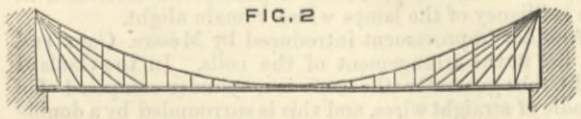
THE ALBERT BRIDGE.

As will have been seen in our advertisement columns, tenders are invited by the Metropolitan Board of Works for the strengthening of the Albert Bridge over the Thames at Chelsea; and since there appears to be some anxiety concerning the strength of the bridge—an anxiety which we are glad to remove by the present article—it may be interesting to give some account of the bridge, which has now been of service to the public for the last twelve years. The distance of more than a mile between the Chelsea Suspension Bridge, designed by the late Mr. Thos. Page, and the dilapidated old Battersea Bridge, had for a long time been felt as an inconvenience, and as new neighbourhoods grew up on the south of the river, and the Battersea Park became more frequented, the need of a new crossing led to various projects, and to several applications to Parliament. The first idea of a bridge at this place originated with Prince Albert; hence the name of the road and bridge, it having been intended to call Page's Bridge the Victoria. The name has, however, been given to the London, Chatham, and Dover Railway bridge at Chelsea. The Albert Bridge Company was formed to construct a bridge from the site of the old Cadogan Pier, Chelsea, to the road on the Surrey side which skirts the further end of the Park, and Mr. R. M. Ordish prepared a design. The scheme fell through for a time, till a certain Captain Roberts brought forward a wonderful project for making light and cheap bridges of wires, not only for moderate spans, but, if we remember right, for crossing the Straits of Dover. The apparent cheapness of this method induced the directors to adopt it, but the proposal was so absurd that it would have been condemned by any competent engineer. However, a certain share capital having been subscribed to carry out the design, a Bill was promoted in the year 1870 for carrying the scheme of Captain Roberts into effect. The Bill was naturally opposed by the proprietors of the old Battersea Bridge, who saw their ancient monopoly and revenue threatened, and this opposition was only overcome by the new company taking to the old bridge, and guaranteeing a preferential dividend to its proprietors from the total revenues of the two structures. When, however, Captain Roberts' design of the proposed Albert Bridge came to be explained to a Parliamentary Committee, satisfactory evidence of stability was, of course, not forthcoming, and it appeared as if the Bill would be thrown out. But as the need for a new bridge had been amply proved, and as the Committee had passed the preamble of the Bill, Mr. Roberts' scheme was abandoned, and Mr. R. M. Ordish was called in to show that a substantial bridge could be constructed from the means available. Mr. Ordish had, about three years previously, constructed a bridge over the river Moldau, at Prague, on his rigid suspension principle, and this bridge over a river of about the same width as the Thames at Chelsea had proved very successful, not only winning the approval of the leading German engineers, but gaining for its author from the Emperor of Austria the Gold Medal of Arts and Sciences. A bridge of this kind having been proposed to the Committee, the Bill was passed on the condition that the bridge be constructed according to Mr. Ordish's design, the somewhat unusual course being adopted of inserting this stipulation, with the name of the engineer, in the Act of Parliament.

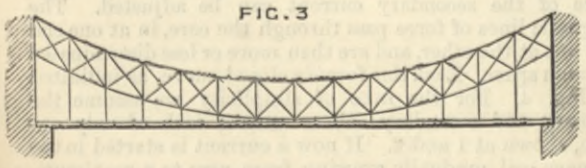
The chief drawback to the ordinary type of suspension bridges, where the platform is suspended from a catenary chain, is the undulating nature of the platform under a moving load, and several methods have been proposed and adopted for meeting this difficulty. Thus Roebling, in some of his American bridges, reduced the deflection of the platform and the consequent distortion of the chain by assisting to support the moving load at various points by straight ropes or chains extending from the towers to the platform, as in Fig. 2. These ropes are light and quite sub-

FIG. 2



ordinate to the main rope. Another plan is that adopted at a railway bridge in Vienna of rendering the chain rigid by dividing it into two parts, placed one above the other, and bracing them together, as in Fig. 3. Another plan is

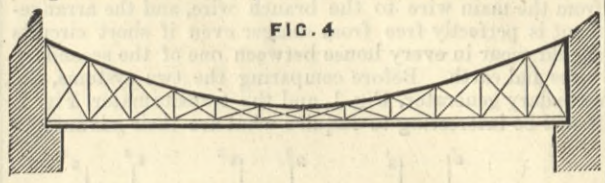
FIG. 3



that adopted by Mr. P. Barlow in the Lambeth Bridge, where he reduced the alterations in the form of the catenary by placing diagonal bracing between it and the platform, as in Fig. 4.

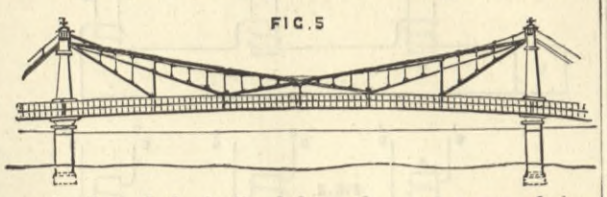
If it were possible to maintain in straight lines inclined ropes, such as Roebling adopted, they might be used for carrying the weight of the bridge, and the catenary might be dispensed with or become of secondary importance; but this did not appear feasible till Mr. Ordish, in his Prague bridge above referred to, held the inclined chains or bars

FIG. 4



in a straight line—as in Fig. 5—by the catenary, which, being used for this purpose only and not to carry any of the bridge load, has always the same weight upon it—

FIG. 5



namely, that of the inclined bars, the proper curve being always maintained both with equal and unequal loads on the platform, without any of the distortion usual in suspension bridges. This plan was adopted at the Albert Bridge, with the modifications that the catenary rope carrying the weight of the inclined bars or chains also supports a portion of the weight of the platform and the moving load of the bridge at points 20ft. apart, as well as the whole of the weight and the moving load of the central section of the bridge, which is more or less than 40ft. in length, according to the arrangement of the moving load. From the fact that the catenary cannot alter its form without affecting the action of the straight chains, there will

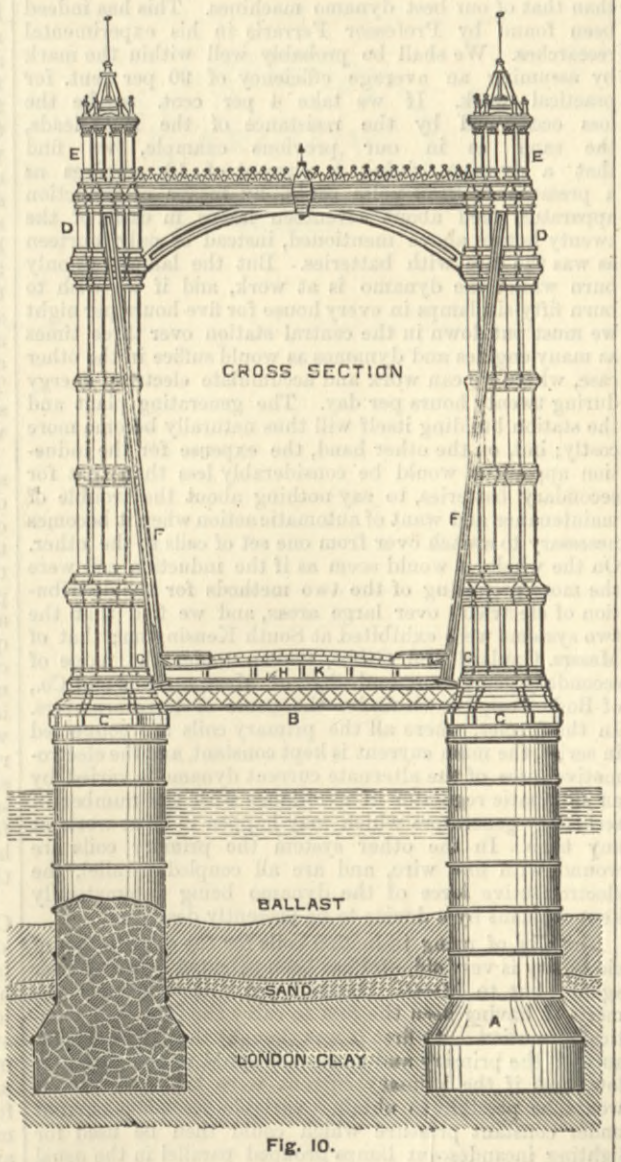


Fig. 10.

always be a certain proportion between the weight supported at the apex of the catenary and that supported by it at each of its suspending points, its form also being so calculated as to prevent any change in the proportion.

The present difficulty in regard to the bridge, which is the cause of the alterations now proposed by the Metropolitan Board of Works, has arisen from the defective condition of the wire rope. Mr. Ordish desired to make the catenary chains of links as he had done at Prague, and as he subsequently did at a bridge of a similar kind at Singapore; but the directors of the company having purchased some of the wire for Captain Roberts' foolish scheme above referred to, and having only a limited amount of money at their disposal, preferred that this wire be used for making the catenary, and as this plan, if properly carried out, is quite feasible, Mr. Ordish consented. The rope is not twisted, but consists of parallel steel wires about $\frac{1}{8}$in. diameter. Great care was taken to lay the wires so that each maintained its proper position in the rope, and the rope is clipped at intervals of about 7ft. But in order to protect the cable thus formed from rust, and from bulging between the clips, it ought to have been wrapped closely with small wire, as, for instance, is done at the suspension bridge over the East River at New York, and this was, of course, the intention of the engineer of the Albert Bridge. But the wrapping of the cable is an expensive operation, requiring a special machine to do it effectually; and when this point in the construction of the bridge was reached, the funds of the company were exhausted, and, despite the engineer's protests, the cable has remained unwrapped to the present day. The necessity for replacing the rope by links, as is now to be proposed, was foreseen, and it would have been done when sufficient funds had accumulated, but for the sale of the bridge to the Metropolitan Board of Works. Thus unprotected, the cable has bulged between the clips, as was expected, leaving wide gaps into which the rain can enter between the wires, so that the rust is having a serious and rapidly deteriorating effect.

FIG. 1.

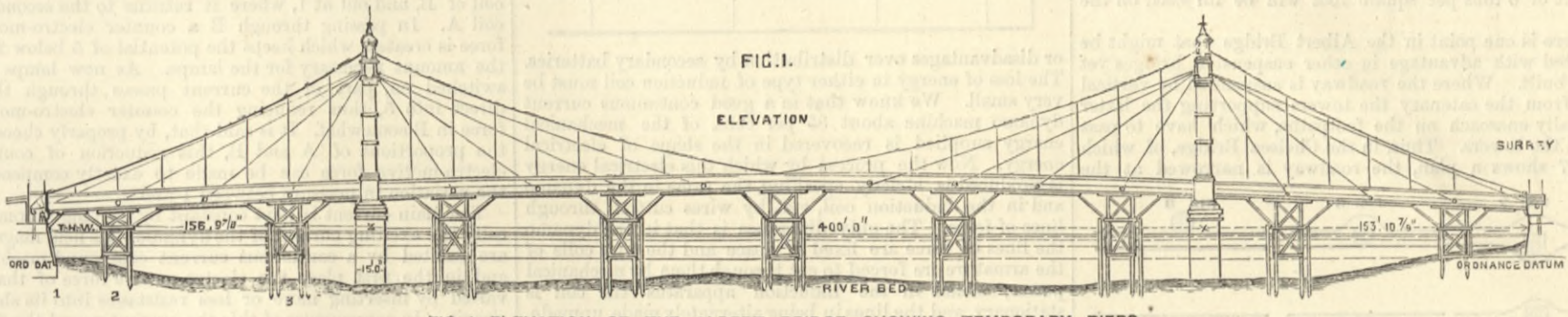
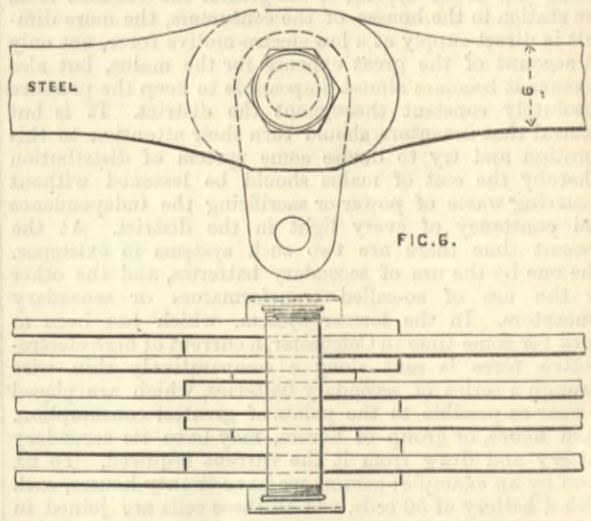


FIG. 1—ELEVATION OF THE ALBERT BRIDGE SHOWING TEMPORARY PIERS.

If the bridge were of the ordinary suspension type, depending entirely on the catenary rope for its stability, this deterioration would be a much more serious matter; but as it is, no harm would occur under ordinary traffic if the ropes were entirely taken away. As the Albert Bridge is at the present moment probably the strongest suspension road bridge in Europe, it is greatly to be regretted that the neglect of the cable renders an expensive alteration necessary.

It is now proposed to remove the wire cable, and to substitute a chain made in the ordinary way of links. These links are all 6in. wide, but vary in length between 21ft. and 23ft., and they afford a total sectional area for each chain of 30 square inches. The links interlace at their junction in the chains, as in Fig. 6, alternating from four to five in



number; and in order to maintain the same sectional area of 30in., the four links are $1\frac{1}{4}$in. thick and the five links are 1in. thick. Assuming that the steel has a strength equal to 30 tons per square inch, the chains will have a resistance to fracture of 900 tons, or about five times the maximum strain that can in all probability be ever brought upon it.

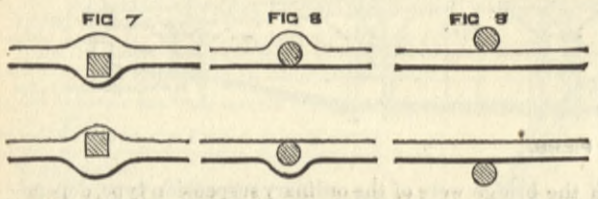
The quality and tests of the steel are described in the specification as follows:—"Should any link tested rupture across its body under a less tensile stress than 67,200 lb. per square inch of original cross section, or uniformly elongate under that strain less than 10 per cent. on any portion of the length of the body of the link, another link shall be tested in its place, which latter, if also found to be of inferior quality or strength, shall justify the engineer in rejecting the batch of links delivered therewith. Any small specially prepared test specimens shall be selected by the inspector, and cut out of the body of the link from one of its edges. They shall be planed perfectly straight on their inner edges only, to a uniform sectional area throughout their lengths. They shall not be less than $2\frac{1}{2}$ square inches sectional area, and shall resist an ultimate tensile stress of not less than 72,000 lb. per square inch, and elongate under that strain not less than 12 per cent. in a length of 24in."

It will be seen that no maximum strain is specified as is usual in the Admiralty tests for ship plates to ensure against undue harshness. In order to take all strain from the present wire rope, and to allow the substitution of the new chain, the bridge is to be supported temporarily by timber piers, as shown in Fig. 1, each pier consisting of 13in. piles driven into the bed of the river and suitably framed together. Upon the bridge a scaffolding will be erected to support the inclined chains and the new catenary chain during the operation. The substitution of

the chain will require some alteration in the upper saddles on the towers which receive the present wire rope.

The Chelsea member of the Metropolitan Board of Works has, according to the newspaper reports, expressed some anxiety as to the weight that a heavy fall of snow might impose on the bridge, and it may be some consolation to him and other people in the locality to know that the Albert Bridge is probably the only road suspension bridge strong enough to need no restriction as to the kind of traffic, that a traction engine or a road-roller may pass over it safely, and that if loaded with the traffic of London Bridge the structure would be perfectly safe for many years to come if the cable did not deteriorate by rust at a greater rate than at present. The towers of the bridge rest on two cylindrical piers, each having a base 21ft. diameter, sunk down to the hard London clay foundation, the concentrated load upon the clay being at its heaviest only about 3½ tons per square foot of surface. This loading of the foundation is well within what is usual in similar cases. When the Victoria Railway Bridge for the London, Chatham, and Dover Railway was widened in 1865-6, the engineer, Sir Charles Fox, made careful experiments by loading the concrete in the cylinders with nearly 4 tons per foot with practically no yielding. The Charing-cross and Cannon-street Railway Bridges of the South-Eastern Railway have cylindrical piers resting on the London clay, and with such an area of base that when each line of railway is loaded to 1 ton per lineal foot, a weight of 6 tons per square foot will be imposed on the clay.

There is one point in the Albert Bridge that might be imitated with advantage in other suspension bridges yet to be built. Where the roadway is suspended by vertical rods from the catenary the towers supporting the latter generally encroach on the footpaths, which have to pass round the towers. Thus, in the Chelsea Bridge, of which Fig. 7 shows a plan, the roadway is narrowed at the

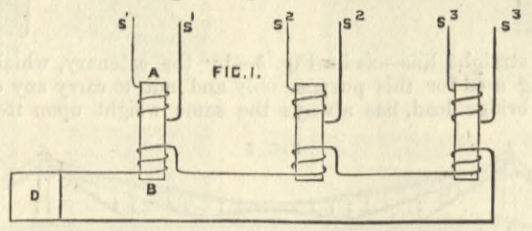


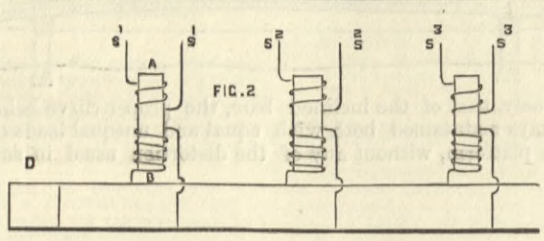
towers and the footpaths are diverted; in the Prague Bridge, Fig. 8, the roadway is maintained at its full width and only the footpaths are affected; while in the Albert Bridge both roadway and footpaths are maintained at their full width. This is done by building the towers entirely outside both roadway and footpaths, and as will be seen by the cross section, Fig. 10, the platform is suspended by chains not in a vertical plane.

ELECTRIC LIGHTING BY INDUCTION.

One of the greatest difficulties which stand in the way of supplying private houses with electric light from a central station is that of distribution. The larger the area which has to be served, or the greater the distance from the station to the houses of the consumers, the more difficult is direct supply at a low electro-motive force, not only on account of the great expense for the mains, but also because it becomes almost impossible to keep the pressure absolutely constant throughout the district. It is but natural that inventors should turn their attention to this question and try to devise some system of distribution whereby the cost of mains should be lessened without incurring waste of power or sacrificing the independence and constancy of every light in the district. At the present time there are two such systems in existence. The one by the use of secondary batteries, and the other by the use of so-called transformators or secondary generators. In the former system, which has been at work for some time in Colchester, a current of high electro-motive force is sent along a comparatively thin wire through a series of secondary batteries, which are placed as near as possible to the points of greatest consumption. Each house, or group of houses, may have its secondary battery and draw from it the current required. To fix ideas by an example; assume we have twenty houses, each with a battery of 50 cells, and all these cells are joined in series with the line wire, the charging current being 10 ampères. The counter electro-motive force of each battery will be about 120 volts, and adding 5 volts per house for the resistance of the wire, we would require a dynamo of about 2500 volts external electro-motive force in the central station. Assuming the efficiency of batteries and line to be 70 per cent., we could then, by keeping the dynamos running for twenty hours a day, light fourteen 20-candle lamps in each house during that time, or 56 lamps during five hours every night. If the house wires were attached direct to the terminals of the battery whilst the same is inserted into the main current, serious danger might arise in case of short circuits taking place simultaneously in two distinct houses between their wires and fittings or earth. To avoid this danger a duplicate set of batteries must be used in each house, one of these being charged whilst the other is connected to the house wires, and the switches and connections must be so arranged that it is absolutely impossible to join house and main wires simultaneously to the same battery.

In the second system, which requires an alternating main current, induction coils are used instead of batteries, and they may be arranged either in series or parallel. In the former arrangement, Fig. 1, the same current passes through all the coils in succession, and in the latter arrangement, Fig. 2, a small portion of the current is drawn off the + main at each coil and returns to the − main without having passed through any of the other coils. To avoid misapprehension we must state that we use the term + and − main simply by way of brevity. Since the current flows backwards and forwards many times in a second, each main is alternately positive and negative. The current from the dynamo D, Fig. 1, is led through a coil surrounding an iron core *a b*, and then passes on to the next coil, and so on. The secondary circuits to which the house wires are joined s_1 s_1 s_2 s_2 and so on, are quite distinct from the main wire, and do not even touch it. Consequently no actual transfer of current can take place from the main wire to the branch wire, and the arrangement is perfectly free from danger even if short circuits should occur in every house between one of the secondary wires and earth. Before comparing the two systems, the secondary generator, Fig. 1, and the transformator, Fig. 2, it will be interesting to inquire what are their advantages





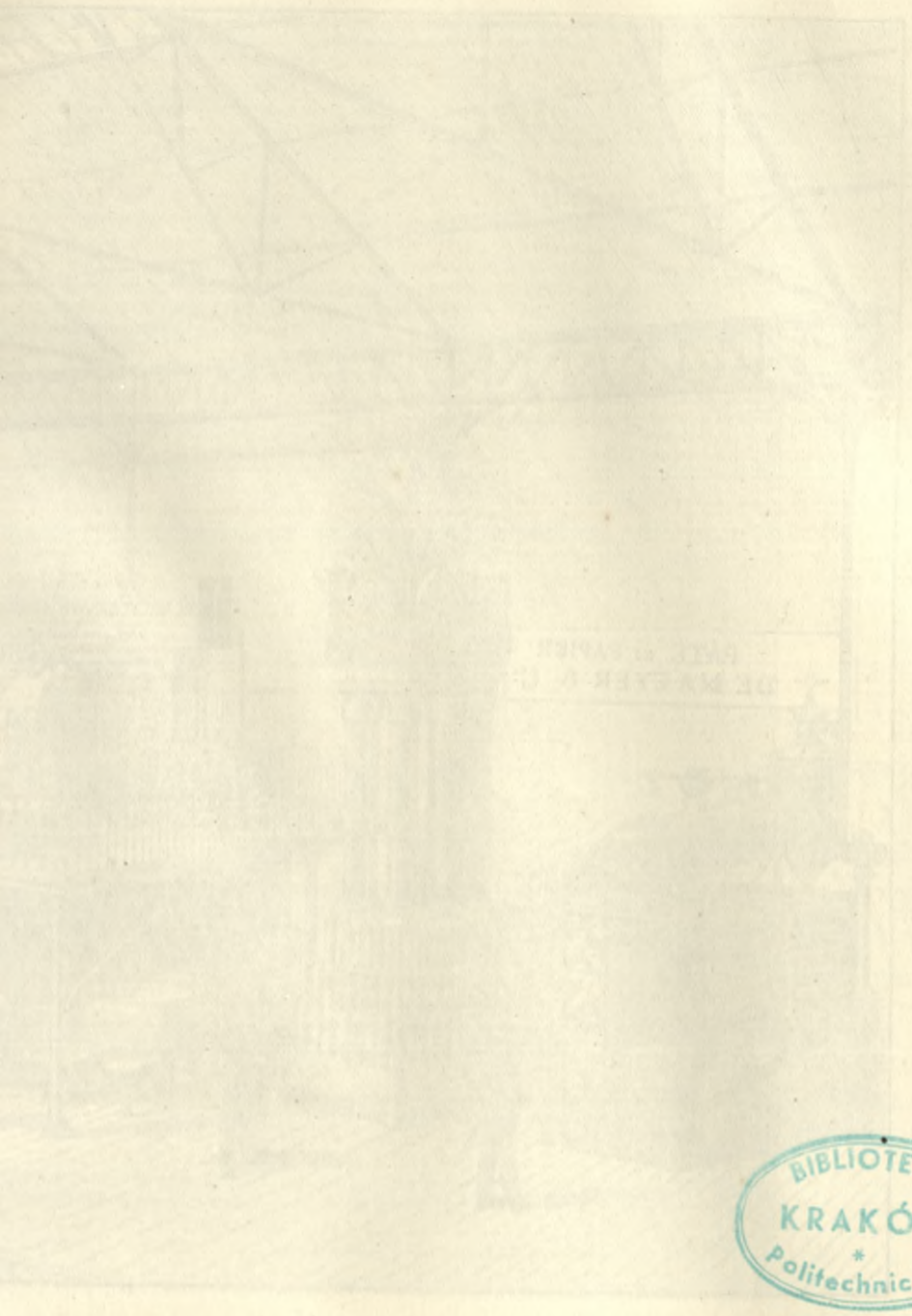
or disadvantages over distribution by secondary batteries. The loss of energy in either type of induction coil must be very small. We know that in a good continuous current dynamo machine about 85 per cent. of the mechanical energy supplied is recovered in the shape of electrical energy. Now the process by which this electrical energy is produced is, strictly speaking, the same in the dynamo and in the induction coil, viz., by wires cutting through lines of force. The only difference is that in the dynamo the lines of force are fixed in space and the wire coils of the armature are forced to cut through them by mechanical power, whilst in the induction apparatus the coil is stationary, and the lines in being alternately made, unmade, and reversed by the primary current, cut through the coil. That loss of energy which is caused by heating of metallic masses exists in both cases, but is necessarily greater in the dynamo, because it has moving parts which are subjected to heavy mechanical strains, and in which therefore the subdivision of these masses of metal cannot be so completely carried out as in the induction apparatus, where everything is at rest. That loss of energy which in dynamos is caused by mechanical friction and resistance of the air is, of course, entirely absent in the induction coil, and for these reasons we may expect that the efficiency of secondary generators and transformators should be greater than that of our best dynamo machines. This has indeed been found by Professor Ferraris in his experimental researches. We shall be probably well within the mark by assuming an average efficiency of 90 per cent. for practical work. If we take 4 per cent. to be the loss occasioned by the resistance of the main leads, the same as in our previous example, we find that a dynamo giving a current of 10 ampères at a pressure of 2500 volts could, by means of induction apparatus, feed about seventeen lamps in each of the twenty houses above mentioned, instead of only fourteen as was the case with batteries. But the lamps can only burn whilst the dynamo is at work, and if we wish to burn fifty-six lamps in every house for five hours per night we must put down in the central station over three times as many engines and dynamos as would suffice in the other case, where we can work and accumulate electrical energy during twenty hours per day. The generating plant and the station building itself will thus naturally become more costly; but, on the other hand, the expense for the induction apparatus would be considerably less than that for secondary batteries, to say nothing about the trouble of maintenance and want of automatic action when it becomes nesessary to switch over from one set of cells to the other. On the whole, it would seem as if the induction coil were the more promising of the two methods for the distribution of electricity over large areas, and we find that the two systems were exhibited at South Kensington; that of Messrs. Gaulard and Gibbs, known under the name of secondary generators, and that of Messrs. Ganz and Co., of Buda Pest, known under the name of transformators. In the former, where all the primary coils are connected in series, the main current is kept constant, and the electro-motive force of the alternate current dynamo is varied by an automatic regulator in accordance with the number of secondary generators which may happen to be at work at any time. In the other system the primary coils are wound with fine wire, and are all coupled parallel, the electro-motive force of the dynamo being automatically kept constant by a device to be presently described.

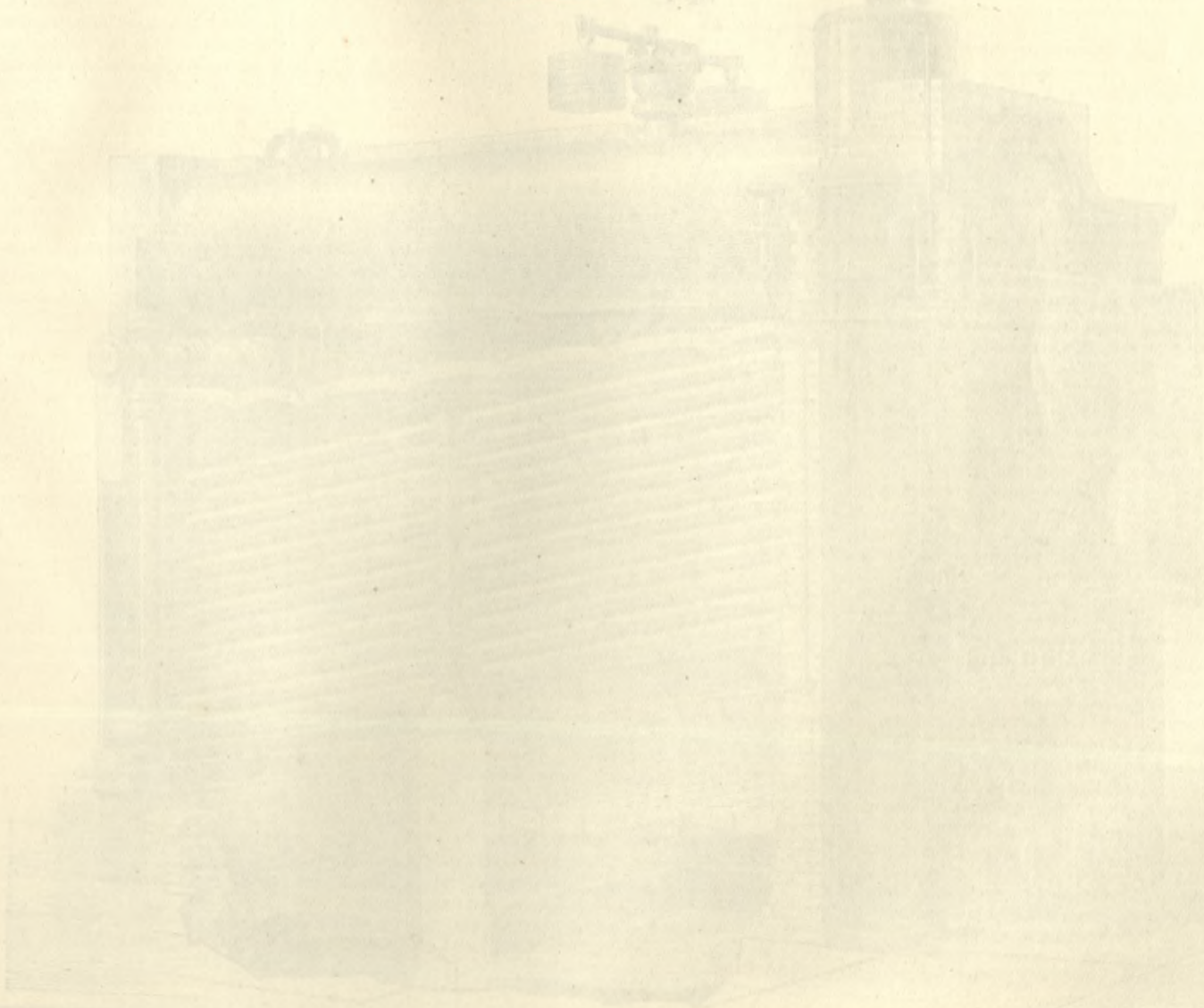
The idea of using induction coils for the distribution of electricity is very old, and has been patented over and over again; but to Messrs. Gaulard and Gibbs belongs the merit of having been the first to carry the idea into practical execution. At first it was thought that if the resistance of the primary and secondary spiral were sufficiently low, and if the primary current were kept constant, it would be possible to obtain a variable secondary current under constant pressure which could then be used for lighting incandescent lamps grouped parallel in the usual way. But it was soon found that on switching out some of the lamps those remaining became brighter, thus showing that constancy of pressure was not to be obtained in so simple a way. To explain the reason why the pressure rises with a diminution of the secondary current we must refer to Fig. 1. The iron core *a b* is subject to the magnetising influence of both the primary and the secondary spiral, and since the current in the latter is always in opposite sense to that in the former, the magnetisation of the core, or, to speak more precisely, the number of lines which shoot out from it with every reversal of current, is due to the difference between the two currents. The weaker the secondary current, the more lines are created and the higher must be the electro-motive force on the terminals of the secondary coil. If, on the other hand, the secondary coil be short-circuited, its current will increase so as to be almost equal to the primary current—the number of convolutions in the two coils being in the Gaulard and Gibbs instruments generally the same—and the magnetisation of the core, as well as the electro-motive force, is almost *nil*. Thus the pressure varies with the current, and if the secondary generator were to be used in this simplest form to feed a group of incandescent lamps placed in parallel connection, their brilliancy would vary inversely as the number of lamps burning at any time. To overcome this difficulty, the inventors have devised an apparatus which automatically regulates the secondary current, and keeps the pressure at the lamps constant whatever may be the number burning. This regulator consists of a small secondary generator inserted as shown in Fig. 3, where A is the first secondary generator connected with the main leads I. II. in the usual manner; 1, 2 are the secondary leads, connected with the lamps L and with another smaller secondary generator B in such way that the current from 2 may either go through the lamps or through the secondary coil of the small generator. When all the lamps are switched out the current flows from 2 to 3, then through the secondary coil of B, out at 4, then at 5 into the primary coil of B, and out at 1, where it returns to the secondary coil A. In passing through B a counter electro-motive force is created, which keeps the potential of 5 below 2 by the amount necessary for the lamps. As new lamps are switched on, part of the current passes through them direct into 5, thus reducing the counter electro-motive force in B somewhat. It is said that, by properly choosing the proportions of A and B, this reduction of counter electro-motive force can be made to exactly compensate the variation in pressure between 1 and 2.

The main current is kept constant by varying automatically the exciting current of the dynamo. Its field magnets are excited by a continuous current compound machine, and in the first place the electro-motive force of that is varied by inserting more or less resistance into its shunt circuit. In consequence of this the current round the field magnet of the large alternating current machine is varied, and with it the electro-motive force in the main circuit, and this keeps the primary current itself constant. The automatic regulator consists of a solenoid through which the main current flows, and of an iron core, which is suspended from one end of a balance beam, the other end of which is provided with a number of U-shaped contact pieces of various lengths dipping successively into mercury cups. In this manner a greater or smaller number of coils in a rheostat are short-circuited, according to the position of the core in the solenoid. This rheostat being inserted in the shunt circuit of the exciting dynamo, any variation in the strength of the main current is thus rectified automatically. From the above description of the Gaulard and Gibbs system it will be seen that in order to secure the independence and constant brilliancy of every lamp there must be not only an automatic current regulator at the dynamo, but every secondary generator must be fitted with a regulating apparatus in the shape of a smaller secondary generator. Now this complicates the system to some extent, and Messrs. Ganz and Co., of Budapest, or rather, their engineers, Zipervowsky, Deri, and Blathy, have tried to improve on the original plan by making, in the first place, every induction coil, or transformator as they call it, self-regulating; and in the second place, by substituting for the regulator at the dynamo, which as above described is a somevhat delicate piece of mechanism, an apparatus which contains no movable pieces at all. They have also simplified the system by introducing a self-exciting alternate current machine, thus doing away with the little exciting dynamo hitherto employed.

Messrs. Ganz and Co. group their coils all parallel, as shown in Fig. 2. From what we said above about the differential magnetising action of the primary and secondary current on the core of the induction coil, it will be evident that the counter electro-motive force in the primary and the electro-motive force in the secondary coil are both proportional to the magnetism of the core, and therefore are proportional to each other. As a necessary consequence, if we keep the electro-motive force on the primary coil constant by arranging all these coils in parallel connection on main leads between which a constant pressure is kept up, the electro-motive force of the secondary coil will also be constant even if its current should vary. In reality this constancy of electro-motive force will be slightly impaired by the resistance of the coils, but that is so small as to be almost negligible. By the use of transformators it is therefore possible to switch any number of lamps out without producing a perceptible alteration in the brilliancy of the lamps which remain alight.

Another improvement introduced by Messrs. Ganz and Co. lies in the arrangement of the coils. In the Gaulard and Gibbs generator the core is a cylinder composed of a bundle of straight wires, and this is surrounded by a double helix of thin copper discs. Discs 1, 3, 5, and so on, are joined up to form the primary, and discs 2, 4, 6, and so on, are joined up to form the secondary spiral. The core is movable in the coil, in the manner of the well-known medical induction coils, and thereby the electro-motive force of the secondary current can be adjusted. The magnetic lines of force pass through the core, in at one end and out at the other, and are then more or less disseminated through space. Each line forms a closed curve, as indicated in Fig. 4. For the sake of simplicity we assume the primary and secondary coil to consist each of only one turn, shown at 1 and 2. If now a current is started in the primary coil, gradually growing from zero to a maximum, its lines of force—or, as it is also called, the magnetic whirl surrounding the current—will also grow from curves of infinitesimal diameter to those filling a considerable space around the wire. As the current grows the curves expand and become more numerous, and in so doing they are bound to cut the secondary coil and to create thereby





WATER-TUBE BOILERS AT THE ANTWERP EXHIBITION.

MESSRS. DE NAEYER AND CO., WILLEBROECK, ENGINEERS.

(*For description see page 431.*)

Fig. 1

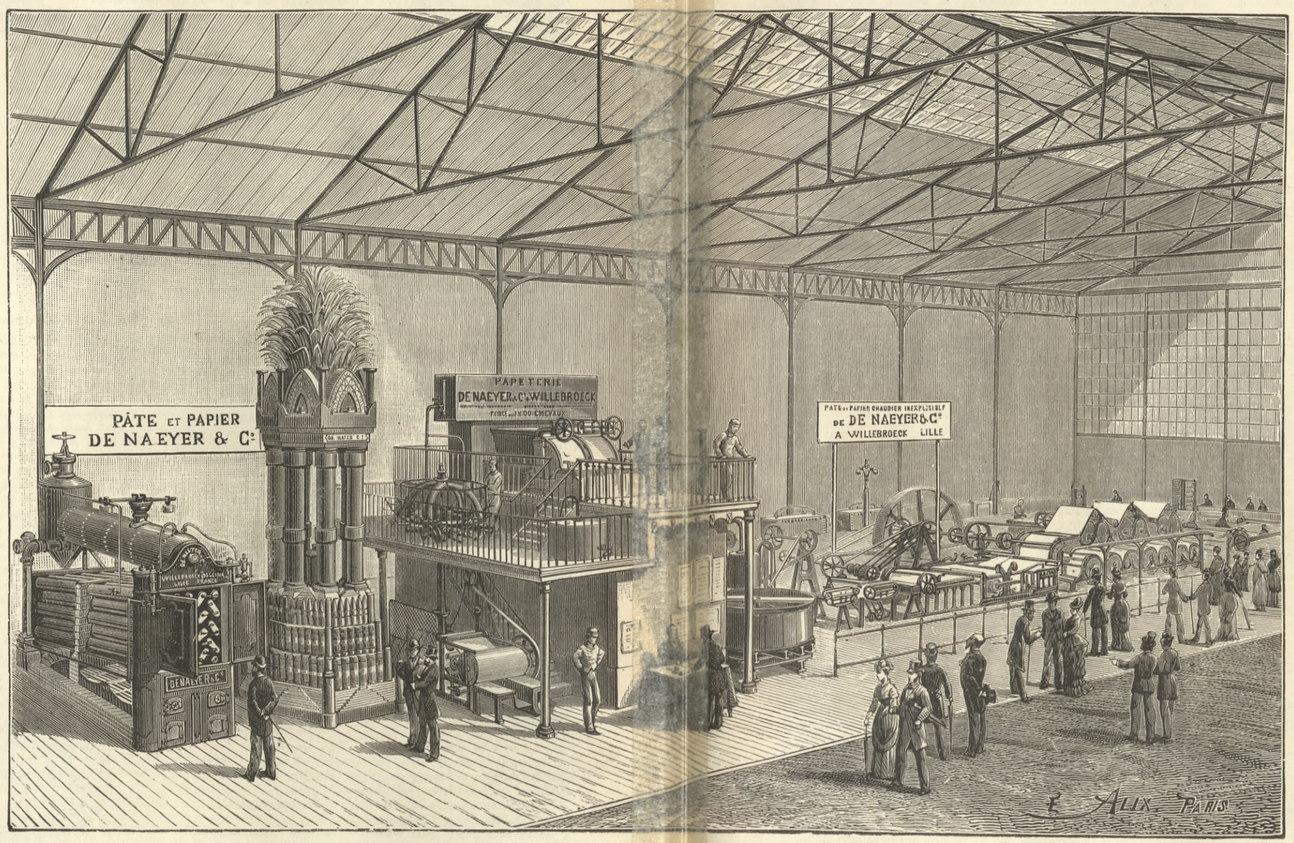


Fig. 8

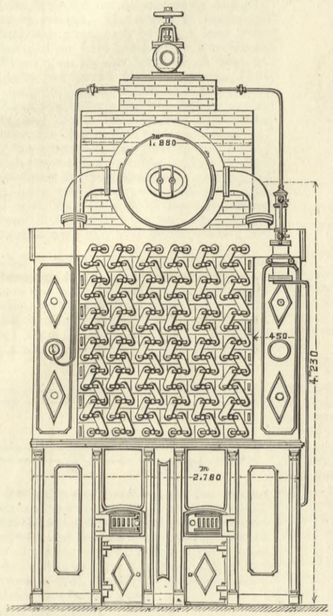


Fig. 2

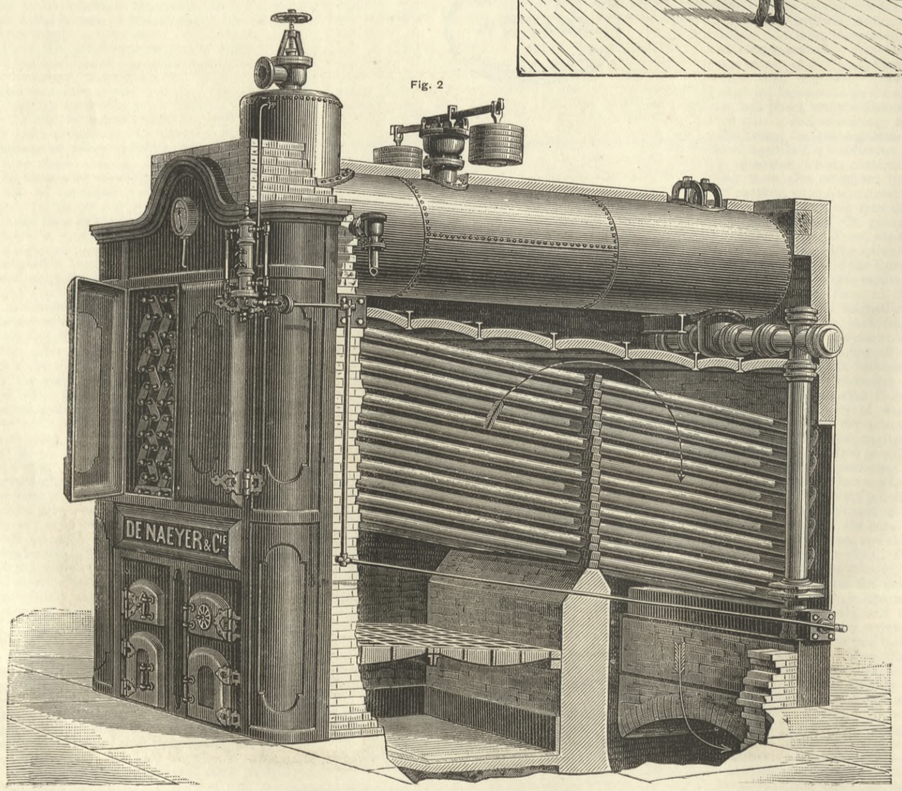


Fig. 7

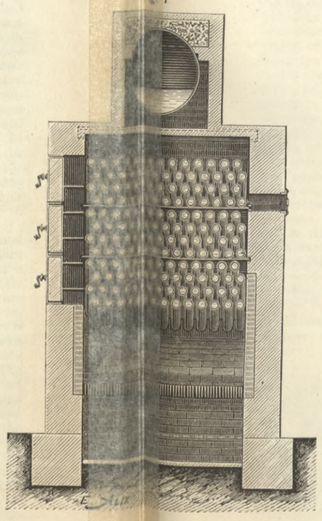


Fig. 5

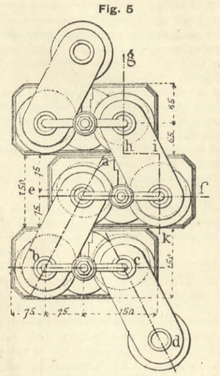


Fig. 6

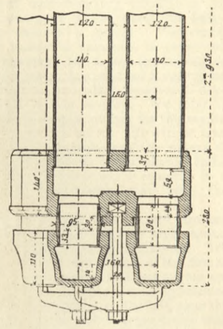


Fig. 10

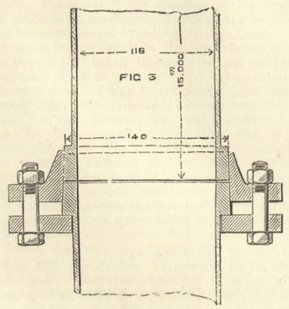


Fig. 4

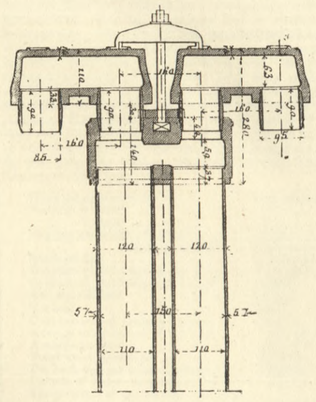


Fig. 9

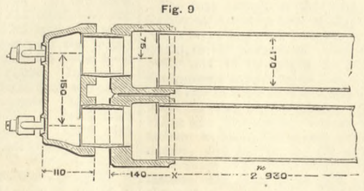
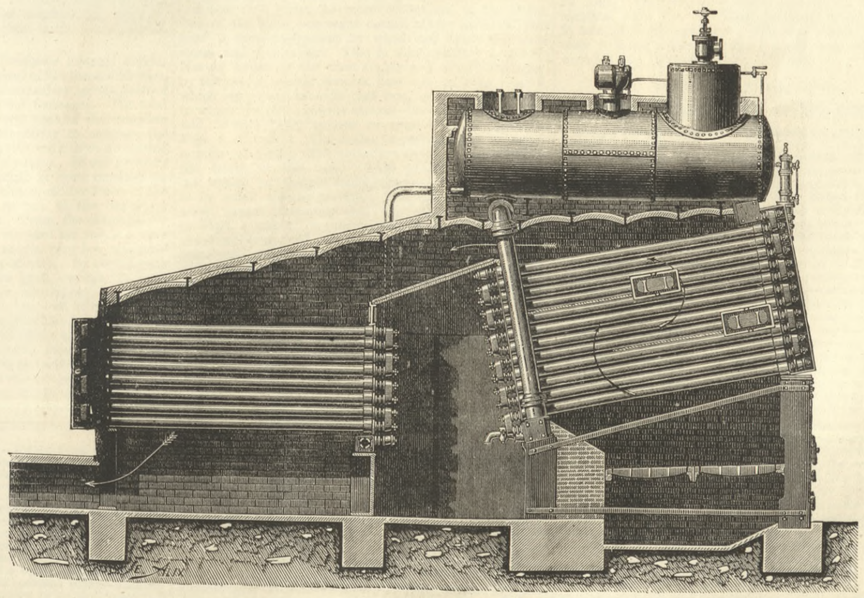


Fig. 3



an electro-motive force in it. When the primary eurrent has attained its maximum and begins to diminish, its lines of force shrink together again and create in the secondary coil an electro-motive force opposed to that created during expansion. If through this coil a current is permitted to flow it will in its turn have a magnetic whirl always opposed to that of the primary current, and the electro-motive force created in the secondary coil will then be due to the differential action of the two sets of lines. It has been pointed out when we were discussing the general principle of dynamo machines that the electro-motive force is proportional to the number of lines cut by the wire in unit time. To obtain a high electro-motive force in our secondary coil we must therefore have a large number of lines each time the primary current attains its maximum strength, and we must have a large number of reversals per second. The latter point depends on the dynamo at the generating station ; the greater the number of coils in its armature and the greater its speed the higher will be

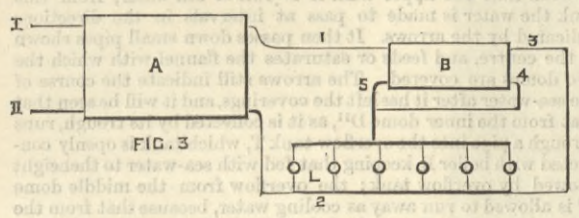


FIG. 3

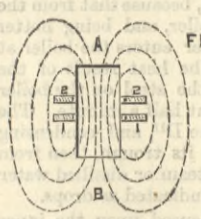


FIG. 4

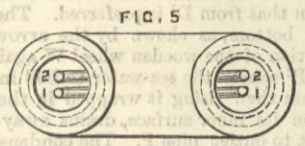


FIG. 5

the electro-motive force in each secondary coil. As regards the number of lines created and effaced at each reversal, it will be evident that to make this a maximum we must make the magnetic resistance of each induction apparatus a minimum. Now in the Gaulard and Gibbs system, the path of the lines lies partly in iron and partly in air, and since air has about 700 times more magnetic resistance than iron, it will be clear that the number of lines created with a given current must be considerably smaller than would be the case if the path of the lines would contain iron only. This is the case in the transformators of Messrs. Ganz and Co., Fig. 5. The two coils are again represented by two wires, 1 and 2, and the iron of the core is applied in the form of a ring-shaped shell surrounding both coils completely. This arrangement can best be described by comparing it to a Gramme armature in which the copper and iron have changed places. Imagine what is usually the core in an armature replaced by the primary and secondary coils, and instead of the outer winding of insulated copper wire, wind iron wire around the coils, and we have one of these transformators. In consequence of the lower magnetic resistance of the transformator as compared to the secondary generator, it is to be expected that the electrical output obtainable with equal weights of copper and iron will be considerably greater in the former apparatus. This has indeed been found experimentally by Professor Ferraris, of Turin, who has published some of his results in the *Zeitschrift für Elektrotechnik*. In this paper he compares a transformator giving 3000 watts output with two secondary generators giving, combined, the same energy. The weights are 76 lb. for the transformator, and 170 lb. for the two generators. At the same time, the number of reversals of the primary current was smaller with the transformators, and taking this circumstance into account, Professor Ferraris finds that the coefficient of induction—on which depends the output of the apparatus—is 3·6 times as great in the transformator as in the secondary generator.

The transformator on which Professor Ferraris experimented consisted of a primary spiral of 216 turns, ·099 wire, ·562 ohms resistance, and of two secondary spirals, each of 54 turns, ·137 wire, ·135 ohms total resistance. The total weight of copper was 31·5 lb., and that of the complete apparatus was 76 lb. It is interesting to compare the results obtained with this apparatus with those attainable with a good continuous current dynamo. In our previous articles it was shown that the length of wire required on the armature for every volt of electro-motive force in the external circuit can be taken as one of the important factors when judging a machine. From the examples we have given it will be seen that one yard per volt is a very good performance, there being only a very few machines which require a smaller quantity of wire. By the courtesy of Professor Ferraris, who was good enough to send us some of the figures of his calculations, it appears that in the transformator tested the two secondary coils when coupled in series had a length of 92·5 yards. There were eighty-eight complete reversals of the main current per second, and the electro-motive force obtained was 100 volts. If there had been 100 reversals per second, the number for which the apparatus was designed, the pressure would have been 114 volts, being at the rate of ·81 yard for every volt.

NATURAL GAS.—The Philadelphia—Westinghouse—Natural Gas Company is supplying over 1500 dwellings with natural gas, compared with 640 a month ago, 66 glass factories, 34 rolling mills and 45 other industrial works, besides 69 miscellaneous establishments, and the cry is still for more, with which request the company is complying as rapidly as it can. It is estimated that at the present time from 8000 to 10,000 tons of coal daily are displaced. In the spring the company will make some changes in its system of supplying gas. In the first place, the plan just adopted in Smithfield-street for supplying domestic consumers will be made general. That is, a pipe will be laid along each side of the street and a street box placed in front of every alternate house, whether the occupant signifies desire to use the gas or not. In case he ever makes up his mind to use it, it will only be necessary to make connection with the box. In the next place, the system of contracts will be abolished, and meters will be placed in each manufactory and dwelling using the gas.

THE ANTWERP EXHIBITION.

No. XI.

IT is a noteworthy fact that the Cornish and Lancashire boilers are not popular out of Great Britain. On the Continent of Europe steam generators of the elephant type modified in various ways were used almost from the first. In the United States the preference has always been for boilers consisting of two, three, or more long cylinders seldom more than 3ft. in diameter—often, only half as much—arranged in groups and fired externally. Within the last quarter of a century, tubulous boilers—that is to say, boilers built up of a number of comparatively small and long tubes—have come into use, and are gaining in popularity everywhere, save in this country, where the Cornish and Lancashire generators are being slowly superseded by boilers of the locomotive type. There is, on the whole, so little to be said in favour of the double-flued boiler that the persistence of the type is somewhat remarkable. It is not our purpose to consider here to what its popularity is due. It will suffice to point out that engineers and steam users in other countries have not seen fit to follow the example set by Cornwall and Lancashire.

Various attempts have been made to produce a good tubulous boiler, and we not long since published a very interesting paper recording and illustrating the growth of one which finds great favour in the United States. When we come to examine the failures which have taken place, and to inquire the cause, we find that want of success has almost without exception been due to ignorance on the part of the designer concerning the phenomena of ebullition in small tubes; neglect of manufacturing details; or an abandonment of what was good in the search for something new enough to deserve a patent. We could, were it necessary, cite numerous examples to prove our proposition ; it will, however, be more interesting to describe a tubulous boiler which has attained a very great popularity indeed in Belgium, and which deserves to have its merits fully recognised in this country. We refer to the De Naeyer boiler which supplied steam for the machinery gallery of the Antwerp Exhibition. It will be seen that M. De Naeyer has fully comprehended the nature of the conditions which the water-tube boiler should fulfil, and that he has produced a generator which complies in a very straightforward and workmanlike way with the demands made on it.

The works of Messrs. De Naeyer and Co. are situated at Willebrock, Lille. The firm enjoys a very high reputation as manufacturers of paper-making machinery. We give in our supplement a view of the exhibit of the firm at Antwerp, Fig. 1. The wood grinding and rag engine are situated on the raised platform. The paper-making machine is seen stretching away to the right. On the left, near the trophy of Esparto Grass, &c., is a De Naeyer boiler with the brickwork removed to shows its construction.

Steam was supplied to the machinery gallery at Antwerp by two groups of De Naeyer boilers, as we have stated in one of our first articles on the Exhibition. At the north end there were four boilers, and at the south end two boilers. These were in steam. A third boiler of small size—that first referred to as standing near the trophy was, of course, not in use. At first sight the boiler looks like a great many other water-tube boilers. Its details, however, are different, and it is on detail that success or failure in this class of generator depends. The boiler consists, it will be seen, of a number of tubes from 10ft. to 14ft. long, $4\frac{3}{4}$in. diameter, and about $\frac{1}{5}$in. thick. The ends of the tubes are coupled in pairs by boxes of malleable cast iron, as shown in Figs. 4, 5, and 6. Each pair of tubes constitutes what is called an "element." The complete boiler is built up of groups of elements, the assemblage of a certain number of elements being called a "series." The greater the number of elements in a series the more economical is the boiler. One of the most important details about boilers of this kind is the arrangement by which the tubes are made steam and water-tight. This is accomplished in the De Naeyer boiler in the most simple and effective manner, by the use of conical ferrules, best seen in Figs. 4 and 6, which are ground into the cast iron, and into the boxes to which the tube ends are secured—two tubes, as we have said, always being secured in each box, as shown in Figs. 4, 5, and 6. The boiler is composed of a certain number of series. The tubes are inclined, sloping from the front to the rear. This arrangement permits the steam to escape freely, because it rises, thanks to its small specific gravity. The steam from all the series passes ultimately into the steam drum shown in Figs. 2 and 3. A pipe descends from the back end of the steam drum, and communicates with a strong rectangular pipe, which is open to all the tubes in the lower row. Thus the water carried up with the steam into the drum flows to the back end, and descends the down pipe, to pass once more through the tubes for evaporation. Connected with this lower distributor is a large blow-off cock, to get rid of mud, which all appears to find its way to this point —no doubt because it is at once the lowest and the most tranquil in the generator. The tubes are arranged in quincunxes. The flame and products of combustion are distributed by partitions as shown. It need scarcely be said that the boiler can stand a very heavy pressure without risk. Every boiler, before it is sent out is tested by hydraulic pressure to 600 lb. on the square inch. The steam pipe joints are made as shown in Fig. 10.

It is well known that water charged with lime or mud is by no means suitable for water-tube boilers, and it may be asked how does M. De Naeyer deal with cases in which the feed-water is bad. The principle he adopts is to pump the water into the drum, where it is heated before it enters the tubes and precipitates a great deal of its lime, for reasons which we have often explained. The tube ends can be opened at any time with the greatest ease, and a steel scraper driven through them will remove any deposit. In a boiler with sufficient surface the products of combustion pass away at a temperature of about 450 deg. When further economy is desirable an economiser is added at the back of the boiler, as shown in Fig. 3. This is composed of a worm composed of a number of straight horizontal tubes united by boxes and caps like the boiler tubes. The feed-water is pumped in at the bottom and escapes to the boiler at the top, so that the hottest gases are always in presence of the hottest water. The result of the adoption of the heater is that the products of combustion finally escape to the chimney at a temperature not exeeding 280 deg. Fah.

Deposit is only found in the lower tubes of the boiler, the greater part being thrown down, as we have said, in the steam drum or receiver. The tubes are cleaned outside from dust and soot by means of a jet of steam, played among them when necessary through small openings provided for the purpose in the brickwork, shown in Fig. 7. The boiler is provided with a low-water alarm, shown in Fig. 8. If, however, through neglect, the water is suffered to run short, a tube may be burned and caused to split. Such accidents never produce any bad consequences ; and, from the way in which the boiler is put together, the damaged tubes can be removed and replaced with spare tubes and the boiler restarted within two hours.

It will, we think, be admitted that we have here a very simple and safe boiler. It remains to be seen if it is economical. That it is considered to be so is proved by the very large demand for it which exists on the Continent. For example, during the first four months that the Exhibition at Antwerp was open, M. De Naeyer and Co. sold no fewer than forty-nine boilers, representing 8196 nominal horse-power, allowing 10 square feet of surface to the horse-power. We think it will be admitted that a boiler which can be sold at this rate, after being before the world for some years, deserves to be called good. A great many independent tests of the boiler have been made, as, for example, at the Belgian National Exhibition in 1880, at the Vienna Electrical Exhibition in 1883, and at the Paris Electrical Exhibition in 1881. It will suffice if we give the results of the Paris trial. This took place on the 12th of October, 1881, with coal which came from Pont de Loup, in the Charleroi basin. This coal is very bituminous, burning with a long flame.

Total capacity of boiler	10·5 cubic metres.*
Volume of water	8·0 ,, ,,
,, of steam	2·5 ,, ,,
Heating surface in the boiler	1700 sq. ft.
,, ,, in the economiser	1140 sq. ft.
Grate surface	40 sq. ft.
Duration of the experiment	3 hours.
Coal burnt, including lighting up	1820 lb.
Ash and clinkers	111 lb.
Net coal	1709
Coal per foot of grate per hour	14·25 lb.
Average temperature of the feed	55 deg. Fah.
Average pressure	106 lb. per sq. in.
Total water consumed	17,820 lb.
Per hour and per square metre†	32·6 lb.
Pounds of water per pound of coal	9 72 lb.
Temperature of gas leaving the economiser	185 deg. Fah.

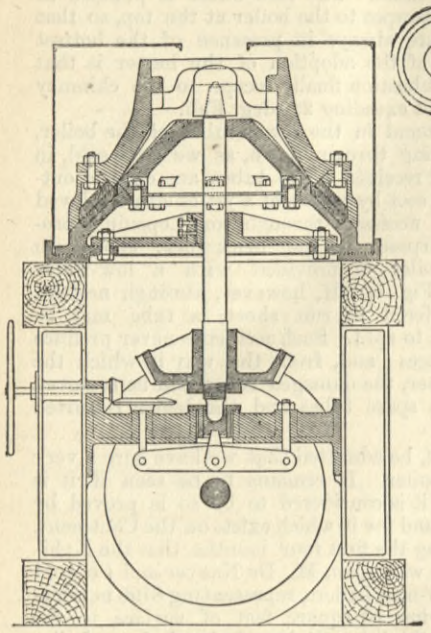
The four boilers at the north end of the Machinery Gallery at Antwerp were of slightly different dimensions. Nos. 1 and 2 had each 14 tubes in width and 12 tubes in height, or 168 tubes in all. Nos. 3 and 4 had 12 tubes in width and 12 in height, or 144 tubes in all in each. Economisers were fitted to Nos. 2 and 3; that attached to No. 3 had 16 tubes in width and 8 in height, or 128 in all; while the other had 14 tubes in width and 8 in height, or 112 in all. The heating surface in No. 1 was 252 square metres; in No. 2, 220 square metres; in No. 3, 190 square metres; and in No. 4, 216 square metres. The two economisers had respectively 140·8 and 123·2 square metres. The total production of steam per hour was about 11,800 kilos., or nearly 11 tons. The two boilers at the south end had each 168 tubes, arranged 14 wide and 12 high. They were without economisers, and were identical with No. 1. They produced 6000 kilos., or $5\frac{1}{2}$ tons, of steam per hour. The coal burned was in all cases a small slack, wetted. Draught was supplied by wrought iron chimneys about 60ft. high.

RAILWAY EXTENSION IN SOUTH AUSTRALIA.

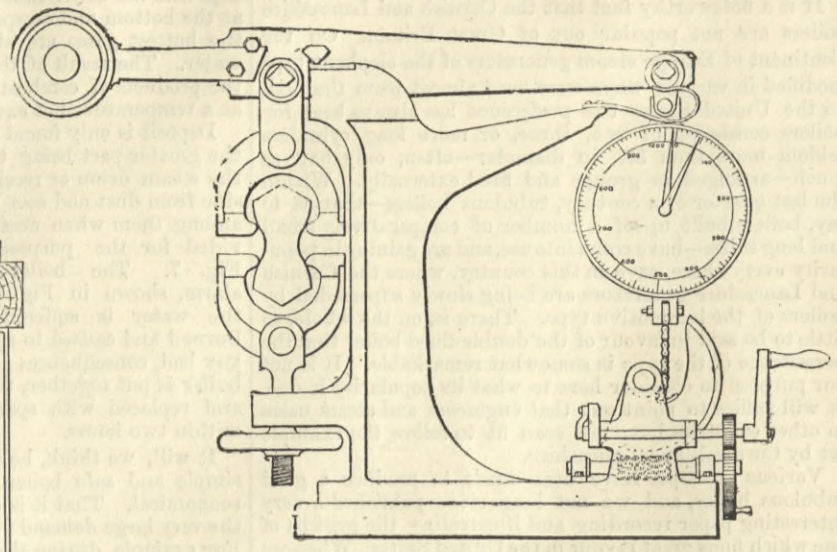
A FEW years ago South Australia earned the gratitude of the Australian Colonies and the world at large by carrying, in the face of great, and many thought insuperable, difficulties, a telegraph line from Adelaide to Port Darwen, across the centre of the continent, till then untrod by any but a few hardy explorers, whose names are now well known in historical geography. A more substantial iron road is rapidly following up the lighter work, and a railway journey across "the bush" can be foreseen in the near future. In the South a railway is already opened from Adelaide to Hergott Springs—441 miles—and another section, *vid* Strangeways Springs to the Peatre—about 200 miles—is under construction. Tenders are asked for for the most northern section of this trans-continental railway, from Port Darwin south to Pine Creek—158 miles—and at the terminus a large jetty and other harbour works are already in course of construction. These works in the northern territory are being supervised by Mr. J. W. James, M.I.C.E. The railway from Hergott Springs is being constructed with labour directly employed by the Government, under the direction of Mr. J. Randall Mann, A.M.I.C.E. These, as well as the numerous other railways in course of construction in the colony, are under the direction of Mr. H. C. Mais, M.I.C.E., the engineer-in-chief. A motion is now under the consideration of the Parliament to at once commence the survey of the connecting link, and it is confidently believed that parties will be sent out early in the ensuing year to carry on the work between the Peatre and Pine Creek. The capitals of New South Wales and Victoria—Sydney and Melbourne respectively—are already connected by railway, and early in 1886 a South Australian line will be completed to Wolseley on the border, and the section on the Victorian side—Serviceton to Dimboola—is now in course of construction. South Australia is also making a railway from Petersburg to the New South Wales border near Silverton—150 miles—to tap the trade of the silver field in the Barrier Ranges, which, it is now confidently believed, will soon astonish the world, and rival the great Nevada mines.

* The cubic metre = 1·308 cubic yards.
† One square metre = 10·764 square feet.

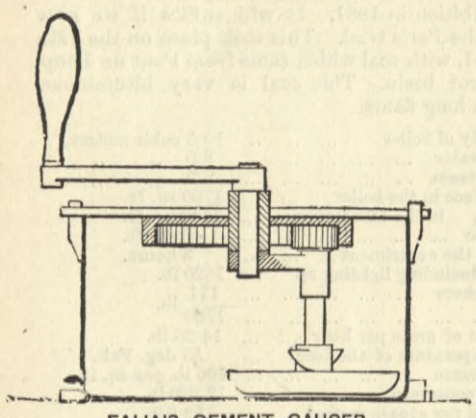
FAIJA'S CEMENT MILL AND TESTING APPARATUS.



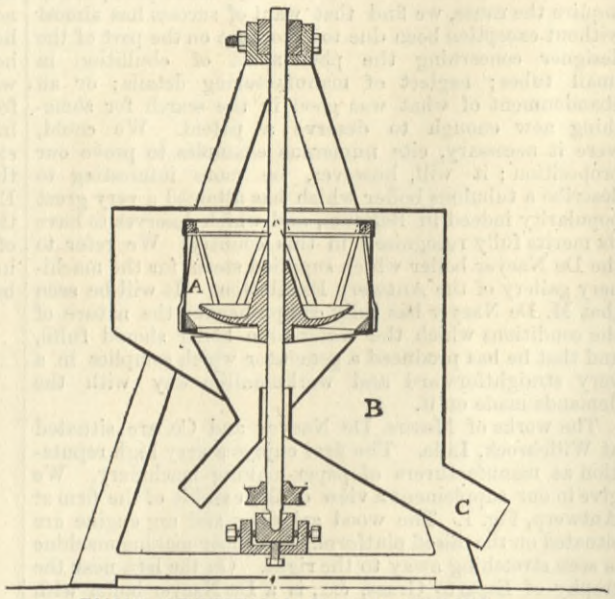
FAIJA AND DAWSON'S CEMENT MILL.



FAIJA'S CEMENT TESTER.



FAIJA'S CEMENT GAUGER.



FAIJA'S CENTRIFUGAL SLURRY DRESSER.

FAIJA'S CEMENT MILL AND TESTING APPARATUS.

A new mill for grinding cement and other hard material has been devised by Mr. William Dawson, and has been tested exhaustively by Mr. Henry Faija, of Great Queen-street, Westminster, by whom the apparatus we now illustrate was exhibited at Kensington. It appears that none of the numerous mills and pulverisers which have been produced, have superseded in any degree the existing French burr stones. Roller mills, introduced from Germany, have to a certain extent been adopted to assist in reducing the cement to that great fineness now sometimes required, but it is said that their first cost is not small, and the cost of grinding and of maintenance is greater than grinding with ordinary horizontal millstones. The machine we illustrate by section has been devised to do the same amount of grinding per hour to the same degree of fineness, and with the same consumption of power, as French burrs, but intended to require no dressing in the ordinary sense. So, that taking the dressing period as one-third the working period, this would mean that existing works could grind thirty-three per cent. more clinker, and the cost of dressing would be almost all saved. The principle on which this mill is designed is that of having a soft metal grinding surface, and its success has been proved by experiments with a mill 4ft. 6in. in diameter. It will be seen that the mill resembles an ordinary stone mill, except that the stones are replaced by an inner and outer conical and renewable annular grinding ring. These rings are of soft metal such as copper, and between them much of the fine grinding is done by the cement itself.

The above engraving sufficiently illustrates the testing machine to make description unnecessary. The ordinary sized machine, adapted to test briquettes of one square inch section, will test from 1 lb. up to 1000 lb.; it stands 14in. high, is 14in. long by 3in. wide, and weighs under 30 lb.

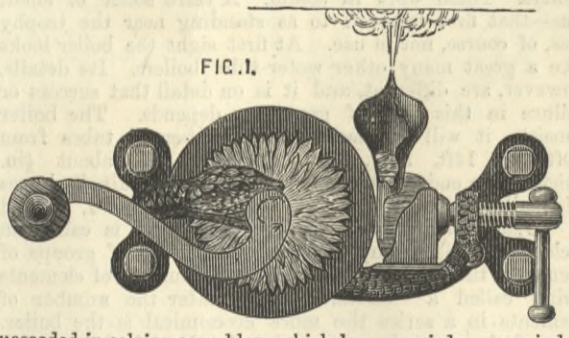
By the use of this machine the cement can be reduced to the proper consistency for forming into briquettes in considerably less time, and with much less water, than is possible by hand gauging. The object is to obtain better and more regular results when testing the briquettes, and also to obtain better comparative results by eliminating the discrepancies due to the skill of different operators.

Another machine of Mr. Faija's is the slurry dresser illustrated below. It removes from the slurry the small particles of hard chalk, flint, or stone after it leaves the wash mill. In the above sketch, A is a cylindrical sieve of the necessary mesh. It revolves at a moderately high speed; the slurry, fed on to the distributing saucer, is thus forced through it, and passes into the casing B, and out by spout C. The coarse particles are, by a mechanical arrangement, retained in the sieve, and fall into the inner casing, whence they are ejected from the small spout. A machine, having a sieve 18in. in diameter, will, we are informed, easily deal with the slurry from a 14ft. wash mill. Besides removing the small particles retained in the slurry, the mechanical admixture of the materials is considerably improved. It does not require much power to drive it, and in most cases the millstones often used for grinding the slurry as it leaves the wash mill may be dispensed with.

PEARSE'S FRICTION STILL.

The friction still illustrated by the accompanying engravings has been devised by Mr. Lional Pearse, of Coalbournbrook, near Stourbridge, for the production in an open boat, or in any boat at sea, of small quantities of fresh water from sea water without any heat supply except that of muscular energy. The still and the small machine for illustrating the frictional generation of heat are very ingenious applications of well-known phenemona and of the experiments of Count Rumford. Mr. Pearse has

FIG. 1.



succeeded in solving a problem which has occupied many minds, and although no vessel expects to be wrecked, there is little doubt every well-appointed passenger ship will carry several of these little machines for their boats. Nothing has been

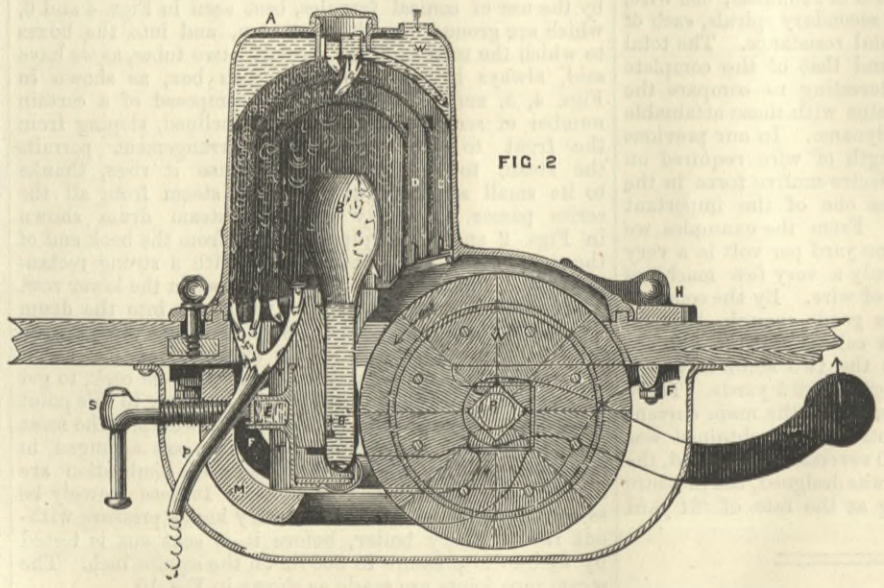


FIG. 2

done for ages which is of so much value in alleviating the sufferings of the shipwrecked as this ready means of producing fresh water.

Fig. 2 shows a friction still fixed to and let through the seat or after thwart of a ship's boat; above that seat is the condensing or domed part, and below is the malleable iron framing. The machine may, of course, be fixed to any, or the most convenient, place in a boat. Our engraving is about one-fourth full size. The framing may be said to consist of two parts, one fixed and the other movable, the fixed frame F being bolted through the seat, fixes the part above the seat to that below. The metal supporting the boiler must be understood to be part of this fixed frame though the section does not clearly show it. The movable frame M is capable of a sliding motion in three bearings, one above the pressure screw S and another to each side of friction wheel W. It is single where shown in section, and branches off to each side of the wheel to form bearings for the spindle P. This frame brings the friction wheel W in contact with the boiler B at B^1 with any desired pressure, regulated by the pressure screw S.

The inequalities which may occur in the periphery of the friction wheel are compensated for in the elasticity of the packing at E. Either side of the spindle may be fitted with a handle, and the same still can be worked effectively within the range of power from that of a lad of fourteen years of age to 4-man power. The boiler B is held in a hard wood block to prevent heat being readily conducted to the metal frame supporting it. The upper part of the machine is hinged at H, and may be thrown open, leaving boiler and friction wheel exposed, the inner domes D^1 D^{11} also hinge open or take out for any attention that might be required. The overflow tank T is pivotted so as to be easily released from the boiler. The manner in which it is fed and the action is as follows:—It will be seen that the upper tank A is full of sea-water, from this tank the water is made to pass at intervals in the directions indicated by the arrows. It then passes down small pipes shown in the centre, and feeds or saturates the flannel with which the two domes are covered. The arrows still indicate the course of the sea-water after it has left the coverings, and it will be seen that that from the inner dome D^{11}, as it is collected by its trough, runs through a pipe into the overflow tank T, which tank is openly connected with boiler B, keeping that fed with sea-water to theheight allowed by overflow tank; the overflow from the middle dome D^1 is allowed to run away as cooling water, because that from the inner dome is sufficient feed for the boiler, and being hotter than that from D^1 is preferred. The water enters the boiler at the bottom, as shown by the arrow. The heat result of the friction of the wooden wheel W against the steel on the boiler at B^1 causes the sea-water to boil in about half a minute. The steam then rising is wrapped in the dome D^{11}, and condensing upon its inner surface, drains away into its trough, then from that to outlet pipe P. The condensed steam or distilled water may be traced throughout the engraving indicated as drops.

The heat given up by the steam condensed upon the inner surface of dome D^{11} will be imparted to the sea-water held in the saturated flannel covering the dome D^{11}; this water is freely vaporised at a lower temperature than that required for the boiler, its vapour being condensed upon the inner surface of dome D^1, enclosing it. The action of vaporising and condensing goes on in the next compartment, as just described, but at a lower temperature; the product from the three condensing surfaces can be traced as drops all flowing into and out of outlet pipe P. The feed water W in the tank A will, when the machine is in full work, reach a temperature that a delicate hand cannot bear by heat imparted to it from the vapour which condenses upon the domed bottom of the tank.

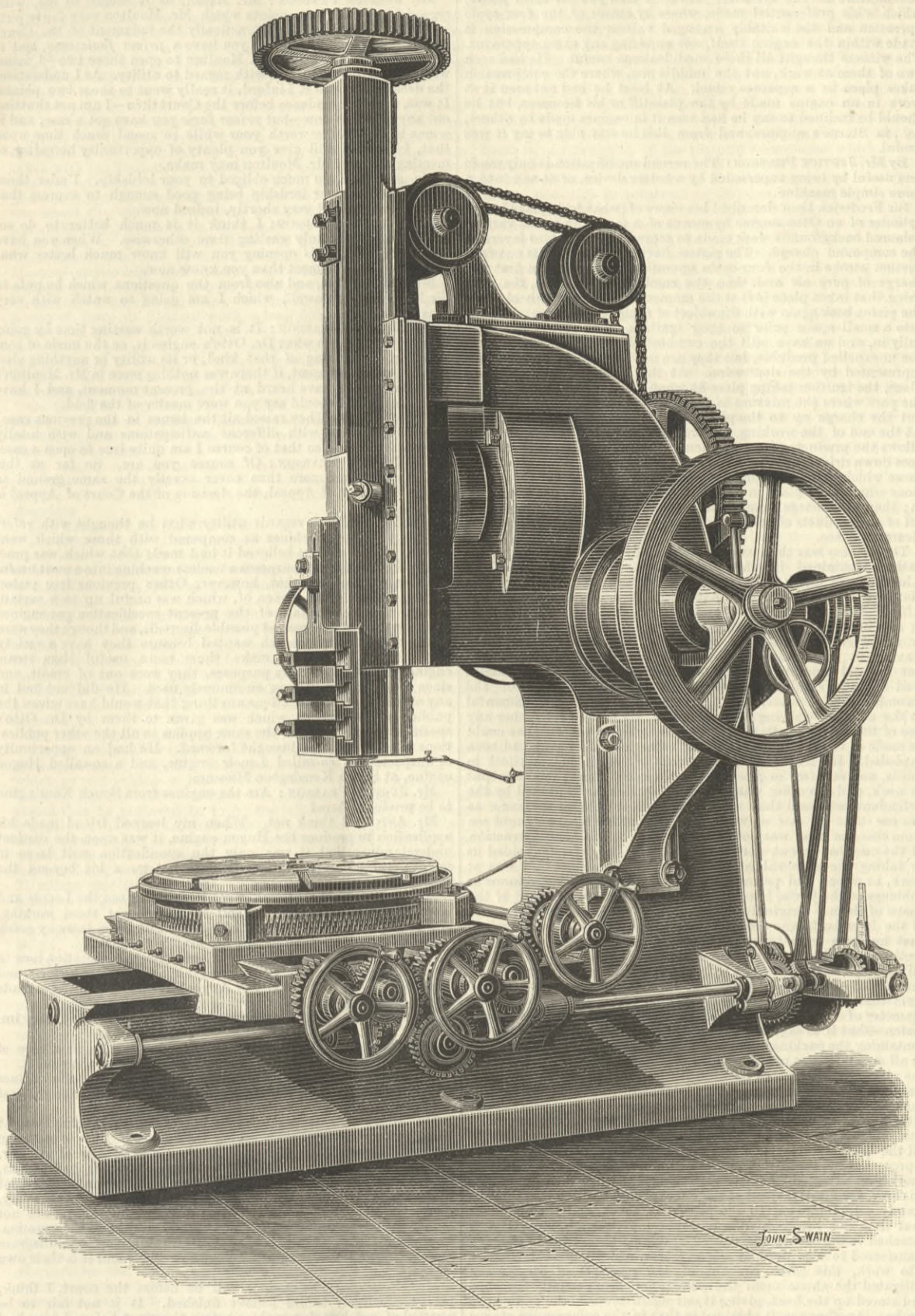
If the machine is worked by the power of a boy of fourteen years, the product from the two flannel-covered domes will be nearly double that of the boiler; if worked by a man the product from the boiler will be equal that of the two domes, making the profit through the domes upon the man's work much less in proportion to that of the boy's work. Covered domes may be used with profit to any convenient number, but on account of size the inventor prefers to put only three in the friction still. In its present form the still is capable of producing thirty pints of distilled water in twenty-four hours, sufficient, he thinks, for any small boat's crew. Salt will not, we are informed, appear deposited if the machine is used properly, or unless all in the boiler or in the domes is vaporised to dryness. Should this occur—and it must occur many times before sufficient salt is encrusted to cause any serious loss of heat—it can be got at by throwing the top open and releasing the overflow tank. The domes are cleansed by allowing a quantity of water to flow over them when not at work. The inventor explains the non-appearance of salt in the boiler and on the flannels by saying that, in the case of the flannels, all the water fed to them is not vaporised; thus the salt is kept in solution, and is carried off in the water as it runs to waste or to the overflow tank. The boiler does not show any, because of the overflow tank, which is always wasting water, and its water being nearly as heavily charged with salt as that of the boiler, because a certain amount of circulation goes on between them; so the salt is kept at an equilibrium, regulated by the salt carried away in the overflow. The hard salt that does appear is only found on the outside of the overflow tank T T. So long as the evaporation in the boiler is not allowed to empty it, no salt appears there.

Fig. 1 of our engravings shows another arrangement by the same inventor for utilising friction as a mode of heat. As this is not like the still—a thing treating of life or death—he has thought fit to make it rather fantastic, and his design carries us back many ages. A single casting taking a snake-like configuration and the necessary course, forms the whole of the frame; a sliding box carries the wood in which the boiler is mounted: the spindle of friction wheel has one bearing in the mouth of the creature and another in the frame at the opposite side of the friction wheel; the radiating flame piece or wheel boss is in one piece with the spindle or is fixed thereto, the purpose of it being to fix the wooden wheel; an ordinary handle and bolts complete the machine, the boilers for which may have various sizes or shapes, according to purpose. The inventor devised it as specially suitable for lectures on physics, for use in magazines where fire is not allowed, or for heating shaving water, where half a minute's vigorous work every morning serves the purpose of providing a little hot water for this purpose, waking the shaver up, and providing him with exercise which is better now than in July.

Naval Engineer Appointments.—The following appointments have been made at the Admiralty:—James D. Nicholson, chief engineer, to the Vernon, additional; Charles H. Pellow, engineer, to the Landrail; Thomas Green, engineer, to the Bloodhound; John R. R. Potam, engineer, to the Rupert; and David J. Bennett, engineer, to the Vernon, additional.

COMBINED MILLING AND SLOTTING MACHINE.

MESSRS. KENDAL AND GENT, MANCHESTER, ENGINEERS.



COMBINED MILLING AND SLOTTING MACHINE.

THIS is a new machine patented by Mr. Dixon, one of the partners in the firm of Kendal and Gent, Manchester, and it has been designed to combine in one machine the operations of roughing out objects with the slotting tool, and afterwards finishing them complete with the milling cutter, without the loss of time, and what is of still more importance, the risk of inaccuracy, due to the necessity, as hitherto, of changing and re-setting work from one machine to another. A further advantage secured by the combination is that in medium sized works where it is often difficult to find sufficient employment for a large machine adapted for slotting only, the addition of the milling motion gives so much more scope for the constant running of the machine, and, in fact, in any engineering works a combined tool of this class is more than doubly serviceable, as either operation can be made use of according to the nature of the work, many objects even requiring both. Our illustration is taken from a photograph of the first machine of this type that Messrs. Kendal and Gent have constructed, and which we had an opportunity of seeing at work before its dispatch to the Antwerp International Exhibition, where it has figured very prominently, and was, in fact, the largest and most powerful machine tool exhibited. The machine is capable of admitting an object 6ft. 2in. in diameter and 27in. deep, and it is adapted for taking a cut of 15in. deep with either slotting or milling tool. The main frame is exceptionally strong, giving great rigidity to the whole, and carries a long counterbalanced ram, working in rectangular slides, and provided with improved quick return motion by means of elliptic wheels, the disc plate being well supported and arranged for taking up all wear. The ram carries a strong steel spindle for milling, driven by gearing and side shaft at the top, the whole being so arranged as not to impede in the slightest degree the slotting motion when this is required to be put in operation. The ram can be raised and lowered or clamped in any position by screw, so that when milling it forms a rigid support for the cutter quite up to the face of the work. The driving is by a large cone pulley and strong gearing, and is arranged transversely to the machine so that it serves both milling and slotting motions, an arrangement being provided for instantly changing from one operation to the other. The machine can be changed from slotting to milling, or *vice versa*, in less than one-tenth of the time usually required to re-set an object on another tool. The tables are made very strong, and are well supported quite up to the edge. The handles for working the various motions are placed together at the side of the machine and are well under control. For keeping up a constant supply of lubrication when either milling or slotting, the machine is fitted with a small centrifugal pump. The total weight of the machine is about 11 tons. We may add that Messrs. Kendal and Gent, amongst the exhibitors of English engineering work to whom awards have been made, have received the Diploma of Honour at the above Exhibition, which is the highest award given.

LEGAL INTELLIGENCE.

HIGH COURT OF JUSTICE, CHANCERY DIVISION.

Before Mr. JUSTICE PEARSON.

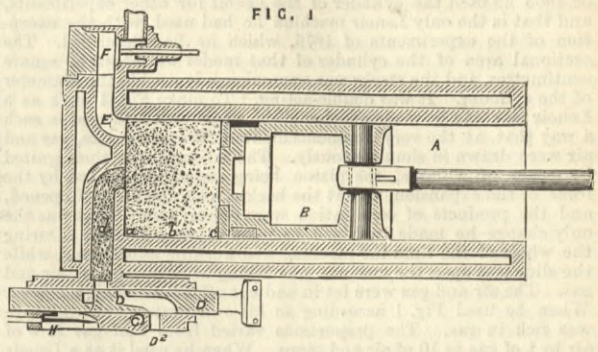
OTTO *v.* STEEL.

IN our last impression we gave a summary of the opening proceedings in this most important case.

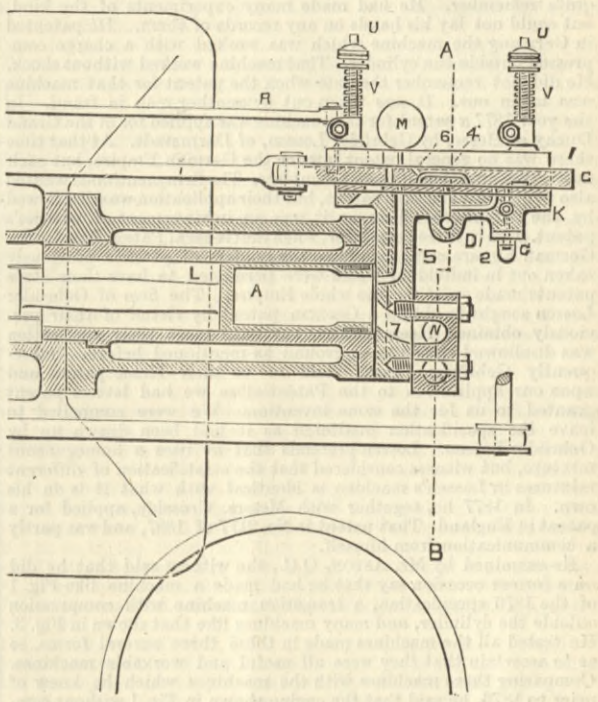
The following is an abstract of the deposition of Dr. Nicolaus August Otto, the plaintiff, which was taken before an official examiner in May last, when Dr. Otto was in England, and is now, by the consent of both parties in the action, admitted as evidence.

Examined by Mr. ASTON, Q.C.: Nicolaus August Otto, residing at Cologne on the Rhine, Doctor of Philosophy, stated that he was an engineer carrying on business as a member and director of the Gas Motoren Fabrik, at Deutz, near Cologne. He was also an Honorary Doctor of Philosophy of University, of Würtzberg. The company manufactures machines called the Otto machine on a large scale, upwards of 5000 having been manufactured at Deutz since he had been connected with it, and about 10,000 at other places. All those machines have been made since the date of the patent in 1876. He had been engaged on gas motors since 1861, and knew the Lenoir engine in that year He had made a model of that engine, and carried out some experiments with it, the charge used being a simple mixture of gas and air. Had tried to work that machine by putting in a charge of air first and then a mixture of gas and air, but not before 1876. In 1876 he communicated the invention the subject of the patent granted to Charles Denton Abel, dated the 17th May, 1876, and numbered 2081. The drawings sent over to Mr. Abel were copied from two machines, one like Fig. 1 and one like Fig. 3 in the specification. Had made a machine like Fig. 1 and also one like Fig. 3 in those drawings. Prior to 1876 had never employed a compound charge consisting of a combustible mixture of gas and air introduced into a cylinder containing a considerable quantity of incombustible fluid, and as far as he knew, the use of such a charge for working gas engines was new in 1876, and he was the originator of the system. Had heard of the Lenoir machine between 1862 and 1876, and became specially acquainted with it at the Paris Exhibition of 1867. Also knew of the Hugon machine as early as 1862 or 1863, and at the

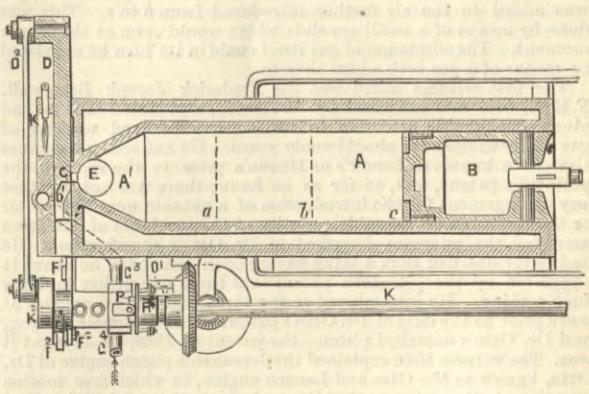
FIG. 1



Paris Exhibition of 1867. Never saw the Lenoir or Hugon machine worked with a charge of a combustible mixture of gas and air introduced into a cylinder containing a considerable quantity of incombustible fluid. Had made only one machine like Fig. 1. It worked well and usefully, and comparing it with the Lenoir, it worked without shock and consumed less gas. He knew this, more particularly from the fact that he worked his engine alternately according to his own principle and according to Lenoir's principle, the power being measured by means of a dynamometer. The consumption of gas was accurately ascertained by means of a meter. When working on the Otto plan he introduced into the cylinder first a considerable quantity of atmospheric air, and then a strong combustible mixture of gas and air. The mixture of gas and air was then fired and moved the piston. The machine was worked in both cases without compression, and in both cases he compared the result by means of meter measurement



and dynamometer to indicate power developed. The effect in Otto's machine exceeded that in Lenoir's to the extent of 20 per cent. and more. That superiority of 20 per cent. applies to the saving of gas. His machine worked without any shock with a compound charge of gas and air and the previously introduced air, but on the Lenoir plan a shock took place. Comparing the machine Fig. 1 with the machine shown in Fig. 3 the latter is the best. He had made many machines like Fig. 3 with the conical termination. Three engines were made at first, and then about 100 were made in which the termination was rather more oval than conical. In the machine shown in Fig. 3 there is first introduced a charge of air, then a charge of gas and air into the cylinder, which contained the residuum of the previous charge, and then the charge was compressed and fired. He had made upwards of



4000 machines in Germany with small changes in mechanical details, but with the same arrangement of charge as just mentioned, and these machines work well. In all those machines the compression of the charge takes place in the cylinder. Referring to the specification of Abel's patent, No. 2081 of 1876, page 3, line 34, he said that instead of compressing the charge in the cylinder, gas and air may be simply compressed before being introduced into the cylinder, and he thought such an engine would work well, but had not made one. He had made an engine in which the air was uncompressed, but the combustible mixture was introduced under pressure. It was compressed in a pump before being introduced into the cylinder, and the machine worked well, better than the machine shown in Fig. 1, in which there is no compression. He had sold no machines made on the plan of having the charge compressed outside; it was the transition stage from Fig. 1 to Fig. 3. The combustion is gradual in all three kinds of machines, in Fig. 1 and the transition one, and the machine made according to Fig. 3. If in Fig. 3 the charge consists of a combustible mixture and residuum alone, instead of a combustible mixture of air and residuum, the machine will work well. He considered that the Hugon machine he saw at work in Paris in 1867 was similar to the

Lenoir engine, but the ignition of Hugon's engine took place by means of a flame, whereas that of Lenoir's was by means of an electric spark. The charge in Hugon's consisted of a mixture of gas and air only, without incombustible fluid.

Cross-examined by Mr. Moulton, Q.C., Dr. Otto said that the only time he saw a Hugon machine at work was in 1867, and at a subsequent Exhibition in Paris, and at this distance of time he could not very accurately remember the details of those machines. He thought they were machines made in Paris by the Hugon Company. He first knew the Lenoir engine in 1861, through a description. He made the model in 1861 or 1862, and about 1862 or 1863 he used the cylinder of the Lenoir for other experiments, and that is the only Lenoir machine he had used, with the exception of the experiments of 1876, which he had described. The sectional area of the cylinder of that model was about 80 square centimetres, and the stroke was approximately double the diameter of the cylinder. It was double-acting. To make Fig. 1 work as a Lenoir machine he made another slide, which was arranged in such a way that, at the very commencement of the out-stroke, gas and air were drawn in simultaneously. The mixture was then ignited by means of a flame, the piston being impelled forward by the force of the expansion, and at the back-stroke the valve F opened, and the products of combustion were driven out. That was the only change he made in Fig. 1 to work it as a Lenoir. During the whole of the time the machine was working as a Lenoir, while the slide was open the machine was taking in a mixture of air and gas. The air and gas were let in and cut off at the same moment. When he used Fig. 1 according to his own system, the mixture was rich in gas. The proportions varied from 1 of gas to 6 of air to 1 of gas to 10 of air and more. When he used it as a Lenoir he regulated the proportions by opening the gas cock more or less. He could have measured those proportions, but he did not do so except in his own engine. He just remembered that, while experimenting on Fig. 1, working it according to Lenoir's principle, he also took measurements by meter. He did not remember the proportions used in the Lenoir, but he did remember that when used according to his principle there was a less expenditure of gas proportionally to power as compared with the Lenoir. The proportions between the gas and air admitted in the combustible mixture were substantially the same as those he had given, but they varied, because he made a series of experiments. The proportions between the air and the gas in the combustible mixture varied in the different experiments. The machine commonly known as the Otto silent machine is substantially that shown in Fig. 3, and embodies the alleged invention which he claimed in the first claim of his patent of 1876. When he was working the engine made like Fig. 1, he thought he took diagrams, but could not quite remember. He had made many experiments of the kind, but could not lay his hands on any records of them. He patented in Germany the machine which was worked with a charge compressed outside the cylinder. That machine worked without shock. He did not remember the date when the patent for that machine was taken out. It was taken out by another man in fraud. In the year 1877 a patent for this machine was applied for in the Grand Duchy of Hesse, by Gebrüder Lossen, of Darmstadt. At that time there was no general patent law for the German Empire, but each individual State had its own patent law. The firm mentioned wanted also to obtain a Prussian patent, but their application was disallowed by the Patent-office because it was an infringement of witness's patent. Two or three years later, when the General Patent Law for the German Empire came into force the holders of patents previously taken out in individual States were permitted to have their State patents made valid for the whole Empire. The firm of Gebrüder Lossen sought to obtain a German patent by virtue of their previously obtained Hesse patent, but once more their application was disallowed on the same ground as mentioned before. Subsequently Gebrüder Lossen sold to us their Hesse patent and upon our application to the Patent-office we had letters patent granted to us for the same invention. We were compelled to leave the specification unaltered as it had been drawn up by Gebrüder Lossen. Lossen pretends that he uses a homogeneous mixture, but witness considered that the stratification of different mixtures in Lossen's machine is identical with what it is in his own. In 1877 he, together with Messrs. Crossley, applied for a patent in England. That patent is No. 2177 of 1887, and was partly a communication from himself.

Re-examined by Mr. Aston, Q.C., the witness said that he did on a former occasion say that he had made a machine like Fig. 1 of the 1876 specification, a transition machine with compression outside the cylinder, and many machines like that shown in Fig. 3. He tested all the machines made in those three several forms, so as to ascertain that they were all useful and workable machines. Comparing these machines with the machines which he knew of prior to 1876, he said that the engine shown in Fig. 1 without compression consumed somewhat less gas than the Lenoir, but its principal merit was that it worked without shock, and he came subsequently to the conviction that he should also be able to work with gaseous compounds that had been compressed prior to the combustion. As far back as 1862 and 1863 he had come to see that a better return could be obtained with gases compressed in this manner. His answer given yesterday that the Otto machine made like Fig. 1 effects a saving of 20 per cent. of gas and more as compared with the Lenoir is correct. Being asked in what order of usefulness he put the three machines as being made by him in 1876, he said Fig. 1 was good, the transition machine better, and the machine made according to Fig. 3 best. The slides were arranged in such a way that from *a* to *c*—see figures—air could be drawn in by suction. After air had been drawn in from *a* to *b*, gas was added to the air further introduced from *b* to *c*. This was done by means of a small gas slide which would open at the proper moment. The admission of gas itself could in its turn be regulated by means of a gas cock added thereto.

The first witness called was Sir Frederick Joseph Bramwell, F.R.S., who was examined by Mr. Aston, and stated that he had given considerable attention to the construction and working of gas motor engines for about twenty years. He had seen gas engines that were known as Lenoir's or Hugon's prior to the date of the plaintiff's patent, and, so far as he knew, there was not in either any arrangement for the introduction of a notable quantity of air or the retention of a notable quantity of the residuum of the gases used for the purposes described in Dr. Otto's specification. He had never heard of such a thing having been done until he heard it suggested by the plaintiff's patent that there was utility in doing such a thing. He remembered seeing three kinds of gas engines at work prior to the date of Dr. Otto's patent of 1876—Lenoir, Hugon, and Dr. Otto's detached piston—the patent of 1866, he thought it was. The witness then explained the detachable piston engine of Dr. Otto, known as the Otto and Langen engine, in which free motion was given to the piston, so that the explosive action might take effect on the piston at once, and the energy might be converted into work instead of being consumed uselessly as heat absorbed by the metal. The explosion did not directly drive the fly-wheel, but it drove up the piston against the resistance of the atmosphere and against its own weight, and then the piston having attained the summit of its movement became interlocked with the thing which drove the fly-wheel and drove the fly-wheel in its descent. The engine was very noisy and made a great deal of shock, and was no doubt objectionable. It was a great improvement so far as regards getting good results out of a certain quantity of gas; but it was an incomplete and objectionable form of engine as compared with such a thing as we have before us now. Asked whether he found the specification of Abel's patent sufficient to enable the three modifications referred to therein of the Otto engine to be constructed, the witness said he thought so, perfectly. He thought so before the drawings were amended, and he thought so, of course, now. He saw no reason to change his opinion. The three modifications were then described as follows:—The patentee tells you that you may either take the air and combustible mixture into an engine which shall make a certain portion of its stroke in drawing them in, and their ignition shall take place, and that the piston being thereby driven to one end of the cylinder shall return either by a corresponding momentum from the other end or return by the momentum of the fly-wheel, there being in that instance no compression. He then tells you that you may if you please compress, exterior to the engine, by any ordinary compressing apparatus, such as a pump, and use the mixture in the cylinder. He then tells you the third mode, which is his preferential mode, where by means of the four-cycle operation and the suitably arranged valves, the compression is made within the engine itself, not requiring any extra apparatus. The witness thought all these modifications useful. He had seen two of them at work, not the middle one, where the compression takes place in a separate vessel. At least he had not seen it at work in an engine made by the plaintiff or his licensees, but he should be inclined to say he had seen it in engines made by others, *e.g.*, in Sterne's engines, and from this he was able to say it was useful.

By Mr. Justice Pearson: The second modification is only made less useful by being superseded by a better device, or at any rate, a more simple machine.

Sir Frederick then described his views of what took place in the cylinder of an Otto engine by means of a model, in which various coloured backgrounds were made to represent the various layers of the compound charge. The piston having completed its outward suction stroke in the four-cycle operation, and drawn in first the charge of pure air and then the combustible mixture, the next thing that takes place is that the momentum of the fly-wheel sends the piston back again with the object of compressing these materials into a small space prior to their ignition. The piston has gone fully in, and we have still the combustible mixture, the air, and the unexpelled products, but they are now diminished to the space represented by the depression. At this time the ignition takes place, the ignition taking place at what is called the touch-hole, at the part where the mixture is the richest, and extending throughout the charge up to the piston. That is the working outstroke. At the end of the working outstroke the exhaust valve opens and allows the products of combustion to escape, and the piston as it goes down drives out before it the products of combustion except those which remain in the clearance space. Those are the operations which take place in the four-cycle. First, the charge drawn in; then the charge compressed; then ignition; then the getting rid of the products of combustion except those which remain in the clearance space.

The witness was then examined generally as to the alleged anticipations contained in the specifications of Johnson, of 1860; Alexander, of 1875; Barnett, of 1838; Matthew Bolton, of 1866; Matthew Bolton, of 1868; Attwater, of 1869; Lake, of 1872; Alfred Newton, of 1866; and stated that he did not find in any one of those specifications anything which would tell, or direct the mind of the reader to the benefits arising from leaving in a notable proportion of the combustible charge; but he did find in certain of them directions which would lead a reader's mind to get rid as soon as he could of the incombustible remains, looking upon them as being detrimental to the efficient working of the engine. He did not remember any one of them which calls attention to any beneficial use that could be made of the residuum of the explosive gases after they had been exploded. He had visited the works of the defendant Steel in Leeds, and saw two engines in the workshop there; one was put to work, and the other was taken to pieces as far as needed by the defendant, who said that we might regard it as being the same as the one that we saw at work, and that, therefore, we could see from this one that was not at work, what the inside construction of the one that was at work was. Further, the defendant aided us in taking the slide valves, and so on, of the engine that was at work, to pieces, and permitted us to take what engineers know as rubbings of the parts, in order that we might have a record of the shape of them. Original rubbings were taken then in the presence of the defendant, who took a tracing at the time. The conclusions that he drew from these rubbings were that the defendant correctly stated that there was no admission of air separate from the mixture. The whole of the indraught into the cylinder was an indraught of mixture, and there was no introduction of air separate from that mixture. The stroke of the piston was 1ft., and the diameter of the cylinder 7½in. Behind the operative part of the piston—that is to say, that part of the piston which was needed for containing the packing ring—there was cast to it, or attached to it, at all events, a sort of open-ended pipe projecting backwards from the piston. It projected backwards 9½in., and the hole inside of it was 6in. The consequence would be that there would be left inside the cylinder at the termination of the return stroke of the piston, after the working stroke, so much more of the products of combustion than those which would inevitably be left in any engines to fill the ordinary clearance and the slide valve passages, as was represented by this cavity in the pipe at the back of the piston. One object attained by such a plan being that when the combustible mixture was fired, instead of the effect of that ignition being immediately communicated to the piston by shock, and the piston at that time not being capable of rapid movement because it was attached to the crank, and a considerable portion of the heat being transferred to the sides of the cylinder, instead of being turned into work, this extra amount of the products of combustion mitigated the shock upon the piston, and also partially absorbed and stored up the heat, giving it out again towards the end of the stroke. Another result obtained is that in the compression stroke it afforded the cubic contents into which the charge could be compressed. In his judgment it tended to prevent shock and undue absorption of heat. The defendant's engine corresponds with that part of Abel's specification where he tells you that you need not draw air in, but that you may dispense with that and content yourself with leaving in the products of combustion—page 5, line 23. There would be a charge of the combustible matter over and above the residuum. "Separate," is the patentee's word, but then he says that they will shade off one into the other.

Mr. Moulton here stated that with regard to the question of infringement which had been raised by his lordship at an earlier period, that he could not give it up, because it is very often necessary to keep the issue of infringement in order to prevent too narrow an interpretation being put on the patent, because, of course, if he admitted he infringed, then the learned counsel for the plaintiff would place as narrow a meaning on the patent as possible, in order to keep it from the anticipation.

Mr. Justice Pearson: The Court is not obliged to follow the lead of the learned counsel on the other side.

Mr. Moulton: No, my lord; therefore I wanted to tell your lordship frankly that my own opinion is that it is not a question of infringement, but a question of validity.

Mr. Justice Pearson: So I thought.

Mr. Moulton: I do not formally give it up, but I tell your lordship that it is my opinion.

Mr. Justice Pearson: It will come to that.

Mr. Moulton: It will come to that, my lord, in my opinion.

Mr. Justice Pearson: Mr. Moulton, as it seems to me, has dealt with this case very fairly in throwing away everything immaterial on his side, and, as I understand, not taking away from him any question about infringement which he says may be technically necessary, in this case the real point to be decided between you is the novelty of the invention?

Mr. Moulton: The validity of the patent. Whether it will be novelty, whether it will be sufficiency of specification, or whether it will be utility, may depend on the exact interpretation of the words, but the validity of the patent is the real issue here. The infringement, in my opinion, is, as I say, only just reserved for technical purposes.

Mr. Justice Pearson: I thought from what you said the other day that the real question which you will ask me to decide will be, was Dr. Otto's engine anticipated?

Mr. Moulton: It goes much further than that. A great question, no doubt, will be was it anticipated, but another will be, supposing that the invention is for what he describes, has he given any means for attaining it? A third one will be, supposing he had given means and it was novel, would there be the least utility in it? So that they are all three substantial issues, and I think when your lordship has heard the way in which I put my case—

Mr. Justice Pearson: I have no doubt you will puzzle me.

Mr. Moulton: No, I am sure I shall not.

Mr. Justice Pearson: Mr. Aston, as it seems to me, with regard to two of those points which Mr. Moulton very fairly puts before the Court, you have practically the judgment of the Court in your favour, and therefore you have a *prima facie* case, and it seems to me it will be for Mr. Moulton to open those two—I mean with regard to novelty and with regard to utility. As I understand the decision in Otto *v.* Linford, it really went to those two points. It was, upon the evidence before the Court then—I am not shutting out any evidence now—but *prima facie* you have got a case, and it seems to me hardly worth your while to spend much time upon that, because I will give you plenty of opportunity hereafter of meeting any case Mr. Moulton may make.

Mr. Aston: I am much obliged to your lordship. Under those circumstances, your lordship being good enough to express that view, I shall take it very shortly, indeed now.

Mr. Justice Pearson: I think it is much better to do so, because it will be only wasting time otherwise. When you have heard Mr. Moulton's opening you will know much better what points you have to meet than you know now.

Mr. Aston: Yes, and also from the questions which he puts to Sir Frederick Bramwell, which I am going to watch with very great care.

Mr. Justice Pearson: It is not worth wasting time by going over and over again what Dr. Otto's engine is, or the mode of construction or anything of that kind, or its utility or anything else. At the present moment, if there was nothing more in Mr. Moulton's case than what I have heard at the present moment, and I have heard nothing, I should say you were master of the field.

Mr. Moulton: They raised all the issues in the previous case; they raised them with different anticipations and with totally different evidence, so that of course I am quite free to open a case.

Mr. Justice Pearson: Of course you are. So far as this evidence does no more than cover exactly the same ground as before the Court of Appeal, the decision of the Court of Appeal is binding.

Asked generally as regards utility what he thought with reference to the Otto machines as compared with those which went before, witness said he believed it had made that which was practically for commercial purposes a useless machine into a most useful one, leaving out of that, however, Otto's previous free piston engine, which he had spoken of, which was useful up to a certain extent. Before the date of the present specification gas engines were certainly in the greatest possible discredit, and though they were things that were very much wanted because they have a variety of useful applications to make them more useful than steam engines for a good many purposes, they were out of credit, and since then they have been enormously used. He did not find in any of the prior specifications anything that would have given the public the information which was given to them by Dr. Otto's specification of 1876, and the same applies to all the other publications which have been brought forward. He had an opportunity of inspecting a so-called Lenoir engine, and a so-called Hugon engine, at South Kensington Museum.

Mr. Justice Pearson: Are the engines from South Kensington to be produced here?

Mr. Aston: I think not. When my learned friend made his application to produce the Hugon engine, it was upon the distinct understanding that it was only the specification writ large in metal; therefore practically it does not go a bit beyond the specification.

Mr. Moulton: I shall ask your lordship to see the Lenoir and Hugon engines working; we shall be able to get them working, and I am perfectly certain your lordship will learn more by going to see those engines than by any amount of evidence.

Mr. Justice Pearson: There is the strongest objection now in this court to a judge going to see anything, because, if he does, and the case goes up to the Court of Appeal, it is said the judge made himself an arbitrator, and they will not hear the appeal.

Mr. Moulton: That has been departed from in some very important cases.

Mr. Justice Pearson: That is the reason why, in a case of this kind, I should hesitate to throw that risk upon the parties.

Mr. Moulton: If it is only a question of seeing the engines working, they could be made to work anywhere with the greatest ease at any time.

Mr. Justice Pearson: I should judge from their being brought here, and my seeing them working here; but if I go to see them somewhere else, I do not know what the Court of Appeal will say.

Mr. Aston: May I say this, if my learned friends had chosen, they could have supplied your lordship with diagram models that illustrate as clearly as possible what those two engines are; nay, more, they could even do it with drawings, but they have not chosen either by drawings, which I should subject to the examination and evidence of Sir Frederick Bramwell, nor by a diagram model, to bring these engines before the court, and it is their own laches.

Mr. Moulton: The engines will be before the court, I think, pretty effectively before I have finished. It is not fair to be accused of not bringing engines before the court before I have had a chance of saying a word.

Mr. Aston: If my learned friend had his drawings, and if he had his diagram model, is it to be believed that he would not have answered your lordship by saying that you need not go? Therefore he has not them.

Mr. Justice Pearson: No, he could not have answered me in that way after what I said. I said a model produced to me was much more satisfactory to me, and gave me a much clearer idea of the case than drawings with which I am not familiar.

Mr Aston: Certainly, I am not going into the details of these engines, especially after what your lordship has said; I am not a bit afraid of them.

The witness then said, in reply to Mr. Aston, having regard to the engine which he saw at Petworth, and the engine which he saw at South Kensington, or indeed any other gas engines which he had seen, they did not, in his opinion, anticipate the Otto engine as regards its working, if made as described in the specification No. 2081 of 1876.

The proceedings and evidence so far given we shall continue in our next impression. The action has now been before the Court for seven days. As our readers will have seen, we purpose giving a full report of the proceedings, so far as we consider them to be of interest, but as this will necessarily extend over several weeks, the following brief summary, showing the stage to which matters have been brought up to the present time, will probably be appreciated:—

On the first day, November 19th, the case was opened by Mr. Aston, Q.C., as reported in last week's Engineer. Then came the examination in chief of Sir Frederick Bramwell.

On the second day, November 24th, the examination in chief of Sir Frederick Bramwell and cross-examination by Mr. Moulton took place, as reported above.

On the 3rd day, November 25th, the first part of the sitting was occupied in discussing the publication of certain documents which the defendant wished to put in as evidence. One of the most important of these, "Nouvelles Recherches sur les Conditions Pratiques de plus Grandes Utilisation de la Chaleur et en Général de la Force Motrice," by M. Beau de Rochas, published in Paris in 1862, will be found in another page. Mr. Fletcher, assistant librarian in the department of printed books in the British Museum, was called by Mr. Moulton to prove the accessibility of this work to the public, but failed to satisfy the learned judge.

Sir Frederick Bramwell was re-examined by Mr. Aston. Beau de Rochas was touched upon, but not gone into fully. The witness, however, gave it as his opinion that no gas engine was

described at all, the work being merely an abstract scientific treatise.

Mr. MOULTON then asked a few questions chiefly in relation to Otto's modification 1, and after a few more words from Mr. ASTON, the witness withdrew.

Mr. C. DENTON ABEL then proved the original patent of 1876 as the communicant of Dr. Otto.

Mr. John Imray was the next witness. Mr. ASTON took him through the same course as he had done with Sir Frederick Bramwell previously, but examined him more closely in relation to certain experiments he had made with the view of ascertaining whether stratification really does exist in the Otto engine, and if it does exist, whether it exerts any beneficial effect.

The deposition of Dr. Otto, which appears above, was then read, Mr. Imray's cross-examination being deferred till the next sitting.

On the fourth day, November 30th, Mr. John Imray was cross-examined by Mr. MOULTON on the same general lines that were taken with Sir Frederick Bramwell. Indicator diagrams were produced in reference to the time occupied in arriving at maximum pressure in the Otto and Lenoir engines, the point being that if it was about the same in both, the explosion in the Otto must be three times as violent as in the Lenoir, as the rise of pressure is three times as great. Much time was given to discussing the experiments described by Mr. Imray in his examination, Mr. Moulton contending that there were certain differences in the method of working the charges which entirely upset the results witness had deduced from them. On Mr. Moulton offering to put in a copy of Beau de Rochas' work, a long discussion ensued lasting to the end of the sitting. Mr. Aston contended that the book never formed part of the stock of public knowledge—that it was a publication in a foreign language buried in the shelves of the library of the British Museum, and insufficiently catalogued, and therefore inaccessible to the public.

On the fifth day, December 1st, Mr. ASTON continued his remarks on Beau de Rochas. Finally the learned JUDGE said that he could not admit the book on the evidence Mr. MOULTON had placed before him.

Mr. Imray was further cross-examined by Mr. MOULTON in reference to his experiments. He was then re-examined by Mr. ASTON, who cleared up one or two points about the indicator diagrams.

This completed the plaintiff's case.

Mr. MOULTON, Q.C., then opened the case for the Defendants in a very able speech, in which he dealt very fully with the meaning of the word explosion, which, he held, was "an action which, in an incredibly short space of time, produces a pressure that did not exist before."

After luncheon another attempt was made to get in Beau de Rochas. Mr. Haas, a dealer in foreign books in the Strand, was called, and stated that in Lorenz's "Catalogue Générale de la Libraire Française," published in 1867, there was a list of Beau de Rochas' publications, the "Nouvelles Recherches," &c., among others. Mr. Fletcher, from the British Museum, also gave evidence as to Lorenz's catalogue being well known. The work was not admitted.

Mr. MOULTON then resumed his address.

The sixth day, December 2nd, finished at luncheon time. It was entirely occupied with Mr. MOULTON'S address, the substance of which we will publish in due course. On the seventh day, December 3rd, Mr. MOULTON resumed his address. In conclusion he stated that he proposed to prove the following facts:—Explosion is a rapid rise of pressure from combustion and development of heat, and is measured by the extent to which the pressure rises and the time it takes. In explosion, Otto's engine far exceeds practical engines that preceded it. Shock depends on rapidity of explosion. To reduce rapidity of explosion you must use dilution. The Otto indicator diagram is just what would be brought about by dilution. There is no special advantage in residuum, beyond its being an inert gas; but there is a positive disadvantage if it is heated. The alleged cushion in Otto does not exist. Supposing segregation of charge did exist, it would not be advantageous; it would not prevent shock, and it would not be new. If, as Sir Fred. Bramwell says, there is continuous combustion after explosion, then continuous combustion is the property of all explosive gases. The learned Counsel then indicated the evidence he proposed to give on the more important questions.

After luncheon, Dr. Hopkinson was called, and was examined by Mr. MOULTON.

(*To be continued.*)

OTTO *v.* LINFORD.

IN our last impression we commenced the re-publication of the judgment of the Court of Appeal in this case. We now continue it from page 413.

In a case which I argued, which is reported—*Renard* v. *Levinstein*—I was for the defendant and took the same objection. That was an invention for a dye. There they never sold an ounce of dye made according to the patent, because immediately afterwards the inventor had discovered an improvement, and they had always sold the improved dye, and they were obliged to call a witness to show they had made a few ounces of dye and tried it, and that it would dye. The answer was that under these circumstances the mere fact of not selling the original dye was nothing at all.

As in this case we have rather a stronger illustration because the inventor has patented three modifications, and it turns out that what he had used, made, and sold, have been almost entirely No. 3's, and that the other things sold have been almost entirely—not quite—improvements on No. 1. No. 1 itself does not appear ever to have been sold, but then they say that No. 1 will work, and they call witnesses to prove it, and there is no evidence on the other side. Of course, nothing could have been easier for the other side than calling witnesses who had made machines according to No. 1. Therefore there is evidence of utility. It is very small indeed as regards No. 1, because that is not the one which proved most useful, but it is quite sufficient for the support of a patent; and, as to this question of utility, as we know, very little will do.

Then that disposes, I think, of every material objection, at least the only ones I have taken a note of except the most important ones of novelty and infringement.

As regards novelty, that was the one upon which the defendant succeeded in the Court below, and it turns upon this.

The defendants say that by the patent of one Johnson—which is really a communication from Lenoir—so long ago as the year 1860—that is, sixteen years before the patent—there was a description of that for which the patent was taken out. Well, now this is very remarkable, because it turns out in the evidence that Lenoir, the inventor and communicator, so far as Johnson's patent is concerned, is a great maker of gasomoter engines, and it seems that a very large number of his engines which appear, according to the evidence, or, at least, according to my recollection of the effect of the evidence, to be made, under a subsequent patent of his of 1861; great numbers of these were made and sold and publicly exhibited, and, if, therefore, this invention of the patent had been proved, it is very remarkable that they could not produce a witness who has either made, or sold, or seen in work an engine made according to the plaintiff's patent which produced the effect which the plaintiff said could be produced. That is strong evidence to my mind that Johnson's specification did not disclose the plaintiff's patent. It is not like a sealed document; it is not like a book not generally known; it is one of Lenoir's own patents, and therefore, as I said before, it would have been a most remarkable thing if it did disclose it and was not put into practice, being a very valuable thing. Of course that is not conclusive; it is only a remark as to the probability; the specification itself must be considered by the Court like any other document. Still we have to observe that there is no machine to be set against the plaintiff's patent; none could be shown to have been worked; and there was not an attempt to show it, or at least it did not succeed, before the date of this patent in 1876. Then how are we to find out that it describes the plaintiff's invention? We can only find it out, it appears to me, in the same way in which the Court considers other documents, that is, by reading it and finding out the natural meaning. Now having read it and considered it most attentively, I have arrived at this conclusion—that so far from pointing out the principle or idea published by the plaintiff, and the mode of carrying out that principle or idea, the machine described in Johnson's specification is a machine worked by the sudden expansion of an inflammable mixture, and intended to be worked in that way; and that so far from telling the public that you can make the machine to work by gradual expansion, by the protection of a cushion, the only reason for which air is introduced into this machine is for a totally different purpose, and with a view to the quickening or making more sudden the expansion of the gases. If that is so, there is no description of the plaintiff's invention which is a new principle or idea with the mode of applying it, but of something entirely different. If, however, this had been the case, that it was a necessity in constructing Johnson's machine to make a machine which would work according to the plaintiff's invention, so that I mean only a machine could be made which would work by gradual expansion, which was one part of Mr. Millar's argument, then I agree that it would have been anticipated. But there again it is plain from reading the description of Johnson's specification that it is not so, because I suppose he tried it, and he described it as an explosive machine. It is so described by the witnesses, and nobody ever saw it in action as a gradual expansion machine, and, indeed, the plaintiff's witnesses say that a quantity of air admitted through the aperture, in the first instance, would only be a film, and would not have the effect at all. There is another part of Johnson's invention which I must say I may be mistaken in, but it does appear to me that the man who drew out this specification—whether it was the inventor or not I cannot tell—was under the impression that the gas was inflammable *per se*, and he has, it appears to me, so described the invention. It does not affect the point upon which my decision turns. But it is plain, if you look at page 3, between lines 25 and 30, and read the description there, or turn to page 5, between lines 5 and 10, and read the description there, the notion is that the gas explodes? that it heats the air and expands the air, and then the expanded air drives the piston—that is the notion. Well, then, he does introduce a supply of air into the cylinder before the gas is allowed to enter. That is the only expression which is at all like the plaintiff's scheme. Look at what he says between lines 10 and 15—"The object of introducing a supply of air into the cylinder before the gas is allowed to enter is to neutralise the effect of the carbonic acid gas formed by the combustion of the first portion of the inflammable gas." That appears to me to be a total mistake; but still, we are only considering now what he is disclosing to the public, and that is what he is disclosing to the public; and there are no quantities here. Now apply the same test as I applied before. What is a workman to do? He lets in a little air, and then he finds the thing explodes. If he had let in none it would not explode—I mean none of the previous air. Then he lets in air and gas together. He does not go any further, as the machine does not work, and he has no idea disclosed to him that if he had put in some air he would have changed the sudden explosion which works the machine into the gradual explosion, which is the object of the plaintiff's specification. It appears to me, therefore, that, quite independent of the surrounding circumstances, nobody ever understood that specification of Johnson's as describing or intending to describe that which the plaintiff has claimed by his specification; that Johnson's specification does not tell the public at all that which the plaintiff has told them, and is by no means an anticipation of the invention.

I now come to the last point, which is that of infringement. It is quite true that the defendant's machine is a double-action machine, or rather a machine with two pistons, and works in rather a different way—there are six motions to four motions; but does it or does it not adopt the plaintiff's idea with a substantially similar mode of carrying it out. Well, I think it does. When you come to examine the defendant's machine you will find it works in this way: There is a cushion of air, as described by the plaintiff, or the stratum of air next the piston; there is the combustible mixture next that; then there is more combustible mixture, that is on the other side; another stratum of air, and another piston on the other side; and then you light it in the middle—that is, you light it at what has been called in the plaintiff's invention the richest part, or that which contains most gas. The only difference is, that it has a double action. The action is exactly the same—the explosion is modified in exactly the same way; and though, of course, as you have doubled your piston, you have to alter a little your cams and excentrics and slides. That is exactly what is meant by being "substantially the same."

Here, again, the evidence on the part of the plaintiff wholly preponderates. Their engineers are quite positive that there is no difference, and when you look at the defendant's engineers' evidence it really does not contradict them. Taking it to be a patent for a machine he says it is not the same, but he never contradicts it in the view that I have expressed of the patent; he does not say that supposing the patent was really for an idea with a mode of carrying it out substantially the same as in the plaintiff's that it is not substantially the same; and that is the only point which we have really to determine. I think, therefore, the infringement is made out, and the result will be, that the decree of the Vice-Chancellor will be reversed, and the plaintiff will have his injunction with costs.

LORD JUSTICE BRETT: I have been inclined not to express any judgment in this case, because I know I shall be followed by my brother Holker, who has been, to my knowledge, engaged in very nearly every patent case which has arisen in the North of England for the last twenty years—the North of England being the great nursery of patent inventions, and being fully aware, therefore, that he knows a good deal more about this subject than I do. But inasmuch as this case has been elaborately argued, and all the points have, to my mind, been most clearly stated by Mr. Millar, I think it due to the arguments which have been adduced before us to give my opinion, as shortly as I can, upon the separate points that have been made.

Now, I will take the objections in the order in which they have been presented to us, presuming only that the judgment of the Vice-Chancellor seems to be substantially on one point, and, therefore, we have not the benefit of a full exposition of his views upon the other objections.

The first objection, as my lord has pointed out, was that there was not a sufficient subject matter for a patent, and the ground taken was that it was a claim for a principle only, and without any reference to a machine. In order to determine that point and some of the other points which have been raised, it is necessary to consider what is one's own view of the construction of the plaintiff's patent. To my mind there is no great difficulty in construing the plaintiff's patent. It seems to me to be a patent which is more than usually clearly expressed. The patent begins by pointing out what was the alleged defect in gas motor engines, and I take it that the defect pointed out in such machines is that in working them in the way in which they were constructed, there was a too suddden expansion of the gas and development of heat. That was the mischief in the machines which produced certain evil results, both of which seem to me to be pointed out in the patent. The evil results were a waste of heat, as it was said, and also a shock, both of which are pointed out at different parts of his patent.

Now, what the plaintiff states in his specification that he intended to do by his patent was to cure the evils in the machine, and in the working of the machine, that is, to cure the evils in such machine of a sudden expansion of the gases and development of heat. It seems to me that he points out the mode in which he intends to do that, namely, by so introducing matter into the cylinder that instead of a sudden expansion of gases and a sudden development of heat, there shall be a gradual expansion of the gases and a gradual development of heat. Those are the evils pointed out, and that is the cure which he proposes to adopt.

He then points out the means by which he intends to obtain that gradual expansion; and it is really by introducing, first, next to the piston, simple air—pure air—and then a combustible mixture after that. Now having done that, it is obvious to my mind that he does not mean that those two strata are to remain absolutely and mathematically distinct. The moment the combustible mixture is introduced behind the air it will begin, where it is next to the air, to impregnate itself, as it were, into the air. But then, before it can do that, there having been air next to the piston, he fires the combustible mixture at the opposite end from where it touches the simple air, and by that means he gets what he calls a gradual explosion.

Well, it seems to me that if he had said only that in this patent, applying it to the working of the machine, that would have been sufficient to make it the subject matter of a patent. But he goes further, and he so arranges the machinery of the machine as to carry out that object of introducing first of all the air, and then the combustible mixture. That certainly is true as to his first and second modifications. It seems to me to be equally true of the third—that the third consists of first of all introducing the air, and after that the combustible mixture, in the same way as he has done before, and then compressing them, but compressing them not so as to make one homogeneous mixture; for after his compression, it seems to me he states distinctly that it will not be homogeneous—that the compression cannot take place perfectly, but that, because of the introduction of air first, and afterwards of combustible mixture, although they will be more amalgamated than they had been under the first modification, yet even then they will not be wholly amalgamated before the ignition; so that the effect will be substantially the same. It seems to me that he describes that effect in the third modification as clearly as he described it in the two first. Therefore, that being what his invention is, it seems to me to follow that, supposing it to be sufficiently described, it is a sufficient subject matter for a patent, and about that, I think, there can really be no substantial doubt. That, therefore, disposes of the first objection.

Now the second objection is that the description in the specification of that invention is not a sufficient description, so as to enable the matter to be worked. And first of all it was said that it was not sufficient on account of the mistake in the drawings. I shall refer no further to that mistake than to say that I do not think the objection was much pressed by Mr. Millar; and I think he was quite right in not pressing it. It is obvious to my mind that, in the present case, at all events, it is not a valid objection. The real objection upon this point seemed to me to be the statement that there was no sufficient description of the proper proportion between the simple or pure air first introduced, and the combustible mixture which was to come in behind it.

In the first place I maintain the view which I expressed during the argument, that any exact proportion between those two is no part of this invention at all; that if at one time, for instance, the proportions might be as 4 to 7, or if, on another occasion, they were as 3 to 7, yet if, in both cases, it would not be a sudden explosion, but a gradual explosion, although in one case more gradual than in the other—both of them would be within this patent. It does not tell you any exact proportion, and moreover, in order to obtain the result, no exact proportion is necessary, as I have just shown Therefore, to say that it does not show the proportion—meaning thereby, the exact proportion—is no objection at all. Then, if it is urged that it does not show that there must be a substantial introduction of simple air next the piston, that has been met by what my lord has pointed out, and what was pointed out in the argument and in the evidence, that that was the necessary consequence of any man with a willing mind attempting to work this machine. It does not require experiment, it requires only regulation; and, if so, the objection fails.

But then, as to the third modification, it was said that there was no sufficient specification in this case, because in the third modification there will not be a gradual expansion or development. Now the objection must come to this, as was pointed out. It is certain that the plaintiff in his specification describes and declares that there will be that same gradual expansion in the third modification as there was in the first. He says so, and therefore this objection comes to be, not that the specification has not stated that it would be so in the third, but that it has stated wrongly that it will. That of course must be a matter of evidence, that goes beyond the mere construction of the specification; it must be a matter of evidence as to how, when the specification is applied to a machine, it will work.

Now, certainly Mr. Imray, to my mind, distinctly stated that in the third modification there would be a gradual expansion or development; and it seems to me that Mr. May did not contradict that really, in fact he was not asked upon this point. But it is said that this indicator or diagram, or paper, or whatever you please, proves it conclusively, and we are told that that proves it so conclusively that if we say it does not we shall be saying something which is contrary to the laws of mechanics. Well, if we are it is unfortunate, but I cannot think so, because, at all events, we have the authority of Sir Frederick Bramwell for thinking that there would not be that sudden explosion; and as for that diagram, I take it it is very like arithmetic. The diagrams which are put in in patent cases almost always seem to me to be able to prove anything, and therefore they prove nothing. But I care not. I do not flinch from that diagram myself, and if I do say something which is very ignorant, so much the worse for me; but as far as I understand it, it does not show that the effect of this explosion throughout the cylinder will be instantaneous or sudden. Therefore, to tell me that it is evidence, and conclusive evidence that it will, is to ask me to say something which, upon my own view of the diagram, I do not believe, and upon the evidence I do not think is accurate. Therefore all the objections as to this not being a sufficient description seem to me to fall to the ground.

Then the next point taken was inutility, and there it seemed to me that the whole matter was based first of all upon a wrong view of parts of the evidence, and, secondly, upon an illogical inference; because the argument that was used was this: that if an inventor takes out his patent and makes his specification, and files it, and then soon after he takes out another patent, declaring that it is an improvement upon his former one, the logical inference is that he has come to the conclusion that the first one is wholly useless. All I can say is that that is an illogical conclusion, and one which I am not therefore prepared to draw.

Then it was said that there was no evidence that anything had ever been done with machines under this specification of 1860, and that that was strong evidence against the inventor that he thought that specification was wholly useless. With regard to the first modification, it is true that he never has done anything; but with regard to the second, there was one model made; and with regard to the third, the evidence seemed to me to be that several machines had been made according to it, had been sold, and had never been returned. Therefore it is untrue as a matter of fact to say that it had never been used by the first inventor of this patent. With regard to the first modification never having been used, and the second only having been tested by one model, the answer seems to me to be that that is not conclusive as against their having some utility; and the evidence is that they were of some utility.

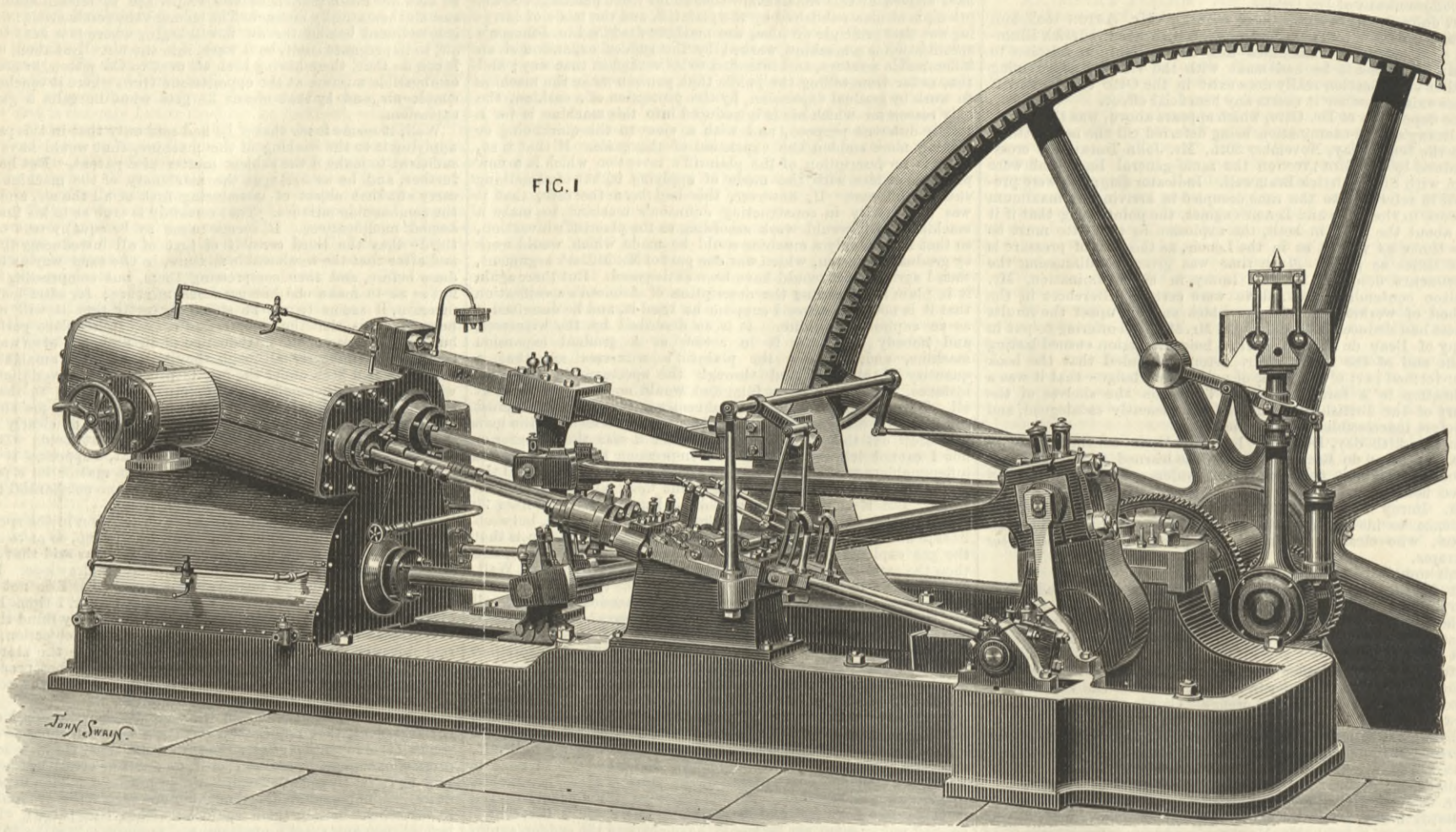
(*To be continued.*)

SOUTH KENSINGTON MUSEUM.—Visitors during the week ending Nov. 28th, 1885:—On Monday, Tuesday, and Saturday, free, from 10 a.m. to 10 p.m., Museum, 8354; mercantile marine, Indian section, and other collections, 1657. On Wednesday, Thursday, and Friday, admission 6d., from 10 a.m. to 4 p.m., Museum, 1208; mercantile marine, Indian section, and other collections, 102. Total, 11,321. Average of corresponding week in former years, 13,486. Total from the opening of the Museum, 24,460,576.

COMPOUND ENGINE AT THE INVENTIONS EXHIBITION.

MESSRS. GALLOWAY AND SONS, MANCHESTER, ENGINEERS.

FIG. 1

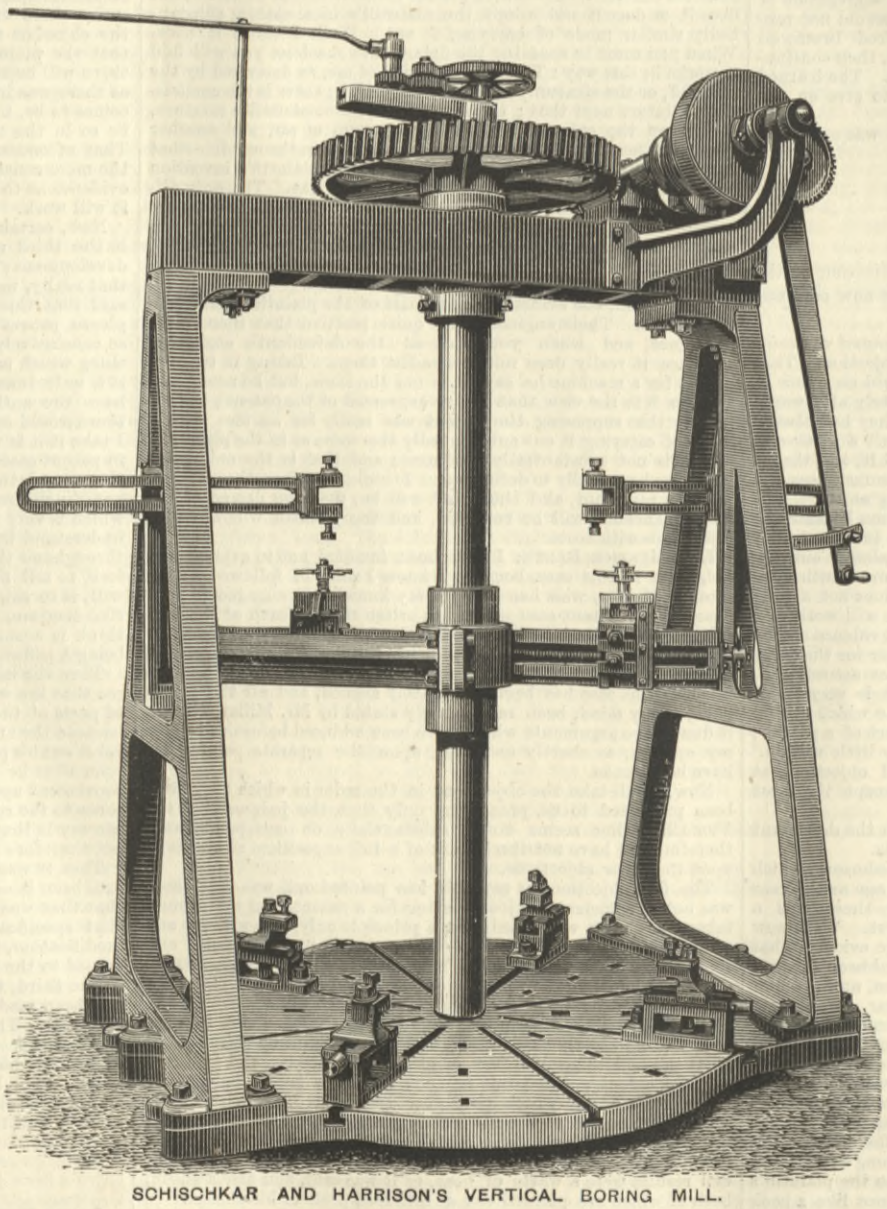


THE GALLOWAY COMPOUND ENGINE AT THE INVENTIONS EXHIBITION.

The accompanying illustration is taken from a photograph of one of the compound engines which Messrs. W. and J. Galloway and Sons, of Manchester, have had working at the International Exhibition. In this engine it will be seen that a departure is made from the usual arrangement, and that the high-pressure cylinder, instead of being placed on the same level as the low-pressure, is placed upon it. The two piston rods work through connecting rods on to one crank pin, and thence through the shaft to the fly wheel in the ordinary manner. The guide for the low-pressure cylinder is on the bed plate, that for the high-pressure is on a steel slab connected to the cylinder at one end, and to a pedestal piece at the other, thus serving the purpose of giving additional strength and stability. Several of these engines have been set to work, but hitherto they have been fitted with an expansion motion on the link system, thus enabling the pedestal piece to bridge over the piston rods, and giving a very simple arrangement to the engine. To meet, however, the modern requirements of high expansion, with instantaneous cut off, this engine has been provided with a patented arrangement of gear. This arrangement has an admission valve for each end of the cylinder, these valves being opened by an excentric shaft, and when released by the governor acting on the trip gear, they are closed by the pressure of steam in the valves cutting off the admission instantaneously from 0 per cent. to 75 per cent. of the stroke. It will be seen from our illustration that this engine, for one of the horizontal type, occupies the smallest possible space; it is, in fact, got into the space usually occupied by a single cylinder engine, whilst it dispenses with the use of a cranked shaft, and throughout is exceptionally compact in construction. Messrs. Galloway's patent governor is attached to this engine, by which the admission valves are controlled in accordance with the work at any moment upon the engine. This governor consists of a vertical spindle, upon which slides a heavy counterpoise, slotted to a parabolic curve, the cylinders or balls being swung from a cross bar on the top of the spindle, and rolling along this curve. The governor is simple and compact, and it has been found to give excellent results, being free from vibration, and the counterpoise will run at any height with a variation of speed of not more than 1·5 per cent. to 2 per cent. It will be seen that the engine above described has a pulley for transmitting the power, and is also provided with teeth on the internal rim of the pulley. This is for the purpose of being turned by an arrangement of patent safety barring gear. This gear certainly has the merit of great simplicity, and, briefly described, it consists of a shaft carrying a pinion for engaging in the teeth abovementioned, this pinion being fitted on the shaft with two helical feathers, and when the handle of the starting gear is turned, the pinion bears against a collar on the shaft, which is thus compelled to turn with the shaft, and thereby giving motion to the large wheel, but when the large wheel feels the impulse of its own engine and turns the pinion faster than the shaft on which it is placed, the pinion instantly and automatically slides out of gear. The advantages of such an arrangement are obvious, especially in the case of large engines, in the saving of a considerable amount of time and annoyance. It may be added that the engine shown at the Exhibition has no condenser attached to it, and as it is very exceptional for compound engines not to be fitted with this apparatus, it is perhaps as well to explain that the reason why it has not been supplied in this instance is simply that water is not readily available.

VERTICAL BORING MILL.

The annexed engraving represents an improved vertical boring mill for boring out cylinders, &c. It is supplied with a massive base plate, fitted with convenient slots and bolt holes, is capable of holding a cylinder 5ft. 6in. in diameter, and is supplied with four stiff dogs for holding down the article to be bored. It will take in in height 7ft. from base plate to the underside of the bridge piece, and 5ft. 8in. between the standards. The boring bar, 6in. in diameter, is of cast iron, and is fitted with a feed screw ¼in. pitch and 1¼in. diameter. The bottom of the bar runs in a phosphor bronze step, the bridge piece being fitted with an adjustable cap for convenience in lifting the bar in and out, an eye bolt at the top of the bar being also supplied for that purpose. The slide fitted on to the boring bar is of steel, and is 16in. deep by 1⅛in. thick, with a flat on it for keying the boring heads to. In addition there is also supplied one double tool box slide to clip the bar, having a vertical adjustment of 5in., which will face up anything that the machine will take. The feed can be varied from $\frac{1}{16}$in. to $\frac{3}{8}$in. A self-acting hoisting arrangement for bringing back the bar is also supplied. The complete weight with overhead motion, &c., is 5½ tons. It is made by Messrs. Schischkar and Harrison, of Halifax.

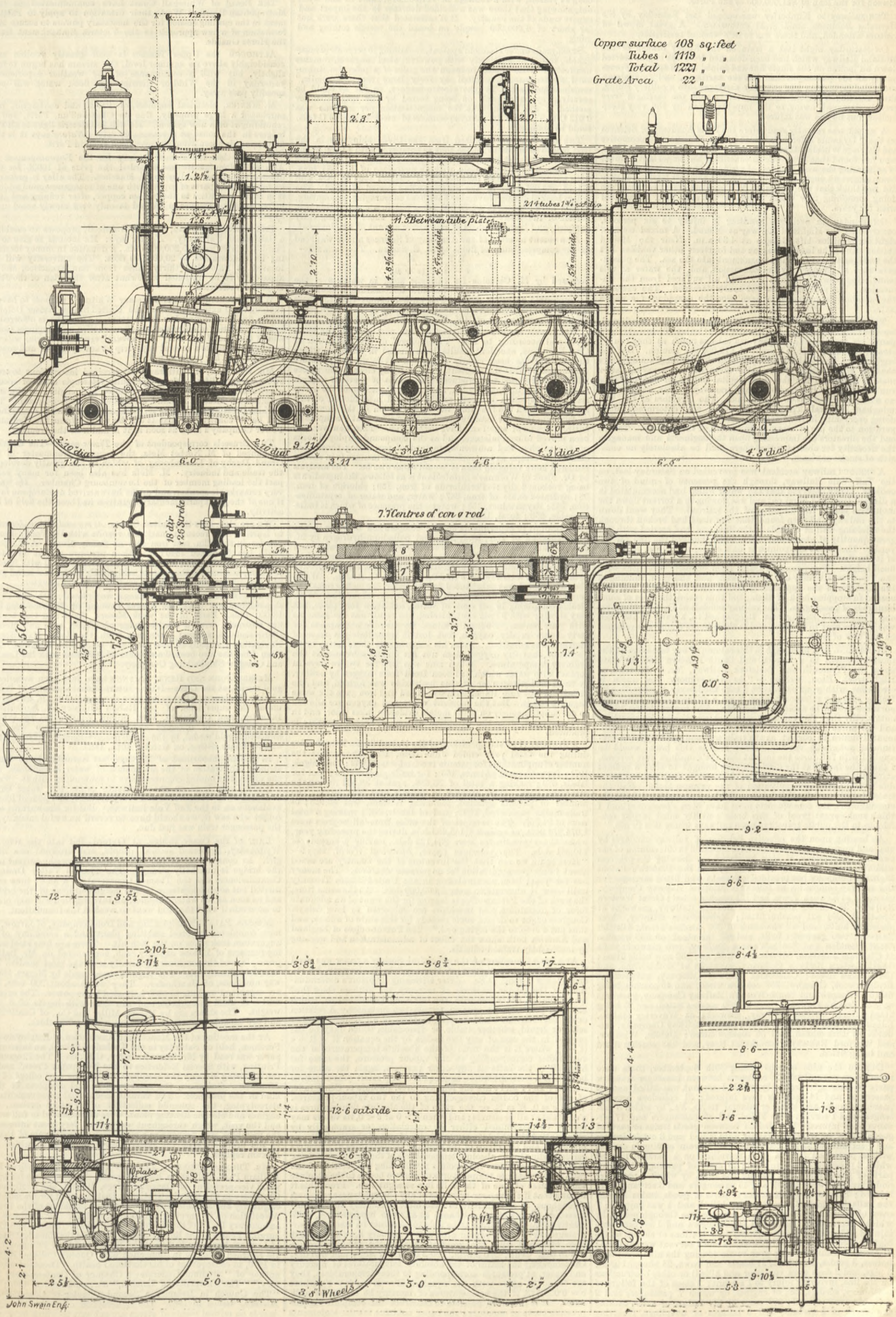


SCHISCHKAR AND HARRISON'S VERTICAL BORING MILL.

New Steel Works at Jarrow.—Steel-making has been commenced at Jarrow by Palmer's Shipbuilding and Iron Company. The Jarrow Works cover an area of 98 acres, and, although trade is now depressed, employment has been given in them to as many as 4000 hands, while the firm of which Mr. Palmer is the head has, in its various industries, engaged no fewer than 10,000 hands. Here are to be found, not only all manner of workers in iron, but also artificers in wood, in cotton and woollen fabrics, in stone, and in every material, raw and manufactured, that can be made available for constructive purposes. Joiners, carpenters, plumbers, glaziers, upholsterers, sailmakers, mast-makers, and spar-makers do not exhaust the list. From the commencement of the Jarrow works in 1852 to the end of the year 1868 there had been launched 239 vessels, with an aggregate burthen of 205,419 tons, while the engines built in the same period represented 27,399-horse power. If we assume that the value of the ships built over this period at Jarrow is £20 per ton, we shall find, after multiplying 205,419 tons by 20, that the value of the vessels launched at Jarrow during these sixteen years was considerably over four millions sterling. Since that time there has on an average been an output of 20,000 tons, and in round figures it is estimated that the money value of the product by this single firm has reached the colossal sum of eight million sterling; and now the manufacture of steel is introduced, and the first ingots were cast on the 26th ult. It is recorded that the steel trade was carried on nearly 300 years ago on the river Derwent, near to Shotley Bridge, and within a very short distance of the spot now occupied by the extensive works of the Consett Iron Company. Sir Ambrose Crowley, who became Lord Mayor of London, commenced the manufacture of steel at Winlaton Mill in the year 1691, but from this early date to the close of the last century the trade appears to have been all but effete. About the year 1810 Messrs. Crowley, Millington, and Co. introduced into the Newcastle district the Huntsman process. In the following year, the Messrs. Spencer erected works at Newburn for the same process. This firm was followed by Messrs. Cookson and Co. at Derwent Cote, for the Huntsman process, while some years later works were founded at Dunston by Messrs. Falthorpe and Co. The new works at Jarrow are to the north of the rolling mill. They were commenced on the 3rd February of this year. They are illuminated with the electric arc light, in seven 2000-candle lamps, the installation being by the Gateshead firm of Messrs. Clarke, Chapman, Parsons, and Co. The steel melting furnaces—four in number—are each of 15 tons capacity, and are constructed on what is known as "Bathos'" patent. There are four regenerators to each furnace and the gas is manufactured in a double range of Wilson producers. The engines weigh over 200 tons, and are capable of exerting up to 6000 indicated horse-power. The cogging mill is made throughout of steel. It is intended for cogging ingots up to five tons in weight. The shears are capable of shearing blooms or slabs 30in. wide by 9in. thick, and are provided with hydraulic apparatus for regulating the length of the piece to be cut.

GOODS ENGINE, INDIAN STATE RAILWAYS.

(*For description see page 442.*)



RAILWAY MATTERS.

The Council of Ministers have finally rejected at Constantinople, November 29th, as unacceptable, the conditions proposed by Baron Hirsch for the loan of £11,000,000 to the Porte.

The railway to Kimberley was opened last Saturday by Sir Hercules Robinson amid great enthusiasm. A great crowd of visitors attended, and there was to be a week of festivities.

On Saturday night last a train on the Ripley branch of the Midland Railway which had been detached from the engine started down an incline on the single line and gained a high speed. Fortunately all the passengers had left the carriages, and a signalman succeeded in turning the runaway carriages into a colliery siding, thus averting a serious disaster. It is said the carriages were greatly damaged, owing to the impetus given by the very steep incline, but no one was injured.

A paper was recently read before the Paris Academy of Sciences on the "Dynamic Effects Produced by the Passage of Locomotive and Carriage Wheels at the Junction of the Rails," by M. A. Considère, who has found that these effects constitute an important element in estimating the wear and tear of traffic on the metals of railways. Some American engineers have also found this out lately, but they did not think that the wheels, as M. Considère seems to think, are doing something now which engineers had not been acquainted with for years.

On Sunday an accident, resulting in injury to six persons, occurred on the Highland Railway at Mound. A mixed train of eighteen vehicles left Golspie at 4.30 a.m. Near the Mound station one of the leading wagons and fourteen other vehicles left the rails, and went over an embankment into the sea. The passengers were all stunned by the concussion, and, the water at this point being between 2ft. and 3ft. deep, all suffered from the immersion. The post-office van was much damaged. The cause of the accident is supposed to have been the snapping of a wagon axle.

The new cable tramway lines in Birmingham will, it is believed, turn out a good thing for the Birmingham Central Tramways Company. If by cable the company can earn as much as they can by steam, the result will be a profit of £19,000 per annum. But the engineers of the Cable Company inform the Birmingham directors that on the working of the cable there will be a saving, after making allowance for the extra capital outlay, of 2½d. per mile run over the cost incurred by steam tramway. This would mean an extra profit of £6000 per annum. The directors of the Birmingham Central Tramways Company are determined upon doing everything in their power to retain the sanction of the Corporation to the use of steam upon certain of their routes. To this end the directors are impressing upon the engineers and managers the necessity for observing that there shall be absolutely no emission of smoke or steam.

A serious railway accident was prevented on Saturday last, on the Taff Vale Railway, through the presence of mind of two colliers. They observed that the water which had accumulated in a disused level had burst out and was flowing in a torrent down the mountain side in the direction of the railroad. They went down to the railway and then found that the flood had broken through the retaining wall at the side of the line, and had carried with it a great quantity of stones and trees, which blocked the line for 100 yards. The line at the point was on a curve, and on the other side of it the Taff river was flowing at the base of an embankment at flood height. Two passenger trains from opposite directions were the *Times* says, nearly due at the point, and the men, running in the direction of the approaching trains, gave the alarm, and succeeded in stopping both of them, and thus saved the lives of some hundreds of passengers. The railway officials at Cardiff, Merthyr, and Pontypridd having been telegraphed to, a gang of 100 men was at once sent to the spot, and in three hours traffic was resumed on one line of rails.

Referring to a paragraph in this column of our last issue on the recent accident to a London and South-Western Railway train upon the Plymouth and Tavistock Railway, Mr. G. Mitchell, of High-street, Eton, writes: — "As the report you quote is erroneous, with your permission I take the liberty of correcting it, feeling sure any misapprehension upon a subject of so much importance should be avoided, if possible. The report states: 'It is noteworthy that the carriages were not overthrown or smashed, and no brake seems to have been employed.' It is this statement I desire to correct, as the train was equipped with the continuous automatic vacuum brake; and as this brake would be applied with full force the instant that the couplings were severed, I think the fact that the carriages were brought to such a prompt standstill must be, if not wholly, at least in a very great measure due to this automatic application of the vacuum brake. Had the train shared the fate of the engine and been precipitated down the embankment, the consequences must have been disastrous; and I think such cogent proof of this brake's utility must inspire confidence in the public travelling upon railways where it is in use."

As bearing upon the effective lighting of railway carriages by gas, and upon paragraphs which have appeared in this column of our two last impressions, it may be stated, as showing the progress which is being made in this country, that the Pintsch's Patent Lighting Company has provided gasworks and fitted carriages for the railway companies as follows:—Midland Railway Company, gasworks at Kentish Town, and 121 coaches fitted; Great Western Railway, 38 coaches fitted; Great Eastern Railway, gasworks at Stratford, and 621 coaches fitted; Metropolitan Railway, three gasworks built, and all the stock of 301 coaches fitted; District Railway, two gasworks built, and all the stock of 350 coaches fitted; London and South-Western Railway, two gasworks built at Clapham Junction, 561 coaches fitted, and 100 now being fitted; South-Eastern Railway Company, gasworks at Rotherhithe, and 154 coaches fitted; Caledonian Railway Company, gasworks at Bridge-street, Glasgow, 259 coaches fitted, and 40 coaches being fitted; Glasgow and South-Western Railway Company, gasworks at St. Enoch's station, Glasgow, 260 coaches fitted, and 25 being fitted; North British Railway, gasworks at Waverley station, Edinburgh, and 50 coaches fitted; Mersey Railway Company, gasworks at Birkenhead, and 56 coaches fitted; Dublin, Wicklow, and Wexford Railway, gasworks at Bray, and 183 coaches fitted and being fitted.

During the nine months ending 30th September, there were reported on our railways 28 collisions between passenger trains or parts of passenger trains, by which 1 servant was killed and 86 passengers and 14 servants were injured; 31 collisions between passenger trains and goods or mineral trains, &c., by which 5 passengers and 1 servant were killed, and 85 passengers and 17 servants were injured; 12 collisions between goods trains or parts of goods trains, by which 2 servants were killed and 3 cattle-drovers and 7 servants were injured; 1 case of a train coming in contact with a projection from a train travelling on a parallel line, by which 2 passengers were injured; 49 cases of passenger trains or parts of passenger trains leaving the rails, by which 1 passenger and 4 servants were killed, and 45 passengers and 3 servants were injured; 12 cases of goods trains or parts of goods trains leaving the rails, by which 2 servants were killed and 1 was injured; 7 cases of trains travelling in the wrong direction through points, by which 1 servant was killed and 14 passengers and 1 servant were injured; 11 cases of trains running into stations or sidings at too high a speed, by which 87 passengers and 1 servant were injured; 91 cases of trains running over cattle (during the nine months 20 horses, 3 ponies, 2 donkeys, 21 beasts and cows, 28 sheep, 1 goat, 3 pigs, and 2 dogs were run over and killed) or other obstructions on the line, involving injury to 1 servant; 3 cases of the failure of machinery, springs, &c., of engines, by which 7 passengers and 2 servants were injured; 269 cases of the failure of axles, causing the death of 1 servant, and 5 failures of couplings, involving injury to 3 servants.

NOTES AND MEMORANDA.

In the year ending June, 1883, 669,148 vessels, with a tonnage of 144,793,457, entered and left our ports, whereas last year only 656,744 vessels, with a tonnage of 144,000,375, came in and went out, showing that there was a decided decrease in the import and export trade of the country. It is estimated that there were not far short of 4,000,000 people on board the vessels coming and going.

Steel made under Hadfield's patent, containing 15 per cent. of manganese, tested magnetically with powerful steel magnets, remains unaffected. Bars placed between the poles of a powerful Ruhmkorff electro-magnet, excited by forty large tray "Daniells," remained unaffected by the electro-magnet, so far as could be perceived by hand; and on being tested by the magnetometer method it was found that the magnetisation per gramme was 0·013 C.G.S., while in many specimens of steel 40, 50, 60 C.G.S. could be obtained.

The new shipping launched from the Clyde shipyards in the past month amounts to 13,485 tons as compared with 13,850 in the same month of last year, and 43,697 in November, 1883. During the eleven months 195 vessels, with an aggregate of 171,084 tons, were put into the water against 221 of 262,922 tons in 1884, and 271 of 369,687 tons in the corresponding period of 1883. The orders booked during November have been encouraging, amounting, as they do, to upwards of 30,000 tons, but in a considerable proportion of the yards the stocks are yet far short of being fully occupied, and large numbers of operatives are out of employment.

At a recent meeting of the Academy of Sciences a note was read on the compressibility of fluids by M. E. Sarrau. The formula—

$$p = \frac{R T}{v - a} - \frac{K}{T (v + \beta)^2}$$

proposed by M. Clausius for carbonic acid, in which p = the pressure, v = volume, and T = absolute temperature, is shown to be applicable to other gases. The author claims that for these gases he had deduced the elements approaching the critical point before the experiments of MM. Wroblewski and Olszewski.

Wollmar's system of disinfection has now been in use since 1876, and according to the "Proceedings" of the Institution of Civil Engineers, excellent results have ensued in all cases where the material has been rightly employed. It is necessary, before making use of this disinfectant, to thoroughly cleanse the places where it is proposed to introduce it, as traces of previous impurities rapidly set up putrefaction, and nullify the action of the material. An objection hitherto to the general introduction of this system had been the fact that the deodorisation of the excreta is so complete that the manure merchants consider that a compost so entirely devoid of smell can have little value. This, however, has been proved to be a mistake, and as the compound employed locks up the sulphur and ammonia, instead of permitting those substances to escape as ammonium sulphide, the manure is in reality rendered more valuable than it would otherwise be. The analysis by Dr. Fleck of Wollmar's disinfectant is as follows, the ingredients being reckoned dry:—Perchloride of iron, 130; chloride of iron, 58; hydrated oxide of iron, 247; water, and water of crystallisation, 162; dry sawdust, 153; water—the presence of which is indispensable, 250; total, 1000.

According to experiments on the co-operation of water in the slow oxidation of zinc, lead, iron, and palladium-hydrogen by M. Traube, zinc, lead, and iron, when moistened with water and subjected to the action of an inclosed volume of air for twenty-four hours, were all acted on, and yielded precipitates of their respective hydroxides, $Zn(OH)_2$, $Pb(OH)_2$, and $Fe_4O_3(OH)_6$. When absolute alcohol was substituted for the water, the metals remained perfectly bright and unattacked, even after several months. With alcohol containing 10 per cent. of water, oxidation took place, but very slowly; with 50 per cent. alcohol, the result was the same as with pure water. Sodium retained its metallic appearance for forty hours in dry oxygen, but lost it immediately a trace of moisture was admitted. From his experiments there seems to be no doubt that dry oxygen does not act on any substance at the ordinary temperature. When zinc was left for twelve days in contact with water which had been freed from oxygen by boiling, no trace of hydrogen or of zinc hydroxide was formed, and the metal did not lose its brightness. Lead and iron gave the same negative result. But the moment water and oxygen are allowed to act simultaneously on these metals oxidation takes place, and in all these cases, with the exception of iron, hydrogen peroxide is produced.

A statement of the operations of the United States Patent-office during the fiscal year ended June 30th, 1885, shows that the number of applications for patents received was 32,662; for designs, 1071; for reissues of patents, 156; for trade-marks, 1126; and for labels, 673; making a total of 35,688, against 38,832 during the preceding year. The number of caveats filed was 2515. The number of patents granted, including reissues, was 22,928; of trade-marks registered, 1092; and of labels, 337; making a total issue of 24,357. The receipts of the office from all sources were 1,074,974 dols., as against 1,145,433 dols. during the preceding year, while the expenditures were 934,123 dols., leaving a surplus of 140,851 dols. The American paper, *Electrical World*, says:—"Here again we see that the inventors of the country are taxed about 4 dols. per application for no purpose whatever. The money has for years been accumulating in the United States Treasury until now it amounts to over 2,000,000 dols. At the same time, the work of the Patent-office is lagging for the want of an adequate force of examiners, and inventors are subjected to long delays. Congress ought to devise some remedy for this state of affairs, and thus put a stop to the crying evil." The Patent-offices of England and America both show the effect of administration and working by inefficiently trained officials.

At a recent meeting of the Chemical Society a paper was read "On the Vapour-pressures of Mercury," by W. Ramsay, Ph.D., and Sydney Young, D.Sc. After criticising Regnault's determinations of the vapour-pressures of mercury, the authors show that his results do not agree with the following generalisation, which has been proved to be true in twenty-two instances. A relation exists between the absolute temperatures of all bodies, whether solid or liquid, whether stable or dissociable, which may be expressed in the case of any two bodies by the equation $R' = R + c(t' - t)$, where R is the ratio of the absolute temperatures of the two bodies corresponding to any vapour pressure, the same for both; R′ is the ratio at any other pressure, again the same for both; c is a constant which may equal 0, or a small plus or minus number; and t' and t are the temperatures, absolute or Centigrade, of one of the bodies corresponding to the two vapour-pressures. When $c = 0$, $R' = R$, or the ratio of the absolute temperatures is a constant at all pressures; and when $c > 0$ or $c < 0$, its values may readily be determined either by calculation, or graphically by representing the absolute temperatures of one of the two bodies as ordinates, and the ratios of the absolute temperatures at pressures corresponding to the absolute temperatures of that body as abscissæ. It is found in all cases that points representing the relation of the ratio of the absolute temperatures of the two bodies to the absolute temperatures of one of them lie in a straight line. From this it follows that if the vapour-pressures of any one substance are known throughout, it is sufficient to determine accurately the vapour-pressures of any other substance at any two temperatures, sufficiently far apart, in order to be able to construct its whole vapour-pressure curve. The vapour-pressures of mercury have accordingly been measured with the greatest care at the temperatures:—222·15 deg. Cent., 270·3 deg., 280·2 deg., 447 deg., and 448 deg. On comparing the ratios of the absolute temperatures of mercury and water, at pressures corresponding to those temperatures, they are found to agree with the equation $R' = R + c(t - t')$, where $c = 0{\cdot}0004788$, if the temperatures of mercury be chosen as ordinates. It is therefore possible to construct the complete vapour-pressure curve of mercury; the paper contains tabular statements of the values.

MISCELLANEA.

The Glasgow office of the Pulsometer Engineering Company of Nine Elms Works, London, is now at 74, Broomielaw-street.

The Board of Whitehall Court have communicated to the Metropolitan Board of Works their intention to apply to Parliament in the ensuing session for the necessary powers to secure the formation of a new approach to the Victoria Embankment from the Horse Guards.

Although the Upper Thames is still greatly swollen and considerably above its summer level, the stream has begun to fall slightly, but with a continuance of the weather experienced yesterday in the Windsor district the flood water will not speedily pass away.

M. Menier, electrical engineer, of Paris, and contractor, has purchased a large property, Rue de Chateaud'un, Paris, and is rebuilding it on a new system. He will sell electric light to all the lodgers in the house at a reasonable rate. *Nature* says it is the first time this speculation has ever been tried in Paris.

It is said that the French Society for the Encouragement of Arts and Manufacture has awarded the prize of 1000f. for the discovery of a useful alloy to M. Marches. The alloy is prepared by mixing three parts of copper with one of manganese, and adding it in small quantities to the molten copper, after refining and just before casting. Copper so treated is only very slowly acted upon by sea water.

The wealthy American, Senator Stanford, proposes to establish a Californian University. *Nature* says: He intends to give to it, besides estates worth 5,300,000 dols., a donation in money increasing its endowments to 20,000,000 dols. The university will be located at Palo-Alto, thirty miles from San Francisco, and is apparently to be modelled somewhat after the plan of the John Hopkins Institution.

We understand that it is Secretary Whitney's purpose to have a thorough and extended trial of the United States cruiser Dolphin before finally assigning her to a station. After she is officered, a board, consisting of officers of the Construction and Engineer Corps and of the line of the Navy and several civilian experts, will be appointed to make a several days' trip at sea upon her and report in detail upon her performance.

Mr. Stannah, of Southwark, has received instructions to erect two hydraulic lifts, and an hydraulic telescopic crane of special construction, with accumulator, pumps, and engine, at the new premises of Messrs. Holland and Sherry, Golden-square. The working pressure will be 700 lb. per square inch, and the machinery will be so constructed that it can be worked from the Hydraulic Power Company's main as soon as it is laid near the premises.

The Brussels correspondent of the *Times* says:—The death is announced of M. Norbet Metz, the principal ironmaster in the Grand Duchy of Luxembourg, of which he has greatly developed the trade and industry. M. Metz has also been for many years past the leading member of the Luxembourg Chamber. He was a very remarkable speaker, and might have arrived at European fame if one of the great parliamentary countries had been the field of his activity.

We are glad, says the United States *Army and Navy Journal*, to learn of the recent remarkable results with Du Pont's brown powder in the 12in. cast iron gun at Sandy Hook. A charge of 265 lb. has furnished 1840 f.s., with a pressure of but 14·5 tons using a projectile of 800 lb. This result is unequalled with foreign powders, and insures the success ballistically of the new naval guns 8in. and 10in. calibres now being completed at Washington.

A large amount of new tonnage was placed with the Clyde shipbuilders last week, the figures running up to something like 18,000 tons. Early in the week Messrs. Scott and Co. booked five steamers, with a total tonnage of 13,000, tons and Messrs. Caird and Co. secured a contract from the Royal Mail Steam Navigation Company of 4500 tons, and of 5500-horse power. The Glen Line has also booked a steamer of 3000 tons with the London and Glasgow Shipbuilding Company.

Messrs. John and Henry Gwynne have just been awarded a gold medal, at the Lecce—Italy—International Concours of Water Lifting Machinery, after exhaustive comparative trials, carried out under the supervision of the Italian Ministry of Agriculture, Industry, and Commerce, with pumps constructed by various manufacturers of different countries. This pump was also awarded a gold medal, by the Académie Nationale of France, at an extraordinary sitting, on October 16th, 1885.

In the neighbourhood of Merthyr last Saturday there was a striking illustration of the abundance of water in collieries, and the difficulties mining engineers have in contending with it. From a disused coal level on the Plymouth estate the water burst, sweeping away trees, walls, and every obstacle, and poured like an avalanche on to the Taff Vale Railway. But for the warning of a collier who saw it, we should have to record an awful calamity, as the passenger train was just due.

Part of the Osney Bridge, at Oxford, fell into the river on Wednesday, immersed several people, and drowned one little girl. In consequence of the recent heavy rains the current near the bridge is unusually strong. The Thames Valley Drainage Commissioners and the Thames Conservators a short time since carried out some operations in the neighbourhood of the bridge, and as soon as the water subsides, an investigation will take place, to ascertain if what they did went to weaken the foundations.

Messrs. Palmer's Shipbuiling and Iron Company, of Jarrow, has now completed its steel smelting plant, and a ceremony of inauguration took place on the 26th ult. There are four steel melting furnaces of 15 tons capacity each, constructed on Mr. Batho's principle, and the machinery generally is of the most modern and complete description. The engines were made by Messrs. Galloway and Sons, of Manchester. They weigh about 200 tons, and are capable of working to 6000 indicated horse-power. The cogging mill is of steel throughout, and can deal with ingots of 5 tons weight. The shears are by Messrs. Miller and Co., of Coatbridge, and are capable of cutting slabs 30in. wide by 9in. thick.

At the meeting of the Manchester Association of Employers and Foremen, held on Saturday in the Technical School, an interesting paper was read by Mr. Thos. Ashbury, C.E., on "The Progress of Printing, with Special Reference to the Newspaper Press," and on the following Monday the members visited the new offices of the *Manchester Guardian*, the most modern and complete of their kind in the provinces. The various mechanical arrangements for stereotyping, the splendid collection of printing presses, the engines and electric lighting plant, were all inspected in full work, and the visit, which throughout was one of very great interest to the members, was brought to a close with a cordial vote of thanks to the proprietors of the *Manchester Guardian*, to which Mr. Buxton replied.

Mr. Thomas Andrews, LL.D., F.R.S., died last week at Fort William Park, Belfast, in his 71st year. Deceased was for many years vice-president of Queen's College, Belfast, and Professor of Chemistry in the same institution. Distinguished for his scientific originality and attainments, he was chosen president of the British Association on its meeting in Glasgow, in 1876. Dr. Andrews was an honorary LL.D. of the Universities of Dublin, Glasgow, and Edinburgh, a Fellow of the Royal Society, Fellow of the Chemical Society of London, honorary Fellow of the Royal Society of Edinburgh, &c. He resigned his office in connection with Queen's College, Belfast, in 1879, in consequence of his shattered health. Deceased was the author of "Studium Generale: a Chapter of Contemporary History," "The University of London," &c., published in 1867; and "The Church in Ireland: a Second Chapter of Contemporary History," issued in 1869. The liquefaction of gases and experiments on critical points of steam are subjects to which he devoted much attention.

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A. W. N.—*Your engine is too small to drive a launch.*

T. H.—*We cannot publish your letter. Consult a lawyer if you believe your patent rights are being infringed.*

H. L. (Maitland Park).—*Messrs. Greenwood and Batley, of Leeds, can supply you with the machine you want.*

YOUNG DRAUGHTSMAN.—"*Strains in Ironwork,*" *by Henry Adams, and published by E. and F. N. Spon,* 125, *Strand.*

W. M.—*According to American reports the Panama Canal undertaking is in a disastrous condition materially and financially.*

DOUBTFUL.—*The extension limit is so very small that we feel certain it is intended to apply across the grain of the plate. Any rubbish will extend* 6 *per cent. with the grain.*

BIRMINGHAM.—*Messrs. Sulzer, of Winterthur, will supply you with the second expansion gear you name. We do not know anything of the first, and suspect that you have not got the right name.*

HANKWILL TIN-PLATE.

(*To the Editor of The Engineer.*)

SIR,—Can any reader favour me with the address of the mill where the Hankwill brand of tin-plate is made? J. T.
London, December 2nd.

SPENCE'S METAL.

(*To the Editor of The Engineer.*)

SIR,—Will any reader have the kindness to give me the address of the manufacturers or proprietors of Spence metal? P.
Monville, Seine Inférieure, November 27th.

POWER REQUIRED TO DRIVE LATHES.

(*To the Editor of The Engineer.*)

SIR,—Will any reader kindly tell me how large a cylinder steam engine I should require to drive a 5½in. centre back-geared lathe, and if there is a good book on construction of small power engines? TURNER.

SUBSCRIPTIONS.

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MEETINGS NEXT WEEK.

THE INSTITUTION OF CIVIL ENGINEERS, 25, Great George-street, Westminster.—Tuesday, Dec. 8th, at 8 p.m.: Ordinary meeting. Papers to be further discussed: "High-speed Motors," by Mr. John Imray, M.A., M. Inst. C.E. "Continuous-current Dynamo-electric Machines, and their Engines," by Mr. Gisbert Kapp, Assoc. M. Inst. C.E.

SOCIETY OF ENGINEERS.—Monday, Dec. 7th, at the Town Hall, Caxton-street, Westminster, at 7.30p.m.. a paper will be read "On the Dephosphorisation of Iron in the Puddling Furnace," by Mr. Philip S. Justice, of which the following is a synopsis:—Generally depressed condition of ironworks dependent on phosphoretic pig—necessity of some means of obtaining improved quality with cheapened production—that "puddling is a thing of the past" shown to be false—phosphorus, the chief obstacle, eliminated by Beasley's process, with description and practical results of its working.

KING'S COLLEGE ENGINEERING SOCIETY.—A general meeting will be held on Tuesday, Dec. 8th, at 4 p.m., when Mr. F. C. Fairholme will open a discussion "On Railway Brakes."

SOCIETY OF TELEGRAPH ENGINEERS AND ELECTRICIANS, 25, Great George-street, S.W.—Thursday, Dec. 10th, at 8 p.m.: Annual general meeting for the election of Council and officers for the ensuing year. The following papers will be read: "A Method of Eliminating the Effects of Earth and Polarisation Currents in Fault Testing," by Mr. Walter J. Murphy, Assistant Electrician E. and S. A. T. Co.'s ss. Great Northern. "A Method of Localising a Fault in a Cable by Tests from One End only," by Mr H. Kingsford, Associate.

THE PARKES MUSEUM OF HYGIENE.—Thursday, Dec. 10th, at 8 p.m.: A lecture will be delivered by Mr. Eric S. Bruce "On Health and the Electric Light."

SOCIETY OF ARTS, John-street, Adelphi, London, W.C.—Monday, Dec. 7th, at 8 p.m.: Cantor Lectures. "The Microscope," by Mr. John Mayall, jun. Lecture III.—Binocular microscopes—demonstration microscopes. Wednesday, Dec. 9th, at 8 p.m.: Fourth ordinary meeting. "The Load-lines of Ships," by Professor Francis Elgar, LLD., F.R.S.E., M. Inst. C.E. Sir Edward J. Reed, K.C.B., M.P., F.R.S., will preside.

THE ENGINEER.

DECEMBER 4, 1885.

THE SIEMENS MEMORIAL.

SOON after the death of Sir William Siemens, it was proposed—we do not know with whom the idea originated—that something should be done to keep him in memory. The Institution of Civil Engineers took the question up, followed by the Iron and Steel Institute, the Institute of Naval Architects, the Institution of Mechanical Engineers, and the Society of Telegraph Engineers. It was ultimately decided that a memorial window of stained glass should be erected in Westminster Abbey, to the memory of the illustrious dead, at a cost of about £800, the money to be supplied by subscription. On Thursday, the 26th ult., the window was unveiled with some ceremony, representatives of all the five societies named above being present. The party assembled at 1.45 in the Jerusalem Chamber, where they were met by the Dean and other members of the clergy, and Mr. J. L. Pearson, R.A., architect of the Dean and Chapter. There were present of the relatives and private friends of the deceased: Mr. Arnold Siemens, Miss Gordon, Dr. Werner Siemens, Mr. Alexander Siemens, Mrs. D. M. Gordon, Miss D. M. Gordon, Mr. J. G. Gordon, Mr. and Mrs. Cheyne, Lady Fowler, Sir Theodore Martin, K.C.B., Mr. and Mrs. Alexander Grahame, the Rev. G. Cowper Smith, Mr. H. Macpherson, Mr. G. von Chauvin, Mr. Fereday Smith, Mr. A. B. Joy, Dr. Dudgeon, and the principal members of the staff of the late Sir William Siemens. Among the representatives of the societies whose members have erected the window, there were present:—Of the Civil Engineers: Sir Frederick J. Bramwell, F.R.S., president; Sir Charles H. Gregory, K.C.M.G.; Mr. Bateman, F.R.S.; Mr. Barlow, F.R.S.; Sir J. W. Bazalgette, C.B.; Mr. Brunlees; Sir James N. Douglas; Mr. Preece, F.R.S.; Sir R. Rawlinson, C.B.; and Mr. Forrest, secretary. Of the Mechanical Engineers: Mr. P. D. Bennett and Professor Alex. B. W. Kennedy. Of the Institute of Naval Architects: Admiral Sir R. Spencer Robinson, K.C.B.; Mr. J. Wright, C.B.; and others. Of the Iron and Steel Institute: The president, Dr. Percy, F.R.S.; Sir Bernhard Samuelson; Sir Henry Bessemer, F.R.S.; and Mr. J. T. Smith. Of the Telegraph Engineers: Mr. Spagnoletti, president; Major-General Webber, C.B., R.E.; Professor W. G. Adams; Sir F. A. Abel, C.B.; Professor D. E. Hughes, F.R.S.; Professor Ayrton, F.R.S.; and Dr. Hopkinson, F.R.S. The day chosen was in every way suitable, being the second anniversary of Sir W. Siemens' interment.

The occasion was one which called for a certain amount of speech-making. The party was welcomed by the Dean of Westminster, to whom Sir Frederick Bramwell replied. That reply contained a good deal with which we very fully agree, and to which we desire to draw special attention. After rapidly sketching a few of the principal events in the life of Sir William Siemens, Sir Frederick Bramwell went on—"In matters of pure science we owe to Sir William Siemens not merely the knowledge of the effect of continuous light upon the growth of plants, to which I have already alluded, but we owe many philosophical modes of measurement. It was a hardy conception which devised the bathometer, by the aid of which, and without taking soundings, the depth of the ocean could be ascertained by the mere reading off of the indications given by the instrument on board ship. Again, profound must have been the thought that produced the electrical pyrometer, which while competent to deal with ordinary temperatures, was also suited for ascertaining the highest temperatures, and the readings, electrically transmitted, could be taken at any distance without the removal of the instrument from the place the temperature of which was being ascertained. I know there are those who regret that Sir William Siemens did not confine the employment of his remarkable talents to the pursuit of pure science, but I do not think that this regret is justified even in the interests of pure science itself, and I am sure it is a regret that will not be shared in by mankind at large. They, I believe, will agree that Sir William Siemens was doing not only good but noble and high work when he used his talents and devoted his scientific knowledge to the application of that science to engineering and to industrial pursuits, and even purely scientific men should rejoice that from time to time there are found those who, like Sir William Siemens, make practically useful for the purposes of life those truths which science has discovered, but which, failing application, would remain inert and barren of useful consequences, a condition of things which, if it continuously prevailed, would inevitably cause all interest in science to cease, resulting in the abandonment of the pursuit of pure science itself." The growth in this country of a class who hold that what is called the pursuit of pure science is the highest and noblest work which man can undertake, is much to be regretted, and we find no small pleasure in placing Sir Frederick Bramwell's outspoken words on record in our paper.

A glance at the recent history of the subject—and it has only a recent history—will suffice to show that the pursuit of pure science may or may not be remunerative according to the worldly wisdom of the pursuer. Pure science does not put gold into anyone's pocket, but when pure science is combined with oratorical powers of some weight and sufficient skill in the art of asking—we will not say begging—it has usually proved at least fairly remunerative. If the individuals who call themselves men of pure science were content to follow their own way in peace and to leave to others the doing of the world's work, no one would take exception to them; but the votaries of pure science are nothing if not arrogant. It is, we fear, too much to hope that they will take to heart Sir Frederick Bramwell's memorable words, that "failing application, the truths which science has discovered would remain inert and barren of useful consequences—a condition of things which, if it continuously prevailed, would inevitably cause all interest in science to cease, resulting in the abandonment of pure science itself."

The difference between such a career as that of Sir William Siemens and that of any eminent man of pure science whose name may occur to the reader is simply enormous. The value of the work done by the two men does not admit of comparison for a moment. Even Sir Frederick Bramwell is infected with the pure science taint, and he could not avoid, it seems, referring to the work of that kind done by Siemens. Fortunately for the world this was very small; and if we contrast it with the practical work which he did we shall find it dwarfed into utter significance. Take, for example, his researches on the effect of the electric light on the growth of plants. They represent some time wasted, nothing more. The bathometer is a pretty scientific toy. The electric pyrometer has never attained to any practical adoption. Had he followed the course suggested by some persons, his life would have been wasted in devising scientific toys; or in making researches on the growth of peas in presence of an arc lamp. Siemens was made of sterner stuff. Pure science might serve for relaxation, but not for work; and so we find that all his achievements represent the labours of a mind very practical in its quality, and of a man very fully impressed with the conviction that the value of work must be judged by its results. Probably the greatest thing Siemens ever did was the production of the regenerative furnace, which at once enabled the highest temperatures known in the arts to be obtained with indifferent fuel. In one sense, Siemens did much harm to this country, for he equalised the conditions under which iron and steel can be produced with bad and with good coal; and it is not too much to say that in this way he mainly contributed to put the iron and steel trade of Germany on its present footing. The next highest work he did was in the region of electricity, and he will rank to the end of time with Gramme as the inventor of a distinct and excellent type of dynamo. That Siemens loved science for its own sake is indisputable; that he prized it because he could make it useful is yet more certain. To Siemens science played the part of Aladdin's genii; but the work done by the Afrit was always useful. Put the man of pure science in possession of Aladdin's lamp, and the genii will be employed in the production of toys and the search for rarities only valuable because they are rare, and losing their worth in the moment of discovery simply because they are discovered.

It is difficult to say all that we feel tempted to say concerning the modern doctrine of the perfection of pure science without using names. We are sorely tempted to draw a contrast between the career of Sir W. Siemens and that of several other men held just now in high esteem simply because the world has taken them at their own valuation. "Comparisons are odious," and we must be silent; but we may at least ask our readers when they hear pure science praised, applied science condemned as an improper thing, to put this question to all whom it may concern—What has pure science really done for the world? If its value is so great, the question we suggest would almost answer itself; but there is no answer. Paraphrasing the words of a great old world authority, we say, "Science without works is dead."

EASTERN MAIL CONTRACTS.

THE notification lately appearing of the desire of the Postmaster-General to receive tenders for Eastern mail contracts reminds us that the time is approaching when the existing contract for its performance by the Peninsular and Oriental Company will close. The terms in which that notification is made afford proof of another step in advance as regards our distant communications achieved since that contract was entered into. It is observable that in addition to the services at present performed, offers are sought for a fortnightly steamer from Coal Harbour—Burrard Inlet, British Columbia—to Hong Kong, calling at Yokohama; and back from Hong Kong to Coal Harbour, calling at Yokohama. This is, of course, but an extension of the present arrangements for conveying the Japanese mails; but it is due to the completion of the Canadian Pacific Railway, as to which we but recently wrote; and the fact strongly accentuates the importance of the completion of that connecting link with our Eastern possessions, traversing as it does, throughout its entire length, British territory.

The negotiation of a fresh contract for the important work of conveying our Eastern mails naturally creates a stir in the mercantile shipping world. The period to which that at present in operation is confined, seven years only, is perhaps too short to admit of any very great advance during it in the performances of steamships; but it has at all events sufficed to further develope the desire on the part of British colonists in the countries to be served for more rapid communication than is at present afforded to them. It is on that ground that we propose to offer some remarks upon the terms of the advertisement made by the Postmaster-General. It will have been observed that those terms are of the most general character, no stipulations being laid down which are to bind intending contractors as to speed, or as to the character of the vessels to be employed. The authorities may have considered that in leaving these matters open they are likely to secure a wider range of offers than would otherwise be obtainable. Such a view may, we admit, possibly prove to be correct. But, on the other hand, we doubt much whether the absence of a stated basis upon which to tender will be conducive to a ready appreciation of the relative merits of offers which may be received. As we have said above, our colonists greatly desire that the present duration of the mail journeys should be shortened, and there is nothing in the advertisement quoted calculated to give effect to that desire. We have no doubt, from all that reaches us as to the aspirations of our colonists, that the absence of any provision to secure the boon they desire will be productive of much disappointment to them. Still, of course, it does not follow as a necessity that among the various offers to be sent in there may not be some which include an increase on the present

rate of speed; though, for reasons which we shall now proceed to give, we must say that we consider this to be extremely unlikely.

We believe we are correct in saying that the present contract with the Peninsular and Oriental Company provides for an average rate of twelve knots per hour on this side of Suez, and ten and a-half or eleven knots on the Asiatic side of that port. But the aspirations formed by our colonists are for an average as high as fourteen knots! Now it cannot be said, in view of what is at present being done by the American liners, that there is anything particularly extravagant in such aspirations. The speed asked for is practically attainable; and there can be no doubt of the advantage which would result from its establishment, while the ships that performed it could not fail to secure by far the greater bulk, if not the whole, of the passenger traffic to the East. There is, however, one insuperable difficulty presented to the accomplishment of this desire by the very nature of the present contract and of that called for. To maintain an average of fourteen knots in the high temperature of tropical waters, vessels capable of eighteen knots speed without undue pressure must be provided. We do not hesitate to say that but very few such vessels, except those performing the American mail services, are at present in existence. To comply with such a condition of speed as is desired by our colonists would therefore require the creation of an entirely new fleet of steamships to perform the service. We may well ask if for a term of only seven years of guaranteed employment any parties are likely to be found willing to go to the enormous expense of building such a fleet?

The man, or company of men, starting a new venture, always require a guarantee of seven, fourteen, and twenty-one years for the lease of the premises wherein or whereupon it is to be conducted. Without such a guarantee they will not invest any considerable capital. Under a seven years' agreement only, we are certain that for a similar reason no tenders are likely to be secured by the Postmaster-General for a rate of speed in any marked excess of that at present given. It is only in most exceptional cases—such as that of racing tea ships—that the voyages of the present mail-boats are surpassed. It may be accepted, therefore, that but few vessels are now in existence which are capable of doing this. For the reasons we have named we must conclude that the restrictions as to the duration of the contract imposed by the Postmaster-General is certain to act as a deterrent to improved enterprise, and that the wish of our colonists is not likely to be fulfilled.

In one sense, all must regret this; but in another, perhaps, we do not feel disposed to cavil at the disability created. It is certain, to our minds, that the chief elements to be desired in a mail service are regularity and punctuality. Unless those qualities are ensured to it, the whole of our commercial arrangements abroad must of necessity become disorganised. The company to which is at present entrusted the conveyance of the Eastern mails has been eminently successful in both these respects, and it should, we think, require the gravest reasons for disturbing arrangements which now work so satisfactorily. There is no probability, in our opinion, that they can be disturbed so long as so short a period as seven years is fixed as the limit of contract. The very same reasons as we have named as certain to prevent the creation of a faster fleet must operate to deter opposition to the line at present working—*i.e.*, the uncertainty attending the investment of the large capital which would be required to compete successfully with it. That capital would have to be represented by millions. Who, we submit, is likely to be found willing to invest them on a basis of seven years' contract only?

There is another side to this question, which—as we pointed out when referring to a desire of some of the Australian colonies for a change in their system of present mail service—we hold cannot be lightly disregarded. The long-established and excellent fleet of the Peninsular and Oriental Company has been of inestimable value in time of apprehended warfare. The late crisis of that character occurred at a time of great commercial depression, when hundreds of fine steamers were without employment, and consequently at the disposition of the Admiralty. This may not be the case in any other eventuality of the kind. Owners of vessels in established employment would not then be so ready as they were of late to offer their ships for emergent engagement. This consideration should make our authorities extremely careful how they risk breaking up the only certain source to which they can resort in case of such urgent need as we have quoted. It is therefore not without some degree of satisfaction that we see in the limitation of a seven years' term some assurance that present arrangements will not be subjected to any dangerous competition; but we should, nevertheless, welcome its extension to fourteen years, as offering inducement which would enable a faster service to be provided. We may be sure that the company which has done, and is doing, so much for our Eastern possessions, would not then be wanting in the competitive spirit to secure it.

PRIORITY OF INVENTION.

There are few subjects interesting to engineers concerning which more ignorance exists than priority of invention. The conditions which constitute priority of invention seem, indeed, either not to be understood at all, or they are comprehended in a dim and misty fashion eminently unsatisfactory. Any resemblance between two machines or two processes is sufficient to render them in the eyes of some men absolutely identical; while, on the other hand, it is by no means difficult to find individuals who can trace no resemblance between inventions which are doubtless the same in substance. At such times it usually happens that both parties are interested on opposite sides, and we are by no means to suppose that either is dishonest or gives way to unworthy motives. The truth is, that originality of invention is in many cases an extremely subtle thing, difficult to define; and what constitutes novelty to one man does not necessarily constitute novelty to another. Besides what may be called the faiths of experts, we have to deal with questions of law, and these still further complicate matters, because it will be found that in almost every instance when priority of invention is called in question, there are patent rights involved, and the construction to be put on a patent often raises very grave issues.

Since the Patent Act of 1884 came fairly into operation we have received a large number of letters, each and all disputing the originality of inventions. The number of these letters is augmenting, and we think it will be well to explain at once the line of action which we propose to take in dealing with them, and our reasons. The course of events is usually as follows: An illustration appears in our columns of some machine made by Messrs. A. and Co. Within two or three days we receive a letter intended for publication, and stating that precisely the same machine was invented by B. at an antecedent period, varying between half a century and three weeks. In some cases these letters are anonymous. Nothing further need be said about them. In others they are signed with a *nom de plume*, the writer's name and address being supplied to us in confidence. In a very few cases the writer has the courage of his opinions, and gives his name and address to the world. We now beg to state very plainly that only under most exceptional circumstances will we give publicity to any correspondence of this kind, and it is a *sine qua non* that letters concerning priority of invention must appear in our pages, if at all, over the writer's name. We fancy we hear it said that by adopting this course we shall do an injustice. It is easy to prove that this is not the case, but that, on the contrary, the publishing of letters impeaching the originality of inventions and the validity of patents may do grievous injustice and much harm.

We began this article with a statement concerning the prevalence of ignorance concerning priority of invention. It is this ignorance which renders it necessary to adopt the course we take, and decline to publish correspondence on the subject. A. invents a pump, let us say, which he patents and puts into the market. The pump is a success. There is a demand for it. The patentee has spent much time, and thought, and money over it. He receives a moderate reward, and he deserves it. The pump is illustrated in our pages. It is made known to thousands of persons who never heard of it before. Then B. writes to say that it is not a new pump at all, and that, of course, by implication, the patent is worthless, so that anyone can make it. If B. is pressed a little with such a pertinent question as why the original (?) inventor did not make a success of it, he will in ninety-nine cases out of a hundred explain that the first man could not make it succeed because of a trifling detail. We are perfectly familiar with this class of statement. Here B. shows his entire ignorance not only of law but of justice. The little improvement in detail makes A.'s pump novel and his patent valid, because it makes the pump a success. The apparent insignificance of a modification is no test at all of its value—that is, in all cases measured both in law and in fact by the results which follow from its adoption. In many cases, however, B. is entirely ignorant that any modification at all has been made. He regards the two machines as identical, and fails altogether to see that there must be some reason why one failed and the other succeeded. It is clear that in either case an injustice might be done to A. by the circulation of B.'s statements. He might find himself called upon to sue rival pump-makers for infringements, the rivals being encouraged to infringe B.'s letter. Again, very often letters of this kind are written, or procured to be written, by rival manufacturers. It is a noteworthy fact too that those who are most prone to dispute the validity of patents in our pages, ostensibly for the public good, would not write a line on the subject if it cost them anything. We never find that men of this type resort to the advertising columns of this or any other journal to make the iniquity of the anticipated patentee known. Let us further assume that B.'s charge against A. is perfectly true, and that he has patented in ignorance an old idea. Does he not deserve some reward for his energy and expenditure of capital? In making an old failure a success, does he injure anyone by the possession of a patent? We think there can be but one answer to this. If A. demands royalties to which he is not entitled, then the law is open to the aggrieved party; a dispute on such a point certainly cannot be settled in the pages of The Engineer.

A remarkable instance of how much can be said for and against the novelty of an invention is supplied by the case of Otto *v.* Steel. This is one of the most important patent actions ever tried, and we make no apology to our readers for placing a very full report of the proceedings before our readers. Obviously we can say nothing while the case is pending concerning its merits, but we may point out that nothing would be easier than for some of our correspondents to write to us to say that Otto's invention is not new. When such statement comes to be sifted and tested by competent judges and lawyers and expert witnesses, it is found that things are not so simple as they appear to be to the superficial observer. The essence of invention often lies deep—it is none the less real; and we believe that we best consult the interests of all parties when we state that while we certainly do not guarantee the novelty or the originality of any machine or process illustrated or described in our pages, we equally decline to permit our correspondence columns to be employed to impeach it. Of course, circumstances may arise under which it will be desirable in the interests of justice to depart from this rule, but such exceptions must, we think, be rare.

FOREIGN BUYERS OF VESSELS.

We have referred in The Engineer once or twice to the purchase and sale of vessels from and to foreigners, and have shown that whilst the number so bought by us is few, the sales are comparatively numerous. It may be interesting now to look at the nations which buy of us. We do not mean those vessels which are built for foreigners, but the vessels which have been owned by British owners and afterwards sold abroad. In the last month reported on as yet—October—there were sold from the registers of the United Kingdom, eight iron steamers, the tonnage of which was 2522 tons net register; one wood steamer, 29 net tons; and seven wood sailing vessels of 1846 tons net. There were others sold from the registers of our colonies, but we do not need to take these into account, because the returns from the colonies are not always concurrent. Of the eight iron steamers sold from the United Kingdom, there were two sold to Italy, both of comparatively small tonnage—224 tons net, and 342 tons respectively. Austria bought one of 149 net tons; Turkey bought a large one, 1205 tons; France, one of 473 tons; Denmark, one of 9 tons only; and Spain the last one, a 14-ton vessel. Most of them were several years old, the two sold to Italy being the latest in date. The wood steamer was built in 1883 and was sold to Spain. Of the wooden vessels we have only full particulars of four which were sold to the United States, Germany, and Norway; and one of 398 net tons, and sold to Greece. The others are simply described as being "sold foreign" without the names of the buying nations. All of them were comparatively old vessels. It would thus appear that we sell—in addition to the vessels we build for foreign nations—a certain number of old vessels abroad, and that we have thus a market for a limited number of the vessels which with us are not so usable.

ENGLISH *v.* AMERICAN RAILS.

It was stated a short time ago in the money article of the *Times* that an order for 10,000 tons of steel rails had been placed at Barrow from the United States. This statement excited some surprise, and figures were quoted to show that there must be some mistake. It was mentioned that 33 dols. was the price for steel rails in America. In this country £4 15s. was the figure fixed by the rail syndicate. Adding freight to the duty, British-made rails could not be laid down at a port in the United States under 41 dols—that is, a difference of 8 dols. per ton. Mr. J. T. Smith, formerly president of the British Iron Trade Association, in a letter to the *Times*, shows, however, that it is quite possible, under present conditions, to ship steel rails to the United States. He says that not only is it true that the Barrow Hematite Company has made a contract for 10,000 tons of rails for America, deliverable at New York, but they have got 10s. per ton more for them than the current regulation price of the Steel Rail Maker's Association. Mr. Smith adds that negotiations are now going on, which are expected to lead to further business, and points out that the Americans would not pay over 50s. per ton more for English-made rails unless they were satisfied of their superiority in respect of wear over those made in their own country. This order is of special importance at the present moment, as it bears out what has all along been contended for by English rail manufacturers, that Vanderbilt would never have placed his heavy rail contracts in this country unless he had been convinced that better value was to be obtained through the durability and superior quality of the English production.

PAVING IN LONDON PARKS.

We are pleased to see that a further endeavour is being made to render available for foot passengers the means of crossing dryshod the wide spaces of open ground which divide our metropolitan districts. The quality of gravel used for the foot-paths in and about our parks is not of the best quality, and in wet weather any attempt to cross these has to be made with the certainty of encountering a disagreeable amount of soppiness. We have observed that the asphalting of the path which skirts St. James' Park from Queen Anne's-gate to the steps at the foot of the Duke of York's column is now being undertaken. We cannot too strongly commend to our authorities the further prosecution of similar works of public convenience. There are many localities in which their continuance in so useful a work might be recommended; but we need not go far from the site of their present operations to cite a prominent instance. Why should the Horse Guards parade itself, traversed as it is daily by thousands, and affording, as it does, a very short and most convenient cut from Westminster westwards, be for ever left in the disagreeable condition we have above named? Surely military exigencies do not require that it should be so. Once a year only, perhaps, on the occasion of the trooping of the colours on the Queen's Birthday, do any number of troops assemble on it, and we cannot realise that their evolutions could in any way be interfered with by a few intersecting lines of pavement in the directions most frequented. Public convenience certainly demands priority over any such consideration, even if there really exists necessity for giving it at all.

THE COLOMBO WATERWORKS.

We notice that the important works which, since 1882, have been in hand for the supply of water to the capital of our important colony, Ceylon, now approach completion. On the 1st August last the water was turned into the main pipe leading from the source of supply at Labugama to the chief reservoir near the city at Maligakanda. It took from that date to the 29th of the following month for the water to traverse the whole length of the main, as the latter had to be carefully tested as the pressure was allowed to increase, and the pipes themselves had to be thoroughly washed out. The reservoir at Maligakanda presents many important features of construction, but these have been so fully described in the "Transactions" of the Institute of Civil Engineers that we need not here again detail them. The very low levels of the country which surrounds Colombo rendered it necessary, in order to secure the required head for distribution, to construct the reservoir almost entirely above ground level, and the character of the work this involved was particularly heavy. In a very few months the 30,000 inhabitants of Colombo will secure the distribution among them of the blessing—great in all countries, but more especially so in those of tropical climates—of an abundant supply of pure water. Hitherto they have been dependent either upon wells or on the supply available in the Colombo lake, the latter source being rendered most impure by the ablutions of crowds of not over-clean natives, and by the washing of elephants, cattle, and horses, together with that of all sorts of vehicles.

FREEZING BY COLD AIR IN TUNNELLING.

A rather remarkable and novel piece of work is at present being carried out in the construction of a tunnel at Stockholm. The tunnel passes through a hill on which are built residential houses of considerable size, the soil in many places consisting of a light wet gravel mixed with sand, not so wet as to form a really running mass, but sufficiently so to cause great anxiety in connection with the foundation of the houses above, which owing to the great depth of material, it would have been an exceedingly costly matter to underpin. Under these circumstances, the contractor, Captain Lindmark, conceived the idea of freezing the troublesome material by means of cold air, and some few months ago he visited England and purchased one of Lightfoot's patent dry cold air machines from Messrs. Siebe, Gorman, and Co. The results of the freezing method have surpassed all expectations. The machine has only been at work for a few weeks, and already with its aid two five-storey houses have been successfully passed under. We hope early next year to give a detailed account

of the construction of this tunnel, as it presents several new features which we believe will be of interest to our readers.

LITERATURE.

Egyptian Obelisks. By HENRY H. GORRINGE, Lieut.-Commander U.S. Navy. London: J. C. Nimmo. 1885. 4to., 187 pp.

THIS is a handsomely got up account of Egyptian obelisks in different countries, commencing with the history, application for, and gift of one of Cleopatra's needles to America, its removal from Alexandria to New York, and its erection in Central Park of that city. This occupies about one-third of the book, the remaining two-thirds being devoted to accounts of the London obelisk, the obelisks in Rome, Paris, and Constantinople; a record of all the Egyptian obelisks; notes on ancient methods of quarrying and transporting and erecting obelisks, and analysis, chemical and mechanical, of the granite and of materials found with the obelisks. The book is very fully illustrated with autotypes and photo engravings. The original suggestion of removal of the obelisk to New York seems to have been through Mr. John Dixon and Mr. Louis Sterne, but in the subsequent negotiations and work their names do not appear.

Both the Paris and London obelisks were transported in specially built vessels towed at no great distance from shore, but even then not without serious difficulties met with in sailing. The American needle was transported in an iron screw steamer, the Dessong, bought from the Egyptian Government for £5100. It was built up in a wooden cradle or caisson 83ft. in length, varying in width from 22ft. to 30ft. and, 11ft. deep. In this it was floated out from the sandy shore to the Government graving dock at Alexandria, and there slid into the hold of the Dessong through a hole made in her starboard bows. The needle weighs 220 tons, and the total deadweight, with needle, pedestal, coal, &c., on the Dessong was 1470 tons as she made her voyage out from Gibraltar. After leaving Alexandria stops had to be made for boiler repairs and for replacing a broken screw shaft with the spare one. The vessel reached New York 19th July, 1880; on 5th August the foundation stone was laid in Central Park, and then the obelisk, in a wooden sheathing, was removed from the ship's hold, and transported on temporary balk rails and rollers running on iron bars placed upon the balks, and forming a marine railway—channel irons and cannon balls having failed through the cutting of the channel irons into angle irons by the balls. A good part of the traverse in the Park had to be done on a high wood trestle viaduct, but this need not have been done if timber had been very dear, one part of the object of the viaduct being to bring the needle up over its position on the pedestal without having to raise it on the spot. The needle was surrounded at the height of its centre of gravity by a belt with trunnions, and by these supported on a steel A-shaped trussed frame or pier, and when over its site was simply turned so as to assume the vertical, lowered a few inches, and the work completed. The work was carried out by the author, and of it he has given an interesting account, which is enhanced by the history he gives of the needle itself. An interesting and handsomely-illustrated account of the removal of the Luxor obelisk to Paris, by M. Appolinaire Le Bas, a French naval constructor, written by Lieutenant Schroeder, of the U.S. Navy, follows the author's account of his own work. Illustrated descriptions of this operation have appeared in many places, and everyone is familiar with the method of carrying it out. The account of the removal of the fallen obelisk of Alexandria to London, by Mr. Dixon, is also written by Lieutenant Schroeder. The re-erection of the Vatican obelisk is also by him. These are all clearly written, and are instructive as well as interesting; but the book will probably be chiefly sought for, less for its engineering information than for the general accounts of the obelisks still in Egypt, and those which have found their way abroad, together with the history of some of their surroundings. The book is well got up.

Electrolysis: a Practical Treatise on Nickeling, Coppering, Gilding, Silvering, the Refinement of Metals, and Treatment of Ores by Means of Electricity. By HIPPOLYTE FONTAINE. Translated from the French by J. A. BERLY, C.E., A.S.T.E., &c. Thirty-four illustrations. E. and F. N. Spon. 1885.

OF the making of many books there is no end, and, the remainder of the quotation is well known to our readers. It would be difficult to find any other reason for the appearance of this work except bookmaking. The internal evidence shows that the author is merely a compiler and not a master of his subject, and that the translator is neither a master of the English tongue nor familiar with the subject matter of the book. When we are told in all seriousness that Mr. Urquhart is "the English author the most extensively consulted in all questions of electro-chemistry," p. 103, we feel that some decided expression of opinion is needed. The fact—if fact it be—is certainly new to the English scientific world. Nor do we suppose the practical world would accept Mr. Urquhart's dictum against that of Dr. Gore for example. Nor would Mr. Urquhart himself support a claim to the prominent position given him. Not for a moment do we wish to detract from the just claims of the gentleman mentioned—the example is taken merely to show that the author is not well acquainted with the standing of English authorities on electro-chemical and electro-metallurgical questions.

To return to the book. It contains nothing new. Part is written up to date, while part is, to say the least, more or less ancient. Comparisons are odious, but in the case of a book translated from a foreign language, wherein is expected something new or information expressed in a simple and clear manner, comparison may be made. Taking an example at random, p. 183, we find a formula for a brass bath, as follows:—Potassic carbonate, 3730 grammes; potassic cyanide, 570 grammes; zinc sulphate, 466 grammes; cupric chloride, 310 litres; water, 56 litres. Prepare separately the various solutions. Add to the zinc sulphate and to the cupric chloride a part of the dissolved carbonate; dissolve the precipitates which are formed by adding ammonia; introduce the remainder of the potassic carbonate and the cyanide, and complete with water."

Dr. Gore, in "The Art of Electro-metallurgy"—Longmans—p. 279, says:—"Take 12½ gallons of water, and dissolve in it 10 oz. of chloride of copper, 20 oz. of sulphate of zinc, 24 oz. of cyanide of potassium, and 160 oz. of carbonate of potassium; add the cyanide last."

It seems to the ordinary mind that the latter is straightforward and clear, while unless the workman knows how to set about the preparation of the former the book is not likely to assist him. Then the translator has given some of the formula as so many parts to parts, some, as the one quoted, with grammes and litres.

One extract to show the translator's Frenchified English—"Bunsen was the first who succeeded in rapidly preparing in comparatively large quantities *the* magnesium, *the* barium, *the* aluminium, and *the* calcium by means of electricity." The italics are ours, and serve to show the difference between French and English use of the article.

While the part of the book devoted to practical work, pp. 101—256, cannot be credited with information other than can be obtained in several English works, the introductory 100 pages contain some information both useful and interesting. Chapters II. and III. are worthy of careful study, as is also part of Chapter VII.

One remark on the preliminary notions, and we have done. It is one upon which Mr. Sprague expresses strong opinions. What is an ampère, and what is a volt? The question seems an absurd one, and yet we doubt if anyone will be bold enough to answer it. When the question is definitely answered it will be time enough to ask, Upon what units were the data given in the value—Chapter IV.—obtained? Certainly not from the ridiculous "legal" ohm of the Paris conference. As a matter of fact, we are taking these units something after the manner in which boys open their mouths and shut their eyes to splutter over whatsoever the comrade pushes into the gaping orifice.

WALTER FLIGHT.

WE announce with sincere regret the death of a valued contributor to our pages. Walter Flight was the son of William P. Flight, of Winchester, in which city he was born, on January 21st, 1841. He was sent after a period of pupilage at home, to Queenwood College, Hampshire, in the days when George Edmonson was head master and Tyndall and Debus were the teachers of science. From Queenwood he went to the University of Halle, where, in the laboratory of Professor Heintz, he pursued his chemical studies during the winter session of 1863-64. During 1864 and 1865 he entered the University of Heidelberg, where in the laboratories of the celebrated Professors Bunsen, Kopp, and Kirchhoff, he applied himself early to acquire that thorough knowledge of the various branches of theoretical and practical chemistry, and that marked facility for overcoming experimental difficulties which characterise the practised and careful worker. From Heidelberg Flight passed to the University of Berlin, where he remained until 1867, studying and working in Professor Hofmann's laboratory, and for a time filling the office of his Secretary and Chemical Assistant.

Returning to England in 1867, he graduated D.Sc. in the University of London, and in the following year was appointed by the senate to the office of Assistant Examiner under Professor Debus—his former teacher at Queenwood. On September 5th, 1867, Dr. Flight was appointed an assistant in the Mineralogical Department of the British Museum. Here under the direction of Professor Maskelyne, the keeper of Mineralogy, he commenced a series of researches into the chemical composition of the mineral constituents of meteorites and the occluded gases they contain. Many of the methods by which he carried out these investigations were originated by him in the course of the research, and displayed in a remarkable degree his skill and ingenuity in chemical manipulation.

He was shortly after this date appointed examiner in chemistry and physics at the Royal Military Academy, Woolwich, and in 1876 examiner to the Royal Military Academy, Cheltenham. For several years Dr. Flight served on the Luminous Meteors Committee of the British Association, to which he lent much valuable assistance.

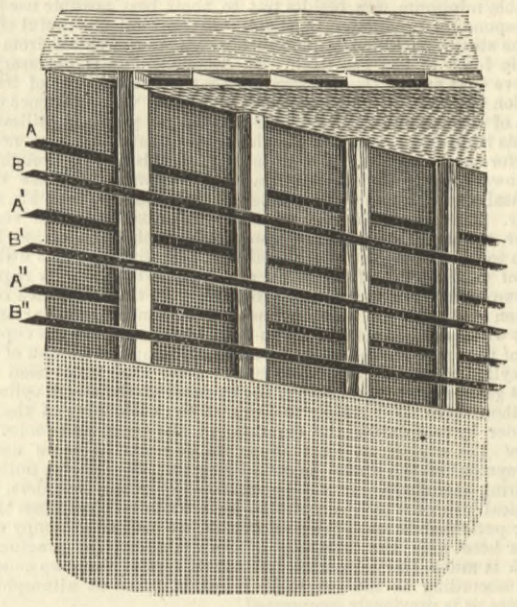
Between the years 1864 and 1883 he was author of twenty-one original papers, including "A Chapter in the History of Meteorites," which appeared in a succession of twenty-three articles in the *Geological Magazine* in 1875, 1882, and 1883. He was also joint author or contributor of results to many other papers, chiefly on the chemical composition of minerals. His important memoir on the Cranbourne, Rowton, and Middlesbrough meteorites was read before the Royal Society in 1882, and he was elected a Fellow in the following year.

In 1884 he was seized by illness which prostrated his mental powers, and rendered it needful for him to resign his appointment in the British Museum in June last, and notwithstanding every care which medical skill or affection of friends could devise, he succumbed on November 4th, leaving a wife and three young children to deplore his early loss.

FIREPROOF CEILINGS AND PARTITION WALLS.

SOME time back we noticed the introduction of wire netting as a foundation for ceilings in the place of the ordinary wood laths. Since then a further development of this invention for fireproof construction has been introduced by Messrs. Richard Johnson, Clapham, and Morris, of Manchester, in what is known as Johnson's patent rolled wire lathing with iron backing, and the special advantages of this lathing as a foundation for fireproof plastering either for ceilings or partition walls were subjected to a very severe test, with very successful results, at Manchester on Tuesday, in the presence of a large number of architects, builders, insurance officers, and others. Two huts 8ft. by 4ft. and 7ft. 6in. high had been erected, alike in every respect except the lathing, the ceiling and sides of one being plastered on wood laths in the ordinary way, while in the other Johnson's patent wire lathing was the surface for the plaster.

The back of the wood lathing hut was constructed to represent one of Johnson's fireproof partition walls constructed solely of iron with rolled wire lathing. The huts were filled with shavings and dried wood in equal quantities, and upon these in each case half a gallon of benzine spirits was poured. These were fired simultaneously under the superintendence of Mr. Tozer, the superintendent of the City Fire Brigade. In eight minutes the fire began to show through the sides of the hut constructed of wood laths, in ten minutes it had broken completely through, in twelve minutes it had broken through the top, and in less than a quarter of an hour, if a room had been above it would have been set on fire. In the hut constructed with the patent wire lathing the fire appeared to have comparatively little or no effect, and although a second supply of fuel was thrown in, it had suffered less damage in twenty-five minutes than was shown on the wood lath hut after the burning of eight minutes. At the end of twenty-five minutes the fires were extinguished, and it was then found that while the hut built in the ordinary manner was almost entirely wrecked except the back, formed of Johnson's fireproof partition, the other hut had no external marks of injury, while internally beyond a discoloration and slight cracking of the surface of the plaster, it was also practically intact. Another advantage also demonstrated was that whilst in the wood lath hut the pouring in of the water to put out the fire resulted in the plaster giving way, it had no apparent effect whatever upon the wire-lathing plaster. The accompanying illustration shows pretty clearly the construction of the rolled wire lathing. It is formed of galvanised wire netting



rolled after manufacture to stiffen it. The netting is not stapled direct to the joists, but thin slips of iron A B half an inch wide, coated with varnish to prevent rust, are just fastened by special staples edgeways across the joists from 6in. to 9in. apart. The netting is then spread on this iron backing and stapled to the joists, from which, however, it is always separated by the width of the slip of iron A B. By this arrangement it will be seen that plaster can key under the thickest joist or beam. The fire-proof partition walls, as tested in the above trial, are intended to supersede the ordinary studded walls and brick partition walls. The wood framework of the partition is replaced by angle iron, covered with galvanised rolled wire netting instead of laths, and the whole is then plastered in both sides. The same principle, it may be added, can be applied to make a fire-proof roof.

THE THEORY OF GAS ENGINES.

IN the case now pending, Otto *v.* Steel, much importance has been attached to a paper by a French *savant*, M. Beau de Rochas, entitled "Nouvelles Recherches sur les Conditions Pratiques de plus Grande Utilisation de la Chaleur et en General de la Force Motrice." This paper was published in Paris in 1862. We give a translation of it, not only in order to make the course of events clear in the case of Otto *v.* Steel, but because it is really a very valuable contribution to the theory of heat motor engines.

6.—*Combined gas and steam motor.*—When we examine what takes place in the combustion chamber of the gas-fired boiler above described, we are struck with the enormous volume which gases raised to a high temperature attain. If the combustion, on the other hand, takes place at constant volume the dilation will be replaced by an equally considerable accession of elastic force, and the return to the original pressure by means of expansion will give precisely the same volume at the same temperature as if the heating had originally taken place under constant pressure. It is directly evident from this that in the mere fact of combustion there may be a production of power of an order of considerable greatness, and completely independent of that which would afterwards result from the formation of steam by the cooling of the burnt gases. From which we conclude that the complete utilisation of the phenomena of combustion requires that we should at the same time profit by the elastic force which gases can directly acquire from combustion at constant volume, and the elastic force which they can subsequently communicate to steam by giving up to it their dilating heat, a heat which is identically the same as if they had been heated without producing an excess of elastic force over the surrounding pressures. This complete utilisation would have been manifestly impracticable with the use of solid combustibles alone. It becomes infallible on their previous conversion into gases, which are themselves combustible. And such is the immense final result of the invention of gas furnaces, the priority in which belongs to Messrs. Thomas and Laurens, but in respect of which it is only fair to afford considerable recognition to the scientific labours of Messrs. Helman, in France, and Faber Dufaur, in Germany. We must henceforth, then, consider as essentially incomplete—and so consider from our knowledge of the cause—all gas engines alone and steam engines alone, and it is easy to demonstrate that the one is necessarily the normal complement of the other. The action of gases as vehicles of motive force assumes the previous starting of the motor apparatus, for precisely because gases exist already formed and cannot do work without expansion, they are incapable of setting themselves to work and can only enter as active agents into a system already in motion. It is for this reason there have never been and there never will be gas engines, whatever their principle, which can be applied to cases in which the starting requires more or less powerful or rapid effort without the simultaneous concurrence of some external force. Gas engines pure and simple are, therefore, essentially engines of small powers. Steam engines, on the contrary, are capable of the most powerful direct action, but at the price of an excessive expenditure of heat. That is, in effect, how M. Regnault expresses himself on this point—*Comptes Rendus*, 18th April, 1853:—"In air motors—allowance being made for exterior losses and for mechanical obstacles which may present themselves in practice—all the heat expended is utilised for working power, while in the best steam engine the heat utilised in mechanical labour is not the twentieth part of the heat expended, and it is even much less in most cases." This normal inferiority of return is a certain sign that steam alone cannot be a truly economical agent for the transmission of work, but the very mechanism of its formation makes it the indispensable starting agent. Such, then, is the proper use of steam, to be, if not the preponderating expansive power, at least the finger always ready to press the

trigger. This proposition may appear in contradiction to certain facts which would tend to establish that it is difficult to obtain from gases a great power of expansion. The permanent gases appear in fact perhaps even more sensible than vapours to the various causes of loss of heat. But we must distinguish between normal losses and accidental losses, notably by dispersion. Permanent gases ought to be considered as vapours infinitely below their point of saturation, and it is impossible that they can restore in any case one particle of their specific heat, and it follows from this they ought in working to cool at a much greater rate than vapours. But it is of little importance whether the curve of pressure falls more or less rapidly on expansion if the useful effect is in the end more considerable. As for the accidental losses, if in combining the gas engine with the steam engine we arrange things in such a way that these losses are turned more especially to the profit of steam raising itself, we have realised the maximum practical effect, for even if gases are really difficult to handle, it is chiefly by reason of their great dispersive power, and if the losses accruing under this head, already supposed as reduced to their possible minimum, are besides put to their best possible use in a corresponding production of steam, we have all the useful effect of the steam, as hitherto, plus that which we can obtain from the elastic force of the gas itself. In conclusion, it is necessary to observe that among the necessary and rational conditions of transmission of force, the first appears to be the very existence of a mass of superabundant heat, and the limit of practical utilisation of this is manifestly arrived at when the quantity of heat necessary for the formation and maintenance of this mass is brought to its lowest point by disposing in their rational order the only physical agents which we can generally use, namely, fuel, air, and water. This is the leading idea of the mixed gas and steam motor, a natural consequence also of the application of gas furnaces to the heating of steam boilers. The simultaneous utilisation of the expansive force of gas and steam will generally require the employment of two sets of cylinders, viz., those in which combustion is effected and steam cylinders. The most simple arrangement will consist in making the in-draught of gas from the cupola, and of the fresh air necessary for combustion by the suction of the gas cylinder itself, and in forcing out after their expansion the burnt gases in the steam boiler, the exhaust of the steam cylinder will then serve most readily to diminish the cushioning of the gas cylinder by facilitating the expulsion of the burnt and cooled air out of the engine, at least unless we can find a more useful employment of the steam in condensing it. There being nothing requiring modification in the arrangement of steam cylinders, the practical use of which appears to have followed close upon their being perfected in each particular case, we will only occupy ourselves here with the designing of gas cylinders, the practice in which is much less advanced. We shall distinguish two general cases according as the gas to be burnt is taken at atmospheric pressure or is previously compressed.

A.—*Arrangement without previous compression.*—Combustible gas and fresh air are drawn in during a portion only of the stroke of the pistons of the gas cylinders. These cylinders thus perform the function of suction bellows by drawing in air for the supply of the cupola. Taps and valves regulate the access and proportions of the two descriptions of gas. The mixture is effected at low temperature, in conduits arranged for that purpose, and ignition is produced by known processes. The volumes of the gas and steam cylinders are arranged in accordance with the expenditure of the two fluids. Nevertheless, the steam cylinders ought to be of themselves powerful enough to start the whole machine. It could then be arranged, according to circumstances, that the steam throttle valve might be entirely opened for the purpose of starting, and normally more or less closed during working. The high temperature produced in the gas cylinder by direct combustion would be a cause of speedy destruction of the machine, if the walls were not maintained at a very low relative temperature. This low temperature would be an energetic cause of cooling in the gases, if it could not be met by other arrangements. But there will always be only a very slight drawback from direct utilisation if the heat thus dissipated gives return in producing steam. The gas cylinders, as well as their frames, will therefore be surrounded by water, and placed, by means of their exterior surfaces, in communication with the boiler in such a way as to ensure the circulation of the water and the creation of steam. The elevation of temperature, even if very great, would otherwise cause no sensible inconvenience with the walls maintained at a constant temperature. It must be understood, in fact, that the metal walls, even though we suppose them to be very thick, can always transmit the total heat furnished to them without their temperature at the point of contact with the hot air being ever able to rise to an appreciable extent above that of the boiler. The coating of air in immediate contact with the wall will always then be in instantaneous equilibrium of temperature with it. The propagation of the cooling through the gaseous mass will otherwise always proceed in accordance with the laws of dispersion—that is to say, in proportion to time and to distance. An analogous action takes place in the piston faces, in the castings in front, and in the piston-rod, for these surfaces incessantly exchange radiated heat, and cannot therefore differ sensibly in temperature. The temperature of the gaseous mass, for a given position of the piston, will be highest then in those parts furthest from the cool walls. It will at first only vary slowly, and will only commence to fall really suddenly at a small distance from the same walls. The conditions of procedure then will not be sensibly different in gas and steam cylinders; there will be nothing to change essentially in the pistons, stuffing-boxes, &c., the lubrication of which can be effected by ordinary processes. The work produced being in proportion to the pressure produced by the combustion, it is desirable to preserve the highest possible value of this factor, for we can always regulate the strength of the machine accordingly. Besides, it is the special advantage of gas engines that they admit, without danger, of pressures in the cylinders in which combustion takes place which would be unattainable in a steam boiler. Now, we attach in practice a greater and greater value to increase of pressure, and with reason, for in pressure alone lies not only the cause of motion, but, above all things, the utilisation of force. Pressure being in inverse ratio to the temperature before ignition, it is important that the gas from the cupola should be, as far as possible, cooled before its entry into the cylinder. With this object the boiler will be furnished with two systems of tubes, one on the side of the cupola, the other on the side of the exhaust, in such a way as to form two interior compartments, separated at least by a partition impermeable to air. The fire-proof jacket of the interior cylinder will be done away with as useless in the case in question. Consequently, the combustible gas will be drawn from the first compartment, after having traversed the tubes in it, and being brought to the temperature of steam or thereabouts. The burnt gases will be driven into the second compartment, and discharged by the chimney after being equally cooled. The condition of things of which we are treating requires that the steam should be of the lowest pressure possible. It must not descend, however, below the point at which the temperature will be insufficient to cause the precipitation of the calcareous salts in the purifying apparatus, which is in this case absolutely indispensable. The pressure in the boiler, therefore, should never exceed six or seven atmospheres.* The pressure is, moreover, proportional to the temperature of combustion. This temperature will be highest when we only admit the amount of fresh air absolutely necessary for combustion. It is to these particular conditions of air supply that the maximum effect of the engine will evidently correspond. The effect will diminish in proportion as, in accordance with the work required, we admit a greater or less excess of air, or, what comes to the same thing, we more or less close the regulator of the cupola. But even in the case in which the duty of the engine is smallest, it is still desirable to work with the maximum useful effect. Now, for a combustion temperature corresponding to a given proportion of combustible gas, and consequently to a known pressure after combustion, there is a certain length of suction—we should say "inlet" in case of a steam cylinder—for which the work developed in the cylinder is a maximum. The variation in amount of suction answering in each case to the maximum of work, being confined within narrow limits, the use of a slide will perfectly suffice to obtain the greatest variation in the yield of combustible gas. The arrangement, therefore, of the gas cylinders in the case in question can be made in the simplest manner with a common slide valve, modifying, it is always understood, the forward and backward movements of it, to meet this particular requirement.

B.—Arrangement with previous compression —The arrangement before described appears certainly the simplest that could exist. It will perhaps be the only one applicable to locomotives. Then the increase of utilised power resulting from it will certainly be clear gain and without any doubt out of proportion to the cost of setting up. But the true conditions of the best employment of the elastic force of gases, at least its most important conditions, are not there observed, and simplicity is perhaps only acquired at the expense of utility. These conditions, in fact, are four in number—(1) the greatest possible cylinder space with the least possible exterior surface; (2) the greatest possible quickness of action; (3) the greatest possible expansion; and (4) the greatest possible pressure at the commencement of the expansion. The dispersive power of gases, so favourable to the use of boiler tubes, is evidently, on the contrary, an obstacle to the utilisation of elastic force developed in the gaseous mass. Now, we have seen that in the case of boiler tubes the efficiency—that is to say, the heat transmitted—was proportional to the diameter of the tubes. The loss would, therefore, be in inverse ratio to the diameter in the case of cylinders. But that is only applicable to cylinders of very small diameter, and the loss decreases in reality in a more rapid proportion than the diameter increases. Therefore an arrangement which, for a given consumption of gas, will give cylinders of the greatest diameter will be that with which the greatest direct utilisation of heat will correspond in this respect. We equally conclude from this that, as far as possible, we must only employ one gas cylinder in each separate machine. But dispersion depends also upon time. Cooling, then, will be as much greater, other things being equal, as the working pace is slower. Now, a more rapid working pace seems to imply as a consequence cylinders of a smaller volume; but this contradiction disappears when one reflects that the length of stroke is not necessarily related in an invariable manner to the cylinder volume for a given expenditure. In like manner as for the elastic force of steam, the utilisation of the elastic force of gases requires that the expansion should be the most prolonged possible. In the arrangement above described there is a maximum of expansion for each particular case. Thus the effect is necessarily limited. The advantage, therefore, rests with an arrangement which will permit of giving back to the machine that which we may call the free play of the expansion, that is to say, the power of expanding so far as we may think it convenient within the limits only imposed by the nature of things. Finally, the utilisation of the elastic force of gases still depends on one element which is entirely their own, but which is at bottom intimately connected with the utility of prolonged expansion. This element is compression, which should be the greatest possible for the greatest effect. It can be easily seen that we are dealing here with heated expansion obtained after cold compression, which is a way of prolonging the expansion in some sort inverse to that which consists in causing a vacuum, a way to which steam could not adapt itself, it being always understood that all compression causes inevitably an equivalent condensation in such a way that, even supposing steam to be combustible, instantaneous heating would be rendered impossible by reason of it. We can therefore theoretically get as indefinite a utilisation of the elastic force of gases by compressing them indefinitely before heating, as we can get an indefinite utilisation of the elastic force of steam by indefinitely prolonging expansion. But practically we soon attain an impassable limit. It is that at which the raising of temperature due to previous compression brings about spontaneous ignition. In fact, in their continuing compression we shall only recover from the expansion up to this same point the work furnished by compression, less the loss occasioned by all useless action. There, then, is the limit imposed by the nature of things, and the final advantage in respect of utilisation will rest with an arrangement which will permit of its attainment. The question being thus propounded, the sole arrangement really practicable consists evidently in forthwith employing but one cylinder, so that it is the largest possible, and further in reducing the resisting movements of the gases to their absolute minimum. Then, and for the same side of the cylinder, we are naturally led to execute the following operations, in a period of four consecutive strokes:—(1) Suction during an entire stroke of the piston; (2) compression during the following stroke; (3) ignition at the dead point and expansion during the third stroke; (4) forcing out of the burnt gases from the cylinder on the fourth and last return stroke. The same operations being reproduced on the other side of the cylinder in a similar number of strokes of the piston, there results a particular sort of single-acting machine, we might say of *half power*, but which evidently satisfies the condition of largest possible cylinder, and at the same time that condition, which is still more important, of previous compression. We see at the same time that the velocity of the piston is the greatest possible in relation to the diameter, since we do in a single stroke the work for which we should otherwise take two, and we evidently cannot do more. The temperature of the gas coming from the cupola is appreciably constant. That of the external air relatively varies only between narrow limits. Then the initial temperature of the mixture at the moment of the suction into the cylinder will also be appreciably constant. It will therefore be possible to determine the limit of compression at which ignition would become inevitable, and to arrange the machine accordingly. We shall thus constantly have the absolute maximum effect for each proportion of combustible material. We shall at the same time be freed from the intervention of electricity, for, the starting being effected by the action of the steam, the gases need never be introduced until the speed shall have become sufficient for ignition to be produced with certainty. In all cases compression will favour instantaneous ignition by helping complete mixture, and in raising the temperature. In fine, and with an initial temperature corresponding to a pressure of five to six atmospheres in the boiler, ignition will be spontaneously produced with a degree of compression reaching to about a fourth of the original volume—at least, if we neglect the effect of dispersion. Then the pressure after ignition would attain barely thirty atmospheres, and as we are dealing here with the case in which combustion is effected without excess of air, the pressure would necessarily be lower in all other cases. It is therefore probable that in many cases we can really attain the absolute limit of utilisation. To sum up, while manifestly lending itself, in the completest possible manner, to the utilisation of elastic force developed in the gaseous mass by combustion under constant volume, the arrangement now in question is not less simple than the preceding one—at least, unless we consider as a complication the necessity, or rather the convenience, of employing in some cases distribution by clack valves. This distribution is generally the most advantageous, and there is nothing to prove that it is not generally applicable even to locomotives, and, above all, to the case in question.

* Here there is, however, a question of maximum for the total work of the gases and of the steam which we can only indicate in passing.

GOODS ENGINE, INDIAN STATE RAILWAYS.

A short time since, the Indian State Railways invited tenders for some heavy locomotives, built to designs, illustrated on page 436. The specification was of the usual character. They are six-coupled tender engines, with 18in. cylinders, 26in. stroke, and 4ft. 3in. wheels. The tractive pressure is 165 lb. per pound of average cylinder pressure.

LETTERS TO THE EDITOR.

[*We do not hold ourselves responsible for the opinions of our Correspondents.*]

DR. LODGE'S MECHANICS.

Sir,—Mr. Muir's courteous and intelligible letter scarcely demands a reply from me. Indeed, seeing that he plainly tells me that I am a liar, many of your readers will no doubt feel some surprise that I reply at all. As, however, it is important that a good definition of inertia should take the place of the foggy and unsatisfactory definitions which now obtain, I take the opportunity given me by Mr. Muir and quote Dr. Lodge's own words from the last volume of The Engineer, page 380, middle column. "'Φ. Π.' goes on to illustrate inertia as the *capacity of a body for motion*"—the italics are Dr. Lodge's—"Yes. That is a very good way of putting it; inertia is the ratio of Force to acceleration produced by it, and is thus somewhat analogous to what is called capacity in heat and electricity. I am obliged to him for the idea." This is, I think, at once precise and conclusive.

It is evident either (1) that Mr. Muir does not know what Dr. Lodge has written, or (2) that knowing it, he wilfully makes misstatements concerning it. This is a dilemma. He can have his choice of horns.

He has evidently not read much about dynamics or he would know that the definition of momentum is "Quantity of Motion." We cannot suppose that there is a quantity of motion in a mass of matter without assuming at the same time that the mass of matter can contain it, has capacity for it in fact. My definition of inertia is a corollary to the generally accepted definition of momentum.

Mr. Muir could just now employ his time better in reading than in writing. Occupation of this kind would keep him from inditing such statements as those he has made concerning attraction, in which no one with the smallest pretension to scientific education believes. To Mr. Muir is, however, due the credit of an entirely novel proposition, viz., that motion may become distance, which is equivalent to stating that the temperature of boiling water is the distance from the earth to Neptune. Mr. Muir must not be surprised if I decline to take any further notice of his letter.

London, November 23rd. Φ. Π.

Sir,—Notwithstanding "Φ. Π.'s" contemptuous opinion of my knowledge of the fundamental truths of physical science, I feel sure he will answer with the explicitness and candour becoming a true philosopher the few questions which I still venture to ask him:—(1). What is Dr. Lodge's definition of motion?

(2). How does "Φ. Π." ascertain the mass of a body when he is making numerical evaluations of formulæ which involve the value of the mass?

(3). Which of his statements about acceleration is true? They cannot both be. (*a*) The acceleration produced in a given time by a given cause will vary directly as the mass of the thing accelerated. (*b*) If we double our mass it will take just twice as long, or twice as much force to double its velocity as it did before.

(4). How does he reconcile the two contradictory statements about inertia? (*c*) Inertia is in no sense or way affected by the weight; it varies directly as the mass of the bodies. (*d*) Inertia is simply the reciprocal of momentum.

November 26th. W. Donaldson.

TRADES UNIONS AND PIECE-WORK.

Sir,—The letter from "A Young Fitter," published in your last issue, calls for some reply. Your correspondent is in error in supposing that the eminent firm he mentions is an exception among engineer employers in dealing fairly and honestly with its workmen. I feel confident that no respectable firms would sanction the proceedings he mentions. If they did, there are only too many solicitors who would take the men's case up, and obtain the money due to them. I have sometimes found that men, after receiving their balance on piece-work, were dissatisfied, and believed they had not been fully paid up; but I have always found that this idea was based on an imperfect knowledge of the elementary rules of arithmetic. Large fortunes have no doubt been made in the past be manufacturing engineers equally so with other trades and professions; and even now large incomes are still made by a favoured few. Surely this is an advantage to the working class, as it encourages capital to embark in the trade, and therefore gives employment to more workmen. If the objects of the Trades Unions are to compel the masters to carry on their business without a fair profit, then their success would soon make both masters and young fitters as extinct species as the Dodo. For every firm who have made a fortune by engineering it would be easy to mention double the number who have lost their whole capital. Very many firms are now carrying on business without profit, and even in some cases at a loss, the workmen being the only class to derive any benefit by their doing so.

The argument that day-work employs more men than piece-work would be quite satisfactory if the amount of work to be obtained was constant, and if we had not to compete at a great disadvantage with foreign nations paying far lower rates of wages. My grievance with the Trades Unions is, that just at the present time, when every reduction in cost price is so valuable to the employer as a means of pushing his wares, they take this inopportune period to throw increased difficulties in the way of cheapening production by putting their veto on the increased use of the piece-work system. Seventeen years' experience of mechanics convinces me that "A Young Fitter" libels his class. I have found them to be, as a rule, quite the opposite to what he states them to be. I know scores of cases where mechanics have saved money on piece-work, and either set up as masters themselves, or invested their money in some other trade or business. They could not have done this on their ordinary rate of wages Some of our most respected and successful engineer employers have risen from the ranks. Surely it is an advantage to all good and steady workmen to have such opportunities of improving their position. The Trades Unions are at present managed for the benefit of the worthless workmen at the expense of the good. The latter can almost always obtain employment, and seldom sponge on the Club funds. We call ourselves a Free Trade nation, but how can we deserve the title when some of the most powerful societies in the kingdom prevent thousands of workmen from entering into contracts for doing work by the piece? If "A Young Fitter" is a smart workman, will leave his Union, and take piece-work, the summit of his ambition may yet be gratified by his name appearing at some future date in the "Wills and Bequests" column of the *Illustrated London News*.

London, November 25th. A London Master.

LOCOMOTIVES FOR NEW SOUTH WALES.

Sir,—I notice in your last week's issue the question about the twelve locomotives for New South Wales. I guess the reason why they are advertised in America is because the engineer of the railway is an American. Our colonials seem to prefer Americans and American articles. I understand from a friend just returned from Australia that this gentleman was recently on the New Zealand Railways, where such a fuss has been made about the locomotives from America, which you illustrate in this week's issue. I cannot see anything about them to crack about; but for the bogie, chimney, and wood house, I could fancy I saw the old six-wheel coupled Bury locomotive of my youth, with bar frame, cast iron wheels, and no platform; it is a scarecrow-looking engine, that an English engine will very soon run into a cocked hat.

From illustrations I have seen in your paper I should think they are designs of engines that the Baldwin Works have always on hand, or a good many parts of them. No wonder if, when the Americans gained the appointment on the New Zealand Railways in the first instance, he would introduce that style; consequently, it would be an easy matter for the Baldwin Works to supply those engines in the time stated, as, if they had no parts in progress, they would have all drawings, patterns, and templates to hand.

With the competition in the home and colonial markets John Bull is having, or rather not having, a lively time of it; in fact, I shall soon fancy he is about played out, and he had better form an alliance with America and Germany, unless the new Parliament will take some steps to secure our trade and appointments to our countrymen, or else relieve us of some of the heavy taxation and other penalties we have to carry in the race for trade with the before-mentioned competitors. We are continually having it dinned into us about imitating others in technical education, &c., to the better compete against these well-educated countries; but my dull brain cannot comprehend why these educated people stick to protection, while John Bull in his ignorance has adopted the advanced and enlightened principles of free trade.

November 28th. BRITISHER.

ROLLER MILLING.

SIR,—I notice on page 395 of your last issue amongst the "Miscellanea," a note on flour milling, which note, based no doubt on particulars supplied by Mr. Carter himself, would convey to any unprejudiced mind (1) that Mr. Carter built the first complete roller mill in this country; (2) that the most considerable number of roller mills in the North of England and possibly elsewhere have been built by Mr. Carter. Now, the facts are:—(1) That the first complete roller mill plant without the use of millstones, both in England and Ireland, was built by me. (2) By far the largest number of complete roller mills constructed in this country by any milling engineer, including also the largest and most important roller mills for single firms, have been built by me.

The number of mills erected by me and working on my system in England, Scotland, and Ireland is now about 150. The number of mills now in the hands of either my millers, erectors, or engineers in England, Scotland, and Ireland alone, *i.e.*, mills not yet finally delivered over to their owners as finished, and mill plants on order, is nineteen, as per enclosed list. This list contains amongst others the third order for Mr. Seth Taylor, the largest London miller, for his St. Saviour's mill, which was recently burnt down. When this plant is finished Mr. Taylor will have a productive power of at least 100 sacks, of 280 lb. each, of flour per hour, *i.e.*, as my mills are worked 144 hours per week, the consuming power of Mr. Taylor's mills will be 2500 tons of wheat per week.

In the single city of Liverpool alone more than one million sacks of flour are made by my machinery in nine or ten different plants. In the towns of Leeds and York I have put up about half-a-dozen mills in each; and the same in Glasgow, Belfast, &c. In the face of these circumstances, I venture to think that the note in question ought in fairness to have been differently worded, and I, therefore, request you to be good enough to insert this correction in your next issue. HENRY SIMON, M.I.M.E.

20, Mount-street, Manchester,
November 26th.

TECHNICAL EDUCATION AND ITS PROFESSORS.

SIR,—Your correspondent "G." in your last issue, attaches no value to the combined study of practice and theory in engineering. No doubt many of your readers have in their experience met with designs of all kinds of engineering work which appeared to be perfect to the designer on paper. When the drawings have been put into the workshop they have been found to be impracticable, or costing too much; practical engineers have ridiculed simple theory; castings are designed in such a manner as to be very difficult to produce, and on which only the best skilled labour can be applied. Forgings are made of such intricate form, unnecessarily, as to be very costly to make. If simple theory only were studied as "G." suggests, public and private work would be saddled with costly incompetence; besides which, all good theory must progress with constant attention to practice.

Of course, if professors neglect their students there is just cause for indignation, but there is no reason whatever why this subject should be introduced by your correspondent, when he assails the accepted method of acquiring engineering skill, because the complaint is clearly attributable to personal neglect.

H. KEMRETH AUSTIN.

Saltley, Birmingham, November 24th.

ROLLED GIRDERS.

SIR,—In your review of the "Iron and Coal Trades—Wales and Adjoining Counties," in your issue of the 13th inst., after expressing a lament of the ironmasters as to the longevity of steel rails, and the desirability of finding some fresh field for the employment of steel, you remark, "The query is, to what purpose can steel be applied?" and notice a suggestion from one of your correspondents as to its use in pit props. Why do not our ironmasters in these dull times apply themselves to the manufacture of steel rolled joists with unequal flanges, and endeavour to divert to their own works the large orders which are sent to Belgium for the unscientific sections—equal flanged—so extensively used in this country. There are, no doubt, sound reasons why they have not before gone in for the manufacture of rolled joists in competition with the Belgian and French works, but as there is great room for improvement in the sections now made, and as times are so bad, one would imagine so obvious a field would have been worked before this. J. J. FLETCHER.

73, Gracechurch-street, London, November 20th.

THE MINING EXHIBITION, GLASGOW.

SIR,—We notice several inaccuracies in your report of the Mining Exhibition at Glasgow in describing our installations and exhibits. In the first place there is not 6in. clearance between the armature and field magnets of the dynamo machine as you state, but only $\frac{1}{16}$in. Secondly, our stall was illuminated by thirty incandescent lamps of 20-candle power each, and not thirteen lamps varying from 28 to 100-candle power. We showed lamps of from 10 to 100-candle power of our manufacture, but these were in addition to those used for illuminating the stall. If you will kindly insert these corrections in your next issue we shall be much obliged. We write this as you will no doubt see that the mistakes arose in the hurry in giving your able correspondent the information. W. C. TEALE, Managing Director.

(For the Simplex Electric Light and Plant Company.)

Valley Mill, Eccles, Manchester, Nov. 24th.

STEEL PLATES IN THE NORTH OF ENGLAND.

SIR,—The account of excentric behaviour of steel keel-plates being used in a north-east coast shipyard, and made in a well-known company's works, is apt to create misunderstanding in the minds of people not intimately acquainted with the various processes of steel manufacture.

The mysterious cracking referred to has not been experienced by the makers of ship steel by the Siemens process, and thousands upon thousands of tons have been supplied. But uncertainty of behaviour and want of uniformity of quality are characteristics of steel manufactured by the Bessemer or basic processes.

Is it not possible that slabs made by either of these methods may have got mixed with Siemens plates? STEEL.

December 2nd.

EFFICIENCY OF TURBINES.

SIR,—I regret to find that Professor Smith refuses to give straightforward answers to my questions. Was not his object in writing the papers to enlighten the public? In my previous letter I pointed out that Professor Smith had given two totally different definitions of the meaning of the letter *m*. Has he no explanation to give?

Whether Professor Smith's silence is or is not to be taken as an affirmative answer to my questions, anyone who cares to study the equations referred to will see that the answer must be in the affirmative, and must draw his own conclusions.

Professor Smith affirms that much more than 78 per cent. of the net head in the guide blade chamber can be utilised. Has he arrived at this conclusion by working out his own equations? If so, I am sure your readers would like to see the details of the numerical calculations. W. DONALDSON.

November 26th.

AMERICAN NOTES.

(From our own Correspondent.)

NEW YORK, November 21st.

THE week's business in the heavier industries shows a full volume, in the light industries a restricted volume, in wholesale and manufacturing circles. In retail channels a gratifying distribution is maintained according to the evidence furnished by agents, jobbers, and branch houses in the West and South. This improved feeling has given an impulse in manufacturing circles in the New England and Middle States. In the Western States less general activity is noted, as the effects of the addition of new capital in circulation has not yet penetrated that far.

The statements of improving activity next year are based on such facts as these. The railroad managers are in closer unity than for two years, and additions to mileage are announced. The volume of idle money is declining, and scores of new projects calling for much money are to be pushed. A great deal of machinery, rolling stock, locomotive capacity, &c., has worn out, and replacement has now begun on a large scale. The trans-Mississippi region has received a large new population, and markets are developing. The extensive investments of manufacturing and railroad capital in the Southern States have created valuable and permanent markets there, and finally the exportation of manufactured articles has reached a point where makers are much encouraged to work foreign markets through agencies more vigorously. The danger to which the healthy condition of things is most subject is the overdoing of the markets. This danger is being offset by trade combinations, and by the conservative management which has taken deep hold on all American manufacturing and railroad interests. The demand for railroad material is quite large. Four locomotive works have quite recently booked orders for some sixty engines, and car-builders are increasing their car-work engagements.

Steel and iron rods continue in good request at 41 dols. to 42 dols., and the sale of tin and terne-plates shows no falling-off. Copper is quiet and slightly weaker. Supplies are large, and new sources are to be developed. Several mining companies have been formed to develope rich mining properties within easy railroad reach of the works connecting with the city of Mexico. The mineral and fuel resources of the region lying between the South-Western border and that city are being studied by experts, in the pay of investors. Important bridge-work is now under consideration, and the capacity will probably be fully employed all winter.

The Baltimore and Ohio Railroad managers to-day refuse to acquiesce in the trunk line combination agreement, unless that road is permitted to use the Pennsylvania tracks from its present terminus to New York city.

Railroad stocks are moving in large blocks under a speculative impulse, in the hands of the leading manipulators, but the rank and file, whose well-grown fleeces are wanted, bleat quietly in the distant pasture.

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

(From our own Correspondent.)

THE progress of the elections again occupied much of the thought upon 'Change in Birmingham this—Thursday—afternoon, and in Wolverhampton yesterday. The uncertainty which at present prevails as to the ultimate balance of power is influencing pig iron makers outside this district, but who send large deliveries here, to postpone definite replies to inquiries from their representatives, made on behalf of consumers, touching the terms upon which they will accept next year's business.

Pig buyers continue their offers to purchase forward throughout the first three, six, or nine months of 1886, but the actual orders at present accepted are, on account of the reason just given, few. Consumers desire to place the contracts at current rates. All-mines are 55s. to 57s. 6d.; part-mine pigs, 40s. to 45s.; and cinder pigs, 32s. 6d. to 35s. per ton.

Outside the sheet branch the manufactured iron trade does not wear an active appearance, nor is it likely that new lines of much individual size will be received during this month. Taking the works generally, the average of employment is not more than half to two-thirds time.

The demand for thin sheets and tin-plates keeps brisk. In addition to home orders a satisfactory demand is being expressed on account of Australia, the United States, Europe, and other parts of the world, and makers regard prospects with satisfaction; £10 to £11 is quoted as the basis for working up sheets, and £11 to £12 for stamping sheets.

South Staffordshire tin-plates are said by makers this week to be worth more by from 6d. to 1s. a box compared with a month ago, the larger rise being upon charcoal qualities. Galvanising sheets keep at £6 12s. 6d. to £6 15s. for 24 gauge, and £7 12s. 6d. to £7 15s. for 27 gauge. Liverpool merchants were reported this afternoon to be hopeful of spring shipping prospects in the iron trade, and good Canadian orders are expected to be to hand in a fortnight or so.

The bar trade is tame, and hoops and boiler-plates are generally quiet, though a few of the hoop makers are doing fairly well.

The quotations of John Bagnall and Sons stand at:—Bars, 1in. to 6in., £7 10s.; 6½in. to 9in. flat bars, and 3½in. to 4in. round bars, £8; 4½in. to 4¼in., £8 10s.; 4⅝in. and 4½in., £9; 4⅝in. and 4⅞in., £9 10s.; 4¾in. and 5in., £10. As to rounds only, the large sizes are:—5⅛in. and 5¼in., £10 10s.; 5⅜in. to 5½in., £11; 5⅝in. and 5⅞in., £11 10s.; 5¾in. and 6in., £12; 6¼in. and 6½in., £13. Hoops and angles are quoted £8, and rivet iron, £9 to £10, according to quality. Sheet quotations are:—20 g., £9; 24 g., £10 10s.; and 27 g., £12; but these quotations are hardly more than nominal. Boiler plates are £9, £10, £11, and £12, according to quality.

The whole of the extensive Swan Garden Ironworks of Messrs. John Lysaght, Wolverhampton, has been lighted up by the incandescent electric system. The apparatus has been erected by Mr. Geo. B. Wright, Wolverhampton, and the two dynamos—each of which is capable of supplying 200 lamps of 20-candle power—are made by Messrs. Elwell Parker, engineers, Wolverhampton.

Messrs. Muntz and Co. are just now experiencing a very welcome influx of orders, mainly for brazed copper sheets, for Japan, China, and India. These orders have enabled the firm to resume full time, after a quiet period rather prolonged. In seamless brass tubes for boiler purposes, Messrs. Muntz are also busy. When it is remembered that this firm employs something like 500 hands, the difference to the weekly out-turn of two-thirds time, such as has of late been made, and the full time which will now be run, will be recognised as very considerable.

Shropshire wire-rod makers quoted rolled wire rods, Nos. 0 to 5, £6 to £6 2s. 6d. per ton, Liverpool; No. 6, £6 10s.; and drawn rods, Nos. 0 to 6, about £7 10s., Liverpool; rolled rods of superior quality for local consumption were quoted £6 10s., delivered Birmingham, and drawn £7 10s. per ton. Some makers reported a better demand.

Orders in the North Staffordshire iron trade are quiet. It is not anticipated that any marked improvement will manifest itself before early spring. Meanwhile makers are active in securing all the specifications put upon the market for immediate delivery, and prices are correspondingly easy.

Messrs. R. Heath and Sons quote, delivered Liverpool or equal, flats from 1in. by 1¼in. to 6in. by 1in., and rounds and squares ½in. to 3in., £5 15s.; best, £6 5s.; and double best, £7 5s. Best grooved shoe iron from 1in., best turning bars to 3in. diameter, and angles from 1in. by 1in. by ¼in. to 9 united inches, and tees to 8in., all £6 5s.; best angle and tee iron, £6 15s.; and double best, £7 15s. Ravensdale best hoops of 1in. to 5in., £6 15s., and best waved hoops, 1½in. to 16 w.g., £7. Best rivetted iron from $\frac{15}{16}$in. is quoted £8 5s., and plates are as follows:—Bridge or tank sorts or tank sheets not thinner than 13 w.g., £7; best boiler, £7 10s.; double best, £8 10s.; and treble best, £10 10s. Messrs. Kinnersley and Co. quote crown bars, £5 10s.; angles, £6; tees, £6 5s.; and boiler-plates, £7 5s.

The South Staffordshire bridge building, girder, and roofing trades are scarcely so active as they were a little time ago. Still the works are fairly employed, and contracts are being secured for Japan, Australia, and Central America. The pipe casting trade does not show any extensive development.

The agricultural machinery set out this week in Bingley Hall, Birmingham, at the show of the Birmingham Smithfield, is not very extensive in consequence of the comparatively limited space; but it includes goods from many of the leading implement engineers the kingdom over.

Nearly every exhibitor, it is gratifying to learn, does more or less of a trade with foreign users and with the colonies, and some exhibitors do a very large export trade. More than a few are able to pay the carriage of their machines to America, and then to undersell the Americans in their own markets. One large maker, whose name is familiar to agriculturists throughout the kingdom, professed himself at the show unable to understand the complaints about foreign competition, and other makers expressed a decided opinion that we need never seriously fear the rivalry of foreigners.

Messrs. Tangye give particular prominence among their exhibits at the show of the Birmingham Smithfield this week to a sight-feed lubricator for steam engines, which so nicely regulates the supply of oil, that it is computed to effect a saving of 75 per cent. Messrs. Tangye had on view, as an example of finished workmanship, one of the engines which, with their centrifugal pump attachment, are being supplied to the Admiralty for the furnishing of torpedo boats.

Messrs. G. E. Belliss, engineers, of Birmingham, have just scored a further very gratifying success in the building of special machinery for naval purposes. They fitted in all the machinery to the large torpedo-boat catcher Swift, which, as THE ENGINEER showed last week, has just been invented and built by Messrs. White, of Cowes. The Swift has compound engines of the three-cylinder type, the high-pressure cylinder being 20in., and the two low-pressure cylinders 24in. diameter. The stroke is 18in. Great care has been taken in the design to keep weights as low as possible, having due regard to efficiency. There are two air-pumps, driven off the low-pressure crossheads, while the feed pumps are driven direct from the crank-shaft. Steam is supplied by two locomotive boilers, with the feeds so arranged as to ensure an equal supply of water to each boiler; and as the result of a recent trial, the possibility of employing two boilers with fixed draught, without difficulty either as regards feed or pumping, was clearly demonstrated.

A striking instance of the disadvantage under which our manufacturers are placed by the existing want of the most-favoured-nation treatment with Spain is mentioned concerning a recent experience of Mr. Ralph Heaton, a well-known Birmingham merchant. This gentleman had to supply a considerable quantity of brass to Spain, and he sent his order to Germany, the reason being that the import duty from Germany is £7 per ton, whereas from this country it is £14 per ton.

It is with deep regret that I have to record the untimely death of Mr. Peter Duckworth Bennett, the managing director of the Horseley Engineering Company, Tipton. Mr. Bennett, who was sixty years of age, was one of the guests on Saturday at the Mayoral luncheon given in the Council House, Birmingham, to the Prince of Wales. To obtain a view of the departure, Mr. Bennett and several others walked on to a portico overlooking the entrance to the Council House. A bandsman stepped through an unprotected glass skylight upon the portico, and in recovering his balance dragged Mr. Bennett through the glass, and he fell upon the pavement below, a distance of some 50ft. Mr. Bennett died in less than a quarter of an hour from shock to the system. The deceased gentleman, who was very highly esteemed, leaves a widow and one son. He was an acknowledged authority upon constructive engineering works, and his was the business which the Horseley Engineering Company was formed to purchase. Out of respect to his memory the works were closed on Wednesday, the day of the funeral.

Negotiations have been entered into between the London and North-Western Railway Company and the Smethwick Local Board for the purchase of land by the company to enable them to carry out further improvements. A new passenger station is to be built, and close by a bridge to carry a road over the railway is to be erected. The company has agreed to contribute £15,000, and the local board has been authorised to raise another £23,000 for the improvements.

The Dudley Corporation have decided to call in the advice of Mr. H. J. Marten, C.E., as to the best method of draining the district of Woodside.

A meeting of the Iron Trade Wages Board before the president, Alderman Owen, will be held next Thursday in Birmingham, to consider the employers' claim for a reduction.

The men employed at the Old Bury Railway Carriage Works turned out on strike on Wednesday, against a reduction in wages introduced by one of the managers. The managing director has consented to inquire into the grievance if the men resume; but they demand the manager's dismissal.

NOTES FROM LANCASHIRE.

(From our own Correspondent.)

Manchester.—Business generally, as regards both iron and coal, has during the past week continued in so unsettled a condition, owing to the political excitement of the elections, that the market has afforded no trustworthy indication as to the actual state of trade. For the moment there is little or no disposition to entertain seriously anything beyond hand-to-mouth requirements, and it is very questionable whether much will now be done until after the turn of the year. If anything, there would seem to be an indication of a stronger tone in some directions, chiefly in the steel trade, where large inquiries are reported, with a considerable weight of business offering at the present low current rates for next year's delivery, and in hematites, with here and there common pig iron also displaying a tendency towards firmness. It is, however, very doubtful whether this is based upon anything more than mere speculation. There is certainly nothing in the present state of trade to warrant the belief that consumers are getting appreciably busier, and the absence of any perceptible growth of requirements for actual consumption remains a fatal weakness, which must give a doubtful character to any apparent improvement in the market.

The Manchester iron market on Tuesday was fairly well attended, but the business doing was extremely small. For Lancashire pig iron, makers were asking a slight advance upon their late minimum rates, 39s. to 39s. 6d., less 2½, being quoted for forge and foundry qualities delivered equal to Manchester, and on the basis of these figures one or two small local sales were reported. District brands were, however, without change, one or two of the leading Lincolnshire irons being still quoted at 39s. 6d. up to 40s., less 2½, delivered here, with some brands to be got as low as 37s. 6d. to 38s., less 2½, whilst in North-country iron, although for the leading brands the recently advanced rates are still being quoted nominally, concessions of fully 6d. per ton would be readily made to secure orders.

Although there is still no great weight of actual buying going on in hematites, so far as consumers in this district are concerned, where sales are made better prices are being got, and 52s. 6d. to 53s., less 2½, is now being quoted for good foundry qualities delivered here.

The finished iron trade is no worse than it has been, but only a very dull business is still reported generally. The basis of list prices remains at £5 5s. for bars delivered into the Manchester district, and it is only in exceptional cases that much below this figure is openly quoted for anything like good brands; makers, however, are in so many cases in pressing want of immediate work to keep them going, that there is no difficulty in placing actual specifications for prompt delivery at £5 2s. 6d. per ton.

Several ironfounders complain very much of the depressed condition of trade; in heavy builders' work especially there is so little giving out that where anything is to be got, prices are cut excessively low, and cast iron columns are being quoted at £4 10s. to £4 15s. per ton delivered into Manchester. In cast iron pipes also excessively low prices are ruling; ordinary sections are to be got readily at £4 4s. per ton delivered here, and good orders would in some instances be taken as low as £4 2s. 6d.

Some of the large engineering firms in this district are not quite so badly off for work as they were, but generally there is no improvement, and complaints of extreme slackness continue prevalent in all branches.

Two important papers of interest to mining engineers were read before the members of the Manchester Geological Society at their ordinary monthly meeting on Tuesday. Mr. J. S. Burrows, of the Atherton Collieries, near Manchester, contributed the second portion of a paper on "Accidents in Mines," in which he dealt specially with accidents underground other than explosions. After pointing out that these, in the reports of the Inspector of Mines for 1883, had resulted in six times the number of deaths as compared with those caused by explosions, Mr. Burrows suggested various improved methods of working, by which he thought this large death-roll might be reduced, and summarised the following points as worthy of consideration:—(1) All material to be of the best quality, and with a large margin of strength for the work to be done. (2) The appointment of none but the steadiest and most experienced men as officers. (3) Separate travelling roads where practicable, and strict regulations to be observed in travelling any engine, brows, or jigs. (4) The systematic inspection of the mine by the workmen as provided for in general rule 30. (5) Every man, whether officer or workman, to do his duty in his own sphere, as if not only his own, but every one else's safety depended upon his care and vigilance. Mr. Burrows admitted that he did not feel as hopeful of avoiding accidents in connection with the ordinary working of a mine as he did of preventing explosions, but he maintained that there were far too many fatalities, which ought to be prevented by the exercise of foresight and prudence.

The second paper consisted of a translation by Mr. J. S. Martin, Inspector of Mines, of an important report on the effect of atmospheric changes upon the development of fire-damp which had been issued in connection with a series of experiments that are being made at the Archduke Albert's colliery, near Karwin, in Austrian Silesia. The barometrical diagrams obtained in these experiments showed that the atmospheric changes above and below ground were symmetrical, and in reference to the question of the issue of fire-damp from fresh faces, by comparing the diagrams of changes in the pressure of the atmosphere and the quantities of gas in the air the following deductions were arrived at:—(1) That the volume of fire-damp in the air generally increases or decreases as the atmospheric pressure decreases or increases respectively; (2) that the volume of fire-damp in the air depended upon the rapidity with which the barometric changes take place; (3) that the issue of fire-damp does not depend on the actual pressure of the atmosphere; (4) that where, after a rapid rise of the barometer, it continues to rise slightly, or remains stationary for some time at its maximum, a gradual increase in the volume of gas in the air will set in, or if, after a rapid fall of the barometer, it continues to fall gradually, or remains stationary at its lowest point, a decrease in the quantity of gas will become apparent—from which it will be seen that the extreme limits of the atmospheric variations are not the points indicative of the maximum or minimum evolution of gas. As the result of these experiments, it may be stated that instructions have been given at the colliery that atmospheric changes are to be watched for, and that upon the approach of a falling barometrical condition, especially of a severe one, after a high one, blasting is to be prohibited in all places that may be dangerous, and all dangerous workings are to be stopped.

A very quiet tone generally prevails throughout the coal trade of this district, and supplies of all descriptions of fuel are plentiful. Quoted prices are unchanged from last month, but here and there a disposition is shown to recede upon the full list rates, and the tone of the market is weak rather than firm.

For shipment there has been a fair trade doing in some directions, but generally a continued quieting down is reported, and prices are on a low basis.

The miners' agitation for an advance of wages has collapsed completely, and in the various Lancashire districts where the men, in accordance with the advice of the recent conference of delegates in Manchester, had sent in notices to cease work unless an advance of 10 per cent. were conceded, have this week requested the permission of their employers to withdraw these notices.

Barrow.—There is a continuance of the better tone which arose in connection with the hematite pig iron trade a week or a fortnight ago, and a brisk inquiry has been experienced both on home and foreign account, especially for Bessemer samples. Sales have been largely made, both for immediate and forward deliveries, and it is noteworthy that stocks which for many months have been large and unwieldy, have been largely reduced. The demand for ordinary qualities of hematite pig iron is not strong, but all qualities that can be utilised in steel manufacture are in request. It is observable that prices have moved upward as the demand has improved. On Wednesday this week prices were given at 44s. 6d. No. 1 Bessemer net at makers' works prompt delivery; No. 2, 44s.; No. 3, 43s. 6d.; and forge and foundry samples, 42s. to 43s. per ton. Forward deliveries, which have been more freely sold of late are quoted at 1s. per ton over these prices. Stocks are large, yet at some works and in store yards where warrants are warehoused, makers have yet found no reason to increase the output of their furnaces, as evidences of the permanent improvement of the demand have not shown themselves. It is clear, however, that steel makers will require larger deliveries of Bessemer iron during the winter months, as they have sold largely both for home and American consumption, with continental and colonial orders also requiring their attention. Rails are in fuller request, but merchant steel is still in very quiet inquiry. There are no new features in shipbuilding trade which remains quiet and without new orders. Engineers and others employed in minor trades are short of work. Iron ore 6d. per ton more money, prices now being from 9s. to 10s. 6d. per ton net at mines.

THE SHEFFIELD DISTRICT.

(From our own Correspondent.)

The foremost man of business in Sheffield has passed away by the death of Mr. George Wilson, J.P., chairman and managing director of Messrs. Charles Cammell and Co., Cyclops Steel and Ironworks, Saville-street. At the age of nine, Mr. Wilson was brought to Sheffield by the late Mr. Charles Cammell, the founder of the Cyclops Works. Mr. Cammell was in the habit of taking excursions for sporting purposes into Scotland, and while shooting in the neighbourhood of Broughty Ferry, in Fifeshire, took a fancy to the boy George, and persuaded Mr. Wilson's father to let the lad go to England with him. He was educated at the Collegiate School, Sheffield, after which Mr. Cammell took him into his own office as clerk in the iron department. There he showed such remarkable aptitude for business that he was picked out to go to America to extend the connections of the firm in those markets. This, it was anticipated, would be a work of three years, but Mr. Wilson was enabled to do it most satisfactorily in six months. On his return to Sheffield he occupied a foremost position at the Cyclops Works, and travelled over the Continent many times, and in several parts of Asia. He was a remarkably successful traveller, but his genius lay chiefly in his powers of bold initiative and forcible administration. His brother, Mr. Alexander Wilson, therefore took up the travelling, and Mr. Wilson remained at home to manage the vast concern under Mr. Cammell. On the death of Mr. Cammell in 1879, Mr. Wilson became chairman and managing director, which positions he continued to occupy until his death. In 1880, after a severe struggle with the railway companies on the question of rates, Mr. Wilson came to the conclusion that it was impossible for firms having their works inland to continue the production of steel rails for export in competition with those who had their plant at the coast. Hs brought his views before the shareholders, who endorsed his scheme, and in 1880 Messrs. Charles Cammell and Co. acquired the Dronfield Steelworks, which were noted for their rail-making plant, and the Derwent Iron Company, at Workington, thus initiating the bold policy which has since been followed by other manufacturers in transferring the heavy industries from inland towns to the seaside. This policy was severely criticised at the time, but its success has vindicated the foresight of its originator. Some time ago Mr. Wilson entered into an arrangement with the Russian Government for the production of armour plates, by which all the armour required for the Russian navy was to be manufactured, one half by Messrs. Charles Cammell and Co. at Sheffield, and the other half at Kolpino, near St. Petersburg, under Sheffield superintendence. This arrangement was adversely commented upon at the time, and has since been made an election cry against Mr. Wilson, who supported Lord Edmund Talbot, the Conservative candidate for Brightside. On the 23rd of November it was Mr. Wilson's intention to have taken the chair at Lord Edmund Talbot's meeting and to have explained how the arrangement, though it appeared unfavourable, had really been the means of bringing work to Sheffield which would not otherwise have come. An hour before the meeting he was seized with congestive apoplexy, from which he never rallied, and death took place at three o'clock last Tuesday morning. Mr. Wilson has been connected with the business of the Cyclops Works almost from its inception, and has seen it increase from a small undertaking in Furnival-street to several huge establishments with a paid-up capital of a million and a-half, and employing close upon 10,000 hands. The chief works are the Cyclops Steel and Iron Works, Sheffield, the Ordnance Tire and Spring Works, Grimsthorpe, the Yorkshire Steel Works, Penistone, the Old and New Oaks Collieries, Barnsley, and the Derwent Steel and Iron Works, Workington. Mr. Wilson, who was Master-Cutler in 1874, is survived by Mrs. Wilson, five sons, and three daughters.

I hear more confident expectations of improved trade than at any time during the year. The most favourable symptom is that the Americans are now coming into the market to buy pig iron. During this week they have been offering 45s. per ton f.o.b. at the west coast. This is an advance in quotations of 2s. to 3s. per ton. Another favourable symptom is that all the consumers may be said to be without stock, and are at present working from hand to mouth. They decline to lay in stock under the idea that quotations may rule slightly lower. The moment there is a tendency to rise they will all rush to buy, and this will bring about what the Americans call a "boom." Hematites still continue as low as ever they have been, 45s. per ton at Sheffield being a singularly weak quotation.

The close of the year will witness the end of the threatened strike in the mining districts. It is now increasingly evident that the efforts of the miners' agents to obtain a 10 per cent. advance by a general stoppage of the pits have practically collapsed. In West Yorkshire there is still some "body" about the movement, but to be successful it is necessary that the agitation should be universal, and there is now no hope of the whole of the country joining together in a Quixotic attempt to improve trade by throwing thousands upon thousands of hands idle.

THE NORTH OF ENGLAND.

(From our own Correspondent.)

Business has recently been much disturbed by the elections in progress. There was, however, a good attendance at Middlesbrough exchange on Tuesday last, and the tone was cheerful. Under the circumstances, the amount of business transacted may be pronounced satisfactory. The demand for prompt delivery is but slight, but buyers show considerable anxiety to buy forward over the first quarter and even over the second quarter of next year. For prompt delivery the price offered by purchasers for No. 3 g.m.b. is 32s. 1½d. per ton, but for forward delivery it is not less than 33s. Producers are, however, somewhat shy, as they consider their prospects better than they have been for long. Forge iron is 31s. to 31s. 3d. per ton, and makers have no difficulty in obtaining the latter figure for what they sell.

Warrants are about 33s. 3d. per ton. Holders do not care to part with them at present, in the belief that they will do better shortly.

The stock of pig iron in Messrs. Connal and Co.'s Middlesbrough store was 123,585 tons on Monday last, being equivalent to an increase of 4610 tons during the week. The total increase during November was 10,360 tons.

Pig iron shipments from Middlesbrough amounted last month only to 66,619 tons, as compared with 77,487 tons in October. The principal items were as follows:—Scotland took 30,037 tons; Wales, 5902 tons; Holland, 6490 tons; Germany, 5175 tons; France, 4520 tons; Belgium, 1890 tons; Sweden, 1530 tons; and New York, 1200 tons. The total weight of manufactured iron and steel shipped last month was 22,672 tons.

With regard to the finished iron trade there is nothing new to report. Prices remain unaltered, and although they are not now likely to be lower, only small quantities are inquired for.

The distress among the operatives in northern manufacturing towns owing to want of work is daily becoming more apparent and more extended. In Newcastle the Mayor has called a meeting to consider the best means of dealing with it. Preliminary inquiries have elicited reports to the effect that whilst the sufferers are not more numerous than at this time last year, their privations are believed to be more severe and their destitution more complete. Many cases were met with of workmen who, notwithstanding every effort to obtain employment, had yet been idle for eighteen months. In Gateshead a stone-breaking yard has been opened with good effect. The authorities there have come to the conclusion that those out of employment have at present scarcely any chance of obtaining fresh engagements. At Hartlepool the unemployed population are clamouring for the immediate commencement of the long-talked-of public works for preventing the encroachment of the sea, and it is probable that their reasonable wishes will be met. At Middlesbrough the stone-yards have been re-opened, and numbers of puddlers and others may be seen at work day by day breaking slag for road-making. Seven tons must be broken small for 10s.—a task which is sufficiently severe to prevent any keen competition for the business in case a demand for labour should spring up elsewhere.

A new kind of tube intended to act as a compression stay in the flues of boilers, besides increasing the heating surface and facilitating circulation, was some time since invented and patented by Mr. Bentley, foreman boiler-maker, of Darlington. This tube has some obvious advantages over the ordinary conical tubes, but until latterly there was a difficulty in making it. Now, however, this difficulty has been entirely surmounted, and Mr. Bentley has arranged with a leading firm to take up his invention and produce the tubes in any quantity which may be required. They vary in form according to circumstances. For a vertical heating furnace boiler they are either cruciform, having four branches, or may have three branches only. For marine boiler fire-boxes they have three branches, and for locomotive four branches, that is, they consist of one main horizontal tube with two vertical branches. There seems no doubt but that more heating surface and greater strength can be obtained by these tubes than in the ordinary way, and in the case of locomotive fire-boxes, there is no reason why by the use of them the roof stays should not be entirely dispensed with. The tubes are made of the finest soft steel; they are welded up solid throughout, and are tested with water before being sent away.

NOTES FROM SCOTLAND.

(From our own Correspondent.)

There has again been considerable strength in the pig iron market this week, and speculative values were for the most part fairly well maintained. It was not expected that the shipments would be large, seeing that the shipping season is now at an end. They amounted to 6670 tons, as compared with 7951 in the preceding week and 6540 in the corresponding week of 1884. The demand for some classes of makers' iron has been good, but it is difficult to contemplate without some anxiety the large amount of pig iron that is being sold for delivery into store. The addition to Messrs. Connal and Co.'s Glasgow stocks in the past week is upwards of 5000 tons. There are 92 furnaces in blast as against 94 at this date last year.

Business was done in the warrant market on Friday at 43s. 1½d. cash. The tone was firm at the opening on Monday at 43s. 1½d. cash, but receded to 42s. 10½d. at the close. On Tuesday forenoon business took place at 42s. 9d. to 43s. cash, and in the afternoon the market was steady at 42s. 11½d. to 42s. 11d. cash. Business took place on Wednesday at 43s. 1d. to 42s. 8d. cash. To-day—Thursday—the market was irregular, with business at 42s. 8½d. to 42s. 10½d., closing at the former figure.

The current values of makers' iron are as follows:—Gartsherrie, f.o.b. at Glasgow, per ton, No. 1, 46s.; No. 3, 43s. 6d.; Coltness, 50s. 6d. and 45s. 6d.; Langloan, 47s. 6d. and 45s.; Summerlee, 50s. and 44s.; Calder, 51s. 6d. and 43s. 6d.; Carnbroe, 45s. 6d. and 43s.; Clyde, 46s. and 42s.; Monkland, 43s. 3d. and 41s.; Quarter, 42s. 9d. and 40s. 6d.; Govan, at Broomielaw, 43s. 3d. and 41s.; Shotts, at Leith, 47s. and 46s. 6d.; Carron, at Grangemouth, 51s. and 47s.; Kinneil, at Bo'ness, 43s. 6d. and 43s.; Glengarnock, at Ardrossan, 46s. and 43s.; Eglinton, 43s. and 40s.; Dalmellington, 44s. and 40s.

The total shipments of Scotch pigs to date are 412,948 tons, against 499,428 tons at this date last year.

In the arrivals of Middlesbrough pig iron into Scotland, there is the large increase of 95,026 tons.

As the prices of mild steel have for some time been maintained by Scotch makers at 15s. a ton over the English quotations, there was some danger of Clyde work going to England, and the prices in special cases have now been reduced by that amount.

The foundries and engineering works in the west of Scotland have for the most part a fair amount of work on hand. The malleable iron trade is quiet, but steel manufacturers are busy, and some of them have recently booked considerable orders for shipbuilding purposes.

The shipments of iron and steel manufactures from Glasgow in the past week embraced two locomotives, valued at £3067, for Demerara; £8166 worth of machinery, £7413 steel goods, and £32,000 general iron manufactures, of which £12,000 were for pipes, roofing, bars, &c., sent to New South Wales.

In consequence of the steady working of the miners there has been more doing in the shipping department of the coal trade. During the week 26,697 tons were despatched from Glasgow, 1077 from Greenock, 8508 from Ayr, 2240 from Irvine, 6614 from Troon, 1898 from Leith, and 12,140 tons from Grangemouth. Shipping coals have been a little firmer in price, but owing to the continuance of mild weather, the inquiry for household sorts has fallen short of what was anticipated. In Fifeshire the coal trade has been very busy as a result of the presence of a large fleet of vessels at Burntisland prepared to make what is likely to be a final run for this season to the Baltic. Prices of all sorts are, therefore, reported with a slightly upward tendency, which is not expected, however, to be maintained. Coal freights are also reported firm.

About a month ago the Lanarkshire coalmasters promised the miners an advance of 6d. on 30th November. The men declined the offer and left work, demanding that they should get 6d. at once and a second 6d. on 1st December. Upon this a number of the masters withdrew their first offer, and the men, taking alarm at this, returned to the pits. It is, therefore, much to the credit of the masters that they have now given the men an increase of 6d. a day. They would be quite glad to make it 1s. if the state of trade justified such a step.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Last week, after the despatch of my letter, good news reached Cardiff in the form of a request from the Government to the principal coalowners to send in tenders for considerable supplies of coal. This, with the Admiralty orders which have been placed, will have a tendency to improve things.

Welsh coal is to be sent to Malta, Portsmouth, Portland, Sheerness, and other places on Admiralty account, and I find that amongst the competing firms, Powell Duffryn—generally a successful firm—Tyler and Co, Glamorgan Company, Cory Brothers, Coffin and Co., Naval Company, and the Dowlais Company are included. Cardiff coal shipments and Newport showed a falling off last week, and I am afraid, from one cause and another, it will be the same case this week. Best steam coal commands its price, and the principal coalowners may be said to be fairly occupied; but the great mass of lesser men are quiet, and secondary classes of coal are not in good demand. House coal is only in moderate demand, and the incessant rains we have had, retarding work at collieries and at port, have not tended to improve matters. Compared with previous seasons the house coal trade does not stand well. I find it shown, too, in certain house colliery speculations in the market. Money is at a low rate, and yet speculators do not care to invest. One of our leading house coal men seems to prefer Glasgow pig, as a better investment for capital.

Referring to coal shipments, Cardiff sent away 132,059 tons last week as compared with 146,875 the previous week. Newport only 23,013 tons foreign coal shipments as compared with 32,114 tons, and Swansea only slightly over 21,000 tons as compared with 30,000 the previous week.

The steel rail trade does not show much animation this week. Steel bar is in demand, and no other branch seems to rise above the ordinary dull track. Cyfarthfa "pegs" away at it as briskly as ever, and is about the richest works we can meet with. I rather take to the current view that the turn of the year will bring improvement. Such is the opinion I hear from many quarters.

I have great faith in Cyfarthfa management, having had long experience of the foreknowledge and foresight shown there. In the old days of iron rails, when America and Russia were occasionally free buyers, Cyfarthfa was always well advised, and for its policy in stock working it was unequalled. I see now by American advices that steel rails are gone up a dollar. I know that Cyfarthfa is stocking freely, and I put one and one together; my readers should do the same. Depend upon it the inaction during the year, foreign and home, will be strongly contrasted; American steel rails, too, are of the "shoddy" species generally.

Tin-plate making continues its improved character. Ordinary cokes, Siemens and Bessemer, are all gone up, and the demand is good and inquiries large. Singular enough, I find in the Swansea district that though the sale is becoming very good, stocks are at a high figure. At present they represent 112,494 boxes, showing an increase on the week of over 32,000. Part of this is due to the weather, which has told on shipments, and one good week will clear off a considerable proportion of this accumulation. Prices are, for ordinary coke tins, from 14s. 6d. to 15s.; Bessemer, 15s. to 15s. 3d.; Siemens, 15s. 6d. to 15s. 9d. American buyers are beginning to place orders freely.

NEW COMPANIES.

THE following companies have just been registered:—

Australasian Automatic Weighing Machine Company, Limited.

Upon terms of an agreement of the 16th ult. this company proposes to purchase from Mr. John Spencer Walter, of 12, Addle-street, E.C., his interest in an agreement of the 14th ult. with the Automatic Weighing Machine Company, Limited, for the purchase of certain patents for improvements in weighing machines, for the colonies of Victoria, Queensland, South Australia, and Tasmania, for the sum of £5000. It was registered on the 21st ult. with a capital of £10,000, in £1 shares. The purchase consideration to be paid by the company to Mr. Walter is £8000, payable £3000 in cash, and the balance in cash or fully-paid shares. The subscribers are:—

	Shares.
J. Spencer Walter, 12, Addle-street, Wood-street, manufacturer	1
Louis Freeman, Nicholas House, King William-street, secretary to a company	1
F. J. Lee Smith, Sydenham, Kent, manager to a company	1
A. F. Woodley, 2, St. John's-road, Penge, electrician	1
Cecil Buckland, 8, Chadwick-road, Peckham, journalist	1
J. Jennings, 6, Brooksby-street, Liverpool-road, N., clerk	1
A. Marshall, 69, Brighton-road, Stoke Newington, clerk	1

The number of directors is not to be less than three nor more than five; qualification, shares to the nominal value of £250; the subscribers are to appoint the first; the company in general meeting will determine remuneration.

Heap's Patent Dry Closet and Sanitary Works Company, Limited.

This company proposes to acquire the business of Robert Robinson Heap, of Heap's Sanitary Works, 13, Park-street, Greenheys, Manchester, together with certain inventions of Mr. R. R. Heap, now in process of completion. It was registered on the 21st ult. with a capital of £10,000, in £5 shares. The subscribers are:—

	Shares.
E. G. Evans, Northern-grove, Didsbury, salesman	1
J. E. Radford, 11, York-street, Manchester	1
J. B. Wilson, 108, Cecil-street, Greenheys, Manchester, brick manufacturer	1
S. C. Simpson, Manchester, wholesale jeweller	1
A. R. Reynolds, 21, Barton-street, Manchester, buyer	1
J. E. Labrey, Seascale, Cumberland	1
A. W. Rooke, 34, Victoria-buildings, Manchester, chemical manufacturer	1

The number of directors is not to be less than five nor more than seven; remuneration, 10s. 6d. to each director for every meeting attended. An agreement of the 16th ult. regulates the purchase, consideration being £1500 in cash, and £1500 in fully-paid shares.

Ingrey, Poore, and Latham, Limited.

This is the conversion to a company of the business of electric engineers, agents and merchants, and electric light apparatus contractors, carried on by Charles Ingrey and Greydon Poore at 49, Queen Victoria-street. It was registered on the 20th ult. with a capital of £10,000, in £10 shares, with power to increase. An agreement of the 17th ult. regulates the purchase, the consideration being £2500 in fully-paid shares and a sum in cash not exceeding £150 in payment of debts due by the vendors up to the 1st October. The subscribers are:—

	Shares.
Charles Ingrey, 49, Queen Victoria-street, engineer	125
Graydon Poore, 51, Queen Victoria-street, engineer	125
Ernest Latham, 10, Halton-buildings, Chapel-street, Liverpool	50
Walter Mickelwright, 11, Queen Victoria-street, accountant	1
Alfred Coatsworth, 11, Queen Victoria-street, accountant	1
Henry Johnson, 4, Peckham-grove, Camberwell, draughtsman	1
John Buckett, jun., 111, Norwood-road, Herne-hill, engineer	1

Registered without special articles.

Nunan's Patents Company, Limited.

This company proposes to carry on business as engineers, founders, and cutlers, and upon terms of an unregistered agreement of the 20th ult. between Edward Nunan, of San Francisco and Fleet-street, and I. Slade, of Staines-road, Twickenham, will acquire certain patents of the said E. Nunan, of which no particulars are given in the registered documents. The company was incorporated on the 25th ult. with a capital of £50,000, in £1 shares, with the following as first subscribers:—

	Shares.
C. J. Langton, 54, Cannon-street, surveyor	1
J. Wright, Essex-grove, Walthamstow, warehouseman	1
T. C. J. Thomas, 5, Carlton-road, Finsbury Park, engineer	1
J. F. Shallis, 10, Redcliffe-street, South Kensington, engineer	1
J. Newcomb, 6, Water-lane, E.C., lighterman	1
E. du Balen, C.E., 255, Vauxhall Bridge-road	1
Thomas Brown, Milford Haven, shipbroker	1

The number of directors is not to be less than two nor more than seven; the subscribers are to appoint the first; qualification for subsequent directors, 100 shares; remuneration, £75 per annum each until 10 per cent. dividend is paid, to be increased to £125 per annum each when and after 15 per cent. is paid.

FOR some time mineral oil has been carried in bulk in steamers on the Caspian and Volga. The *Nautical Magazine* says the same thing is now being done on the Black Sea, and three steamers are building for the purpose in Sweden to the order of the Russian Black Sea Navigation Company. The first of the three, named the Svet, which is nearly complete, has a displacement of 1900 tons, and is 282ft. long. The oil will be carried in bulk in twelve compartments, and each compartment has connecting pipes, so that the vessel can be rapidly loaded and discharged. Oil is at present brought by railway from the Caspian to Batoum, and large receiving cisterns have been erected at Batoum, and also at Odessa. The steamers at present under construction will ply between those two ports, and it is said that as the trade developes others will be built with a view to the export of mineral oil.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

Applications for Letters Patent.

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

24th November, 1885.

14,362. MOVABLE GUIDE WIRE for CYCLE HUB LAMPS, J. W. Riley, Ulverston.
14,363. OPENING, &c., SHUTTERS, &c., B. Clarke, Birmingham.
14,364. SULPHUR and SULPHURIC ACID, E. W. Parnell and J. Simpson, Liverpool.
14,365. BICARBONATE of SODA, J. Simpson and E. W. Parnell, Liverpool.
14,366. STOPPERING BOTTLES, F. A. Bird and J. B. Fenby, Birmingham.
14,367. WHEELS, T. Bolas, Chiswick.
14,368. ALUMINIUM and its ALLOYS, C. Hargrove, Olton, near Birmingham.
14,369. REVOLVING TABLE, B. W. Ramsden, Sheffield.
14,370. PREPARING WOOL or other FIBRES, W. Scriven, Bradford.
14,371. PRINTING PHOTOGRAPHS, W. Barry, Hull.
14,372. SOFTENING, &c., WATER, A. Bell, Manchester.
14,373. TEA-SIFTING, &c., MACHINE, W. Parnall, Bristol.
14,374. CHIMNEY TOPS, E. C. Theedam, Dudley.
14,375. METALLIC RINGS for PISTONS, G. Dixon, Ramsbottom.
14,376. TOP BOARDS of SPINNING FRAMES, A. Whiteley and J. Wood, Bradford.
14,377. STOPPERS and BOTTLES, C. H. Boyne, Tiverton.
14,378. HANDLES of UMBRELLAS, &c., H. Ellis and H. Ikin, London.
14,379. MACHINES for WRINGING, &c., J. Robson, London.
14,380. TOILET, &c., SOAP, R. Ross, Pudsey, near Leeds
14,381. ELECTRICAL BATTERIES, J. T. Armstrong, London.
14,382. MATERIALS used in ELECTRICAL BATTERIES, J. T. Armstrong, London.
14,383. ELEMENTS for ELECTRICAL BATTERIES, J. T. Armstrong, London.
14,384. POROUS PLATES for ELECTRICAL BATTERIES, J. T. Armstrong, London.
14,385. MAKING MOULDS for CASTINGS, M. R. Moore, London.
14,386. GAUGE GLASSES, C. Melin, London.
14,387. TRIMMING EMBROIDERIES, H. J. Allison.—(*The West and Galland Company, U.S.*)
14,388. DYNAMO MACHINES, M. Immisch, London.
14,389. HOSE PIPING, H. and J. Ainsworth, R. Hindle, and G. Haworth, London.
14,390. SOFTENING, &c., WATER, F. R. Lipscombe, London.
14,391. DISINFECTANT and CLEANING LIQUID, H. Endemann, London.
14,392. HEATING and SUPPLYING AIR, T. S. Dobson and A. Murfet, London.
14,393. TREATING WEBS, WOOL RAGS, &c., M. Iwand and Messrs. Rudolph and Kühne, Liverpool.
14,394. LIQUID FUEL VAPOUR ENGINES, L. H. Nash, London.
14,395. BOOTS, A. J. Boult.—(*G. Valiant and J. Turner, Canada.*)
14,396. SCREW PROPELLERS, J. A. Berley.—(*E. Monnier, France.*)
14,397. PARAFFINE STOVES, W. Holbrook, London.
14,398. BUTTERFLY for HANSOM CABS, M. J. Rowley and C. A. Wheeler, London.
14,399. COMPOUND STEAM ENGINE CYLINDERS, E. H. Pye and J. H. Turvey, London.
14,400. GOVERNORS, J. F. Haskins, London.
14,401. CAST METAL PIPES, F. Shickle, London.
14,402. SADDLES for VELOCIPEDES, A. H. Overman, London.
14,403. POSTAGE, &c., STAMP or LABEL DAMPER, L. B. Bertram, London.
14,404. SAFETY APPARATUS for LIFTS, &c., F. Pelzer, London.
14,405. GAS MOTOR ENGINES, H. Williams, Manchester.
14,406. CASE for FRAGILE INSTRUMENTS, H. St. G. Boswell, London.
14,407. COMBINED HAIR BRUSH and COMB, W. M'Millan, London.
14,408. INKSTAND, E. Verdié, London.
14,409. GAS METERS, W. Cowan, London.
14,410. BALANCING SEMAPHORE and other SIGNAL ARMS, W. Roberts, London.
14,411. UTILISING WASTE PRODUCTS from GALVANISING IRON, R. Heathfield, London.
14,412. EXPLOSIVE COMPOUND, C. D. Abel.—(*F. Gaens, Germany.*)
14,413. ROLLER MILLS, M. W. Clark, London.
14,414. TANNING LEATHER, E. Edwards.—(*C. Kollen-Corneille, France.*)
14,415. WATCHES, A. M. Clark.—(*A. O. Jennings, United States.*)
14,416. STEAM BOILER A. M. Clark.—(*M. L. J. R. L. de Montais, France.*)
14,417. STEAM BOILERS or GENERATORS, R. Murray and J. Paterson, Glasgow.
14,418. GAS RINGS for COOKING and HEATING PURPOSES, T. Ure, Glasgow.
14,419. HOLDING REINS whilst RIDING and DRIVING, M. Ballinger, London.
14,420. SUPPORTING and DISPLAYING DRESSES, &c., W. R. Lake.—(*J. D. Richardson, F. Le M. Manchester, and J. W. Sullings, United States.*)
14,421. OIL BAIZES, &c., W. Oppenheimer, London.
14,422. PIANOFORTE SOUND-BOARDS, H. W. Petherick, London.
14,423. STEAM ENGINES, D. D. Hardy, London.
14,424. AZO DYES, J. Y. Johnson.—(*Farbenfabriken vorm. Friedrich Bayer and Co., Germany.*)
14,425. TUNNING, &c., BEER, J. Hodson, London.
14,426. ROLLED METAL ARTICLES, &c., G. F. Simonds, London.

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14,427. OPERATING STEAM or HYDRAULIC PRESSES, R. Gee, Halifax.
14,428. CATHETERS for AILMENTS of URETHRA, L. Casper, Wimbledon.
14,429. COLD STEEL and IRON SAWING MACHINE, I. Hill, Derby.
14,430. DESKS and CABINETS, A. Ashworth, Manchester.
14,431. DETENT for SPINNING SPINDLES, R. N. Cottrill and J. M. Hetherington, Manchester.
14,432. AUTOMATIC INDICATING DOOR BOLT, H. Davies, Birmingham.
14,433. RAISING, &c., VENETIAN BLINDS, J. S. Orton, Birmingham.
14,434. WOODEN SCREW STOPPERS, J. Laycock, Hunslet.
14,435. HORSESHOES, T. Grainger, and W. and W. A. Thomas, Porth.
14,436. CIRCULAR BRUSHES for CLEANING TUBES, W. and N. Motherwell, Glasgow.
14,437. RAILWAY WHEELS, L. Sterne, Glasgow.
14,438. INDIA-RUBBER and METAL TIRES for WHEELS of TRICYCLES, &c., F. T. Brown, Liverpool.
14,439. BLOWING AMERICAN ORGANS, J. Murgatroyd, Bradford.
14,440. PAPER FASTENERS for DRAWING, T. R. Donnelly, London.
14,441. SECURING WIRES for FENCES, J. Westgarth, Liverpool.
14,442. WATER METERS, &c., T. Melling and F. Butterfield, Liverpool.
14,443. HOLDERS for TWIST DRILLS, F. Butterfield, Liverpool.
14,444. RAILWAY, &c., WHISTLES, A. B. O'Connor, London.
14,445. WALL SOCKET for PORTABLE ELECTRIC LAMPS, A. P. Lundberg, London.
14,446. REVERSIBLE BOLTS for LOCKS, J. Armstrong, London.
14,447. PIPES, &c., L. F. R. Monsch, London.
14,448. TENSION WHEELS, I. W. Boothroyd and P. L. C. F. Renouf, London.
14,449. RAILWAY SIGNALS, H. Williams and A. Williamson, London.
14,450. PRESSING IRON, J. Umbach and E. Schultz, London.
14,451. FISH MANURE, J. B. Spence, London.
14,452. DELIVERING PREPAID GOODS AUTOMATICALLY, C. F. B. Birchall and E. Beckley, London.
14,453. BOTTLES and STOPPERS, J. F. Ryan, London.
14,454. HEATING the CUSHIONS of BILLIARD TABLES, A. Rigby, London.
14,455. FIRE and BURGLAR PROOF SAFES, J. Thompson and H. P. Lavender, London.
14,456. WINDING, &c., YARNS, W. and W. T. Martin, London.
14,457. PIVOT and WEATHER-BAR ARRANGEMENT for SWING and REVERSIBLE WINDOWS, &c., E. and J. M. Verity, and B. Banks, London.
14,458. BREAKING-DOWN COAL, E. Mould, London.
14,459. MAKING FODDER from CERTAIN WASTE PRODUCTS, H. Hencke, J. Palm, and E. Seelig, London.
14,460. STEAM BOILERS, J. T. Milton, Blackheath.
14,461. REGENERATIVE GAS LAMPS, &c., H. G. Frost, London.
14,462. GLASS, &c., J. M. Beuzel, London.
14,463. SLIDING ELECTRIC LAMPS, P. Krautz, London.
14,464. PRODUCING MOTIVE POWER, R. Dormer, London.
14,465. MUSICAL INSTRUMENT, W. Marshall, London.
14,466. HOLDER for NEWSPAPERS, E. F. J. Callaghan, London.
14,467. GLAZING, J. Jeffreys, London.
14,468. IMPRINTING DEVICES upon GLASS, &c., T. Bolas, London.
14,469. COOKING UTENSILS, C. C. Hull, London.
14,470. STOPPERING BOTTLES, H. Theaker and G. W. Staniland, Sheffield.
14,471. DISTANCE INDICATOR for CABS, G. B. Smith, Birmingham.
14,472. POCKET BOOKS, &c., J. S. Fairfax, London.
14,473. RAILWAY COUPLINGS, E. Edwards.—(*A. Jammes, France.*)
14,474. ELECTRIC MOTORS, H. E. Newton.—(*H. W. Cook, Italy.*)
14,475. LASSO for CAPTURING DOGS, T. Leonard and J. W. Ryland, London.
14,476. FORMING the BUNG HOLES of CASKS, &c., A. D. Roth, London.
14,477. DELIVERING from THRASHING MACHINES into CHAFF-CUTTING MACHINES, R. and H. Tasker and C. F. Asbridge, London.
14,478. STIRRUPS, C. Groombridge and J. P. Rickman, London.
14,479. BLOW-PIPE, LIGHTING APPARATUS, and WORK BENCH COMBINED, R. J. Robinson and J. Carpenter, London.
14,480. SHELLS for ORDNANCE, M. Delmard, London.
14,481. SHELLS for ORDNANCE, M. Delmard, London.
14,482. MACHINE-GUNS, R. H. Armit, London.
14,483. ELECTRIC BATTERIES, H. Aaron, Glasgow.
14,484. VENTILATING and CHIMNEY COWLS, A. Noble, Glasgow.
14,485. SEWER ENTRANCE COVERS, &c., F. G. L. Ham and E. J. Preston, London.
14,486. NEW GAME, R. Brewer, London.
14,487. MONEY TILLS, W. Stabb and W. Collis, London.

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14,488. DISH COVERS, W. J. Tanner, London.
14,489. LIGHTING LAMPS for BICYCLES, &c., R. Crawford, Southsea.
14,490. MACHINERY for CULTIVATING LAND, J. Ralph, London.
14,491. SOUNDING INDICATORS, L. Levi, Hull.
14,492. HORSESHOES, W. J. Smith, Canada.
14,493. WINDOW FASTENERS, W. H. Lilly, Birmingham.
14,494. STOP VALVES, W. T. Cortin, Newcastle-on-Tyne.
14,495. RAILWAY WAGON BRAKES, R. Morton, Manchester.
14,496. GLOVE FASTENERS, J. H. Preece, London.
14,497. GAS-BURNERS, M. Steel, Gosforth.
14,498. BALL-COCKS, C. Bailey, Birmingham.
14,499. AUTOMATIC COUPLER BUFFER, J. McAlpine, Glasgow.
14,500. SASH LINE SOCKET, W. Musselwhite and W. Prewett, Bournemouth.
14,501. SPLIT or DIVIDED PULLEYS, B. P. Tideman, Glasgow.
14,502. RECEPTACLE for TEA, &c., B. J. Littlehales, New Brighton.
14,503. SINK TRAP, H. Sutcliffe, Halifax.
14,504. LOOPED FABRICS, F. Mortimer and A. Mortimer, Bradford.
14,505. STOPPERED GLASS BOTTLES, E. Hardon, Heaton Norris.
14,506. PAPER BAG MAKING MACHINES, T. L. Daltry, Manchester.
14,507. STEEL CONVERTER LININGS, A. E. Tucker, Salop.
14,508. RING FRAMES for SPINNING COTTON, J. Wilson, Manchester.
14,509. PACKING-BOXES, W. Grimshaw, Manchester.
14,510. BEATING EGGS, &c., E. Griffin, London.
14,511 CARPETS, W. Fawke and F. B. Fawcett, Kidderminster.
14,512. MANUFACTURING CARBON from LIGNITE, F. A. Cowell, Newton Abbot.
14,513. PUMPS, C. Isler, London.
14,514. BEARINGS for CYCLES, &c., G. D. Leechman, London.
14,515. DENTAL INSTRUMENTS OPERATED by ELECTRICITY, A. Kirby, London.
14,516. LAWN-TENNIS BATS, J. Malings and W. Muckle, London.
14,517. COMBINED PASTRY BOARD and ROLLER, W. King, Watford.
14,518. ARTIFICIAL ROCK-WORK and GROUND, J. R. Ward, London.
14,519. PLUMMET, J. Johnston, Glasgow.
14,520. FRAMES of BALANCED TARGETS, P. MacGibbon, Glasgow.
14,521. ASTRAGALS and SASH BARS, W. H. Luther, Glasgow.
14,522. BOTTLING, W. T. Read, London.
14,523. SAUCERS for INDIAN INK, H. Hübers, London.
14,524. CHEST EXPANDERS, A. P. Largiader, London.
14,525. DISCONNECTING SYPHONS, J. Gordon, London.
14,526. TABLE SALT, M. Wolff, Liverpool.
14,527. ROLLER MILLS, L. Rappaport, Liverpool.
14,528. LEVER FASTENER for GLOVES, &c., E. Fisher, London.
14,529. WATERPROOF NON-CONDUCTING COVERINGS, W. Heatly and G. Hutchins, London.
14,530. BAGS for LAWN-TENNIS, &c., ARTICLES, F. H. Ayres and E. T. Sachs, London.
14,531. OPERATING upon ZINC ORE, J. Lea, London.
14,532. TOY, J. T. Humphrey, London.
14,533. MECHANICAL TELEPHONE, L. N. Loeb.—(*C. Loeb, United States.*)
14,534. UMBRELLAS, L. N. Loeb.—(*O. Bachmeyer, Germany.*)
14,535. MECHANICAL TELEPHONE, L. N. Loeb.—(*C. Loeb, United States.*)
14,536. GUN CARRIAGES, J. Vavasseur, London.
14,537. SOCKETS of CANDLESTICKS, A. G. C. Stollery, London.
14,538. PROTECTING ASTRAGALS of GLASS ROOFS, D. Brown, London.
14,539. BALL CASTORS, H. Wingfield, Birmingham.
14,540. ORNAMENTING METALLIC TUBES, J. Earle and G. Bourne, London.
14,541. TRAYS for CIGAR ENDS, D. L. Brain, London.
14,542. LIFE-BOATS, A. M. Wood, London.
14,543. DETERMINING DEVIATION of a SHOT'S FLIGHT, J. P. Pieri, London.
14,544. MOTOR for ELECTRICITY, &c., R. H. Heenan, London.
14,545. WATER-CLOSETS, A. T. Bean, London.
14,546. SAFETY LOCK for SMALL-ARMS, J. Imray, London.
14,547. TRANSFORMATION of FORCE into DIRECT ACTION, P. and A. Dou, London.
14,548. BORE of GUNS, J. P. Pieri, London.
14,549. CARTRIDGE for GUNS, J. P. Pieri, London.

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14,550. UTILISATION of GAS FITTINGS, H. F. Joe London.
14,551. FRAMING, &c., HATS, J. Bevan, Manchester.
14,552. PRESERVING FOOD and LIQUIDS, B. H. Thwaite Liverpool.
14,553. BRICKS and TILES, W. Brierley.—(*F. G. Kohlmann, Germany.*)
14,554. PIANOFORTES, B. R. Grindrod, Rochdale.
14,555. VALVES, J. Whitley, Leeds, and J. Keith, London.
14,556. RUBBERS for BOOTS, &c., M. Brindle, Southport.
14,557. HURDLES and FENCING, S. Bayliss and R. Parton, London.
14,558. TANDEM and other TRICYCLES, F. J. J. Gibbons, London.
14,559. FIRE-PROOF PILLARS and COLUMNS, R. B. Lee and J. Hodgson, Manchester.
14,560. TRAVELLING CAPS, J. J. Mann, Manchester.
14,561. MACHINE-GUNS, W. Jones, Liverpool.
14,562. AUTOMATIC COUPLINGS, W. Burnell and G. Ward, Liverpool.
14,563. FIRE APPLIANCES, J. Fletcher, Ashton-under-Lyne.
14,564. SECURING BRUSHES, J. C. Watkins, Bradford.
14,565. ADJUSTABLE WHEEL GEARING, F. G. M. Stoney and G. Turton, London.
14,566. THIMBLES, J. S. Dewsnap and W. B. Hatfield London.
14,567. GAS MOTOR ENGINES, J. Pointon, Liverpool.
14,568. CARRIAGE SPRINGS, J. H. Topham and W. H. Brassington, Manchester.
14,569. BLIND TASSEL, F. J. Hartley, C. Bolton, and F E. Harrison, London
14,570. HORSESHOES, E. Price and E. Price, jun., Sutton Coldfield.
14,571. ATTACHING STUDS to CARDS, G. W. Elliott and J. W. Egginton, Sheffield.
14,572. SEWING MACHINES, G. Johnston and J. Lockwood, Glasgow.
14,573. MOULDING or PRESSING GLASS, D. Rylands, Stairfoot, near Barnsley.
14,574. MOTIVE-POWER ENGINES, J. Black, Glasgow.
14,575. CORD HOLDER, G. A. Skinner, London.
14,576. RACQUET BATS, I. T. Townsend, Birmingham.
14,577. FRINGING TOILET COVERS, J. Lindley.
14,578. COUNTERPANES, &c., J. Lindley, London.
14,579. FIRE ESCAPE, W. Cooper, London.
14,580. RULING PARALLEL LINES, A. H. Gibbings, London.
14,581. ENVELOPES or WRAPPERS, C. W. Townley, London.
14,582. TOBACCO PIPES, R. Bowie, Glasgow.
14,583. WARPING-BITTS, G. Adamson, London.
14,584. SAWS, E. Wright, London.
14,585. VERTICAL STEAM BOILERS, M. Straker, London.
14,586. REGISTERING APPARATUS, G. Taylor and D. Boyd, London.
14,587. CRANKS, C. T. Crowden and H. J. Pausey, Lewisham.
14,588. ENVELOPES, G. Dolby, London.
14,589. LOCK, &c., for DISENGAGING SHIPS' BOATS, &c., W. Balch, London
14,590. STEAM ENGINES, J. Bremner, London.
14,591. LUBRICATING BEARINGS, E. Edwards.—(*M. Carrette, France.*)
14,592. IMPARTING MOTION to COAL-CUTTING and other MACHINERY, T. Bower, R. W. Bower, and J. Blackburn, London.
14,593. BI-AERATED BREAD, C. D. Barker, London.
14,594. ATTACHMENT to LADIES' DRESSES, E. Dearden, London.
14,595. TIN OPENERS, R. Axten and W. B. Fordham, London.
14,596. SEAT COVERS for VEHICLES, &c., W. J. Thompson and C. C. Deane, Liverpool.
14,597. WATCHMAN'S RECORDING CLOCKS, A. Newman, Liverpool.
14,598. BICYCLES, W. J. Lloyd and W. Priest, London.
14,599. OVENS for MAKING BREEZE and COKE, J. K. Jones, London.
14,600. HANDLES for SAUCEPANS, E. Fisher, H. W. Ludlow, and J. Hickman, London.
14,601. SHEEP SHEARS, R. Danvers, London.
14,602. FIRE-ESCAPE, J. Burrell, London.
14,603. LACING HOOKS for BOOTS and SHOES, &c., B. L. D'Aubigne, London.
14,604. VELOCIPEDES, F. G. M. Stoney and G. Turton, London.
14,605. FASTENER for ARTICLES of DRESS, H. Forman, London.
14,606. TOILET ARTICLES, T. Birch, London.
14,607. KNITTING MACHINES, F. Mellor, London.
14,608. SUPPORTING and RAISING VIOLIN STRINGS, &c., L. Meo, London.
14,609. STIRRUPS and STIRRUP LEATHERS, J. M. Fletcher, London.
14,610. PARING and BURNISHING BOOT HEELS, J. and S. Keats, London.
14,611. POCKET KNIVES, J. Y. Johnson.—(*J. Lepage, France.*)
14,612. GALVANIC BATTERY, A. Dun and F. Hasslacher, London.

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14,613. WEAVERS' SHUTTLES, J. Waddington, Bradford.
14,614. RAILWAY, &c., CARRIAGE COUPLING, A. N. Watts, Sharnbrook.
14,615. SYPHONS, A. J. Morison.—(*J. Morison, United States.*)
14,616. TUBULAR OIL LAMPS, R. Wallwork and A. C. Wells, Manchester.
14,617. GAS OVENS for SOFTENING HATS, J. Ditchfield, Denton.
14,618. TIN-FOIL, W. Brierley.—(*R. Lüders, Germany.*)
14,619. PRESSING BRICKS, &c., T. C. and J. D. Fawcett, Halifax.
14,620. SECTIONAL WARPING MILLS, A. Armitage, Halifax.
14,621. BOTTLE STOPPER, L. S. Mapleson, London.
14,622. ICE CREAM MACHINES, W. Grainger and R. Bigland, Birmingham.
14,623. RAISING GLASSES of CARRIAGES, N. K. McLeod, Aberdeen.
14,624. METALLIC HANDLES of CHESTS, &c., J. Lindsay, Glasgow.
14,625. SURFACING ASPHALTE ROADWAYS, W. Smith, London.
14,626. SECURING LUGS to BARRELS of GUNS, E. C. Green, Cheltenham.
14,627. SCORING at CRICKET, &c., C. E. Jeffcock, London.
14,628. MOULDING POTTERY-WARE, W. H. Hales, Birmingham.
14,629. TREATMENT of ALKALINE LIQUORS, C. Wigg, Liverpool.
14,630. ALBUM, G. B. Physick, London.
14,631. STITCHER for PERIODICALS, &c., J. F. Young and A. R. Molison, Swansea.
14,632. SPOKES for WHEELS of VEHICLES, J. K. Starley, London.
14,633. ELECTRIC CABLES, A. M. Clark.—(*E. Flotron and F. B. A. R. de la Bastie, France.*)
14,634. STAIR-RODS, CORNICES, &c., S. E. White, Liverpool.
14,635. APPLIANCES for use with LEAD PENCILS, J. F Williams, Liverpool.
14,636. MAGNESIUM BRONZE, L. J. O. Mouchel, London.
14,637. BLEACHING COTTON, J. C. Mewburn.—(*La Société Leblois, Piceni et Cie., France.*)
14,638. MEASURING ROTATIVE STRAIN, R. H. Froude, London.
14,639. BED TABLE SUPPORTS, &c., R. J. D. Pargeter, London.
14,640. MOUNTING LIDS of BOXES, &c., R. J. D. Pargeter, London.
14,641. MOTIVE POWER ENGINES, F. M. Young, London.
14,642. GAS COOKING RANGES, A. Frame and T. Russell, Glasgow.
14,643. COMBINATION FUNNEL, H. O. Dahms, London

14,644. Purifying Middlings, W. Weaver, London.
14,645. Boiling Fruit or Vegetables, J. H. Brinjes and P. T. Goodwin, London.
14,646. Travellers' Flask, H. A. Silver and W. S. Bennett, London.
14,647. Colouring Cards, &c, T. R. Shillito.—(*The Firma Grahl and Hoehl, Germany.*)
14,648. Open Hearth Regenerative Furnaces, J. Powell and L. Roberts, London.
14,649. Regulating Heat Conduction of Gas Flame, H. E A. Wallis and H. T. Ratcliff, London.
14,650. Making Shot, &c., E. Hammerstein.—(*F. S. Köhler, Germany.*)
14,651. Shearing Metal Plates, E. Hammerstein.—(*F. S. Köhler, Austria.*)
14,652. Scraper for Saucepans, &c., W. H. W. Poole, London.
14,653 Tricycles for Children's Use, R. Wallwork, Manchester.
14 654. Water Gauges for Steam Engines, S. Eddington and J. E. Steevenson, London.

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14,655. Guiding Mechanism M. Baerlein, Manchester.
14,656. Fire-extinguishers, A. J. Eastwood, Manchester.
14.657. Furnaces of Steam Boilers, J. A. Rowe, North Shields.
14.658. Carriage Lamps, A. C. and A. W. Auster, Birmingham.
14,659. Bags, W. H. Blackwell and J. Ridyard, Ashton-under-Lyne.
14,660. Gearing Rollers, W. Clarke and J. Ogden, Manchester.
14.661. Signalling Trains in Foggy or other Weather, G. Brockman, Penge.
14,662. Brewing Ale and Porter, E T. Pemberton, Liverpool.
14,663. Black-lead, E. J. Digby, London.
14,664. Cleansing and Preserving Fruit, J. Sharman, Sheffield.
14,665. Regulator for Infants' Feeding Bottles, C. J. Clark, London.
14,666. Spindle for Spinning Frames, J. Robertson, Dundee.
14,667. Horseshoes, C. Cashmere, London.
14.668. Proving the Concentricity of Revolving Bodies, T. Thompson, Stockton-on-Tees.
14,669. Tool, &c., Sharpeners, W. H. Duncan, Salop.
14,670. Chemical Safety Paper for Checks, &c., F. M. Hill, Brooklyn, U.S.
14,671. Telescope Couch and Chair, A. Leveson, London.
14,672. Treads for Staircases, &c., G. Bonehill, London.
14,673. Buttons, J. M. Carlyle, Birmingham.
14,674. Preventing Noise in Flushing Cisterns, W. H. B. Kimber, London.
14,675. Cake, J. Findlay, London.
14,676. Propelling Boats, A. J. Sedley and E. Cole, London.
14,677. Coin Cylinders, R. Grumbach, London.
14,678. Skates, M. Helliger, London.
14,679. Separating and Withdrawing Coin in Vehicles, F. Pudney, London.
14,680. Auxiliary Starting Gear for Engines, W. H. Martin, London.
14,681. Electric Alarum Clocks, M. Emanuel and R. Eras, London.
14,682. Velocipedes, A. S. Bowley, London.
14 683. Washing Machines, R. and A. Hay, Glasgow.
14,684. Shot, A. W. Marshall —(*F. S. Köhler, Germany.*)
14,685. Disc Coffee Huller, A. M. Clark. — (*J. Guardiola, Central America.*)
14,686. Split Coupling Link, A. M. Clark.—(*W. H. Clay, United States.*)
14,687. Boot and Shoe Protectors, A. M. Clark.—(*T. Gribble, United States.*)
14,688. Coffee Huller, A. M. Clark.—(*J. Guardiola, Central America.*)
14,689. Banjos, C. J. Kelly, London.
14,690. Throttle Valves, E. Edwards.—(*J. B. Beun, Germany.*)
14,691. Reed Organs, J. B. Hamilton, London.
14,692. Musical Instruments, J. B. Hamilton, London.
14,693. Internal Stoppered Bottles, J. W. Dobson, London.
14 694. Manufacturing Fabrics, R. A. Matthews and W. Birks, London.
14,695. Electrical Apparatus for Releasing Door Fastenings, C. L. Carson, London.
14,696. Glove Fasteners, W. R. Comings, London.
14,697. Preserving Alimentary Substances, H. Pischon, London.
14,698. Bearings for Shafting, W. Lorenz, London.
14,699. Removing Oil, &c., from Fibrous Materials, E. Mansfield and A. P. Rivolta, London.
14,700. Bearings for Shafts and Axles, J. and H. J. Anthon, London.
14,701. Horseshoe Nail Blanks, W. A. Barlow.—(*R. Dahlström, Germany.*)
14,702. Knife-cleaning Machine, W. A. Barlow.—(*G. Atmer and C. Möller. Germany.*)
14,703. Product for the use of Ivory Turners and others, C. H. Coiffier and T. R. Jordan, London.
14.704. Skein-holder, W. Bown and G. Capewell, London.
14,705. Holding Dressmakers' Requisites, W. Bown and G. Capewell, London.
14,706. Railway Switches, W. R. Lake.—(*A. Boyd, U.S.*)
14,707. Stove, M. E. P. Chaboche, London.
14,708. Surface Condensers, J. Templer, London.

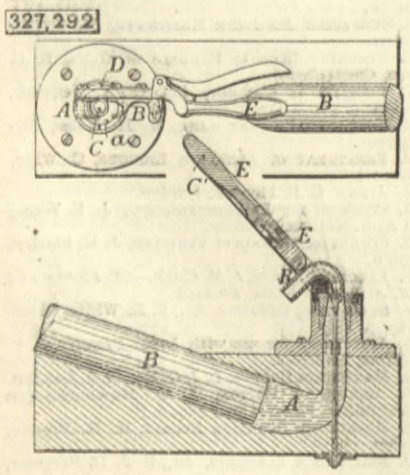
SELECTED AMERICAN PATENTS.

(From the United States' Patent Office Official Gazette.)

327,292. Apparatus for Making Plumbers' Traps. *John McCloskey, New York, N.Y.—Filed December 16th*, 1879.

Claim.—(1) The combination of an annular die for soft metal, a bulb connected to the core thereof, a jaw or shoulder adjacent to said die provided with a rounded arc-shaped face, and a bending lever provided

327,292



with a jaw having a rounded arc-shaped face, substantially as described. (2) The combination of the bulb C or its equivalent with the annular die *a*, substantially as and for the purpose herein set forth. (3) The combination with an annular die *a* of a gripping or bending device for bending the metal simultaneously with the operation of the die and a shoulder or support for giving definite curvature to the tubular metal as bent by the bending or gripping device, all substantially as and for the purpose herein set forth. (4) The combination of movable shoulder A^1, a gripping or bending device B^1, and an annular die *a*, whereby the operation of forming the different curves of an S or similar trap is caused to proceed simultaneously with the ejectment of the soft metal in tubular form from the die, all substantially as and for the purpose herein set forth. (5) The combination of the annular die *a*, the rotatable collar D, having the shoulder A^1, and a gripping or bending device for bending the tubular material over said shoulder as it issues from said die, all substantially as and for the purpose herein set forth. (6) The combination of the lever E, carrying the sliding gripping jaw B^1, the collar D, provided with the curved shoulder A^1, the annular die *a*, the chamber A, and a plunger, all substantially as and for the purpose herein set forth. (7) The combination of an annular die for soft metal, a bulb connected to the core thereof, a jaw or shoulder adjacent to said die provided with a rounded arc-shaped face, and a bending lever provided with a movable jaw having a rounded arc shaped face, substantially as described. (8) The combination of an annular die for soft metal, a bulb connected to the core thereof, a jaw or shoulder adjacent to said die provided with a rounded arc-shaped face, a bending lever provided with a movable jaw having a rounded arc-shaped face, the shank of said movable jaw having an inclined slot, an elbow lever pivotted to said bending lever, and provided with a pin which engages said slot, substantially as described.

327,499. Safety Device for Electric Circuits, *H. C. Spalding, Boston, Mass.—Filed February 21st*, 1884.

Claim.—(1) In a safety device for electric circuits, the combination, with a fusible safety-strip, an electro-magnet, and a pivotted armature lever connected by a spring with the safety strip, of a circuit breaker and shunting device connected with the lever, and constructed and arranged for operation, substantially as set forth. (2) In a safety device for electric circuits, the combination, with a fusible safety strip, an electro-magnet, and pivotted armature lever weighted and connected by a spring with the safety strip, of a circuit breaker and shunting device connected with the lever, and constructed and arranged for operation in substantially the manner described. (3) In a safety

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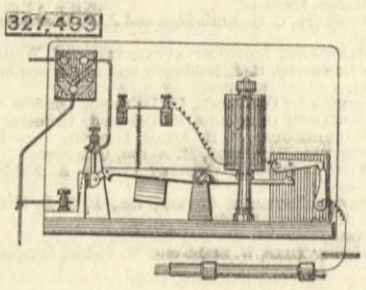

device, the combination, with an electro-magnet and pivotted armature, of a circuit breaker and shunting device, each comprising as the means for operating them a pivotted lever, and links connecting the pivotted armature with said levers, whereby a movement of the armature is imparted to the levers, substantially as and for the purpose specified. (4) In a safety device for electric circuits, the combination, with a safety-strip, an electro-magnet, and a pivotted armature connected by a spring with a safety strip, of a circuit breaker and a shunting device, each comprising as the means for operating them a pivotted lever and links, connecting the pivotted armature with said levers, whereby a movement of the armature is imparted to the levers, substantially as and for the purpose specified.

327,524. Shaft Hanger, *John Chivill, Chicago, Ill.—Filed July 6th*, 1885.

Claim.—(1) In a shaft hanger, the combination of the yoke B, cast in one piece, and a cap provided with a hollow stem d^1, and arms d^2 d^2, substantially as and for the purposes set forth. (2) The combination of the

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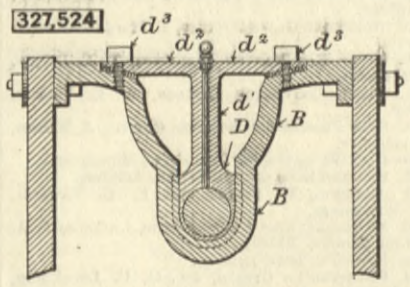
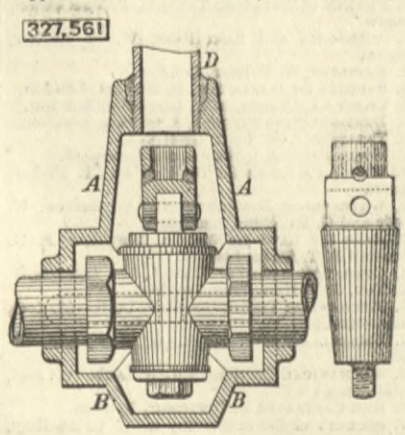


yoke B, cast in one piece, and adjustable cap D, said cap having a hollow stem d^1, arms d^2 d^2, adjustably secured to said yoke, and flanges *d*, substantially as and for the purposes set forth.

327,561. Casing for Street Cocks in Gas and Water Service, *Edward Lindsey, Cleveland, Ohio.—Filed December 17th*, 1883.

Claim.—In combination with the casing formed of the upper and lower sections A B, and the tube D, the

327,561



key seat having the upper opening for the reception of a turning key and the inclined openings extending from the said opening.

327,582. Battery Electrode, *John B. Odell, Chicago, Ill.—Filed June 26th*, 1884.

Claim.—(1) In an electrode, a supporting wire located entirely within the same, substantially as set forth. (2) In an electrode, a supporting wire arranged vertically and entirely within the same, as set forth. (3) An electrode provided with a supporting core arranged vertically within the same, substantially as set forth. (4) The combination, with the base having the upwardly-projecting stem, of a wire located within the stem and base to strengthen the same, as set forth. (5) The combination, with the base having the upwardly-projecting stem, of a wire arranged within the stem and base to strengthen the same, said wire having its end bent, substantially as set forth. (6) In an electrode, the combination, with the base having an upwardly-projecting stem, of a wire located within the stem and

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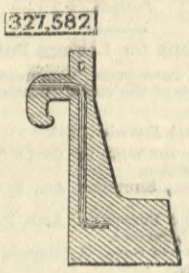

base to strengthen the same, and having its end bent in opposite directions at right angles to its body, as set forth.

327,610. Rod Cutter, *Charles F. Stackpole, Lynn, Mass.—Filed September 15th*, 1884.

Claim.—(1) An improved rod or wire cutter, consisting essentially of a pair of concentric die blocks provided with a pair of excentric dies having rod receiving orifices and a collar adapted to retain the die blocks in proper relation with each other and permit rotary movement thereof for the purpose set forth. (2) An improved rod or wire-cutter, consisting essentially of a pair of concentric die blocks adapted to be rotated on their common axial point with relation to each other, as specified, and provided with a retaining collar and a pair of dies having a common axial point excentric with relation to the axial point of the die

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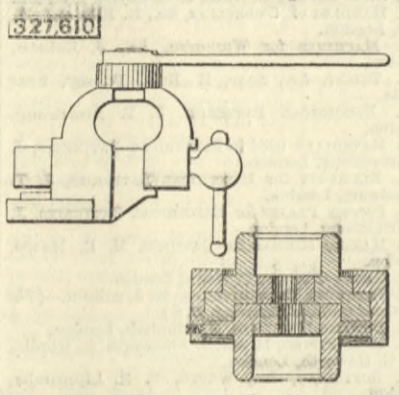

blocks, substantially as set forth. (3) An improved rod or wire cutter, consisting essentially of a pair of concentric die blocks having meeting faces and provided with a pair of dies having suitable rod-receiving orifices, the said dies arranged in the die blocks concentric with each other and excentric with the said die blocks, and means for retaining the die blocks in proper relation with each other and yet permit the rotation of one or the other on the axis common to both, substantially as set forth.

327,662. Beer Registering Faucet, *David W. Davis and William G. Latimer, Detroit, Mich.—Filed July 9th*, 1885.

Claim.—(1) A faucet provided with a registering device and a valve having a stem connected with said registering device, as described, whereby pressure on said stem operates said registering device, as set forth.

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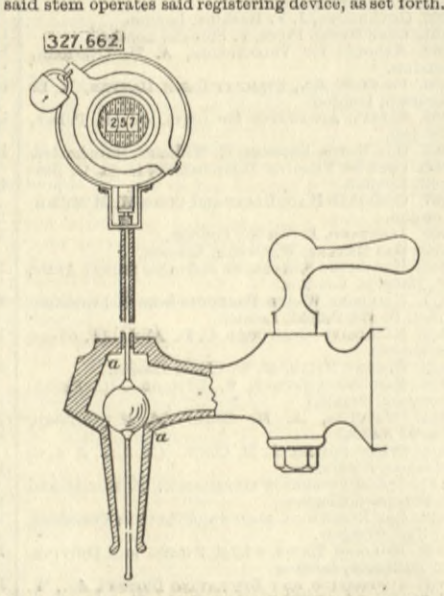

(2) A faucet having circular valve seats *a* surrounding the vertical passage thereof at its junction with the horizontal passage, in combination with a ball valve seated upon the seats *a* and secured through its axis to a rod, as a means for operating a registering device, substantially as and for the purposes specified.

327,728. Rolling Mill, *Charles Schulz, Cleveland, Ohio.—Filed May 7th*, 1885.

Claim.—(1) In a rolling mill plant, the combination of a series of overhanging rolls removably mounted on their respective shafts and arranged to form a continuous train, each shaft provided with flanges and

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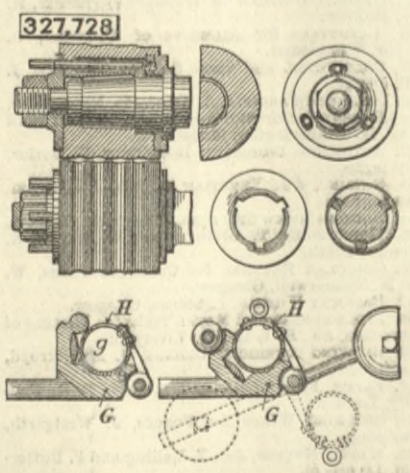
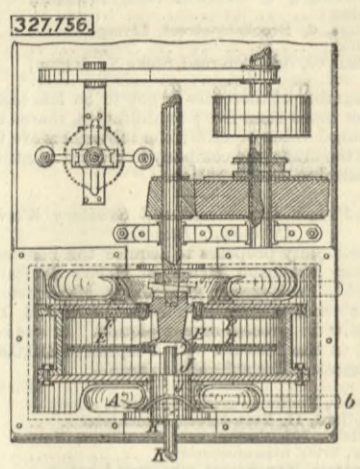


nuts for embracing the ends of the rollers and tightening the same, and set screws for adjusting the rollers lengthwise on the shafts, substantially as set forth. (2) In a rolling mill plant, the combination, with an overhanging roll removable mounted on a shaft provided with collars for embracing the ends of the roll, and nuts for tightening the collars, the shaft, and roll respectively, provided with one or more splines and engaging grooves, for causing the shaft and roll to revolve together, of set screws extending longitudinally through the roll and through the outside flange or washer, so as to be operated in front, said set-screws abutting against the rear flange or washer and arranged to adjust the roll lengthwise on the shaft, and to back the roll from its seat, substantially as set forth. (3) The combination, with the guide G, provided with a channel *g*, of the tube H, hinged to the guide, and so arranged that a pressure from within will open the tube outward and open the channel in the guide, substantially as set forth. (4) The combination, with a continuous train of overhanging rolls and guides arranged between the set of rolls, of brackets secured to the train frame for supporting the guides, the arrangement of parts being such that the brackets are adjustable vertically or lengthwise of the train, and the guides adjustable laterally, substantially as set forth.

327,756. Centrifugal Creamer, *Henry Beimling, Philadelphia, Pa.—Filed July 1st*, 1884.

Claim.—(1) A hollow cylinder having a hub, within the interior portion of which is a pocket E^1 having pipes leading radially therefrom to near the inner side of the circumferential wall of the cylinder, in combination with a supply pipe passing through one of the ends of the said cylinder into the said pocket, and bent pipes F, opening at one end inside of the cylinder near the inner side of the circumferential wall, and having at the other ends thereof cocks opening outside of one of the ends of the cylinder near the hub, substantially as described. (2) A cylinder having a hub formed with a pocket E^1 and pipes E leading there-

327,756



from and provided with an opening J in combination with a guard J^1, inlet pipe K, an annulus K^1, having a flange K^{11}, flange A^{11}, and pipe *b*, substantially as and for the purpose set forth. (3) A centrifugal milk and cream separator composed of a hollow cylinder provided with a hub having a bearing in suitable casing, said hub having a pocket within said cylinder and pipes leading from said pocket to near the circumferential wall thereof, milk discharge pipes open at both ends leading from the side of said cylinder, cocks in said pipes, and a cream outlet formed by a guard J^1 and annulus K^1 on the opposite side from the milk discharge, substantially as described.

327,899. Device for Stopping Leaks in Water Pipes, *W. H. Robertson, Toronto, Ontario, Canada.—Filed March 23rd*, 1885.

Claim.—(1) In a device for stopping leaks in pipes, the combination, with a clamp A provided with a screw and formed with a seat E of cups C and D, one of said cups fitting in the seat of the clamp, and the

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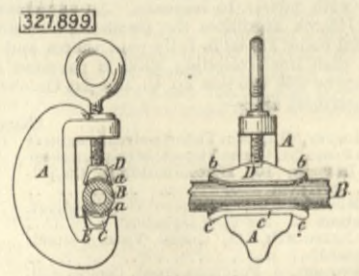
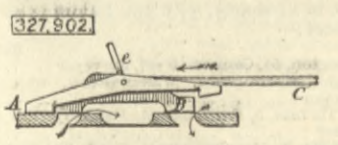


other adapted to have the screw bear against it, and both formed with sharp edges *a*, substantially as described. (2) A device for stopping leaks in pipes, consisting of the two elongated cups C and D, formed with sharp edges on their inner faces to enter a pipe, and having notches *b* and *c* on their exterior faces, substantially as and for the purpose described.

327,902. Cut-off Valve, *Peter O. Solie, Portland, Dak.—Filed March 27th*, 1885.

Claim.—(1) The combination, with a slide valve, of a rectangular frame or cut-off device pivotted thereto at or near its centre, a pin secured to the cut-off, and suitable stops adapted to rock the cut-off to close the ports, substantially as herein described. (2) A cut-off attachment pivotted to and enclosing a slide valve and

327,902



suitable stops for changing the position of the cut-off and thereby close the ports, substantially as herein described. (3) The valve chest A, provided with a valve stem C, a rod D, and suitable stops *d* d^1, secured thereto, in combination with a slide valve B, and enclosing cut-off pivotted thereto, and a pin *e* adapted to engage the stops, substantially as and for the purpose described.

Production of Marls in the United States.—In New Jersey about 875,000 tons, worth 437,500 dollars at the pits, were dug in 1884. In addition, small quantities were produced for local use in some of the Southern States. The production is declining, owing to competition with fertilisers made from phosphate rock, &c.