ENGINE GOVERNORS.

By Prof. R. H. Smith.

No. I.

Governors can be, and are, used for regulating the action of many other kinds of machines than engines. They were used for regulating the flow into water-wheels long before the first steam engine was made. Moreover, they may be applied, not only to motors or driving machines, but also to driven machines. Again, their purpose may be to regulate one or other form of action in the machines on which they operate. The detailed design and mode of operation of governors must, therefore, vary greatly, according to the kind of machine and according to the special function of that machine which they are called upon to control.

Examples of wholly different kinds of machines requiring quite distinct methods of control are windmills, water-wheels, turbines, hydraulic pressure machines, steam engines, gas engines, oil engines, dynamos, boiler furnaces, metallurgical furnaces.

As regards the distinction between driving and driven machines, this is not an easy matter to deal with in a strictly definite manner. The difficulty is closely connected with the scientifically unsatisfactory idea of a machine in common vogue. Prof. Fleeming Jenkin was the first to point out that in order to arrive at a scientifically complete and accurate system of investigating the dynamics of machinery, we must include in our definition of a machine both driver and driven machine. From the manufacturing and commercial point of view, of course, it would be impossible to utilise such a definition; but even in the most commercial aspect of the matter we get a suggestion of the above scientific necessity from the fact that no engineering firm of good repute will undertake to supply engines guaranteed to run satisfactorily without being given the fullest information as regards the work that the engines are to be put to. Now the governor forms a most important connecting link between driver and driven machine. Variations in the action of either machine infallibly influence the action of the other, and the real purpose of the governor is to control the combined action of both machines. If heavier work is put into the lathes, the governor mounted on the steam engine has to act so as to increase the supply of working steam. If a rise of furnace temperature increases the effective pressure on the steam engine, the lathes will run too fast unless the governor so acts as to reduce the supply of steam. The purpose of the governor is to restrict within prescribed limits the variation of one particular kind of function which is a function of both driver and driven machine; and the primary cause of this variation may arise at either end of the train, either at the driving end or at the place where the final work is done. It is usual to make the governor an integral part of the motor—that is, to mount it at the driving end of the complete train of machinery, and this is, in fact, usually the most advantageous arrangement. But cases occur frequently in which it is better to place the governor at the driven end of the train; and it would be also often desirable to have two governors, one at each end. For example, in high-pressure pumping the intermittent action of the engine is controlled by a stop governor on the accumulator. If mere quickness of action were alone aimed at, evidently it would be ideally best always to place the governor close to the place where the variation which it is required to limit in extent first arises, or where the primal cause of this variation acts. But placing it so would in most cases lead to unnecessary complication of mechanism, the place where the governor has to act being in general distant from that where this primal cause arises. If, however, electric and pneumatic transmission of signals and impulses be further developed in this connection than it is at present, it is practically certain that governing methods will become more and more employed, in which the controlling mechanism consists of two parts, a receiving part placed where the primal cause of variation arises, and an acting part placed where the work of control is to be done; these two parts being connected electrically or pneumatically or otherwise. An instance in which such an arrangement would have most beneficial effect is in the governance of marine engines to prevent racing when the propeller becomes uncovered of water between two waves, or in consequence of pitching. A float at the stern arranged so as not to be influenced by inertia—and this is not difficult—would give the signal, which, transmitted electrically to the engine-room, would put in action a relay governor to cut off steam, or open a special governing exhaust valve.

The next important point in the philosophy of governors is to recognise very clearly that their purpose is not at all to keep constant any function of the machinery, but to restrict this function within prescribed limits of variation. Practically every governor that has ever been used or invented is put in action by that variation itself which is to be limited. The governor does not prevent a variation occurring, it prevents it becoming large; a small variation, acting upon and through the governor mechanism, shifts some gear which counteracts the tendency towards the increase of the variation.

While the fact that this is the actual method of operation of practically every governor that is used should be thoroughly grasped, it seems at the same time important to recognise that it is not necessary that the permitted variation should be more than temporary. Thus, for example, suppose the problem to be that of keeping the mean effective pressure, or, say, the valve chest pressure, in a steam engine nearly constant, in spite of variations of boiler pressure. The practical solution of this problem is possible by passing the steam from the boiler through an automatic reducing valve on its way to the valve chest. If the adjustment of the reducing valve is controlled, not by the difference of valve chest and boiler pressures, but by the boiler pressure alone, it is possible to set it so as always to reduce to the same pressure. Suppose at one instant the valve to have the position suited to the then existing boiler pressure, and suppose that the boiler pressure then rises; the valve will not change its position until some rise of boiler pressure has actually occurred, and until the valve is shifted the valve chest pressure will have increased by reason of the rise of boiler pressure. But this does not prevent the increase of boiler pressure shifting the valve into a new position, correct for reducing from the new higher boiler pressure down to the original valve chest pressure. The operation takes time to perform, and during that time there is a disturbance of chest pressure from constancy. The amount of the disturbance of pressure and the time during which it lasts may both be made large or small by decreasing or increasing the sensitiveness of the controlling apparatus. The reader may find it useful to go through the same train of reasoning in connection with, say, the control of the carbon-point distance in an electric arc lamp, in spite of variation of voltage in the leads. But it must be noted that the governing of steam engines is not usually or mainly necessitated by variation of boiler pressure, but by variation of load to be driven by the engine; while the governing of the carbon-point distance in arc lamps is not mainly necessitated by variation of voltage in the leads, but by the burning away of the carbons themselves. Therefore, practically all governing apparatus permits a restricted range of long duration variation in the function to be controlled.

It is usually supposed that the invariable object of a governor is to keep speed nearly constant. Uniformity of speed is actually often the important object aimed at. For instance, in the tooling of metals, wood and stone, there are fairly well-established cutting speeds proved to be most economical, due regard being had for the wear of the tools; and again, in such operations as spinning, uniformity of speed is of very high importance. But in general there exists, I imagine, an altogether exaggerated estimate of the real importance of constancy of speed; and this too often results in the overlooking of other conditions that are essentially more urgent. It is hardly too much to say that in the bulk of work done in industry, it is of very little consequence, so far as the quality of the work is concerned, whether it be performed at one rate or doubly as fast. As regards speed, all that can be logically asserted in such cases is that the faster the work is done the more profitable is the manufacture. In other words, the more work done per hour the more profit is there per year, nearly up to the limits at which increased speed begins to be inordinately destructive to the bearings and other working parts of the machinery.

Take only one instance. It is generally supposed that great uniformity of speed is of primary importance in engines driving dynamos for electric lighting. Here what is really primarily desired is that the brilliancy of each individual lighted lamp in the system should keep constant. This is secured if a constant current be maintained through each lamp. This constancy of current is most readily secured by maintaining constancy of voltage between the out and return leads. The dynamo is designed electrically, so that when driven at constant speed it creates nearly the same voltage whether the load be great or small. Therefore, that is because the dynamo is designed for constant speed, constancy of speed in the driving engine is desirable. But if the dynamo were not designed in this way, constancy of speed in the engine would be undesirable; and because dynamos cannot be, or at any rate are not, designed so as to give exactly the same voltage at constant speed under light and heavy loads, therefore exact constancy of engine speed is not what is wanted, but rather such a variation of speed as will correct the deficiency of the dynamo. Thus, if the characteristic of the dynamo give a rise of voltage along with an increased demand for current, this may be corrected by putting on the engine a governor which will make a decrease of engine speed occur simultaneously with an increase of its load. Or, again, since in all dynamos increase of speed—other conditions remaining unaltered—causes increase of potential, the engine speed may obtain direct governance from the voltage at the dynamo terminals, a fall of this voltage being made to operate the engine governing gear in the direction of increasing the engine speed, and thus restricting the fall of voltage within narrow limits.

Taking for granted that in incandescent lighting the cheapest method of maintaining uniform candle-power in each lamp is to keep the dynamo voltage constant, it should be borne in mind that this is really what is required, namely, to keep this voltage constant in spite of variation of demand for current, and that theoretically there may be a dozen different modes of attaining this end with more or less accuracy; none of which, however, seems to make exact constancy of engine speed desirable. The usually employed mode of accomplishing this end is an extremely indirect one. Without asserting that this indirect method is not the best available one, it concerns us here to emphasise the undesirability of allowing ourselves to be misled by its indirectness into the belief that constancy of engine speed is *per se* a necessary condition of good incandescent lighting.

Examples of the exaggerated nature of the common engineering belief that constancy of engine speed is essentially and always a good thing, could be easily multiplied to almost any extent. There are, however, three propositions which may be succinctly stated, and which appear to be incontrovertible and universally true. They are these:—

(1) Sudden and irregular fluctuations of speed should in all circumstances be avoided; they can only be disconcerting and troublesome to those in charge of the driven machinery.

(2) Increase of speed to the racing point, or to the limit at which knocking in the joints of engines and other machinery, or overheating of bearings, armatures, &c., begins, must be strictly avoided.

(3) Unless there be good reasons against it in the nature of the work being done, it is distinctly advantageous that some slowing of speed should take place along with a rapidly increased demand for engine effort, because a maintenance of speed with an increased volume of steam used per stroke rapidly exhausts the store of steam in the boiler, and the boiler pressure consequently falls—it cannot be maintained even by increased rate of stoking, because this does not act rapidly in increasing the supply of steam.

One other proposition may be stated here, its truth not being always recognised. No steam, gas, or oil engine (except a steam turbine) exercises a constant driving torque upon its shaft; on the contrary, the torque varies sometimes through very large ranges within each revolution. The necessary consequence is rythmic variation of speed. It should be never forgotten that it is no part of the function of what is called the "governor" to minimise the range of this variation. The work of steadying the speed within the period of one revolution, in opposition to the disturbing influence of the rythmic and cyclic change of driving effort, is done wholly by the fly-wheel, which cannot be helped in this work by the governor. Many governors are made so sensitive that their sleeves move rythmically in synchronism with variation of speed caused per revolution by the cyclic change of driving effort. Such sensitiveness is wholly useless; if it has any effect on the speed it aggravates instead of diminishing the pulsation, and it is besides harmful, as it needlessly wears out the joints of the governor and its gear, while the perfect close and smooth fit of all these joints is especially important for the proper action of the governor. A treatment of the subject of fly-wheels, with rules for their proper proportionment, appeared in The Engineer, 9th January, 1885.

Stability is a fundamentally essential characteristic of every useful governor. A variation in the function to be controlled occurs, and is followed by a movement of the governor gear such as prevents large development of this variation. As soon as this variation disappears, that is, when the disturbed function returns to its nominal amount, the governor must tend to draw its gear back to its normal position. If it does not do so, it lacks stability; and if it lacks this, it really does more harm than good. Many governors in the market are deficient in stability; their stability is too small for the duty they are put to.

A good governor moves its controlling valve or other gear a distance duly proportionate to the amount of disturbance that has occurred in the function to be controlled. The duly proportionate distance is such as will (1) at once check further development of the disturbance, and (2) will bring back the disturbed function to nearly its normal amount within a short period of time. The length of this short interval that is permitted to elapse before rectification takes place ought to be specified, and its reciprocal would form an excellent measure of what might be called the "time sensitiveness" of the governor. This time will depend, however, not on the governor solely, but also upon the character of the machine controlled; and, therefore, to obtain a fair measure of the "time-sensitiveness" of any governor, it must be supposed to exercise its control under standard conditions.

In the endeavour after extreme sensitiveness, governors are often employed which shift the controlling gear an unduly great distance out of proportion to the amount of the disturbance which has caused the shifting. The result is that they produce too great a righting change of driving effort, and the speed or other function to be controlled is over rectified. This leads to more or less violent oscillation of the condition which it is desired to steady, and this result is technically called "hunting." It is needless to remark that a hunting governor is worse than no governor at all.

A close consideration of the whole operation of governance will be useful at this point. It is needful to study separately the two cases of the disturbing cause arising at the driving and at the driven end of the train of machinery. To render the statement more definite, we will make it in terms of the action of our ordinary steam engine.

First: The disturbing cause is rise of pressure in the boiler due to increase of furnace temperature. There is now a want of balance between the effort exerted at the driving end of the train and the driven resistance at the other end. The difference, or excess of the former over the latter, is, while it lasts, spent in increasing the momentum of the mass of machinery between these two ends; the speed is increased; the excess of work is stored up as extra kinetic energy in this mass. The increase of speed lasts so long as the excess of effort over resistance lasts. Under good working conditions increase of speed leads to decrease of frictional coefficients at bearings; and, although the friction increases with the total of the two pressures on opposite sides of a bearing, still since, if the bearing be well set, this total does not increase with any moderate increase of driving load — the pressure on one side being lightened as the other is made heavier—therefore, in so far as concerns the bearing friction resistances, the increasing speed aggravates the want of balance between driving and driven forces. In most kinds of useful work done, however—for instance, in pumping, tooling, and milling—the force-resistance increases, although sometimes very slightly, with increasing velocity. This increasing resistance, so far as it exists in any one kind of work, diminishes the excess of driving effort that has arisen. One other effect of the increased velocity is to draw off steam more rapidly than before from the boiler, and thus to lower the boiler pressure somewhat towards what it stood at before the disturbance began.

Thus, without the intervention of any governor—without any shifting of throttle valve or change of cut-off—the necessarily-resulting change of speed produces automatically three changes of condition, one of which aggravates the want of balance, while the two others to some extent rectify it. If for want of a governor the speed go on rising, the increasingly rapid drain of steam from the boiler would in most cases ultimately bring about a renewal of the balance; but if the boiler power be ample in proportion to the size of the engine, this balance is not generally reached before racing and actual breakdown takes place. The most fortunate and least expensive kind of breakdown is the heating of a journal, whereby renewal of the disturbed balance is brought about by the abnormal increase of frictional resistance.

The action of the governor is to lessen, either by throttle or hastening the cut-off, the mean effective pressure in the cylinders below what it was before the governor acted. In order to simply check further rise of velocity, the governor ought in general to be so set as to leave the mean effective cylinder pressure somewhat greater than it was before the increase of boiler pressure caused the disturbance. In order to bring back the speed to the normal, the governor ought to effect a slightly greater reduction from boiler to cylinder pressure. If it reduce it to equality with that existing before the beginning of the disturbance, the want of balance will be reversed—because the resistance has slightly increased—and gradual slowing of speed takes place. During this slowing the increase of resistance dies away because it arose from increased speed, and when the speed has come down to the normal there will once more be balance. Thus, when an abnormal rise of boiler pressure $\Delta . p$ produces an abnormal rise of speed $\Delta . N$, this rise in speed in the governor ought to shift the control gear an amount that will effect a reduction $\Delta . p$ from boiler to cylinder m.e. pressure. The rise of speed $\Delta . N$ produced by $\Delta . p$—*i e.*, the ratio of $\Delta . N$ to $\Delta . p$—depends upon (1) the massiveness of the whole train of machinery controlled, (2) the lapse of time before the action of the governor overtakes the accelerating action of the rise of pressure, (3) the frictional character of the bearings in the whole train, (4) the law of increase of working resistance with increase of speed, and (5) the ratio of the capacity of the boiler to that of the engine cylinders. The governor should be set so as to give between its $\Delta . N$ and the drop of pressure it produces from boiler to cylinder the same ratio as arises from this complication of five influences. The magnitude to which $\Delta . N$ may rise before further increase is checked, and the length of time that elapses before re-adjustment of the speed to normal and of the balance between the driving and driven forces, depend firstly on (1) above, and secondly upon the quickness with which the governor makes the change of speed be followed by the full corresponding movement of the valve gear.

It is easy to see that if a fall, instead of a rise, of boiler pressure be the disturbing cause, the same chain of results follow, except that each has its sign changed; and that, if the governor be set so as properly to restore balance when the disturbance is positive, it will also do so when the disturbance is negative.

Second: If, the boiler pressure not having changed, disturbance be caused by abnormal lowering of the working resistance at the driven end of the train of machinery, there results similarly increase of speed and kinetic energy in the machine masses. This effect is, again, aggravated by the change in bearing friction, is also again usually partially counteracted by increase or recovery in some degree of the working resistance, and by the more rapid drain of steam from the boiler, which lowers the cylinder steam pressure. There is, again, a partial automatic rectification of the disturbance, which has to be completed by the governor action. The governor necessarily acts in the same way as already described above on increase of speed—that is, it effects a still further drop of cylinder pressure by increasing the drop from boiler to cylinder m.e. pressure. This it will or ought to do to such an extent as to re-establish balance between driving and resisting efforts; but since the governor exercises no influence on the magnitude of the resistance in the driven machinery, this re-establishment of balance takes place not under the same conditions as existed before the disturbance began, but at a lower level of working force. If things be so adjusted as to accomplish this at the original normal speed, this will mean a lower horse-power in engine and driven machinery; and if the stoking be not reduced so as to bring down the boiler horse-power to this lower grade, there may be difficulty in maintaining the balance if the diminution of the working resistance be much prolonged.

Now call this disturbing drop of driven resistance $\Delta . p$, and imagine its magnitude to be the same as the abnormal rise of boiler pressure, which at another time has produced a disturbance of the first kind. So long as only small changes are operating, the laws of variations of bearing friction, &c., remain the same for negative as for positive changes, and the accelerated masses being the same, the same ratio between the rise of speed $\Delta . N$ and want of balance $\Delta . p$ will hold as in the first case—*i.e.*, for same engine and driven machinery working under same normal conditions—and the governor will cause to follow this approximately the same fall—by throttling or change of cut-off—from boiler to cylinder m.e. pressure. Thus so long as fairly small disturbances only have to be dealt with, the same setting of the governor will be equally correct whether the disturbance be caused by rise of boiler pressure or by drop of working resistance. The importance of this conclusion ought not to be overlooked. It is not a mere logical conclusion, but a fortunate adjustment of physical conditions. In the one case, however, the boiler furnace horse-power ought to be kept steady, while in the other a change in the rate of stoking is called for if the altered conditions are prolonged.

King's College Engineering Society.—At a general meeting on November 12th, Mr. W. J. Shelley read a paper on the "Manufacture and Use of Concrete." The author, after defining concrete, gave a short historical sketch of its early use. He then dealt very fully with its manufacture, paying special attention to the selection and preparation of the various materials employed. The great dangers of using carelessly-prepared concrete, and many instances of failures through this cause, were pointed out. The paper was illustrated throughout by numerous very carefully-prepared lantern slides and by several specimens of cements. A discussion then followed, at the termination of which a hearty vote of thanks was accorded to Mr. Shelley for his very instructive paper.

H.M.S. POWERFUL.

Her Majesty's ship Powerful underwent her progressive speed trials in Stokes Bay, with the results set forth in the following table. Without going into elaborate deductions, we may say that 2892 indicated horse-power were required to raise the speed of the ship by 1·983 knots—that is, from 14·223 to 16·206 knots. Again 1717 indicated horse-power sufficed to raise it through 1·731 knots; and lastly, 1479 indicated horse-power raised it through 2·101 knots.

The midship area at the deep load draught when these progressive trials were made was 1800 square feet, and the wetted surface of the ship was 43,800 square feet. It will probably be not far from the truth if we say that thrust multiplied into distance represents 50 per cent. of the indicated horse-power. Thus at her lowest speed, say, 10·6 knots, the thrust power would be 1128 horses, and the thrust would be about 34,627 lb. Supposing the whole resistance to have been skin friction, we have about 1·29 lb. per square foot of wetted surface as the resistance at a speed of 1075ft. per minute. The performance of the ship, it will be seen, was very fine.

REPORT OF PROGRESSIVE SPEED TRIAL OF H.M.S. POWERFUL IN STOKES BAY.

Draught of Water:—Forward 28ft. 5in.; aft 29ft. 8½in.

Date ... ... Trial ... ... Steam in boilers... ...	29-9-97. Four runs at 10 knots. 227½.		30-9-97. Four runs at 12 knots. 230.		29-9-97. Four runs at 14 knots. 225.		30-9-97. Four runs at 16 knots. 227.	
	Starboard.	Port.	Starboard.	Port.	Starboard.	Port.	Starboard.	Port.
Vacuum	26·1	26·75	26	26	26·0	26·2	25·9	26·2
Revolutions per min. ...	50·97	50·14	60·35	59·34	68·64	68·78	79·21	79·73
Mean pressure — High	20·75	18·02	29·7	25·72	34·15	34·22	45·87	45·62
Mean pressure — Inter.... ...	6·72	7·02	10·37	9·17	12·87	13·67	16·5	19·17
Mean pressure — Fd. low ...	4·0	3·67	5·2	4·97	6·0	6·85	8·05	8·32
Mean pressure — A. low ...	3·52	4·1	4·85	5·45	5·42	7·32	7·75	8·55
I.H.P. — High	407	348	696	588	904	909	1403	1402
I.H.P. — Inter.... ...	320	329	591	508	824	880	1218	1464
I.H.P. — Fd. low ...	224	203	347	325	453	518	702	730
I.H.P. — A. low ...	198	227	325	355	410	554	675	750
Total I.H.P....	1149	1107	1959	1776	2591	2861	3998	4346
Collective I.H.P.... ...	2256		3735		5452		8344	
Speed of vessel	10·591		12·492		14·223		16·206	

IRRIGATION WORKS IN CYPRUS.

Nineteen years have elapsed since the island of Cyprus was taken over by the British Government, but it is only within the present twelvemonths that the important question of storing up a supply of water there—for irrigation of the plains during a dry season—has been seriously faced. A grant of money has now, however, been placed at the disposal of the island authorities, and Mr. Medlicott, an engineer from India, has arrived at Larnaca with the object of commencing the necessary works.

It must not be imagined that the supply of water to towns and villages has been altogether neglected by the representatives of the various nations that have held rule in Cyprus from the Phœnicians to Great Britain. On the contrary, all over the island we find interesting records of the vigour of successive batches of conquerors, who thought out the water supply in a variety of ways. The Phœnicians and Greeks had tanks and reservoirs, the ruins of which at Salamis, Larnaca, Amathus, Curium, Pappho, and other places can be seen at the present day; and many of the Greek wells, with inscriptions above them, showing that they date back to the earliest years, are still in use almost everywhere. The Knights of St. John and the Templars went still further in this direction. They provided for their "commanderies," or districts, in many instances, solid stone aqueducts built upon high arches, coming from perennial streams in valleys far inland, capable of conveying sufficient water for the irrigation of 1200 or 1500 acres of land, even in the driest weather. Illustrations of these may be found at Kolossi Tower near Limassol, which has an aqueduct seven or eight miles long, fertilising a whole district; another at Kiti, the probable site of the ancient Kitium, and a very imposing one at Larnaca which brings a water supply for the whole town. Similar works exist at Poli, and all round the island. The occupation of the island by these knights was of very limited duration, and it is much to their credit that they could find, in the intervals of their crusading duties, time for creating such useful and imperishable records of their stay. The Lusignan kings, the Genoese, and the Venetians were more selfish in their arrangements, providing enormous tanks and reservoirs within their forts and castles for the use of their soldiers and immediate retainers, but leaving the villages and country districts to look after themselves. Some of the great Venetian tanks were in a high state of preservation and full of water when the British occupation took place, notably one in the fort at Kyrenia. On the very summit of the Kyrenian Range, at an altitude of 4000ft., in the Lusignan castles of Hilarion and Buffa Vento, immense water tanks were constructed, but now contain no water, as the slopes and leads by which they were filled during the rains are in ruins. The Turks, during their occupation of two hundred years, did nothing of any value towards the improvement of the water supply, and their reckless improvidence in cutting down trees without planting fresh ones to take the place of those removed added to the gradual decay of the aqueducts, which were never repaired, has caused that excessive dryness of the plains during the summer season which the proposed irrigation works are designed to counteract.

The valleys in Cyprus are generally short and steep, the result being that the streams running down them are of small volume; and where they pass through the plains, in summer, the river beds have no flow of water apparent, although there is a considerable quantity below the surface of the gravel and stones. Such valleys do not readily lend themselves to the useful construction of reservoirs by means of dams stretching from side to side. It has been found, by experience in India, that only valleys which have a very small descending angle, and a copious supply of water running down them, can be made to keep full in the dry season; and that steep valleys either fill very slowly when dammed up, or do not fill at all. The great reservoir which was constructed at Hong Kong, in a steep valley leading down from the peak, would never keep full, although there was a considerable stream running down it. And a fresh water supply had to be sought for near Stanley, on the opposite side of the island. It is probable, therefore, that Mr. Medlicott will experience great difficulty in finding valleys and water-courses suited to the construction of reservoirs at such a height above the level of the plains as would admit of irrigation being effected by the natural fall. We speak from a five years' experience of every hole and corner of the island. The river Pedias, which is the longest in Cyprus, is entirely dried up throughout its whole course of twenty-five or thirty miles across the great central plain during the summer, yet after the rains it discharges into the sea vast quantities of muddy fresh water which discolour the Levant for many miles in each direction. To obviate this terrible loss of soil and fresh water should be the aim and object of the newly appointed engineer. Something of the nature of a "barrage," such as that which dams back the waters of the Nile below Cairo, might, it is conceivable, be placed across the valley of the Pedias above Nikosia where it debouches into the plain. Then the canals which conduct the imprisoned water towards the various cultivations which extend from Nikosia to Famagusta should be carefully lined with clay, otherwise the precious liquid will disappear with extraordinary rapidity. In order to convey an idea of how quickly water is absorbed in this locality, we may mention that a stream of water which rushes out from beneath Mount Pentadactylon, in the Kyrenian Range, 6ft. wide and 3ft. deep, runs down the Kythrea Valley, in the course of which about twelve water mills are negotiated. It is then led out by irrigation over a patch of cultivation about twelve miles long by three or four wide, and disappears bodily, not a vestige of green appearing beyond the outskirts of this patch during the summer.

To sum up, we would counsel the leaving of the steep valleys alone; but that the Pedias and its tributaries—of which the Kythrea stream should be one, if it was not absurdly wasted—should be controlled by hook or by crook. Finally, the planting of new forests should be encouraged to any extent, more especially on the summits of ranges. The senior medical officer of the Guards, whilst in Cyprus in 1885, remarked that the forests were gradually disappearing, from the earth around tree-roots being washed away in storms. This is a fact which we observed ourselves during our five years' stay. It can only be prevented by increasing the duration of rainfall. This is effected by planting right and left, as done by the late Sir Pope Hennessy in Hong Kong. Violent rain storms are not conducive to the growth of mountain forests, but gentle and sustained showers.

ROLLING BASCULE RAILWAY DRAWBRIDGE AT CHICAGO.

The Chicago River, which passes through the heart of the city of Chicago, is crossed by a great number of drawbridges, the traffic across the river being very considerable. Most of these bridges are of the ordinary swing type, turning on a centre pivot, but as the channel is narrow the pivot pier must frequently be placed on the bank, so that half of the length of the bridge swings over the land. Thus the Jackson-street Bridge, with a length of 280ft., gives a navigable channel of only about 85ft., the centre pier being entirely on the shore, and the bridge swinging over land which is worth many times the cost of the bridge.

Another serious objection is that as the bridge swings horizontally much valuable water front is rendered useless. One of the first bridges built with a view to avoid the objections to the swing bridges, was the vertical lift bridge at South Halsted-street, which was built in 1894. On each side of the river is a steel frame tower with pulleys on the top, over which pulleys pass wire cables which are attached to the end of the bridge. These cables are operated by winding engines, and the bridge, which is counterweighted, is lifted bodily up between the towers to a height sufficient to clear the masts of vessels. This bridge gives a channel about 100ft. wide.

A new type of drawbridge, known as the rolling bascule bridge, invented by the late Mr. William Scherzer, has been introduced, and three of these bridges have been built across

ROLLING BASCULE BRIDGE OVER CHICAGO RIVER

(*For description see page* 516)

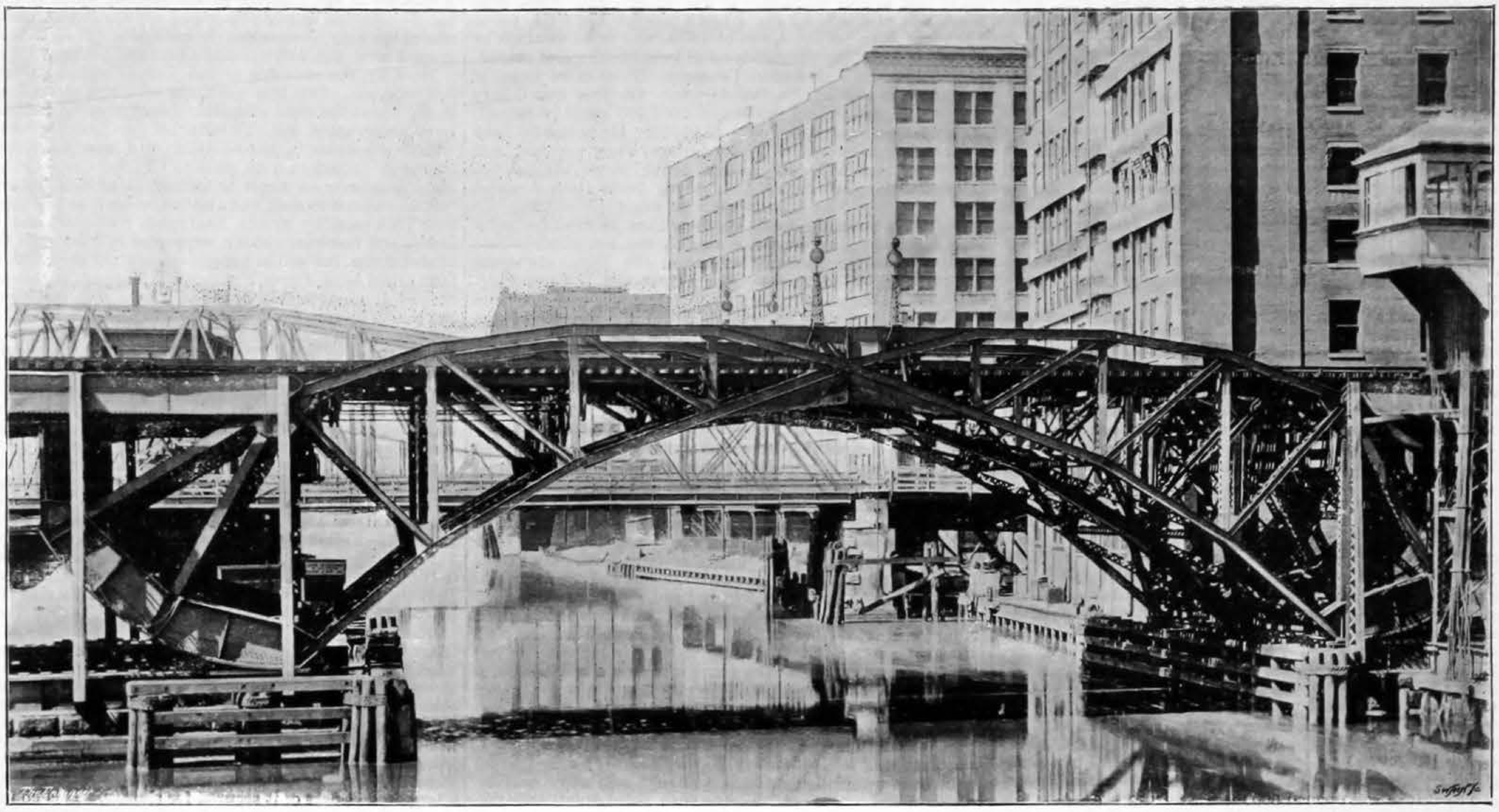


Fig. 1—BASCULES LOWERED

Fig. 2—BASCULES RAISED

the Chicago River. Each bridge has two leaves. The heels or shore ends are fitted with curved and counterweighted girders which roll on a path on the bridge abutment, the girders having holes which fit over the teeth of a horizontal rack which serves to guide the motion of the bridge. The first of these bridges was the one at Van Buren-street, which has a span of 115ft. between centres of bearings, the width of waterway being 109ft. The bridge has three trusses with a roadway 41ft. wide—with two tracks for an electric tramway—and two footwalks 8ft. wide. The latest is the North Halsted-street Bridge, with a span of 127ft., and a channel 121ft. wide; this has two trusses with a roadway 34ft. wide, and two footwalks 7½ft. wide. This bridge also has an electric railway over it, and, like the Van Buren-street Bridge, is operated by electricity.

The two accompanying views represent the bridge of this same type which carries the Metropolitan Elevated Electric Railway across the river, showing it open and closed. This bridge is between the Jackson-street and Van Buren-street bridges, and a swing bridge would have interfered with the swing bridge at Jackson-street, as may be seen from the view, Fig. 2, where the end of the open Jackson-street Bridge appears on the left, just beyond the raised bascule. On the right is the plate girder approach of that bridge, opposite which is the three-masted schooner. The closed bridge beyond is the Madison-street Bridge. Fig. 1 shows both the railway bridge and the Jackson-street Bridge closed across the river.

The railway bridge carries four lines of rails, and has a span of 114ft., centre to centre of bearings, over a channel 108ft. wide. It is composed of two similar or duplicate bridges placed side by side, each carrying two railway tracks, the two parts being coupled together to act as one bridge, but they can be uncoupled if necessary, as in case of accident to part of the operating gear, forming then a double-track bridge. Each leaf is so counterweighted that on drawing the centre and end locks it rises to an angle of about 30 deg., rolling back on the abutment, and the application of power is only required to completely open the bridge or to close it. The weight of each double-track leaf is about 135 tons. The bridge can be opened or closed in thirty seconds, and is ready to receive traffic in less than a minute from the time it starts to close. When closed, each leaf is a cantilever, anchored by a projecting tail which takes a bearing against the underside of the approach viaduct, the approach being firmly anchored to the masonry of the abutment. The end lock holds this tail firmly home against its bearing.

Each leaf is operated by two horizontal struts connected to the ends of the trusses, the struts being run in or out by gearing operated by a 25-horse power electric motor, current being supplied from the motor circuit of the railway, the line being operated by electricity. There are four 25-horse power motors. The amount of current consumed in operating the bridge is so small that no separate record is kept of it. The bridge was opened 5000 times during the last eight months of 1896, and between May, 1896, and July, 1897, about 1200 trains per day have crossed the bridge. The delay to trains caused by the passage of vessels and opening and closing the bridge is only from three to five minutes. The railway signals, bridge locks, and bridge motors are all operated from the tower at the right-hand side of the bridge.

The general dimensions are as follows:—

Length between ends of approaches	276ft.
Span between bearings	114ft.
Width of channel	108ft.
Headway at centre	35ft.
Depth of truss at its shore end	26ft.
Depth of truss at its free end	6ft. 6in.
Width between trusses	21ft. 2in.
Total width of bridge	51ft. 10in.
Radius of heel of truss	26ft.
Weight of each double-track leaf	135 tons
Total weight of bridge	540 tons
Counterbalanced weight on each side	28 tons

SOME EARLY SHIP CANAL SCHEMES.

ALTHOUGH Manchester has been the first place in this country to construct a canal for sea-going vessels of recent dimensions, it is well known that ship canals are a very old idea. They date, in fact, from before the Christian era, whilst a notable modern instance is the Caledonian Canal, made by Telford, and opened in 1822, to connect the eastern and western sides of Scotland by utilising a chain of rivers and narrow lakes. Ship canals were rather in favour early in the present century, mainly as a means of avoiding some of the injury—considerably greater than our patriotism allows—inflicted upon English shipping by the French during the long wars. A London and Portsmouth ship canal was projected in 1807, at a time when Government was paying about £200,000 a year for the transport of troops, stores, and munitions of war between those places. It sometimes took weeks to effect the passage, vessels waiting for a wind or for a man-of-war as convoy, till a number of craft were ready to go together. It was estimated that over 100 vessels were lost annually between the Downs and the Isle of Wight, and that the French captured about £3,000,000 of English shipping in that distance during the twenty years or so the war lasted. The plan was called the Portsmouth, Southampton, and London Junction Canal, and would unite the Itchen Navigation at Winchester with the Basingstoke Canal, or the Wey at Godalming, *viâ* Alton and Farnham. It was intended for small coasting vessels, which presumably would have discharged into barges at Weybridge, as the bridges at Kingston, Richmond, Kew, &c., would not have allowed them to come to London. Plans were drawn up by the elder Rennie, but capital was not forthcoming, and nothing was done just then. A chain of ordinary barge canals was made soon after, by two separate companies, which utilised and improved the rivers Wey and Arun as part of the inland waterway from London to Portsmouth. The route was from the Thames at Weybridge, by Guildford and Pulborough to Arundel, then, skirting the coast, into Langston Harbour. In spite of these boat canals being nearly finished, a "London and Portsmouth Grand Ship Canal" scheme was brought out early in 1825, Sir Charles Dance, the well-known experimenter in steam road-traction, being its secretary. The estimated cost was something over four millions, but five millions were to be raised. A company was formed, but it does not appear that the money was raised or the work begun.

The year 1825, however, was one of bubble companies and mad undertakings of every sort and kind, and this ship canal, which was to have no locks at all between Deptford—where it joined the Thames—and Portsmouth, was apparently one of them. Another London and Portsmouth Ship Canal, which seems to have been more or less in contemplation from 1824 to 1827, was projected by N. W. Cundy, a clever but enthusiastic and rather unpractical engineer of the time. His line of country was from a tide-lock in the river at Rotherhithe, by Kennington Common, where there was to be a large basin, along nearly the course now taken by the London and South-Western Railway between Vauxhall and Wandsworth, up the Wandle Valley, then by Epsom, Dorking, and Ockley, to Arundel. From there it would go through much the same country as the boat canal of the Portsmouth and Arundel Navigation Company of 1817, except that it was to cross Portsea Island, on which Portsmouth stands, and end about where Southsea Pier now is. Cundy put the cost of a canal about eighty miles long at four millions. It was to be 150ft. wide, 30ft. deep, and available for the largest merchant vessels, about 1200 tons, then built. A rise of 127ft. was to be attained by only four locks, the summit level of twenty-one miles extending southwards from Epsom Common. Four more locks, of course, were needed for the descent. On this line Cundy expected a gross yearly revenue of £662,800 could be earned, with working expenses of only £112,800. He seems to have contemplated the use of steam towage, when required, and estimated that 1200-ton vessels could come through to London in fourteen hours, and fishing boats from Arundel Bay in eight. The former were to pay £240 in tolls. So confident of success was the engineer that he even devised a plan for employing on the canal all the sea pilots whose occupation in the Thames and round the Forelands would be ruined by it. Although Government was not unfavourable to the scheme, they lent it no useful aid, and investors not then being used to projects requiring money by the million, it fell through. Three other lines of route, all longer and less practicable, were surveyed by different engineers, but were never even begun. The two barge canals, however, were completed, Josias Jessop being the engineer, but they were not very successful financially. They agreed between themselves and the two river—Arun and Wey—navigations completing the waterway between the Thames at Weybridge, and Portsmouth, to charge a through rate of 4s. 6d. per ton upon all goods carried between those points in time of peace. In war time the highest rates allowed by the Acts forming the companies might be charged. This 4s. 6d. rate was far lower than could possibly have been made by the stage wagons, which then formed the only means of inland heavy transit between London and Portsmouth. The river Wey between the Thames and Guildford—extended to Godalming about 1760—it may be observed, was canalised under an Act of 1671, and is said to have been the first inland navigation in this country to be provided with locks.

At the same time that the above schemes were in hand, a ship canal was also projected by the English and Bristol Channels Ship Canal Company. Proceeding inland from Seaton Bay, close to the junction of Dorsetshire and Devonshire, it would have gone by Colyford, near Axminster, Chard, and Taunton, to Bridgwater Bay at Stolford, a few miles below the town of Bridgwater. Although only about half the length of a London and Portsmouth ship canal, this one would have been much more difficult of execution and maintenance. No fewer than twenty-nine locks were needed at each end of the summit level of 12½ miles. To supply these locks several hundred acres of reservoirs would be necessary. The total length was to be 44⅜ miles, the summit level being 245ft. above low-water level at the Seaton end, but 267ft. 7in. above it at Bridgwater Bay. This difference arises from the much greater rise and fall of the tides in the Bristol Channel than in the English Channel, where they have more room to expand. Upwards of 220 miles' distance would have been saved by this canal between Bristol or any port east of Bridgwater and Beer Harbour in Seaton Bay or any port in the Channel east of the latter. The Land's End was a very troublesome point to round sometimes for sailing vessels, quite as bad as the Downs, but without any good anchorage or harbours of refuge near. Telford's estimate for the work amounted to £1,712,844, and the company proposed to raise £1,750,000, with borrowing powers of three-quarters of a million more. It succeeded so far as to obtain an Act of Parliament, July 6th, 1825, but its powers were allowed to lapse, and nothing was done. A return of at least 12 per cent. upon the capital was expected. Although termed grandiloquently a ship canal, it was not intended for vessels of more than 200 tons burthen—in fact, coasting schooners and brigs. Large vessels probably seldom required to pass between London or the south-coast ports and Bristol; but no doubt the canal would have been considerably used by small sea-going craft, if it had been made. Brindley had planned a small canal from Exeter by Tiverton and Taunton to Uphill Bay, in the Bristol Channel, in 1769, with a similar object to the above, but that, too, ended only in talk.

NEW RAILWAY WORKS IN SOUTH LONDON.

THE unromantic neighbourhood of Waterloo Station is just now a centre of great activity in the way of railway construction. Within a stone's throw of each other, no fewer than three railway companies have important works in hand. Commencing at the south end of Carlisle-street, Lambeth, at arch No. 189, the London and South-Western is widening its line towards Waterloo, under powers obtained in 1893. The old houses—1813—in Penlington-place, Hercules-road, have been pulled down from Carlisle-street to No. 68, after which the line keeps at the back of the houses, crosses Homer and Allen streets, goes behind Newnham-terrace and its southern part, widening out, stops in the rear of the Westminster Bridge-road houses. The part immediately adjoining the existing railway on its southern side will go on over the north end of Carlisle-street, pass behind the Canterbury Music Hall, cross the Westminster Bridge-road, and rejoin the main line upon the site of the Woking Necropolis Company's private station, just outside Waterloo. None of the four bridges which will be necessary are yet up, but the abutments for those over Homer and Allen streets are finished, and are quite 40 yards wide on the east side of the latter. The western abutment in Carlisle-street is also up; these are all faced with white glazed brick, which is certainly a great improvement on the old style for such remarkably dark and dingy thoroughfares as these. That portion of the new work which stops short of the Westminster Bridge-road is to be used as sidings, more room for which is urgently needed. All this is but part of a further scheme of widening, beginning at Wandsworth-road. Power to execute this and to acquire the whole space between Waterloo Station and Lower Marsh, with a view to future necessities, will be sought in the coming session.

On the south side of Waterloo Station, and separated from it only by Aubin-street, may be found the subterranean terminus of the Waterloo and City Electric Railway. The area is about 50 yards wide by 100 or so in length, and extends to the back of Lambeth Lower Marsh. Across it, from the latter street, ran Lancelot-street, the middle part of which has been entirely absorbed. The retaining walls round the station site are nearly finished, and the power house, in the south angle but on the ground level, is getting on. A fine octagonal chimney in connection with it may be about 130ft. high. The line will run out under Aubin-street, and below arches 251 and 252 of the 1879 portion of Waterloo Station. These arches have been cleverly thrown into one, the upper part of the division between them now resting on the crown of a tremendously strong arch of eight rings of blue brick. A glimpse of the interior of the tunnel, beneath Waterloo, can be obtained from Aubin-street. The bottom of the station site of the City electric line is some 30ft. or 40ft. below the ground level, the line running about due north as it goes out.

Hard by, the widening of the South-Eastern Railway is in full progress. This line was made with two up roads and one down, about the time when the Brighton and Chatham lines were constructed into Victoria on the same system. The widening consists in the addition of a new down line, and begins at Belvedere-road, close to Charing Cross Bridge. At Manners-street an angle is formed to contain a turntable, Sutton-street is crossed, and a lattice bridge is now being erected over York-road by Messrs. Eastwood, Swingler, and Co., of Derby and London. This is supported in York-road by three timber struts, but will be a single span. Four narrow thoroughfares called Anne, Agnes, Frances, and Mepham streets are then crossed, the first named by the only brick arch on this section, the others by iron bridges. Waterloo Bridge-road will have to be crossed by a span, not yet begun, which will cover part of Alaska-street as well. The abutments here are ready, and faced with white bricks. At Waterloo Junction the signal-box of that name will have to be moved; in fact, the station must be nearly rebuilt. It will certainly bear a great deal of improvement. All the houses on the north side of Sandell-street have to come down, but at present they have only had their windows smashed as a preliminary. Cornwall-road will be crossed, but nothing has been done here yet. After this point, the arches of the new viaduct are fast rising between Wootton-street and the old part of the line. Two narrow slums called Windmill-street and Eaton-street will be spanned, but operations are not yet begun. A bridge over Broad Wall is finished, and another over Collingwood-street as well. Between these lies Isabella-street, all the north side of which has been removed, six arches of stock brick taking the place of the houses. The large span, some 35 yards, across Blackfriars-road against the old Surrey Chapel, is still in progress, necessitating heavy timbering in the roadway. At Gambia-street the line only requires widening by 3ft. or 4ft., owing to there having been a station—called Blackfriars—near here originally. Fortunately, ample room was left beneath the London, Chatham, and Dover, which will not have to be interfered with. Gravel-lane is next crossed, and then Ewer-street. Between them, but on the other side of the line, is a large space, part of it secured for sidings. It is bounded on the north by Lavington-street, and may be 200 yards long from east to west by 130 yards wide. A portion is occupied by the girder stores of Messrs. Measures Brothers and by other works, the sidings taking up the southern half. These will be upon brick arches, fifteen or sixteen in number, and about 30ft. span, accessible from Ewer-street. The centres of many at the Gravel-lane end are already up. Apparently the siding neck will run from the north side of the line at Great Guildford-street. After Ewer-street comes a bridge, not quite finished, over Great Guildford-street, succeeded directly by Southwark Bridge-road at its junction with Union-street. This bridge, which is not commenced, will be 50 or 60 yards in length. From here eastwards the arches of the viaduct are not yet turned, nor are the bridges over Worcester and Red Cross streets begun. At the latter Cannon-street West junction signal-box is temporarily underpinned for the new work to pass, and will be rebuilt. Close by, on the south side of Southwark-street, this portion of the widening ends, the distance from Belvedere-road being a few yards more than a mile. All the bridges are or will be by Messrs. Eastwood, Swingler, and Co., the abutments in all cases being of white glazed bricks.

A new single-line bridge, or iron viaduct rather, has been finished across Borough High-street and the northern approach to London Bridge Station for some time, but it was only brought into use on the 11th Oct. Instead of crossing both by one span, like the hideous old bowstring bridge alongside, it has two piers in the ascent to the station. At the junction of the western road up to the station—termed Railway Approach—and Denman-street, the City and South London Electric Railway is making a station, which will be about three furlongs from the Monument and Borough Stations on either side of it. A good view of the works can be got from the iron viaduct just mentioned.

Of the South-Eastern works below London Bridge, described in THE ENGINEER for November 20th, 1896, the widening of the Greenwich line on the north side for about three-quarters of a mile between Goodson-road, Rotherhithe, and Rolt-street, Deptford, is nearly finished, though the bridge over the Grand Surrey Canal is not yet up.

SEWING-NEEDLES IN GERMANY. — The sewing-needle, though small, forms a very important article of commerce in Germany. While formerly England supplied that country with needles, this industry, according to the United States Consul at Annaberg, has during the last few years developed to such an extent that the Germans are able to meet their English competitors, not only on the markets of the world, but in the British Colonies and in England as well, says the *Journal* of the Society of Arts. The principal seats of the industry are Aix la Chapelle, Burtscheid, Iserlohn, Altona, Nuremburg, and Schwalbach. The factories of Aix la Chapelle alone produce 50,000,000 needles weekly. The following figures show to what extent the exports from Germany of these needles have developed. During the eight years from 1880 to 1887, the German export of needles of all kinds—embroidery, knitting, darning, sewing, and sewing-machine needles—amounted to 11,600,000 lb., of the value of £2,500,000. The following eight years make a still better showing. During this period the quantity exported was 15,000,000 lb., valued at £3,000,000. The enormous growth in the production of this article is due principally in the export trade to China, where Germany seems to entirely control the market. Other countries importing German sewing-needles are British East Indies, France, the United States, Austria, Hungary, Italy, and Turkey. In conclusion the American Consul says:—"Under the protection of their Government the Germans have built up a needle industry which commands the respect of the world. At first they imitated the English methods of manufacture, but their superior technical training soon enabled them to discover the defects of the English machinery, and they adopted new and improved devices, and followed their own course of manufacture. The infant industry of a few years ago has become one of national importance. The manufacturers go into the markets of the world, preferably into new countries, and compete successfully everywhere."

DAVIS'S MOTOR CAR STEERING GEAR

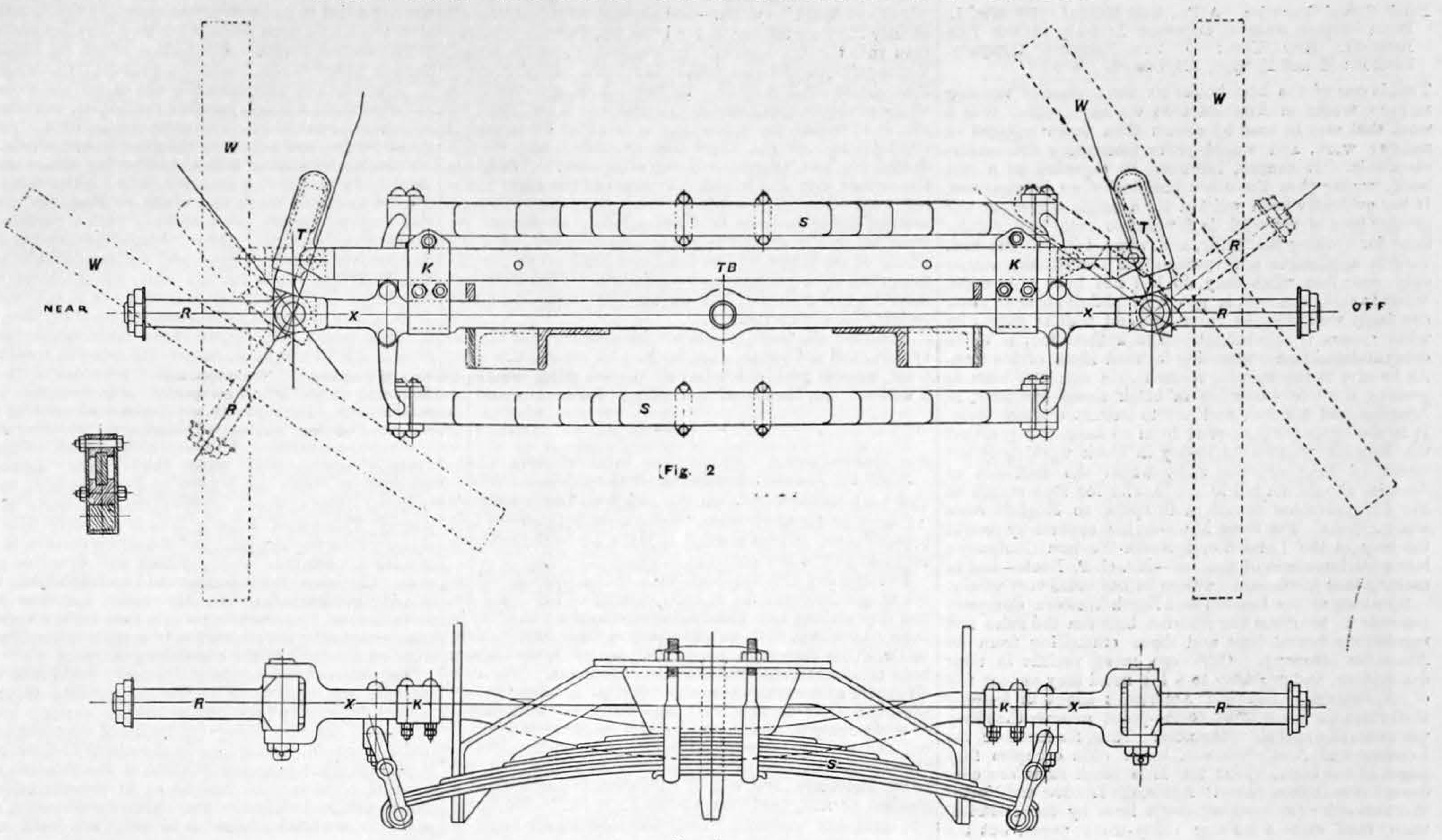


Fig. 2

Fig. 1

A NEW MOTOR CAR STEERING GEAR.

THERE are still some few earnest workers in the self-propelling motor field who are giving very close attention to all that pertains to the motor car as an entity. Among these, we think, may be included Mr. H. T. Davis, the inventor and patentee of the improved steering gear, more especially intended for motor cars, but applicable to all four-wheeled vehicles, which we illustrate in Figs. 1, 2, 3, and 4.

It is, of course, known to all constructors of wheeled carriages that to ensure their proper working it is necessary that the axes of rotation of all their wheels should be parallel to one another when the carriage is moving on a straight course, and convergent to a common axis perpendicular to the supporting plane, when moving on a curved course. To ensure this action in four-wheeled vehicles the front axle has hitherto been pivoted on a central pin at its mid-length, but as all coachmen are aware, such an arrangement without a pole, or shafts, to restrain the erratic movement of this axle, when any obstruction is met with by either of its wheels, requires very cumbrous controlling gear.

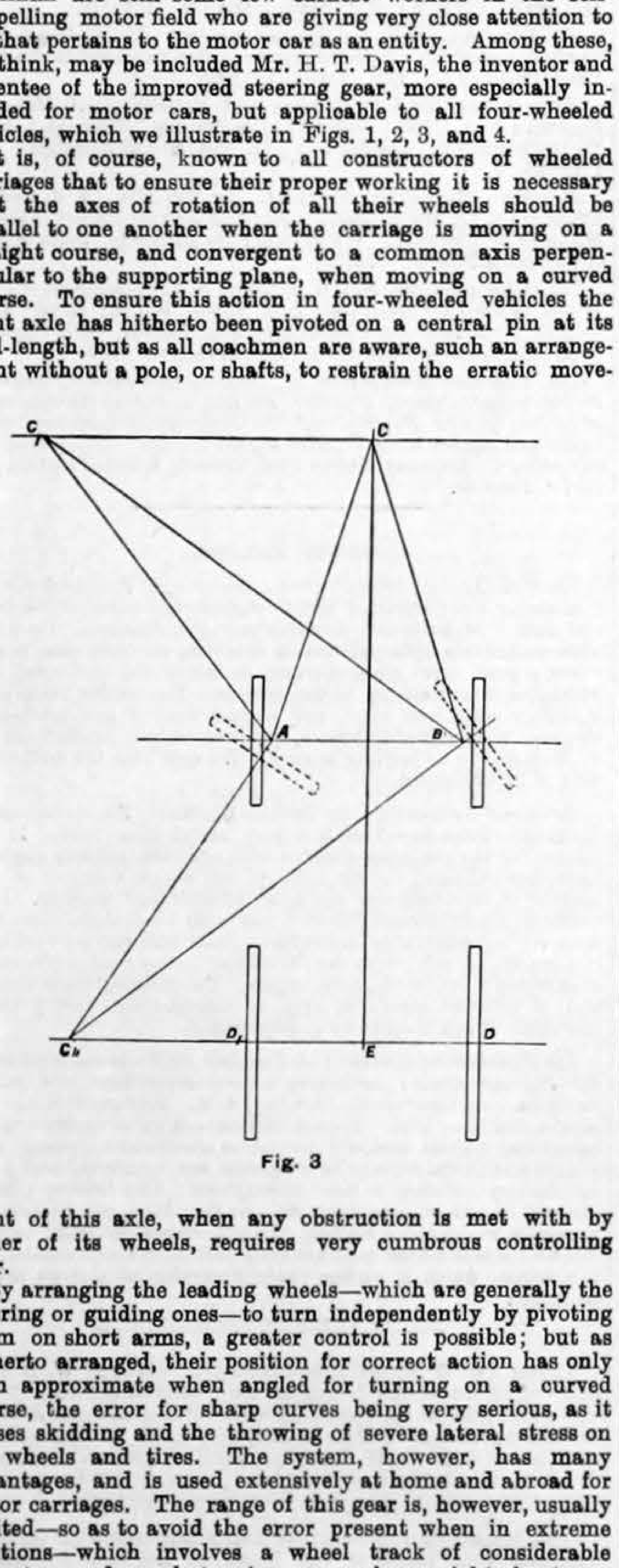


Fig. 3

By arranging the leading wheels—which are generally the steering or guiding ones—to turn independently by pivoting them on short arms, a greater control is possible; but as hitherto arranged, their position for correct action has only been approximate when angled for turning on a curved course, the error for sharp curves being very serious, as it causes skidding and the throwing of severe lateral stress on the wheels and tires. The system, however, has many advantages, and is used extensively at home and abroad for motor carriages. The range of this gear is, however, usually limited—so as to avoid the error present when in extreme positions—which involves a wheel track of considerable diameter, and much turning room when a right about or a complete turn is necessary. It also requires the operation of what is known as "backing and filling," in order to get round—methods which are unsuited to narrow roadways or crowded thoroughfares, and are moreover discouraged by the Local Government Boards in their motor carriage regulations.

The invention illustrated in Figs. 1 to 4 has therefore for its object to so construct steering apparatus for all kinds of road carriages and wheeled vehicles as to ensure that their wheels shall at all times occupy such positions, that their axes when produced shall converge to and intersect in a common or instantaneous axis when viewed in a direction perpendicular to the supporting plane.

Its action will be more easily understood by a reference to the diagrams—Figs. 3 and 4—which accompany our illustrations of the gear itself. These latter need little explanation, Fig. 1 being an elevation of the improved gear, and Fig. 2 a plan of the same looking on the top side of the springs and axle. In Fig. 1 X X is the axletree, having forked ends, to which are attached the jointed arms R R on which the wheels W W when in motion turn. With these arms are combined—in one forging—the tiller heads T T, fitted with sleeve pieces coupled to the ends of the movable tiller bar T B, which is carried in the clip guides K K fixed at both ends of the axletree X X, the springs S S supporting the fore body of the car being located on either side of the axletree, and carried by it as shown. Motion may be given to the bar T B by any kind of hand gear preferred by the carriage builder.

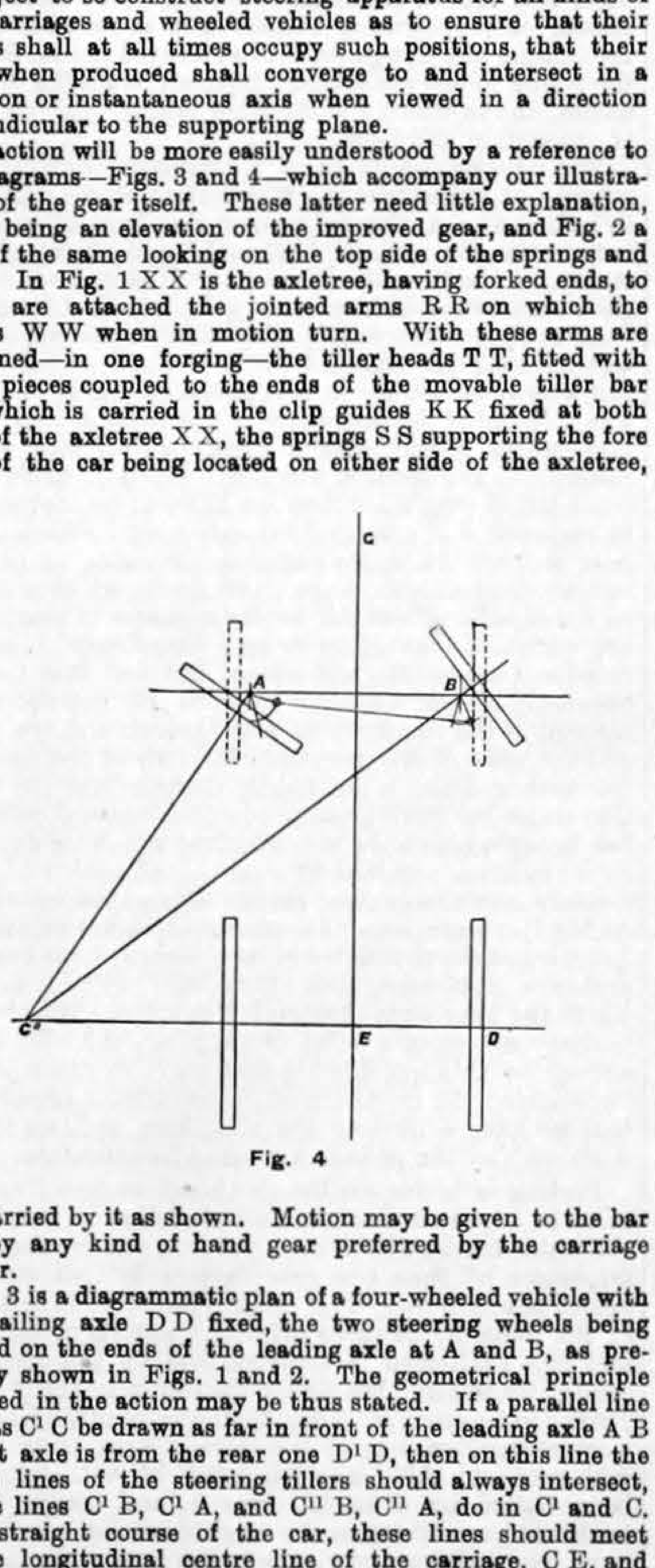


Fig. 4

Fig. 3 is a diagrammatic plan of a four-wheeled vehicle with the trailing axle D D fixed, the two steering wheels being pivoted on the ends of the leading axle at A and B, as previously shown in Figs. 1 and 2. The geometrical principle involved in the action may be thus stated. If a parallel line such as C^1 C be drawn as far in front of the leading axle A B as that axle is from the rear one D^1 D, then on this line the centre lines of the steering tillers should always intersect, as the lines C^1 B, C^1 A, and C^{11} B, C^{11} A, do in C^1 and C. For a straight course of the car, these lines should meet on the longitudinal centre line of the carriage, C E, and for other positions on either hand of it. This arrangement gives geometrical accuracy for all positions. In the examples, the amount of angle given to the leading wheels is equal to what is accomplished when any ordinary carriage is brought to half lock, or the fore carriage moved through 45 deg.

Another advantage claimed for this improved arrangement of steering gear is, that it gives an increased leverage to both wheel tillers as the angle of lock becomes greater. With ordinary linkwork it will be seen on reference to the diagram, Fig. 4, that in the extreme position, the angle made by the joint rod and lever is dangerously near zero, or 180 deg., in the case of one of the wheels.

RAILWAY STATISTICS OF THE UNITED STATES.

FROM the introduction to the 1897 edition of Poor's "Manual of Railroads," our American correspondent has compiled the following statistics, which refer to the year ending December 31st, 1896:—

Length of line laid to December 31st, 1896	182,600 miles
Net increase of mileage during 1896	1,206 "
Railways reporting statistics	178,549 "
Second track and sidings	56,933 "
Total mileage	239,533 "
Steel rails	207,620 "
Iron rails	27,864 "
Locomotives	36,080
Cars—	
Passenger	24,788
Baggage and mail	7,839
Freight	1,250,061
Total (exclusive of company's cars and parlour and sleeping cars)	1,272,688
Liabilities (dols.)—	
Capital stock	5,290,730,567
Bonded debt	5,416,074,969
Unfunded debt	339,502,302
Current accounts	386,382,440
Total liabilities	11,432,690,278
Assets (dols.)—	
Cost of railway and equipment	9,953,767,710
Real estate, stocks, bonds, and other investments	1,450,418,025
Other assets	231,915,121
Current accounts	161,396,357
Total assets	11,997,497,213
Excess of assets over liabilities	364,806,935
Passenger traffic—	
Mileage of passenger trains	337,641,115
Passengers carried	535,120,756
Passengers carried one mile	13,054,840,243
Passenger earnings, dols.	265,313,258
Average receipts per passenger per mile, cents	2·032
" " " cents	49·58
" " " train mile	78·58
" " mile of railway, dols.	1,467
" passengers per mile of railway	2,958
" miles travelled per passenger	24·40
Goods traffic—	
Mileage of goods trains	497,248,296
Tons of freight	773,868,716
Tons of freight carried one mile	93,885,853,634
Freight earnings, dols.	770,424,013
Average receipts per ton per mile, cents	0·821
" " " cents	99·55
" " " freight train mile, cents	154·94
" " " mile of railway, dols.	4,259
" tons per mile of railway	4,278
" miles per ton	121·32
Finances (dols.)—	
Gross earnings	1,125,632,025
Net earnings	332,333,756
Operating expenses	793,298,269
Total available revenue	436,341,298
Payments from total available revenue—	
Interest on bonds	242,415,494
Dividends	81,304,854
Gross earnings per mile of railway	6,223
Net " " "	1,837
Percentage of expenses to earnings	70·48 per cent.
Interest on total bonded debt	4·43 "
Dividends paid on total share capital	1·54 "

All the figures are exclusive of the elevated railways of New York, Chicago, and Brooklyn, and also exclusive of those railways which are operated mainly for switching or shunting purposes in connection with terminals and industrial enterprises.

THE INSTITUTE OF MARINE ENGINEERS.—The ninth annual conversazione of this Institution will take place at the Town Hall, Stratford, on Friday, the 3rd December. In addition to the lighter portions of the evening's entertainment, the president, Mr. J. Fortescue Flannery, M.P., J.P., M. Inst. C.E., will deliver an address, entitled "Some Successive Steps in the Past Progress of Marine Engineering: Its Existing Condition: Some Possibilities of the Future."

LITERATURE.

Block Signal Operation. A Practical Manual. By Wm. L. Derr, Superintendent, Delaware Division of the Erie Railroad. New York: D. Van Nostrand Company. London: E. and F. Spon, 125, Strand. 7s. 6d.

This is one of the best books on the system of working railway traffic in America that we have seen. It is a work that may be read by others than those engaged in railway work, and would prove interesting and understandable. It cannot, however, be regarded as a text book, seeing that there are practically no illustrations. It has evidently been written by a traffic officer, as the greater part of the work is devoted to rules and regulations for working the traffic, and when, towards the end, various appliances and systems are named, the author only describes what they do but not how it is done. What is said, however, is put very plainly, and any one can fairly well imagine from the end that is gained by what means it is wrought. The author, too, is to be congratulated in not thrusting forward ideas of his own. As he says in the opening remarks, his aim has been to present the latest practice in block signal operation in America and Europe, and not to submit original ideas. It is also gratifying to read from an American pen that the English practice of to-day in block working is the result of long experience by which the railroads of America should not fail to profit, and for that reason he has devoted some considerable space to English rules and methods. For these Mr. Derr has apparently sought the help of the London and North-Western Company's late superintendent of the line—Mr. G. P. Neele—and in seeking that gentlemen's advice he has acted very wisely.

Speaking of the London and North-Western Company reminds us to notice the contrast between the rules and regulations issued here and those emanating from an American company. Ours are most prolific in their description, and probably to a lay mind they appear full of repetitions. But the Americans adopt in framing their rules the same terse, to-the-point manner that they use generally in their utterances. Thus, for instance, the London and North-Western block code occupies fifty pages of the book, whilst the Erie block rules are condensed into sixteen pages. Again, the London and North-Western rules for working single lines by the electrical train staff system occupy thirty-three pages, but the Chicago, Milwaukee, and St. Paul line need but ten pages under the same heading.

Anyone acquainted with the systems used in both countries cannot but be struck by two great contrasts—first, the small amount of absolute block used across the water as compared with this country, where it is absolute block everywhere on passenger lines, except in busy stations where trains have to make connections; secondly, the advanced state which automatic signalling has reached there, whereas here we have only the single installation on the Liverpool Overhead Railway. Of course, under this second head, there comes the question of working points and signals by mechanical means instead of by manual power. That has been carried out to a very large extent in America, but so far there is no actual installation in work in this country, where both points and signals are manipulated, and one by a signalman in the usual way.

The first contrast is readily disposed of. Across the water, their block sections are generally so long that trains would necessarily have to be detained some minutes at a block station whilst the proceeding train got through the section, and consequently it is found more expeditious, and apparently equally as safe, to work most of the traffic on the permissive system. Then, again, it must be remembered how much of their mileage is single where most of the movements of the traffic are regulated by the despatcher at headquarters. Here we cover less area, and only in sparsely-populated districts are really long block sections to be found. Here, also, our railway companies are too much at the mercy of public opinion, which guides the House of Commons, who in turn influences the Board of Trade, and so we have laid down for us specific rules as to how our trains shall be worked; and let us here mention, in parentheses, that the inspecting officers are now apparently getting anxious to have all the goods trains worked on the absolute block system. From all these regulations, except in a certain few States, the American Railway Companies are free.

As regards the second contrast, *i.e.*, the mechanical and automatic working of signals, it seems to us that this may be due to two reasons. The principal cause, to our mind, is the difference in the variations of the temperature. In our moist climate it is useless to expect much from a track circuit. Then, again, probably a second deterrent effect has been the same public opinion to which we have just referred. Most of the officers of the British lines would only be too glad to get either an automatic signalling plant or mechanical means to assist the signalman. The traffic manager knows that the staff of signalmen, the wear and tear of locking frames, signals, point and signal connections, would be reduced. But where would his traffic be if there was a breakdown of the machinery? and would not his competitors gain were he to have a collision through an automatic signal failing to go to danger?

Amongst the methods of automatic signalling referred to is the Hall system, which, by the way, one of our contemporaries said the other day, the Hall Signal Company was anxious to try in this country. We notice in the rules for working found on that system issued by the Lake Shore and Michigan Southern Company, that should a driver come to a signal at danger he shall stop, and after waiting two minutes, he may go ahead cautiously. This appears to show great confidence in the driver, and yet what a contrast to the system adopted at junctions and level crossings. Here in this country we are satisfied to provide signals, and expect a driver to obey them; but in America they are apparently accustomed to signals being ignored, as at all junctions and level crossings, facing trap points, or derailing switches, are provided.

In dealing with track circuits, Mr. Derr touches two points which are great difficulties in the adoption of any "lock and block" system—and about that subject we shall shortly have something to say in an article to itself. He says that the track circuit, or contact, must be placed the maximum distance inside the home signal in order that signal shall not be thrown to danger until the whole of the longest train has passed it. What, then, we ask, is to ensure the protection of a short train, and if short trains are not absolutely protected, are we not destroying half the value of the safeguard? Again, the the author says that in order to prevent the train clearing itself when only part of the train passes into the next section, either because of a break-loose, or part of the train being left on the line for shunting purposes, the whole of the length of line from one block section to the next shall be a continuous rail circuit. Mr. Derr has named a real difficulty, but we are not prepared in this country for such a remedy.

But after all, these comments are directed towards the system, and not towards the book. As regards the work itself we will end as we began, by remarking that it is a well-written, clear, and interesting book.

The Dwelling-house. By George Vivian Poore, M.D., F.R.C.P. London: Longmans, Green, and Co. 1897.

The book before us is a worthy successor to the author's "Essays on Rural Hygiene," being written in a clear and popular style, so that it must appeal alike to the sanitary engineer and to the public at large.

The opening chapter deals with the modern dwelling-house, pointing out its defects, paucity of light and air, and deprecating that blind adherence to the cult of sanitation by water, with its attendant syphon traps, which, as Dr. Poore demonstrates, are but too often the culture beds of innumerable putrefactive organisms. We have all grown so accustomed to the "typical London house," that, like children with their catechism, we never dream of questioning it, until a prophet of science arises to point out the glaring defects and sanitary inconsistencies of these mansions, and we have perforce to admit the truth of his strictures, and will, if wise men, as far as circumstances permit, "set our houses in order." We quote one pregnant sentence, "That the internal channels of communication, instead of serving for the supply of fresh air, merely facilitate the exchange of foul air." Who does not know the damp, unwholesome smell coming to the first floor from "the basement," or the smell of cooking which pervades the whole house? These things have been and are in the older dwellings, but there is no excuse for perpetrating them afresh, as our author gives the outline of a design for a five-storeyed house, in which the living rooms are entirely separate from the domestic offices, and in which the staircase ensures the maximum of ventilation and light.

The wrong-headedness of constructing houses in the suburbs or in the country, where often ample curtilage is to be had at a moderate rent, on the lines of a London house with its walled "backyard," and storey piled on storey, is dealt with severely. "Traps and trapped gullies are evils which are only to be tolerated for the prevention of greater evils." Therefore in the country rain water should be collected for future use or allowed to run over open gullies to a convenient patch of ground. The disposal of the slop water of the house, a very important matter, is dealt with at length by Dr. Poore, who has carried out numerous experiments which go to show that much larger quantities than are likely to be met with can be disposed of in open gullies, constructed with a shallow floor of large flints, thus leading the water to percolate into the soil and to nourish the shrubs which are grown on either side. Desirable as dry methods of treatment of the various off-scourings from a house may be, as advocated in Chapter II., we cannot but feel that they are impracticable in crowded centres of population, on account of the carelessness and ignorance of the people, and the want of the necessary land about the dwellings. Our author deals in the fourth chapter with the legislation which has made great sewerage schemes possible, and has brought about the overcrowding which we deprecate, by the facilities provided for removing all those undesirable matters inseparable from closely aggregated populations. As Mr. Herbert Spencer has often maintained with so much force, legislation has failed of its object, and has but added problems still more difficult to deal with than those which the laws were constructed to solve. Why have the sanitary enactments failed of their object? Dr. Poore's answer to this question is that we have attempted the impossible; the expulsion of nature with a pitchfork, in that we have denied to the soil those matters that are dealt with by the process known as humification.

Perfection is impossible in things human; and if it must be admitted that certain evils follow in the wake of the water carriage of sewage, yet it is evident that we are far better off than our grandfathers in that our public health is improved. This improvement it is not denied is the outcome of more efficient methods of sanitation, and this sanitation is accomplished by the removal of sewage by water. We find a discussion on the "Sewage Farm" in Chapter VI. Very small communities have made a commercial success of the sewage farm, when worked with care and skill; any relaxation of watchfulness has been visited by financial disaster, and danger to the health of those living in the neighbourhood. Great cities have spent millions of money in the attempt so to dispose of the solid sewage on a great scale, and have failed because humification does not take place as rapidly or as satisfactorily as was anticipated, and because the crops of the cabbage family grown on human excreta are unfit for human food; and recourse has had ultimately to be made to rye grass, as the one crop that can be grown with certain success on a sewage farm.

Water carriage is enormously costly, but it is the only method which can be depended on for the removal of the "undesirable" from our houses and neighbourhoods without causing a nuisance. The offence caused in cities, when the pail system was in vogue, by the passage of the night-soil carts through the streets, was so intolerable that the inhabitants preferred heavy taxation for sewers rather than endure it. The section of the second chapter dealing with "Wells," with its practical illustrations, is of interest, as it advocates the use of surface-wells, and, as far as we can judge, justifies the advice, provided that a proper site be chosen. This dictum must be received with great caution, and a rigorous attention to limitations. The fourth chapter dealing with overcrowding comes home to the Londoner, proving that the Strand is the most fatal district to infant life in the whole of England, notwithstanding the many open spaces, parks, gardens, and mansions it contains. These "lungs" of London do not compensate for lack of light and air immediately around the dwellings. It is too late now, the mischief is past mending. Until the public conscience is so far awakened that owners of houses in the area can be compelled, or do of their own initiative pull down their houses to give access of light and air to others, the evil will remain, and to speak plainly, we must make the best of it while dreaming with Dr. Poore and Mr. Bellamy of the millennium. Lack of space prevents our quoting freely from the section headed "Remedies for Overcrowding," which is admirable, and should be read and re-read by sanitary authorities until they have thoroughly digested it. "We have been long accustomed to hear that our chief sanitary necessity in this world is pure water. This would be quite true if we were fish. But it is obvious that the purity of the air we breathe is of far greater importance. . ." Which well deserves quotation. Our friend the ubiquitous and useful bacillus, whose activity renders all putrescible matter harmless to the animal world by converting it into food for the vegetable, thus completing the circulation of organic matter, receives a fitting eulogium in the concluding chapters.

The present tendency in the sanitary world is to recognise the supreme value of the oxygenating faculty of certain organisms upon refuse organic matter, and experiments are now being conducted of exposing sewage under favourable conditions to the action of these organisms. Should a practical solution of the problem of the disposal of sewage be arrived at in this direction, Dr. Poore will be justified in the claim for Nature's, as opposed to artificial methods, so ably set forth in this book.

BOOKS RECEIVED.

Journal of the Royal United Service Institution. Vol. xli. November, 1897. London: J. J. Keliher and Co. Price 2s.

La Traction Mécanique des Tramways: Etude des différents Systèmes comparaison et prix de revient. Par Raymond Godfernaux. Paris: Baudry and Cie., Editeurs. 1898.

Comprehensive Guide to Printing and Publishing: A Manual of Information on Matters connected with Printing, Publishing, &c. &c. Eleventh edition. London: W. H. and L. Collingridge. 1897. Price 6d.

New Zealand Railways Statement. By the Hon. A. J. Cadman, Minister for Railways. 1897. Including Annual Report of General Manager of Railways. Wellington: By authority, John Mackay, Government Printer. 1897.

Legislative Assembly, N.S.W.: Report of the Department of Public Works for the Year ended 30th June, 1896. Printed under No. 17 Report from Printing Committee, 26th August, 1897. Sydney: Wm. Applegate Gullick, Government Printer. 1897.

The Practical Management of Engines and Boilers, treating of Boiler Setting, Pumps, Injectors, &c. &c., including Compound and Multiple Cylinder Engines, and the Practical Management of Dynamos and Motors. By William Barnet Le Van. Illustrated by 60 engravings. London: Kegan Paul, Trench, Trübner and Co., Ld. 1897. Price 6s.

SHORT NOTICES.

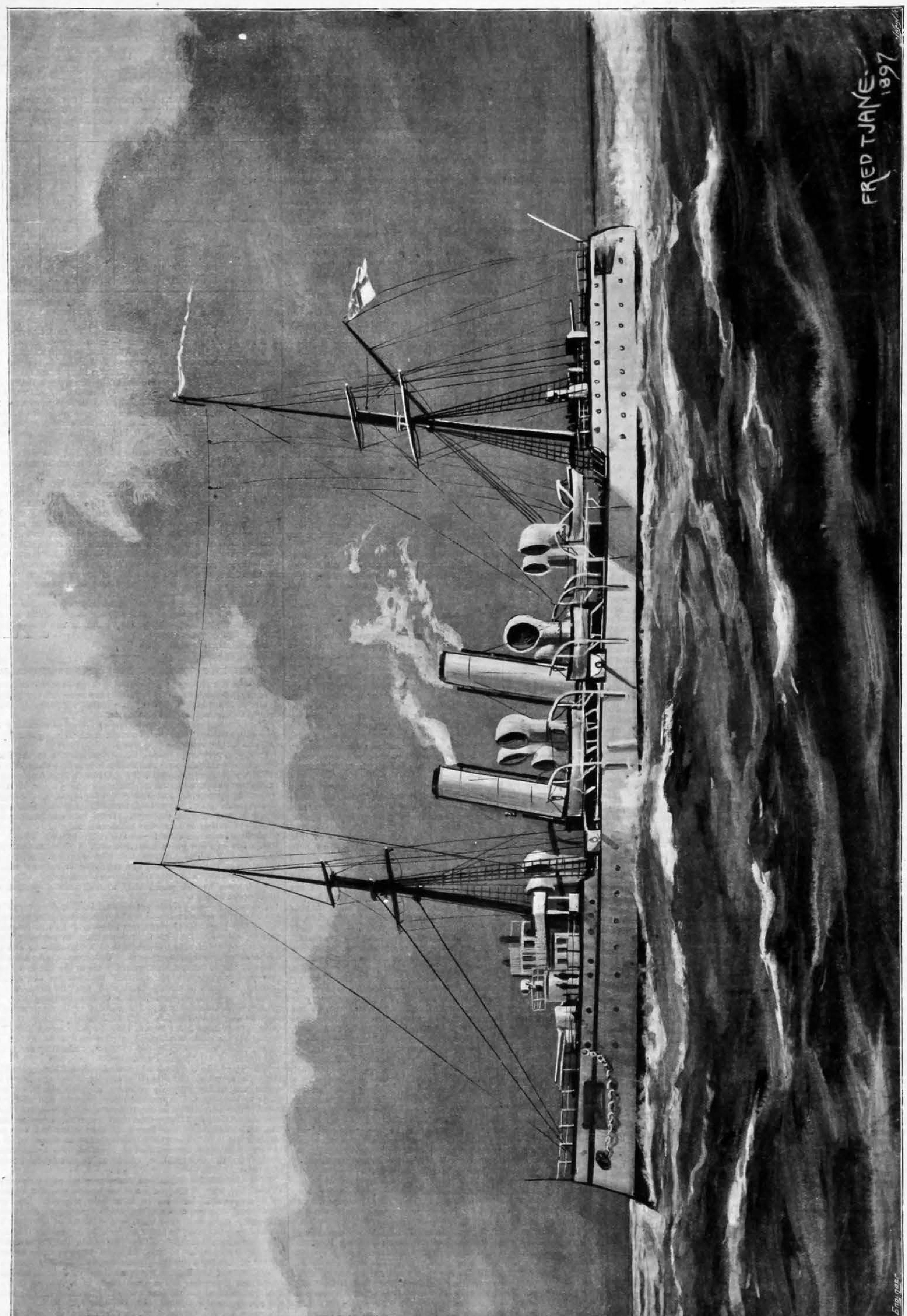
The "Mechanical World" Pocket Diary and Year-book for 1898. Containing a collection of useful engineering notes, rules, tables, and data. Manchester: Emmott and Co., Limited. Price 6d.—This remarkable little publication enters its eleventh year in a new cover, a good stout cloth binding replacing the cardboard cover which has been used up to the present. The matter has also been entirely reset in new type, and a good deal of new matter, particularly with regard to beams, has been added, so that the little work should be as popular as ever. We note that the edition consists of 22,000 copies.

Rails and Accessories. By Thomas W. Ward, Fitzalan-chambers, Sheffield. Price 1s.—This is a very useful little book. It is intended for the guidance of those who, not being railway engineers, have, nevertheless, to lay colliery or works sidings, or short lengths of line between one establishment and another. It explains in a very straightforward way what kind of rails are in the market, for what they are suitable, and the various methods of constructing tracks, from the little 18in. trolley road to one capable of carrying a full-sized goods engine. The information is accurate, and, if followed carefully, even an amateur can hardly make a mistake. It is a book to be recommended.

The Essentials of Gearing: A Text-book for Technical Students and for Self-instruction; containing numerous problems and practical formulas. By Gardner C. Anthony, A.M. Boston, U.S.A.: D. C. Heath and Co. 1897. Price 1.50 dols.—A valuable little volume, containing a great deal of information about tooth-gearing, put in a clear and useful form; the diagrams are excellent, and a very satisfactory notation is used throughout. The folding plates at the end of the volume open out, so that they can be seen conveniently whilst one is reading the letterpress referring to them. We notice that helical gear has been omitted, which seems a defect in a volume which is, on the whole, deserving of a large measure of praise.

Trade and Business Announcements.—Messrs. W. B. Brown and Co., Globe Works, Liverpool, have secured the highest award and gold medal at the recent Queensland International Exhibition for the excellence of their quality and make in steel wire ropes and cables.—Mr. R. D. Batchelor, J.P., of Queen Victoria-street, London, and Chatham, well engineer, has accepted the position of High Constable of Gillingham for the year ensuing.

The Board of Conciliation and Arbitration for the Manufactured Iron Trade of the North of England, and also the similar organisation in the Midlands, sent a deputation to the Home Secretary on Wednesday to urge the exemption of these industries from the operations of the Truck Act, as they are convinced that it will introduce friction in the relations between employers and employed, and they can manage much better if they are outside the Act.



HER MAJESTY'S THIRD-CLASS CRUISER POMONE

LETTERS TO THE EDITOR.

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

LOCOMOTIVE FIRE-BOXES.

SIR,—An engineer of nearly sixty years' experience once told me that in the old days, when coke was used for firing locomotives, and the blast was so fierce that the fuel was continually bouncing against the tube plate, the trouble experienced with the fire-boxes was not so great as it is at the present time. This statement furnishes matter for reflection, and indicates either that the copper of modern manufacture possesses less endurance than that which was formerly used, or the design of fire-boxes is not so good. Probably both these causes have helped to make possible such an unsatisfactory comparison. The chief object aimed at in the design of a locomotive boiler—next of course to safety—is to evaporate water with the greatest rapidity, and to do this it has apparently been considered desirable to obtain copper of high conductivity, and also as large a heating surface as can be procured by crowding the greatest possible number of tubes in the tube-plate. I venture to think that, in all probability, evaporative efficiency might be increased, and the life of fire-boxes prolonged by using copper of comparative impurity and decreasing the tube-heating surface.

During the years 1890, 1891, and 1892, Mr. A. J. Durston, Engineer-in-Chief of the Navy, made some exhaustive experiments on the "Transmission of Heat through Tube Plates." He found that when a little mineral oil was mixed with the feed-water the following results were obtained:—

Pressure of steam	140 lb. per square inch
Temperature of steam	184 deg. Cent.
Temperature of tube plate..	571 deg. Cent.
Temperature of combustion chamber ..	1760 deg. Cent.

The presence of the mineral oil militated against the free transmission of heat, and thus caused the high temperature of the plate; and it will be observed that if the circulation of the water is impeded in any way, or if scale is deposited on the plates, over-heating results. I have frequently noticed, after a locomotive has been working hard, that immediately the regulator is shut, the dampers dropped, and the fire doors opened, the steam pressure has very rapidly increased. In one particular instance an engine hauled forty-five mixed mineral and heavy goods a distance of one mile up a gradient of such steepness as to necessitate the lever being kept in the bottom notch. One injector was on when the regulator was shut, and the indicated pressure was 120 lb. per square inch. Seven seconds after the closing of the regulator, the safety valves blew off at 140 lb. per square inch. Now, though during the time an engine is being "thrashed" the fire burns fiercely, and this fierceness must to a certain extent keep up for a short time after the blast has ceased to act, and thus augment the pressure; yet it seems impossible that under normal conditions the pressure could rise 20 lb. per square inch in so short a time as seven seconds, with one injector on, both dampers shut, and the doors wide open. The correct explanation of the phenomenon appears to be that while the engine is working hard very rapid combustion is going on in the fire-box, the temperature of the fuel nearly approaching 1800 deg. Cent., and owing to the tubes being crowded together so closely the circulation is impeded, with the result that considerably more heat is delivered to the water adjacent to the tube plate than can possibly be distributed by convection. The water is therefore driven from the plate by the force of its own vapour, and a modified form of the "spheroidal state" is thus set up, and the temperature of the plate rises with great rapidity. When the regulator is shut, the plate quickly cools to a temperature below that at which the spheroidal state can be maintained, and the water therefore again comes in contact with it, the result being that a comparatively large quantity of water is suddenly evaporated, thus causing the increase in the steam pressure. The temperature of the hot surface essential to the maintenance of the spheroidal state at atmospheric pressure is 200 deg. Cent., and as this varies with the boiling point, it may be concluded that the lowest temperature essential to the maintenance of the spheroidal state in a locomotive boiler at a working pressure of 140 lb. per square inch would be 364 deg. Cent. As previously mentioned, Mr. Durston has observed a temperature of 571 deg. Cent. in the tube plate of his experimental boiler, so it may be reasonably assumed that a temperature of over 364 deg. Cent. is sometimes attained in locomotive tube plates. Cracks frequently occur in the meshes of tube plates, and sometimes extend from tube hole to tube hole, either along the top row or in the first one or two vertical rows next the flanges. The plate almost invariably fractures first on the side next the water, and the cracks, either gradually or suddenly, work through to the fire side, thus showing that the water side of the plate has been subjected to sudden and violent changes of temperature, which is evidence of the water having existed in the "spheroidal state."

All old fire-boxes exhibit evidences of the evils arising from restricted expansion; the plates are buckled more or less between the stays, the flanged corners of the tube and back plates are distorted into acute angles, and are frequently cracked, the metal immediately round the stayholes is much thicker than that between the stays, and the general appearance of the box indicates that the plates, after repeated expansions, fail to contract to their original dimensions and positions. This suggests that the physical properties of the copper have changed, and resemble those which are found in the metal at high temperatures. As a matter of fact, the density of comparatively pure, new copper is greater than that of a chemically similar metal cut from near a stayhole of an old plate, and the density of the latter is greater than that of copper taken from between stayholes. It is probable that other physical properties undergo a change, and it is obvious that conductivity decreases, because that quality varies with the density. The use of copper of high conductivity would be eminently satisfactory, if we could be certain that it would retain its properties after having been subjected to restricted expansion and contraction. The researches of Professors Dewar and Fleming on the electrical resistance of pure metals, alloys, and non-metals, at temperatures ranging between 100 deg. Cent. and −197 deg. Cent., suggest that comparatively impure copper would, at those temperatures at which locomotive fire-box plates work, conduct heat quite as well, if not better than pure copper. They found that in the case of absolutely pure nickel, the electrical resistance rose very rapidly as the temperature increased, whilst in the case of some nickel containing a very small amount of impurity, the resistance did not increase nearly so rapidly.

We may conclude that to build a fire-box which will last long and give little trouble, a copper must be selected which has a low coefficient of expansion, high conductivity at temperatures ranging from 200 deg. Cent. to 400 deg. Cent., and its tensile strength should not decrease very rapidly as the temperature increases. Further, the tubes should be set at a reasonable distance apart, and artificial means for improving the circulation might be adopted with advantage. HY. SIMPSON.

Pontymoil, Pontypool, November 22nd.

THE VOLITION OF "THINGS."

SIR,—What is a "thing"? Anything, let us say, which has not got life, as we commonly understand the word; which is unable to move of its own volition, unable to think, unable to behave, in brief, otherwise than we have observed it to behave within the limits of the small matter of circumstances by which we—men—are able to surround it. What is not alive, then, is a thing; a piece of inert matter, to give it its scientific title.

Now, the engineer daily deals with matter, in many environments and under many conditions; he observes that a steel girder, for example, if loaded to excess will break. Nothing is more simple, apparently, than to say that in such a case the load being in excess, the stresses were too severe, and the material yielded in the line of least resistance. But let us get a little closer; let us ask ourselves the meaning of the words we use and of the phenomena which are conveyed by them. Excess; we have loaded a beam to excess; excess of what, excess beyond what? Beyond what it will bear, as evidenced by our sense of vision, is the natural answer. But do we stop to think why the beam has yielded? Not, I think, very often; and it may not prove uninteresting to pursue the inquiry. Failing obtaining speech of the beam, let us turn to analogy for assistance.

Take a human being in possession of his normal sensibilities and stick a pin in any part of him; the result is a matter of common knowledge; a foregone conclusion. He feels pain, and shrinks away from it. But give him an anæsthetic, and repeat the experiment; he feels nothing and makes no sign. Why? Because, you say, he has been deprived of sensation, which being merely the willingness of part of the man to respond to certain circumstances, may be called volition, or, if you like, he has been endowed with a new sense, namely the absence of volition. So far so good. Now take a plate of wrought iron, support its extremities, and load it—apply the pin—with a certain load it does absolutely nothing, as far as we can see; increase the load, it deflects, shrinks away; and, a limit of endurance being reached, it collapses. Put a similar plate through the process of conversion into the finest steel—apply the anæsthetic—and you have an increased power of resistance, and a product of totally different capabilities. Why Nobody knows.

Take another man and push him gradually out of a window; presumably he will grasp the sill and hang on as long as he can. Why? Because self-preservation is the first law of nature; or, shall we say, because like any other kind of matter he is reluctant to change his state because he knows it will hurt him. At all events his volition prompts his muscles to resist gravity as long as they may; he fights hard, silently if he is wise, in order to husband his powers, but eventually he yields. Now take a bit of string, fix one end to the window sill, and to the other attach a weight, closely approximating to that which the string would point blank refuse to support—I mean, one which would break it, in every-day language. Let it hang there; by-and-bye "it" will break the string. May we not legitimately say that the silent battle has gone on until the worn-out string gives up, until gravity has its way, until the weight falls? Double or treble the thickness of the first-mentioned beam; it will bear more. Alter the position of the supports and it will bear more or less as they are closed or separated. Is there any use in endeavouring to explain this by mathematics and formulæ? If the phenomena mean anything, do they not mean that material adapts itself to circumstances, and nothing more or less than that statement with all its attendant consequences?

We throw a stone into the air; it returns to earth. Why? Gravity, we say, compelled it to do so. Well, what is gravity? Oh, gravity is the manifestation of the "attraction" which exists at the centre of the earth for all terrestial objects, or, for all objects which come, no matter whence, within its range. That is beautifully simple, and to doubt it is idiocy. The mathematical centre of the earth is non-existent; indeed from its very shape the earth can have *no* centre, properly so called. What is it, the originator of this gravity? What power, substance, entity or non-entity calls upon matter to act in one definite way which we call falling? Is a gas matter? If so, why do not all gases fall when liberated? Because, you say, some are lighter than air. Has gravity, then, nothing to do with anything lighter than air? What I want to know is, why, if I burn a defunct Parsee on the top of a burning ghât, gravity says to his bones, "I want you, come here," and to many of his resultant gases, "I don't want you, you may go where you will—at least, your volition is not subject to mine, but to that of something or someone else." And does gravity differentiate between them, or do the gases know their duties?

I take a lump of coal, which is fairly a slave, as far as I can see, to gravity. I make it into coal gas, and though gravity claims its tithe, I have liberated, endowed with superior volition, the remaining portions. All this leaves me as much in the dark as to what and why gravity is, and whether it really is at all, as my great-great-grandfather was in his day. And I confess I find it difficult to believe that my great-great-grandson, supposing I have one, or more precisely, that one has had me as such a condition precedent, will think as I now think I do, or will have much hesitation in accepting new, but unchangeable, "laws of nature" for himself.

Is life motion, or is motion a sign of life? A man cannot run a mile a minute, thanks to gravity, but he can frame materials, metamorphose components of himself, into an apparatus for performing that feat; he can get the better of gravity by his brains. But if tension managed to break a signal wire and gravity lowered the semaphore, as it frequently did before man became up to that trick, gravity probably got the better of him and smashed both his machine and himself. Accident? A fortuitous happening? Or is it volition, called accident because it manifests itself as malevolence, and because we shrink from recognising malevolence all around us? Yet we do recognise malevolence every day of our working lives; for what is it but behaviour which results in bad consequences to ourselves? And are we not in the habit, having some knowledge, or observation, of the properties of materials, of so placing them, so arranging and distributing them, that their good qualities only may be called into play, while the others remain dormant? I say dormant advisedly, for every engineer knows the result of eventual fatigue of his materials. Does all this mean that those qualities which we call evidences of reasoning power in humanity, exist in matter, and that we, persistently denying the possibility, have been laboriously striving to create properties and to discover causes for them which shall, contrary to reason, make no such demands on our exclusiveness? Do we not tacitly admit that wrought iron has one sphere of usefulness, cast iron another? Very well; then why seek to deny that material, taking different forms through force of circumstances — the demands of men—is able to adapt itself, like every other form of life, to the calls of environment; can, in other words, exercise volition.

No tenable argument can be brought forward to show why a weight *x, per se*, can break down a beam, while a lesser weight cannot do so, unless a power of sensation be conceded to the material of the beam. This concession, whether tacitly or openly, must eventually be made; it lies in reality at the bottom of the matter. If the particles of the beam have their own consciousness they will resist breakage as long as they can, whatever *can* may mean if it does not imply consciousness; and if they have no consciousness no coherent power of resistance, why does the beam ever break at all, seeing it is unaware of the load imposed on it? As I said in a previous article, it is all very well to talk learnedly of compressive and tensile strains; that does not help us in the least to any intelligible answer to the questions, "If a girder is unconscious of a load applied to it, why does it break? and how does the unconscious load break it?"

Look at it from another standpoint. Put a ton in the middle of a beam as slowly as it can be deposited there; nothing happens. Put on the same strain instantaneously, and the girder breaks. I take it that if this means anything, it means that the beam, caught napping, is unready for the enemy and suffers accordingly. Many people, doubtless, will say that my reasoning is false, my ideas ridiculous. From them I shall only ask a plain answer in every-day language to the question above: "How does an unconscious material break under a load?" H. J. FULLER.

VENTILATING FANS.

SIR,—I have read with much interest Mr. W. G. Walker's experiments upon propeller ventilating fans, which is a very valuable addition to what is already known of this class of ventilators. With regard to what he there says about tunnel ventilation and centrifugal fans, I think I must take some exception to it, as he brings the centrifugal fan into such a very poor position by the comparison he has made. To find out what a centrifugal fan can do, it is best to take actual tests of a modern centrifugal fan, working on low gauge on a wide mine. I therefore have pleasure in showing the work of a new Capell patent mine ventilator, on Mine No. 2 of the MacClure Coke Company at Lamont, Pennsylvania, United States. The tests are at various speeds, from 100 to 214 revolutions, and show the peculiar action of this fan when used as a blowing mine fan—a use to which these fans are being rapidly applied in the United States.

The fan is a double-inlet Capell mine fan, new type. Diameter, 12ft. 6in.; width, 10ft.; two inlets, 7ft. 6in. diameter; area of inlets, 88·34 square feet; area of outlet, 100 square feet; direct driven by engine, 17in. by 18in. stroke. Body capacity of fan = 1227 cubic feet.

	Revolutions per minute.	Water gauge actual inches.	Volume of air per minute.	Body output of air per revolution, cubic feet.	Percentage of body output.	Percentage of useful effect.	Manometric effect, per cent.	H. P. of diagram.
(1)	100	1	144,730	1447·3	117·67	75·67	52·6	28·11
(2)	122	1·3	176,000	1443	117·6	81·75	45·77	40·78
(3)	154	2·1	223,050	1443	118	91·72	46·55	80·46
(4)	214	4	390,650	1825	148·8	94·	47·02	259·55

These trials were made most carefully by ten engineers of the company, as the fan was most strictly guaranteed to pass 300,000 cubic feet per minute, and it was thought unlikely it could do it. The diagrams are before me, and there is no doubt about them. I think this puts the centrifugal fan in a very different light to that brought forward in Mr. Walker's paper, and it is a mere question of size and adaptation to make fans for tunnel ventilation to sanitary conditions, and give the highest useful effects. I myself believe that for a fan effectually to empty a tunnel it must have a reserve of water gauge. Otherwise, when a train sweeps the air before it, it will reverse the air current in the fan; while if a fan is turning its gauge into volume, as a centrifugal fan does when working on light friction with large volume, the moment extra friction is present, and volume reduced by a passing train, the gauge will run up, and the air will still be exhausted, the centrifugal fan "rising to the occasion" literally, while the propeller fan, with its low and feeble gauge, has no such reserve of power behind it.

With $\frac{1}{10}$in. water gauge, as suggested in Mr. Walker's paper, I believe the air would as often be entering the tunnel through the fan propeller as it would leave it by the action of the fan. Many of these fans, driven by electric motors, and passing over 100,000 cubic feet of air per minute, are at work on mines, and in some cases are $1\frac{1}{2}$ miles away from their steam engines, and under these conditions show over 50 per cent. useful effect on the indicated power of the engines. This, it seems to me, is the way to ventilate metropolitan tunnels, where there is no room for steam engines with the fan. I have studied the action of the propeller fan as well as the centrifugal fans, and concluded that where even $\frac{1}{2}$in. of water gauge is required, the centrifugal fan is superior to every other machine. The new Capell fans embrace the propeller system in the form of special scoops on the inner wings, which has largely increased their air-passing power, which is the main object of a mine or tunnel ventilator. G. M. CAPELL.

Passenham, November 15th.

THE PROFESSION OF ENGINEERING IN AUSTRALIA.

SIR,—A few notes on the profession of engineering in Australia, compiled by one who has now spent close upon twenty years in it in one of the principal Australian colonies, will probably be acceptable to subscribers to THE ENGINEER.

The following remarks, although applying particularly to the colony in question, may fairly be taken as being generally applicable to all the others of the group.

Firstly, a very large proportion of the work is in the hands of Government officials, who practically monopolise the whole of the public undertakings carried out from time to time, including roads, bridges, railways, waterworks, harbours and jetties, lighthouses, deepening operations, fortifications, telegraphs, all drainage and sanitary schemes of any extent, irrigation and water conservation schemes, and original surveys. Even refrigerating plants and stores—including in one case what can only be described as a butchering establishment!—and certain mining plants, have, within the last few years, been included in this most comprehensive category. The Government also deal with all repairs to locomotives, the construction and repairing of railway vehicles of all descriptions, and mechanical work connected with railway maintenance, besides which they manufacture a portion of the waterworks fittings.

The scope for the private practitioner is, therefore, very limited; a few crumbs occasionally—but also, now-a-days only too seldom—fall to him from the Government table, and he has frequently—that is, provided that he is in a position to compete with the numerous body of able and established architects—to eke out his existence with architectural work. Unfortunately for him, too, the whole of the municipal arrangements are in the hands of salaried surveyors or engineers, while similar business for the up-country District Councils is mostly dealt with by "licensed surveyors" under the supreme supervision of a Government engineer. These gentlemen practically occupy the position of Government officials, they having to conform to departmental regulations throughout their proceedings; moreover, they largely monopolise private surveying, as such work will not pass muster as a rule in the survey office, unless carried out by them, while they are protected by certain special Acts of Parliament.

The pay of the Government professional staff throughout is anything but alluring, while their prospects, from the heads downwards, are, in the majority of cases, most uncertain. They are liable to sudden and capricious retrenchments and dismissals in consequence of political or departmental difficulties, and once outside the service, find themselves most frequently complete nonentities, notwithstanding that they may have spent the best portion of their life in it. The public look askance at them, while there is very little opportunity afforded them of ever again obtaining work from the Government, either as departmental officials or otherwise.

In the locomotive workshops, many men are regularly employed as workmen who, if they only had an opening, would be carrying on a mechanical business on their own account. The sons of clergymen, lawyers, doctors, well-to-do tradesmen, &c., including university men, and even members of some of the best known learned societies, may be found at the lathe or bench. Occasionally some unfortunate member of the profession, getting caught in a very tight corner, has to betake himself to some other means altogether of earning a livelihood, but this, in a country where a legal practitioner of the English Supreme Court of Judicature has been found acting as usher in the dress circle of a theatre, and a duly qualified medical practitioner may daily be seen selling matches in the streets, need excite no particular surprise.

To sum up, the Government service offers, in the majority of cases, subject to the drawbacks above referred to, a tolerably reliable source of employment for a time, while in spite of the restricted field for operations, there is generally scope for a very limited number of private practitioners in the metropolis, who, however, if they wish to succeed, must be first-rate all-round men—on no account specialists—not afraid of hard work, prepared to wait for several years before making an income; and lastly, exceedingly scrupulous in their professional relations.

The following extract from Sir John Rennie's "Autobiography," pp. 289, 290, may well be quoted in concluding these brief remarks:—"The State must and ought to have such establishments as should be able to do their own work when occasion requires; but in a country like England, where the arts and manufactures are carried to the highest possible extent by individual competition, and where the field of exertion is so vast, and the prizes of success are so great, no Government establishment can compete with them—*i.e.*, private firms. It cannot hold out sufficient inducements for exertion, and hence we find that no great invention has ever emanated from a public establishment. Certain officers the Government must have, and these must be at fixed salaries, for which they have to do a certain quantity of work, and for this the hours are fixed; they have no inducement to go beyond this. Yet this is perhaps the wisest course for a Government like ours; it can always command the talent of the day, and it is far more economical for a Government to pay the market price, whatever it may be, than to take persons, however well qualified, wholly into its employment; the moment this is done, the inducement to extra exertion ceases, and the Government must go again to the market for the next best talent, and so on. Hence it is my opinion that the Government should have the fewest possible establishments it can get on with, so as not to leave itself wholly dependent upon private firms; and that it should go liberally to the public, specifying in general terms what is required, then it will obtain the best workmen in the wisest manner, without being taxed by extra pensions or any other drawback; by this means a Government would command all private establishments, and make the most of its own."

October 8th. ASSOC. M. INST. C.E.

WATER-TIGHT BULKHEADS IN SHIPS.

SIR,—On page 389 of your last issue you print an extract from *Cassier's Magazine* describing the use of water-tight bulkheads by the Chinese. This mode of construction is mentioned by Sir George Staunton, in his account of Lord Macartney's embassy to China in 1792—3. Describing a fleet of sea junks which the squadron conveying the embassy met with in the Yellow Sea, Staunton says—vol. i., page 500:—"The hold, or cavity below the upper deck, is divided into about a dozen distinct compartments by partitions of 2in. plank, and the seams are caulked with a cement of lime, prepared in such a manner as to render them perfectly impervious to water; or, in the marine phrase, water-tight. This cement, Dr. Dinwiddie observes, is composed of lime and oil, with a few scrapings of bamboo; the latter article serving the same purpose as hair in English plaster. This composition, he adds, becomes very tenacious and hard, and will not burn. If, notwithstanding the oil, it possesses that incombustible quality, it is no doubt preferable to pitch, tar, or tallow, none of which are used over the wooden work or round the ropes of Chinese vessels. The advantages arising from dividing the holds of those vessels seem to have been well experienced, for the practice is universal throughout China. From hence it sometimes happens that one merchant has his goods safely conveyed in one division, while those of another suffer considerable damage from a leak in the compartment in which they are placed. A ship may strike against a rock and yet not sink, for the water entering by the fracture will be confined to the division where the injury happens to be sustained; and a shipper of wares who charters several divisions has a chance, if one of them proves leaky, that those contained in the remainder may escape. To the adoption of a similar plan in European merchantmen, besides the opposition of popular prejudice and the expense, as well as uncertainty of new experiments, an objection might arise from the reduction it would occasion in the quantity of freight, and the increased difficulty of stowing bulky articles. It remains to be considered how far those objections ought to prevail against the greater security of the vessel, crew, and cargo. At any rate the objection does not apply to ships of war, in which to carry very heavy burdens is not an object of consideration."

In March, 1848, there arrived in the Thames from Canton a Chinese junk named the Keying, which was for many months an object of curiosity. It is described in the *Illustrated London News* for May 20th, 1848, and the writer says, "Coming from the bow to the after-part of the vessel we find a series of water-tight compartments, such as we have adopted in our steam vessels." A descriptive pamphlet was sold on board the junk, which may perhaps give details of the construction of the hull; but I am not just now able to refer to a copy. RICHARD B. PROSSER.

75, Dartmouth-park-road, N.W., November 3rd.

SIR,—With reference to the paragraph on "The Early Use of Water-tight Bulkheads in Ships," which appeared in your issue of October 22nd, it may be of interest to mention here that this contrivance was suggested as long ago as 1759 by an anonymous writer in the *Universal Magazine*. His article is under the title, "A Method for Preventing Ships from Sinking, after receiving such Damage as must otherwise unavoidably cause them to Founder." It would be too great a tax upon your space to give it *in extenso*, but perhaps you can find room for the opening paragraph, which runs as follows:—"Let a ship have its cavity beneath the lower deck divided into three (or four) nearly equal parts, by bulkheads or partitions rising from the bottom to the lower deck. Let these bulkheads extend from one side of the ship to the other, and join closely to the timbers. Let them be strong, made of 2in. plank, well braced by cross pieces, and let them be well caulked. Let there be sliding hatches in the bulkheads, through which a man may easily pass under deck. Let these hatches for this purpose be usually open; but in time of action, or other danger, or at furthest on springing a-leak, let these hatches be close shut, so that no water may pass from one of the three divisions to another. Now, in a ship thus provided, as soon as she springs a-leak, it may immediately be known in which of the three divisions the leak is. . . . By the water being confined to a third (or fourth) part of the ship, all the water that fills that part will not sink the ship."

I have a note also, to the effect that Laird and Co. in 1832 built a steam packet, the Garryowen, which was divided into compartments; but I am not aware whether this was the first ship so constructed in this country. RHYS JENKINS.

London, November 8th.

THE RHODIN CELL.

SIR,—In the description of the Rhodin electrolytic cell, which appears in your issue of Friday last, an unaccountable error occurs in a matter seriously affecting the success or otherwise of the new cell. The statement I refer to is as follows:—"There is no loss of mercury, and as it is entirely under the surface of the liquids and never requires to be disturbed, and the hydrogen is given off on the inner surface of the iron containing-vessel, there is no mercury vapour given off—a point of great importance."

In electrolytic cells in which the kathode is surrounded by water, hydrogen certainly does come off at the surface where the current leaves the cell. But this is merely a secondary and not an electrolytic reaction, and is brought about by the decomposition of the water by the electrolytically separated sodium, and has nothing whatever to do with the electrolysis pure and simple. The evolution of hydrogen therefore takes place at the surface where this decomposition is going on, and not necessarily where the current leaves the cell. The simple and elementary experiment which we have all seen performed at school of throwing a small piece of sodium upon water, watching the decomposition, and collecting the hydrogen evolved, is nothing more nor less than that which takes place in this secondary action in such an electrolytic process.

In the Rhodin cell the current passes from the revolving carbon anodes to the surface of the mercury, carrying with it the sodium, forming a sodium amalgam, and then leaving the cell by the iron base without causing further reaction. This amalgam is then transferred to the outer annular compartment by the rotation of the anode cell, where the sodium of the amalgam decomposes the water, forming caustic soda and hydrogen, according to the equation

$$Na + H_2O = NaOH + H.$$

The hydrogen is thus liberated at the surface of the mercury and not at "the inner surface of the iron containing-vessel" as stated. Hydrogen thus liberated at a mercury surface has been proved by experience to carry off so much mercury vapour as to be absolutely inadmissible on a commercial scale, as is admitted in your article.

This is but one of several shortcomings of the new apparatus which some years' practical experience in the electrolytic production of alkali and chlorine has enable me to detect.

LOUIS C. KEMP.

8, Avenue-road, Erith, Kent, November 8th.

[The statement that the hydrogen is given off from the inner surface of the iron containing-vessel, and that there is practically no loss of mercury, was given upon the authority of Mr. Rhodin himself.—ED.]

TRAIN RESISTANCE.

SIR,—I read the leading article, and also the letter from your correspondent on the above subject, contained in your issue of the 22nd ultimo with great interest, and would like, with your permission, to make a few remarks thereon.

Agreeing with the remarks in your leader that the tractive force, and consequently the train resistance, would decrease as the speed increases, it appears to me that this may in some degree be accounted for in the following manner. Let us suppose that we have two ropes suspended vertically, the one comparatively non-elastic, such as an ordinary rope, while the other is of some very elastic material, say india-rubber. Now let some one attempt to climb each of these ropes in turn, first very slowly, taking some appreciable time between the various upward movements; and in the second place very rapidly, in fact, as quickly as it was possible to climb. I think it would require a much greater effort in the former than in the latter case, owing to the length of period allowed to the material, especially the very elastic one, to stretch to its full extent, which represents an absorption of energy equivalent to that required to stretch it. Of course this difference would be very much greater in the case of the very elastic than in that of the ordinary rope.

Applying this to the case of a railway train, we have the rails upon which the train runs composed of a comparatively non-elastic material, as compared with the india-rubber before mentioned, but nevertheless fairly elastic; and these being supported horizontally at intervals on the chairs or sleepers, the action of the train rolling on it is to cause a bending, so that the train has to climb up hill to a certain extent, which, of course, is equivalent to a certain amount of energy expended in overcoming this. I am well aware that you have already suggested this theory, but it also occurred to me that the speed played a very important item in the effects produced. Because when the train is just starting, we have as in the case of the two ropes before referred to, sufficient time allowed for the full stretching, and consequently bending of the rail to take place; whereas when the train is fairly started, and running at a good speed, the time would be very much less in which to produce the bending, the inertia of the material composing the rail playing a very important part in the result, so that in this case less work would have to be expended in maintaining the train at a good speed than at a much slower one, or when just starting.

I think from the preceding it will be seen that the tractive effort, and consequently the resistance, might be expected to decrease as the speed of the train increases; but what is really required is a series of practical experiments, as suggested by you, in order to arrive at some data on which some empirical formula might be based. Apologising for writing to you on this subject.

EDWARD J. M. DAVIES.

24, Harrington-square, London, N.W., November 11th.

THEORETICAL DYNAMICS.

SIR,—With regard to your correspondent's question on the above subject, it would seem that the stone and the monkey must move either up or down in exactly equal amount. The downward movement is easily seen. Suppose the stone and the monkey of equal weight, the system frictionless, inelastic, and without weight. Now, let the monkey let go for a given time, allowing the rope to slip through his hands. Both monkey and stone being of equal mass must acquire equal momentum, in equal times; and if the monkey catches the rope at any moments the whole system must come to rest, monkey and stone in the same relative position. In a similar way, any force exerted by the monkey to raise himself must also be exerted on the stone, and the latter must therefore rise an amount equal to the monkey.

At first sight it would seem that Newton's first law of motion applies directly, producing the effect that the centre of gravity of the whole system remains fixed in space. But the system is subject to external forces, the pulley and gravity. The falling of both bodies, when the monkey lets go, is the most obvious answer to the fixed position of the combined centre of gravity. The whole question would seem to turn on the centre of gravity of monkey and stone remaining in a fixed position relative to either.

Another way of looking at the problem is as follows:—"Action and reaction are equal and opposite"—Newton, Law III. Now, the force applied is at the monkey's hands, and from above law is upwards and downwards. Now, nothing is attained by moving the point of application of a force along its line of action. Move the point of application from the monkey some way up the rope, and suppose it—the rope—to contract at that point. Equal forces are now applied to each body, and the rising of both is obvious. J. S. V. BICKFORD.

Camborne, Cornwall, November 16th.

SIR,—May I be permitted to solve yet another of the world's difficulties, and add yet another laurel to the brow of the immortal Pickwick?

The monkey and stone are supposed to be fixed to a rope, which is free to move on a pulley, and the system is in equilibrium. In attempting to ascend, the monkey may be supposed to loosen one, say, of his front limbs, and grasp a part of the rope above him; then he brings his second front limb to about the same level. He next transfers the weight of his body to his arms, so to speak, while he moves his legs up.

During the momentary loosening of his legs from the rope his arms are pulled taut, and during this tightening up his body must have changed its character as a stationary load to that of a load of impulse. In other words, the load is taken off the rope at the instant his legs are removed, and is not put on again till his arms pull taut. During this fraction of time, then, the stone will be unsupported, and will move down. The next instant, the load comes on to the rope again with a jerk; and, in my opinion, will, in its new character of an "impulse load," be sufficient to overcome the momentum of the stone and re-establish equilibrium.

Lincolnshire, November 16th. SHADE OF PICKWICK.

SIR,—*Apropos* of the question put by Mr. Alfred Jingle in the last issue of THE ENGINEER under the head of "Theoretical Dynamics," I beg to submit my answer. Assuming both to be at same height when at rest, in theory the monkey and the stone must keep abreast of one another whether the monkey hauls in the rope or slackens it out.

The reason why the stone will keep level with the monkey, whatever the latter may do, is this:—When both are at rest the tension is equally distributed through the string, and is equal to the weight of one of the two—monkey and stone. When the monkey pulls himself up the tension is equally distributed through the string, and any difference in tension will also be instantaneously distributed through it, and is equal to the weight of one of the two, plus the tension necessary to produce whatever acceleration of velocity the monkey may attain at any moment.

The + tension will instantaneously react upon the stone and produce a precisely similar acceleration of upward velocity, so that if the monkey kept pulling, it and the stone would reach the pulley together. HERBERT D. PAINE.

Dorking-road, Deptford, November 15th.

THE PREPARATION OF PARLIAMENTARY PLANS.

SIR,—In the first instalment of Mr. Fuller's interesting article upon the "Preparation of Parliamentary Plans for Railways," certain remarks upon the subject of levelling are introduced, and these appear to be seriously open to criticism. Everyone will admit that there are certain fundamental principles applicable to all levelling, whether for the preparation of parliamentary plans or for the accurate construction of works, and these principles appear to be at variance with Mr. Fuller's assertion that, "if you go to work to adjust a level yourself, you waste far more time than the money saving will justify. If the instrument is out more than three-hundredths in 200 yards you had better send it off at once and use another." This doctrine, published in your widely-read journal seems to me to be too sweeping to be allowed to pass unchallenged by one, at least, whose experience is very much to the contrary. Since the level must, in any case, be set up and the points fixed upon which to ascertain a possible error, and having presumed, by the remark that "you have now the difference of level between these two points," that the axis of the bubble is known to be parallel to the plane of rotation, then the few minutes that would be spent in turning the adjusting screws necessary to bring the optical axis of the telescope parallel with the axis of the bubble, or in other words, to cause the instrument to read the correct difference of level, would be much less than the time spent in obtaining a fresh instrument, however near to hand it were. I believe that the operation would take a shorter time than it took me to write the above long and possibly involved sentence.

Again, Mr. Fuller says, "It is quite unnecessary to read to anything closer than the nearest tenth of a foot when changing." My experience of levelling, which is fairly extensive, is that I have always found it necessary to read the changes with the utmost accuracy in order to close in upon the bench marks with "absolute precision." I conjecture that there are many besides myself who would like to be absolutely certain as to whether it would be considered reliable, in England, to read the changes only to the nearest tenth. I hope you will allow some of your numerous correspondents to give their experience on this highly important detail. I am too busy and too timid to experiment with Mr. Fuller's doctrine. HENRY SADLER, A.M.I.C.E.

November 23rd.

THE MANCHESTER SHIP CANAL.

SIR,—With reference to the short account of the "Manchester Ship Canal" in your issue of the 19th inst., will you kindly allow me to make a few remarks?

I much regret that I was unable to attend the meeting at the Institution of Civil Engineers on Tuesday, the 16th inst., when the paper on the above subject was discussed; had I been there I should probably have asked the author a few questions.

The figures I see mentioned in THE ENGINEER are (1) the total cost of construction of the Canal, viz., £15,168 796; and (2) the tonnage of traffic passing through the Canal in 1896, amounting to 1,826,237 tons. I should like very much to know what was the cost of maintenance of the Canal for that year, and what was the amount of tolls received for the same period. If these figures were supplied we could then form some idea of what the Canal was doing, and whether there is a likelihood of its being able to pay the interest on the enormous sum of upwards of fifteen millions of pounds sterling. Please observe, I find no fault with the engineering of the Canal, which is a marvel of construction, but for the sake of comparison let me mention another canal—the North Sea and Baltic Canal—which is nearly double the length of the Manchester Ship Canal, and yet cost only half as much, viz., £7,500,000.

I have nothing whatever to do with either of these canals and have no interest in them, neither have I seen either of them; but I should like a little more detailed information as to the statistics of the Manchester Ship Canal.

If you think it worth while to notice this communication perhaps one of your readers would enlighten me. MEM. INST. C.E.

London, November 22nd.

OIL ENGINES IN LIGHTHOUSES.

SIR,—In your issue of the 19th we notice a paragraph on the subject, and shall be much obliged if you would kindly draw attention to the fact that our oil engines have been extensively used for this purpose, with as much prominence as has been accorded to other makers.

We may mention that as far back as 1893 we supplied two of our 4-horse power oil engines to the Commissioners of Northern Lights for working air compressors for the fog-signalling apparatus at Pladda Lighthouse on the Isle of Arran. We recently erected three of our 4-horse power oil engines at the Mull of Galloway, and three of the same size at Rattray Head, all for working air compressors in connection with the fog-signalling apparatus at the lighthouses in those districts; and at the present time we have three 10-horse power oil engines on order for the Inchkeith Lighthouse from the Commissioners of Northern Lights. You will see, therefore, that at the majority of the places mentioned in your notice as having been fitted up with oil engines we supplied the motive power, a fact which would certainly not be inferred by anyone reading the paragraph.

We may also mention that six of our gas engines are erected and are in operation on Ailsa Craig, in connection with the lighthouse work. Four similar gas engines are also at work in lighthouses on various parts of the coast of Ireland, two in lighthouses on the Isle of Man, and three others in lighthouses on different parts of the coast of Scotland.

CROSSLEY BROTHERS, LIMITED,
Manchester, November 22nd. D. H. IRWIN, Director.

FLOW OF AIR.

SIR,—I have no opportunity of consulting any of the recent authorities on the flow of gases, and I shall be much obliged if any of your readers will kindly state what is, according to the latest experiments, the velocity of, and the quantity of, air flowing into a vacuum through a nozzle one square inch in area; pressure of air, 14·7 lb. per square inch; temperature, 60 deg. Secondly: What will be the velocity of flow through the same nozzle when the pressure is 600 lb. per square inch, and temperature 600 deg. Fah., this high-pressure air being discharged into a vacuum?

November 13th. OCTOGENARIAN.

(*For continuation of Letters see page 534.*)

SHIPBUILDING AND MARINE ENGINEERING ON THE THAMES IN THE VICTORIAN ERA.

No. VIII.

Still aiming at the reduction of weight and space occupied in the ship by the latest improved type of marine engine and steam generator, together with the desire to increase the handiness of engines by doing away with parts which it was found on a closer study of the subject could be well dispensed with without injury to their effectiveness, the marine engineering firms on the Thames continued to improve on their existing designs, or to originate fresh types.

Among the improved types of engines for paddle-wheel propulsion introduced towards the close of the first decade of the Victorian era, was the double piston-rod single-cylinder direct-action engine of Messrs. W. Joyce and Co., of the Greenwich Ironworks. This firm were not only marine engineers, but shipbuilders also; and their works and shipyard being contiguous, they had the great advantage of practically ensuring that their ships and engines should combine in them the best workmanship with the latest improvements in design. Of their improvements in the direction of paddle engines, those fitted at this time to the City of Paris, an iron steamship built by their firm for the Commercial Steam Navigation Company, to ply between London and Boulogne, were the most compact and simple in their arrangement of any type then in existence.

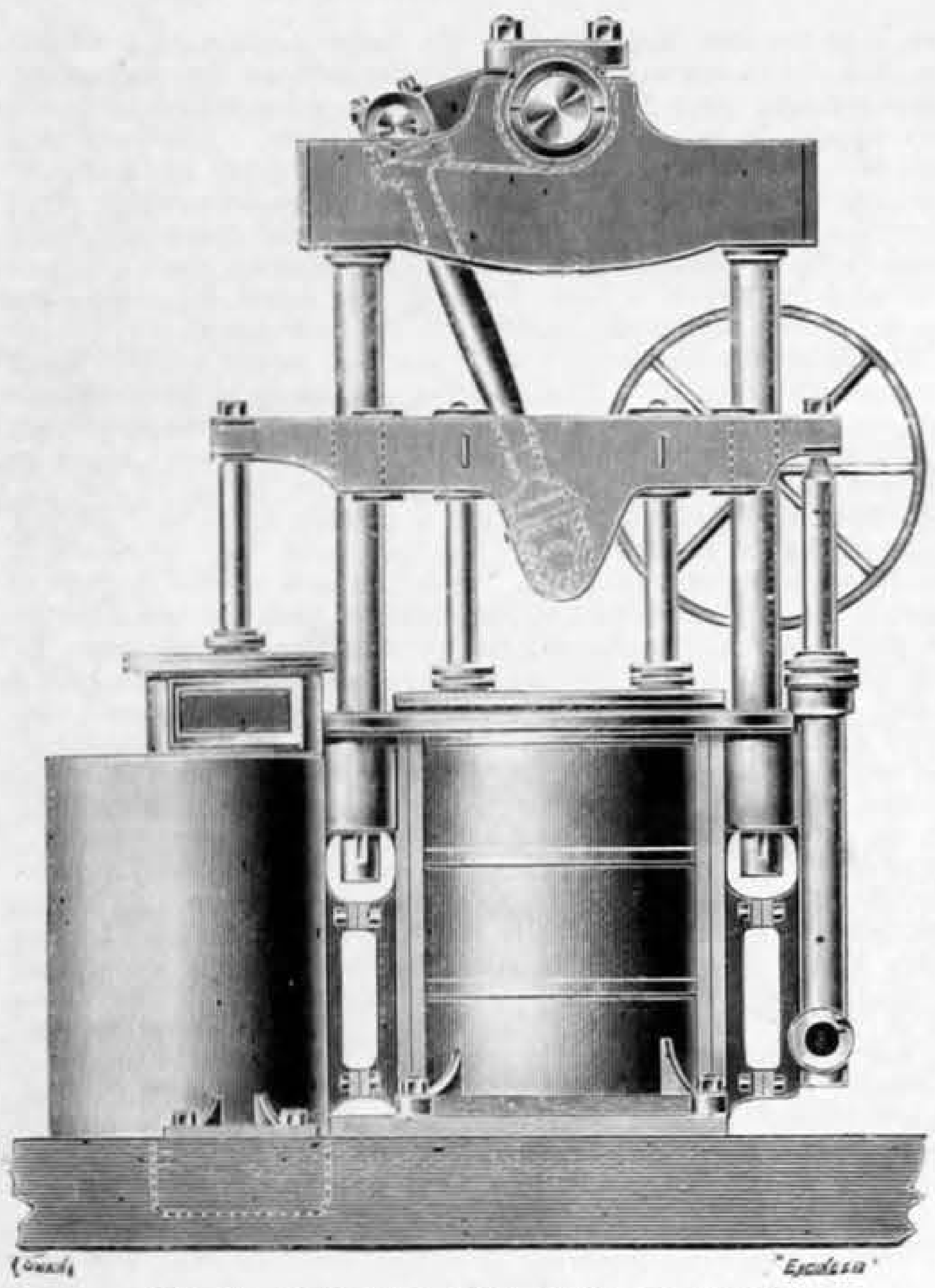


Fig. 38—ENGINES FOR CITY OF PARIS

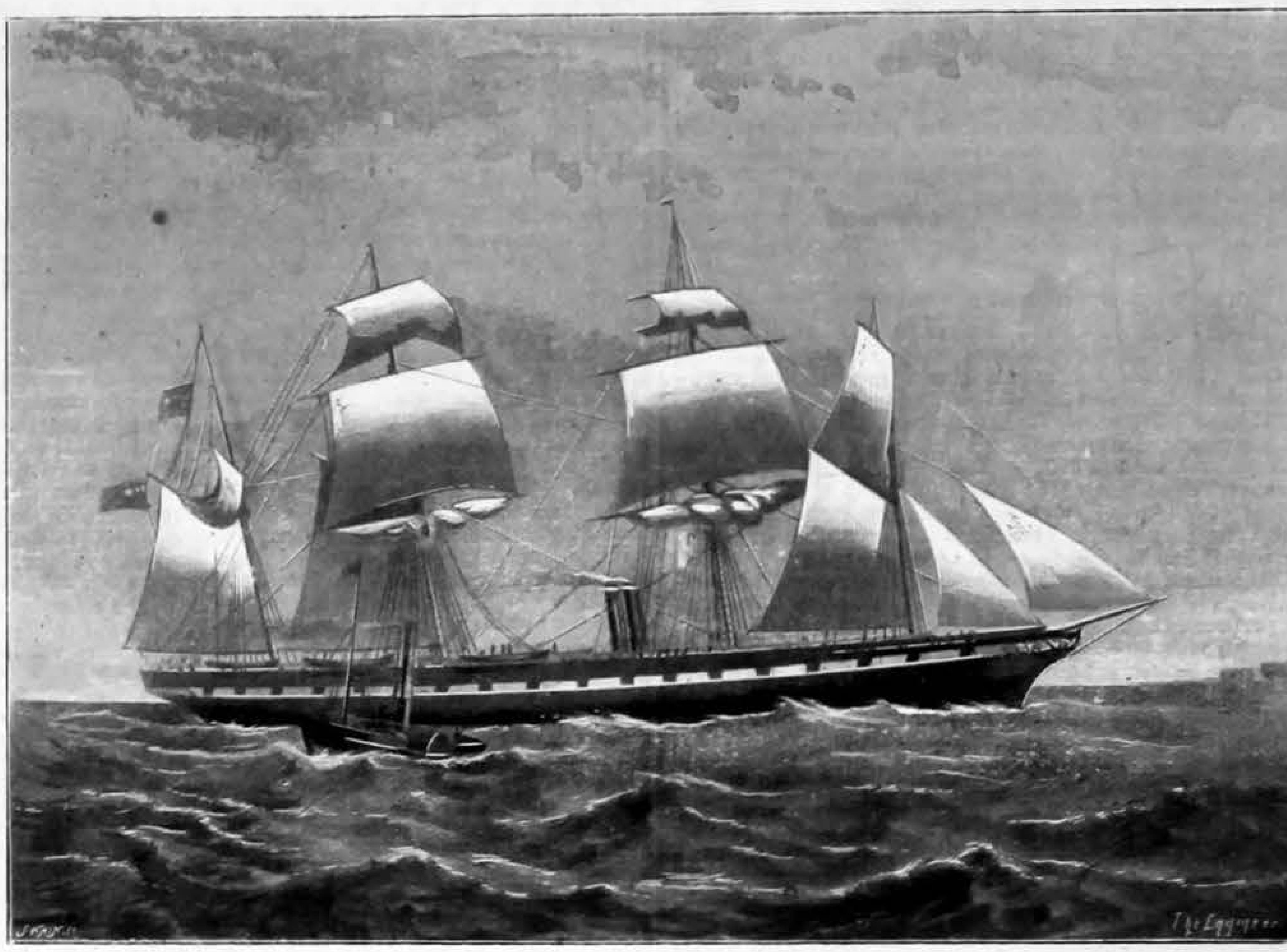


Fig. 39—THE GREAT BRITAIN STEAMSHIP, 1852

In Fig. 38 we give an illustration showing the arrangement of the few parts that were required to form an engine capable of exerting a large power without having a considerable portion of that exerted by the steam, dissipated in giving motion to a number of parts that the design shows could very well be dispensed with. These engines were from 130 to 140 nominal horse-power collectively. Each engine—there were two, placed side by side—had but one cylinder, as shown, directly under the paddle shaft, whose piston had two piston-rods placed so far apart as to allow the lower end of a short T-shaped crosshead, to which they were attached, to descend into a shallow cup-shaped well formed in the cylinder cover, thereby permitting of a longer connecting-rod, and the descent of its bottom end considerably lower than is possible in the single piston-rod direct-acting engine.

The crosshead fitted to these engines was built up of two wrought iron plates, connected together with studs, to which the piston, air, and feed pump rods were attached, and carried between them the connecting-rod's lower end and the piston rods guide brasses, which were made adjustable for wear. It will be noticed that the columns which form the guides for the piston-rods also act as supports to the main bearing frames, and being secured to the sides of the cylinder, as shown, make a very compact and self-contained engine.

The air and feed pumps were worked by a prolongation of the crosshead forward and aft, and being directly connected by bolting to the sides of the cylinder, made the whole a very strong and substantial arrangement, the working stresses of the engine being confined within its structure, and not transmitted or thrown on any part of the vessel's hull. These engines occupied less space than any other marine engine then existent, and were a good specimen of a type wherein a great reduction of space and weight was effected over earlier examples.

The City of Paris, which was the first iron steamship ever built at Greenwich, was a vessel of the following dimensions:—Length between perpendiculars, 165ft.; moulded breadth, 23ft.; depth in hold, 14ft; water draught, 6ft. 6in.; and her burden was 425 tons. Her speed in still water with the above-described engines was 15¾ statute miles.

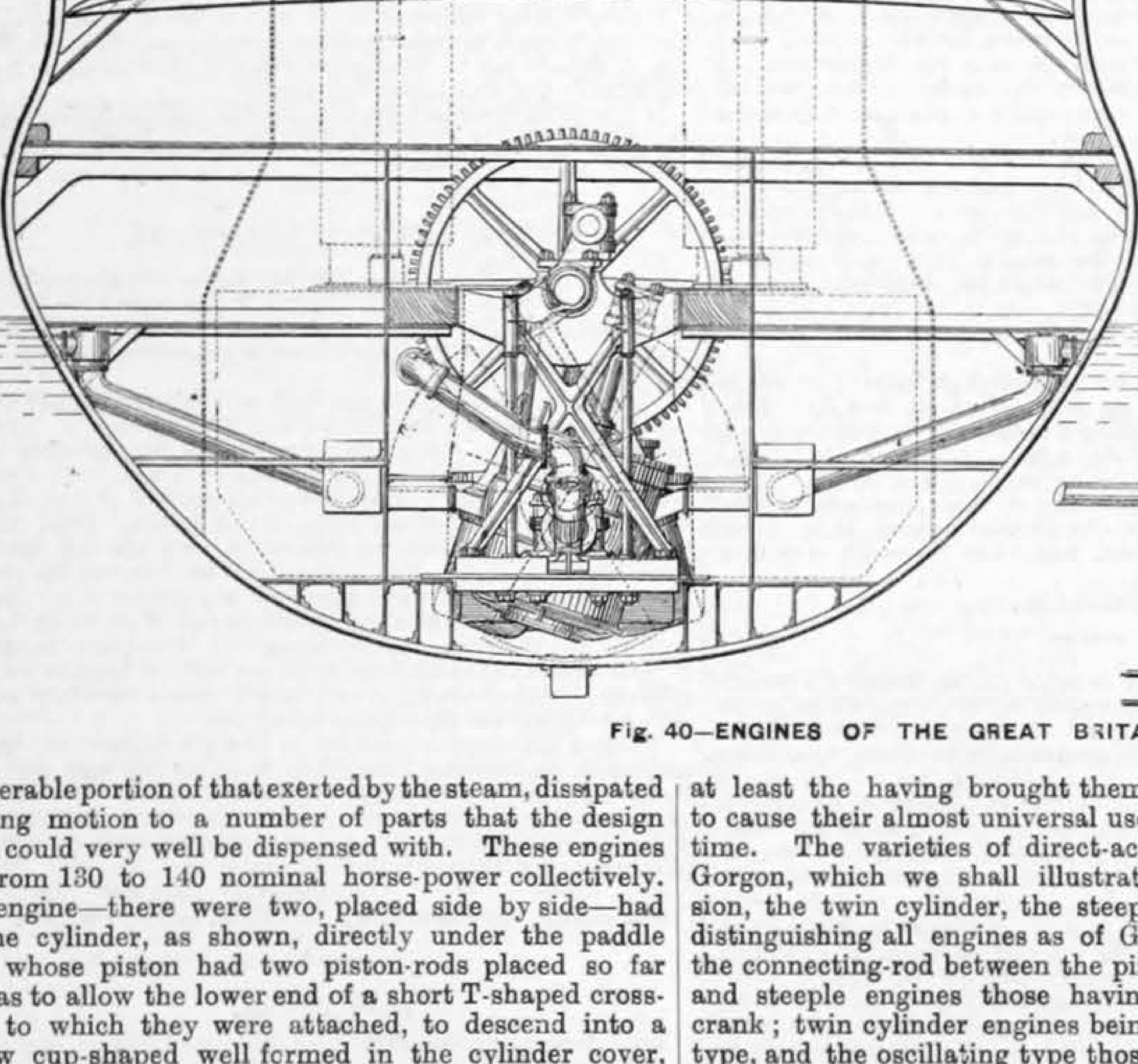
Now it is obvious from the marine engines constructed by Thames builders during the first decade of the Victorian Era, that their aim was to bring into use those of the direct-acting type, and to simplify their mechanism as far as possible. Of this type there were among these builders four distinct varieties, and we think we may claim for their makers, if not their origination, at least the having brought them to such perfection as to cause their almost universal use for some considerable time. The varieties of direct-action engines were the Gorgon, which we shall illustrate in another impression, the twin cylinder, the steeple, and the oscillating, distinguishing all engines as of Gorgon type which have the connecting-rod between the piston-rod and the crank, and steeple engines those having that rod above the crank; twin cylinder engines being those of the Terrible type, and the oscillating type those in which the cylinder rocks on trunnions.

Of each of these varieties we have in our articles given a typical example, and where possible have illustrated them, and it is a notable fact that all the most favoured and efficient of these varieties had their origin with Thames engineers in the first decade of our Queen's reign. In directing attention to this fact, it must not be inferred that no progress was made in marine engineering on the river prior to the time mentioned, as, on the contrary, close attention had been given to the matter. As a proof of this we have thought it would interest some of our readers if we recorded the attempts of a Mr. T. Howard—just prior to Queen Victoria's accession—to introduce a new and original way of raising steam of a somewhat higher pressure than was then in use on shipboard, practically without the use of a boiler at all, and after the steam had done its work in an engine condensing it by an original process.

The engine in which the steam was used was dependent for its action on the difference between the evaporating points of water and quicksilver, the one being 212 deg. and the other 660 deg. The steam was produced by vaporising the smallest possible quantity of water in the least possible time. The ordinary boiler was therefore done away with, as well as the whole body of water it contained. This was the principle of action of the proposed steam generator. The *modus operandi* was as follows:—

A shallow wrought iron tapered pan, having three-fourths of a square foot of surface, when full, per horse-power of engine required, was filled with mercury and closely covered with a thin iron plate. This pan was placed above a coke fire located beneath the working cylinder of the engine. On heat being applied below the pan of mercury its temperature was raised to between 400 and 500 deg. Fah., when a spray of water previously raised to boiling point was injected through a nozzle upon the thin plate covering the mercury, on which it was instantly and completely converted into superheated steam. The water spray was not continuous, but intermittent, or one injection for each stroke of the engine's piston; the quantity injected, which determined the power of the engine, being regulated by a valve. To keep up the high degree of heat necessary, the coke fire was urged by a fan regulated to supply a uniform quantity of air.

Around the engine cylinder was a chamber into which the steam was collected before it entered it, this chamber having itself a casing through which any waste heat not absorbed by the mercury was made to pass before reaching the funnel. By this arrangement the temperature of the steam could be raised to upwards of 400 deg., while its pressure was generally not more than 10 lb. above the atmosphere. No condensation of steam occurred, and instead of the loss of effect which takes place—



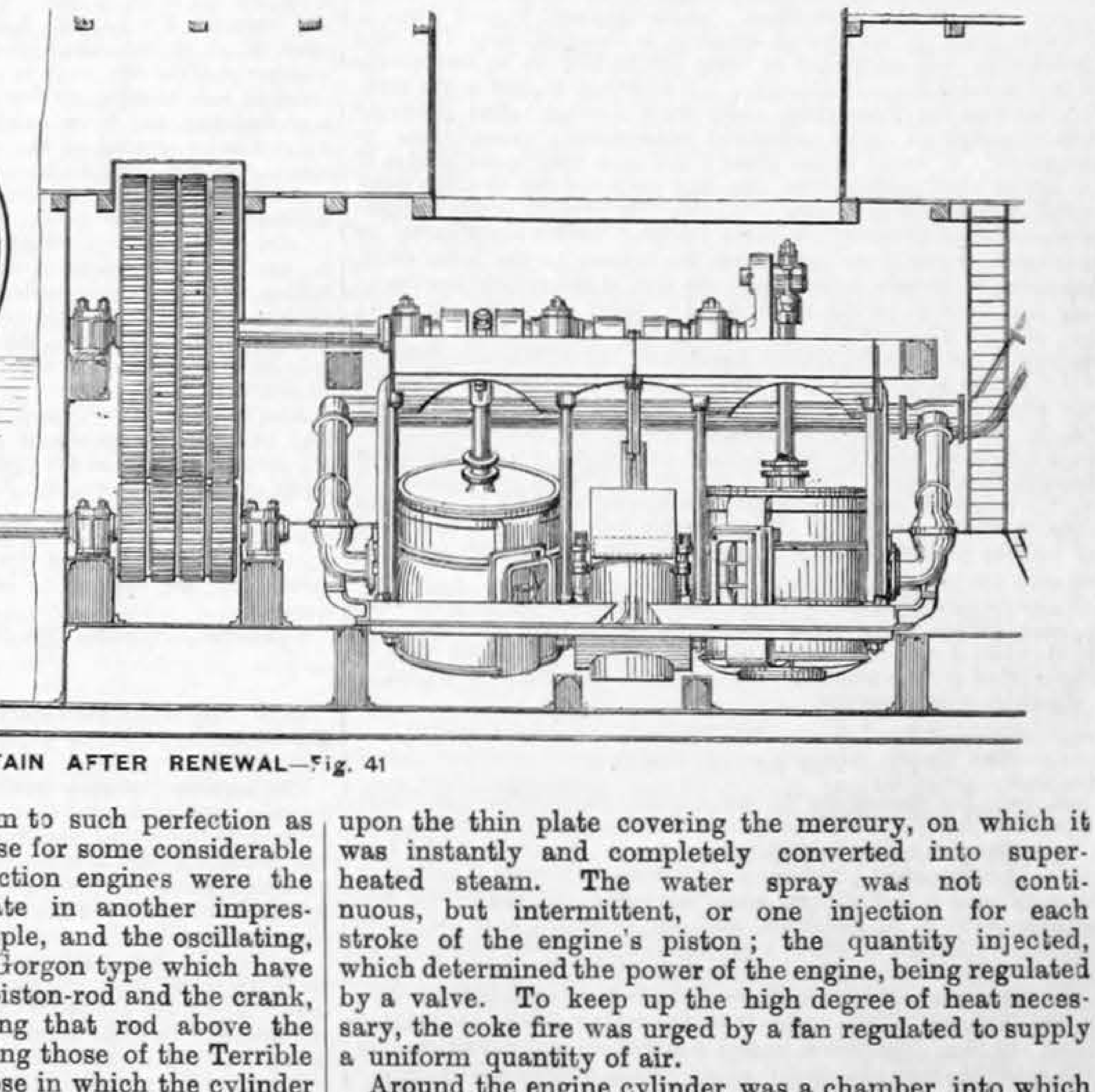


Fig. 40—ENGINES OF THE GREAT BRITAIN AFTER RENEWAL—Fig. 41

through condensation—in an ordinary engine, an additional power of expansion was given to the vapour and prevented it. A volume of steam, which in contact with water would show 212 deg. of heat, became, according to the inventor, expanded when above the mercury to a volume and a-half at 450 deg. To economise the steam it was worked expansively, being cut off at the cylinder at about quarter stroke.

When the steam had done its work in the cylinder it was re-condensed to water in the following manner:—On escaping from the cylinder by the exhaust pipe it was received into a copper condenser, surrounded with cold water. To the bottom of the condenser two pumps were connected, worked by the engine, and from them a copper pipe proceeded, which, after many coils in the cistern surrounding the condenser—so as to expose a sufficient cooling surface—left it at the lower part by a valve. Sufficient water was introduced into the condenser to fill the pipe and pumps which continually drew the warm water from its bottom and passed it along the coiled pipe, by which means the heat was abstracted from it, and on being injected amidst the vapour instantly reduced it to a liquid state. In this process of condensation no air was admitted, as in the ordinary steam engine, nor was more than one supply of water required, the same being used over and over again. From the condenser the water was conveyed back to the injecting nozzle of the evaporating apparatus. In a word, the inventor used a jet condenser, but cooled the condensing water.

To give this novel steam generator of Mr. Howard's a practical trial the Government of the day allowed him to fit one on board H.M.S. Comet, a paddle-wheel steamer of some 330 tons burden, engined by Messrs. Boulton and Watt with a pair of side lever engines of 80-horse power, having two cylinders 35½in. diameter with a piston stroke of 3ft. 6in., driving a pair of paddle-wheels 14ft. diameter. Two Mediterranean voyages were made with this vessel, which were attended with favourable results, but accidents having occurred while making them, the Government abandoned any further trials of the apparatus.

Nothing daunted by this temporary discouragement,

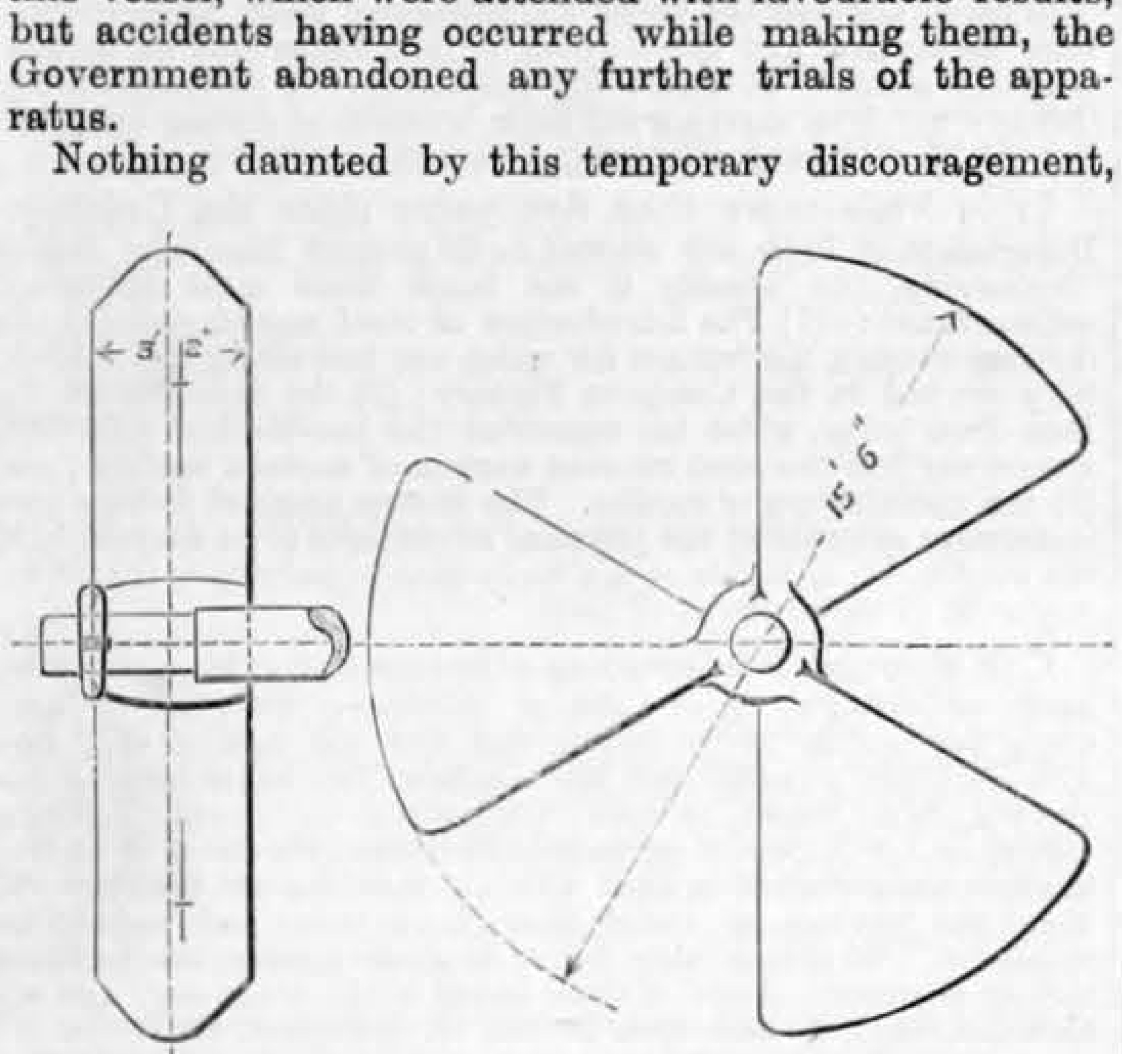


Fig. 42—NEW SCREW PROPELLER OF GREAT BRITAIN

Mr. Howard persevered with his idea, and it is recorded that he subsequently fitted with his apparatus a vessel named the Columbus, which he took round from the Thames to Liverpool, and had a trial with her in the Mersey on the 24th April, 1838.

The Columbus was a paddle steamer of 330 tons burden, 145ft. long on the keel, 21½ft. beam, and 13½ft. deep in the hold. She was fitted with a pair of engines of 110-horse power, having cylinders 40½in. diameter, with a piston stroke of 3ft. 6in., driving a pair of wheels 17ft. 6in. diameter. With these engines, supplied with steam from Mr. Howard's quicksilver boiler, this vessel attained a speed of 10 statute miles an hour, the immersed midship section of the vessel at the time, with twenty days' fuel on board, and 30 tons of ballast, being 150 square feet. The fuel in use was a mixture of coke and anthracite, which gave off a strong local heat with little flame. The consumption was three tons per twenty-four hour day, the total fire bar surface being only 22 square feet. Air was supplied by a fan under easy regulation.

The iron plates exposed to the fire were perfectly secured from any ill effect from the great heat by their close contact with the mercury between them, which absorbed and gave out the heat very rapidly. The combined effect of the reduction in the consumption of fuel, and the weight and size of the vaporiser, in comparison with the boilers of the time, was such that a steam vessel of ordinary tonnage and power was enabled at her usual loaded immersion to make a voyage of five times the length otherwise practicable. A serious accident caused by the burning of a plate of one of the vaporisers and the "explosion" of the mercury was, we believe, the eventual cause of the abandonment of the spray boiler for use on shipboard. We hope to be able to illustrate it in a later issue.

Many of our readers will remember that at the time of the advent of the magnificent Atlantic liner the Lucania, we drew a comparison between her and her venerable ancestor the Great Britain, the first successful screw-propelled steamship that ever crossed the Atlantic. In drawing that comparison we gave a full description of the vessel and her machinery as she left the hands of her builders and owners—the Great Western Steamship Company.

The Great Britain being an exceptional ship as to design, construction, and propelling machinery when first completed, we can now only refer those interested in her as she was, to our previous description, published in 1893, where they will note that after three very eventful voyages to New York, and while on her fourth, on a very dirty night in the month of September, 1846, when making a north-about passage—off the Giant's Causeway—she was stranded in Dundrum Bay, County Down, Ireland. There she remained for eleven months through a tempestuous winter, until she was finally floated in the following autumn and taken to Liverpool.

On examination, her bottom was found to be seriously damaged, so much so, that her necessary repair was too costly for her owners, and it was decided to dispose of her. Her original cost was £125,000. She was put up to auction in Liverpool on September 18th, 1848, and had only £35,000 been bid for her she would have been sold. However, Messrs. Gibbs, Bright, and Co., of Liverpool, subsequently became her purchasers, at about one-fourth her original cost; who had her bottom—the only damaged part of her hull, her lines being as fair as when she was built—reconstructed, fitted her with new engines, and re-rigged.

As recorded and illustrated in the article before referred to, the ship had orginally six masts, all of which, with the exception of the mainmast, the second from forward, were made to lower on deck like that of a river barge. In Fig. 39 we give an illustration of the renovated ship at sea; Figs. 40 and 41 are longitudinal and end views of the new engines fitted to her by Messrs. Jno. Penn and Sons, of Greenwich; and Fig. 42 shows her new screw propeller. It will save the trouble of reference if we here repeat the principal dimensions of this fine old ship, and give brief particulars of her original propelling machinery, that it may be contrasted with that with which she was afterwards supplied.

The Great Britain was built of iron of so tough yet ductile a quality that after laying on the rocks at Dundrum for eleven months very few holes were made in her, her bottom plates being principally indented, but not punctured. Her principal dimensions were:—Length over all 322ft., between perpendiculars 289ft., breadth moulded 50ft. 6in., depth to upper deck, 32ft. 6in. Internally she was divided into compartments by five water-tight bulkheads. Her propelling machinery consisted of a pair of direct-acting engines of 1000-horse power, each having two cylinders 88in. diameter with piston strokes of 6ft.; the steam distribution being effected by a piston valve to each cylinder driven by a single excentric. Each pair of cylinders was inclined to the other, their connecting-rods being coupled in pairs to the crank pins of two over-hung cranks at either end of a main crank shaft, which was 17ft. long, and 28in. diameter at its middle part, and 24in. at the bearings. This crank shaft carried a large toothed drum 18ft. 3in. diameter at pitch line, and 38in. wide; around which and a lesser drum 6ft. diameter, keyed on the screw shaft proper below, four sets of pitch chains worked, the motion of which was smooth and noiseless, caused by what served for teeth in the drums, being bars of teak in the larger one, and lignum vitæ in the smaller. The drums were speeded to give nearly three revolutions of the screw shaft to one of the engine shaft, which latter weighed some 15 tons and the pitch chains seven tons; and it was computed that the continuous pull on the main crank shaft bearings with the engines making 18 revolutions per minute was 85 tons.

The boilers supplying these engines with steam had one outside shell 34ft. long, 31ft. wide, and 21ft. high, divided internally into three distinct boilers, by two longitudinal partitions. Each boiler had four furnaces at each end, or twenty-four furnaces in all, each of which had its own distinct course of flues, terminating in one uptake in the middle. The total grate surface was 360 square feet, furnace surface exposed to the fire 1248 square feet, and flue surface 9852 square feet. The pressure these boilers were worked at never exceeded 5 lb. per square inch.

The new propelling engines of the Great Britain, as shown in Figs. 40 and 41, had a pair of oscillating cylinders, 82½in. diameter, with a piston stroke of 6ft. They were nominally of 500-horse power—half that of those first fitted and drove by means of wheel and pinion gearing a three-bladed cast iron screw propeller—illustrated in Fig. 42—15ft. 6in. diameter, and 19ft. pitch. The gearing consisted of morticed spur wheels of four steps, 14ft. diameter and 12½in. broad, having ninety six teeth, in gear with a four-stepped iron-toothed pinion, 4ft. 6¼in. diameter, of thirty-one teeth, the pitch of teeth being 5½in.

The boilers supplying the engines with steam were tubular, six in number, of box form, each 12ft. 9in. long, 10ft. 9in. broad, and 9ft. deep, each having three furnaces, the total heating surface being 8750 square feet, and the working pressure 14 lb. per square inch. On trial with the engines running at twenty revolutions per minute, they developed 1450 indicated horse-power, and drove the ship when light 12 knots, without sails. At her load water draught of 19ft. the speed attained was over 10 knots, without sails.

After her complete overhaul and renewal the Great Britain was put by her new owners into the Australian trade, where she remained twenty-one years, and retained the name of being a splendid sailer, and a fairly successful steamship, until the requirements of modern passenger transit had outgrown her capabilities. Our illustration, Fig. 39, shows her after renewal leaving Liverpool, May 1st, 1852, on her first trip to Australia. In her it was incontestably proved that a three or four-bladed screw was a decided improvement on one of six blades, and that without any propeller at all the Great Britain was a triumph of naval architecture as a sailing ship, which of course cannot be said of a modern Atlantic, or, in fact, any ocean passenger screw steamship.

Work Turned Out During the Strike.—The North-Eastern Marine Engineering Company, Limited, Wallsend, has just concluded the trial trips of three large cargo vessels—one with engines of 4000-horse power—within the space of one week. Since the commencement of the strike this firm has shipped the engines and successfully carried out the trial trips of seven large steamers, and in addition have shipped the boilers in other three steamers, amounting in the aggregate to 15,150 indicated horse-power. Considering the difficulty of running trial trips during the continuance of the present strike, this speaks well for the above enterprising firm.

NARROW GAUGE ENGINE, IMPERIAL JAPANESE RAILWAYS.

Our supplement this week illustrates one of the small types of tank locomotives in use on the Imperial Japanese Railways, some of which have been recently completed by Messrs. Sharp, Stewart, and Co., Limited, Atlas Works, Glasgow. The engine, as will be seen from the drawing, is of the ordinary outside-cylinder six wheels coupled class, with side tanks and hind coal bunker. The leading dimensions are:—

Cylinders, diameter	18in.
" stroke	18in.
Boiler barrel, diameter outside, smallest ring	3ft. 5⅝in.
" length	8ft.
Fire-box shell, length	3ft. 9in.
" " width	2ft. 10⅞in.
Copper fire-box, depth at front	4ft. 5½in.
" " " back	3ft. 5⅝in.
Tubes, number	126
" external diameter	1⅝in.
Heating surface, fire-box	46·5 sq. ft.
" " tubes	442·0 sq. ft.
" " total	488·5 sq. ft.
Grate area	8 sq. ft.
Wheels, six all coupled, diameter	3ft.
Wheel base	10ft. 6in.
Frames, length	19ft. 3½in.
" thickness	⅞in.
Capacity of water tanks	450 gallons
" " coal bunker	27 cu. ft.
Weight, empty	18 tons 5 cwt.
" in working order	22 tons 3 cwt.
Gauge of railway	3ft. 6in.

The boiler plates are of the best Yorkshire iron, the fire-box plates of copper and tubes of brass; the wheel centres are of wrought iron, with cast steel axles and tires. The boiler is fed by one pump and one injector. The engines are fitted with an ordinary screw brake; the valve motion is Joy's patent, the details of which can be clearly seen on the drawing. This is a very neat narrow-gauge engine, carefully designed, compact, without being crowded, and ought to give complete satisfaction in use. The Joy valve gear has contributed very much to this desirable result.

H.M.S. POMONE.

The latest addition to her Majesty's fleet, the third-class cruiser Pomone, was launched from Sheerness yesterday. She is one of eleven practically similar vessels, eight of which are either built or building, whilst the remainder are on the programme, and are known as the Pelorus class. They are nominally 20-knot third-class cruisers, and carry eight 4in. quick-firing guns as their main armament with eight three-pounders, other small guns, and two torpedo tubes as the secondary armament. The displacement is 2135 tons; length, 300ft.; beam, 36ft. 6in.; draught, 17ft.; and she is propelled by two propellers with 7000 indicated horse-power.

A picture of the Pomone as she will appear at sea will be found on page 521. She forms one of a squadron which should prove of great importance for dispatch work, as not only can they attain a high speed, but are of a size capable to work well in a heavy sea, and are sufficiently armed to give a good account of themselves against torpedo destroyers and other vessels of their own class. These vessels have 2in. protective decks, but are otherwise only lightly armoured round the gun positions.

THE INSTITUTION OF ELECTRICAL ENGINEERS.

The ninth annual dinner of this Institution was held on Wednesday evening at the Hotel Cecil, the President, Sir Henry Mance, being in the chair. Upwards of 200 gentlemen were present, including the Marquis of Tweeddale, Lord Kelvin, Sir Courtenay Boyle, General Sir E. Markham, Sir J. Crichton-Browne, Sir A. K. Rollit, M.P., Sir J. Wolfe Barry, Colonel J. Pennycuick, Major P. Cardew, Captain D. Brady, Professor W. E. Ayrton, Professor D. E. Hughes, Professors S. P. Thompson and Perry, Dr. W. J. Collins, L.C.C., Mr. C. E. Spagnoletti, Mr. A. Siemens, Mr. R. E. Compton, the Rev. Dr. A. Robertson (President of King's College), Mr. J. G. Griffiths (President of the Institute of Chartered Accountants), Mr. W. H. M. Christie (Astronomer Royal), Mr. J. W. Swann, Mr. G. Morse, and Mr. Webb (secretary).

The toast of "The Scientific Societies" was proposed by Professor Ayrton, who, in the course of a few amusing remarks, alluded to the improved conditions under which laboratory work was carried on now as compared with 1866 when he was a pupil under Lord Kelvin.

Lord Kelvin, who first replied, claimed for the Institution of Electrical Engineers, though it was not included in the toast, that it was one of the most scientific of all the scientific societies. The Royal Society, which was the parent of them all, had every reason to be proud of its offspring. He believed these institutions were most useful for promoting the objects whose titles they bore. They were most powerful aids to research and most valuable instruments for the promotion and advancement of the science of the world.

Sir J. Wolfe Barry, President, who next replied, said that twenty-five years ago business men set a much higher value on practice than on theory, but now it was recognised that we must go to science for new developments and for guidance in trade and manufactures. Most manufacturers looked to the laboratory superintended by a scientist as one of the most valuable departments of the establishment. Foreigners, perhaps, had realised that in a more acute way than we did, and to some extent had got the start of us, but he felt certain that we should fetch up whatever lee-way we had lost. Referring to the deputation which waited on the Prime Minister last summer to urge that some steps should be taken to put science more at the disposal of the manufacturing arts, he expressed satisfaction at the appointment of a Government Committee on the subject. The terms of its reference were limited, and though we could not comtemplate anything like such an expenditure as was borne by the German Government, still a beginning was made.

Sir J. Crichton-Browne, hon. treasurer of the Royal Institution, also acknowledged the toast, remarking that the Electrical Engineers had done more even than statesmen towards that consolidation of the Empire of which they had recently heard, so much and which they all desired. This country did not hold such preferential resources with regard to electricity as others and that ought to make us more earnest in that industrial warfare in which all nations were engaged. This was not the time for disputes, but for concord and mutual confidence. The Marquis of Tweeddale and Dr. Collins responded to the toast, "Our Guests." In proposing the toast of the "Institution of Electrical Engineers," Sir Courtenay Boyle mentioned that while in this country only 132 miles of electric tramways or railways were in operation or being constructed, in the United States the mileage was 17,000. That was a matter which called for the co-operation both of the scientist, the Legislature, and the departments of Government. The President, in response, said the Institution numbered over 3000 members, and its finances were in a most satisfactory condition.

RAILWAY MATTERS.

A REUTER's cable from Bulawayo states that in consequence of "wash-aways" the train service on the Bulawayo line has been suspended until further notice.

MR. T. ANDUS, of Newcastle-on-Tyne, mineral manager of the Northern Division of the North-Eastern Railway, will retire at the end of the year, and Mr. J. Fairless, his assistant, has been appointed to succeed him.

THE Secretary of State for India has appointed Colonel Sir William Sinclair Smith Bisset, K.C.I.E., R.E., late Secretary in the Public Works Department of the Government of India, to be Government Director of Indian Railways, in succession to General Sir Edward Williams, K.C.I.E., R.E., whose tenure of the office has expired.

To the Ceylon Railway Administration is due the credit for first initiating refreshment cars on railways in the East. The Bombay papers, in noting the recent addition of a dining car to the Bombay-Calcutta limited mail, speak of this as the first dining car on an Indian railway. This is not quite accurate, as a dining car has been running on the Rohilkhand and Kumaon Railway for several years back.

IN tearing up a siding on the Straitsville division of Baltimore and Ohio Railroad, the other day, the section men discovered that several of the rails had been made in 1863. Subsequent investigation revealed the fact that these rails were part of a lot that were bought in England during the war at a cost of 125 dols. a ton in gold. The rails were still in fair condition, and for light motive power would last ten years longer.

THE North-Eastern Railway Company is about to spend £50,000 in improving the dock accommodation at West Hartlepool, and their consulting engineer—Sir J. Wolfe Barry—is engaged upon the plans. There will be additional berths, extended storage space, and double instead of single lines of sidings. As they already possess the necessary land, they have not had to include this matter in their this year's Bill to Parliament.

THE Japanese Railway Company of Tokio, which operates the largest railway line in the Japanese Empire, has decided to expend about 13,000,000 dols. during the next six years in extending its lines and increasing the equipment. The improvements include the double tracking of an important line 140 miles long. The company's rolling stock will, says the *Japan Mail*, be increased to 500 locomotives, and 1600 passenger and 5200 freight cars.

THE 51 kiloms. of the Piræus-Athens-Peloponnesus line from Myli to Calamata between Tripolis and Kourtage are now completed and in working order. There remain now only about 26½ kiloms. to construct—15 kiloms. of which are expected to be finished early in 1898—to effect the junction with the Calamata side, and thus complete the whole line between Myli and Calamata. This would have a very beneficial effect on the traffic receipts.

THE latest addition to the railways on the outer skirts of London suburbs is the Chipstead Valley Railway just opened. This is a single-line railway which, starting from Purley, below Croydon, goes at present to Chipstead, Kingswood, and Tattenham Park, with stations at those three places, and a contemplated terminus on the Derby racecourse on Epsom Downs. An entirely new building district is opened up by this line, and one which, traversing as it does Banstead Downs, Burgh Heath, and Headley-on-the-Hill, should be particularly bracing and healthful. The fact of this being a single-line railway at present is, however, a drawback to any speedy development of this district.

THE promoters of the Sheffield District Railway Company are applying to Parliament for further powers. Instead of there being merely a station at Attercliffe, and several subsidiary branches connecting with the Midland passenger station at Sheffield, the line will now, if permission is obtained, join the Midland near the River Don Works, Brightside. This junction is obtained by the Midland Company constructing a new line from Treeton, on their main line, to Brightside. The Midland system will then be connected with the terminus of a branch of the East to West Railway at Beighton. The Midland Company have obtained the requisite parliamentary powers to construct the Treeton and Brightside line, but an arrangement has now been made for a transference of these powers to the Sheffield Company, and the latter will now build the line, subject to the transfer being confirmed by Parliament.

MR. H. A. P. HAMILTON, the District Superintendent of the Great Central Railway Company, Grimsby, has been appointed Assistant Superintendent of the Metropolitan Railway Company. Mr. Hamilton, who has had great experience during the twenty-six years he has been in the service of the Great Central (late Manchester, Sheffield and Lincolnshire) has always exhibited signal organising capacity and administrative ability. He has enjoyed the confidence of the entire staff, and has in every position the respects of the commercial and general public. The Great Central, in their new extension to London, run over forty-two miles of the Metropolitan Company's line, from Quainton-road to Finchley-road, which is under the charge and control of Mr. Hamilton, who leaves the North with the best wishes of his board, the chief officers of the Great Central and other railways, and indeed of all who knew him.

GREAT satisfaction is felt in Flintshire by the notice given by the Wirral Railway Company of their intention to apply to Parliament in the ensuing session for a Bill authorising the company to extend their system to Rhyl. The projected extension will commence at Little Meols, West Kirby, by a junction with the main line of the company between Hoylake and West Kirby, and will terminate at Rhyl at a point on the north-east side of Vale-road, immediately opposite the north-east end of Marsh-road. The railway will pass through Little Meols, West Kirby, St. Oswald's—Chester detached—and the Dee in Cheshire, and Trewaelod, the Dee, Gwespyr, Gronant, Llanasay, Prestatyn, Nantwith-Prestatyn, Meliden, Dyserth, Rhydorddwy, Trellewalyn, Brynhedydd, and Rhyl, in Flintshire. The railway will thus open out a practically virgin country untouched at present by the London and North-Western Railway Company. The London and North-Western Company have also given notice of their intention to apply for an Act with the object of carrying out a large scheme of railway extension. At Rhyl it is intended to widen the line for a considerable distance, and re-model the railway station.

LATE on Thursday evening, the 18th inst., the Great Northern Railway Company's Manchester to London express passenger train narrowly escaped being wrecked. A heavy fog prevailed at the time, and at about 10.30 a goods train from the North to London, due to pass Wolmer Green, midway between Welwyn Junction and Knebworth, was signalled to slacken speed and proceed into a long siding to enable the express passenger train to pass. Owing to the density of the fog, however, the driver of the goods train seems to have mistaken the signals, and, thinking he was on the main road, proceeded ahead, with the result that he ran into the siding stops, which were knocked down, while the engine turned over on to the embankment, followed by two trucks of hay, which toppled on to the engine, burying it completely. The driver and fireman had the presence of mind to jump from the engine, and so escaped with slight injuries. A number of other wagons in the rear of the train were derailed and thrown across the up and down main lines just as the express passenger train was due to pass. The driver, however, surmising that something was amiss, applied the brakes, and stopped immediately in front of the wrecked wagons.

NOTES AND MEMORANDA.

THE President of the British Association for 1898 is Sir W. Crookes, F.R.S. The meeting in Bristol will open on September 7th.

THE official *Gazette* of the United States Patent-office for October 26th contains the claims of specifications of 124 patents for multiple switch boards taken out by Milo B. Kellog, of Chicago. So far as we are aware, this constitutes the largest number of patents taken out by one man included in one publication. The claims alone occupy 142 large octavo pages of close print.

THE annual reports of U.S. Chief Naval Constructor Hochborn show that on 1st October the strength of the navy consisted of 141 vessels. The report of the engineer-in-chief, Commodore Melville, proclaims great advantages from the use of water-tube boilers in late years, resulting in their exclusive use for torpedo boats. He also favours the use of oil for fuel on torpedo boats, but fears that the supply of petroleum is not nearly adequate to what the demands for it would be if any considerable proportion of the steam vessels afloat called for it as fuel.

A NEW form of electric seismoscope is described in the last *Bollettino* of the Italian Seismological Society, the chief merits claimed for it being its comparatively slight cost, and its great sensitiveness. In most seismoscopes the movement of a pendulum is magnified by a long pointer, whose tip just passes through a hole in a metal plate, contact with which completes an electric circuit and starts a clock previously set at twelve. In the new instrument the metal plate is not as usual fixed, but is connected with a second inverted pendulum, the bob of which is near the top of its supporting rod, while that of the first is near the base.

"IT is an ill wind that blows nobody good." The loss of the Gangoot has been the cause of the making of an important and interesting test. With a view to disproving certain statements that had been made to the effect that the transverse partitions in ships were of little use when they had never been tested under water pressure, the constructor of the General Admiral Apraxine, a Russian coast-defence ship of 4126 metric tons displacement, obtained permission to put 500 tons of water into the vessel. The level of the water was 20ft. above the upper keel, but the bulging of the partitions was very slight, and the leakage of no importance. This is, it is stated, the first experiment of the kind performed in any country.

THE experimental roller boat invented by Mr. Francis Knapp, and just built at Toronto, was given a trial recently, and showed herself under perfect control. A speed of only six miles per hour was attained, but the inventor and builder say that the boat was not ready for a speed test, and they merely wished to demonstrate the correctness of the principle of construction. That being settled, they claim it is a mere matter of detail to arrange the machinery with power enough to give almost any desired speed. The present engines, it was found, did not have the necessary equilibrium to risk a high speed without a strengthening of a number of parts. According to *Fairplay*, in this boat the whole circumference of the craft, which is 100ft. long, revolves.

IN a lengthy paper by Mr. Charles H. Cramp, read before the full convention of the New York Board of Trade and Transportation recently, the author stated that subsidies paid to British steamships from 1833 to 1895 inclusive amounted to £48,985,600, to which should be added about £2,400,000 paid by the United States Post-office Department to foreign steamships—about 85 per cent. British—for carrying American mails, from the destruction of the Collins Line in 1858 to the end of the fiscal year of 1896. Meanwhile the United States Government had paid to American steamships, including the Collins' subsidy from 1851 to 1858 and varying rates of mail pay since, a grand total of only 28,456,730 dols. This, he said, was the reason for the lack of increase of the American merchant marine.

SINCE Mr. W. Duane discovered the true source of his "new magnetic effect" in the presence of extremely minute admixtures of iron to the specimens of sulphur and other dielectrics, he has been endeavouring to make this source of error a highly sensitive reaction for the presence of iron, rivalling spectroscopy itself in that respect, says the *Electrician*. Instead of measuring the damping factor, he now suspends the specimen to be tested by a quartz fibre in a glass tube and introduces it into a rotating magnetic field produced by electro-magnets rotating bodily. The deflection of the specimen indicates the presence of iron. Whereas in the former method a certain specimen showed a hardly perceptible damping factor of 0·00009, it now gave a deflection of 17·6 cm. at a distance of one metre.

THE National Museum at Washington has just been enriched by a very valuable interesting collection. This comprises the private papers of Mr. Cyrus W. Field relating to the laying of the first Atlantic cable, cable despatches first sent, objects with which Mr. Field worked out the idea of laying the cable, and many other things of interest pertaining to the project. The correspondence and autograph copies of telegrams sent by this gentleman to the President of the United States and other eminent persons are included. The globe, which was constructed in London, and on which was traced the course of the cable to be laid from Newfoundland to Ireland, forms an attractive object of the collection. It is about 18in. in diameter, on a stand, with a magnetic compass underneath, and shows many signs of hard usage. The journal kept by Mr. Field and notes of deep-sea soundings set down by him and officers of the Great Eastern, which laid the cable, are part of the collection. Mr. Field's private library, with all the literature relating to the work of laying the cable, forms another part. There are also copies of medals presented to him by Congress and the French Government, engrossed resolutions passed by public bodies in the United States and in Europe, a cane from the wood of the Great Eastern, &c., as well as cases containing sections of the first Atlantic cable. The collection was secured by Professor Watkins from Mrs. Isabella Field Judson, of Dobbs Ferry—New York State—who is a daughter of the late Mr. Field.

AN interesting paper was recently read before the Engineers' Society of Western Pennsylvania by Mr. C. A. P. Turner, in which is discussed the possibility of determining the character and intensity of stresses in metals by measuring the heat gained or lost when a load is applied. The author attempted by actual tests, compressive and tensile, on bars of soft and medium steel, cast iron bars, short columns of steel, and plate girders, to demonstrate fluctuations of temperature. For the exceedingly delicate measurements of temperature Mr. Turner used the thermo-electric current generated by a Melloni antimony-bismuth thermopile, and recorded by a Thomson astatic reflecting galvanometer. With the instruments used he estimated that a variation of $\frac{1}{3000}$ deg. Cent. could be determined. The conclusions which Mr. Turner draws from the results obtained may be summarised as follows:—That stress can be quite accurately measured by the change in thermal condition of the piece, when the load is applied, if the stress does not exceed about ⅞ths of the commercial elastic limit. That difference in the intensity of stresses of the same kind, though slight, occurring at two different points, can easily be detected by a modification of the same apparatus. For medium steel there appears to be a thermal limit, below which the test piece grows slightly and regularly cooler as the tensile stress is increased, and beyond which for a considerable space there is little change, until the commercial elastic limit—the drop of the beam—is reached, when heat is generated so rapidly that the curve is almost normal to the axis of abscissæ.

MISCELLANEA.

THE Vickers 6in. gun and mounting, which were successfully tried on October 21st on board the Pincher gunboat, at Portsmouth, are, says the *Times*, to be sent to Shoeburyness for further trial.

H.M. CRUISER Doris, which is to take the place of the cruiser St. George as flagship of the Cape of Good Hope station, carried out a three hours' steam trial off Plymouth on Wednesday. The mean results were:—Steam in boilers, 150 lb.; air pressure in stokeholds, 0·6; revolutions, starboard 136·8, port 135·9; indicated horse-power, starboard 3997, port 4088, total 8085; speed 17·6 knots. The draught of water was 19ft. 9in. forward and 23ft. 3in. aft.

THE great conflagration of which the city of London was the scene during the latter part of last week has proved the most severe since the great fire of 1666. It was found on Saturday that the fire originated, not in Hamsell-street, as at first reported, but in a warehouse in Well-street, in the occupation of a firm of ostrich feather dealers. The last of the steam fire-engines employed in suppressing the fire was sent away on Saturday morning. The area affected by the fire is approximately 17,000 square yards; the number of buildings destroyed, burnt out, or damaged, 96; and it is believed that the total loss will be at least £2,000,000.

AT six o'clock on Monday morning the whole of a wide masonry wharf recently constructed opposite the Custom House at Lisbon, and having a frontage of nearly 300 metres to the Tagus, suddenly subsided and disappeared into the bed of the river. It was built on the mud because in the soundings taken previous to the commencement of the work to a depth of 36 metres no solid foundation was found. Owing to the earliness of the hour nobody was on the wharf, says the correspondent of the *Times*, but had the disaster occurred during the day hundreds of lives would have been lost. The damage is roughly estimated at £50,000.

THE new flood channel which the Thames Conservators have constructed through the lock island at Teddington, between the lock and the weir, was formally opened by Sir Frederick Dixon-Hartland, M.P., on Monday afternoon. The channel is 80ft. in width, and the sill is 6ft. 6in. below the highest flood water-mark of recent years, so that in the event of any abnormal rise in the river above the weir the water will pass away much more quickly than heretofore, and the flooding of the banks will be proportionately abated. A dense fog prevented the members of the Conservancy from carrying out their intention of coming by water, but this cleared away completely before the ceremony.

IT is little more than five years since the Ordnance Department of India was started on its present lines, says *Indian Engineering*, but already it can boast three most important achievements:—(1) The introduction of steel manufacture by the Siemens process, the furnace for which was first set up and successfully worked in the Cossipore Factory; (2) the invention of the Dum-Dum bullet, which has converted the Lee-Metford rifle from a mere toy into the most efficient weapon of modern warfare; and (3) the manufacture of cordite. The success attained forms a very instructive example of the practical advantages to be derived from the application of highly specialised scientific training to the every-day work of Government officials.

ONE of the most interesting of submarine craft now being equipped is that of Simon Lake, of Baltimore, designed to creep along the bottom of the ocean and find old wrecks, &c., says *Fairplay*. At a recent test she remained two hours beneath the surface, and guests enjoyed themselves on board, smoking cigars, &c. The plan of communication with wrecks is in having the bow compartment so filled with air that the air pressure will equal the pressure of water from the exterior and prevent its admission. Of course, only divers in their armour are to be in this air chamber. Some of them tested it the other day, and say that they kept the door open for half an hour from the vessel but no water entered, and thus access and egress to the hull of the craft is easy. The vessel is named the Argonaut.

UP to the end of last week statutory notice had been given by seventeen local authorities and others of their intention to apply to the Board of Trade for Provisional Orders under the Electric Lighting Acts, 1882 and 1888, for power to produce and supply electricity for lighting purposes. Since then similar notice has been given by twelve other authorities to a similar effect, namely, the Rural District Council of Chelmsford, the vestry of the parish of Marylebone, the Midland Electric Light and Power Company, Limited, for the borough of Royal Leamington Spa, the Hastings Corporation, the Haworth Urban District Council, the Weston-super-Mare Electric Light and Power Syndicate, the Crewe Corporation, the Lewes Corporation, the Gravesend Corporation, the Dartford Urban District Council, the Aston Manor Urban District Council, and the Batley Corporation.

APART from the ordinary uses to which we are accustomed to see asbestos put, the Cape Asbestos Company, Limited, Minories, London, have made a departure in adapting their product to electrical purposes. Accumulator boxes for battery cells are made by them by a patent process from blue asbestos. These have the advantage of being unbreakable, as compared with glass or earthenware, while they are cheaper than vulcanite or ebonite. The boxes are made in various sizes as desired. The same material has by a similar process been used in the manufacture of tubes for covering cables, both for underground and indoor work, any diameter desired being procurable. The material, it may be mentioned, allows of the tube being threaded for a joint the same as if it were iron. Yet another application of the material in its formation into sheets for insulating purposes for which it is made in all thicknesses.

THE casting intended for use at the Old Level iron-works, Brierley Hill, as a steam hammer block, reached the vicinity of the works on Sunday. It began its journey more than three months ago from the dismantled works of the New British Iron Company at Cradley Heath. It had only to travel about two miles as the crow flies, but the adoption of a circuitous route became necessary. While it was approaching a bridge carrying the highway over the Great Western line at Round Oak, the company's officer interposed and refused to allow it to traverse the bridge. Its great weight, nearly 50 tons, did not, they said, come under the classification of ordinary traffic of the district, and might lead to an accident. On the other hand, it was contended that, though of exceptional weight, it was traffic which the company ought to provide for in an iron-making district. The casting, after being stranded for weeks on the roadside, was at last drawn alongside a private railway of Lord Dudley's, and on Friday was loaded upon a special machine truck sent by the Great Western Company for the purpose. On Sunday it was taken by a triangular route to a point near its final resting place. As the truck and its load weighed 70 tons, the utmost vigilance was exercised in passing over points and bridges, and an hour and three-quarters was occupied in the seven and a-half miles of metals traversed. All went well till almost the last moment, when, as the bogie truck was slowly rounding a sharp curve, a rail broke and the front pair of wheels of the truck left the metals. This contingency had been provided for, and powerful appliances were used to raise the truck and get the displaced wheels on the metals again. This was done, and it was decided to run the truck and its load into a siding, and there transfer it to a carriage on which it can be drawn by a pair of traction engines into the works where it is required. A great number of people watched the transit and arrival of the casting.

CONTENTS.

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.

F. R. S. B. (Foulsham).—The question is somewhat obscurely worded. We cannot pretend to settle what the author's meaning is. We have no doubt that he will settle the difficulty at once if you will write to him.

YOUNG PLATER.—There is no book which would teach you how to value steamships. To do that well requires a life's experience in shipping matters. The only way to learn is by entering the office of a shipping broker. There is no rule; a ship may change her value many times in the course of a year, according to the freight market and other varying conditions.

INQUIRIES.

FLOW IN CANALS.

SIR,—Can any of your readers give me a simple formula or rule for ascertaining what fall in feet per mile of length will produce a stated velocity in miles per hour, in a canal of given material and dimensions? The result of any experience would be much appreciated.

November 24th. READER.

MEETINGS NEXT WEEK.

THE CIVIL AND MECHANICAL ENGINEERS' SOCIETY.—Thursday, December 2nd, at 7 p.m., at the Hotel Victoria, Northumberland-avenue, Charing Cross, S.W. Opening address by the President, Mr. H. Coward, C.E.

THE INSTITUTION OF CIVIL ENGINEERS.—Tuesday, November 30th, at 8 p.m., Ordinary Meeting. Paper "On the Law of Condensation of Steam," by Messrs. Hugh L. Callendar, M.A., F.R.S., and John T. Nicolson, B.Sc. Friday, December 3rd, at 8 p.m., Students' Meeting. Paper, "Permanent Way: its Construction and Relaying," by Mr. Grote Stirling, Stud. Inst. C.E.

SOCIETY OF ARTS.—Monday, November 29th, at 8 p.m. Cantor Lectures—"Gutta-Percha," by Eugene F. A. Obach, Ph.D., F.C.S. Three lectures. Lecture I.:—The Raw Material—The year 1847—Early history and the Society of Arts—General properties and distinction from caoutchouc—Botanical derivation and geographical distribution—Expeditions in search of gutta trees and experimental cultivation—Analysis of particular specimens and of various commercial brands—Exports from Singapore, imports into the United Kingdom, and fluctuation of prices. Wednesday, December 1st, at 8 p.m., Ordinary Meeting. Paper, "The American Bicycle—the Theory and Practice of its Making," by Prof. Leonard Waldo, D.Sc.

THE ENGINEER.

NOVEMBER 26, 1897.

AFTER THE CONFERENCE.

AT last the long talked-of Conference is an accomplished fact. In another place we give a list of the names of the delegates. So far matters are proceeding smoothly. The masters are extremely firm, and they hold that, being firm, they can best serve the interests of the men. Their contention is, indeed, that if the various absurd restrictions which are enforced by the New Unionism were removed, there would be more work turned out, better prices realised, and larger wages paid; that, in a word, the men would be able to earn more money by far than has been possible for some time past. The masters are meeting the men in a conciliatory spirit. As we have already stated, they are most reluctant to do anything which will break up the union, but it is not to be denied that much bitterness exists among some of the employers, who maintain that under the rule of Mr. Barnes they have been unable to make profits, give satisfaction to their customers, or enjoy life.

It is not a little suggestive that the Federated Trades Unions found some difficulty in selecting representatives to attend the Congress. Mutual jealousy stood in the way. It was held that the Amalgamated Engineers were represented far too strongly by ten delegates out of fourteen, and finally Mr. Barnes had to give way and rest content with nine. It is worth notice that the leaders of the Amalgamated Engineers claimed the larger representation on the ground that they had already financed the strike to the extent of £500,000. Possibly the world in general will be told one day where this enormous sum came from, and how it was spent. We hope for the best. Indeed, the lesson of the strike would be very incomplete if the certified balance sheet were lacking.

It would be wholly without profit at present to attempt to forecast the result of the Conference; but it is well to consider what the position will be after it is over. There are three possibilities. First, the Conference may effect nothing. Secondly, the men may obtain important concessions from the masters; and lastly, Mr. Barnes may be beaten all along the line. No doubt, in the latter case, the men would return to work with all conceivable promptitude. Very large numbers of non-union hands have been taken on, and come what will, these men are sure of their berths. The employers are bound by every consideration of honour and morality to give them work. There is so heavy an arrear to be cleared off that it is probable room will be found in the shops for unionists and non-unionists alike; if not at once, then as soon as the shops have been got into full swing; but meanwhile the strikers feel not a little natural anxiety as to their position. It may be, however, that as we have suggested, the Conference may end in nothing, and this is by far the most interesting aspect of the struggle. What, in such a case, would happen? We believe that the answer is simply that the strike would die a natural death. The mere flux of time and operation of the natural laws of political economy would bring the struggle to an end. In truth, if the masters only knew it, they are in an impregnable position. To by far the greater proportion of them it would mean little more than a large trade loss if they kept their works closed for another six months. They would, no doubt, have a very bad year; but the stoppage does not mean ruin, or bankruptcy, or starvation. They have so much capital lying idle, or nearly idle; that is in the main all. With the men the case is different. The strike is costing about £38,000 a week. This is found in large part by the very heavy levies paid by the hands who are at work. So far as the union is concerned, these men become fewer every day; and the collapse of the Conference would no doubt be followed by the closing of a large number of shops now open, and a further diminution of the levies. It is by no means easy to get at the facts, but it seems that the number of Amalgamated Engineers drawing strike pay is diminishing. If this be true there is, of course, but one explanation—men are breaking away from the union and returning to work. The weakness of the union is that it represents so small a fraction of the whole population of the British Isles; about one man in one thousand inhabitants is on strike. We speak now of the engineers only. In a country like this, where so many are devoted to mechanical pursuits, there ought to be small trouble in getting a second man per thousand to take the place of the strikers. No doubt this substitution of labour would have taken place wholly instead of in part, long since, but for the militant action of the strikers. But picketing cannot go on for ever. All the acquired experience of past strikes shows that they tend to die out. The strikers in any one town drift by degrees into other towns and find work. Some years ago a very important strike took place in the Midlands; it lasted really for a couple of months—nominally it was not over for a year. But all the works were fully employed, and the masters carried on their operations. In process of time just the same thing would occur with the present strike. An access of cold weather and difficulties in getting strike pay would settle the whole affair before the year is out.

We have yet to consider what will happen if the men win. One of the first results would no doubt be the closing of a number of the smaller shops, and an entire reorganisation of those which remained. So far as the men are concerned, however, all this is of secondary importance. What they will have to consider is the pecuniary position of the union. Men have complained bitterly of the grievous burthen laid on them by the New Unionism. When asked why they do not break away from the Society, they reply that by doing that they would lose all the money they had paid in for years to provide for their old age, to support them when out of work, and to bury them when dead. This argument can no longer prevail. The whole of the accumulated fund of the Society has been spent, and the union is heavily in debt besides. At this moment there is no available benefit fund whatever. If the men break away from Mr. Barnes they will be no worse off than they are now. Possibly they will be better off; because it is rumoured that one of the first steps to be taken by the leaders, when work is resumed, will be to impose an enormous levy to, in part at least, replace the benefit funds.

The best thing about the Conference is that it will secure a free interchange of opinions and information. But the benefit will be largely neutralised unless the whole of the discussion is made public. The meetings will take place behind closed doors, but this would not prevent the subsequent publication of the proceedings. Mr. Barnes is understood to have said that district officers have interfered in an unauthorised way with shop management. He will now have an opportunity of learning facts concerning which, for a man in his position, he seems to be strangely ignorant. We have repeatedly pointed out in these pages that much trouble and friction would be avoided if the masters would take pains to keep their men better posted up about the course of trade; a subject concerning which they are, as a rule, totally ignorant. A working boilermaker, for example, can, if he will take the trouble, easily enough work out for himself the cost of the materials, plates, rivets, angle irons, &c., of, say, a Lancashire boiler. The cost of labour he ought to have at his fingers' ends. He finds such a boiler "listed" at a price which apparently leaves an enormous profit, and he grumbles accordingly. It would be worth while to explain to such a man some of the facts anent discounts, agencies, general charges, freightage, bad debts, long credits, and so on. He would then see the whole matter in a different light. The masters in the first instance refused to discuss the eight hours question at all at the Conference. They have given way on this point, and wisely, we think. It is impossible to consider the length of the day and its effect without putting before the union delegates facts of which they are, we believe, quite ignorant. The diffusion of knowledge cannot fail to be useful.

PERMANENT WAY—BRITISH AND AMERICAN.

Two articles have appeared in the columns of the *Pall Mall Gazette*, one on September 17th and the other on October 26th. They attack the permanent way of Great Britain, and assert that the railroad track used in the United States is very much better. That track, as no doubt most of our readers are aware, is almost identical with a system of construction long used in this country, and given up finally because of its defects. A flat-footed or Vignoles rail is secured to transverse sleepers or "ties" by spikes. Very great care is taken to support the weak joints by more or less elaborate clamps or fish-plates. A large number of sleepers is used; they are pitched about 18in. apart, centre to centre; and being wide, the wooden portion of an American railway has, not inaptly, been compared to a deck laid on the ballast. We are assured by our contemporary that it is only in this way that a really first-class road can be made; and that our road is peculiarly bad because we use chairs. There are, however, two facts connected with the American system that present great difficulties to English engineers. The first is the enormous outlay which would be incurred were such a road made in England, where sleepers cost from 3s. 6d. to 5s. each, as against 1s. to 1s. 6d. each in the United States. The second is, that railway men here have not yet found out how to keep in order a track with the sleepers so close together that they cannot be properly packed. Perhaps in this matter, as in many others, climate has an important influence; and packing is not required in the United States to anything like the extent it is needed here.

Our contemporary takes the ground that derailments which have occurred in this country plainly indicate the defective character of our permanent way. A derailment at any place outside a station yard is so rare an event with us, however, that it may be regarded as miraculous. It is something contrary, if not to the laws of nature in general, at least to the laws of railway nature in particular. During the last two years there have been five cases wherein a passenger train has got off the metals. These occurred at St. Neots, Little Bytham, Preston, Welshampton, and Mayfield. We have refrained from comment on the articles in the *Pall Mall Gazette* until we were in possession of the Board of Trade report on the Mayfield accident. That has just been made public, and we learn from it, as we expected, that the superstructure of the permanent way had nothing whatever to do with the accident, which was due to driving the train at too high a speed over a curve on an embankment composed of chalk; a naturally treacherous material in wet weather. It will be well to state the facts as given in Lieut.-Col. Addison's report first, and then to return to the consideration of the relative merits of English and American permanent way, in so far as the safety of the travelling public is affected.

The Eastbourne and Tunbridge Wells Railway is partly a single line, forming a portion of the system of the London, Brighton, and South Coast Company. The section between Hailsham, three miles north of Polegate, and Eridge, with which alone we have to do, was opened in 1880, the permanent way consisting of 78 lb. steel rails, in 21ft. lengths, carried in cast iron chairs, weighing 33 lb. each, fastened to 9ft. by 10in. by 5in. sleepers by three hollow trenails and spikes. There were eight sleepers to each rail length, laid 2ft. 2in. apart at the rail joints. The rails were fished at the joints with fish-plates weighing 23 lb. per pair. The bottom ballast is stated to have consisted of chalk and the top ballast of shingle. From Polegate to Horeham-road, 8¼ miles, the line presents no special features which need be referred to, but from the latter place to Eridge, 12¼ miles, there are numerous short reverse curves and steep gradients alternately rising and falling. The accident occurred at a place known to the railway men as Tooth's Bank, where the line is carried on an embankment, at the foot of the falling and rising gradients of 1 in 50, and where the line is on a curve to the right of 24 chains radius. The train consisted of six coaches, drawn by one of Mr. Stroudley's four-coupled tank engines, weighing about 38 tons. The centre of the boiler is 6ft. 11in. above the rail level. The four coupled wheels are 5ft. 6in. in diameter, and the trailing wheels 4ft. 6in. The total wheel base is 15ft. The engine and coaches were all in perfect order, and the engine was running chimney first. The train left the rails, and one carriage rolled down the embankment. The driver was killed on the spot, and the fireman was badly cut about the head, yet with a courage worthy of all praise lent valuable assistance until he fainted. Some thirty passengers complained of more or less serious injury. It was a bad accident beyond all question. Colonel Addison carried out a very careful inquiry; we need not reproduce the evidence. His conclusion is given in the few following words:—"I can have," he says, "no hesitation in attributing the accident to the combination of a comparatively high rate of speed with a rough road."

Let us see what this means. It is not disputed that the sleepers were quite sound, the rails in capital condition, and the chairs well secured to the sleepers, the keying was all right, the permanent way inspectors appear to have done their duty efficiently. The weak spot in the whole system is the material of the embankment. It is suggestive that one witness stated that gravel was not used on the embankment as ballast because it was too heavy. Such a road required constant attention to keep it in order, and no doubt it was on the whole well looked after. We gather from Colonel Addison, however, that the cant of the curves was not properly maintained. He states that he found the super-elevation of the outer rails of the curves to be very irregular, which should not be the case, and which would go far to account for the oscillation complained of when trains run at all fast. Immediately before that part of the embankment on which the accident took place, where the line is on a curve of 24 chains radius, the super-elevation of the left-hand rail dropped from 2½in. to ½in.; at the same spot, the road was found—after the accident—to have been pushed out, towards the outside of the curve, about 1in. in four rails' length, but it is possible that this displacement was caused by the wrecked train. We have in all this not one scrap of evidence that the catastrophe was due to defective permanent way. No doubt the torrents of rain which had fallen about the end of August had much to do with the sinking or weakening of the road. Colonel Addison points out that the defects of the line are mainly due to the original trace. In a word, it is a cheap line, and any alterations in the curves, &c., would entail a very large outlay—more, no doubt, than the traffic justifies. The proper way to prevent accidents in future is to treat the line with a due regard for its deficiencies, and allow more time for traversing the distance between Heathfield and Mayfield. Obviously no deductions whatever bearing on a first-class main line can be drawn from events taking place on a cheap branch road such as this.

Going back now to our contemporary, we would ask him to compare the number of derailments which occur in the United States in a single month with those which, taking place in this country, he considers sufficient to condemn our system of construction. In the month of September alone no fewer than 70 cases of derailment occurred in the United States, and of these we are told that 23 were "unexplained." Even after we have made due allowance for the enormous mileage of the United States, 23 unexplained derailments in one month do not speak very well for American permanent way. The average in this country is 2·5 cases per annum, against 276 per year in the United States. Again, let us see how far the English cases, few as they are, bear out our contemporary's contention. We need not again refer to the Mayfield accident. At St. Neots the train left the road because it broke a rail—a most common event, we may add, in the United States. At Bytham an express train left a curve because the inspector of permanent way allowed it to run at a very high speed indeed over a portion of the road which had been relaid. The ballast had not been properly consolidated. It was due to an error of judgment, and not in any way to the system of construction. The Preston accident had nothing whatever to do with the construction of the permanent way. A curve in the station-yard was passed over at 50 miles an hour instead of the 10 miles an hour proper to the locality. In the Welshampton accident two heavy goods engines were hauling a passenger train over a bit of road out of order.

It would extend this article to an unreasonable length if we proceeded to consider in detail the relative merits and demerits of flanged and bullheaded rails. That we may do at another time. Our object at present has been to show that, in so far as derailments are concerned, the railway track of Great Britain is in no way inferior to that of the United States. Questions of excellence or the reverse, of goodness or badness from other points of view, have comparatively little interest for the public for whom the *Pall Mall Gazette* exists. It will be admitted that safety is the first consideration. All the rules and regulations of the Board of Trade have that as their paramount object. The general public may rest content. It seems to be impossible to produce a system of permanent way which, judging from experience, shall be safer than that which is now and has been for years past in favour in this country. Nothing in the United States is better in this respect. The weak spot in our railway track is beyond all question the ballast. In many places railways were made in the good old times without sufficient money and without enough knowledge. But it is good and pleasant to know that in this respect improvements are being effected daily. The risks caused by defective ballast would not be diminished by the adoption of more sleepers, but rather perhaps augmented, because of the difficulty of packing up, and so maintaining the level of the road.

SUDDENLY IMPOSED LOADS.

It is pretty generally admitted that the effect of a suddenly imposed load is twice that produced by the same load quietly or statically applied. In accepting this statement and in applying it to the structures under their charge, bridge engineers take it for granted, in other words, that a live load produces twice the stress that is caused by a dead load of the same amount. While tacitly conceding the first statement, it may be remarked that the truth of the second has been seriously questioned by experienced and competent authorities. They do not reject the actual principle, but maintain that it does not apply to moving or live loads passing over bridges at different velocities. That an engine and train rapidly traversing a bridge is a live load no one will deny; but before it can be said to act in the manner assigned to it there are one or two disputed points to be considered. In the first place, is a load moving over a bridge, such as the one instanced, a suddenly imposed load? Is it an axiom in kinematics that it should be so, necessarily and unconditionally, or shall we rest content with granting that under certain adverse circumstances it might become so? The other point to be kept in view is, to what extent does a live load act as an absolute dynamical or impactive agent? It is obvious that however quickly an engine and train may rush on to a bridge, some little time must elapse before it is distributed over the whole span, or at least over as much of the span as it can cover. Again, directly the leading wheels of the engine clear the abutment and impinge upon the superstructure itself, the effect is felt throughout the whole length of it, and at the further end, a few seconds probably before the load becomes imposed upon that part of the bridge. Assuming a train running at about fifty miles an hour, it would require nearly three seconds before it would traverse a bridge 200ft. in span. This can hardly be called a suddenly applied load, and in any case, except for spans of dimensions so small that they are not worth consideration, the load of a moving train may be fairly expressed as one gradually applied; quite distinct from a static load, and yet not possessing all the properties of the genuine impact, shock, or blow, attendant upon falling weights.

Apart from accidental and unfavourable circumstances due to an inferior and poor permanent way, badly balanced drivers, defective designing, and other causes—all preventable—there is nothing to interfere with the smooth, even passage of a train over a bridge of any span at almost any reasonable velocity. Practical men, regular bridge inspectors, have expressed their opinion that the mere passage of a train at a high speed over a small bridge does not, *per se*, cause any appreciable augmentation in the actual stresses set up in the different members of the structure by the same load moving slowly and leisurely. With a bridge, road, and rolling stock, all in first-class condition, it is probable this assertion is very near the truth, but not otherwise. With a road in perfect order there can be no real vertical impact in the proper sense of the term. There is no doubt some force in the contention, although we really know very little about it, that it takes time for the stresses to be brought to their maximum amount upon all parts of a bridge, although some parts are unquestionably stressed proportionally heavier than others. One or two experiments appear to confirm this time theory. For instance, an engine and train were brought to rest upon a bridge of 110ft. in span, and after a short interval the deflection was observed. Subsequently the whole load was made to traverse the bridge at different rates of speed, and when the velocity was some thirty-two miles per hour the deflection dropped to 50 per cent. less than what it was when the same load was at rest on the structure. It may be mentioned also that the experiments conducted many years ago on the Ewell Bridge proved that the central deflections increased but very slightly with an increase in the speed of the moving load. Some of these deflection tests plainly indicate that for bridges of certain spans, and presumably for train loads of certain weights, there is a velocity which, though not itself the maximum, yet causes the maximum deflection. In one experiment a speed of twenty-four miles occasioned a deflection nearly double that due to the same load statically imposed. A velocity of forty-five miles per hour reduced the deflection produced by the dead load to nearly one-half, and with speeds less than the first the deflections varied roughly approximately with the rate of speed.

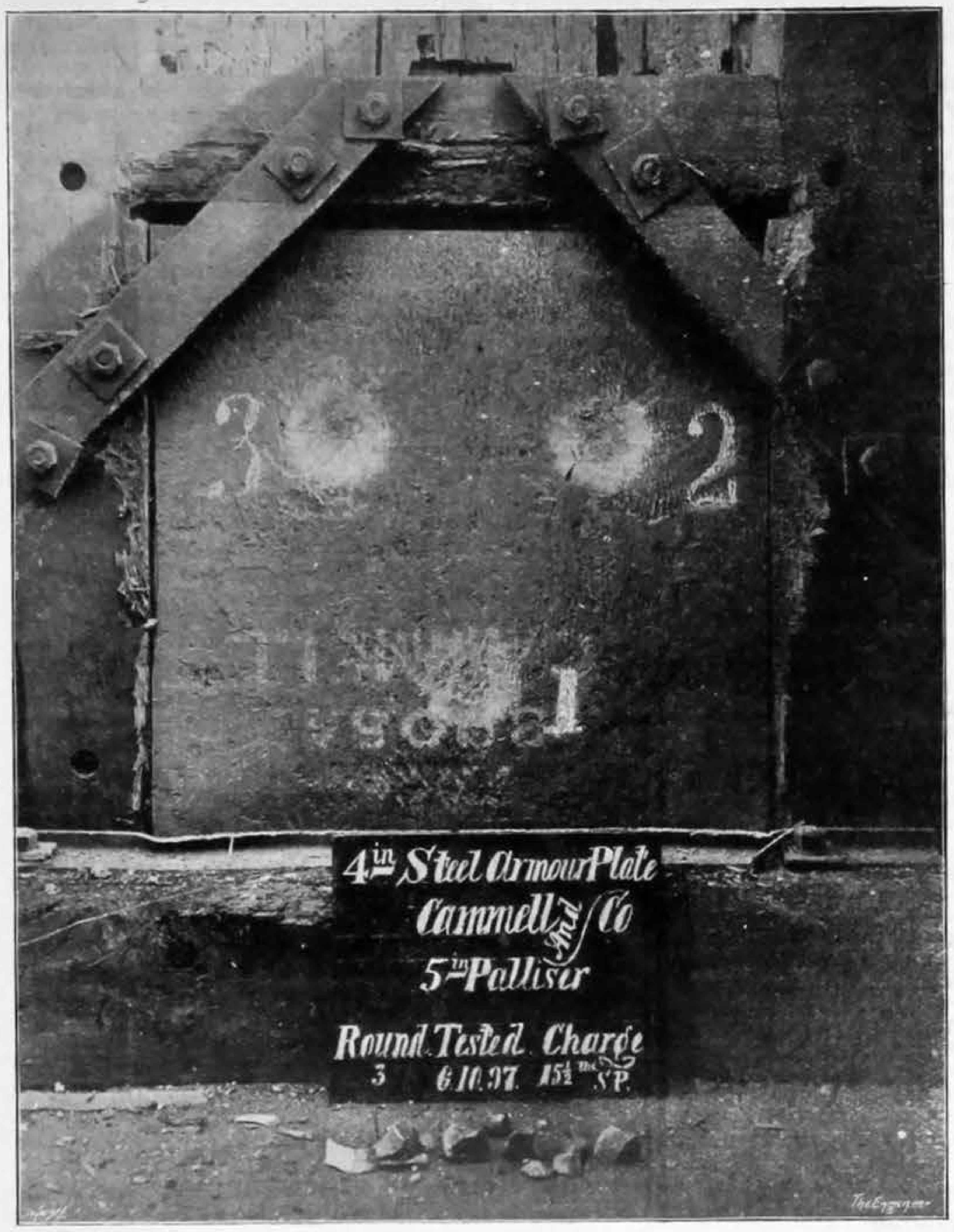
Even if impact in the strict sense of the term be denied to the description of live loads we have been considering, there is no question but that their action is distinctly of a dynamical character. Concerning the effects of this action exercised by moving train loads, nearly everything has yet to be learned by engineers. We have no means of estimating the dynamic action of live loads on railway bridges; that is, it is impossible at present to fix any rule or formula which will express with any approach to accuracy the relation existing between the effects of a live load and what is termed its equivalent dead load. Such equivalent loads have been calculated, and are used, but they are based upon assumptions which are little better after all than guesses, and guesses are dangerous things to indulge in when railway bridge building is called in question. Experiments, tests, and observations on bridges already constructed will help us, no doubt, a little, and would help us a great deal more if the different results were not unfortunately so frequently at variance. While there is no difference of opinion among engineers respecting the necessity of making some allowance for the dynamic effects of a moving load, they are by no means at one, regarding either the amount that should be allowed, or the manner in which the bestowal of it should be adjusted. Some provide—or rather, attempt to provide—for the ever-varying and eccentric conditions of live loads, which are not susceptible of scientific treatment, by the addition of certain percentages, having very scanty, if any, rational basis, to the live load stresses. Now static stresses or the effects of static loads can be calculated, but the dynamic effects of live loads cannot. A static stress may be defined as that caused by the imposition of a load so gradually applied as not to be accompanied by any perceptible velocity or appreciable momentum or *vis viva*. A dynamic or impactive stress is strictly due to the force of a blow or shock, the static weight of the moving or falling body itself contributing but little to the result, or the momentum, which are nearly all produced by the velocity at which the body is moving. It is clear that a live load, as already stated, occupies an intermediate position somewhere between these two extremes, without adequately representing the one or the other.

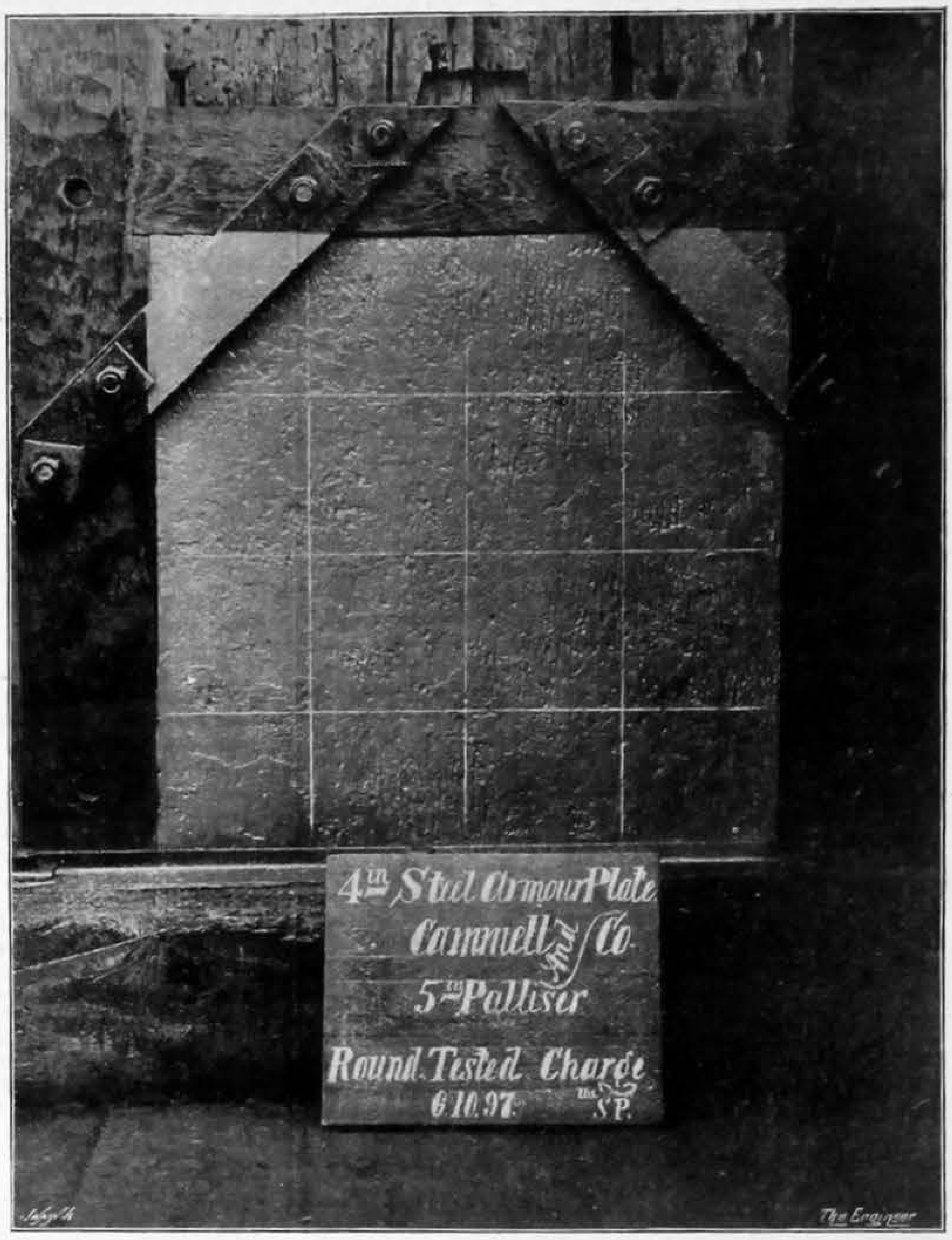
Some finality, at least so far as safety is concerned, in treating of the effects of live loads, might be arrived at were it not for the great diversity in the percentages suggested, which range, according to the span of the bridge, from a very trifling amount to 100 per cent. By some authors and authorities the percentage to be added for bridges of 20ft. span and under should be 25 per cent, and increased to double that value for larger spans. Others advocate an allowance of not less than 50 per cent. for all railway bridges, irrespective of length of span. As it is fairly well established that the dynamic effect of a moving load varies with the length of span and the speed of the load, it is but reasonable that the percentages, or coefficients of impact, as they are otherwise called, should vary also. According to the type and design of a bridge, so will it be differently affected by the live loads traversing it; and to meet the requirements of open web structures, which, unlike their solid-sided brethren, are subject to secondary stresses, it has been proposed to adopt an additional coefficient of impact equal to one-fifth. Some years ago the French Government authorised the substitution of an equivalent uniform load for the live loads running over railway bridges. With a range of span from 10ft. to 500ft. the allowance made varied from 7000 lb. to 2000 lb. per lineal foot. What are really needed in order to institute a fair and to some extent a trustworthy comparison respecting the separate action of live and dead loads are more experiments upon actual structures, with a view of ascertaining the stresses to which the individual members of the bridge are exposed. Experiments of this nature, however, take the form of tests, and railway companies very naturally object to these inquisitorial trials of their works and ways when they have once successfully undergone the scrutinising ordeal of the officials of the Board of Trade. It is no doubt a matter of regret that we are not in possession of more accurate information regarding our subject, particularly when it is known that some rather lightly-constructed bridges have given better results than the more heavily and rigidly built-up specimens. On the other hand, it is gratifying to learn that, so far as safety is concerned, the imperfect methods used err upon the right side.

GERMAN RAILWAYS IN AFRICA.

Africa is not the easiest country in the world in which to construct a railway, and perhaps the Germans are not much to blame that greater progress has not been made with Urambara line on which they are engaged. This is a metre gauge line, and 15½ kilo. rails were orginally laid, but having been found too light they are being replaced, we understand

FOUR-INCH CAMMELL ARMOUR PLATES





by a heavier make. Sleepers are, of course, the greatest trouble, as they always have been in countries where tropical weather, hardy vegetation and white ants abound. Mangrove wood has been tried, but has proved of small durability, and experiments are now being made on wood, probably mangrove, soaked in carbolineum. This treatment it is hoped will have the desired effect. Metal sleepers would be used if it was not for their great cost which the company is not in a position at present to support. A new railway is shortly to be commenced, when the Bill is passed by the Reichstag, connecting the lakes with the sea. It is worth mentioning here that great trouble has been found in road-making, as even macadam is rapidly covered with vegetation of various sorts. The natives, too, have no consideration for the road-makers, but adhere to primeval habits, and by walking always in single file, maintain only a narrow path. We imagine this must be almost a unique experience in the construction of roads. Wheeled vehicles are almost unknown.

VERA CRUZ HARBOUR.

The great harbour works at Vera Cruz, which we mentioned some time ago—The Engineer, March 5th, 1897—in connection with a 40-ton Titan crane of special design, made by Messrs. Stothert and Pitt, for the contractors, Messrs. S. Pearson and Son, are making rapid progress, and it is anticipated that the harbour will be complete in less than two years from the present time. The work involves the construction of three large breakwaters:—(1) The north-west, running from the mainland to the island of San Juan de Ulua; (2) the north-east, running from the island towards the Lavandera Reef; and (3) the south-east, running from the mainland to the Lavandera Reef. Between the ends of the north-east and south-east breakwater a channel 260 metres in breadth will be left for the entry of shipping into the harbour. The first breakwater, which is 1000 metres in length, is complete to 12ft. above water level; of the second, which will be some 25 per cent. shorter, about 60 metres is complete; and the rubble mound for the third, which is nearly as long as the first, is already laid. Besides this, work has also been commenced on the deep water quay, which will be 1246ft. long by 328ft. wide, with 33ft. of water alongside at low tide. This it is hoped to finish within the next eighteen months, and a channel leading to this pier will be dredged to the depth of 33ft. The new Customs steel jetty is well under way, and will be completed within the next four months; it will be 590ft. long, with a width of 74ft., and will have 28ft. of water alongside.

Royal Agricultural Show, 1898.—A Selection Committee of the Royal Agricultural Society, consisting of Earl Spencer, president; Hon. Cecil Parker, hon. director of the Royal Showyard; Sir Jacob Wilson, Col. Sir Nigel Kingscote, &c., have this week visited Birmingham on the invitation of the Corporation, and have selected Four Oaks Park, near Birmingham, as the site for next year's exhibition in place of Maidstone. The alternate site offered was Perry Park, but though this site is nearer the city the land lies much lower than Four Oaks, and the approaches are by no means so convenient. The Four Oaks site is both high and dry. It may now be taken for granted that this will be the selection for the 1898 show. The show will be held between Monday, June 20th, and Friday, June 24th, inclusive; the implement yard will be open on the previous Saturday, June 18th. The final date for the entry of implements for exhibition will be Tuesday, March 15th. Post entries may be tendered up to Friday, April 1st, at double fees.

CAMMELL 4in. ARMOUR.

We give herewith a copy of two official photographs of Cammell 4in. armour plates tried on board the Nettle on October 6th last. The attack was made by Palliser 5in. projectiles, each weighing 50 lb. Three rounds were fired, the first with a striking velocity of 1406 foot-seconds, and striking energy 685 foot-tons, the second and third each with a striking velocity of 1750 foot-seconds and striking energy of 1062 foot-tons. The plate measured 4ft. by 4ft. by 4in., and probably weighed a little over a ton. The theoretical perforation of the second and third rounds would be, by Tresidder's formula, 88in. of iron, making the test one calling for a resistance to perforation or figure of merit of 2·2, that is, the plate to resist the perforation of 2·2 its thickness in iron, and a striking energy or shock per ton of 905·3. This, however, is dependent on the power of the projectile to hold together; and seeing that it is a Palliser projectile, the test is greatly discounted. On the other hand, the fact that the projectile is of a calibre exceeding the thickness of the plate, is to be borne in mind. On the whole, the test cannot be compared in severity with that to which the 6in. plates are subjected. The fact that the test is not a severe one, however, does not prevent its being sufficient to show that the plate is excellent. Judging from the photographs, it could well have borne a much more severe attack, for the projectiles have been shattered against the face with very little effect, and we may expect that, this being so, the standard may be raised in time. This plate, in appearance of face resembles others made on the latest processes, and may be taken as a sample of the armour turned out by Messrs. Cammell on their application of the Krupp and other patents secured, that is, modified by their own experience and system of working.

On the same occasion was tested an admirable 6in. plate, which we do not give, simply because the result closely resembles similar plates recently attacked, and illustrated by us in previous numbers.

THE STRIKE AND LOCK-OUT.

The event of the week in London is the conference which began at the Westminster Palace Hotel at 11 o'clock on Wednesday. No reporters are admitted. The proceedings will be kept strictly private for the present. The following is the complete list of the employers' representatives who will attend the conference:—Colonel Dyer (Messrs. Armstrong, Whitworth, and Co., shipbuilders, machine gun manufacturers, and general engineers, Elswick and Manchester), Sir Benjamin Dobson (Messrs. Dobson and Barlow, engineers, Bolton), Sir Benjamin Browne (Messrs. Hawthorne, Leslie, and Co., Limited, Newcastle), Mr. C. E. Allan (Messrs. Workman, Clark, and Co., Limited, shipbuilders, engineers, and boilermakers, Belfast), Mr. George Clarke (Messrs. George Clarke and Co., Limited, marine engineers and boilermakers, Sunderland), Mr. John Donaldson (Messrs. Thornycroft and Co., Limited, shipbuilders and engineers, Chiswick), Mr. W. H. Ellis (Messrs. John Brown and Co., Limited, steel and armour plate manufacturers, Sheffield), Mr. A. P. Henderson (Messrs. D. and W. Henderson and Co., Limited, shipbuilders and marine engineers, Glasgow), Mr. George Jessops (Messrs. Jessops and Appleby Brothers, Limited, engineers and boilermakers, Leicester), Mr. J. Hawthorn Kitson (Messrs. Kitson Brothers, Limited, locomotive engine makers and general engineers, Leeds), Mr. John Laird (Messrs. J. Laird and Co., Limited, shipbuilders, Birkenhead), Mr. S. R. Platt (Messrs. Platt Brothers and Co., Limited, machinists, Oldham), Mr. R. Sinclair Scott (Messrs. Scott and Co., shipbuilders, Greenock), and Mr. Alexander Siemens (Messrs. Siemens Brothers and Co., telegraphic and electrical engineers, London). Colonel Dyer has been elected to preside over the employers' section at the conference.

The men will be represented by Mr. George N. Barnes (general secretary of the Amalgamated Society of Engineers), Mr. Alfred Sellicks (chairman of the Executive Council), Mr. George Ferguson (organising delegate of the Engineers' Society for Scotland), Mr. Frank Rose (organising delegate of the Engineers' Society for the North-West Coast district), Mr. James Ratcliffe (organising delegate of the Engineers' Society for the North-East Coast district), Mr. John Whittaker (organising delegate of the Engineers' Society for the Manchester, Oldham, Bolton, &c., districts), Mr. Alfred Golightly (Executive Council of the Engineers' Society), Mr. Albert Taylor (Executive Council of the Engineers' Society), Mr. J. Hooson (Executive Council of the Engineers' Society), Mr. Albert Bigby (organising delegate of the Engineers' Society for the London and South of England districts), Mr. James Shea (United Society of Smiths and Hammermen), Mr. W. Craven (London United Society of Brass Finishers, engineering section), Mr. James Swift (Steam Engine Makers' Society), and Mr. Councillor M. Arrandale (United Machine Workers' Association). Mr. Alfred Sellicks was appointed to preside over the men's section at the conference.

At the close of the first day's proceedings the following statement was handed to the press:—"The conference, after the opening preliminaries, at once passed to the consideration of the agenda as set forth in the basis of conference mutually agreed upon. The first subject which fell to be taken up was the employers' freedom of management. The employers embodied their definition of this in a resolution, which was handed to the other side for consideration. The Affiliated Societies' representatives submitted an amended resolution. This was discussed, and a further proposal was made by the employers, which was under discussion when the conference adjourned for the day. The terms of the respective proposals are not given, as the subject is still under discussion."

Yesterday morning the time of the Conference was entirely taken up again with the consideration of the same clause, namely, the employers freedom of management. The proceedings appear to have been of a very amicable character.

Considerable attention, writes our Birmingham correspondent, has this week been drawn to some statements which have been made by the New Conveyor Company, Limited, Smethwick, regarding the effect of the strike upon its shops in the purchase of foreign machines. The company communicate that to equip the new works which it has built at Smethwick, it placed orders in the month of May with engineering firms at Halifax, Manchester, and Sowerby Bridge for lathes, wood-working machinery, &c. The strike supervened and the firms returned their orders. It was imperative that the company should obtain a few of the machines, so it visited Germany, and any official of the Amalgamated Society of Engineers can, it observes, look at the German machines on any day they care to visit the works. It is stated that they are "equal at least to English make and 20 per cent. cheaper." It was with great reluctance that the company decided to meet its most pressing wants with

German machinery, but it was necessary in order to hold their markets against foreign competition. Mr. Gilbert Little, the managing director of the company, states that what the trade union leaders call the "bogey of foreign competition" is no bogey, but is in an alarming manner getting daily more widespread and active. And this is because English workmen, through the levelling rules of the New Unionism, are not now as a body in front in the matter of effort to produce a paying output for a given wage. If the system of "the least work for most money" is not abandoned by the engineers and by men in allied trades, the country as a manufacturing nation must, he declares, recede in the race. He observes further, "I suppose if James Watt, who attained the crowning of all distinctions in the engineering trade, came to Birmingham again, the New Unionist officials would not let him operate a machine." Messrs. Humber and Co., of Coventry, the well-known light engineering firm, have this week held their annual meeting, when the chairman stated that they had been existing for ten years, and there had been ten years of almost invariable peace and harmonious relations with the workmen, so that the strike in the engineering trade brought to the directors a vast amount of thought and a great responsibility. However, by the unanimous vote of the Board, the directors decided to join the Employers' Federation, and to cast in their lot with the masters throughout the country. Necessarily, work to a large extent had been stopped and still was so. They had no feeling about trades unionists. For years they had had both unionists and non-unionists in their shops, and had never attempted to put down trades unionism. Fortunately, however, for them and for England, a conference was being held, which they hoped would restore harmonious working. This cessation of work had given the directors time for reflection, and the result, they hoped, would be that the works would be still more efficiently conducted. This week a circular has been issued to the miners of Cannock Chase from the headquarters of the Miners', Enginemen's, and Surfacemen's Association, stating that it has been decided to make a special appeal in aid of the locked-out engineers. The Miners' Federation of Great Britain, it is pointed out, is giving the men £200 per week, Yorkshire £100 per week, and every other district is making special grants. The Cannock General Council, in addition to paying a share of the levies, has granted £5 per week for the last five weeks, but in view of the fact that such a vast body of people has to be supported, it is felt that a special effort ought to be made.

Our Manchester correspondent writes:—With the principal official local representatives of both the federated employers and the trade union organisations for the present engaged at the conference sitting in London, there is necessarily very little of special importance to report from this district, except that evidence continues to be accumulated with regard to restriction of output and interference with workshop regulations as practised by the engineering trade union societies, and if all the cases that so far have been brought forward are to be dealt with by the conference, the proceedings are not unlikely to extend over a considerable period. A further series of examples of restriction and interference has been issued this week by the Employers' Federation, and this includes additional cases in this district which it may be interesting to summarise. One Manchester firm who have had much difficulty with the Amalgamated Society of Engineers in connection with piecework, write that they believe individual members of the above Society, who had strong objections to piecework, but did not like to assert it personally when their fellow-workmen were agreeable, have continually reduced their actual output, either for the purpose of getting advance in prices, or to discredit the piecework system. Just before the strike this firm was informed by men with whom they remonstrated for a falling off in output, that they had received instructions from the Society not to earn more at piecework than the equivalent of the standard wage, the effect being to reduce the total output by about 30 per cent. Another local firm made proposals to their men anent piecework prices, and payment of foremen's wages out of same, which were accepted by them, but vetoed by the A.S.E. officials, whose object was to force upon the firm a system of consultation with them over all such matters. As the employers refused to meet the officials to discuss the arrangement the men were ordered by the Society not to do piecework, and the result was a reduction of about 22 per cent. in the output. The same firm give a number of examples in detail to show the determination on the part of the Amalgamated Society of Engineers to compel them to consult not only the men really interested in any particular work or job, but also men in other departments who have had no experience of the work in question—in short, to deal with the Amalgamated Society of Engineers and not with the individual workers on their merits. They also report on the Amalgamated Society of Engineers interfering and protesting against the action of foremen in speeding the lathes and timing the men, so as to stimulate individual production. With regard to the working of machines a case is given by a Manchester firm who, in 1895, introduced a number of automatic and special milling machines, for pulleys and other articles in which there was a large amount of repetition work. These tools were thoroughly automatic, and when once the correct cutter was put into position, and the tool set for the work to be done, it only required the article to be dropped on to a spindle and a nut screwed up, the rest being done automatically by the machine, which could do no harm when the work was finished. A labourer was put in charge of four of these automatic machines. The Amalgamated Society of Engineers demanded this work on the ground that it was displacing their own labour. The following cases of interference with foremen and apprentices are also given:—A Manchester firm say they have had their foreman pulled up before the Society for pushing lazy but prominent members of the trade union; also for making boys return to work while the strike was on. Another Manchester employer reports that the unionists threaten their boys into joining the clubs by refusing to teach or assist them in doing their work, and when the boys have joined they become indifferent, by relying on the clubs rather than on their own ability as good workmen. The employer has known them to threaten boys and new workmen for doing too much, and to hide an apprentice's job because he did it too quickly. In one case a handy lad, who happened to have worked at home a good deal, had his patterns broken up, and even then replaced them in the time taken by the journeyman on similar work.

As to the outcome of the conference opinions vary considerably, but it is generally admitted that it is only the complete exhaustion of the trade unions' financial resources that will bring about a submission to the terms which have been very definitely put forward by the federated employers, and from which they are not likely to depart to any appreciable extent. I understand from very well-informed quarters that the Amalgamated Society of Engineers have had the greatest difficulty in finding money to meet the demands of strike pay last week, and that this week their difficulty would be even still greater. It is now generally well known that the funds of the workmen's organisation are practically at an end, and it is not thought that with only special strike levies and outside support to rely upon, the struggle can be much longer continued. In any case, it is more than likely that in the not very probable event of the Amalgamated Society of Engineers deciding to stand out against submitting to the federated employers' terms, the other trade unions involved in the dispute will break away, and this would eventually bring about a collapse of the strike.

There is marked eagerness, writes our Barrow correspondent, on the part of the engineers locked out or on strike in this district to return to work, and hopes are entertained that the conference which has been opened this week may lead to an early settlement of the dispute. The masters are equally anxious for this, but they are also still more anxious that a perfect settlement shall be come to on the vast number of difficulties that have arisen, and they would prefer waiting a few weeks longer, so that when a start is made there will be nothing to cant about, but the way opened for a long and permanent run of good and brisk work. It is known that although the hours question and the machine question are the two principal difficulties to settle, that the last difficulty is a much greater one than the first, many other difficulties will engage the attention of the conference. It was not until the masters became federated that they were able to compare notes as to how their work had been interfered with in a variety of ways by the societies. These difficulties have all been tabulated, and will be shown up, and an effort made to establish something like an equitable basis of operations for the future. It is the knowledge of this fact that makes the men of this district somewhat apprehensive as to whether the conference will be in a position to come to a definite understanding, and it is certain that much more time will necessarily be required in conference than is generally believed will be necessary. If the conference fails to come to terms it is certain that many of the men, who are utterly sick of the position, and the length to which the difficulty has been drawn out, will leave the societies and begin work on independent lines in the interest of their families and themselves. The local relief funds are still inadequate to meet the many cases of semi-starvation now existing among the labourers. The engineers who are out of work are grumbling about the small pittance they have to live on, and the men who are at work are making a noise about what they consider the excessive levies they have to face every week—charges that will continue for a long time after the dispute is ended.

Our Sheffield correspondent writes:—The engineering dispute continues to drag its slow length along, waiting such developments as the conference in London may bring about. Although there have been none of those serious breakdowns in machinery which were confidently predicted by the men on strike when the trouble began, it is an open secret that the masters as well as the men would be very thankful for a termination of the conflict. Work is proceeding wonderfully well under the circumstances, and in most of the machine shops the hands are adequate to keep the plant employed. While the employers would be quite pleased to have an end of the trouble, they are as determined as ever in their resolution to maintain in future the control of the machinery and the internal management of their works. If it should become necessary—and there is some talk of it—for a concession to be made in the direction of an eight hours day, it will be met as far as possible by the work being carried on in three shifts, and overtime will then be practically abolished. Where that course cannot be adopted, there will be greater strictness in requiring the men to be punctual in coming from and going to their work. Every day one hears of fresh orders leaving this and other districts for foreign firms, owing to the inability of the home manufacturers to undertake deliveries as required. There is no doubt that when the dispute has come to an end the drifting of that work abroad will seriously affect what is left for the early part of the spring of next year.

A significant feature of local business is the extraordinary demand which continues for engineers' tools. These—it is important to know—are almost entirely for continental and American markets. This also applies to the demand for steel, which, although falling off at home, is in exceptionally heavy request for foreign ports. The steel and the tools to work it are both required for work which, under ordinary circumstances, would have been done in the Sheffield district. The strike is also being more severely felt in the coalfield, both in respect of steam coal and engine fuel. Colliery proprietors combine in saying that if it had not been for this lamentable misfortune, the coal trade would have held at this time of the year a much stronger position than it did at the corresponding period of last year. A satisfactory feature of the week has been the quietude prevailing in the disturbed districts. The pickets, evidently anticipating a peaceful settlement, are now giving very little trouble, and the non-union men brought from a distance are able to move about much more freely, although a good many still remain day and night on the premises where they do their work. Collections are being taken in the streets at all available opportunities on behalf of the engineers, as well as of the labourers, whose work came to an end with their going out. A demonstration in aid of the engineers took place at Mexborough on Sunday afternoon under the auspices of the Mexborough and District Federated Trades Council. At a mass meeting, attended by some 2000 persons, resolutions of sympathy with the engineers were passed, and all the working men of the district were strongly urged to agree to a weekly levy on their behalf.

No further stoppages of shipyards or engineering works are to be recorded in the North of England, but at Middlesbrough Sir Raylton Dixon and Co.'s men on Tuesday commenced to work short time, starting at 8·45 a.m. and finishing at 4.15 p.m., with an hour's interval for dinner. But so much is the engineering behind the shipyard work that even this short time cannot be continued for long. A large number of men are idle in the Teesside towns and Hartlepool, and the number would have been larger still if the construction of the electric tramway between Norton, Stockton, Middlesbrough, and North Ormesby, had not afforded employment for a good many. This work is being pushed on with great rapidity at several points, and it is fortunate for the men that this is so. The greater part of the men are not those on strike at all, but those who are thrown out of work because of the action taken in the engineering industry. Messrs. William Whitwell and Co., Limited, Thornaby Ironworks, are about to put the men at their mills on short time. At the annual meeting of the Newcastle and District Association of Foremen Engineers and Mechanical Draughtsmen on Saturday, Mr. T. Galloway, an honorary member of the Association, who presided, in reference to the engineering dispute, dwelt at considerable length on the question of foreign competition. He held that our industrial army had to encounter abroad, not ill-equipped irregular forces, but armies well trained and possessing all the material resources of our own. Our insular position made it difficult for our workmen to become personally acquainted with what was being done in their crafts in other countries. There was thus the more reason why those to whom they had hitherto looked for guidance should have made themselves personally acquainted with all the conditions under which manufacturing operations were carried on elsewhere. He considered the funds of a trades union could not be better employed than in sending deputations of trustworthy men to see for themselves what their alien competitors were doing. He was afraid the leaders of the engineers in the present dispute had not paid such visits. On the other hand, many of the employers had, and were thus able to form an estimate of possibilities based upon actual observation, instead of mere guesswork. He (the speaker) could endorse all that Colonel Dyer had said in his letter to the *Times* as to the superiority of the appliances and methods in vogue in America, and the longer hours worked, as he had visited many of the works about the same time as Colonel Dyer. The only reply that Mr. Barnes could make to Colonel Dyer's statements was that they would not have the same system in England, and that foreign competition was a "bogey." Mr. Galloway held that our great competitor in the near future would not be the plodding German, but the energetic, enterprising, and fertile-minded American. The president of the Society said the greatest amount of mischief that had ever been caused in the engineering trade had arisen through the introduction of the minimum wage, which meant that the good workman had to carry on his back the inferior workman, and there was no inducement for a man to do his best.

Our correspondent in Wales writes:—The influences of the engineering strike are stated, by shrewd authorities at the Cardiff dock, to be felt in the matter of freights. In the outward freight market rates all around have steadily advanced, and still have an upward tendency, and the cause of this, they suggest, is attributable to the prolongation of the strike, and to the fact that a large number of steamers employed in the grain trade have left this country in ballast for the United States. In addition to affecting freights, it was stated on 'Change, Swansea, this week, that it unmistakeably affects the copper trade, and no improvement is expected until the strike comes to an end. The demand for armour plates, too, owing to the deadlock, has fallen off considerably. It is fortunate, ironmasters say, that a fair amount of business has been placed in bars and rails, and that the inquiry for small goods, merchant iron, &c., has been tolerably well sustained, otherwise the suffering which the engineers have so rashly brought upon themselves, and the members of many an allied industry, would have been extended throughout the Principality. In the Swansea district this week it was stated, that while the finished iron and steel works were fairly employed on rails, tin-plate bars, &c., there were exceptions in some branches affected by the strike, and shown by the lessened consumption of material; otherwise the work done might justly be regarded as satisfactory.

FUEL ECONOMY.—Some remarkable instances of fuel economy, resulting from the use of indicator diagrams, were adduced in a paper upon this subject, read on Saturday before the South Staffordshire Institute of Iron and Steel Works Managers, by Mr. Sidney R. Lowcock, A.M.Inst.C.E., of Birmingham. Among a large number of diagrams submitted, two—Nos. 14 and 15—were from the high and low-pressure cylinders respectively of a coupled compound condensing engine, fitted with expansion valves controlled by the governors. The high-pressure diagrams were very good, but showed that at the front end the steam admission was a little late, and the low-pressure diagram showed the same defect in a greater degree; whilst on the exhaust side of the other the steam was shown to be somewhat obstructed on its way to the condenser. The consumption was 20·4 lb. of steam per indicated horse-power per hour. This engine was erected to take the place of two high-pressure engines, and whilst using only two-thirds of the steam it developed 50 per cent. more power, so that the efficiency of the new engine was 125 per cent. greater than that of the old one or, in other words, it developed 2¼ times as much power as the old, with the same amount of steam. The wastefulness of the old engine had been detected by means of an indicator, and this had led to the substitution of the new and so much more economical engine. Numerous other instances were given of the commercial advantages afforded by steam engine indicators, affording as they do an exact reproduction, on a reduced scale, of the motion of the piston.

THE INSTITUTION OF JUNIOR ENGINEERS.—On Saturday afternoon, 20th November, a large party of the members of this Institution availed themselves of the opportunity for visiting the Electricity Works of the Islington Vestry, at Eden-grove, Holloway. They were shown over by Mr. Albert Gay and Mr. C. H. Yeaman. The station was opened in March of last year, and its design includes many novel features. Labour-saving devices have been introduced wherever practicable, a notable instance of which was observed in the coaling arrangements. The wagons are run from the collieries direct into the boiler-house, and there emptied by means of special gear into the bunkers. The main boilers are of the Lancashire type, but there are two water-tube boilers to meet unexpected demands arising from fogs. Meldrum's furnaces and forced draught apparatus are fitted to all the boilers. The steam pipe system also presents some unusual features, which Mr. Gay has devised with the object of retaining the advantages of the "ring" method, whilst obviating many of its drawbacks. All the engines are of the horizontal high-pressure compound non-condensing type, the latest form of Wheelock valve gear being applied. There are rope-driven alternators of the Lawrie-Hall type, the field magnets forming the rotating part; and also direct-driven alternators, in which the magnets are mounted on the engine fly-wheel. Each of the rectifiers is capable of supplying thirty 12-ampère lamps. Since the station was opened it has been necessary, to meet the increasing demands for current, to increase the plant by the addition of four Lancashire boilers; two slow-speed horizontal engines, each of 500 indicated horse-power, direct-coupled to alternators, each of 300 kilowatts.

THE STANLEY SHOW.

This show, which is held annually at the Agricultural Hall, Islington, is rapidly becoming, if it has not already become, one of London's leading sights. The twenty-first exhibition opened on the 19th inst., and closes to-morrow, Saturday, and it may at once be stated that the coming of age of the show has been commemorated by the finest display of cycles, accessories, and machine tools which has ever been got together at Islington. In order to accommodate the 400 exhibitors the amount of space allotted to each has been curtailed, and this has resulted in a reduction of duplicated exhibits.

In the cycling section the show is probably the finest promoted by the Stanley Club, although striking novelties are conspicuously few. Probably, from this point of view, the Pedersen cycle claims the most prominence. The frame of this machine is constructed on the cantilever principle, and consists of twenty-one perfect triangles. It is the invention of Mr. Mikael Pedersen, a Dane, who has resided for some years in this country. Its other features are lightness, elegance of design, and a hammock seat in lieu of the hard saddle. The seat is made of strings of different degrees of tension, running from a point in front to a cross steel bar giving the requisite width behind. Cross strings are interwoven to give the right width and form. The seat is suspended between two supporting points about 2ft. from each other; and running from the cross steel bar to the rear supporting point are several spiral springs, affording the requisite elasticity. The Pedersen cycle frame carries the seat without necessitating a special seat frame. The frame is made entirely of steel, and will take any sort of wheels, spindles, or chains, and the machine can, if necessary, be arranged as a chainless cycle.

Another novelty in cycle frames, and one which shows considerable merit in design, is that made by the Genese Cycle Company, Limited, Great Russell-street, W.C. The "Pyramid" frame is arrived at by making it in the form of two triangles instead of an irregular quadrilateral figure and one triangle. This not only makes an extremely rigid and elegant machine, but saves weight. Another advantage claimed for this machine is that by turning the front wheel round, and placing the handle-bar in a vertical position, the space required for transportation is about one-half that which is required for the usual pattern bicycle. Messrs. Humber and Co., Limited, exhibit for the first time bicycle frames with detachable joints, so that the machine can be all put into a compass regulated practically by the size of the wheels. The joints are made telescopic, and are secured by a tapered pin, nut, and washer. Another novel feature is an adjustable crank for enabling a rider to easily obtain the exact throw best suited to his requirements. To effect this the pedal axle is constructed with an excentric flange which screws into the crank, and which can be easily adjusted.

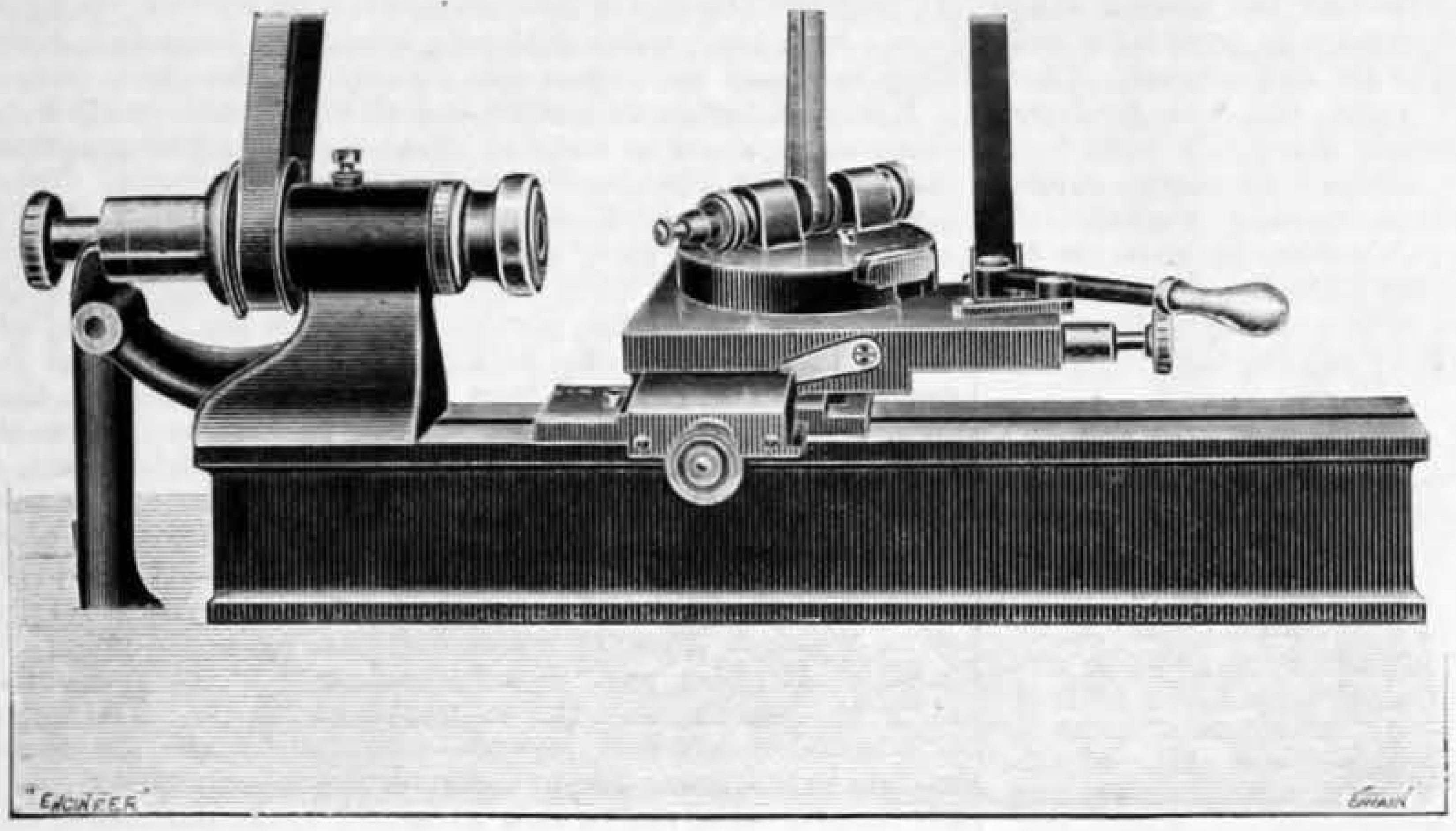


Fig. 4—Messrs. BUCK AND HICKMAN'S CUP AND CONE GRINDING MACHINE

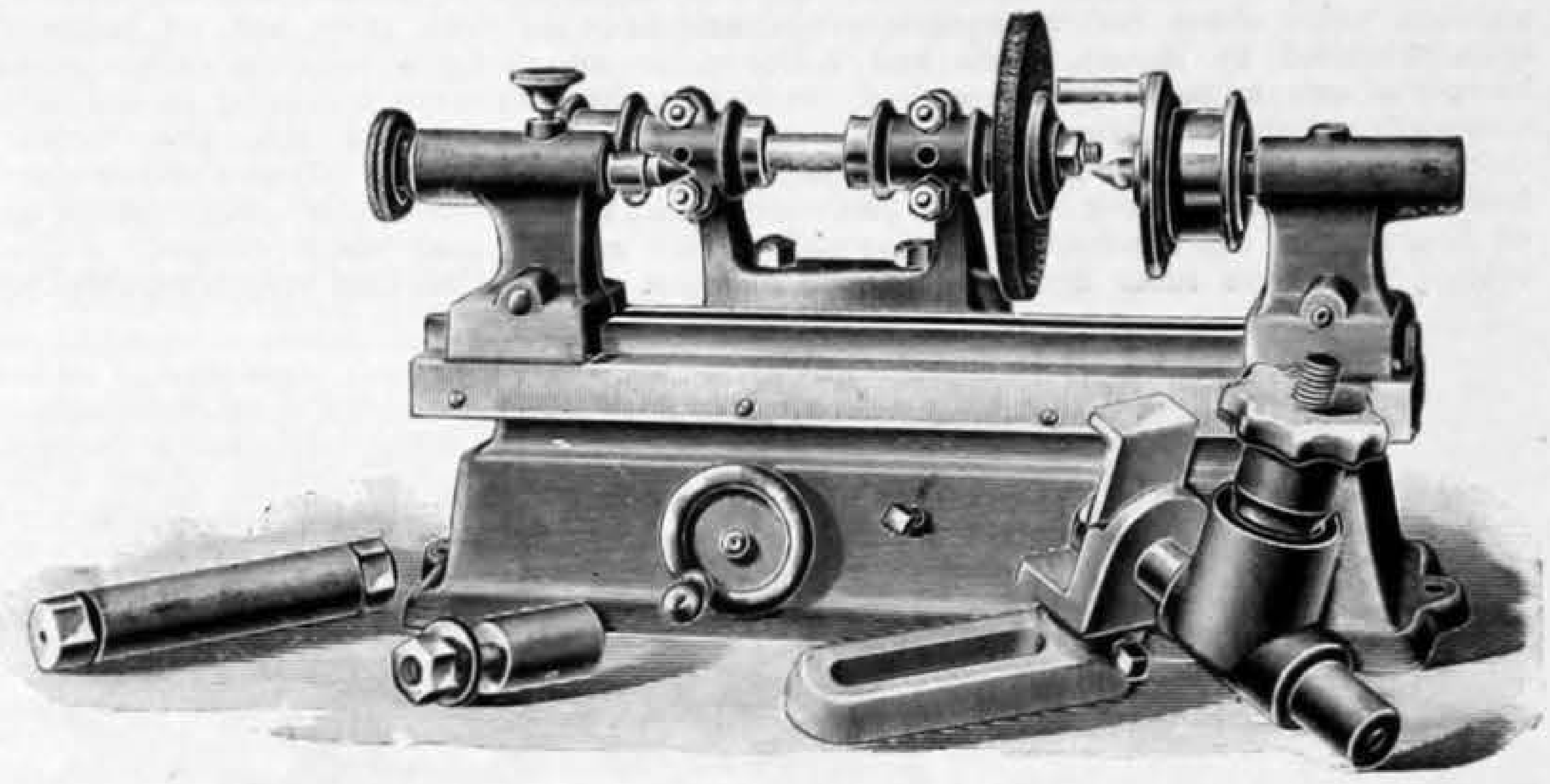


Fig. 6—Messrs. SELIG, SONNENTHAL AND CO.—STANDARD OUTSIDE GRINDING MACHINE

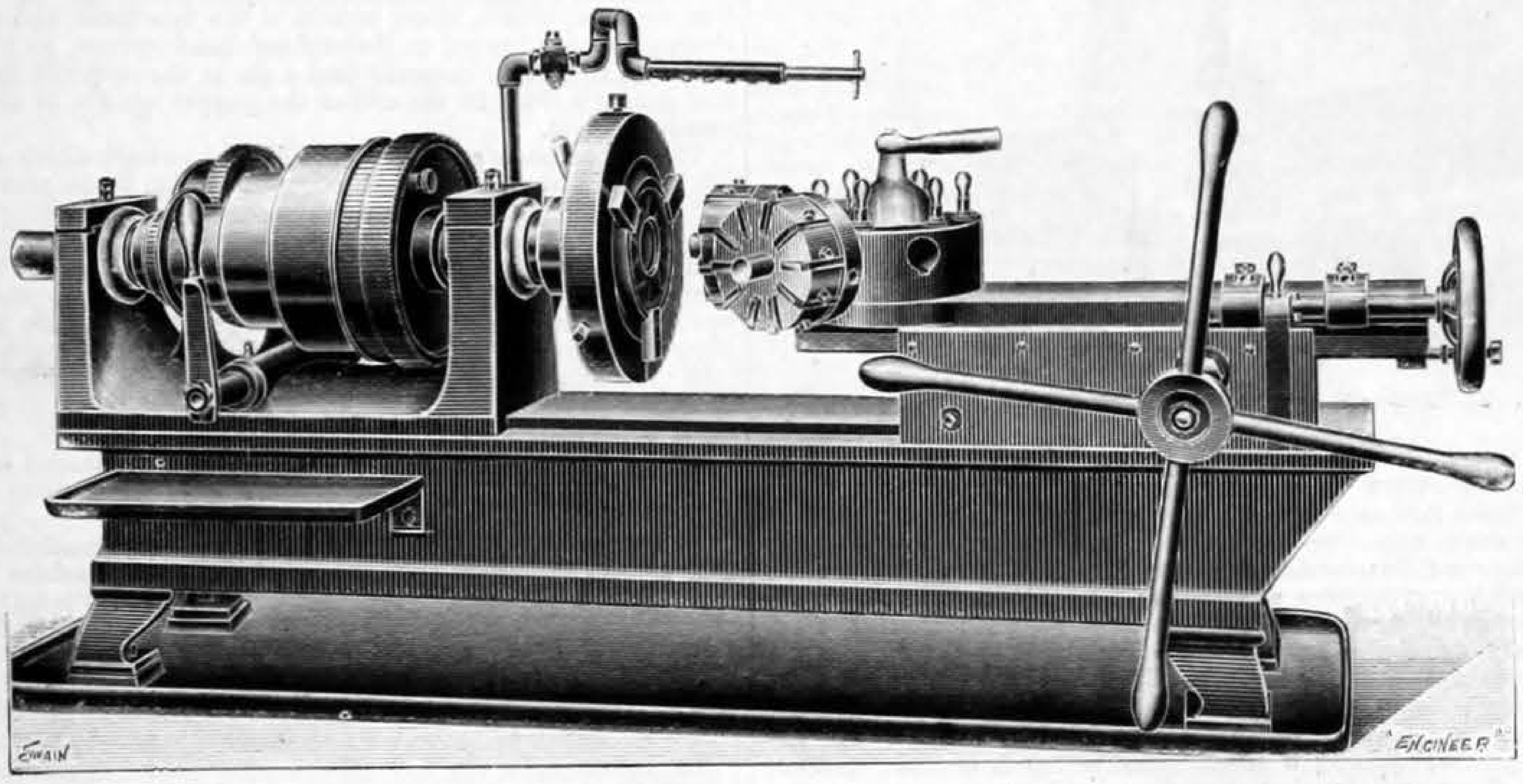
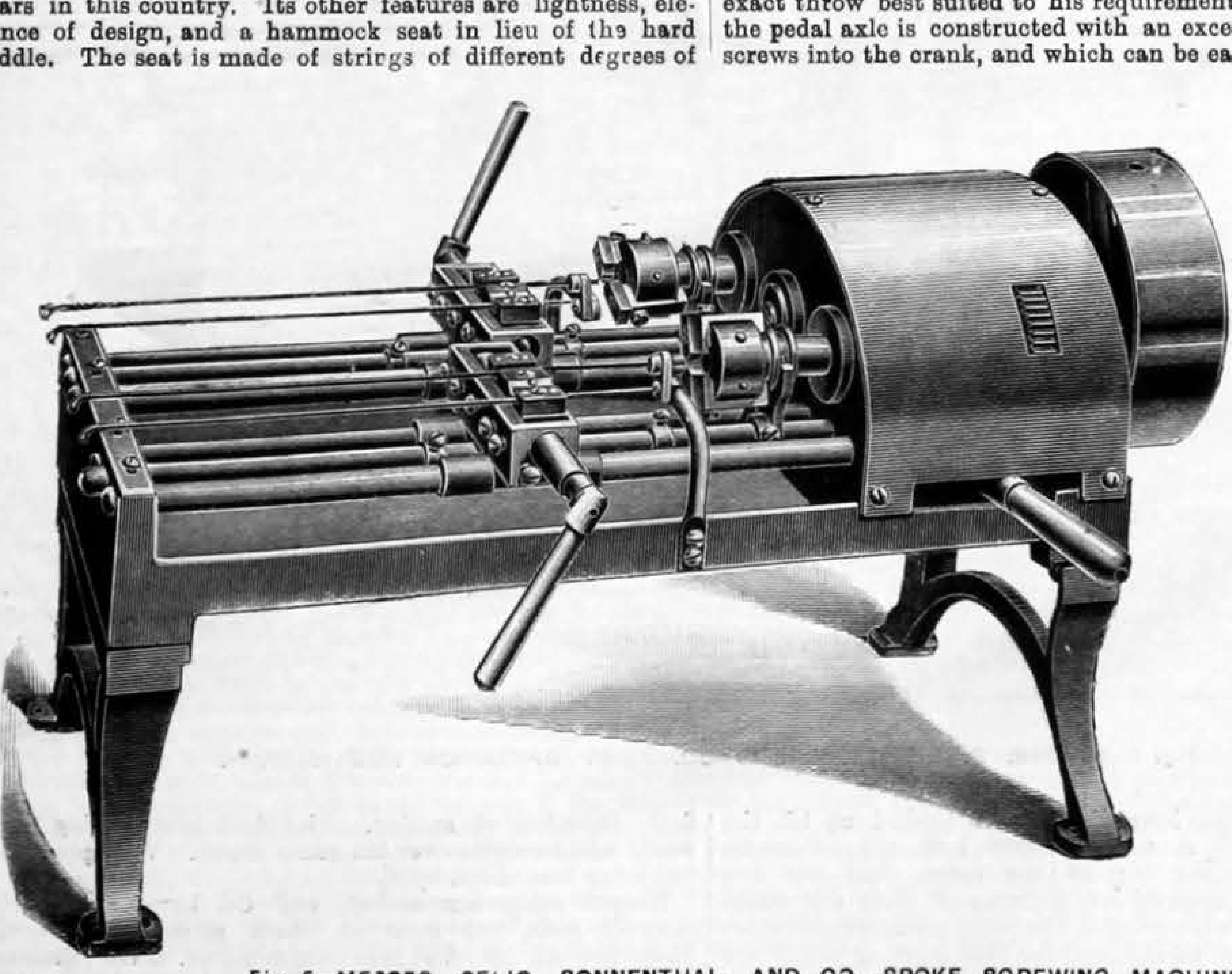


Fig. 3—MESSRS. BUCK AND HICKMAN'S SPROCKET FACING MACHINE



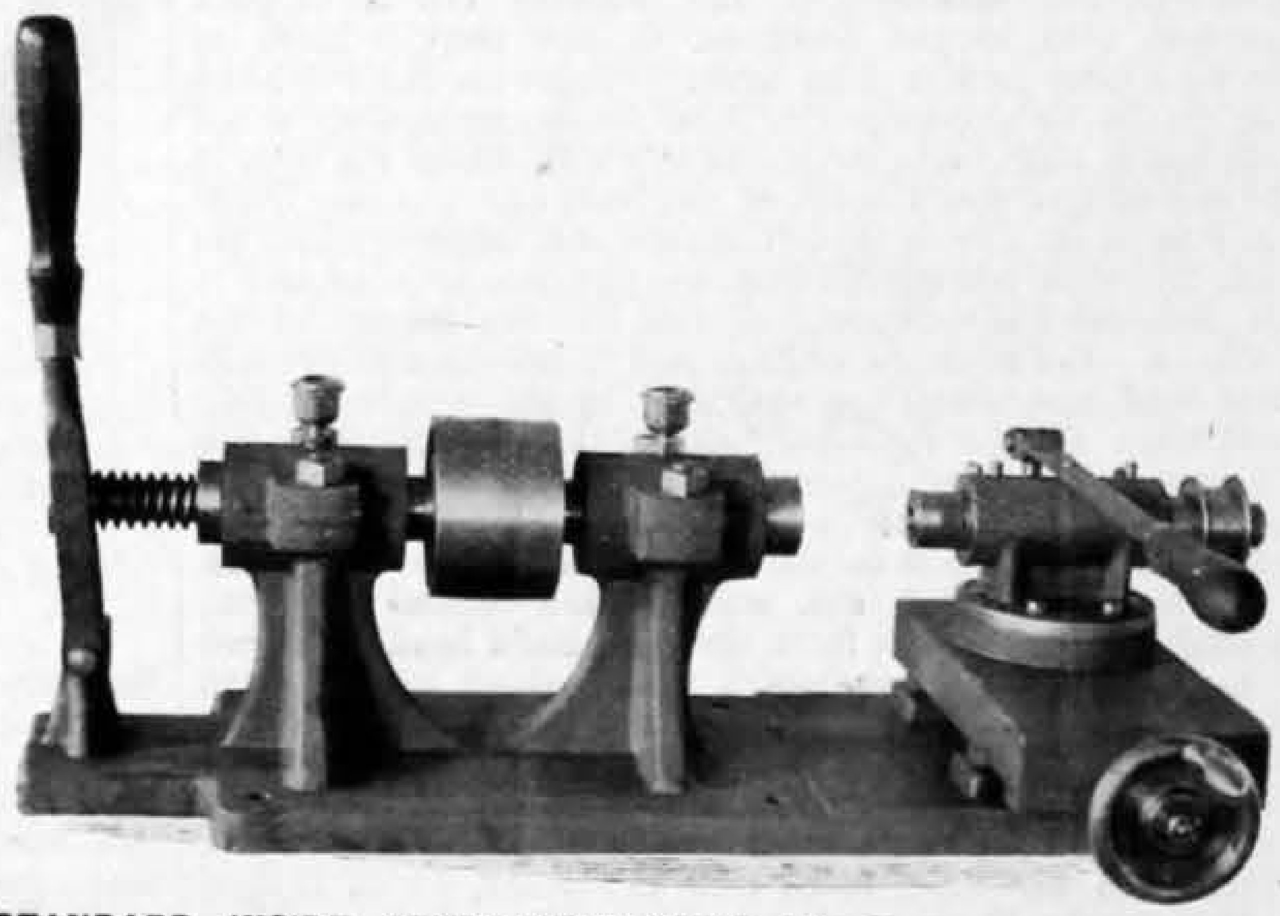


Fig. 5—MESSRS. SELIG, SONNENTHAL, AND CO.—SPOKE SCREWING MACHINE AND STANDARD INSIDE GRINDING MACHINE—Fig. 7

The Speed Manufacturing Company, Limited, London, have on view one or two essentially new features. One of these is the Speed-Bowden brake. This is an adaptation of a new mechanical principle, invented by Mr. Bowden, by which power can be transmitted along a slack wire. By means of this invention an efficient brake is produced, which is entirely concealed. The brake is manipulated by the handle, which merely requires to be turned either way to bring it into operation, the wire being carried inside the handle bar and down the front fork stem to the brake shoe, which is fixed at the bottom of the crown plates. To release the brake the handle simply requires to be given a further turn. The handle bar can be adjusted up or down without interfering with the brake. This is a very pretty arrangement, and no doubt the Speed Company will before long adapt it to the rear wheel, which will be a further improvement. This firm is also introducing a new type of pedal which can be folded up against the crank when not in use, and in that position is out of the way, and incapable of doing damage. The device is an extremely simple one; the pedal being hinged at the end of a projection, which is formed at right angles to the end of the crank. The pedal pin is held in position by a spring, which simply requires to be pushed away to release the pin, when the pedal can be immediately folded against the crank. To bring the pedals into use, they are pulled into their proper position, and the spring snaps over the end of the pin, fixing them securely. A large amount of attention is apparently being paid to the production of a brake which can be actuated by the pedal. Such an appliance is also shown on this company's stand. It is a well thought-out arrangement, whereby clutches on the crank and rear wheel axles can be brought into action by back pedalling.

Chainless bicycles have not been made such a prominent feature as was anticipated, and such as there are seem to be largely designed on the principle which is already well known. In Abbott's chainless machine the method of transmitting power by bevel gearing from the centre of the bottom bracket to the hub of the rear wheel seems to have in it the elements of success. In tires the Maxfield Vacuum Pneumatic is decidedly new in principle, being held in the rim by means of an annular exhaust chamber, which acts independently of the other part of the tire. The outer cover is hermetically sealed, and firmly secured to the rim by deflating or exhausting the vacuum chamber. Should the outer cover be punctured, the tire cannot come off the rim, as it is securely held in position by the exhaust chamber. An interesting application of acetylene gas lighting is exhibited on the stand of Messrs. Bond and Cooper, Birmingham. This firm shows what is termed a "calcium search-light" lamp, with portable apparatus for generating the gas. The generator consists of a cylindrical tube 13in. long and 1½in. diameter, weighing one pound, and is connected by rubber tubing with the lamp. The whole apparatus weighs a little over a pound, and the cost of seven hours' burning of the light is said to be only one penny.

Not much need be said of the motor carriage section, the exhibits of the Great Horseless Carriage Company and the Daimler Motor Company being very similar to those of last year. Messrs. Humber and Co. (Extension), Limited, have on view several motor cycles propelled by electric current derived from accumulators. These machines, although ingeniously contrived, do not strike one as being practicable, but a three-wheel motor carriage propelled by an oil engine appears to be a step in the right direction. It is a neat and comfortable carriage, in which the two front riders are well out of the way of the mechanism, the control of which is left to the rear rider, who steers by means of an ordinary cycle handle bar, seated on a cycle saddle. To facilitate the starting auxiliary pedals are fitted, by means of which the rider can apply additional power when required. It is fitted with a 2½-horse power motor on the horizontal type, and has two speeds, viz., six and twelve miles per hour.

Machine tools form an important feature at the Stanley Show this year. Nearly all those that are shown are, of course, fitted and adapted for bicycle manufacture; but it is hardly necessary to say that slight modifications would render very many of them suitable for the ordinary work of an engineer's shop. Very nearly all, if not all of these machines are of American origin, and we cannot help believing and hoping that the appearance of such a number before

English engineers will incite them to attempt more of this class of work themselves. The underlying principle of all the automatic machines is the same. It is by no means new, and some of our readers are, without doubt, well acquainted with the machines we are about to describe; on the other hand, there must be many who, for various causes, have not given them the attention they deserve. Two weeks ago we described very fully one of the Hartford automatic machine tools. This machine contains the fundamental features of nearly all the automatic turning machines—they are hardly recognisable as lathes—that figure at the Islington exhibition. The stock in all cases passes through a hollow head, and is fed forward by the common wire feed precisely in the manner we described. The work is done by tools carried in a turret, which either revolves upon a vertical axis, as in the tools exhibited by Messrs. Pratt and Whitney, or on a horizontal axis, as in the machines shown by Messrs. Charles Churchill and Co., and Messrs. G. W. Burton, Griffiths, and Co.; in either case if the machine is entirely automatic, the feed of stock and drawback of head is produced by cam plates on drums on a countershaft. So also with regard to the cutting tools; the same designs are used by most of the

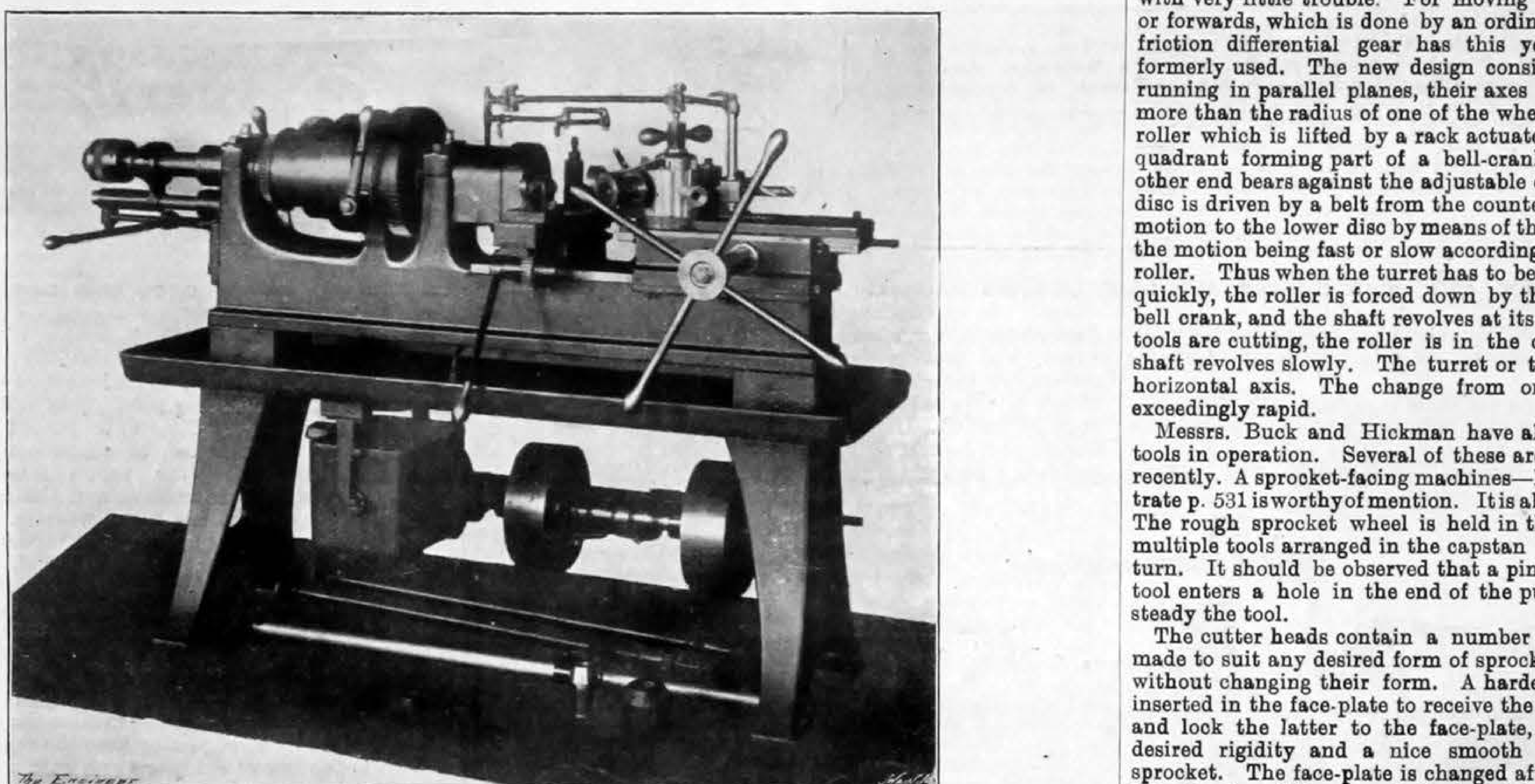


Fig. 2—MESSRS. C. CHURCHILL AND CO.—SECOND OPERATION HUB MACHINE

makers, the now well-known circular tool being used for shaping, and the Tucker opening dies being used for screwing. Twist drills are used almost exclusively for drilling, and pressure oil feed to the point of the drill, either through the tool itself or through copper pipes laid into the drill, is the rule and not the exception. The most perfectly automatic machine to be seen in the hall is probably that made by Messrs. Burton, Griffiths, and Co. This machine is capable of performing thirteen separate independent and automatic operations on one piece without any manual re-chucking. It resembles not a little the Hartford automatic machine, but differs in that it carries two horizontal turrets or discs in place of the one vertical turret in that machine. These tool discs are keyed on a countershaft, which is placed at such a distance behind the main centres that the tools come exactly into line with the work. Upon this countershaft is a small sprocket wheel, over which passes a chain, which also surrounds a friction chain wheel. This wheel is keyed to the cam shaft, placed in similar position to that in the Hartford machine. It has no teeth, but the chain is compressed between two leather-faced discs. The revolution of the cam shaft thus maintains a constant pull on the near side of the chain, and so tends to rotate the tool disc forward. Upon the rim of one of the discs there are flat-sided pins, one of which bears normally against a stop which occupies the centre position on the bed of the machine. The tool discs are moved to left and right by certain of the cams on the big cam drum. As one of them travels to the right it clears the rest and makes part of a revolution, returning in time for the next pin to catch on the stop. A new tool is thus brought into position, and is held very steadily; moreover, the tendency of the working cut is to push the disc pins harder down on to the stop. Each of the tool discs carries four tools. Those on the left-hand disc do the first operation. Thus, for example, they would turn down, screw, &c., the shank of a bolt, whilst the tools in the second disc would finish off the head and do other little odd jobs on it. To do this, of course, it is necessary that the work should be transferred from one chuck to another, and in the automatic achievement of this lies the feature of the machine. The stock, as we have said, is fed through the left-hand head, and is first operated upon by the tools in the left-hand disc. On the right-hand side of the machine there is a somewhat similar head carrying a chuck worked just as that on the left side is worked, and revolving at exactly the same speed. After the tools on the left disc have done their work a big notch in each disc occupies the central position, through this the spindle from the right-hand head is pushed forward by the long cam which is just about to come into operation, and seize the finished end of the work, retiring at once with it to a position to the right of the right-hand tool disc. The discs then revolve, and the series of tools in the hand disc come into action to finish off the work. As soon as this is done the work is ejected from the chuck, which is then ready to receive the next piece. The cutting-off slide, which moves transversely across the bed, is operated precisely as in the Pratt and Whitney machine. To it, moreover, four tools for working in turn on the periphery of the stock can be attached. The head to which they are attached revolves automatically on a horizontal axis. Furthermore, for certain electrical work a little horizontal drill is attached to the right poppet head. A small broach is sometimes placed in one of the discs for working a flat or squaring a spindle. With this machine, we were informed, 120 little screws used in incandescent lamp work, on which eleven operations are required, can be produced per hour. This will give a very fair notion of the rapidity with which this class of tool works.

Turning now to a larger but very similar tool, we illustrate above a hub forming and a hub-finishing machine, both shown by Messrs. Charles Churchill and Co., of Queen Victoria-street. Compared to others exhibited by the same firm, and to that we have already described, these are only semi-automatic in the sense that the attention of the operator is needed to change the tools. In the former machine two similar tools are used for the first cut. These consist of blocks of steel several inches long shaped exactly to suit the desired shape of the hub. They are sharpened readily by grinding a little off the face, and the contour is thus left undisturbed. These two tools are on independent rests, but one is driven by a left-hand screw which passes through a right-hand screw belonging to the other. When both screws revolve together the two tools advance equally towards the centre. Half a revolution can, however, be given to the tool nearer to the operator by turning a handle, the automatic gear which normally drives the screws being thrown out. This half turn is rendered possible by causing the revolutions of one screw to be transmitted to the other by a clutch which is always free to revolve half a turn on account of its having only two narrow stops or teeth. This last half turn is given carefully by hand, so that the surface of the work may be even and smooth. At the same time that the roughing down is being done a large twist drill is fed forward, and drills the longitudinal hole; the drill is carried on a separate bar and not in the turret, as shown in the engraving Fig. 1. The operations taken in order are as follows:—The stock is fed forward by the operator pulling a lever. The turret is moved up, and a short drill makes a centre hole in the end of the bar. The turret is then run back, and the arm carrying

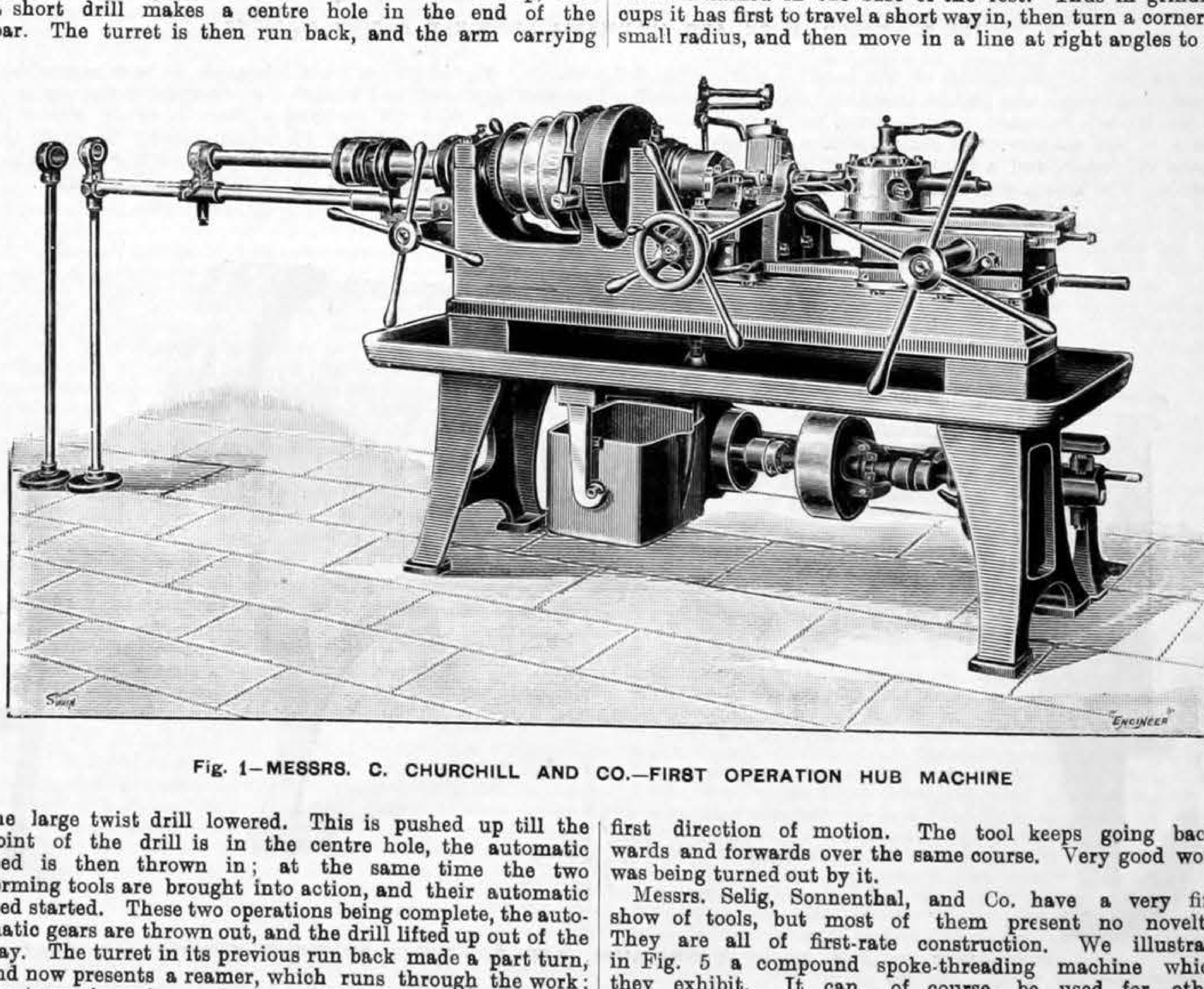


Fig. 1—MESSRS. C. CHURCHILL AND CO.—FIRST OPERATION HUB MACHINE

the large twist drill lowered. This is pushed up till the point of the drill is in the centre hole, the automatic feed is then thrown in; at the same time the two forming tools are brought into action, and their automatic feed started. These two operations being complete, the automatic gears are thrown out, and the drill lifted up out of the way. The turret in its previous run back made a part turn, and now presents a reamer, which runs through the work; the turret is again run back, making a part revolution, and a plain pin or rest comes into position, which, entering the hole in the stock, steadies the work whilst the final cut is made on the outside of the hub. The turret is now run back and forth once more, and the last tool shapes the ball race. The final operation of cutting off the hub is performed by a knife fastened in a hinged rest which is turned over into position when required. The hub finishing machine—Fig. 2—does not differ essentially from that just described. A specially formed chuck is used for holding the hub, and right and left-hand screw dies replace certain other tools in the turret. The dies are carried in chucks, which are free to slide forward but not to revolve, till they have travelled a certain distance. Thus the operator having started the right-hand die by bearing on the turret levers, they lead themselves on till the stop is passed, when the dies and work revolve together; the machine is then reversed by throwing the belt over and the right-hand dies screwed off, the same direction of motion being suited for the left-hand dies, which are immediately brought into operation. An important feature of these machines is the friction "fast and slow" back gear, which is thrown in and out instantaneously. They are made by Warner and Swasey, of Cleveland, Ohio.

Messrs. Charles Churchill and Company also exhibit on their large stand a number of automatic screw machines made by the Cleveland Machine Screw Company. These clever tools are, we believe, pretty well known in this country, as a large number have been in use in various factories for several years past. They differ in certain respects from other machines of their class, particularly in the use of an adjustable cam disc which can be altered very readily so that the machine can be changed from one class of work to another with very little trouble. For moving the turret backwards or forwards, which is done by an ordinary cylindrical cam, a friction differential gear has this year replaced the gear formerly used. The new design consists of two steel discs running in parallel planes, their axes being apart by rather more than the radius of one of the wheels; between them is a roller which is lifted by a rack actuated by a quadrant, the quadrant forming part of a bell-crank lever, of which the other end bears against the adjustable cam plate. The upper disc is driven by a belt from the countershaft, and transmits motion to the lower disc by means of the roller between them, the motion being fast or slow according to the position of the roller. Thus when the turret has to be drawn back and forth quickly, the roller is forced down by the cam bearing on the bell crank, and the shaft revolves at its full speed; whilst the tools are cutting, the roller is in the other position and the shaft revolves slowly. The turret or tool disc revolves on a horizontal axis. The change from one tool to another is exceedingly rapid.

Messrs. Buck and Hickman have also a very fine show of tools in operation. Several of these are of the type described recently. A sprocket-facing machine—Fig 3—which we illustrate p. 531 is worthy of mention. It is almost self-explanatory. The rough sprocket wheel is held in the face plate, and the multiple tools arranged in the capstan head operate on it in turn. It should be observed that a pin in the centre of each tool enters a hole in the end of the puppet spindle, so as to steady the tool.

The cutter heads contain a number of cutters which are made to suit any desired form of sprocket, and to be ground without changing their form. A hardened steel bushing is inserted in the face-plate to receive the plug on end of head and lock the latter to the face-plate, securing thereby the desired rigidity and a nice smooth finish in the faced sprocket. The face-plate is changed after the first side has been faced, and the second side is finished in similar manner After the sides have been faced, the periphery is finished by single cutters on the cut-off block, which is applied to the bed after tools shown in illustration have been removed. Of course the changes of face-plates and tools for second and third operations are not made until a large number of sprockets have undergone the preceding operation.

An entirely new cup and cone grinding machine—Fig. 4—was exhibited by the same firm. This machine is automatic in its action. It consists, as will be seen from the above engraving, of an ordinary driving head, provided with a spring chuck operated by the foot, which grasps the work. In front of this is the rest carrying the grinding gear, driven by a separate belt from the countershaft. The little grinding wheel is caused to move over the desired course by mechanism contained in the base of the rest. Thus in grinding cups it has first to travel a short way in, then turn a corner of small radius, and then move in a line at right angles to its first direction of motion. The tool keeps going backwards and forwards over the same course. Very good work was being turned out by it.

Messrs. Selig, Sonnenthal, and Co. have a very fine show of tools, but most of them present no novelty. They are all of first-rate construction. We illustrate in Fig. 5 a compound spoke-threading machine which they exhibit. It can, of course, be used for other work besides spokes, and the automatic opening screw-cutting chucks, which constitute one of the main features of the tool, are supplied separately for use in other machines, such as lathes, drilling machines, &c. An inspection of the cut will show that two spokes are operated on simultaneously, whilst two more are being fitted in the clamps. The manipulation is very rapid. Figs. 6 and 7 show two Standard combination grinders exhibited by the same firm.

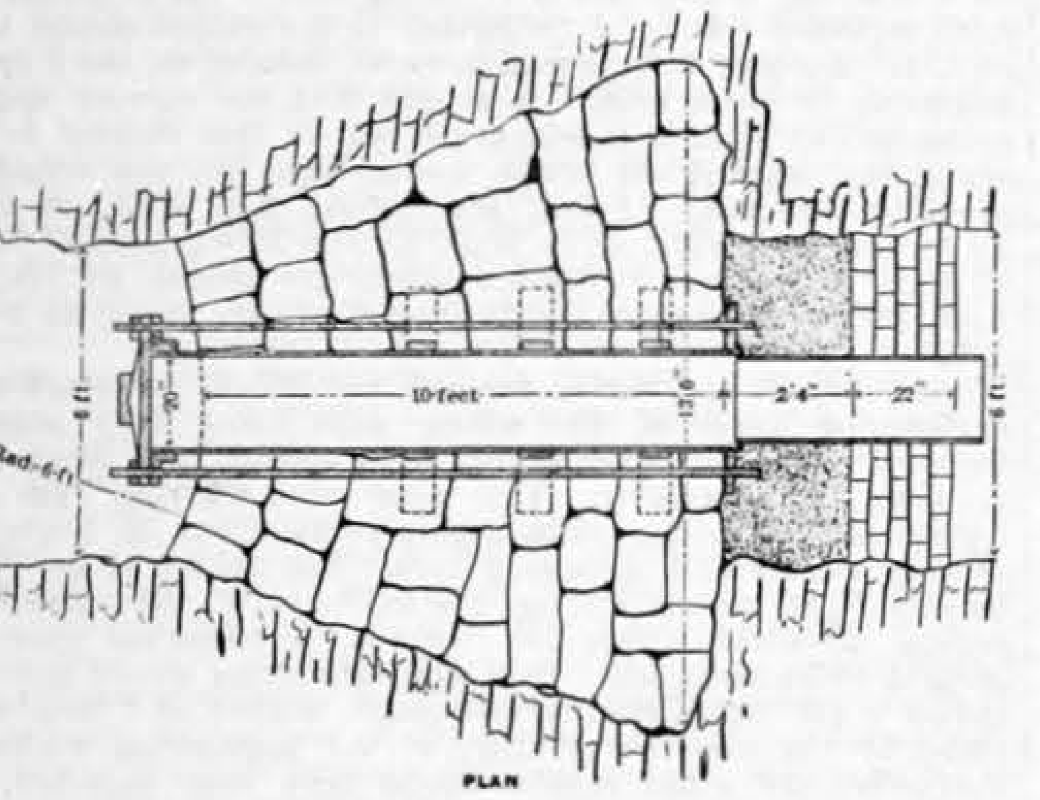
CONSTRUCTION OF A DAM IN A MINING DRIFT*.

An exploring drift on the bottom level of the Curry mine, at Norway, Mich., on the Menominee range, cut a stream of water, which increased considerably the expense of pumping. As the hope that the supply would drain off was not realised, it was decided to build a dam in the exploring drift, as it was estimated that the cost would be recovered by the saving in fuel in less than two months.

The eighth and lowest level of the mine is 780ft. below the surface. The exploring work had started north from the shaft at right angles across a slate to a jasper formation parallel to that which contains the principal ore body. In this north jasper several hundred feet of drifts had been opened in different directions. The dam was located in the slate near the jasper, the drift at this point being 6ft. wide and 7½ft. high. The amount of water enclosed by the dam would be less if it had been built nearer the face of the openings; but the jasper, though hard to drill, is not firm, while the slates, though softer, are dense and solid, and the impermeability and strength of the adjoining measures were of commanding importance.

The dam was built of local sandstone in the shape of an arch upon its side, with a radius of 6ft. and a thickness of 10ft. The mortar was made of one part Hilton cement and two parts sharp sand. The abutments were formed by cutting out the sides of the drift in line with the centre of the curve of the arch, but leaving the rock rough. The floor was excavated 15in. to 20in. below the bottom of the drift, and the top was made 2ft. higher in front and 5ft. higher at the back. In laying the masonry the front courses of stone were cut to fit the arch, and care was taken, particularly at the top, to leave no crevices. Two openings were

Fig. 1.



PLAN

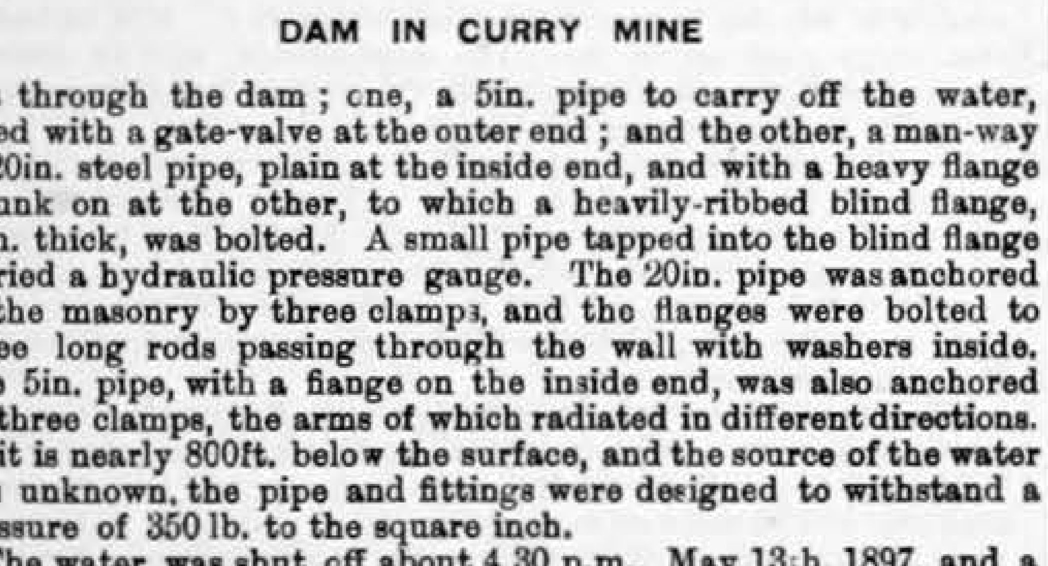
DAM IN CURRY MINE

left through the dam; one, a 5in. pipe to carry off the water, fitted with a gate-valve at the outer end; and the other, a man-way of 20in. steel pipe, plain at the inside end, and with a heavy flange shrunk on at the other, to which a heavily-ribbed blind flange, 2½in. thick, was bolted. A small pipe tapped into the blind flange carried a hydraulic pressure gauge. The 20in. pipe was anchored in the masonry by three clamps, and the flanges were bolted to three long rods passing through the wall with washers inside. The 5in. pipe, with a flange on the inside end, was also anchored by three clamps, the arms of which radiated in different directions. As it is nearly 800ft. below the surface, and the source of the water was unknown, the pipe and fittings were designed to withstand a pressure of 350 lb. to the square inch.

The water was shut off about 4.30 p.m., May 13th, 1897, and a little before noon the next day the pressure was 100 lb., rising to 215 lb. at 3.30 and 240 lb. three-quarters of an hour later. The dam leaked about 30 gallons a minute, the quantity increasing with the pressure. This condition was not satisfactory, and the water was let off. In two hours the pressure fell to 45 lb., and the water rose at the shaft about a foot over the floor. A high pressure was produced by a small quantity of water, showing that part of the watercourse was very small.

The closing of the dam seems to have increased the flow. For

Fig. 2.



LONGITUDINAL SECTION

DAM IN CURRY MINE

the thirty days previous, the record of the pumping, measured by displacements, gave an average of 370 gallons per minute. After opening the dam, the average for fourteen days was 413 gallons.

To put in an impervious stratum, a brick wall 22in. thick was built 2ft. 2in. from the inside of the dam and the space between was filled with concrete. This was made by mixing four parts of limestone, broken to egg size, with three parts of cement mortar. A short length was added on the inside to the 5in. pipe, and a piece of old smokestack, 18in. in diameter, was used for lining the extension of the man-way. Owing to the increase in the water after the dam was opened, there was some delay in draining the mine, and it was seventeen days before the addition to the dam was completed. Before closing it, three loads of horse manure were put against the brickwork and held there by a plank partition.

The water was shut off the second time on June 1st, at 9.30 a.m. While the water was accumulating in the drifts, the pressure increased slowly, but by 7.30 p.m. it had risen to 273 lb., representing an equivalent head of water of 630ft.

On June 8th the pressure was 277 lb. to the square inch, equal to a head of 640ft., and the total pressure against the dam was over 800 tons.

During the morning of June 2nd, before the pressure had reached the maximum, the water which flowed from the dam was collected in a small stream, and showed a flow of about seven gallons per minute.

The second day after, though the pressure was higher, the flow had decreased to five gallons, and four days later it had fallen to 2½ gallons per minute. The water which came through the dam trickled out in eight or ten different places, most of them near the top or one side. The water was milky, and left a heavy calcareous deposit on the face of the dam and in the ditch.

After the dam was closed, the record of the pumps for six days showed that the mine was making 115 gallons of water per minute, a decrease of 295 gallons. The cost of the dam was about £100.

*Abstract of a paper presented to the American Institute of Mining Engineers, by Mr. Wm. Kelly.

LOCOMOTIVE OPERATION*.

How should a locomotive be operated to secure the most economical use of steam and fuel, speed and weight of train to be considered? In this question exist a great many points, as every act pertaining to the merits or demerits of the engineman all leads either to the economical or extravagant use of steam and fuel.

That we may have the many points more clearly in mind, let us include them all in these three great heads:—(1) The skilful manipulation of the different valves and levers that serve to control this force, that it may be used to its utmost capacity when necessary, and its power also be tempered when the conditions so demand. (2) Skilful firing. (3) Education of enginemen.

In this subject generally occurs great diversity of opinion between theoretical and practical enginemen. For instance, from a theoretical standpoint, a locomotive, under all conditions, should be worked at shortest possible cut-off with wide-open throttle, thereby saving heat and fuel by working the steam to its fullest expansive force. However, practice has taught the engineer that this rule does not hold under all conditions; that it is not always the most economical method, where speed and weight of train are to be considered. The fact is apparent to every practical engineman that he saves a certain amount of heat by manipulating his machine in conformity with the conditions relative to speed and weight of train. Regarding the loss of power and heat by working too expansively, we can say that the loss of power has been greatly obviated by the use of the balance slide valve; but the loss of heat from condensation, by increasing the ratio of expansion beyond a certain limit, is enormous, and to overcome this loss is a problem which seems to fail of solution, except by compound expansion and skilful manipulation of the throttle and reverse lever. It is plain that any imperative rule tending to interfere with the engineman in regard to working his engine under all conditions would be expensive and injurious to the service.

If the time is fast, the throttle should be opened wide when starting; but if the time is sufficient to warrant, the speed should be regulated with reverse lever, be hooked up in accordance with speed and weight of train. At this point the engineer cannot be governed by any fixed rule, but should exercise his judgment, and not put the lever back so far that, to use an engineman's term, "the engine will work against herself." "Working against herself" occurs when the engine ceases to maintain her speed in proportion to length of cut-off and throttle, thereby causing back pressure produced by condensation and re-evaporation. This, according to the old rule, is where working expansively is working expensively. Care should be taken not to force the engine into speed faster than necessary to make schedule time, by giving due consideration to schedule, and by making the speed as uniform as possible, avoiding an unnecessary increase of speed for the purpose of making up time before it is lost. For the well-known fact that speed increases expense is very perceptible on the coal record and comparison sheet when the expense is caused unnecessarily by bad judgment.

As the boiler is the great reservoir, the carrying of water depends greatly on its construction. The style of boiler that has the greatest capacity, and will carry water highest when the engine is working at its fullest capacity, is, from an economical standpoint, the most advantageous. Why? The larger the body of water being carried, the less sensitive pressure will be to the feed-water, and the greater advantage may be taken by the engineer to favour the fireman in cases of emergency. Your committee would here state that these emergency cases are of frequent occurrence to the sagacious engineer, for no matter how skilful the fireman may be, he often spoils his fire for a short period by applying coal too heavily in some part of the fire-box. When this occurs, the engineer, by having a large body of water, may close the injector for a few seconds, allowing the fireman to recover from the demoralising effect, and thus regain his confidence, when otherwise he would become excited and continue to get his fire in a worse condition. The boiler being the storehouse for heat, the engineer should take advantage of every opportunity to store the heat therein, instead of allowing it to escape to the atmosphere through the safety valve. How often a fireman has been heard to remark that he could keep plenty of steam for some particular engineer, while on the same engine with some other engineer he found it difficult to make steam enough to get over the road. Where such cases as this exist, it is the opinion of your committee that they are due to the carelessness or incompetency of the engineer. The first-mentioned engineer, by taking advantage of the opportunity to keep the boiler full of water when standing on the siding or at stations, stores away thousands of units of heat that he may draw from by leaving the injector closed at the start, when the engine is labouring into speed, thereby giving the fire a chance to recover from the effect of closed dampers during the stop. The careless, or second-mentioned engineer, pays no attention to the water when the engine is standing or switching, except to keep enough in the boiler to ensure safety, and when ready to start pulls out with water so low that it is necessary immediately to turn the injector on full in order to keep the water within a safe limit. The fireman, noting this, will at once commence to crowd his fire in order to counteract the great drain on the boiler, and the results are, the boiler loses pressure from the effect of a heavy fresh fire, and in almost every instance the fire is spoiled. When the next stop is made, and should it be for any length of time, the fireman, not wishing to be caught again with a low fire, will keep it burning furiously, resulting in a wasteful loss of fuel. The engineer should ever bear in mind that upon good pumping depends a great deal more than simply carrying enough water to prevent the burning of the crown sheet.

As a factor of economy, the fireman stands equal, if not paramount, among all men in railroad service. It has been said that through his carelessness may occur an enormous loss, while through his judicious handling of the scoop dividends may be paid. To tell a fireman how and when to put the coal into the fire-box in order to secure the most perfect combustion would be as impossible as to teach him how to swim by simply telling him how to do it. The art of firing must be acquired by practice and careful study. However, he should be instructed to guard against the many errors into which firemen are liable to fall.

As everything pertaining to the economical management of the locomotive depends on the training of the engineman, the effort should be equally as great in their development as that used in bringing the locomotive up to its high grade of efficiency. Since the construction of the first locomotive, the most strenuous efforts have been made to bring it to the highest state of perfection. As to the results that have been attained, the modern locomotive will demonstrate. Only within recent years has any attention been given to the development of the minds of the enginemen to bring them up to a standard corresponding to the engines they operate. Though the man operating the locomotive may be deficient in technology, though he may not have had the advantage of an academic course of training, he will, quoting the words of one of our officials who has generously taken an interest in the training and betterment of his men, "naturally turn toward knowledge, as a plant would incline toward the light." The engineman should be given every opportunity and encouragement to study the many good books and periodicals concerning his own work, and other lines, which will serve to broaden and expand his mind, thus making him economical, safe, and efficient. In the training of the engineman, care should be taken that his labour be not so arduous as to affect his power of conception, for after a man's muscular powers have been overtaxed and exhausted, he will be incapacitated for any brain work necessary to qualify him a first-class engineman. The human body is only capable of a certain amount of energy, which can be used either in manual labour or developing the brain power; therefore, when this energy is overtaxed in the performance of manual labour, it detracts from the energy that should go to brain work. For example, we will take a railroad president. He may be as strong, physically, as any man, but place him at braking on a local freight train for twelve hours a day, and at the end of the first few days you will find him totally exhausted; but should he continue in this capacity for any length of time, the muscles that had laid dormant for years would develope and become hardened, so that he would be able to stand the work all right, while the nerve fibres that furnish the brain power would deteriorate from lack of energy in that direction. In a short time the directors would not feel disposed to go to him for information in regard to the management of the road, although they would probably be able to get some good points in unloading way freight. In the construction of all large buildings and machinery, the different parts, before being put in, are given the most rigid inspection, also after the construction is completed it is again inspected, to guard against structural weakness. This method of inspection, your committee believes, from an economical standpoint, should apply to the selection of material to operate the locomotives on our railroad systems. In the hiring of men for firemen young men should be chosen who possess the natural qualifications requisite to graduate them into a higher degree. As one of our road foremen of engines, who is known for his broad and liberal views, has expressed it, "In order to handle an engine successfully it would be necessary to begin at least one generation before the engineman is born."

* From a committee report presented to the Travelling Engineers' Association, U.S.A.

AMERICAN ENGINEERING NEWS.

(From our own Correspondent.)

Steel axles for locomotives.—At the annual meeting of the Railway Master Blacksmiths' Association, Mr. Mould, of the Erie Railroad, read a paper in favour of steel for axles. He claimed:—(1) That it is more homogeneous than iron; (2) that it is free from seams, and soon forms a better bearing than iron; (3) that greater loads can be borne by steel than by iron axles of the same dimensions. It was said at the last convention, that the Bessemer process of making low-carbon steel was not reliable for axle making, and upon investigation Mr. Mould found that many of the failed steel axles have been made by this process. His road has been using the open-hearth low-carbon steel for crank pins, side and main rods, piston-rods, locomotive driving axles, engine truck, tender truck, passenger and freight car axles, with the most satisfactory results for a number of years. The reports show that fifty-seven iron axles and only fourteen steel axles have failed. During the last two years and four months the average rate of failure has been fourteen iron and three steel axles per year; the failure of steel axles forming but 18 per cent. of the total number of failures. The reports upon which these statistics are based cover axles of all classes, freight and passenger cars, engine truck, engine tender, and driving axles. Almost all of the outside bearing axles which have failed have fractured in the journal, the most common cause of failure being seamy and dirty iron, fillets worn sharp, and improper or deficient lubrication, causing journals to run hot. They have generally been able to trace the failure of nearly all of the steel driving axles which have failed to some surface defect, such as circumferential scoring, due to careless lathe work, or cutting, due to wear. It is very rarely that a specimen is received which indicates a clean break throughout. At the time of ultimate failure, nearly all specimens show that fracture has occurred more or less gradually. But they frequently receive broken iron journals, the fractures of which indicate that they have been very hot, and that the outside fibres have been severed, and that just previous to ultimate failure the journal was kept in shape by a central core of fibres, all of which gave way simultaneously. In general steel axles are superior to iron axles in homogeneity, in ability to resist abrasion, and in ability to resist greater stresses, both quiescent and repeated alternating stresses. Iron axles are made of metal of good or bad quality, according to the nature of the scrap selected for their composition. To be perfectly sure that iron axles are of the quality specified it is necessary to test each axle in some way or other, for iron is far from being homogeneous. Moreover, in iron axles there is always some danger of the existence of steel scrap, which never thoroughly unites with the adjacent iron, and therefore is a source of weakness and danger. Some axles are usually made of new material, and the mass of steel worked at one time, and from which either Bessemer or open-hearth axles are made, is often sufficient to produce from fifty to seventy-five axles. As this steel is very homogeneous the axles have a physical and chemical composition almost exactly alike, the principal cause of difference being segregation or a separation of certain elementary substances in the steel, such as sulphur, phosphorus and manganese. Segregation, however, rarely becomes a defect of axles, because most steel axle manufacturers discard a certain portion of the top of the ingot, in which portion of the ingot almost all the segregation takes place, and the portions of the ingots used for the manufacture of axles are, generally speaking, free from this defect. Not only are axles of the same heat or run of metal quite homogeneous, but most runs of steel of various heats are so nearly alike that the difference between physical and chemical properties of axles made from these various heats are very slight. If it is especially desired that axles shall be exactly alike in physical and chemical composition, axles of certain heats may be especially selected with this in view, the selection of the heats to be used depending upon a careful consideration of the chemical and physical properties of the metal as shown by the manufacturers' tests.

A three-phase 1500-kilowatt dynamo.—There has been built for the Brooklyn Edison Electric Illuminating Company a great three-phase alternating-current dynamo for supplying high-tension current to sub-stations distributed over an area of 75 square miles. It is of the rotary field type, having 40 field poles and a nominal output of 1500 kilowatts—practically 2000 kilowatts—at 75 revolutions per minute. By directly generating the high current the constant loss due to step-up transformers is avoided, while the current passes out directly to the lines without the intervention of brushes, &c. Static transformers at the sub-stations will reduce the pressure to 375 volts, rotary converters at that pressure supplying the present three-wire low-tension circuits. The armature coils or windings will be mounted inside a great circular frame 31ft. outside diameter and 4ft. 3in. wide. The weight of the revolving field will be 59,000 lb., and the total weight 163,000 lb. The armature frame can be moved laterally on a track, so as to enable the field and coils to be examined and repaired. The field which will revolve within this ring will have eight spokes, carrying a heavy steel ring, to the outside of which are bolted 40 pole pieces built up of sheet iron. The poles are wound with a copper ribbon $\frac{1}{16}$in. by 1½in., and are connected in series and supplied with a low-tension direct current by two copper rings mounted on the driving shaft. This revolving field will be mounted directly upon the shaft of a triple-expansion four-cylinder engine, a heavy fly-wheel on the same shaft preventing undue variation in speed, the engine builders guaranteeing that the variation will not exceed ·25 per cent. per revolution, which will not be sufficient to cause any perceptible change in the brilliancy of the lamps.

Large lake steamers.—The largest steamers now in service on the Great Lakes are the ore-carrying vessels of the Bessemer Line, 434ft. long and 48ft. beam. Two steamers for this same line are now being built, which will be 450ft. long, with 50ft. beam, and the company has also placed contracts for a still larger steamer, which is to carry ore and tow two big steel barges. The steamer will be 475ft. long over all, 455ft. long between perpendiculars, 50ft. beam, and 29½ft. deep, being larger in every way than any vessels now on the lakes. The barges will be 450ft. long and 50ft. beam, with a depth of 58½ft. The steamer will be propelled by a single screw, driven by a quadruple-expansion engine, with cylinders 28in., 40in., 59in., and 85in. diameter, all of 42in. stroke. The boiler-room will contain four Scotch marine boilers. With a draught of 17ft., the steamer will carry 6500 gross tons of iron ore, while each of the barges or consorts will carry 7000 gross tons, so that the three together will carry 20,500 tons of ore in each trip. When the Government completes its work of deepening the channels to a uniform depth of 23ft., the carrying capacity will be even greater. The boats are now being built by F. W. Wheeler and Company, and will cost about £100,000. They are to be ready for service in May, and will be equipped with the most modern devices for the rapid handling of the cargo at the shipping and discharging ports. Plans have been prepared for a steamer 500ft. long, 50ft. beam, and 28ft. deep. The largest passenger steamers on the Great Lakes are 368ft. long, 5000 tons, with twin-screw engines of 7000-horse power.

LETTERS TO THE EDITOR.

(*Continued from page* 523.)

THE STRIKE AND LOCK-OUT.

SIR,—Let me state our own experience since this long and lamentable strike began.

To equip the new workshops we built here we placed orders in the month of May with engineering firms at Halifax, Manchester, and Sowerby Bridge, for lathes, wood-working machinery, &c. The strike supervened, and the firms returned our orders. It was imperative that we should obtain a few of the machines, so I visited Germany, and Messrs. Barnes, Burns, Mann, or any official or member of the Amalgamated Society of Engineers, can look at our German machines on any day they care to visit our works; they are equal at least to English make, and 20 per cent. cheaper. It was, Sir, I can assure you, with great reluctance I decided to meet our most pressing wants with German machinery, to hold our markets against foreign competition. What the Socialists, who are now the trade union leaders, call the "bogey of foreign competition," is no bogey, but is in an alarming manner getting daily more widespread and active. Why? Because our workmen, through the benumbing and dead-levelling rules of the New Unionism, are not now as a body in the front in the matter of effort to produce a paying output for a given wage; and if the system of the "least work for most money" is not abandoned by the engineers and the men in the allied trades, this country as a great manufacturing nation must recede in the race, and Great Britain's days of commercial supremacy be numbered. The handwriting on the wall is already visible to wise and discerning men, who look with grave apprehension to the many advantages now enjoyed by the United States and Germany, and likely, unless the Socialist trade union leaders change their tactics, to be increasingly enjoyed by these countries relatively to our own. We have been so far the greatest industrial nation the world has seen, but we must depend more and more on our manufactures for the national income to purchase the food for our population.

If once a decline sets in, our manufacturing trades will go on the down-grade as rapidly as they formerly advanced. I hope, therefore, the employers and the non-socialistic workmen will combine to fight our common commercial enemies, find out jointly for the advantage of both the economic and natural advantages possessed by our most dangerous competitors, and arrange to hold our trade, as I believe in the trite words which have embellished so many trade-union banners, "United, we Stand: Divided, we Fall;" but for Britain's sake, let those socialist trade-union delegates who "kept the bag" like Judas, make all the reparation they can to the industries and followers they have betrayed, and "go out and hang themselves." Where is the £400,000, supposed to be invested for sick allowance and old age relief? Ought not that to have been kept and given to the poor, instead of being wasted by trade-union officials in a light-hearted strike, fomented and started by the Socialist leaders in London, with the hope of "sniping" down a few of the employers; but the "sniping unionists" found their rifles out of range when the employers federated their artillery. The employers have never before combined to repel the continuous attacks which one or other of them had to face in some part of the country, and I hope they will keep their guns mounted and their ranks closed. Indeed, I think it would be to the advantage of employers and employed if the former now selected a few of their number to retire from business, and be paid from the Federation fund the same as Burns, Tillett, and Company have been paid by the unions. It might be difficult to induce any employer to accept such a position, as they know there are far too many unproductive hangers-on to trade already. Still, as

> "Satan finds some mischief still
> For idle hands to do,"

so the Socialist trade union officials are eternally devising means to cripple trade, and a brigade of sentries of the employers ought always to be on the alert to counteract the attacks of the trade union scouts. Of course I shall be told that the employers have no right to combine to save their businesses.

I suppose if James Watt, who attained the crowning of all distinctions in the engineering trade, came to Birmingham again, the New Unionist officials would not let him operate a machine. Yes, the inventor of the appliances from which our great engineering trade took its rise would be compelled, according to trade union rules, to

> "Beg his brothers of the earth to give him leave to toil.'

They might permit him to be the unskilled help to one of the Amalgamated Society of Engineers' "minimum men." The genius who conferred an immortal fame on the engineering trade, the "Hero of Industry," of whom Carlyle said, although no peerage was conferred on him by the Government or King, still he held the patent for his nobility immediately from Almighty God—would have been hunted from pillar to post by modern district delegates, if he had attempted to touch a machine in an engineering shop "bossed" by the New Unionist officials. GILBERT LITTLE.

Birmingham, November 19th.

H.M.S. LEANDER.

SIR,—After all the pains I took in my letter which appeared in THE ENGINEER of 12th inst. to explain the difference between frigates and line-of-battle ships, and to prove that the Leander of 1813 was a frigate, I did not expect that your correspondent "Jack Ashore" would tax me with affirming the contrary. His "careful reading of everything that has appeared" does not seem to have given him correct impressions. I have no notions for the subject, but accurate knowledge. The Leander of 1813 was a frigate, but of a new sort, enlarged in size, and with some guns in the waist, which were not usually carried by British frigates. James does not seem to like them much, and advocates a smaller sized ship, but his opinions were not adopted. A seventy-four cut down or razeed becomes then a frigate.

The model supplied by Messrs. Green, and photographed in a back number of THE ENGINEER, represents a two-decked seventy-four, and it is not a frigate, but probably the Sultan line-of-battle ship. Not necessarily a "small" seventy-four, as "Jack" says. He makes two mistakes in his concluding paragraph. The Leander of 1805 was not a frigate, as he states, but as James carefully defines, a "fifty-gun ship," that is, a very small line-of-battle ship, with two covered decks besides superstructures. The second mistake is comical, as he calls the Ville de Milan a "twenty-three gun frigate," but there were no such vessels, and James clearly states she carried forty-six guns, the twenty-three being on one broadside only.

The paging mentioned by "Jack Ashore" does not agree with my sets of "James' History." I have three, for 1859, 1878, and 1886 respectively, and two appendices contributed by me are published at the end of the sixth volume, last edition. Perhaps his edition is an earlier one. There is no doubt or mystery on these subjects, they only require to be understood.

Bayswater, November 24th. H. Y. POWELL.

TRADES UNIONISM AND MR. BARNES.

SIR,—Having read with the greatest interest and pleasure the truly peace-making letter of "Live and Let Live" in your issue of the 19th, may I be allowed to congratulate him heartily, and suggest a step further on his lines.

He speaks of inviting employers to attend the annual meetings of the trade societies. Why not give them the right to attend the ordinarily fortnightly business meetings of the society by allowing them to contribute to its benefit funds? Would not both sides then learn more about each other in the only true way, by meeting and talking face to face? Would not all misunderstanding, and mistrust, and misrepresentation be nipped in the bud, instead of growing to alarming proportions? Would not the ever-changing and increasing machine and hour question be dealt with on its local and individual merits? Might not the "club rooms and halls" of your correspondent be built by magic, and would not such many-sided technical discussions take place therein, that the theoretical German and the practical American would alike be held in check? Where is the line, Sir, between so-called "capital" and so-called "labour?" On which side of it is "Live and Let Live," and on which side of it is JACK O' BOTH SIDES?

Manchester, November 21st.

P.S.—As to the Conference, why not "round" the table instead of "across it?"

RAILWAY SPEEDS.

SIR,—With reference to your article last week on "Railway Speeds," it has always been a matter of surprise to me that on this subject no notice is ever taken of the very high speeds attained by the French locomotives in the trials which took place after the Paris Exhibition of 1889. Yet if anyone will refer to the bottom of page 30 of "La Machine Locomotive," by Edouard Sauvage, he will find that a Crampton locomotive attained a speed of 144 kilometres (= more than 89 miles) an hour—that is to say, 19 kilometres an hour faster than either of the English locomotives in the same trials, and several miles an hour faster than the highest trustworthy record in this country; and the Crampton locomotive is an almost obsolete type of engine. Complete details of the trials of the French engines would be most interesting. R. COLLIER.

7, Chelsea Embankment, November 23rd.

SIR,—Having read your article in last week's issue of THE ENGINEER about "Railway Speeds," and "Why will not British Locomotives Run Faster," might I be permitted to suggest the following improvements:—(1) That a better system of lubrication be introduced, and good oil used. (2) That the length of the ports be increased, and the travel of the valve be diminished, and a balanced valve be used. (3) That a harder metal or alloy be used for axle-boxes. (4) That a bigger steam dome be used than what now seems to be modern practice. (5) That a higher steam pressure be used, say 180 lb. per square inch.

Also I venture to say that many locomotive designers seem to undervalue the desirability of having a very large fire-box to prevent the variation of temperature there is in a small one.

I trust my remarks may meet with approval. S. E. B.

Aberdeen, November 23rd.

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

(*From our own Correspondent.*)

THE improvement which has been the leading feature of the market for the past two or three weeks is happily preserved. Ironmasters on 'Change this (Thursday) afternoon in Birmingham, evinced much interest in the course of the conference in the engineering trades, and the general impression now is that the matter will be soon settled. In that case, every branch of the iron trade, including best plates, machinery, heavy castings, and high-class pig iron, will receive a marked impetus, and the improvement that is now appearing should progress into a trade revival. In several departments it is becoming apparent that demand is beginning to overtake supply. But, in pig iron especially, producers are reluctant to increase the output until prices are more remunerative.

The local engineers, machinists, and constructive ironwork firms have a good deal of work on the books, and some capital orders are arriving from foreign and colonial markets for iron and steel piers and girders and other structural work. A steady output is recorded at the boiler and tank establishments. For railway rolling stock there is a heavy list of contracts on behalf of foreign railways, and all the district shops in this line are busy. Among the buying markets Egypt appears to be a prominent customer just now, one order lately placed in the district running to 200 vehicles. There is a good deal of activity just now in the vice and anvil trades, largely on account of Australia, where compensation is being found for the contraction of business in this branch in the United States.

The pig iron market here is watching the tone of the Glasgow and Cleveland Exchanges very carefully, and the remarkably heavy shipments from the Tees are creating a most favourable impression in this district. Stocks here are practically non-existent, whether in the case of makers or consumers; and as the current output is barely equal to the current requirements, values are well maintained. By some consumers an increasing disposition is being shown to buy forward, the opinion prevailing that after the engineers' settlement there will be an improvement of trade, which will to some extent carry prices irresistibly along with it. Higher quotations are, therefore, generally deemed to be ahead of us. This after Staffordshire all-mine cold blast pigs were 90s., hot air about 57s. 6d. (average), part-mine 47s. 6d., and cinder iron 39s. For foundry qualities prices were—all-mine, 62s. 6d.; part-mine, 52s. 6d.; and cinder, 42s. 6d. Northamptonshire grey forge was 41s. 6d. to 43s. at stations; Derbyshires, 42s. 6d. to 44s.; and Lincolns, 46s. 7d. Derbyshire foundry pigs were quoted 46s. 6d. to 47s. 6d. for ordinary and 50s. for best.

Hematites from the West Coast were selling at 58s. 6d. to 60s. for ordinary forge sorts delivered in this district, and 62s. 6d. for Nos. 1, 2, and 3. The engineers' strike was reported to have a good deal interfered with this trade, having kept prices from rising, but when the end comes a distinct advance is anticipated. The scarcity of native ore supplies was noted to-day as acting as a restrictive element to the blowing in of additional furnaces by certain of the best West Coast firms. The increasing price of Spanish ores is also compelling the bulk of the West Coast houses to consider the policy of early advancing prices, recent selling rates leaving no room for an advance in ore. Some of the largest Barrow firms were reported to-day to be turning out from 10,500 to 12,000 tons per week, according to the grades upon which they are blowing.

American pig iron is still coming into the South Staffordshire district, alike for forge and foundry purposes, and experiments by both sheet ironmakers and ironfounders recently undertaken in this district have given very satisfactory results. The iron is indeed said to have exceeded expectations, and ironfounders assert that they are able to make finer castings than with any English irons they have yet tried. Increased importations may, therefore, shortly be expected. A statement has been made that contracts to the extent of 8000 tons are in progress of delivery to South Staffordshire, but this figure I should consider an exaggeration. It is certain, however, that by quoting easy prices, and just underbidding the English rates, the Americans are doing all they can to get into the market.

Marked bars have a limited sale at £7 10s. to £8 2s. 6d., and merchant bars are quoted £6 10s. Makers of unmarked bars are generally busy, with good prospects to the end of the year. The action of the Unmarked Bar Association in raising their minimum is a good deal discussed, and is taken as an indication that the market is generally moving upwards. The effect upon orders has not so far been pronounced, but it will doubtless quicken some buyers in the fear of further upward declarations. Buyers demur at paying the £6 minimum resolved on by the associated firms, and sales are still chiefly made at £5 15s. Outside firms are quoting £5 12s. 6d. and upwards. Hoops continue at £6 5s. to £6 7s. 6d., tube strip £5 15s. to £6 2s. 6d., and fine strip £6s 10s. per ton. Angles are quoted £6.

In the sheet iron trade an effort is being made to secure better values. At a meeting of the trade which has just been held, and when some seventy mills were said to be represented, an improved demand was reported in the galvanising branch, and some mills which have been standing for some time were reported to have recently regained operations. The fuller time being made at some of the mills is mainly owing to better export orders for galvanised sheets. There is, however, still insufficient demand to provide anything like all the mills with full work, and underselling is rampant. At the meeting of the trade measures were discussed for attempting to stop this underselling, and it was suggested that some organised scheme of restriction of the output should be set on foot. Nothing definite was, however, decided on, and a further gathering is to be held. It is said that the current make of galvanised and black sheets combined in this district is only about half what it was twelve months ago, but this estimate is probably excessive. Prices are quoted this week at £6 to £6 2s. 6d., for 20 w.g.; £6 5s. to £6 10s., for 24 w.g.; and £7 7s. 6d., 27 w.g. Galvanised corrugated sheets are quoted £9 12s. 6d., f.o.b. Liverpool, or equal. Stamping sheets are quoted £9 10s. to £10.

Steel keeps in very active demand, particularly for constructive engineering purposes, the rolling mills being fully engaged. Common plates are quoted £6 delivered stations, and sheets £7 to £8 according to quality. The report that a "ring" has been formed among the steel plate makers in the North of England is causing considerable discussion here. The success of the "combination," in having during the existence of the engineering trouble advanced prices 10s. per ton, is remarked upon with surprise and satisfaction. That steel ship plates should have now got up to £5 10s. on the Middlesbrough market, at a time when, owing to the stoppage of many of the engineering works and shipyards, the exact reverse might have been expected, is a matter of wonder to steelmakers in this district. It is understood that some good orders from the shipbuilders, and an increased demand recently experienced from the bridge builders, have considerably helped forward the advance.

The Birchills Hall Ironworks, Walsall, have been acquired by Messrs. H. Bunch and Sons, of the adjoining Staffordshire Ironworks, and will be re-started at once. Messrs. Bunch are makers of bars, small rounds and squares, horseshoe iron, hoops, and hinge strip, and it is understood that the ironworks will be run on the same class of output. They will give employment to some 200 or 300 additional workpeople.

The promoters of the Stourbridge and Kinver Railway, Worcestershire, have now their scheme sufficiently complete for laying before the Great Western Railway Company, and it is understood that this will be done on as early a date as possible. Notices, however, cannot now be given under the Light Railways Act till the month of April, 1898.

NOTES FROM LANCASHIRE.

(*From our own Correspondents.*)

Manchester.—It can scarcely be said that any very sanguine anticipations are entertained in this district as to a satisfactory settlement of the engineering dispute resulting from the conference which commenced its proceedings this week, and amongst both engineering and iron trade representatives the position is one of waiting further developments. This feeling of uncertainty as to the future necessarily operates against buying of any weight, users for the most part being content to cover immediate requirements; and although there is a fair sprinkling of inquiry, the orders put through do not represent the quantities usually taken, and which might even be expected, in view of the possible early termination of the lock-out and strike. There is also considerable diversity of opinion as to the outlook after the dispute is over. The prevailing anticipation is that the resumption of operations will have no material effect so far as any upward movement in prices is concerned, whilst in some quarters it is thought not improbable the tendency may be rather in a downward direction. This latter view of the situation is based upon the assumption that during the strike the heavy work has been going on in most engineering establishments, and that when operations are resumed, activity will be chiefly in finishing, so that there is a probability of the heavy departments being slackened off for a time until the shops get straight, and that there may thus be temporarily even a lessened demand than at present for raw material.

Although the Manchester iron market on Tuesday brought together a fuller attendance of representatives than has been the case for many weeks there was no corresponding improvement in the actual weight of transactions that were being put through. In most quarters only a slow sort of business was reported, and as regards prices the tone in some directions was not quite so strong as last week. For pig iron there are fair inquiries but buying is only limited, very few consumers placing orders in anything like usual quantities. Local brands remain without quotable change at 45s. and 45s. 6d. for forge to 48s. 6d. for foundry, less 2½. Lincolnshire is firm at 43s. for forge to 45s. 6d. for foundry, with a hardening tendency; and in Derbyshire, foundry supplies are so scarce that special prices are in some cases being quoted which are practically out of the market, the average rates being about 47s. to 47s. 6d. net delivered Manchester. Middlesbrough is easier, and readily obtainable at about 50s. for prompt and 49s. 9d. for forward delivery, by rail Manchester, net cash. Scotch brands are about 3d. below last week's prices. Eglinton being about 47s. 9d. to 48s., and Glengarnock 46s. 9d. to 47s., at ports; and Eglinton, 50s. to 50s. 3d.; and Glengarnock, 49s. to 49s. 3d., net prompt cash Manchester docks. American pig iron is not arriving so freely as was anticipated, and prices remain at 46s. to 46s. 6d. net cash, for ordinary foundry qualities delivered Manchester docks.

In the manufactured iron trade bars are in fair request, with Lancashire qualities fetching £5 12s. 6d. to £5 13s. 9d., and North Staffordshire bars still quoted £5 15s. to £6, delivered here. Sheets and hoops are in very slow demand, with prices unchanged, sheets averaging £6 15s. to £6 17s. 6d., and hoops £6 10s. for random to £6 15s. for special cut lengths, delivered Manchester district, and 2s. 6d. less for shipment.

Nut and bolt makers still report business inactive, with list rates barely maintained.

A continued brisk tone characterises some branches of the steel trade. Hematites, for which there has been a fairly good demand, are firm at 56s. 6d., less 2½, as the minimum, delivered here. Local-made steel billets are firm at £4 6s. 6d. net cash. Bars are in more active request, and range from £6 to £6 5s. for ordinary qualities. Common steel plates continue very firm at the recent advance, £5 17s. 6d. to £5 19s. being got, with steel boiler plates quoted £6 2s. 6d. to £6 5s., delivered here.

Throughout the engineering trade the position remains about as last week. Pending the result of the conference, works are going on much the same as they have been doing for some time past, gradually getting in fresh hands. In the event of the conference bringing about a termination of the lock-out and strike—of which, however, there are considerable misgivings, although the general opinion is that the trade union representatives will not allow the conference to break up without some sort of a settlement being arrived at—there will, as I stated last week, be abundance of work on which to re-start operations. It is, however, altogether improbable under any circumstances that there can be any general resumption of work until after the close of the present month, and it is not at all unlikely that engineering works may not again get in actually full operation until after the turn of the year.

During the past week I had an opportunity of going over the works which have just been opened by the Manchester Acetylene Gas and Carbide Co., who have laid down special plant for the manufacture, under Kay's patents, of gas producers and various fittings suitable for the lighting of works and public buildings, or even districts and small towns, and also for manufacturing smaller plants suitable for dwelling-houses, and portable lights to be used much in the same way as the Wells' lamps. The manufacture of acetylene gas is so well known that it is not necessary to explain in detail the process itself, beyond briefly noting the special features of the system that has been patented by Mr. Kay. The whole plant is very simple in construction, consisting of sloping generators at each side of a gas holder, the gas being produced in the usual way by the admixture of water with the carbide. The noticeable feature of this generator, however, is that the gas is produced in the exact ratio required for consumption, and at the lowest possible units of pressure, so that in works, public buildings, or dwellings the usual gas fittings can be used, and the loss by leakage in defective fittings is reduced to a minimum. Another advantage is that the generators can be re-charged while the lights are burning without admitting air to the gas holder, or affecting the brilliancy of the light. In the portable form for outside lighting purposes, a considerable number has been supplied to the Manchester Ship Canal for use in connection with the discharging of cargoes, &c., at the docks. These portable generators are fitted with wind-proof gas lamps and special flexible pipes, enabling the lamps to be fixed up where required in the ships' holds, and they can be placed on the deck or on the quay, and the gas conveyed by piping to the lamps as required. Each lamp has a light of 150-candle power, replacing twenty-four of the ordinary oil cargo lamps.

Messrs. Fletcher, Russell, and Company, Limited, of Manchester, Warrington, and London, are carrying out considerable extensions of their Warrington works, where new combined works are being erected, which will take the place of their present establishment in Thynne-street, and to which will be added a large foundry for the manufacture of castings for the gas apparatus branch of the business hitherto turned out at Pendleton, involving considerable cost in railway carriage between the two places. In connection with this extension the company is increasing its capital by issuing four per cent. debenture bonds.

Although there is perhaps some increased inquiry for the better classes of fuel suitable for house-fire purposes, no really material improvement can be reported in the coal trade of this district. Some of the collieries are not working more than four days per week, whilst where they are running full time the output is only being moved away with difficulty, and stocks, which are usually being heavily drawn upon at this time of the year, remain practically untouched. The better qualities of round coal still hang upon the market, and there is a continued weakness in prices, especially where advances were put on at the commencement of the month, which in some cases are not now being maintained. The lower qualities of round coal continue generally plentiful in the market, the restricted demand for retail yard requirements, owing to the mildness of the season and the lock-out and strike, throwing surplus supplies on the hands of colliery proprietors, whilst the continued stoppage of engineering and ironworks also restricts the consumption for general manufacturing purposes. At the pit mouth good qualities of steam and forge coals remain at about 6s. to 6s. 6d. per ton, the minimum figure being taken readily to clear away anything like quantities. Notwithstanding the lessened output of slack, owing to the restricted demand for round coal, supplies of engine fuel continue ample, with prices only about steady at late rates, common sorts averaging 3s. 3d. to 3s. 6d.; medium, 3s. 9d. to 4s. 3d.; and best qualities, 4s. 6d. to 4s. 9d. at the pit mouth.

For shipment business is moderate, but not so active as a few weeks back, and good qualities of steam coal are not fetching more than 7s. 9d. to 8s., delivered at the Mersey ports or the Manchester Ship Canal.

Barrow.—The market for hematite pig iron in this district remains steady, and business on a fairly large scale is being done by makers, who are well off for orders, and keep adding to their forward delivery engagements. Prices are steady at 48s. 6d. to 50s. 6d. net, f.o.b., for mixed Bessemer numbers; but warrant iron, which has fluctuated between 48s. 4½d. and 47s. 9½d., is easier at 47s. 10d. net cash, sellers; 47s. 9½d. buyers. This is, however, only a speculative change in values, as the market's position would indicate that higher prices should obtain. During the week stocks of warrant iron have been increased by 337 tons, and now stand at 184,144 tons, or 111,802 tons less than at the beginning of the year. There are prospects of a fuller business in Bessemer qualities of iron, but the trade in forge and foundry iron is quiet. Thirty-nine furnaces are in blast, as compared with thirty-five in the corresponding week of last year.

There is no variation to note in the value of hematite iron ore, which stands at 10s. 6d. to 11s. per ton, net, f.o.b., for ordinary good sorts. The market is steady and brisk, and raisers have no difficulty in disposing of their output, as users are increasing their wants, and it is still necessary to supplement the local supply with frequent heavy cargoes of ore from Spain.

The steel trade is brisk industrially, and business is offering to a fuller extent for the heavy classes of product, such as steel rails, &c. Makers, however, have not booked orders on as liberal a scale lately as was the fact up to a few months ago, but it is evident that a better demand is springing up, and doubtless long before makers need new orders plenty will be on offer, as the market is beginning to show new life. Prices have not altered, and heavy rails are still quoted at from £4 7s. 6d. to £4 10s. per ton, net, f.o.b. Light rails and colliery sections are still in quiet demand. Shipbuilders have not given out many orders lately for new specifications, but it is known many large orders are ready to place out so soon as the industrial war which is having so disastrous an effect on various trades is over. The trade doing in other descriptions of steel is well maintained.

Shipbuilders are proceeding with their work as well as is possible under the circumstances, but satisfactory progress is at present impossible. No new orders are reported, and very few offers are in the market.

Coal is in quiet demand, and coke is firm and steady, good prices ruling for the latter, and poor prices for the former.

The shipping trade at West Coast ports is fairly busy. The exports of pig iron during last week were 7325 tons, and of steel 6340 tons, as compared with 4780 tons of pig iron, and 8131 tons of steel in the corresponding week of last year, showing an increase of 2545 tons of pig iron, and a decrease of 1791 tons of steel. The aggregate for the year shows the exports of pig iron to have reached 391,187 tons, and steel 414,549 tons, as compared with 293,927 tons of pig iron, and 440,824 tons of steel in the corresponding period of last year, showing an increase of 97,260 tons of pig iron, and a decrease of 26,275 tons of steel.

During the week one of the furnaces at the Lonsdale Ironworks, Whitehaven, has been put in blast, and another one is expected to be ready in a short time. These works were acquired in the spring of this year by a new company, Mr. T. Barlow-Massicks being the managing director. The works have stood idle for a considerable time.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

THE weather continues so variable—one day mild as spring, the next a keen frost or a blinding fog—that the house coal pits can scarcely be said to have felt yet the full pressure of the winter demand. There is, however, a good volume of trade being done, the collieries being worked fully five days per week. Although some accumulations are being noted, a week of sharp weather will suffice to clear them all off. While the local demand for house coal is quieter than usual values are maintained, and there is not the slightest hope now of any weakening in prices, although some concessions are made to clear stocks which have accumulated on the lines. These are not at all important, the great bulk of the coal being kept at the collieries in anticipation of the brisk metropolitan demand which cannot now be much longer delayed. Best Silkstones are quoted at 9s. to 10s. per ton; ordinary from 7s. 6d. per ton; Barnsley house, 8s. 6d. to 9s. per ton; seconds from 7s. per ton. Although the Baltic trade is now at an end there is still a considerable weight of steam coal being sent to the Humber ports, while the inland business is kept fairly well up, the railway companies taking a tonnage considerably in excess of their contracts. Quotations, therefore, remain firm, Barnsley hards making 7s. to 7s. 6d. per ton, secondary qualities ranging from 6s. 3d. to 6s. 9d. per ton. For engine fuel there is also a steady demand, although, owing to the lessened activity of the coke manufacture, an unusually large quantity of small coal is being thrown on the market. Good nuts make 6s. to 7s. per ton; screened slack, 4s. to 5s. per ton; pit slack, 2s. to 3s. per ton. At the coke ovens there is not so much business being done, and stocks are beginning to appear in some places. Values range in ordinary qualities from 9s. to 9s. 6d. per ton, washed coke making 11s. to 11s. 6d. per ton.

In various parts of the Yorkshire coalfield dissatisfaction is reported amongst the men. At several pits, indeed, permission has been asked of the Yorkshire Miners' Association to shut the collieries down. It is not expected, however, that this extreme sted will be taken, the officials being against any actual stoppage of the pits. The men continue to complain very bitterly of the overcrowding of the collieries. They state that the working face allowed to each collier has been greatly reduced, with the result that, although the output is greater, the men individually are not able to benefit by it, and, in fact, are not so advantageously placed as they used to be.

Work proceeds quietly at the East End, the men who were called in to fill the places of the engineers having now got pretty well accustomed to the machines, and there have been fewer breakdowns than were anticipated. Much activity is at present being shown in military material of all sorts, a feature of recent business in this department having been the increased attention given to the production of armour-piercing projectiles. In railway material, though no large fresh orders have to be reported, there is still abundant employment on the work obtained early in the year. Railway carriage and wagon builders are extremely busy as far as they can be under the difficulties caused by the stoppage. An important local firm, whose work is largely in fitting up railway trains, are now pressed with orders for that purpose, and report that they have never known their business so brisk in previous years. This is owing to the home railway companies having, during the prolonged depression, rigidly restricted their orders for carriages and wagons. When the improvement in trade set in and became more pronounced, almost all the big railway companies in England gave out orders and pressed for delivery. These came at the same time as the foreign trade augmented, and owing to the obstacles put in the way by the recent engineering trouble, it has been, and is still, a matter of extreme difficulty to meet the requirements of the home companies.

Messrs. Vickers, Sons, and Maxim, Limited, whose authorised capital is £2,500,000, announced this week an issue of £1,250,000 4 per cent. first mortgage debenture stock, at £104 per cent., repayable at par on the 30th day of November, 1937, or redeemable at the option of the company at £104 per cent. on and after the 30th day of November, 1912, at six calendar months' notice. The prospectuses were posted on Tuesday evening, the 16th inst., and the issue advertised in the papers on Wednesday morning, the 17th inst. At 4 o'clock the same day, £3,600,000 had been applied for in London alone. On Thursday, at 11.15, the London lists were closed. The allotments were made on Friday evening, and the allotment letters issued at noon on Saturday. The total amount applied for was about £6,000,000.

What is believed to be the largest iron ingot mould ever manufactured in Sheffield has been successfully cast by Messrs. Moorwood, Sons, and Company, Harleston Ironworks, and Sheffield Moor. It was cast from four furnaces, and weighed about fifty tons. This ingot mould was made to the order of a Sheffield firm largely engaged in the production of war material, and it will be used in the processes connected with armour plates.

The lighter trades of the city continue very much as recently reported. A quiet Christmas and New Year's business is anticipated. The bulk of the orders that have recently been taken are in the hands of the larger houses. The smaller firms, particularly those dependent on the home market, are having anything but full order books. A leading feature of the lighter industries at present is an abnormal demand for forks and spoons, a demand which has been so great that in several instances where the orders are accompanied by conditions of urgent delivery, they have had to be refused.

NORTH OF ENGLAND.

(*From our own Correspondent.*)

ON the whole the position and prospects of trade in this district are satisfactory, though this week there is a quietness in the demand for pig iron, due to no particular cause. It is generally expected that there will be great briskness all round as soon as the engineers have resumed operations, and consumers seem inclined to hold back until that consummation is arrived at. It is a widespread opinion that next year will be a very brisk period, as good in all respects as this year has been, if not better, as so much work is already booked for execution, especially by the ship and bridge builders.

Makers of No. 3 Cleveland pig iron for prompt f.o.b. delivery, and also for delivery over the first quarter of 1898, have been quoting 41s. 6d. per ton this week, but some of them, and also most of the merchants, have not refused orders at 41s. 3d., and even at 41s., owing to the fall in warrants. No. 1 is at 43s.; No. 4 foundry at 40s. 9d.; grey forge, 39s. 6d.; and mottled and white at 39s. 3d. The situation for producers of Cleveland iron is satisfactory, as it has been all the year, their stocks are exceedingly small, especially of No. 3; indeed it is stated on trustworthy authority that in the whole of the Cleveland district the stock of this quality in makers' yards is not above 5000 tons, which is far below a fair working stock, and it explains the difficulty that shippers have had lately in securing prompt deliveries, vessels often having had to wait two or three tides before they could get their cargoes. Never in recent years, except during the latter part of the Durham miners' strike of 1892, has there been so small a stock as that now held, and the production still continues short of the consumption. This week the output has been still further reduced, as Sir B. Samuelson and Co., Limited, at the Newport Ironworks, Middlesbrough, have had to blow out a furnace making Cleveland iron, the lining having given way. Shipments of pig iron from the Cleveland district have slackened, not on continental account, however, though the ports in the upper Baltic are closed, but on Scotch account, this being a result of the recent high price of Cleveland pig iron, as compared with Scotch, during which time the Glasgow founders had to buy an enlarged quantity of Scotch. This iron is now being delivered, and naturally less Cleveland iron is required. When the contracts now being fulfilled were entered into Cleveland iron was only 2s. 6d. to 3s. per ton below Scotch, and that did not suffice to cover the cost of conveyance of the former to the Clyde. Now, however, the difference is over 4s., and Scotch buyers are operating more freely in Cleveland iron. The exports of pig iron from the Cleveland district this month have reached 88,605 tons, as compared with 92,189 tons last month, and 102,914 tons in November, 1896, to 24th. The stock of Cleveland pig iron in Connal's public warrant stores on the 24th was 77,131 tons, a decrease of 950 tons this month.

While the producers of Cleveland pig iron are doing fairly well, the situation with the makers of hematite pig is anything but satisfactory, and has been so all the year, and the cost of production, even under the most favourable circumstances, can hardly be covered. For mixed numbers of East Coast hematite pig iron 49s. 6d. is quoted, but 49s. 3d. is not refused, and this though Rubio ore is advancing in value. With hematite at the above-named price, makers cannot afford to give the figure at present quoted for ore, and yet this price does not pay the ore merchants. Iron producers are not prepared to give more than 15s. per ton for average Rubio ore, but merchants have to quote 15s. 6d., and at this they will make nothing, because they have to pay 9s. per ton for the ore at Bilbao, and 6s. 6d. is the freight to the Tees or the Tyne. The difficulty of carrying on the Bilbao ore trade profitably has led some of the merchants to go out of it, and devote their attention to ores from other quarters. Makers complain very much of the poor quality of the ore that is supplied to them, and it is very seldom they meet with 50 per cent. ore.

So unsatisfactory is the hematite pig iron trade, that makers producing this description of iron would, as a rule, be glad to cease its manufacture, if they could get supplies of Cleveland ironstone. But this they cannot, as a rule, because the owners of nearly all the Cleveland mines are themselves pig iron producers, and it would hardly pay them to afford facilities for other firms entering into the competition with them for the sale of Cleveland pig iron, it would certainly bring down the price of this, and what little they would gain on the sale of the one would be lost on the pig iron. Of course, the hematite pig iron makers go on producing though they can realise no profit, as they would be greater losers if they stopped furnaces altogether. The Normanby Ironworks Company, Limited, Middlesbrough, which has had three furnaces in operation, all producing hematite iron, have changed one to ordinary Cleveland, but they are part owners of Cleveland ironstone mines. The stock of hematite pig iron held in Messrs. Connal and Co.'s warrant stores is 51,602 tons, a decrease of 2178 tons this month.

The blast furnacemen of Cleveland are becoming rather impatient that the three shift day is not yet adopted, but the cause of the delay does not rest with the employers, it is among their own members, there being a considerable number of men averse to it, as it will reduce their earnings where they are paid according to the tonnage produced.

The finished iron and steel works are generally well employed, and it is remarkable to find so much activity in the steel plate trade when there are so many of the shipyards idle. But though this is the case, there have recently been given out numerous orders for new steamers, and the builders have been ordering the plates they will require. Among the orders given out are:—To Messrs. William Doxford and Sons, Limited, Pallion, Sunderland, two steamers of their turret deck type, 300ft. and 335ft. long respectively; Tyne Iron Shipbuilding Company, steel steamer of 2540 tons gross for the Stag Line; Ropner and Sons, Stockton, steamer of 1950 tons gross for their own line; Palmer's Shipbuilding and Iron Co., steel steamer of 4280 tons gross for Messrs. R. Alexander and Co.; C. S. Swan and Hunter, Limited, Wallsend-on-Tyne, steel steamer of 3360 tons gross; William Gray and Co., West Hartlepool, steel steamer 336ft. long, for Messrs. Sivewright, Bacon, and Co., of that port; Sunderland Shipbuilding Co., steamer 400ft. long for Mr. W. Lund's Australian Line; Craig, Taylor, and Co., Thornaby-on-Tees, steel steamer of 4360 tons gross. So numerous are the orders booked, and so favourable the prospects for next year, that the steel plate makers of this district have formed a "ring" for the regulation of prices, and have fixed upon £5 10s., less 2½ per cent. at works, as their official figure for steel ship plates, but consumers are not yet prepared to give that. The "ring" does not include the makers of iron plates, but there are now scarcely any of these left. The quotation for iron ship plates is £5 5s., less 2½ per cent. f.o.t. Steel ship angles are at £5 5s.; and iron ship angles £5 2s. 6d.; while common iron bars are at £5 5s., all less 2½ per cent. f.o.t. Heavy steel rails are at £4 10s. net at works, and business is active.

The Parsons Turbinia Company has acquired thirteen acres of land at Wallsend-on-Tyne, and also the copper works of Messrs. Mason and Barry, as well as a further area of ten acres on which to erect buildings and plant for the construction of vessels of the Turbinia type, the invention of Mr. C. A. Parsons.

The eighth annual report of the directors of Messrs. Dorman, Long, and Co., Limited, Britannia and West Marsh Iron and Steel Works, Middlesbrough, states that the gross profit for the year ended September 30th was £52,756, and they will pay to the ordinary shareholders a dividend of 6 per cent. They wrote off £10,000 for depreciation, and carry forward a balance of £15,478, which is sufficient to pay another 2 or 3 per cent. Their girder business has increased so rapidly in London, that they have bought outright the freehold yard which they held on lease, and have leased another plot of ground. They have also extended their engineering department at Middlesbrough. Their works in all branches have been fully employed during the year, and are likely to remain so.

Mr. Walter Hudson, of Darlington, the president of the Associated Society of Railway Servants, is a candidate for the general secretaryship of the Society, as is also Mr. William Keel, of Middlesbrough.

The members of the Incorporated Association of Municipal and County Engineers—Northern Division—held a conference at Sunderland on Saturday, and visited the works of the Wear Improvement Commissioners, including the new Roker Pier. They also inspected the Borough Electric Lighting Works.

The Sunderland Exhibition of Engineering, Shipbuilding, Mining, and Electricity was opened on Monday by the Marquis of Londonderry, and has since been largely attended. The exhibition covers over two acres of land. The main building is 180ft. by 120ft., and there are several smaller buildings. The whole of the buildings are lighted by electricity by the Sunderland Forge and Engineering Company.

While the steam coal trade is becoming quieter, on account of the slackening of the shipping demand, there is greater activity in the gas coal industry, and the prices of the latter are tending upwards, as they are also for manufacturing coal, the contracts for the latter for next year's delivery being made at 3d. to 6d. per ton more than has ruled for coal for the current quarter's consumption. Best Northumberland steam coal is 8s. 3d. per ton, f.o.b. The Northumberland miners have determined to ask for a further advance; they received 2½ per cent. a short time ago. Coke is firm at 13s. 6d. per ton, delivered at Teesside furnaces.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

THE state of business in the iron and allied trades in Scotland is not nearly so satisfactory as could be desired. There can be no doubt that it is at length suffering severely from the effects of the dispute in the engineering trade, and it is hoped by all concerned that this matter may soon be amicably arranged.

The pig iron warrant market has been depressed, and prices have again reached a lower level. Consumers find that their wants are easily met, and there is comparatively little speculative business being done. Scotch warrants have been done from 45s. 5½d. to 45s. 2½d. cash, and 45s. 6½d. to 45s. 5d. one month. There was no inquiry whatever for Cleveland warrants at the beginning of the week, but subsequently a small business was done from 41s. 2d. to 41s. 1½d. cash, and at 41s. 4d. one month. Cumberland warrants sold very slowly at 48s. 3½d. to 48s. 1d. cash, and 48s. 3d. one month. For several weeks there had been nothing whatever doing in Middlesbrough hematite, but this week a limited quantity changed hands at 48s. 11½d. and 49s. for delivery in one month.

The main element of stability in the market at present seems to arise out of the continued heavy decrease in stocks in the North of England. The reduction of stock in the Glasgow warrant stores in the past week was only about 300 tons, but the total quantity remaining on hand is comparatively small.

Since last report four furnaces have been put out of blast at the Clyde Ironworks, temporarily it is understood, in order that some necessary repairs may be done. There are now 75 furnaces blowing in Scotland, compared with 77 at this time last year, and of these 35 are producing ordinary, 36 hematite, and 6 basic iron.

There is not much change in the prices of makers' iron, but the tendency as regards G.M.B. is somewhat lower. Govan and Monkland, f.o.b. at Glasgow, Nos. 1, are quoted, 46s. 3d.; Nos. 3, 45s. 7½d.; Wishaw and Carnbroe, Nos. 1, 46s. 6d.; Nos. 3, 45s. 10½d.; Clyde, No. 1, 50s. 3d.; No. 3, 47s. 3d.; Gartsherrie, Summerlee, and Calder, No. 1, 51s.; No. 3, 47s. 6d.; Coltness, No. 1, 52s.; No. 3, 48s.; Glengarnock at Ardrossan, No. 1, 50s. 6d.; No. 3, 45s. 6d.; Eglinton, at Ardrossan or Troon, No. 1, 47s. 6d.; No. 3, 46s.; Dalmellington at Ayr, No. 1, 47s. 6d; No. 3, 46s.; Shotts, at Leith, No. 1, 52s. 6d.; No. 3, 50s.; Carron at Grangemouth, No. 1, 51s. 6d.; No. 3, 48s.

The demand for Scotch hematite iron is at present comparatively slow, and there is considerably less of it being produced than was the case a few weeks ago. The price is, however, nominally unaltered, merchants quoting 52s. per ton for delivery at the steel works.

The Scotch pig iron shipments are slightly better this week. The manufactured iron trade is, if anything, rather quieter. Makers have fewer inquiries connected with the home trade, and it would not be surprising were business to settle down a little between now and the end of the year. Much will depend upon the issue of the conferences regarding the engineers' dispute. Merchants report that the inquiry for steel is very sensibly diminishing, and holders who have been anxious to realise are reported to have done so within the last few days at somewhat lower prices.

The coal market is in some respects in a better position than of late. There has been a very decided upward movement in freights to the Mediterranean, and although this is no doubt partly due to a scarcity of handy tonnage, it has not been without a favourable effect on the coal market. Some exporters indeed state that stocks are abnormally heavy at Alexandria and elsewhere on the Mediterranean, but notwithstanding this there is a decidedly more hopeful feeling in the trade. The coal shipments from Scottish ports show a good increase, amounting for the past week to 180,300 tons, compared with 170,041 in the preceding week and 129,023 in the corresponding week of last year. The improvement is well distributed over the ports both east and west. Household coals for home use are quieter owing to mild weather; the output of most kinds of coals is large and steady, yet prices are upon a fair level. Main coal is quoted f.o.b. at Glasgow 7s.; splint, 7s. 6d.; ell, 7s. to 7s. 9d.; steam, 8s. 3d. per ton.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

THE manager of an important group of collieries remarked to me this week that the steam coal trade was passing through a trying time, and he was afraid that the cause must be attributed in a large measure to the injudicious action of colliers, in suggesting a "stop week" as a cure for the occasional slackness of business. "Poor fellows," he added, "they have seen now the result of stop weeks." Of late, work has been very uncertain in many of the steam collieries. Merthyr Vale, which as a rule is carried on with a good deal of regularity, has been very stagnant, so too Plymouth collieries, which have able and vigilant representatives at Cardiff. I might go on specifying a long list, but these are illustrations.

Another factor, too, in the dull times, in addition to the action of the men in driving away tonnage, is the fact that at this juncture generally trade is rather quiet, on account of contracts running out, and new ones being entered upon. Very probably a little more briskness will be experienced shortly, as a number of Cardiff steamers engaged in the South American trade are expected on their homeway journey.

A few substantial cargoes were dispatched from Cardiff at the close of the week, and this gave a little animation; 4800 tons were dispatched to Rio, 7000 tons to Port Said, 5400 tons to Colombo, and 4000 tons to La Palmas. Mid-week there were also a few substantial consignments, such as 5700 tons to Monte Video, and 4150 tons to Brindisi; but the majority ranges comparatively low. One consignment left Newport, Mon., on the 23rd, 4700 tons, for Brindisi.

I am enabled to put on record one contract entered into with the Khedive of 20,000 tons, obtained by Milburn and Co. The price is stated to be 16s. 7d., c.i.f.

At the docks, Cardiff, on Saturday last, it was stated that tonnage had come in again very slowly, and business accordingly in steam coal was restricted. Inquiries both for prompt and future deliveries were quite up to expectation, but the drawback was the absence of steamers, and it was noticeable that, notwithstanding the phenomenal rates running to all ports in the Mediterranean, tonnage was "snapped up" eagerly whenever possible. Some idea of these freights is worth giving. A boat was taken on Saturday for Leghorn at 10s. 3d., three were fixed for Genoa at 9s. 9d., and one small steamer for the same at 10s. These rates are stated to be the highest recorded for years, and are about double the quotations which ruled for a time during the depression in 1896.

This week foggy weather has settled down on the Bristol Channel, and this has not improved conditions. The latest report, Exchange, Cardiff, was that the demand for all kinds of coal was indifferent, and prices for prompt shipment difficult to maintain. Closing prices were as follows:—Best steam coal, 10s. 6d. to 10s. 9d.; seconds, 9s. 3d. to 9s. 9d.; dry, 9s. to 9s. 9d.; special small, 6s. to 6s. 3d.; best ordinary, 5s. to 5s. 3d.; seconds, 4s. 9d.; inferior, including drys, 4s. to 4s. 3d.; best Monmouthshire coal, 9s. to 9s. 3d.; seconds, 8s. 7½d. to 8s. 9d.; best house coal, 10s. 9d. to 11s; seconds, 9s. 9d. to 10s; No. 3 Rhondda, 10s. 6d. to 10s. 9d.; brush, 9s. to 9s. 3d.; small, 7s. 6d. to 8s.; No. 2 Rhondda, 8s. 3d. to 8s. 6d.; through, 6s. 9d. to 7s.; small, 4s. 6d.

Swansea coal trade last week was tolerably good, and some of the collieries showed an increased output. This was the case at Birchgrove. The Foxhole collieries too are very busy. With the exception of the old Birchgrove, most of the collieries have a fair measure of activity, and winter business is opening well, though generally, over the whole district the mildness of the season has told adversely on house coals.

Swansea coal prices are firm, and in some cases show an improvement. The following are the latest quotations:—Anthracite: Best pig iron, 11s. to 11s. 6d.; second quality, 10s. to 10s. 6d.; ordinary large, according to quality and selection, 9s. to 10s.; small rubbly culm, 4s. 3d. to 4s. 6d. Steam coals: Best, 9s. 6d. to 10s. 6d.; seconds, 8s. 6d. to 9s. 3d.; bunkers, 7s. to 7s. 6d.; small, 5s. to 5s. 6d. House coals, No. 3 Rhondda, 10s. 6d. to 11s.; through, 8s. 6d. to 9s. 6d.; small, 7s. 9d. to 9s. 6d.; No. 2 Rhondda, 8s. 9d. to 9s.; through, 7s. 3d. to 7s. 9d.; small, 5s. 3d. to 5s. 9d.; cash thirty days.

Patent fuel is somewhat depressed in the Cardiff and Swansea districts. Swansea shipments last week were under 6000 tons. Prices remain. Coke is in good demand at list prices, and in pitwood sales have been effected up to 17s., arrivals having been scant.

The iron and steel trades remain tolerably buoyant, and I hear that very large consignments of ore are coming in, leading to the impression that ironmasters are expecting a continuance of activity.

The Dowlais "Big Mill" has been working throughout the week without the slightest hitch, and the quality of tin bars turned out is reported as uniformly good. In proof of the pressure at Dowlais, half a turn of overtime was worked last week each night in all the mechanical departments, and full time in all the mills and forges.

The Cyfarthfa Works are busy on rails and bars. In the Swansea district the steel works throughout the valley are active. At Briton Ferry the make of hematite pig iron last week was larger than in any of the preceding weeks of the quarter, and the output of steel bars at the Briton Ferry, and also at the Albion, was above the average.

Several of the tin-plate works in this neighbourhood are idle, but in the Llanelly district I am glad to record a settlement of the strike. A settlement was brought about last week, and now the three works are going on briskly. The imports of pig iron into Swansea last week amounted to 2363 tons, iron ore 2940 tons, and 98 tons of steel blooms from Sweden.

The tin-plate trade with America is reported as brightening, though last week the total shipments were only 26,260 boxes, while the quantity from the works totalled 40,207 boxes.

On 'Change, Swansea, mid-week, it was reported that pig iron had been struggling throughout the week, leaving off slightly weaker than at my last report. Consumers are said to have completed requirements for the year, and would wait to see what would turn up. One idea was, that if certain trades succeeded in getting shorter hours, other trades might follow, so it would be wiser to wait developments.

Latest quotations are as follows:—Glasgow pig, 48s. 4d.; Middlesbrough No. 3, 41s. 10d.; hematite, 48s. 9d.; Welsh bars, £5 10s. to £5 12s. 6d.; sheet iron, £6 5s. to £6 7s. 6d.; steel, £6 5s. to £6 7s.; steel rails, heavy, £4 7s. 6d. to £4 10s.; light, £5 7s. 6d. to £5 10s.; Bessemer steel bars, £4 2s.; Siemens, £4 2s. 6d. Tin-plates, Bessemer cokes, 9s. 7½d. to 9s. 9d.; Siemens, 9s. 9d. to 9s. 10½d.; ternes per double box, 28 by 20, 17s. 3d., 17s. 9d., 18s. to 21s.; best charcoal, 10s. 6d. to 12s. 6d. Block tin, £62 17s. 6d. to £63 3s. 9d.

Sir John Jones Jenkins, Swansea, is stated to have said that his company—the Rhondda and Swansea Bay Railway, of which he is chairman—and the Taff are making arrangements for a through route *viâ* Treherbert between Swansea, Cardiff, and Newport.

As intimated lately, the preparations for next session in the form of railway Bills are weighty ones. As stated by a Cardiff authority, if the whole of the Welsh schemes which are foreshadowed are proceeded with, the Committee before whom they will be brought will have a busy time, and the chief members of the Parliamentary Bar reap another golden harvest.

At present I only notice them in brief, as modifications are not improbable. The only dock for which powers are sought is the Windsor.

Barry Railway Company is to make another attempt to obtain powers for constructing an independent line between Cogan and Cardiff. Another important scheme is a continuation of the Barry directors' efforts to reach the Monmouthshire coalfield, from which now the shipments are taken by Cardiff and Newport. Under powers obtained in 1896 they are now constructing a line between St. Fagan's and Penrhos Junction, which will put them in connection with the Rhymney at that point. They will now seek powers to make a short line which will connect the Brecon and Merthyr line with the Rhymney. If gained, this will enable them to touch the coal of the Rhymney Valley, particularly from the Powell Duffryn colliery, and the Rhymney Iron Company's colliery at Bargoed. I note that the Brecon Railway Company is aiming at the same thing.

The Cardiff railway projects are the abandonment of the line to Pontypridd, and instead to make a line from the eastern end of the Roath Dock, running powers with Great Western Railway from Roath, and independent lines from Pontypridd to Aberdare and Merthyr Tydvil. The junction with the Taff Vale at Treforest, which was part of the original Bill, is to be retained. The Cardiff Railways—Bute—propose also to close the Glamorgan and Aberdare canals, and abandon except from Melin Griffith to Cardiff; but to retain all the water rights and certain other powers of the companies, though provision is made for their dissolution. Running powers are sought on the Taff Vale, Rhymney, Great Western, North Western, and Barry. An increase in the number of Cardiff railway directors is also sought, as well as power to divide the stock into preferential and deferred.

A leading feature also is sidings to the Albion, Dowlais-Cardiff, Penrhiwceiber, Nixons, and Harris's Navigation Collieries.

I shall notice these and their important connection later on.

I expect daily to hear of the settlement of the Abernant strike. Prospects are favourable.

NOTES FROM GERMANY.

(*From our own Correspondent.*)

IN the iron-producing districts here the position shows no appreciable change since former letters. The tone generally is firm; here and there orders are reported to have been coming in more freely; as a rule, however, the business done is rather moderate, and the condition of prices has not improved.

The Silesian iron trade has been active in most departments, fresh work coming to hand pretty regularly; quotations remain stiff.

Employment and demand in the various branches of the Rhenish-Westphalian iron industry have been comparatively satisfactory during the week now past, there being generally a slight tendency towards improvement perceptible in the local trade.

On foreign account only a moderate business is being put through. Regarding the different sorts of iron, there has been no change reported since previous weeks; pig iron is in pretty strong request and so is malleable iron; prices show a fair stiffness. German Bessemer is quoted M. 62 to 64 p.t. at works; foundry pig, No. 1, M. 67 p.t.; No. 3, M. 60 p.t. Forge pig, free Siegen, M. 58 p.t.; iron for steel making, M. 60; basic, M. 60·50 p.t. In billets a healthy sort of business is generally done; raw bars in basic are quoted M. 84 p.t.; billets in basic, M. 94·50 p.t. Blooms were a trifle weak just now, quotations for Rhenish-Westphalian sorts having slowly decreased on M. 86 and even 85 p.t.; Siegerland sorts, however, are firmly maintained on M. 90 to 91 p.t., thanks to the Siegerland Union of Puddling Furnaces. In spite of the low prices for blooms, which in many cases scarcely cover the costs of production, the amount of orders booked is much smaller than might be desired. Prices for light section rails have, according to the *Rhenish-Westphalian Gazette*, been moving downwards during the past few weeks, and are at present standing at M. 100 p.t. and below. This decrease may partly be accounted for by the fact that American light section rails were to be bought in Antwerp at much cheaper rates than the Rhenish-Westphalian works could afford to take. The activity of the girder mills is fairly satisfactory, considering the time of the year; M. 105 is the basis quotation, which is likely to be well maintained throughout the winter. Bars remain neglected, buyers showing but little confidence in the future; although the forming of a Bar Convention is generally considered as being sure to take place, nothing definite has, however, been done in the matter yet. The recent bearing of the Pig Iron Convention, which refused to agree to a bounty on export unless all the iron and steel producers have joined in a syndicate, will most likely induce the different parties to come to an agreement before long, and this would be decidedly beneficial to the bar trade, and also to other branches of the iron industry, where the underquoting of the different works prevents a sound business. There is much life stirring in the railway and engineering line, and employment is likely to remain brisk for some time ahead. Several orders for all sorts of railway requirements, such as tires, fishplates, rails, steel springs, &c., will be given out within the course of the present month. According to a note contained in the *Rhenish-Westphalian Gazette*, the endeavours to form a Wire Nail Convention appear to have been pretty successful, the difficulties which have hitherto prevented an agreement between the parties concerned having one by one disappeared, and there are now but a few works that remain somewhat obstinate in the matter. A syndicate has long been looked upon as the only means of improving the conditions of this long-neglected branch of the iron industry, regulating the demand as well as the prices. However, if the endeavours of the leading parties meet with a steady resistance, one need not be astonished if they finally cease to take an interest in the matter. The question is whether the raw and malleable iron conventions will put up with these continual rebuffs. One means to punish, as it were, the refractory mills would be the refusal of the bounty on exports of wire nails. The granting of this bounty is one of the principal conditions for the forming of the Wire Nail Convention, and therefore of some importance.

The business in coal in Rheinland-Westphalia and Silesia, as well as in the Saar district, is animated, and consumption in many instances exceeds the output. Prices are extremely firm. The Government colliery, Königin Louise, has raised the prices for coal and coke 25 Pf. p.t.

To judge from the accounts that are given of the Austro-Hungarian iron industry, the position in some branches appears to be changing from bad to worse. Merchant iron, for instance, is showing an increasing weakness, and some of the smaller bar mills have been compelled to reduce their output. The demand for girders and structural iron has, of course, shown a falling off recently; but there is quite a fair business done in the railway department, orders coming to hand pretty freely. Prices are the same as previously quoted. At a general meeting of the Austrian Scythe and Sickle-makers it has been stated that in 1896-97 the business in scythes has been rather unfavourable.

In Russia, which is the best place of sale for Austrian scythes, the markets in Irbit and Nischni-Novgorod have been but weakly attended; large lots of scythes have remained unsold. In the Wolga and Don district, likewise, consumption has been very limited on account of unfavourable harvests. In the South Caucasus and in the districts about Moscow the business in scythes has, however, been pretty active. To Poland and to the Baltic provinces a moderately good trade was done; Belgium and France have only bought small lots, while Italy consumed a fair quantity. The business in Austrian scythes, sickles, &c., to Bulgaria, has, likewise, been a lively one, but, owing to a bad harvest, a considerable number of the scythes and sickles that were imported have not been sold and fill the stores of the larger dealers.

Demand on the Belgian iron market is lively and the works are well engaged; so that, if prices were a little less inclined to give way where a contract of some weight is in question, the position of the Belgian iron industry might be considered comparatively good. Official quotations are:—Luxemburg foundry pig, No. 3, 60f.; common forge pig, 52f. to 58f. p.t. Merchant iron, f.o.b. Antwerp, No. 2, 131·25f. to 133f.; No. 3, 136·25f. p.t.; the same Belgian stations; No. 2, 132·50f. to 135f.; No. 3, 137·50f. p.t. Girders, f.o.b. Antwerp, are quoted 131·25f. to 133f. p.t.; the same free Belgian stations, 132·50f. to 135f. p.t. Iron plates for export, No. 2, 140f. to 142f.; No. 3, 150f. to 152·50f. p.t. Steel plates for export cost 150f. to 152·50f. p.t.; steel rails, 105f. to 110f. p.t.

A strong tone prevails on the Belgian coal market, owing to a vigorous demand that comes in for all sorts of engine and house coal. The collieries of the Liège district have raised their prices 1f. p.t.

AMERICAN NOTES.

(*From our own Correspondent.*)

NEW YORK, November 17th.

HEAVY exports continue. All commercial factors are stronger. Jobbers are crowded with shipments. Quarantined cities in the Southern States are now opened. Wheat exports last week 5,590,000 bushels, against 3,325,000 same week a year ago. Cold weather has stimulated a demand for goods. Railroad earnings show a steady increase. The banks have a plethora of money. The production of pig iron has increased from 164,000 tons, July 1st, to 213,000 tons a week now, which is 4000 tons per week under the highest production ever reached. Despite this enormous production stocks are steadily declining. On June 1st stocks were 1,067,252 tons, on November 1st, 753,537 tons. There is a heavy consumption, and next year's requirements will probably greatly increase. Prices are somewhat easier just now, but there is nothing to prevent a sudden advance under the appearance of a vigorous demand. Pig iron production appears to be increasing, and the highest limits have probably been passed this week. Billets are in heavy demand at one or two mills. At all others, the reports are that there are no inquiries. Prices are firm at mills, but users of billets are not disposed to buy at any price. They are waiting for the revival of the winter and spring demand, which usually shows itself about December. The bar mills and sheet mills throughout the United States are all doing fairly well, and by next month buyers will have their orders in for winter and spring delivery. Prices for bars and sheets are noticeably weaker than in October, when so much business was placed. Orders for freight, passenger, and baggage cars are now coming in, and if they continue to be ordered it will have a marked influence on the iron trade. The demand for boiler tubes is very active, and boiler plate is also in active request. Plate iron and steel requirements continue to drop in, the latest large order being for 5000 tons. Steel rail orders are coming along better, and prices are very firm. The iron and steel buyers are not anxious to place orders at once, desiring to get a better view of the probable winter requirements. General business is conservative in volume, but the general conditions point to an active winter. The experience of the past five years has made buyers and sellers more cautious. The banks have plenty of money, and failures are fewer in number.

THE NEWPORT HARBOUR COMMISSIONERS' WEEKLY TRADE REPORT.

OWING to the scarcity of tonnage, steam coal is quiet; prices a little easier. House coal is in good demand, with prices very firm. Steel and iron works are well employed. No change in tin-plates.

Coal: Best steam, 9s.; seconds, 8s. 9d.; house coal, best 11s.; dock screenings, 5s. 9d. to 6s; colliery small, 5s. to 5s. 3d.; smiths' coal, 6s. 6d. Patent fuel, 10s. Pig iron: Scotch warrants, 45s. 1d.; hematite warrants, 47s. 10d. f.o.b. Cumberland; Middlesbrough No. 3, 40s. 9d. prompt; Middlesbrough hematite, 48s. 9d. Iron ore: Rubio, 14s. 3d. to 14s. 6d.; Tafna, 13s. 3d. to 13s. 9d. Steel: Rails, heavy sections, £4 5s. to £4 7s. 6d.; light ditto, £5 5s. to £5 7s. 6d. f.o.b.; Bessemer steel tin-plate bars, £4 2s.; Siemens steel tin-plate bars, £4 2s. 6d.; all delivered in the district, cash. Tin-plates: Bessemer steel, coke, 9s. 9d.; Siemens, coke finish, 10s. Pitwood: 16s. 9d. to 17s. London Exchange Telegram: Copper, £48 8s.; Straits tin, £62 15s. Freights advancing and very firm.

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.

10th November, 1897.

26,138. Stoves, T. Fletcher, J. Neil, and Fletcher, Russell, and Co., Ltd., Manchester.
26,139. Centrifugal Machines, A. M. Stuart, Glasgow.
26,140. Goffering Machine, R. Plumber, Paris.
26,141. Batten-fixing Clamp, A. Matthews, Northumberland.
26,142. Fire Lighters, J. Guest, Leeds.
26,143. Non-puncturable Pneumatic Tires, G. Ellis, Rochdale.
26,144. Incubator, E. Pètre, Brussels.
26,145. Guiding Spindle-driving Bands, J. Boyd, Shettleston, N.B.
26,146. Muzzle, S. Osborne, London.
26,147. Martini Fire-arms, F. Greener, Birmingham.
26,148. Mould for Casting Bars, A. E. Heckford, Birmingham.
26,149. Collar, J. Greaves, Belfast.
26,150. Plough, F. Baumann, Berlin.
26,151. Plough, F. Baumann, Berlin.
26,152. Doors for Railway Carriages, J. Scotson, Wigan.
26,153. Pneumatic Boot-tree, T. G. Stevens, Greenhithe, Kent.
26,154. Automatic Boot-tree, T. G. Stevens, Greenhithe, Kent.
26,155. Signalling, W. J. Featherstone and T. Pratt, London.
26,156. Window Sash and Frame, B. Crowther, Birmingham.
26,157. Rubber Tires, F. G. Heath and G. F. Baylis, London.
26,158. Cultivators, E. H. Nicholson and W. Mather, London.
26,159. Urn Taps, W. H. L. McCarthy, Walthamstow, Essex.
26,160. Securing Covers to Wheel Rims, J. Adair, Bristol.
26,161. Mudguards, G. Townsend, London.
26,162. Bottles, A. Plath, London.
26,163. Knotter Mechanism, T. Measures, London.
26,164. Undergarment for Children, I. N. Fooks, London.
26,165. Brakes, L. H. Flory, London.
26,166. Match Box, W. E. Postlethwaite, London.
26,167. Garden-cultivating Appliance, G. W. Shailer, London.
26,168. Pipes, J. H. Sutton, London.
26,169. Driving Gear, E. R. Roche, London.
26,170. Coir Yarn Mat Manufacture, R. E. Evenden, London.
26,171. Brake Set, A. W. Gamage, London.
26,172. Preparing Oxalic Acid, M. Goldschmidt, London.
26,173. Biscuit for Dogs, J. W. Hill, St. Leonards-on-Sea.
26,174. Nitro-glycerine Explosives, C. E. Bichel, London.
26,175. Steam Engines, U. A. Chauveau and L. Guichard, Westminster.
26,176. Halogen Compounds, J. C. Mewburn.—(*Chemische Fabrik von Heyden Gesellschaft mit beschränkter Haftung, Germany.*)
26,177. Locks, J. B. Chancellor and S. W. Lewis, London.
26,178. Sweeping Machines, C. Walkden, London.
26,179. Self-fastening Dress Hook, E. Ramasso, London.
26,180. Ornamentation of Writing Cases, C. Chivers, London.
26,181. Garden Implement, G. D. Howard.—(*G. W. McComas, United States.*)
26,182. Pens, J. W. Milligan and J. Clement, Birmingham.
26,183. Shoes, H. E. Randall and B. Sugarman, London.
26,184. Cleaning Coffee, D. A. A. Frister, London.
26,185. Cycle Support, W. H. Sykes, London.
26,186. Boring Tools, A. Ullrich, London.
26,187. Incandescent Lamp Filaments, A. F. Woodley, London.
26,188. Governors, H. Straus and F. W. Reynolds, Liverpool.
26,189. Hot-water Bottles, E. Waldner, Liverpool.
26,190. Spectacles, J. Gorst and T. Glazebrook, Manchester.
26,191. Deodorising Fatty Substances, C. Culmann, London.
26,192. Firing Mechanism for Guns, J. C. Thompson, London.
26,193. Securing Pedal Axles to Cranks, G. P. Main, London.
26,194. Producing Lint Substitute, F. L. Roeckner, London.
26,195. Spool-braking Device, R. Clad and E. Schnabel, London.
26,196. Treatment of Ores, La Compagnie de Métallurgie Générale (Société Anonyme), London.
26,197. Photographic Roller Blind Shutters, B. W. Horton, London.
26,198. Show Case, J. S. Pickford and The National Bakery Company, Ltd., London.
26,199. Igniting Device, H. H. Lake.—(*C. P. J. Clement and H. von Krohn, Belgium.*)
26,200. Incandescent Gas Burners, R. T. and J. G. Glover, London.
26,201. Cycle Wings, H. S. Purkis, Ilford, Essex.
26,202. Incandescent Mantles, A. Martini, London.
26,203. Lamps, H. A. Fleuss and H. Heaton, jun., London.
26,204. Manufacture of Match-boxes, T. Bishop, London.
26,205. Tubes, W. Wilkinson, London.
26,206. Gun Sights, A. Weston, London.
26,207. Composition for Printers' Rollers, T. Greaves, London.
26,208. Photographic Printing Frames, C. A. McEvoy, London.
26,209. Fasteners for Window Sashes, W. S. Craster, London.
26,210. Game, W. J. Garnham, London.
26,211. Inkwells, M. Wright, London.
26,212. Scissors, A. Bradley, London.
26,213. Railway Chairs, A. Tuck, London.
26,214. Sash Fasteners, J. B. Meeson, London.
26,215. Cycles, A. R. Wintle, London.
26,216. Music Stand, G. Head, London.
26,217. Apparatus for Advertising, J. Warrick, London.
26,218. Crank Mechanism for Velocipedes, I. Rees, London.
26,219. Wheel Tires, A. O. Thomas, London.
26,220. Cycle Seat Pillar, The Garrison Cycle Co., Ltd., and J. Brennand, London.

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26,221. Screw-cutting Die, W. B. Lake and E. F. Elliot, London.
26,222. Cycle Tires, H. S. Stewart, London.
26,223. Pencil Sharpener, J. Boylan, Bradford.
26,224. Ladies' Hat Catch, J. M. Simpson, Elgin.
26,225. Cycle Brake, R. F. Drury.—(*G. M. Doncaster, Germany.*)
26,226. Clearing Steel Wire, T. P. O. Yale, Stockton-on-Tees.
26,227. Rotary Power, E. Bryan, London.
26,228. Bicycle Frame, A. E. Schurr, Sidcup.
26,229. Cycle Brake, F. F. Yeatman and W. Donovan, Reading.
26,230. Drilling Machine, E. Atkinson, Accrington.
26,231. Automatic Joint Air Tube, H. and G. Gardner, London.
26,232. Hand Windguard for Cycles, E. O. Brown, Bournemouth.
26,233. Syphon Flushing Cistern, W. Deeley, Birmingham.
26,234. Attaching Ornaments to Pictures, G. F. Hall, Birmingham.
26,235. Sash Bar for Skylights, J. H. Deam, Wolverhampton.
26,236. Invalid's Chair, W. Whitehead, Manchester.
26,237. Cycle Brake, R. Younger, Newcastle-on-Tyne.
26,238. Looms for Weaving, R. Whitehead and J. Muskett, Manchester.
26,239. Sash Fastener, T. M. Turner and T. Hurley, Leicester.
26,240. Wheel Tires, A. Dugdale, Manchester.
26,241. Window Blinds, T. M. Grant, Glasgow.
26,242. Securing Cycle Spindles, J. W. Neeham, Stockton-on-Tees.
26,243. Floor for Cement Kilns, L. Tebbutt, Cambridge.
26,244. Lighting Safety Lamps, T. Ingham and H. Davis, Derby.
26,245. Cycle Gear Case, W. Sykes, Horbury.
26,246. Changing Plates in Cameras, W. A. Vérel, jun., and W. Eyre, Glasgow.
26,247. Producing Lustrous Effects, W. G. Heys.—(*H. David, France.*)
26,248. Small-arms, R. W. Howe and G. H. Smith, London.
26,249. Rack Pulley, E. A. Allen and G. E. Carter, Birmingham.
26,250. Ozone Preparations, J. H. G. Winckler.—(*G. A. Spranger, Germany.*)
26,251. Stop Cock for Liquids, F. Makin, Ashton-under-Lyne.
26,252. Driving Mechanism for Cycles, A. Bodeker, London.
26,253. Opening Boxes, F. H. Weight and H. C. E. Wood, Birmingham.
26,254. Hinged Box Lid, W. Lowe, Birmingham.
26,255. Crank Driving Mechanism, W. J. S. Strange, Coventry.
26,256. Envelope, A. T. Wilmot, London.
26,257. Photographic Apparatus, N. Browne.—(*Fabrik Photographischer Apparate auf Actien Vormals R. Hüttig and Sohn, Germany.*)
26,258. Water-closet, C. Greenhalgh, Manchester.
26,259. Preparing Tobacco, F. J. Kidgell, Norwich.
26,260. Footrest for Cycles, W. S. Howell, Birmingham.
26,261. Targets, R. Bostock and F. A. Cheetham, Halifax.
26,262. Earthenware Pipe Joint, J. J. Green and C. L. Stiff, Halifax.
26,263. Cycle Brakes, J. Wakefield, Nottingham.
26,264. Attaching Tires to Wheels, J. E. Rogers, Birmingham.
26,265. Pirn Winding Machines, A. W. Metcalfe, Belfast.
26,266. Pianofortes, J. Owles, London.
26,267. Tire Covers, W. A. Griffiths, Birmingham.
26,268. Paint, W. N. Hird, Keighley.
26,269. Producing Acetylene, G. E. Arkell, J. W. Bailey, and J. Clapham, Keighley.
26,270. Supporting Plants, G. H. Brierley, Torquay.
26,271. Kettles, J. R. Syvret and C. O. Hales, St. Brelades, Jersey.
26,272. Tire Valves, T. Law, Wolverhampton.
26,273. Steam Generators, D. Macdonald, Glasgow.
26,274. Tramcar Device, J. Reinsch and J. Habenicht, Glasgow.
26,275. Locking Bolt, H. Daelmans, Portland.
26,276. Driving Gear for Velocipedes, B. F. Sparr, London.
26,277. Cleaning Wire Rods, F. Hill, London.
26,278. Roofing Tiles, F. Latham, London.
26,279. Forming Loop Cloth, T. Hyde and M. Hodgson, Burnley.
26,280. Fender Support, E. Taylor, Birmingham.
26,281. Printing Designs, A. J. Boult.—(*P. A. J. Gasse, France.*)
26,282. Door Locks, W. B. Bust, London.
26,283. Name Plates, F. W. Willett, London.
26,284. Joint for Tubular Cycle Frames, J. V. Pugh, London.
26,285. Shoes, A. C. Zapato, London.
26,286. Circulating Water, H. Schofield and O. P. Macfarlane, London.
26,287. Making Panels, J. N. Mitchell and W. Morrison, Glasgow.
26,288. Wheels, J. Patterson, Glasgow.
26,289. Cowls and Ventilators, T. Drummond, Glasgow.
26,290. Iron, R. and J. Miller, Glasgow.
26,291. Balls, R. Rigg, Glasgow.
26,292. Tea Essences, R. R. Bell and A. C. Butler, Glasgow.
26,293. Toilet Mirrors, H. and C. E. Brassington, London.
26,294. Advertising Tablets, F. Blenkins, London.
26,295. Fog Signalling on Railways, J. Smith, London.
26,296. Holders for Electric Lamps, A. Campbell, London.
26,297. Pins, A. I. Wilson, London.
26,298. Tires, W. Wood, London.
26,299. Securing Hats, E. Johnson, London.
26,300. Vessels, J. Wecer, London.
26,301. Burners, W. R. Comings, London.
26,302. Umbrellas, J. J. E. Pauncefort and D. Alexander, London.
26,303. Transport of Essences, &c., E. J. Boake, London.
26,304. Windows, A. Ansell, London.
26,305. Automatic Grain Production, J. Sleeman, London.
26,306. Switching Gear, The British Thomson-Houston Company, Ltd., and H. M. Hobart, London.
26,307. Igniting Device, W. Rafel and C. G. Knoerzer, London.
26,308. Closing Jars, Betts and Co., Ltd., and W. Nimmy, London.
26,309. Pumps, A. Hahn, London.
26,310. Boxes, B. J. Diplock, London.
26,311. Fabrics for Incandescence Mantles, J. Janz, London.
26,312. Chests, L. Gillrath, London.
26,313. Files, F. B. Moore, London.
26,314. Pressed Designs, W. P. Thompson.—(*Weisse and Co., Germany.*)
26,315. Removing Seed from Raisins, J. G. Gibson, Liverpool.
26,316. Pump, G. Westinghouse, London.
26,317. Hydraulic Pumping Apparatus, G. Westinghouse, London.
26,318. Actuating Safety Gear, J. C. Etchells, Manchester.
26,319. Tires, P. E. Dowson, Manchester.
26,320. Pouches, C. Parker, Manchester.
26,321. Knife Cleaner, G. H. Hill and H. J. Hobson, Birmingham.
26,322. Packing Cases, T. K. and L. Illman, London.
26,323. Ball Bearings, C. H. Potts and J. Forster, London.
26,324. Bunsen Burners, A. J. Boult.—(*G. Barthel, Germany.*)
26,325. Acetylene Gas, A. J. Boult.—(*F. Alexandre, France.*)
26,326. Cyanides, D. Lance and R. L. E. de Bourgade, London.
26,327. Railway Permanent Way, M. Lewis, London.
26,328. Fire-arms, F. Sawyer, London.
26,329. Blotting Apparatus, B. J. B. Mills.—(*E. Moulard and J. Guny, France.*)
26,330. Discharge of Ashes, G. H. Robinson, London.
26,331. Preventing Bottle Refilling, F. X. Clouet, London.
26,332. Electric Cable Jointing, H. E. Menier, London.
26,333. Message Transmission, J. A. L. Dearlove, London.
26,334. Composition, H. H. Lake.—(*O. Leproux, France.*)
26,335. Brackets, C. Erber, London.
26,336. Automatic Gas Lamp Ignition, F. Deimel, London.
26,337. Range-finder, S. Bouverie, London.
26,338. Simultaneously Locking Doors, E. Wright, London.
26,339. Picture Cord Holders, G. W. Wheeler, London.
26,340. Supplying Beer, C. H. A. Hormann, London.
26,341. Photograph Machines, W. J. H. Jones, London.
26,342. Newspapers, H. Thomson, London.
26,343. Filaments, H. S. Maxim, London.

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26,344. Protecting Tires, H. M. Rogers, London.
26,345. Tires, F. D. C. Strettell, Bristol.
26,346. Locking Carriage Doors, H. D. Brandreth, London.
26,347. Turbine, W. Gallimore, sen., Leek, Staffs.
26,348. Tires, J. Pollock, London.
26,349. Brush, F. W. Bills, Birmingham.
26,350. Door, F. Griffiths, London.
26,351. Preventing Accidents in Opening Bottles, J. E. Surridge, Barcombe, Sussex.
26,352. Clothing, E. J. A. Babbage, Plymouth.
26,353. Wheels, A. A. Vérel, Glasgow.
26,354. Wagon Clip, J. Gill, Outwood, near Wakefield.
26,355. Oil Lamps, S. Wyres, Norfolk.
26,356. Liquors, J. Webster and T. Leatherbarrow Liverpool.
26,357. Bicycle Brake, H. E. Defty, London.
26,358. Weather Shield for Cycles, J. F. Hawkins, Leamington Spa.
26,359. Bottles, C. E. Beavis, Bristol.
26,360. Adjustable Cycle Handle-bar, W. J. Fergus, Glasgow.
26,361. Dress Shirts, A. Robertson and P. Galloway, Carron, Stirlingshire.
26,362. Cycle Footrest, J. Johnson, Birmingham.
26,363. Pneumatic Tires, C. W. H. Rowland and H. Brownhill, Birmingham.
26,364. Cycle Brake, J. S. Edge and J. Hall-Wright, Birmingham.
26,365. Economiser Apparatus, J. and C. W. Henwood, Sheffield.
26,366. Picture Hook, E. A. Allen and G. E. Carter, Birmingham.
26,367. Electric Illumination, H. Cooney, Liverpool.
26,368. Cycle Handle-bars, C. B. Loxton, Bristol.
26,369. Gas Meters, J. Anderson, Glasgow.
26,370. Gas Meters, J. Anderson, Glasgow.
26,371. Midwifery Forceps, E. Greville, Edinburgh.
26,372. Screw Wrenches, J. J. Whittaker, Accrington.
26,373. Brush for Dynamos, F. J. Taylor, Belfast.
26,374. Wringers, D. R. Robertson, Glasgow.
26,375. Carrying Cycles in Vans, D. R. Robertson, Glasgow.
26,376. Cycle Tires, J. Y. Johnson.—(*R. J. Stirling, South African Republic.*)
26,377. Cycle Saddles, J. Y. Johnson.—(*R. J. Stirling, South African Republic.*)
26,378. Bicycle Support, J. Y. Johnson.—(*R. J. Stirling, South African Republic.*)
26,379. Castor, G. Bosworth, Birmingham.
26,380. Securing Mouths of Bottles, J. Tomlinson, Barnsley.
26,381. Incandescent Gas Mantle, A. M. Plaissetty, Paris.
26,382. Lamps, J. W. Scarth and W. A. Thornton, Leeds.
26,383. Spinning Tops, A. R. Pollard, Worthing.
26,384. Brick Kilns, F. Hancock and C. B. Winzer, Stoke-on-Trent.
26,385. Syringe Nozzle, W. Hickin, Birmingham.
26,386. Measuring Distances at Sea, J. T. Brown, Manchester.
26,387. Fittings for Stage Scenes, J. B. Ormerod, Accrington.
26,388. Dobbies for Looms, J. E. and H. Barker, London.
26,389. Inking Arrangement for Printing, R. E. Fischer, Barmen, Germany.
26,390. Photographic Printing Frames, J. and A. Wilkinson, Manchester.
26,391. Moving Air Vessels, C. von Wolff, Dresden.
26,392. Chains, G. Wilke, Barmen, Germany.
26,393. Buckles, K. Schmahl and E. Schulz, Barmen, Germany.
26,394. Cutter Wheel, W. E. Garforth, R. Sutcliffe, and W. Buxton, Leeds.
26,395. Cycle Hub, H. M. Genese, London.
26,396. Cycle Head Clip, H. M. Genese, London.
26,397. Cycle Rest, H. L. Davis, London.
26,398. Advertising Device, C. C. Forrester, London.
26,399. Measuring Instrument, G. K. B. Elphinstone and A. C. Heap, London.
26,400. Cycle Tires, J. F. Edwardes and W. Flexman, London.
26,401. Lenses, J. and A. J. Davis and A. J. Loftus, London.
26,402. Gas Engine, G. Opitz.—(*D. Hutinet, Belgium.*)
26,403. Preventing Tires Collapsing, J. H. Goodwin, London.
26,404. Egg Tester, T. Stevens, Helston.
26,405. Revolving Platform and Hood, C. Ashbey, London.
26,406. Purifying Iron, C. H. Alldred, Plumstead Common, Kent.
26,407. Cheque Book, F. H. G. A. Binckes, London.
26,408. Wheel Tires, C. B. Voisey, London.
26,409. Ink-wells, J. Hawkridge, London.
26,410. Belt Fastener, T. Cooke, London.
26,411. Trolley Standard for Cars, G. Henshaw, London.
26,412. Transformers, The British Thomson-Houston Co., Ltd., and H. M. Hobart, London.
26,413. Bed, A. Schumann, London.
26,414. Bottles, C. Bauer, London.
26,415. Wrapper for Covering Cycle Frames, D. Scott, London.
26,416. Ash Tray, H. Pearce, London.
26,417. Gas Meter or Holder, P. D. Justice.—(*P. Wolff, Germany.*)
26,418. Albuminous Substance, A. Classen, London.
26,419. Colouring Matters, C. D. Abel.—(*The Actien Gesellschaft für Anilin Fabrikation, Germany.*)
26,420. Rim for Tires, W. J. S. McCleary, Ware.
26,421. Wheel Tires, J. R. Bell, London.
26,422. Controlling Water Supply, W. H. Witham, London.
26,423. Cycle Support, C. J. Meredith, and C. and C. W. H. Allden, London.
26,424. Railway Signals, J. O. Kriegsmann, Amsterdam.
26,425. Gas Taps, E. O. Taylor, London.
26,426. Cleaning Tobacco Pipes, T. Brown, London.
26,427. Cycle Tires, J. Platt, London.
26,428. Tobacco Pipes, M. M. Grant, London.
26,429. Stair Rod Clip or Fastener, W. Waterworth, London.
26,430. Sleeve Links, E. W. Carr, London.
26,431. Parcel String Holder, E. W. Tate, London.
26,432. Cycle Construction, W. Fletcher, London.
26,433. Peeling and Cutting Device, G. Hemingway, London.
26,434. Driving Gear of Tricycles, F. Schneider, London.
26,435. Making Acetylene Gas, J. and J. Mücke, London.
26,436. Drawing Liquids from Barrels, C. H. Moon, London.
26,437. Self-fastening Frost Cogs, S. C. Woolridge, London.
26,438. Vehicle Springs, A. E. Smith, London.
26,439. Changing Films in Cameras, A. H. Harman, London.
26,440. Magazine Cameras, A. H. Harman, London.
26,441. Preparing Accumulator Plates, C. A. Bennert, London.
26,442. Crystalline Compound of Emetine, W. G. Whiffen, London.
26,443. Earth Closets, F. Dumay, London.
26,444. Collapsible Boats, B. Burleigh, London.
26,445. Joints of Cycle Frames, J. H. Barry, London.
26,446. Pottery Kilns, J. Clowes and T. and A. J. Poole, London.
26,447. Propelling Cycles, H. Woodward, London.
26,448. Electric Cables, G. Sutton, London.
26,449. Skylights, J. H. Buxton, London.
26,450. Stoneware and Metal Pipe Joints, J. Hall, London.
26,451. Boxing Gloves, H. H. Lake.—(*W. G. Wood, United States.*)
26,452. Safety Device for Switches, F. Trenkel, London.
26,453. Shafting, H. A. House, jun., and R. R. Symon, London.
26,454. Liquid Fuel Burners, H. A. House, jun., and R. R. Symon, London.
26,455. Detecting Variations in Electric Circuits, A. U. Alcock, London.
26,456. Appliance for Collecting Dust, S. L. Bradley, London.
26,457. Bicycle Frames, O. Speiss, London.
26,458. Safety Apparatus for Railway Lines, J. M. Laffas, London.
26,459. Boot-cleaning Apparatus, N. A. Thomson, London.
26,460. Animated Pictures, P. Mortier and C. and G. Rosseau, London.
26,461. Liner Soles for Boots and Shoes, M. Wilson, London.

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26,462. Stencils, C. E. L. Menet, London.
26,463. Adjustable Distributing Nozzles, R. Pollock, London.
26,464. Matchboxes, G. Harris, London.
26,465. Cigarette Cork Mouthpieces, F. M. Seddon, Liverpool.
26,466. Destructor for Town Refuse, W. Saint, Manchester.
26,467. Coin-freed Gas and Liquid Meters, J. H. Roby, Keighley.
26,468. Memorandum Desk for Telephones, C. Harryman, Sheffield.
26,469. Forming Cops for Weaving Shuttles, E. Hollingworth, Dobcross, Yorks.
26,470. Wire Fences, P. R. J. Willis.—(*J. B. Johnston, United States.*)
26,471. Sulphonic Acids, I. Levinstein and Levinstein, Ltd., Manchester.
26,472. Steamship Propeller and Gear, J. Innes, Glasgow.
26,473. Cycle Stands, G. H. Atkinson and A. Thomas, Bradford.
26,474. Venetian Blinds, T. W. and F. C. Tidmarsh, London.
26,475. Hub Spring Brakes for Cycles, J. Marriott, Birmingham.
26,476. Electric Lifts, A. Musker, Liverpool.
26,477. Propeller Bearings, J. T. Wood, Newcastle-on-Tyne.
26,478. Trawl Nets, T. F. Adamson and E. Clarke, Newcastle-on-Tyne.
26,479. Braking Cycles, T. Duffy, Bristol.
26,480. Cycle Crank Levers, T. Duffy, Bristol.
26,481. Cycle Brake, T. Duffy, Bristol.
26,482. Cask Sling, W. Tedford, Glasgow.
26,483. Photographic Print Trimmer, J. S. Smith, Sale, Cheshire.
26,484. Acetylene Gas Generating Apparatus for Cycle Lamps, C. A. and F. J. Miller, Birmingham.
26,485. Lamplighting Attachments, C. A. and F. J. Miller, Birmingham.
26,486. Parts of Gas Cooking Stoves, H. J. Yates, Birmingham.
26,487. Cycle Rack, G. M. Young, Stockton-on-Tees.
26,488. Dating Machines, J. A. Philipson and J. A. G. Ross, Newcastle-upon-Tyne.
26,489. Folding Box, G. W. Hart and W. P. News, Kingston-on-Thames.
26,490. Rope Ladder, W. P. Buckley, Kingston-on-Thames.
26,491. Pneumatic Tires, C. Wood, Manchester.
26,492. Temporarily Repairing Pneumatic Tires, H. W. Harrison, Derby.
26,493. Support for Flower-pots, P. G. de Salvo, Burnley.
26,494. Bed-pans, M. Stevenson, London.
26,495. Self-propelled Vehicles, R. Y. McIntosh, Liverpool.
26,496. Water-tight Electric Fittings, H. Davis and L. W. de Grave, Derby.
26,497. Bulkhead Doors, T. Ansboro and J. Fairie, Glasgow.
26,498. Railway Crossings, H. Williams, Glasgow.
26,499. Toys, P. Gill, Leftwich, Cheshire.
26,500. Pneumatic Tires, G. Bruck, Manchester.
26,501. Ventilators, J. Carr, Bradford.
26,502. Tube Expanders, H. Workman, Glasgow.
26,503. Fixing Valves, I. Barton, Birkenhead.
26,504. Boot Stretcher, J. Cochrane, Inverkip, Co. Renfrew.
26,505. Pencil Sharpener, H. Sharpe, Wisbech.
26,506. Vessels for Conservation of Beverages, E. M. Eckardt and C. F. Lorenz, London.
26,507. Combination Match Box, F. and J. M. Aleith, London.
26,508. Steel Wire, C. P. Horton and G. B. Martin, Birmingham.
26,509. Clips, F. E. Hanman and H. Vincent, Birmingham.
26,510. Jig, A. Hatton, Birmingham.
26,511. Animal Traps, W. and G. Sidebotham, Birmingham.
26,512. Driving Chain, F. Hulse, Birmingham.
26,513. Locks and Keys, E. Latham, Wratting, Cambridgeshire.
26,514. Grids, A. E. Greville, London.
26,515. Boots, C. F. Pike and R. H. Porter, Manchester.
26,516. Cycles, J. M. Stratton, Glasgow.
26,517. Penholder, F. C. Edgar, Bristol.
26,518. Sash Fastener, H. Stanley, Sunderland.
26,519. Elements for Water-tube Boilers, G. Lentz, London.
26,520. Beer, G. Delory, London.
26,521. Mounting of Rotary Brushes, E. Pain, London.
26,522. Photograph Backgrounds, J. A. Salmon, Liverpool.
26,523. Tires, J. March, London.
26,524. Cycle Frames, H. Belcher and C. H. Shacklock, London.
26,525. Cooling Liquids, J. T. Bentley, Kingston-on-Thames.
26,526. Sewing Machine Attachment, L. E. Fisher, Kingston-on-Thames.
26,527. Wagon Jacks, I. L. Thompson, Kingston-on-Thames.
26,528. Jug, W. P. Thompson.—(*The Bier-Syphon-Actien Gesellschaft, Germany.*)
26,529. Cycles, E. Hale, Liverpool.
26,530. Heating Buildings, J. A. Dargue, E. Griffiths, and C. H. Wright, Liverpool.
26,531. Fitting Brake Handles to Cycles, A. R. Macbeth and Milner's Safety Cycle Company, Ltd., Liverpool.
26,532. Preserving Beer, J. F. H. Gronwald, Liverpool.
26,533. Stopper, S. Waters, London.
26,534. Candlesticks, M. Wilson, London.
26,535. Castors, J. R. Fox and A. Gunthorpe, London.
26,536. Cleaning Coffee Berries, H. Lobenhoffer, London.
26,537. Printing, A. Macario and C. Scuvero, London.
26,538. Mordanting Cotton, A. C. Marot and A. Bonnet, London.

26,539. Cleaning Sieve Bottoms, H. Illgen, London.
26,540. Carriages, R. Devereux and W. S. Frost, London.
26,541. Washing Machines, R. Hiob, London.
26,542. Bedsteads, F. T. Long, London.
26,543. Current Generation, F. E. Elmore.—(*J. O. S. Elmore, India*.)
26,544. Velocipedes, J. Forbes, London.
26,545. Pneumatic Tires, E. Parr.—(*L. H. Stodder, United States*.)
26,546. Pipe Wrenches, J. C. H. van Duyl, London.
26,547. Supporting Articles of Dress, L. L. Pritchard, London.
26,548. Gear, C. Gordon, London.
26,549. Vulcanising Rubber Goods, G. J. Brunessaux, London.
26,550. Producing Designs, J. E. de Pohl and The North-Eastern Printing and Publishing Co., Ltd., London.
26,551. Screw, W. L. Wise.—(*L. Searelle, South African Republic*.)
26,552. Recording Transfers, W. L. Wise.—(*H. Pim, South African Republic*.)
26,553. Turbines, C. A. Parsons, London.
26,554. Bottles, J. Creasy, London.
26,555. Bit, E. Beckmann and O. von Saal, London.
26,556. Motors, D. Longworth, London.
26 557. Drill Sharpening Machinery, H. O. Palmer, London.
26,558. Breech Mechanism, F. F. Redfern.—(*E. Ternström, France*.)
26,559. Nails, H. Traun, London.
26,560. Chains, J. H. Barry, London.
26,561. Brushes, G. E. Ashdown, Newbury, Berks.
26,562. Portable Fluid Carrier, A. F. de Blumer Belfast.

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26,563. Colouring Matters, W. H. Claus, A. Rée, and L. Marchlewski, Manchester.
26,564. Tools, H. McClelland, Birmingham.
26,565. Cycle Wheel, S. Tonks, Birmingham.
26 566. Burner for Acetylene Gases, J. Gore, Trowbridge.
26 567. Gas Burner, F. G. Bartlett Bristol.
26,568. Brake and Footrest for Cycles, C. Munday, Farnborough, Hants.
26,569. Tires, G. Koller, London.
26,570. Shooting Practice Apparatus, J. L. Crawford, Glasgow.
26,571. Glass Articles, W. Lindsay and D. Anderson, St. Helens, Lancs.
26,572. Beer-saving Apparatus and Filter, J. W. Wyld, Hounslow.
26,573. Boilers, D. Caddick and C. Oliver, Middlesbrough.
26,574. Food Preparations, L. Checkemian, London.
26,575. Chimney Pot, G. W. Hitchen, Burnley.
26,576. Submarine Sentry, The James' Syndicate, Ld., London.
26,577. Wedge Clamp for Rods, J. A. and S. Timothy, Ton Pentre, R S.O.
26,578. Ships' Course Indicator, G. W. Mallet, London.
26,579. Raising a Nap on Fabrics, H. Thornton, Manchester.
26,580. Window Cleaning, J. Watson, London.
26,581. Oil Lamp, D. M. Gentle, Glasgow.
26,582. Tool Bag, F. W. Lavender, Walsall.
26,583. Time Recording Machine, M. B. Cotterell and P. G. Ebbutt, Birmingham.
26,584. Gas Engines, J. F. Bennett and H. S. and T. P. Moorwood, Sheffield.
26,585. Gas Engines, J. F. Bennett and H. S. and T. P. Moorwood, Sheffield.
26,586. Yarn Spinning Machinery, J. and H. Wright, Keighley.
26,587. Sewing Machine, J. Scatchard, Keighley.
26,588. Employing Liquid Fuel, W. S. Sargeant, London.
26,589. Threading Needles, R. and G. A. Hird, Keighley.
26,590. Tobacco Pipes, J. Edgar, Belfast.
26,591. Gas Lantern, A. Wartenweiler, Brussels.
26,592. Cleaning Coffee, J. Luys, Brussels.
26,593. Writing Pens, P. Fritzsche, Brussels.
26,594. Producing Acetylene Gas, E. Helvig, Brussels.
26,595. Valve for Pneumatic Tubes, J. C. MacSpadden, Brussels.
26,596. Stone-sawing Machine, F. Knobel, Brussels.
26,597. Regulating Fire Air Grids, W. Wadsworth, London.
26,598. Tobacco Pouch Fastening, W. C. Lister, Wolverhampton.
26,599. Cycles, T. H. Collingbourne, R. Ryden, and T. Shutt, Halifax.
26,600. Cycles, T. H. Collingbourne, R. Ryden, and T. Shutt, Halifax.
26,601. Cycle Mudguard, E. J. Bullough, Halifax.
26,602. Filling Inkstands, J. Marshall, Halifax.
26,603. Securing Bonnets, T. G. Hughes, Manchester.
26,604. Cigar Box, A. C. Taylor, E. I. Watson, and H. R. Everitt, Norwich.
26,605. Respirators, H. Buchwald, Manchester.
26,606. Break Treadle for Vehicles, J. Stephens, Egham, Surrey.
26 607. Steering Cycles, A. Craig and W. Phillips, London.
26,608. Locking Device for Ball-bearings, H. Tunley, London.
26,609. Beams for Ships' Hatchway Sides, W. Cook, Middlesbrough.
26,610. Feed Mechanism, Lord Brothers, Ltd., and J. Kay, Manchester.
26,611. Producing Changeable Effects, K. McLennan, Manchester.
26,612. Holders for Glass Globes, C. L. Tweedale, Ormskirk.
26,613. Securing Cycle Handles, J. Cooper and F. G. Bensly, Birmingham.
26,614. Lamps, R. F. Hall, Birmingham.
26,615. Guard for Protecting Collars, F. A. Birks, London.
26,616. Valve Tap, W. Errington, London.
26,617. Dust Pan, F. Green, London.
26,618. Perambulators, W. Legge and P. Gilespie, Croydon.
26 619. Gun-loading Device, W. Cochrane, Long Melford, Suffolk.
26,620. Hair Restorer, J. J. W. Cumming, London.
26,621. Guard for Velocipedes, G. Pilkington, Coventry.
26,622. Curtain Poles and Fittings, M. M. Porter, London.
26,623. Fastening Doors, A. Croker-Stewart and B. G. Triggs, London.
26,624. Mixing Grain, F. W. Dawson, London.
26,625. Nightsoil Destruction, H. G. Downton and W. H. Nichols, London.
26,626. Drain Tester Smoke Conductor, L. Sheppard, London.
26,627. Cycle Fork, G. A. Ekman and H. E. Fallshaw, London.
26,628. Producing Food, A. Schmidt, London.
26,629. Air-tight Bottles, H. W. Woodfield Croydon.
26,630. Vessel Taps, C. I. C. Bailey and C. Welton, London.
26,631. Belt Fastenings, H. G. Godwin, London.
26,632. Water-regulating Apparatus, E. C. Peck, London.
26,633. Incandescent Gas Burners, G. W. Chalmers, London.
26,634. Velocipedes, C. Owen and W. J. Saunders, London.
26,635. Sterilising Apparatus, J. Weck, London.
26,636. Throw Crank, A. G. Mumford and A. Anthony, London.
26,637. Wagons, E. Hora, London.
26,638. Safes, L. T. Darnault, London.
26,639. Syphons for Mineral Waters, J. D. Richards, London.
26,640. Electrical Resistance Apparatus, F. Hughes, London.
26,641. Driving Gear, J. J. Duffy, London.
26,642. Appliance for Boots and Shoes, H. Calver, London.
26,643. Submarine Vessels, A. and M. R. Puls, London.
26,644. Interchangeable Velocipede Gear, A. J. Madden, London.
26,645. Pipe Joints, J. Price, London.
26,646. Watt Meters, The British Thomson-Houston Co., Ltd., and F. Holden, London.
26,647. Electric Current Meter, C. O. Bastion and F. M. Staunton, London.
26,648. Prepayment Gas Meters, W. J. H. Jones, London.
26,649. Prepayment Gas Meters, W. J. H. Jones, London.
26,650. Turbines, A. Jourdanet and J. P. Gauthier, London.
26,651. Toy, J. T. Partington, London.
26,652. Grain-washing Machinery, J. S. Steinmetz, London.
26,653. Body Support for Cyclists, E. Merrillees, London.
26,654. Roller Skates, H. W Fairfax and C. L. Downes, London.
26 655. Ridged Roofing, W. P. Thompson.—(*O. Standow, Germany*.)
26 656. Electric Accumulator Plates, P. F. Ribbe, London.
26,657. Guiding Carbons, R. W. L. Holsten and The Elektrische Bogenlampenfabrik Naeck and Holsten Gesellschaft mit beschränkter Haftung, Liverpool.
26 658. Preservation of Eggs, F. H. M. Röver, London.
26,659. Cut-out Device, R. W. L. Holsten and The Elektrische Bogenlampenfabrik Naeck and Holsten Gesellschaft mit beschränkter Haftung, Liverpool.
26,660. Electric Arc Lamp, R. W. L. Holsten and The Elektrische Bogenlampenfabrik Naeck and Holsten Gesellschaft mit beschränkter Haftung, Liverpool.
26,661. Engine Steam Connections, A. H. Beasley, London.
26,662. Grinding Diamonds, L. H. Stern and T. W. G. Cook, London.
26,663. Drilling Machine, S. Pinching, Rugby.
26,664. Cooling Air, F. W. Lord, London.
26,665. Gauge for Measuring Shirts, C. E. Hilditch, London.
26,666. Attaching Bicycle Saddles, A. J. Henderson, London.
26,667. Printing Yarn, P. A. Newton.—(*The Alexander Smith and Sons Carpet Company, United States*.)
26,668. Vessels, F., F. W., and A. P. Jacob, London.
26,669. Rotary Motors, T. U. Gray and F. Bass, London.
26,670. Stamped Ribbon, E. Debenham.—(*H. Vinson, France*.)
26,671. Indicator, A. J. Boult.—(*H. Moutardier and L. Boudet, France*.)
26,672. Operating Device, P. Leschinsky, London.
26,673. Tobacco Pipes, W. E. Sharman, London.
26,674. Tube Cleaner, E. Beckmann and O. von Saal, London.
26,675. Naphthaline Derivatives, C. D. Abel.—(*The Actien Gesellschaft fur Anilin Fabrikation, Germany*.)
26,676. Acetylene Lamps, F. Schmid, London.
26,677. Leather, W. F. Reid and E. J. V. Earle, London.
26,678. Paper Perforating Appliance, P. L. Deighton, London.
26,679. Sleeve Links, A. Pick and M. Fleischner, London.
26,680. Electric Accumulators, A. Tribelhorn, London.
26,681. Cushion, J. F. Nunan, London.
26,682. Electro-medical Apparatus, W. A. Webb, London.
26 683. Petroleum Burner, M. Graetz, London.
26,684. Removing Worn Wood Paving, W. S. Simpson, London.
26,685. Driving Gear, W. P. Isaac, Otago, New Zealand.

16th November, 1897.

26,686. Vehicles for Children, W. Cowburn, Gloucester.
26,687. Road Rest for Cycles, S Warren, Hitchin.
26,688. Ratio Calculator, J. Clybouw, New Brighton, Cheshire.
26,689. Swivel Bye-pass, C. Peach and H. A. Smith, Birmingham.
26 690. Pneumatic Tires, J. P. Jackson, Liverpool.
26,691. Sawing Machinery, J. T. Chambers, Glasgow.
26,692. Treating Fruit for Confectionery, W. J. Dunnachie, Glasgow.
26,693. Construction of Oil Lamps, E. J. Shaw, Walsall.
26,694. Air Engine, H. A. Fenn and H. T. P. Simpson, London.
26,695. Sheep-dipping Machine, T. Harrison, Arnside, *viâ* Carnforth.
26,696. Hooks, D. Hackett, Birmingham.
26,697. Laundry Appliance, T. Kosugi, H. S. Moorwood, and J. F. Bennett, Sheffield.
26,698. Banjoes, H. and W. J. Riley, Birmingham.
26,699. Air Valve, P. Weir, Bristol.
26,700. Mercerising Machine, J. W. Robson, A. V. Dawson, and J. H. Robson, Huddersfield.
26,701. Cycle Stand, A. T. Austin, Birmingham.
26,702. Manhole Cover, W. Warner, Nottingham.
26,703. Plunger for Washing Clothes, A. Boyd, Granton.
26,704. Fishing Bait, S. Allcock, Redditch.
26 705. Propelling Vessels, V. Collyer, jun., and H. O. Bridgewater, Leicester.
26,706. Reducing Ores, H. R. Angel, London.
26,707. Door Fasteners, P. Whelan and R. Partridge, Manchester.
26,708. Wheel Tires, J. J. Warry, Liverpool.
26,709. Electric Gun, A. D. Manlove, Chesterfield.
26,710. Supporting Cycles, W. Langley and H. W. Hobson, London.
26,711. Tire Testing Apparatus, E. Maxwell, London.
26,712. Pulleys, J. E. Donovan, London.
26,713. Folding Seat for Carriages, A. Couach, London.
26,714. Slicing Bread, W. Eisner, Manchester.
26,715. Bottoms for Beds, F. J. Maier, Birmingham.
26,716. Velocipedes, O. Grässler, Brussels.
26,717. Tags for Laces, W. Paton, Ltd., and J. Paton, Glasgow.
26,718. Envelopes, R. Garnell, Holywood, Co. Down.
26,719. Fixing Pneumatic Tires on Cycles, C. Procopides, Manchester.
26,720. Bell, W. J. Nock, Newcastle-on-Tyne.
26,721. Moulds for Casting Tires, J. Hopper, London.
26,722. Water Velocipedes, E. O. Mawson, Manchester.
26,723. Lighting Lamps, E. Mander and W. S. Cordingley, Manchester.
26,724. Pump Clip, S. T. Griffin, Birmingham.
26,725. Tip for Billiard Cues, F. Clarke, Seacombe, Cheshire.
26,726. Bottle-soaking Trays, J. R. Lofthouse, London.
26,727. Electric Brakes, O. J. Menzies and J. A. Bell, Birmingham.
26,728. Crank Axles, C. L. McQuillan and R. A. McCready, Birmingham.
26,729. Electric Motors, W. L. Wise.—(*A. J. Churchward, United States*.)
26,730. Sewing Machines, G. H. Colley and The Weeks-Colley Manufacturing Co., London.
26,731. Curtain Pole Fixtures, J. and E. A. Boland, London.
26,732. Electrical Distributing Systems, L. Andrews, London.
26,733. Magnetic Cut-out Apparatus, L. Andrews, London.
26,734. Electric Switches, W. Hughes, London.
26,735. Cycles, C. G. y Perez, London.
26,736. Device for Decorating, M. Knowles, London.
26,737. Reversible Windows, L. Proll, C. M. Depew, E. W. Hawley, and G. Proll, London.
26,738. Incubators, P. G. C. Alioth, London.
26,739. Cycle Pacer, T. England and J. Pollock, Cardiff.
26 740. Water Waste Preventer, A. E. Parnacott, London.
26,741. Bedsteads, T. A. Brettell, Birmingham.
26,742. Window Sash Fastener, J. W. Scott, London.
26,743. Studs, J. Sample, London.
26,744. Sash Fasteners, A. E. Welbourne, London.
26,745. Incandescent Mantle Supports, G. Brogden, London.
26,746. Sleeve Links, E. W. Carr, London.
26,747. Cycle Wheels, E. Bartram and H. J. Gurney, London.
26,748. Supporting Shirt Fronts, R. A. Fraser, London.
26,749. Cycle Converting Device, E. M. C. Chenard, London.
26 750. Phonographs, W. H. Dunkley, Birmingham.
26,751. Sifting Granular Substances, F. G. Winkler, London.
26,752. Flexible Conduits for Electric Conductors, E. T. Greenfield, London.
26,753. Ticket Registering Apparatus, O. Legros, London.
26,754. Preserving Substances, W. G. Day, London.
26,755. Clips, C. F. Mackness, Broughty Ferry, near Dundee.
26,756. Hose Union, C. Craig and C. Smith, London.
26,757. Boxes, W. Dewey, London.
26,758. Scrubber, E. Haworth, Manchester.
26,759. Handle-bars, J. N L-ter, Wolverhampton.
26,760. Depilating Hid-s, H. Holmes, London.
26,761. Brake, H. Wolf L-ndon.
26,762. Bulbs of Lam-s, F. W. Few, London.
26,763. Stencilling, P. M. Cabell, London.
26,764. Walking-stick, R. J. Edwards, London.
26,765. Tires, R. Graham and J. G. Barbour, London.
26,766. Handles, W. T. Hare, London.
26,767. Paperhanger, J. Hanson, London.
26,768. Preventing Candle Grease Dropping, J. B. Meeson, London.
26,769. Clip, J. S. Wherley, London.
26 770. Clip, P. E. Rycroft, London.
26,771. Advertising, G. E. Hambling and F. E. Derrick, London.
26,772. Protector for Hat Pins, W. M. Cooper, London.
26,773. Pin, F. Dowson, London.
26,774. Sash Fasteners, E. Lamb, London.
26,775. Window Sash Fasteners, D. D. Dendy, London.
26,776. Acetylene Gas Generators, J. Kremer, London.
26,777. Preparing Recording Ribbon, J. B. Edson, London.
26,778. Brakes, B. Lõus, London.
26,779. Bedsteads, F. J. Middleton, Birmingham.
26,780. Bedsteads, F. J. Middleton and F. Harker, Birmingham.
26,781. Electric Light Switches, G. A. Phillips, Birmingham.
26 782. Ships, J. Birkett, Birmingham.
26,783. Sh-ps, J. Birkett, Birmingham.
26,784. Handles, O. Geland, London.
26,785. Bicycle Supports, J. F. Furley and E. Forsyth, London.
26,786. Pipes, T. L. Crosse, London.
26,787. Automatic Thermometers, M. L. Wilkinson, London.
26,788. Petroleum Stoves, H. H. Lake.—(*F. C. Bellinger, Germany*.)
26,789. Tires, A. Gross, London.
26,790 Bottles, C. Hayes, E. E. Chatfield, and A. B. Wilson, London.
26,791. Regulator for Gas Exhausters, S. Cutler, London.
26,792. Wheels, A. W. Knight and A. W. Southey, London.
26,793. Newspaper Sheets, Baron E. T. de Wogan, London.
26,794. Dressguards, E. C. Hitch, London.
26,795. Communicating with Drivers, E. C. Hitch, London.
26,796. Bust Improver, E. C. Hitch, London.
26,797. Bottling Liquors, S. Ray, J. F. Spong, and M. J. Cannon, London.
26,798 Bearings for Marine Engines, G. Cuccotti, London.
26,799. Utilising Heat of Gas Stoves, H. J. Dowsing, London.
26,800. Paints, C. J. Grist, London.
26,801. Balls, C. J. Grist, London.
26,802. Foot Protector for Glasses, A. B. V. Taffs, London.
26,803. Bulbs, G. W. Smiley.—(*F. W. Dunlap, Germany*.)
26,804. Burning Off Paint, J. C. and Z. Barber, London.
26,805. Shirt, C. Davies, London.
26,806. Musical Box with Clockwork Mechanism, A. Junghans, London.
26,807. Mowing and Reaping Machines, W. Birtwisle, Liverpool.
26,808. Bearings, P. E. Dowson, Manchester.
26,809. Recording Pedal Pressure, E. Kantorowicz, London.
26,810. Cycle, Table, and Signalling Lamps, E. Evans, Liverpool.
26,811. Luggage Carriers for Cycles, E. Hürting, Liverpool.
26,812. Organs, V. Willis, London.
25,813. Controlling Fall-down Doors, T. O. Mein, London.
26,814. Baking Pans, W. H. Mullins, London.
26,815. Pneumatic Harness, L. P. Ford, London.
26,816. Driving Gear for Cycles, T. H. Williams, London.
26,817. Preserving Zinc Placards, R. Haddan.—(*C. Verneau, France*.)
26,818. Preventing Refilling of Bottles, L. L. J. Godard, London.
26,819. Reversing Gear, J. B. Furneaux and A. Horne, London.
26,820. Supplying and Aerating Beer, C. H. A. Hormann, London.
26,821. Sewage Treating Apparatus, W. A. Clark, London.
26 822. Machines for Treating Coffee Beans, H. L. Verwohlt, London.
26,823. Steam Generators, D. T. Piot, London.
26,824. Shear Dressing Device, J. M. F. Weidemeyer, London.
26,825. Bottle Stoppers, J. Leahy and A. Webb, Teddington.
26,826. Pneumatic Tires, F. Wynne, London.

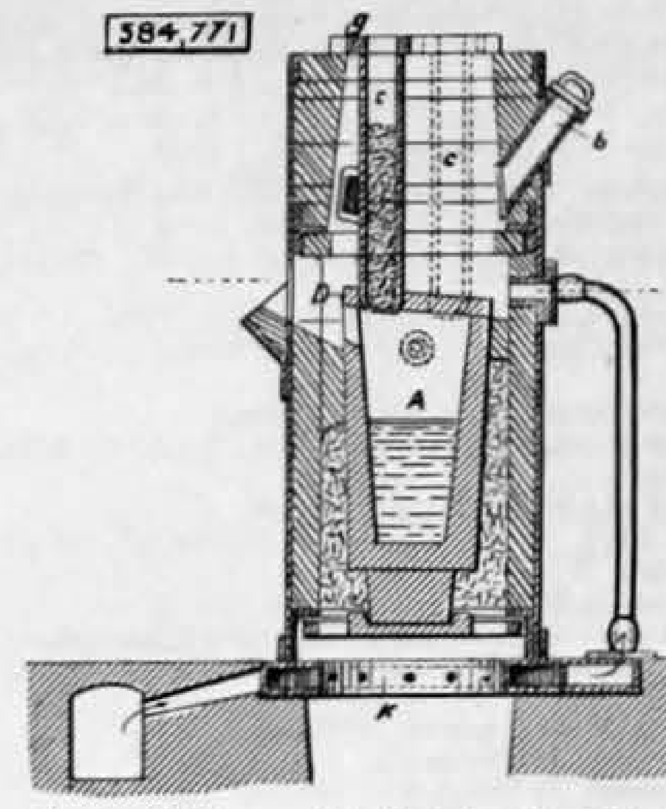
SELECTED AMERICAN PATENTS.

From the United States Patent Office Official Gazette.

584,771. Melting Furnace, *L. Delettrez, Paris, France.—Filed November 25th*, 1896.

Claim.—(1) In combination in a crucible furnace, the crucible A having the lid D, a plurality of extensions or long and narrow flattened tubes *c, c*, imperforate on their sides and extending up from the lid D through which their lower conical ends open into the the crucible, the combustion chamber about the crucible extensions, an air supply leading into the furnace at the height of the lid D, and the perforated socket K connected with the lower part of the furnace, and with an air supply. (2) In combination in a furnace with the crucible A having the lid D, a plurality of extensions or long and narrow flattened tubes *c, c*, inclosed in the furnace imperforate on their sides and extending up from the lid, the said furnace having the side openings b^1, b^2, b^3, b^4, and the passages or flues *e, f, g*, for the escape of the hot gases from around and between the extensions, substantially as

584,771



described. (3) In combination in a furnace, with the crucible A having the lid D, a plurality of imperforate extensions or tubes projecting up from the lid communicating with the crucible through the lid thereof, escape passages for the gas at the top of the furnace and means for feeding the air to the chamber about the extensions, substantially as described.

584,809. Variable-throw Crank, *A. Anthony, Colchester, England.—Filed November 23rd*, 1896.

Claim.—In a variable-throw crank, the combination, with a crank arm, and an arm B for carrying the pedal journalled in the free end portion of the said crank arm; of a cylinder pivoted at its bottom end to the

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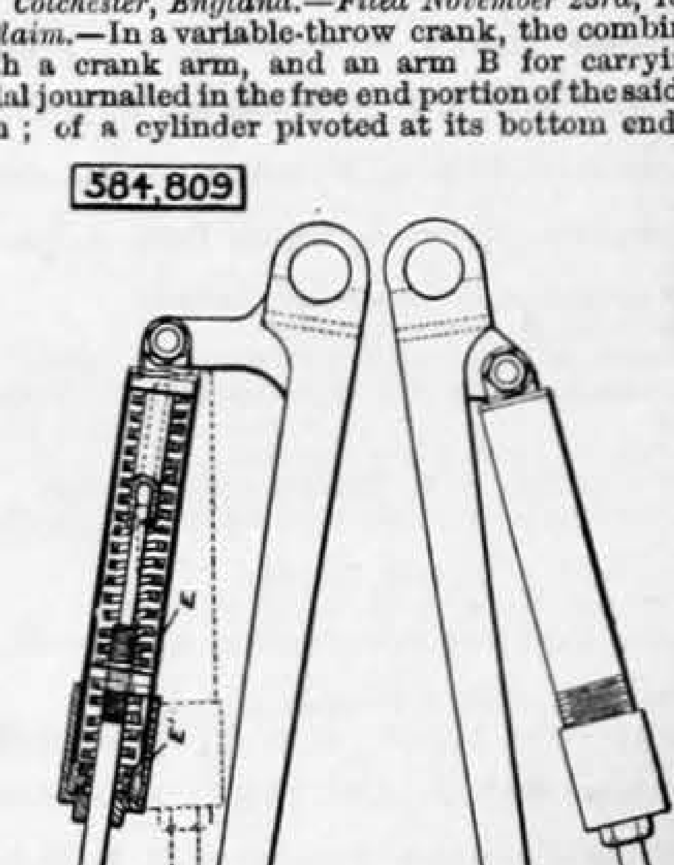
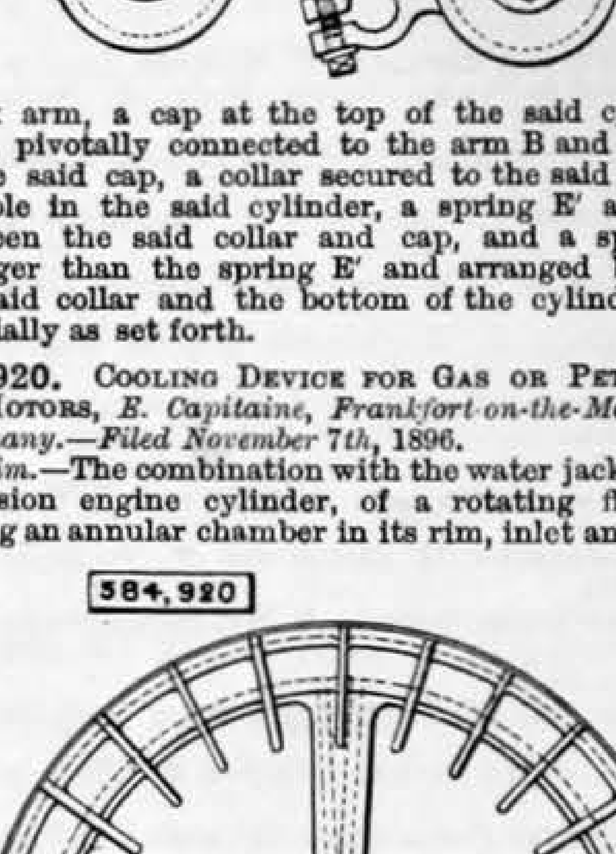


crank arm, a cap at the top of the said cylinder, a rod pivotally connected to the arm B and slidable in the said cap, a collar secured to the said rod and slidable in the said cylinder, a spring E′ arranged between the said collar and cap, and a spring E stronger than the spring E′ and arranged between the said collar and the bottom of the cylinder, substantially as set forth.

584,920. Cooling Device for Gas or Petroleum Motors, *E. Capitaine, Frankfort-on-the-Main, Germany.—Filed November 7th*, 1896.

Claim.—The combination with the water jacket of an explosion engine cylinder, of a rotating fly-wheel having an annular chamber in its rim, inlet and outlet

584,920

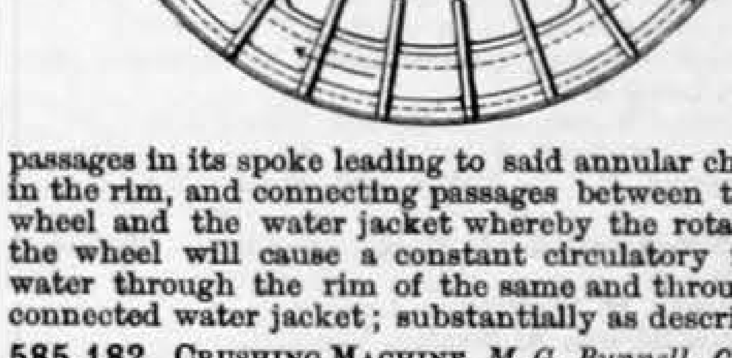


passages in its spoke leading to said annular chamber in the rim, and connecting passages between the fly-wheel and the water jacket whereby the rotation of the wheel will cause a constant circulatory flow of water through the rim of the same and through the connected water jacket; substantially as described.

585,182. Crushing Machine, *M. G. Bunnell, Chicago, Ill.—Filed October 7th*, 1895.

Claim.—(1) A crusher having a crushing hopper comprising upper and lower reciprocating jaws; a pivotally-supported swinging link pivotally connected to the jaws at points which are situated to the rear of the crushing faces of the latter and on opposite sides of the point of support of the link; and means for reciprocating the jaws in alternation, and for vibrating the same about their points of connection with the link during reciprocation, as set forth. (2) In a crushing machine, the combination, with the upper and

585,182



lower reciprocating jaws, of a pivotally-supported swinging link pivotally connected with the jaws at opposite sides of its point of support, whereby the link serves as a support for the jaws and also ensures their reciprocation in alternation, as set forth. (3) A crushing machine having a crushing hopper comprising upper and lower movable jaws; a pivotally-supported swinging link to which the jaws are pivotally connected at points on opposite sides of the pivotal support; a vibrator having a jointed connection at one end with the crushing jaws; and a pitman connected with the opposite end of the vibrator, substantially as described.