London.
553. TENTERING MACHINES, H. W. Honeyman, London.
554. LETTER-CONVEYING APPARATUS, Lamson Store Service Company, Limited.—(Lawson Consolidated Store Service Company, Incorporated, United States.)
555. DRIVING GEAR for CYCLES, A. W. Rider, London.
556. SHAFT COUPLINGS, O. Robinson, London.
557. PRODUCING CURVED PRINTING SURFACES, E. S. Shepherd, London.
558. APPARATUS for MAKING FUEL, J. C. C. Read and C. E. Sage, London.
559. TRANSFORMERS, W. L. Wise.—(The Aktia Gesellschaft Elektrotechnik vorm. O. L. Kummer and Co., Germany.)
560. ARTIFICIAL TEETH, R. Brewster, London.
561. CASH REGISTERS, E. F. Spaulding, London.
562. STITCHING MACHINES, W. L. Wise.—(The Firm Aktiengesellschaft, vormals F. Martin and Co., Switzerland.)
563. PADLOCK, A. Iwaszkiewicz, London.
564. BOLTS, J. Gehle, London.
565. ELECTRIC METERS, J. G. Lorrain.—(H. A. Macdonald, France.)
- 10th January, 1900.
566. SHOT or BLOW-FIGURE CHANGING GAME, S. Cooke, Birmingham.
567. DYED LEATHER, W. H. Claus and A. Rée, Manchester.
568. DRINKING TROUGHS, A. Coulthurst, Halifax.
569. LOCK and LATCH CASES, H. Vaughan, Wolverhampton.
570. LUBRICATING MACHINE SPINDLES, W. Shone, Bolton, Lancs.
571. WAR SHELL, J. Hicken, Portsmouth.
572. CEMENT, J. and W. A. Oddie, Manchester.
573. PUZZLE TOY, H. J. Hayes, Norwich.
574. STARTING GEAR for MOTOR CARS, T. P. Rennoldson, Woolston, Hants.
575. EXTENSIBLE TABLES, A. J. Johnson, Kingston-on-Thames.
576. PRODUCING WHITE LETTERING, J. R. Wigham, Dublin.
577. DISINFECTANTS, J. S. C. Legge and T. P. R. Bradshaw, Drumcondra, Co. Dublin.
578. MONEY TILL and TIME CHECK REGISTER, C. F. Cox, London.
579. SIDE SADDLES, J. Carter, Edinburgh.
580. WHEELED VEHICLES, W. H. Northcott, London.
581. PAPER PRINTING MACHINES, R. Riley, T. Winstanley, and G. H. Fish, Manchester.
582. COIN-FREED VENDING APPARATUS, J. Anisfield, Kingston-on-Thames.
583. STEAM STOP VALVES, A. Mackie, Glasgow.
584. FASTENER for LEGGINGS, Brown and Sons, Limited, London.
585. NEEDLE-BAR MECHANISM, J. K. Macdonald.—(The Singer Manufacturing Company, United States.)
586. STOP VALVES, A. Turnbull, Glasgow.
587. SLIDE VALVES for STEAM ENGINES, H. Butters, Bradford.
588. WAGON COUPLING, A. W., J. A., and H. N. Bray, Manchester.
589. REALISTIC ARITHMETIC, G. McKinlay, Upper Norwood.
590. CARRIER for BRICK PRESSES, W. H. Birtans, Bradford.
591. APPARATUS for REGULATING the CURRENT in an ELECTROLYTIC INTERRUPTER, L. N. Tyack and F. B. Fawcett, Bristol.
592. TIRES, C. W. Hunt, London.
593. MOTOR ROAD VEHICLES, C. W. Hunt, London.
594. MACHINES for CLEANING BOTTLES, J. W. Nathan, London.
595. PRODUCTION of CARBIDES, J. de Burgue and R. Sunyé, Paris.
596. THE TRANSVAAL PUZZLE, C. Vincent, London.
597. FIRE-ESCAPES, M. Standish, Kingston-on-Thames.
598. MINING MACHINES, J. C. Hall, Kingston-on-Thames.
599. COLLAPSIBLE TABLE, O. Imray.—(G. F. Beys, India.)
600. PROTECTING WALLS of FURNACES, G. Claude, London.
601. HAND-POWER BRAKES for WAGONS, D. J. Morgan, London.
602. VALVE for WATER HEATERS, J. Winterlood, London.

603. SUPPORT for CEILINGS, A. Hurum, Berlin, Germany.
604. BAG CLOSERS, E. J. Smith and C. A. Baker, London.
605. "A RECKONER" for MONEY, M. E. Alayveroff, London.
606. PUMPS, H. Moore, London.
607. CASH TILL, G. W. Linthwaite, London.
608. COUPLING WAGONS, H. H. Lake.—(C. A. Gould, United States.)
609. METAL BARS, H. H. Lake.—(F. Krupp, Grusonwerke, Germany.)
610. TELEGRAPH for USE on SHIPS, C. F. Cronheimer, London.
611. INSTANTANEOUS PHOTOGRAPHY, J. F. Guimarães, London.
612. LAMP for COOKING PURPOSES, J. C. Becker, Manchester.
613. SHELLS, G. J. Batters, London.
614. PROTECTING SOLDIERS from FIRE, J. H. Butt, London.
615. CHECKING RECEIPT of MONEY, J. R. Layton, London.
616. SHIELD for PROTECTING AMMUNITION, F. G. Cooke, London.
617. WRAPPERS for ENCLOSING BUTTER, &c., H. Rose, London.
618. CONTACT SUBSTANCES, J. Y. Johnson.—(The Chemische Fabrik vormals Goldenberg Geromont and Co., Germany.)
619. FIRE-ALARM, J. M. Bell, London.
620. BOOT BELTS, J. C. Mewburn.—(Wernick and Muller, Germany.)
621. PROPULSION of VESSELS, J. F. Duke, London.
622. INCANDESCENT ELECTRIC LAMPS, E. Bonhivers, London.
623. CARRIERS for ELECTRIC CONDUCTORS, R. F. Black, London.
624. MAKING SOAPS for SIZING PAPER, C. J. Röhr, London.
625. GLOVES for WASHING CLOTHS, G. F. Steinlechner, London.
626. SHIELD for MILITARY PURPOSES, R. C. Stead, London.
627. RAILWAY SIGNALLING APPARATUS, W. Barlett, London.
628. STORING CYCLES, C. and G. Maurer and E. Gloor, London.
629. CYCLES, J. G. Lorrain.—(T. H. Gledhill, United States.)
630. APPARATUS for CONNECTING METERS, J. R. Dick and The Reason Manufacturing Company, Limited, London.
631. FOOT PROTECTOR for PADDLERS, H. Stewart, London.
632. BURNERS, H. J. Hadden.—(G. Washington, United States.)
633. CYLINDERS with LIQUID PACKING, L. Bayer, London.
634. TYPE CLAMP, H. J. Hadden.—(F. Schmecker, Germany.)
- 11th January, 1900
635. BALL, W. Hazelton, Belfast.
636. SCREENS for ELECTRIC LAMPS, H. Simpson, London.
637. SASH CORD HOLDER, J. Brown, Newport, Mon.
638. ELECTRODE, E. A. Le Sueur, Ottawa, Canada.
639. CONVEYORS for TRANSPORTING COAL, J. W. White, Liverpool.
640. ARRANGEMENTS for INDEXING BOOKS, J. H. Howorth, Liverpool.
641. HOSPITAL SINKS, J. Shanks, Glasgow.
642. WHEELED CARRIAGES, W. H. Northcott, London.
643. SANITARY DUST-BINS, A. W. Martin, Manchester.
644. CONSTRUCTION of BICYCLE FRAMES, E. B. Killen, Glasgow.
645. HORSE HARNESS, R. Douglas, Glasgow.
646. TUBES USED for the MANUFACTURE of CARPETS, F. J. R. R. Jelliman, Kidderminster.
647. LAPPET MOTIONS for LOOMS, W. Slater, jun., and W. Slater, sen., Manchester.
648. FITTINGS for GOLF COURSES, J. Duncan, Glasgow.
649. CENTRIFUGAL APPARATUS, J. Laidlaw and R. A. Robertson, Glasgow.
650. WIRE ATTACHMENT for TIRES, R. J. C. Park, Coventry.
651. BRUSHING APPARATUS for SIEVES, G. F. Thompson, Liverpool.
652. SHOP SEATS, T. Meikle, Glasgow.
653. SINGLE-ACTING MOTIVE-POWER ENGINES, H. A. C. Parker, Manchester.
654. KEY for GLASS TILES, C. A. Anderson, London.
655. ELECTRICALLY ACTUATED MECHANISM, G. E. Vaughan, London.
656. COLLAR STUDS, W. J. Gilroy, London.
657. REPAIRING PUNCTURES in TIRES, F. H. Richards, London.
658. JACKET for MEDICAL PURPOSES, C. von Hillern-Plinisch, London.
659. ELECTRIC SWITCHES, A. Gardy, London.
660. REVERSING GEAR for LAUNCH ENGINES, W. Glass, London.
661. TELEPHONE APPARATUS, W. Moseley, London.
662. DOUBLE-ACTION GRINDING ROLLS, J. C. Wegerif, London.
663. DRIVING GEAR for CYCLES, C. W. Jesty and J. E. Smith, London.
664. BREACH MECHANISM of GUNS, W. Poulson, London.
665. STOPPERS for BOTTLES, W. H. Fieldgate, London.
666. MACHINE for CUTTING CAKES, &c., T. L. Green, London.
667. MACHINES for REGISTERING VOTES, A. F. Bardwell, London.
668. FRAME-MAKING APPARATUS, C. T. Atkinson, London.
669. ADJUSTABLE MUSIC STOOLS, C. C. Bender, London.
670. LOOMS for WEAVING, F. Zapata, London.
671. HOLDERS for CATALOGUES, A. G. Brookes.—(D. E. Hunter, United States.)
672. MANUFACTURE of BOOTS, H. H. Lake.—(A. E. Johnson, United States.)
673. MANUFACTURE of BOOTS, H. H. Lake.—(A. E. Johnson, United States.)
674. MOTORS APPLICABLE to ROCK DRILLS, H. Koch, London.
675. ELECTRIC BATTERIES, H. H. Lake.—(R. C. McCutcheon, United States.)
676. COATING PLASTIC BODIES with METAL, J. A. Daly, London.
677. HATS, W. Ellis, London.
678. A NON-REFILLABLE BOTTLE, W. T. Nuttall, London.
679. RAILWAY SWITCHES, W. F. Butt, Kingston-on-Thames.
680. MACHINE for PLANING GROOVES, F. Regner, London.
681. APPARATUS for LOADING ORDNANCE, R. Matthews, London.
682. PEN CLEANERS, V. I. Feeny.—(R. W. Pope, United States.)
683. METER, V. I. Feeny.—(Allgemeine Elektrizitäts Gesellschaft, Germany.)
684. WELDING METALS, G. A. Dick, London.
685. PROTECTIVE SHIELDS for WAR, M. A. Weir, London.
686. DEVICES for PLATING MACHINES, C. Schürmann, London.
687. DRIVING APPARATUS by FRICTION, A. D. Klaber, London.
688. DISSEMINATORS for PHONOGRAPHS, F. Myers, London.
689. PORTABLE IRON SHELF PLATES, G. W. Howard, London.
690. PHOTOGRAPH FRAMES, &c., G. H. Stepney, London.
691. GAME, G. Scutt and W. Harwood, London.
692. CURTAINS, R. F. Carey, London.
693. LOCKING NUTS, A. T. Hughes, London.
694. SEWING MACHINES, W. H. Brickley, London.
695. MAGNETIC CUT-OUTS, E. Andreas, London.
696. DENTAL BITE-FRAMES, A. F. Benson, London.

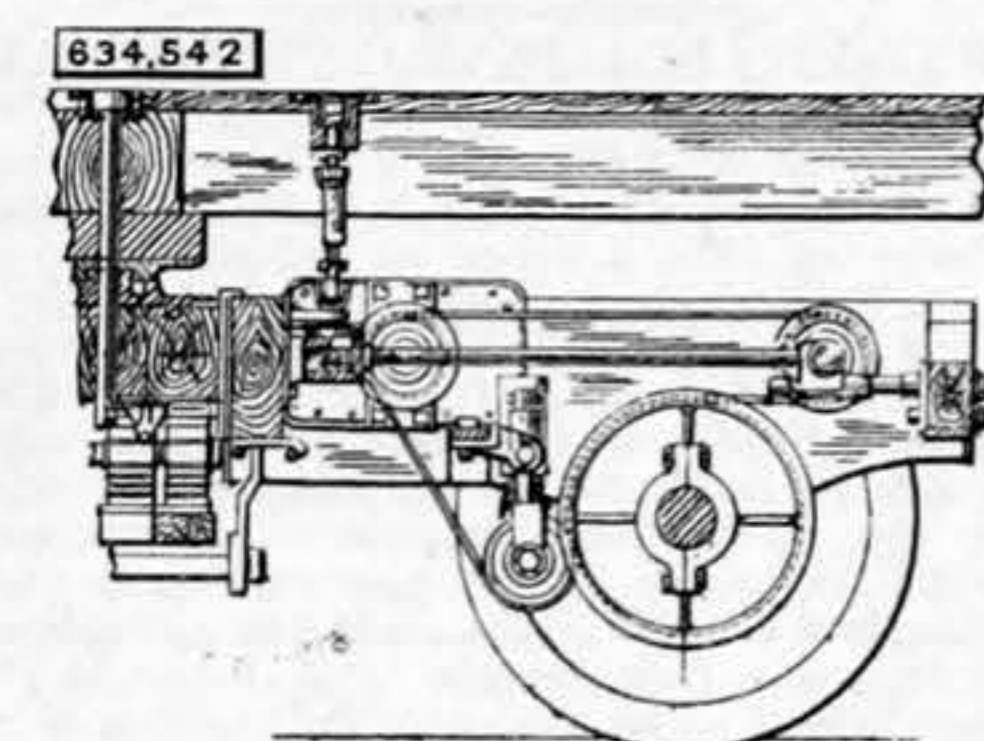
697. BULLET-PROOF STEEL BREASTWORK, C. Young, London.
698. LIQUID-MEASURING APPARATUS, F. G. S. Ham, London.
699. UTILISING STEAM, G. G. M. Hardingham.—(F. H. Trevellick, Egypt.)
700. DIELECTRIC COMPOUNDS, C. Jung, A. Brecher, and A. Kittel, London.
701. CONDENSERS, J. Grouvelle and H. Arquebourg, London.
702. COMBINATION POCKET-GUN and CARTRIDGE HOLDER, W. P. Thompson.—(R. M. G. Phillips, United States.)
703. GENERATORS for LIGHTING VEHICLES, L. Bleriot, Liverpool.
704. SADDLES, J. McCaffrey, Liverpool.
705. DYING APPARATUS, F. W. Golby.—(F. A. Reichmann, Sweden.)
706. BROOCHES, F. F. Zehetmayr, London.
707. PRINTING MACHINES, J. Lewthwaite and R. E. Mack, London.
708. ANIMAL TRAP, W. C. Hooker and K. R. Marks, London.
709. HAMMERS, D. S. Waugh, London.
710. TREATING SULPHUR ORES, G. E. and A. R. Davis, London.
711. BOOK, C. L. Benedict, London.
712. IGNITION GEAR for EXPLOSIVE ENGINES, F. R. Simms and R. Bosch, London.

### SELECTED AMERICAN PATENTS.

From the United States Patent-office Official Gazette.

- 634,542. ELECTRIC LIGHTING APPARATUS FOR RAILWAY CARS, W. F. Richards, Buffalo, N.Y.—Filed August 13th, 1898.

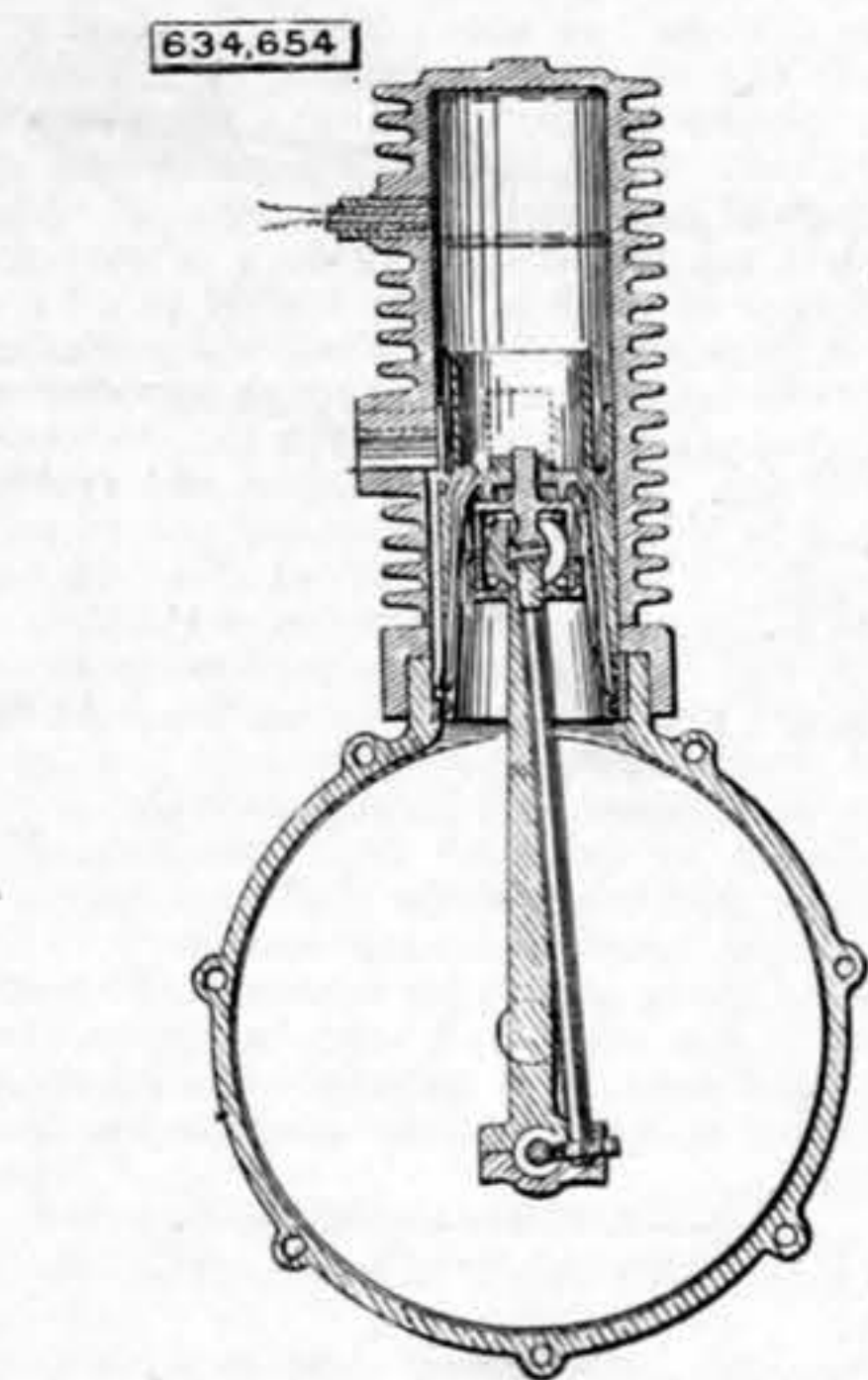
Claim.—The combination with a railway car having an axle provided with a driving pulley, of a dynamo secured to said car above said driving pulley and on one side thereof, said dynamo having a pulley, a tightener pulley arranged on the opposite side of said driving pulley and above the same, means whereby



said tightener pulley can be adjusted toward and from the dynamo pulley, a spring-pressed tightener pulley arranged underneath the dynamo pulley and facing the lower portion of the driving pulley, and a driving belt wrapped around the driving pulley between said tightener pulleys and running around said tightener pulleys and the dynamo pulley, substantially as set forth.

- 634,654. GAS ENGINE, G. A. Whitcomb, Framingham, Mass.—Filed April 1st, 1899.

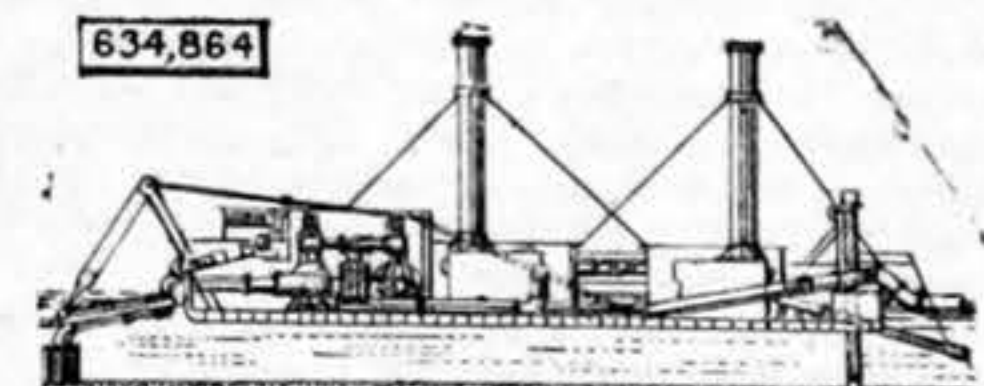
Claim.—In a gas engine, the combination of a cylinder having feed and exhaust ports, and an oblique or spirally-disposed exhaust passage in communication with said exhaust port, a reciprocating piston having cut-offs for controlling said ports and also provided with relief channels communicating



at one end with the explosion chamber of the cylinder and adapted at the other end for communication alternately and at times with said exhaust passage continuously of the inward movement of the piston, and means for turning the piston to cause said cut-offs to move in a direction transverse to the reciprocating path of the piston and establish intermittent engagement of the relief channels and exhaust passage, substantially as specified.

- 634,864. DREDGING MACHINERY, L. W. Bates, Chicago, Ill.—Filed March 4th, 1895.

Claim.—(1) In a hydraulic dredge, the combination of a boat; excavating mechanism adapted to cut across the width of the boat while the boat advances in a right line; means for propelling the boat in a right line; and a discharge pipe made up of sections,

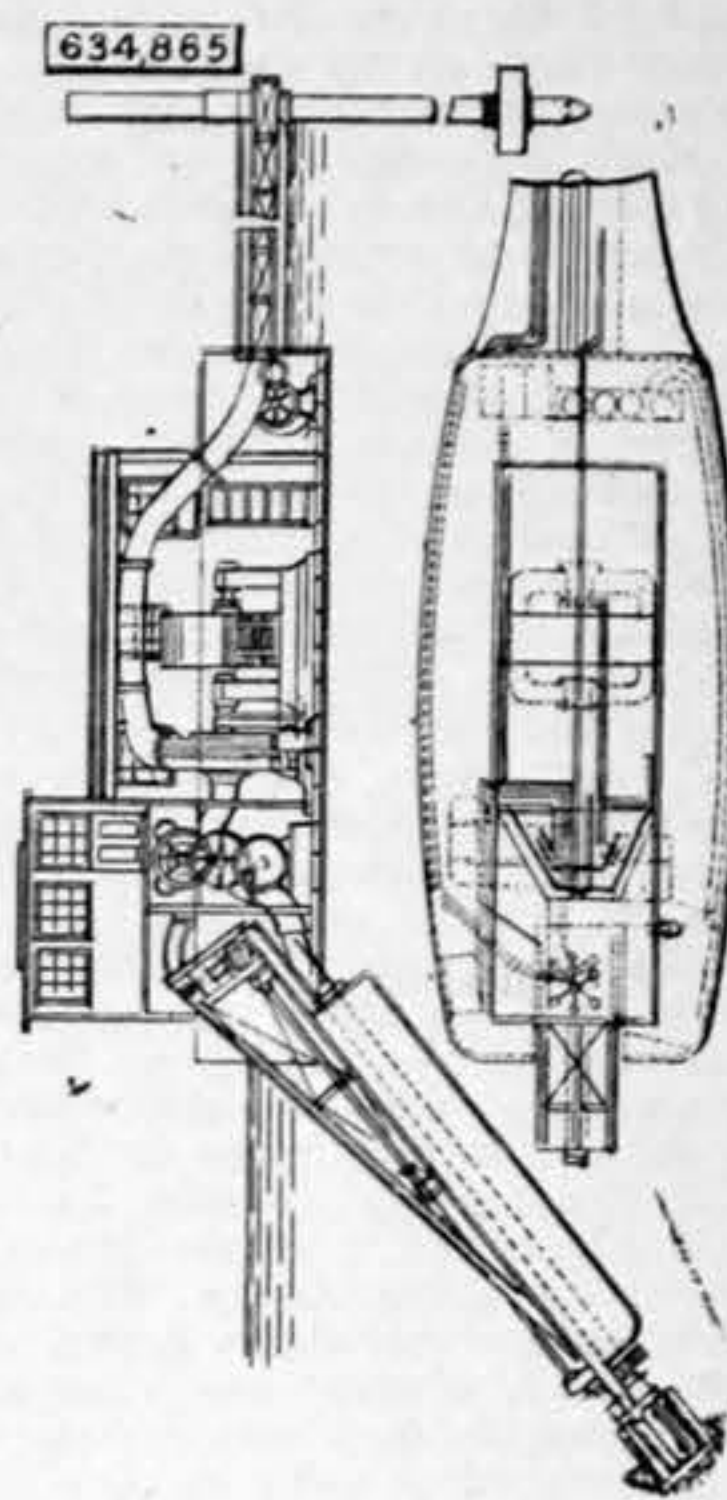


each having an air and water-tight jacket securely attached to it, substantially as and for the purpose set forth. (2) In combination with a boat and its discharge pipe, the posts or anchors *l*, and the rope or cable *m* secured to said posts and passing through an eye *n* on the pipe. (3) A discharge pipe made up of sections each being provided with a semi-cylindrical air and water-tight jacket, said jacket being securely united to the pipe.

- 634,865. DREDGE, L. W. Bates, Chicago, Ill.—Filed June 11th, 1897.

Claim.—(1) In a dredge the combination of a suction pipe; a cutter carried by said pipe; and a buoyant ladder for directly supporting and controlling the position of the suction pipe, substantially as and for the purpose set forth. (2) In a dredge the combination of

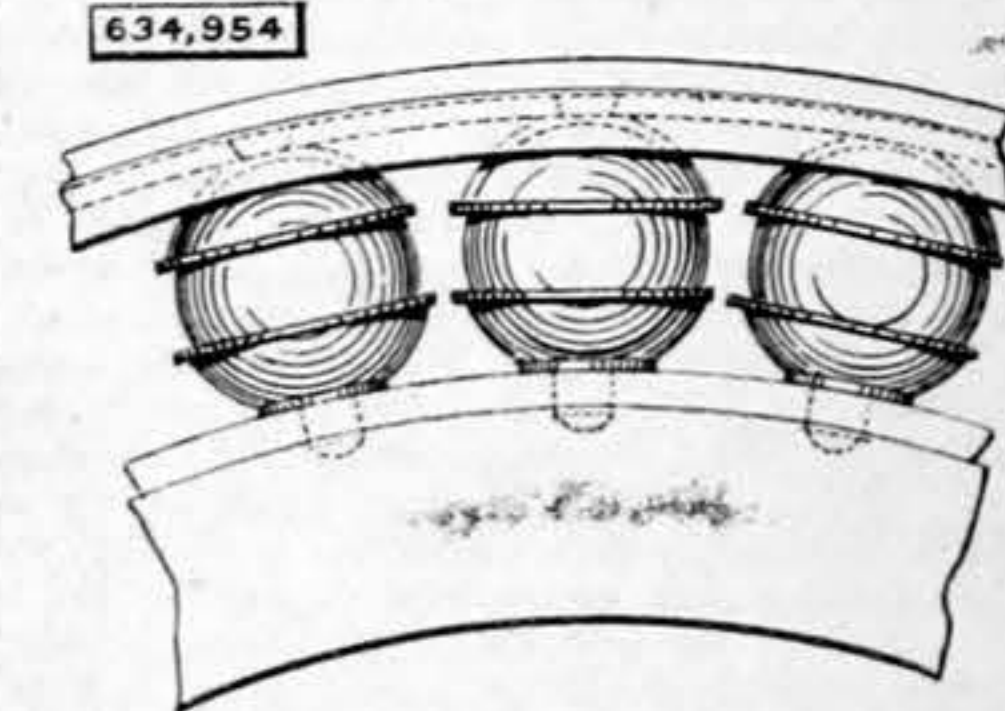
a hull or boat; a buoyant ladder for carrying the cutting or excavating devices; means for controlling the buoyancy of the ladder; means for effecting the feeding movement of the ladder in the cut; an extension arm projecting rearwardly from the hull or boat; a hollow spud or spuds carried at the outer end of said arm,



each provided with an air chamber or tank adjustable on the spud; valves and nozzles for operating the spuds and air chambers; electric motors mounted upon the dredge; and electric conductor for supplying current to said motors; a buoyant support for said cable; and an operating stand upon the dredge, containing devices for directing and controlling the current.

- 634,954. WHEEL TIRE, T. McKinnon and J. Pringle, Glasgow, Scotland.—Filed April 19th, 1898.

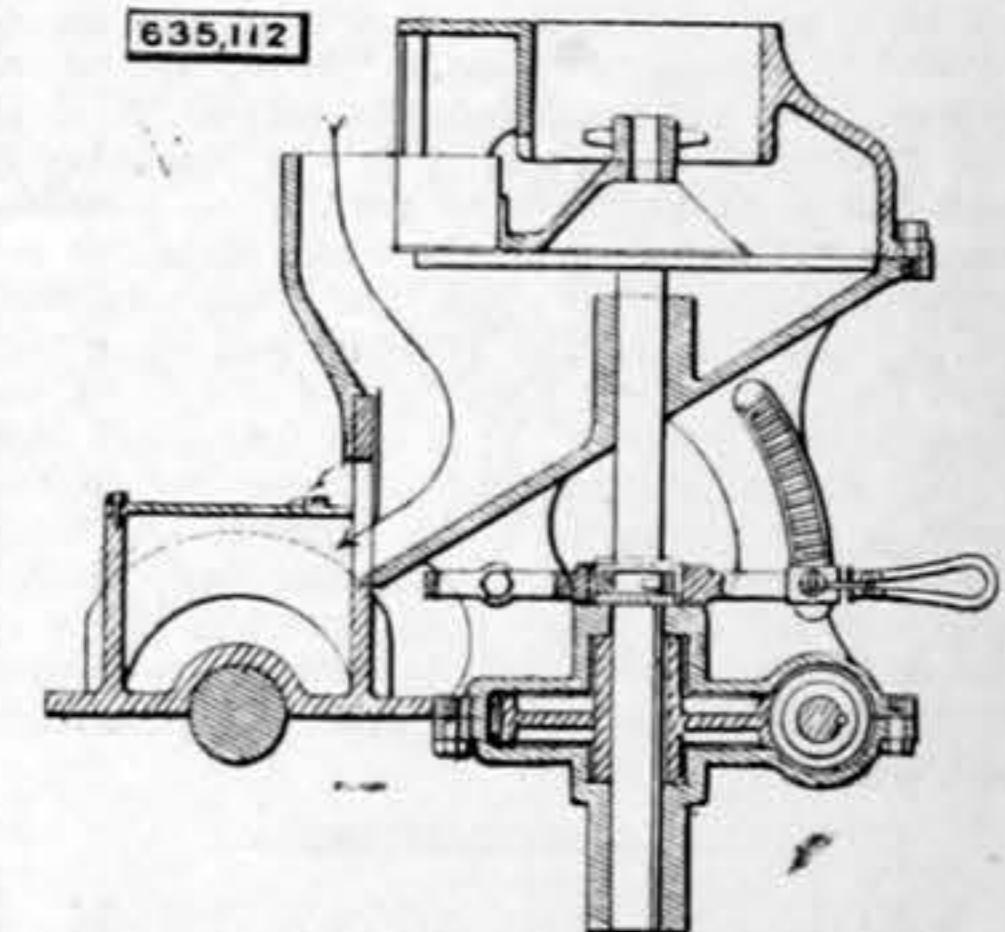
Claim.—In a wheel tire, the combination with the felloe or rim provided with a series of hemispherical



cavities or cups and an outer tread ring provided with a corresponding series of cavities or cups, of a series of hollow rubber balls arranged within and between said hemispherical cavities or cups, substantially as set forth.

- 635,112. FEEDING DEVICE FOR PULVERISERS, W. M. Wheldon, Boston, Mass.—Filed December 9th, 1898.

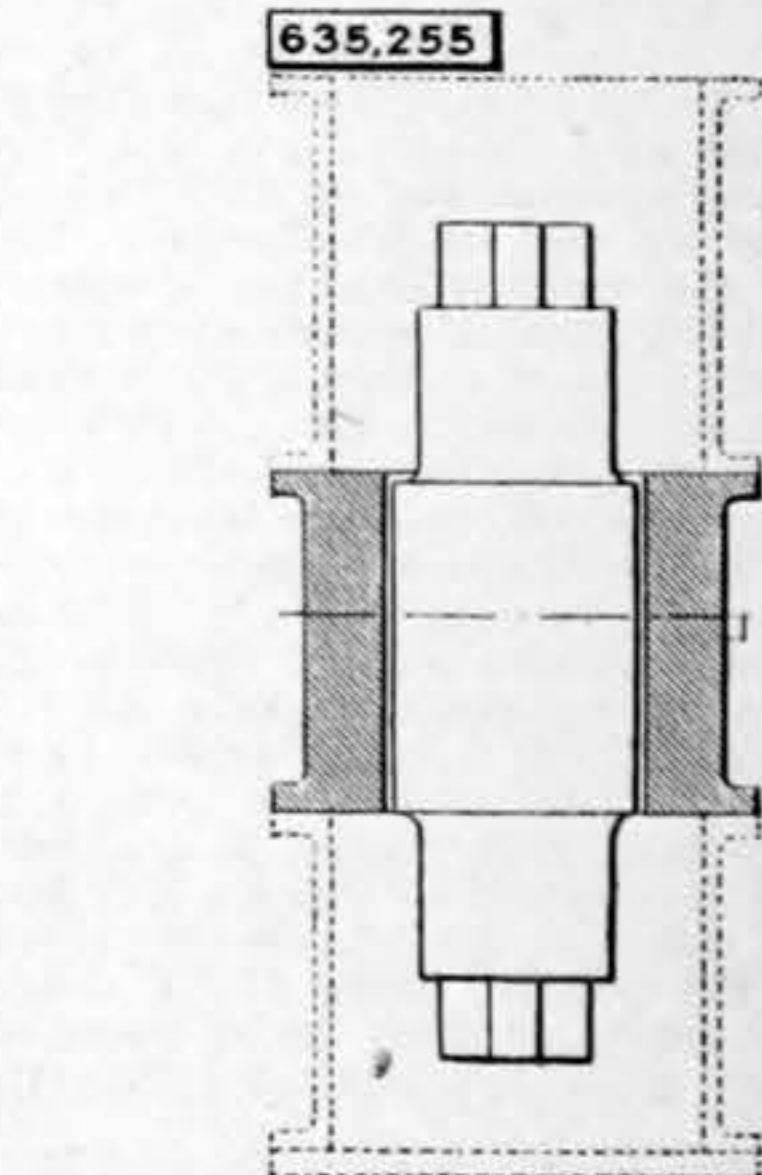
Claim.—In a feeding device for pulverisers, the combination of a feed chamber having an opening therein at the upper end thereof through which material is introduced, a rotatable feed table mounted in said



chamber and adjustable toward and away from the feed opening therein, means for adjusting said table, and a shear adjustable vertically with said table but held from rotation, whereby the shear will remove material from said table, substantially as set forth.

- 635,255. METHOD OF AND MOULD FOR CASTING CHILLED ROLLS, E. E. Kaye, Pittsburgh, Pa.—Filed July 1st, 1898.

Claim.—(1) Apparatus for casting substantially cylindrical rolls with a practically uniform depth of chill consisting of a chill mould the surface of whose matrix cavity is substantially that of a frustum of a cone, substantially as described. (2) The method of



making substantially cylindrical rolls, consisting in casting the metal in a chill mould having a frusto-conical matrix cavity, with its larger end upward, and cooling the outer portion of the cast roll in contact with said mould in such a way as to cause the larger end of the roll to contract to substantially the same final diameter as that of the smaller end, substantially as described.