GRAPHIC KINEMATICS OF MACHINERY.

PROFESSOR R. H. SMITH, of Mason's College, Birmingham, communicated in April last a paper to the Royal Society of Edinburgh on a New Graphic Analysis of the Kinematics of Mechanisms. The following abstract of it was prepared for the press by Professor Fleeming Jenkin, being probably the last thing that distinguished professor wrote for the press before his death. The paper describes a method of constructing velocity and acceleration diagrams for any mechanism however complicated consisting of rigid parts which move in one plane and are so linked together that when the motion of one point is known the motions of all the parts are determinate. This, of course, is a condition fulfilled by almost all rigid bar mechanisms.

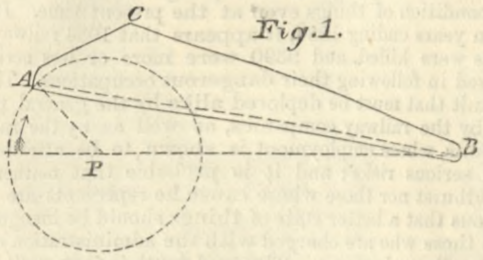


Fig. 1.

The velocity diagram allows the velocity of every point in every bar of the mechanism for all positions of those bars to be easily and accurately found and recorded. The acceleration diagram does the same for the accelerations of all parts of the mechanism.

The velocity of each point is indicated by a vector radiating from a pole; that is to say, by a line the length of which measures the magnitude of the velocity to any convenient scale that may be chosen; while the inclination in the field shows the direction of the motion. In fact, velocity is shown exactly as force is shown in all graphic methods. "Vector" is a convenient name for a line of this description with an arrow on it to show which way along the line the action indicated occurs. All actions which can be represented by vectors can be compounded or decomposed as forces are compounded or decomposed. Velocities and accelerations belong to this order of actions.

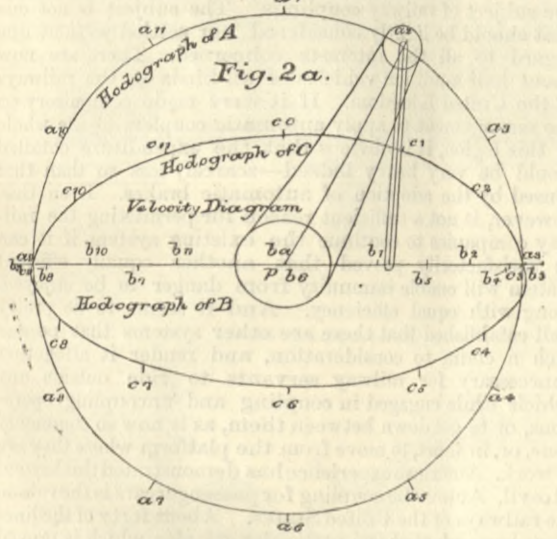


Fig. 2a.

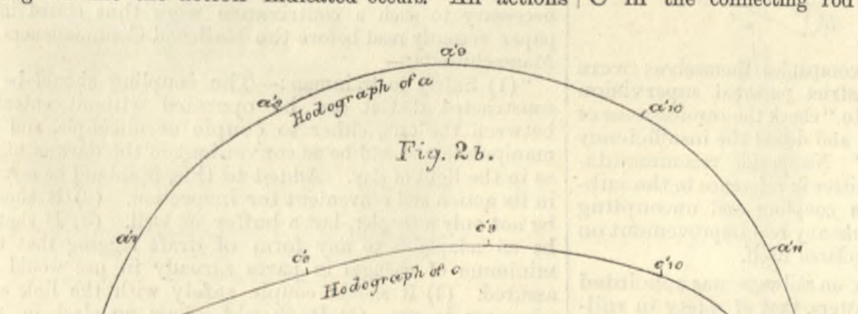


Fig. 2b.
Acceleration diagram.

Professor Smith first points out that if we draw two vectors $p\,a$ and $p\,b$ (Fig. 1a), representing the velocities of any two points A and B of any rigid bar; and if we draw what might be termed an "image" of the bar between the points ab, this image being similar in shape to the bar A B, and having its scale determined by making $a\,b$ of the image represent A B of the bar; then (1) this image will be placed as if turned round 90° from the position of the bar; (2) that a vector drawn from p to any point c in the image will represent the velocity of the similarly placed point C of the bar in the field of the base-plate P; (3) that the vector $a\,b$ (drawn FROM a TO b) represents the motion of B relatively to A in the field the direction of which is fixed by the base-plate P. Similarly $c\,b$, the vector drawn from any point c to any point b of the image, shows the velocity of B relative to C. These consequences follow from the above fact that the image and velocity vectors are exactly similar to the original bar and the radii from the instantaneous axis to the points A B C, &c. The fact that the image $a\,b$ is turned round exactly through 90° is of use in drawing the diagram. Figs. 2 and 2a show the velocity diagram for the ordinary crank P A, the connecting rod A B, the piston rod B, and the base plate P.

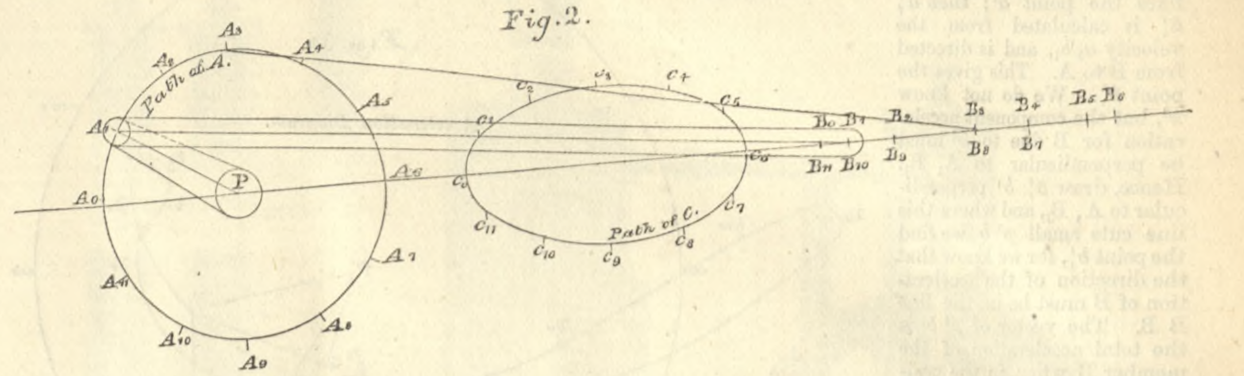


Fig. 2.

Twelve positions of A are shown; A_1 A_2 A_3 A_4 &c., is the path of A; B_1 B_2 B_3 B_4 &c., is the path of B; $p\,a_1$ $p\,a_2$ $p\,a_3$ $p\,a_4$ &c., are the velocity-vectors for A corresponding to the twelve positions. These are known in direction (being perpendicular to the crank at each point) and in magnitude (the angular velocity being constant). The circle $a_1\,a_2\,a_3\,a_4$ &c., is in fact the hodograph of the motion of A. The vectors for B must obviously lie along a horizontal line through p. Their length is determined by drawing $a\,b$ in each position perpendicular to A B for that position. Any other point C in the connecting rod will appear similarly situated on the image $a\,b$, and the curve joining all the points c will be the hodograph of the motion of C. Quite similarly we get the velocity of any point in the crank by the vector from p to the given point in the image (drawn for first position only). The diagram, therefore, gives us accurately the velocity and magnitude and direction for every point of the crank and connecting-rod, without ever requiring that we should draw the path of such a point as C, and to which path, however, the vector $p\,c$ will always be parallel.

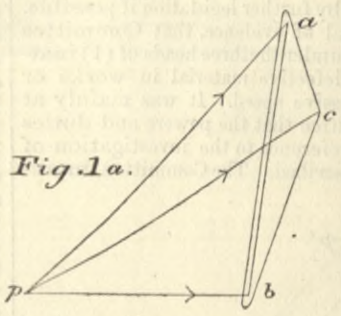


Fig. 1a.

Figs. 3, 3a show a four link mechanism, and its velocity diagram for the complete cycle of motion. The magnitude and direction of $p\,a$ are known—it being assumed that the crank rotates uniformly, the direction of $p\,b$ is known at each point perpendicular to P B—and the point b is then in each case determined by drawing $a\,b$ perpendicular to A B in each position. A curve joining all the a's would be the hodograph for A; a curve joining all the b's, the hodograph for B. Members of the mechanism which are stationary, or move with a velocity of translation only, have their images reduced to points, as p in all diagrams, and b in Fig. 2. The images of the other members as P A, A B, and P B in Fig. 3, wax and wane throughout the cycle, but the scale for the vectors remains constant.

A similar set of propositions hold good in respect of the acceleration vectors. Since an acceleration can be represented by a vector, accelerations can be compounded and decomposed like velocities, and the acceleration of a resultant velocity is the resultant of the accelerations of the component velocities.

Now let P A, Fig. 4, be a crank rotating as shown by its arrow, and let A B be a member of any shape rotating with an angular velocity w. Let $p^1\,a^1$, Fig. 4b, represent the acceleration of A (which if A P is rotating uniformly will be radial from A to P). Let us first suppose the angular velocity of A B to be constant, the total acceleration of any point B relatively to P will be the resultant of the vector $p^1\,a^1$, and a vector $a^1\,b^1$ representing the acceleration in, the velocity of B relatively to A. Now this latter component is w^2 B A directed from B to A. Draw therefore $a^1\,b^1$ equal w^2 B A and turned round 180 deg., and $p^1\,b^1$ will be the required acceleration vector of B. But a similar construction would give any other point c^1, and $a^1c^1 : a^1\,b^1 : c^1\,b^1 = \text{AC} : \text{AB} : \text{CB}$; therefore, an image of A C B drawn as shown turned round 180 deg. and drawn to the scale given by any one vector $a^1\,b^1$ will give all the acceleration vectors precisely as the image turned through 90 deg. gave all the velocity vectors.

Next let us assume that w is not constant, but is being increased at the rate w^1; in other words, let w^1 be the

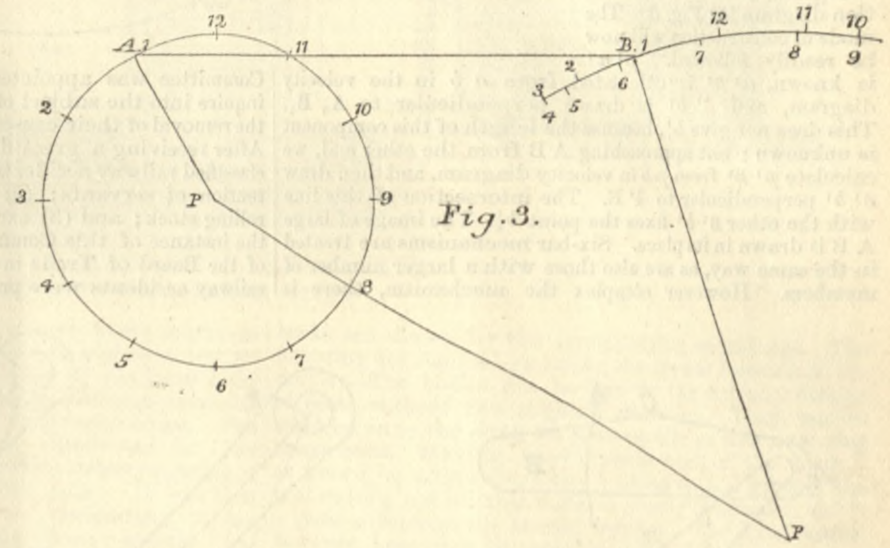


Fig. 3.

angular acceleration, and let it take place in the direction of w. The linear acceleration due to w^1 of any point B relatively to A will be w^1. A B in the direction of the acceleration of rotation and perpendicular to A B. Now, as before, let $p^1\,a^1$, Fig. 4c, be the acceleration vector for the point A. Then let $a^1\,\beta^1$ be the acceleration due to w as before, and let $\beta^1\,b^1$ be equal to w^1. A B, the new acceleration due to w^1 The vector $\beta^1\,b^1$ will be perpendicular to $a^1\,b^1$, because it is perpendicular to A B. The total acceleration of B for this perfectly general case will be $p^1\,b^1$, the resultants of three vectors, $p^1\,a^1$, $a^1\,\beta^1$, and $\beta^1\,b^1$. The vector $a^1\,b^1$, representing the acceleration of B relatively to A, is turned round relatively to A B in the direction of w, by an angle equal to $180° - \beta^1\,a^1\,b^1$. This angle $\beta^1\,a^1\,b^1$ is constant for all points of the member A B C, for its tangent is $\frac{w^1\,\text{AB}}{w^2\,\text{AB}} = \frac{w^1}{w^2}$: Moreover, as before, the vectors $a^1\,c^1$, $c^1\,b^1$, $a^1\,b^1$, are proportional to A C, C B, and A B. Hence, as before, we may fit an image of the bar A B into the place indicated by $a^1\,b^1$, and vectors from p^1 to any point of this image will give the accelerations of the corresponding points in the bar; and this image will be turned round in the direction of w through $180° - \tan.^{-1}\frac{w^1}{w^2}$, where w^1 is counted positive when in the direction of w. The total angle will, therefore, exceed 180 deg. when w^1 is negative. If w and w^1 are *nil*, the image of A B becomes a point, coinciding with a^1.

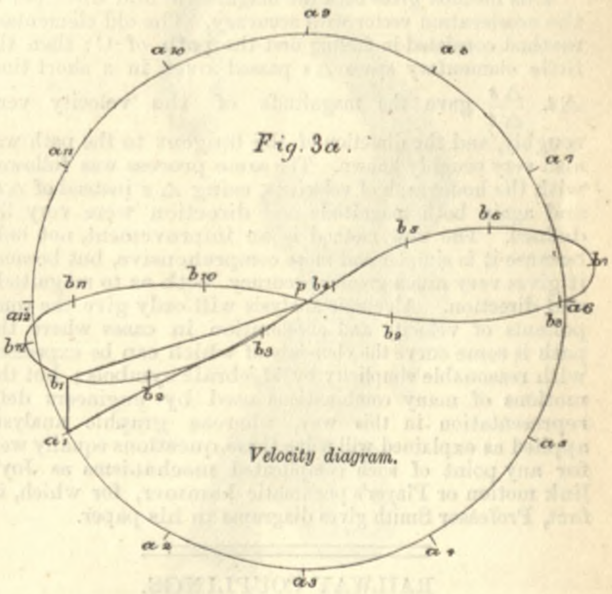


Fig. 3a.
Velocity diagram.

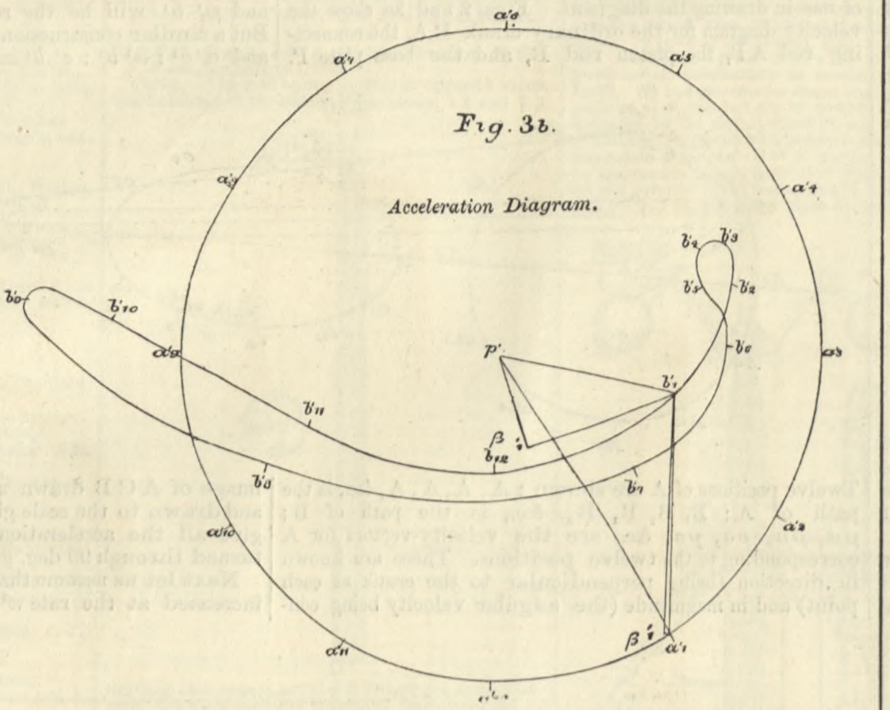
In any mechanism for which we have already got the velocity diagram we shall always be able to calculate what may be termed the centripetal component w^2 A B, since the vector $a\,b$, which is known, gives

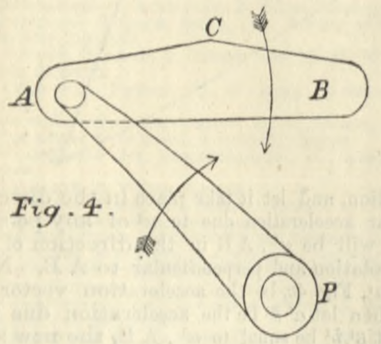
$$w = \frac{a\,b}{A\,B} \text{ or } w^2 . A\,B = \frac{(a\,b)^2}{A\,B}.$$

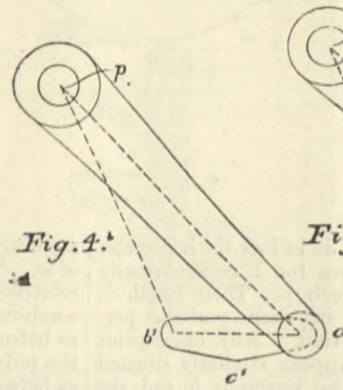
We also know the direction of this component. We seldom know w^1, but we always know its direction, perpendicular to A B; and with this information to guide us, there is usually little difficulty in completing the diagram.

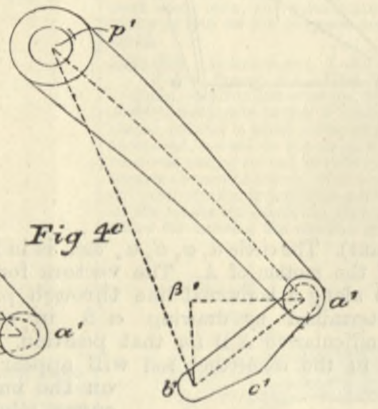
Fig. 2b represents the acceleration diagram for Fig. 2. $p^1\,a^1$ is calculated from the angular velocity of P A, and fixes the point a^1; then $a_1^1\,\beta_1^1$ is calculated from the velocity $a_1\,b_1$, and is directed from B to A. This gives the point β_1^1. We do not know w^1, but the component acceleration for B due to w^1 must be perpendicular to $A_1\,B_1$. Hence, draw $\beta_1^1\,b^1$ perpendicular to $A_1\,B_1$, and where this line cuts small $p^1\,b$ we find the point b_1^1, for we know that the direction of the acceleration of B must be in the line B B. The vector of $p^1\,b^1$ is the total acceleration of the member B when in the position B_1. We can find w^1 if it be desired from $\beta^1\,b^1$. The image of the crank and of the connecting rod are shown in their places; the hodograph for the acceleration of C is shown by the curve.

Fig. 3b shows the acceleration diagram for Fig. 3. The mode of construction will now be readily followed. $p^1\,a^1$ is known, $a^1\,\beta^1$ is calculated from $a\,b$ in the velocity diagram, and $\beta^1\,b^1$ is drawn perpendicular to $A_1\,B_1$. This does not give b_1^1, because the length of this component is unknown; but approaching A B from the other end, we calculate $p^1\,\beta^1$ from $p\,b$ in velocity diagram, and then draw $\beta^1\,b^1$ perpendicular to P B. The intersection of this line with the other $\beta^1\,b^1$ fixes the point b_1^1. The image of large A B is drawn in its place. Six-bar mechanisms are treated in the same way, as are also those with a larger number of members. However complex the mechanism, there is always one pole only for the velocity diagram, and one for the acceleration diagram from which radiate the vectors for all parts of the mechanism; the scale of the vectors also always remaining the same.









This method gives both the magnitude and direction of the acceleration vector with accuracy. The old elementary method consisted in finding first the path of C; then the little elementary space $\triangle s$ passed over in a short time $\triangle t$. $\frac{\triangle s}{\triangle t}$ gave the magnitude of the velocity very roughly, and the direction of the tangent to the path was also very roughly known. The same process was followed with the hodograph of velocities, using $\triangle v$ instead of $\triangle s$; and again both magnitude and direction were very ill-defined. The new method is an improvement, not only because it is simpler and more comprehensive, but because it gives very much greater accuracy both as to magnitude and direction. Algebraic analysis will only give the components of velocity and acceleration in cases where the path is some curve the elements of which can be expressed with reasonable simplicity by algebraic symbols; but the motions of many combinations used by engineers defy representation in this way, whereas graphic analysis applied as explained will solve these questions equally well for any point of such complicated mechanisms as Joy's link motion or Player's pneumatic hammer, for which, in fact, Professor Smith gives diagrams in his paper.

RAILWAY COUPLINGS.

THE question which Mr. Broadhurst put to the Secretary to the Board of Trade on Monday, the 6th July, as to whether that department "will depute one or more of their inspecting officers of railways to examine and report on the various improved railway couplings, designed with the view of minimising the risk to life and limb, now on view at the Inventions Exhibition, and if so will the Board of Trade recommend the adoption by the railway companies of such as may be favourably reported on," raises several considerations of importance, and of which we are likely to hear a good deal more in the immediate future. It is as much the interest of the railway companies, as it is their duty, to take care that if the present dangerous system of shunting can be dispensed with, consistently with the maintenance of due efficiency, no obstacle shall be thrown unnecessarily in the way of the better system or systems that are recommended for their adoption. No one is disposed to deny that the existing methods of shunting are generally rude, cumbersome, and fraught with peril. It remains to be seen how far the efforts of inventors have enabled our railways to get rid of these drawbacks.

It is somewhat surprising that none of the many parliamentary inquiries into the subject of railway accidents have gone much into this matter. In 1857 a Select Committee was appointed by the House of Commons to inquire into the subject of railway accidents with a view to the removal of their causes by further legislation if possible. After receiving a great deal of evidence, that Committee classified railway accidents under the three heads of (1) inattention of servants; (2) defective material in works or rolling stock; and (3) excessive speed. It was mainly at the instance of this Committee that the powers and duties of the Board of Trade in reference to the investigation of railway accidents were prescribed. The Committee, moreover, recommended that the companies themselves were the best parties to give that strict personal supervision which they deemed necessary to "check the carelessness of the men employed on the line, and detect the insufficiency of the material used on them." No specific recommendations were made by this Committee in reference to the subject of accidents to employés in coupling and uncoupling railway vehicles, possibly because any real improvement on the old system had not then declared itself.

In 1865 a Royal Commission on railways was appointed to investigate, among other matters, that of safety in railway travelling. The recommendations of this Commission, however, refer exclusively to the safety of passengers, and do not specifically touch upon the servants of the railway companies. A leading proposal was that the railway companies should be made absolutely responsible for all accidents to passengers, unless caused by their own negligence. Again, in 1870, another Select Committee of the House of Commons was appointed to "inquire into the law, and the administration of the law, of compensation for accidents, as applied to railway companies, and also to inquire whether any and what precautions ought to be adopted by railway companies with a view to prevent accidents." The report of this Committee was mainly devoted to the consideration of compensation for accidents to passengers, but that of accidents to servants, or that of taking steps to prevent such accidents, did not seem to be considered any intrinsic part of the reference.

In June, 1874, another Royal Commission, with the Duke of Buckingham and Chandos as chairman, was appointed to inquire into the causes of accidents on railways, and into the possibility of removing any such causes by further legislation. This Commission, after examining hosts of witnesses, remarked that the several similar inquiries held in previous years had only produced two practical proposals tending immediately to the prevention of railway accidents—(a) requiring a means of communication between the different parts of trains; and (b) the enforcement of the block system; and recommended (1) that the Board of Trade be empowered to enforce the adoption of the block system; (2) that the interlocking of points and signals be similarly enforced; (3) that facilities be afforded to the public to obtain redress for unpunctuality of trains by a cheap and summary process; (4) that all trains should be supplied with sufficient brake power to stop them within 500 yards; and (5) that there be an extension of the civil liability of railway companies for accidents to their servants, and of the criminal liability of persons in railway employments for acts of negligence endangering life. As bearing specially upon the last-named subject, the Commission remarked that accidents to servants "are of very frequent occurrence in shunting operations in the goods yards of railway companies, and more especially from the practice of fly-shunting;" and they recommended that "the attention of the companies should be called to this subject, with the view to the improvement of their arrangements and regulations in goods yards." In the same report, Mr. William Galt, one of the Commissioners, called attention to the fact that in the year 1875, "thirty-nine servants were killed and 514 injured in the discharge of their duty without any fault being attributed to them by the companies," mainly in the processes of coupling and uncoupling. This continues to be the condition of things even at the present time. In the seven years ending 1884, it appears that 1084 railway servants were killed, and 9390 were more or less seriously injured in following their dangerous occupations. This is a result that must be deplored alike by the general public and by the railway companies, as well as by the railway servants, whose employment is shown to be attended by such serious risks; and it is probable that neither Mr. Broadhurst nor those whose cause he represents are more anxious that a better state of things should be inaugurated than those who are charged with the administration of our great railway business. The real truth is that until lately there has been a lack of effective automatic coupling appliances. Many inventors have at one time or another brought out appliances designed to secure the desired result, but they have generally been found deficient in one or other of the qualities that are necessary in a really practicable coupler. There is, however, some reason to believe that these difficulties may now be got over.

It is not for us to anticipate the conclusions at which the Board of Trade may shortly arrive with reference to the subject of railway couplings. The subject is not one that should be lightly considered nor settled without due regard to all the interests concerned. There are now about half-a-million vehicles of all kinds on the railways of the United Kingdom. If it were made compulsory on the management to apply automatic couplers to the whole of this legion, it is obvious that the expenditure entailed would be very heavy indeed—scarcely less so than that caused by the adoption of automatic brakes. Even this, however, is not a sufficient reason for permitting the railway companies to continue the existing system, if it can be satisfactorily proved that another equally efficient system will enable immunity from danger to be enjoyed, along with equal efficiency. And it seems to be pretty well established that there are other systems that possess such a claim to consideration, and render it altogether unnecessary for railway servants to ride outside any vehicle while engaged in coupling and uncoupling operations, or to get down between them, as is now so commonly done, or, in short, to move from the platform where they are at work. American experience has demonstrated this beyond all cavil. Automatic coupling for passenger cars is the rule on the railways of the United States. About forty of the lines there have adopted one particular coupler, which is proved to have all the necessary qualifications for its intended purpose. As a consequence, accidents to railway servants are much less frequent in that country than in this. It may be added that American railway engineers appear to have bestowed more care upon the effort to obtain a really good automatic coupler than our own. The conditions necessary to such a contrivance were thus stated in a paper recently read before the Railroad Commissioners of Massachusetts:—

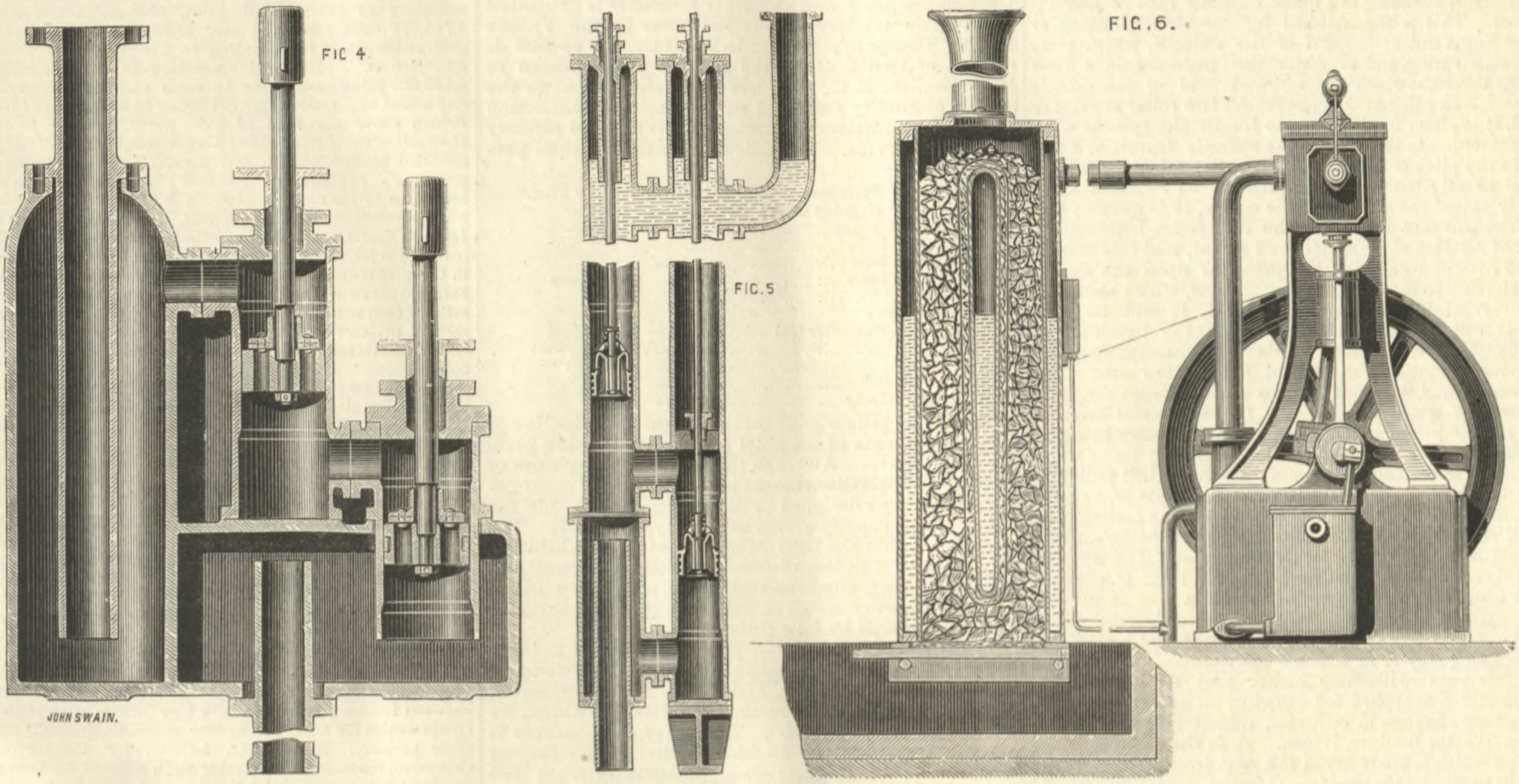
"(1) Safety to trainman:—The coupling should be so constructed that it can be operated without entering between the cars, either to couple or uncouple, and its manipulation should be as convenient in the darkest night as in the light of day. Added to this, it should be certain in its action and convenient for inspection. (2) It should be not only a coupler, but a buffer as well. (3) It should be so adaptable to any form of draft rigging that the minimum of changes in parts already in use would be assured. (4) It should couple safely with the link and pin now in use. (5) It should allow no slack in the coupler, but should have in the place thereof some such substitute as is commonly utilised in the starting of trains. (6) The coupling should allow such freedom of vertical motion to cars, independent of each other when coupled, that the passage of one car over switches or depressions in the track should not result in throwing the entire weight of the car upon the draft rigging of the connecting car. (7) It should curve freely, but have the minimum of lateral motion."

The same writer claimed that the whole of these requirements were fulfilled in a particular coupler which he specified, but as to this each engineer and inventor will, of course, have his own opinion, as he will likewise, concerning the comparative advantages of a slack and a tight coupler. Both the latter systems are now on view at the Inventions Exhibition, and we can imagine no more useful work than that of thoroughly sifting and testing their respective merits, so as to place this hitherto neglected branch of railway working on the same highly satisfactory scientific and economic footing as the brake and the block systems.

MISCELLANEOUS MACHINERY AT THE INVENTIONS EXHIBITION.

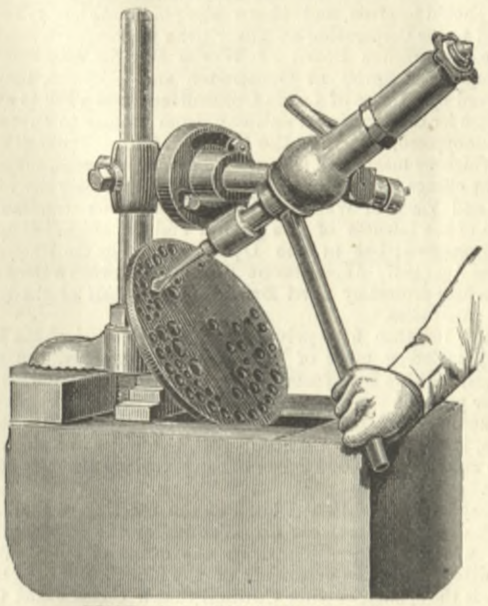
No. III.

MESSRS. HATHORN, DAVEY, AND CO., of Leeds, have an exhibit which comprises a number of specialities. Figs. 4 and 5 represent two varieties of deep well pumps lately patented by Mr. Davey, and which have been specially designed with a view to simplicity of construction. There are two working barrels, each provided with a bucket, one bucket making the up stroke while the other makes the down, so that there is a continual delivery of water into the rising main. In this way the advantages of a double-action pump are secured without the introduction of any valves beyond those in the buckets themselves. Another important feature is that the pump is self-charging. This will be seen by reference to Fig. 4, which shows a section of one of the patent pumps for use above the water level. The lower portion is formed into a vessel into which the working barrel projects, the suction pipe also being carried up as high as possible, so that when the pumps are standing, water sufficient for



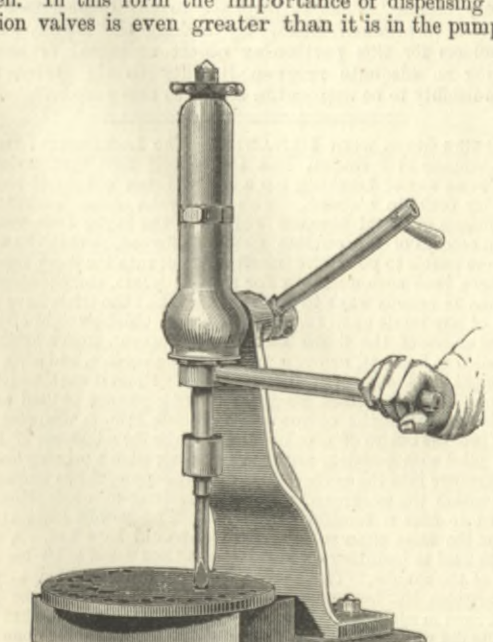
HATHORN DAVEY, AND CO.'S DEEP WELL PUMPS AND DOMESTIC MOTOR

charging purposes is still retained in the chamber. Fig. 5 represents the same type of pumps modified to suit the



PRICE AND BELSHAM'S DRILL.

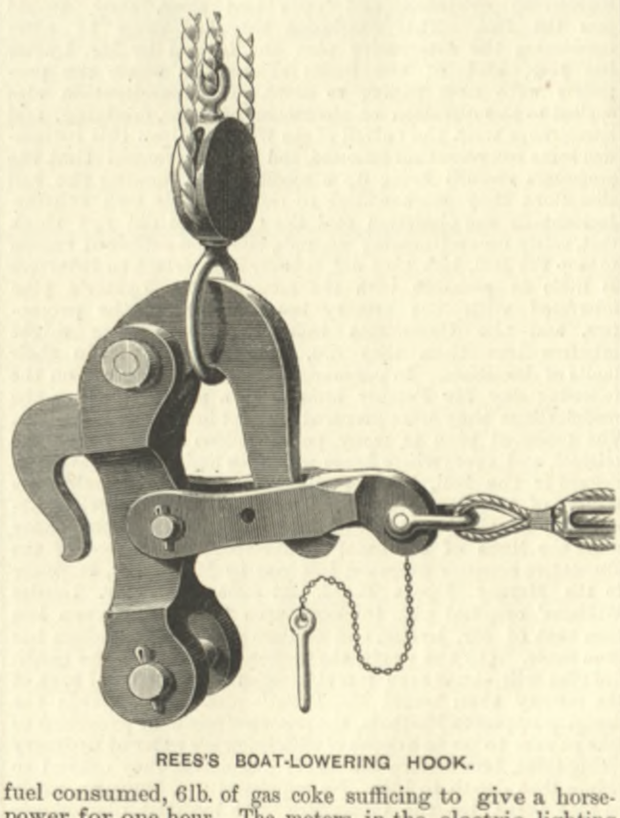
condition of having to be placed below the water level in a well. In this form the importance of dispensing with suction valves is even greater than it is in the pump we



PRICE AND BELSHAM'S DRILL.

have just described, because suction valves under water can only be got at with the aid of fishing tackle or divers. Those who have had much experience with deep well pumps will fully realise the great saving in both time and money from dispensing with the use of such tackle. In this new pump all the working parts are taken out with the bucket by simply drawing the rods. It will be noticed that the bottom barrel is provided with a cover fitting into a conical seating above the bucket, the cover coming away when the bucket is drawn. The tops of the barrels are formed into air vessels.

Four examples of the Davey motor or safety engine are exhibited, two in the electric lighting department and two among the machinery in motion, one of the latter being shown in operation driving a set of deep well pumps suitable for supplying water to a mansion or private house. This motor was fully described and illustrated in THE ENGINEER, in connection with the Shrewsbury meeting of the Royal Agricultural Society last year. It was then quite new. Since that time, we understand, it has been largely adopted and has been greatly improved and simplified in matters of detail. It is specially suited for pumping water for the supply of country houses, railway stations, &c., and is generally applicable to all purposes for which small power is required. Its chief features are its safety, the small amount of unskilled attention necessary, and the small quantity of



REES'S BOAT-LOWERING HOOK.

fuel consumed, 6lb. of gas coke sufficing to give a horse-power for one hour. The motors in the electric lighting department are illustrated in Fig. 6. The boiler, which is shown in section, is detached from the machine itself and is of a novel form, being so constructed that when once filled with coke it will go for eight hours without further attention. This is a matter of great importance. The motor works with steam of atmospheric pressure, which is condensed by means of a supply of a cold water. When used for pumping purposes the water supply itself is made available for condensing, and in other cases a circulating tank is required. This, however, need not be of large dimensions, as the water may be used over and over again. The water resulting from the condensation of the steam is returned again to the boiler, and as no oil or lubricant is put into the steam cylinder, the boiler is kept perfectly clean and free from deposit of any sort. The workmanship of these motors is all that could be desired, every care having been taken not only in designing each part so that it should be easily and cheaply made, but in providing large wearing surfaces, generally of gun-metal, so as to avoid the necessity of frequent attention at the hands of skilled workmen.

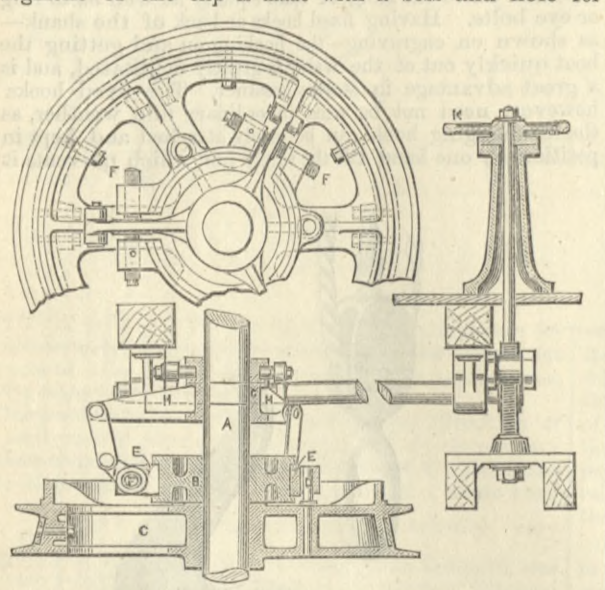
In Group VII., Naval Architecture, Rees' disengaging and hooking-on hooks, for ships' boats, are exhibited by Messrs. W. Reed and Co., of New London-street. These hooks are shown by the accompanying engravings. The following are claimed as among the special features of the device:—The hooks can be fixed to the ordinary fittings of boats without the slightest alteration. They can be shackled on to the sling or span equally as well as to ring or eye bolts. Having fixed hooks at back of the shank—as shown on engraving—the hooking on and getting the boat quickly out of the water is greatly facilitated, and is a great advantage in stormy weather. The fixed hooks however, need not be used in ordinary fine weather, as the disengaging hook can be easily attached and kept in position by one hand till the safety pin, which prevents it

REES'S BOAT-LOWERING HOOK.

from unhooking, is put into place. In lowering the boat, the man in charge holds the thin line till the boat is in the water, when, assuming it to have taken the water evenly, he lets go the line, and both hooks are released instantly and simultaneously. If, however, the boat is allowed to take the water on an even keel, this thin line is not at all necessary, its use being simply to prevent the possibility of either end becoming unhooked in the event of one end taking the water before the other, as sometimes happens.

Messrs. Price and Belsham, Queen Victoria-street, E.C., exhibit a new patent automatic feed drill. This tool has been designed to combine the requirements of a bench drill and ratchet brace, the special features in its construction being the automatic frictional feed and the continuous motion of the drill, the latter being obtained by means of mitre wheels and ratchets actuated by the usual backward and forward motion of the handle, as in an ordinary brace. As a result of these improvements, it is claimed that holes can be drilled more accurately and with much greater rapidity, as the necessity for putting on the feed by hand is entirely obviated, the drill advancing automatically by means of a frictional arrangement capable of adjustment, according as a quick or slow rate of travel is desired. This is accomplished by merely tightening or slackening a nut at the end of the spindle, which bears against a spring, and so varies the pressure on a loose collar, through which the screwed end of the spindle passes. According as the pressure on the collar is great or small, it is either fixed or free to follow the spindle when it is rotated. In the one case the spindle travels at a rate due to the pitch of its thread, and in the other there is no travel at all; but if the pressure be so adjusted as to merely retard the rotation of the collar, it is obvious that the feed will then be due to the difference between the rates of rotation of the spindle and collar, and this may be varied at will by altering the pressure upon the spring. By referring to the annexed illustrations, which show the drill carried in two forms of stand, it will be seen that it can be readily changed from the bench stand to the Universal stand. This is accomplished by removing the nut on the back of the hollow arm. The Universal stand is provided with a slotted flange coupling, by means of which the drill can be readily and securely fixed at any desired angle, all that is necessary being to unscrew two ½in. nuts, and tighten them up again when the drill is in position. By simply adding a belt pulley or hand fly-wheel, the drill may be driven by power, or by a continuous hand motion. The whole of the castings are of malleable iron or steel, the working parts being entirely enclosed in a casing of the former material. The apparatus is therefore likely to be very durable, even if exposed to the usual rough handling that such a tool is sure to meet with in engineers' and boiler-makers' shops. This will be found a useful tool. It is light and handy, the weight being only 21 lb. without the stand.

On this page we illustrate Fisher and Walker's patent friction clutch as applied for working an endless rope for underground haulage in collieries, which is exhibited by Messrs. Walker Brothers, Wigan. A is the main driving shaft, to which is firmly keyed the cast iron friction wheel B, truly turned on the outside. C is the rope pulley which is bored to fit the shaft, but is not keyed to it, and in which three pins D are secured. On the friction wheel is a clip E, made in this case in three segments, the ends of which are enlarged and fitted with gun-metal nuts in which work the right and left-handed screws F. Each segment of the clip is made with a boss and hole for



FISHER AND WALKER'S FRICTION CLUTCH.

receiving one of the pins D. G is a cast iron box sliding on a feather, and provided with arms H carrying links which are attached to the ends of the levers I, keyed to the right and left-handed screws F. When the sliding-box is moved on the shaft by means of the hand wheel K, and connecting gear, motion is communicated to the right and left-handed screws, so that the clip rings opens and allows the friction wheel to revolve freely with the driving shaft, while the rope drum remains at rest. When the box is moved in the opposite direction, the clip is closed on the friction wheel, which it grips, and is thereby caused to revolve, carrying with it the rope drum by means of the pins D. The right and left-handed screws can be arranged so that the clutch can be put into gear by moving the sliding-box in either direction as may be most convenient. The endless rope system for underground haulage in collieries has been largely applied by Messrs. Walker Brothers in cases where a double road could be laid down, and has, we understand, been proved to be very economical in working. The ordinary mode of applying this system is to distribute the wagons over the whole length of the ropes, both as regards the empties going in and the full ones coming out of the mine. In this way, with the wagons fixed at intervals of from ten to twenty yards apart, and the rope moving at the rate of one and a-half miles an hour, a very large amount of material can be passed along one set of ways, while the expenditure of power for hauling is reduced to a minimum. The ropes may either be fixed above or below the wagons, but in the majority of cases the latter is the most convenient method. With either arrangement the ropes are in a great measure carried by the wagons and prevented from rubbing on the ground, independently of the rollers fixed for the purpose. A usual mode of working is to fix the haulage engines overhead at a convenient spot, where the main roads meet, the rope pulleys being placed below the floor on a vertical shaft. A number of pulleys may be fixed to one shaft, and the ropes directed by suitable carrying pulleys to the floor, and thence along the various roadways requiring to be worked. We are informed that the ropes last a very long time, some having been regularly in use for over four years without requiring to be replaced. This is probably due to the absence of severe jerks, which cannot be avoided when the rope has to be stopped and started every time a train is to be hauled.

A well-designed and well-made locomotive is exhibited in the Main Gallery of the Exhibition by the Vulcan Foundry Company, Newton-le-Willows. The engine is the first of two built by the company to the design of Major English, R.E., to replace similar engines sent to the Soudan, originally employed on the works in connection with the fortifications at Chatham, where they had already done good service. The following are the principal particulars, viz.:—

Diameter of cylinders	7½in. by 12in.
Diameter of coupled wheels	1ft. 8¼in.
Diameter of bogie...	1ft. 8¼in.
Rigid wheel base	3ft.
Total wheel base	7ft. 6in.
Capacity of tank	200 gallons
Coal space	6 cwt.
Heating surface:	
Tubes, 1¾in. diameter (71) ... ... =	204 sq. feet
Fire-box	18·75 sq. feet
Area of grate	4 sq. feet
Weight, loaded	10 tons
Gauge of railway	18in.

These engines take a gross load of 45 tons up an incline of 1 in 35 at the rate of ten miles per hour, the working pressure being 150 lb. Although the details contain points of interest, the speciality consists in the swing bogie arrangement, which was designed by Major English to enable the engine to pass readily curves having very short radii. The rails upon which the little Mars stands in the Exhibition are curved to a radius of 50ft. From our sectional and detail engraving, supplemented by the perspective given at page 85, every detail as well as the general character of the design will be fully gathered.

We give this week a full page illustration of a large fixed rivetting machine, designed by Mr. R. H. Tweddell, and constructed by Messrs. Fielding and Platt, Gloucester, a detailed description of which, with further drawings, we hope to publish in our next. The type of this machine is that usually adopted for all fixed rivetters of the largest sizes, capable of exerting closing pressures of from 100 to 150 tons, and having gaps up to 12ft. in depth, the design having been specially made to meet the requirements of engineers engaged in the manufacture of large marine boilers for working with the high pressures now used in triple expansion engines.

PRIVATE BILL LEGISLATION.

AFTER this week, with a prospect of the prorogation of Parliament within a fortnight, there will be little to record in regard to the progress of Private Bills. There are few now left to be dealt with, except to announce their final stage; but the past week has yielded some interesting material in the Committee-rooms and in the two Chambers. Within a few days of the end of the inquiry the Committee again interposed and gave a peculiar and quite unexpected turn to the proceedings. The Chairman, observing that the Committee had now been sitting six weeks and the session was rapidly nearing its close, stated that if the Committee had to decide the question upon the engineering evidence, and upon that alone, they would pass the Bill. This conclusion they had come to after considering the alternative plan put forward by Mr. Lyster last year, and of the limits of deviation which the promoters were now willing to adopt. That consideration also applied to the question of abstraction of water, dredging, and interference with the outfall of the Weaver. Upon this intimation some conversation followed, and it was arranged that the promoters should bring up a modified plan, showing the full alterations they were willing to make in their own scheme. Incidentally the chairman said the Committee did not think that, solely on engineering grounds, there was sufficient reason to stop the Bill, but they did consider it important to interfere as little as possible with the estuary. Mr. Lyster's plan interfered with the estuary less than that of the promoters, and the Committee believed the promoters might interfere less than they did, and yet keep within their limits of deviation. In pursuance of this understanding, on the following day Mr Pember brought up a plan exhibiting the modifications they were prepared to accept in their own scheme. The modified plan in many points follows the lines of the original, and everywhere keeps within the limits of deviation as defined in the Bill, but opposite Eastham and in crossing the estuary of the river Weaver—at which points the principal abstraction of tidal water will be caused—the promoters have made the lines of the canal to correspond with those of the alternative scheme proposed last year by Mr. Lyster, engineer to the Mersey Docks Board. At some points Mr. Leader Williams' original plan infringed upon the estuary even less than that of Mr. Lyster, and at these points no alteration has been made. On the whole, the promoters assert that the modified plan will cause even less abstraction from the tidal area of the estuary than would Mr. Lyster's plan. As regards the dredging opposite Eastham, the promoters originally proposed to take powers to go to a depth of 20ft. below low water of ordinary spring tides, but before the Lords' Committee they offered to reduce that depth to 16ft. No stipulation was, however, made on that point by the Committee. The modified plan shows dredging to the depth of only 15ft. below low water of ordinary spring tides. This alteration would leave a depth at high water of spring tides of 45ft. and of 35ft. at neap tides over the dock sill at Eastham, and would not seriously interfere, as the promoters contend, with the efficiency of the canal. Subsequently, sections and new clauses to agree with the modified plan were handed in. Describing the chief of the new clauses, Mr. Pember said the first alteration of importance was to the effect "that the lower sills of the locks at the entrance to the canal at Eastham shall not be constructed at a lower level than 23ft. below the datum level known as Old Dock sill" at Liverpool. In the original Bill the level mentioned was 28ft.; the limits of deviation allowed an alteration vertically of 5ft., and this alteration, Mr. Pember asserted, was tantamount to dredging outside Eastham to a depth of only 15ft., because a 23ft. sill would make it absurd to dredge below 15ft. Mr. Lyster, the engineer to the Dock Board, proposed to dredge 12ft., the original Bill proposed 20ft., and he now undertook to limit the dredging to 15ft. Another amended clause of importance related to the limits of deviation. Mr. Pember said he understood the Committee, supposing they passed the Bill, to desire to fix a line beyond which the canal should not go further into the estuary. In effect the Committee said, "We will take care that your encroachment on the estuary is reduced to a minimum, and we will carefully define it." Mr. Pember next submitted a tabular statement of tidal capacity cut off from the estuary of the Mersey by the proposed works. On a 14ft. tide the gross abstraction according to the deposited plan would have been 5,904,952 entire yards, and, according to the modified plan, the abstraction would be 3,765,973 cubic yards. In Mr. Lyster's plan the amount of abstraction would be, according to the promoter's calculations, 5,008,000 cubic yards, and according to his own calculation 4,138,000 yards. Deducting in each case the amount of capacity added to the estuary by dredging at Eastham and Runcorn Bridge above the level of low water, the net amount of abstraction would stand thus: Deposited plans, 5,589,952 yards; modified plans, 3,350,973; Mr. Lyster's plan, according to the promoter's calculation, 4,793,000; and Mr. Lyster's plan according to his own calculation, 3,823,000. The promoter's net abstraction on a 14ft. tide was, therefore, according to Mr. Lyster's figures, nearly half-a-million cubic yards less than that involved in Mr. Lyster's plan. Mr. Pember further explained that in this plan the canal would not get into the estuary between Eastham and the river Weaver, and in no case would it be more in the estuary than would Mr. Lyster's. After this some more commercial evidence was taken, and on Monday the investigation entered on its last stage, viz., the closing speeches of the various counsel.

Looking now at the general Bills privately promoted, we find that the difficulty raised in the House of Lords over the Regent's Canal City and Docks Bill has been overcome, and the measure passed by a Lords' Committee. Having passed the Commons, the Bill was opposed in the Upper House on the ground that a provision for paying interest out of capital during construction was contrary to the Standing Orders. The importance of the measure was very generally recognised, and the matter was solved by sending the Bill to a Select Committee—over which Lord Hatherley presided—which reported in favour of the Bill on the ground that it would be difficult to raise the money unless interest was made during construction. The preamble of the Corporation Tower Bridge Bill has also been declared proved by Earl Beauchamp's Committee, although some difficulty has sprung up in regard to compensation. Mr. Saunders, representing the wharfingers and other opponents, proposed the insertion of a clause giving the owners of property between London Bridge and the new bridge a right to claim compensation for anything in the scheme injuriously affecting their property. To this Mr. Littler, for the Corporation, demurred, contending that under such a clause the Corporation would have to pay at least a million and a-quarter in compensation. Instead of that he proposed to give compensation to the extent of one year's net rateable value, which would amount to £75,000.

The Chairman expressed the opinion that two years' rateable value should be given, and there the point was left, to be submitted to the Corporation at their next meeting.

The Metropolitan Board of Works Bill for, *inter alia*, establishing steam ferries at Greenwich and Woolwich, has been approved by a House of Lords Committee; and a Bill to extend the time for constructing a subway from Poplar to Greenwich, being unopposed, has passed the House of Lords. The Hull Bridge Bill, which we mentioned last week, has also passed, subject to a slight change in the design. In the Lower House the Southwark and Vauxhall Waterworks Bill has been withdrawn by reason of the lateness of the period and the amount of opposition threatened; but in the Upper Chamber the Waterworks Clauses Act (1847) Amendment Bill has been read a third time, after a final protest by Lord Bramwell on behalf of the Waterworks Companies.

Nearer 100 than fifty private Bills have received the Royal Assent, including most of the railway, tramway, and water schemes which we have from time to time described and followed in their progress. A curious measure, not involving engineering or structural works, which has passed through Parliament this session, is the Townley Estates' Bill, the object of which is to divide an estate of 40,000 acres among various members of this family.

It may be here mentioned that at the meeting of the Liverpool Chamber of Commerce on Wednesday the following resolution was adopted:—"That, in the event of the Commons Committee passing the preamble of the Manchester Ship Canal Bill, it is the opinion of this Council that a clause ought to be inserted to secure that the necessary funds shall be forthcoming should the Mersey Conservators have occasion to call on the company to restore the estuary to its original condition in case of injury thereto. That it appears to the Council that this object can be attained either by making the liability of the shareholders for this particular object unlimited, or else by attaching an adequate reserve liability to the shares, such reserve liability to be applicable solely to this purpose."

BREAKING STEEL WITH DYNAMITE.—The Lackawanna Iron and Coal Company at Scranton has for a long time been trying to devise some way of breaking up a lot of 6-ton chunks of steel so that they could be utilised. The *American Manufacturer* says these masses of metal became chilled in the ladles from time to time on account of the outlets getting clogged, so that the workmen were unable to pour the molten steel into the ingot moulds. They have been accumulating for several years, and the company has tried in various ways to break them, but the trials have been devoid of any result until now. A 3000 lb. oblong weight of steel dropped on one of the 6-ton bell-shaped masses from a height of 50ft. failed to break it, or even to crack the surface, and after this experiment had been repeated forty or fifty times it was abandoned. Then one of the workmen suggested that powder be used as an explosive to shatter the chunks. So a hole 1¼in. in diameter was drilled into the centre of one of the chunks for a distance of 18in. It was filled with powder, and a steel plug with a priming hole in it was screwed into the orifice. When the powder was ignited by a slow match the workmen, who had retired to a safe distance, expected to hear a terrific explosion. The powder had no more effect on the mass than so much water would have had. A man who was used to handling dynamite was then asked to try his skill on one of the chunks. The steel plug was unscrewed and a dynamite cartridge 5in. long was placed in the hole. Then the plug was screwed in again and the dynamite exploded. All that the dynamite did was to blow the plug out. The next thing done was to place two cartridges of dynamite in the hole and to tamp them down with sand. When they exploded the force all went out of the hole in the wake of the sand. The dynamiter said that he would keep on adding one cartridge at each trial until the hole would not hold any more, and he put in three cartridges the third time and tamped them down with sand. The explosion was heard in every part of the city. The three cartridges had cracked the 6-ton mass into a number of pieces small enough to be melted. One piece, which measured 1200 lb., was thrown more than 100ft. Over thirty chunks of the same size will be similarly treated during the summer.

RAILWAY MATTERS.

A RAILWAY is talked of to connect Beverley and Hornsea, and it is proposed to construct docks at the latter place. Direct communication from Beverley to the sea would be an advantage alike to Yorkshire manufacturers and agriculturists.

THE Russian papers state that the work on the Trans-Caspian Railway is progressing rapidly. Large quantities of material have been forwarded, and forty engineers are employed on different parts of the line. The second railway battalion is reported to have reached Krasnovodsk on the 10th inst.

THE Great Northern Company has about 800 horses in London alone, and their vans carry from 1200 to 1800 tons daily through the streets of the metropolis. Over London Bridge this company sent in one year 4056 vehicles, and over Blackfriars 31,720, or over both bridges for the year 35,000 loaded and 16,900 empty.

No less than five collisions—20 per cent. of the whole of the American railway accidents, during last May—were caused by trains breaking in two. Two were caused by the absence of signals where they were needed; one each by a mistake in train orders, by a misplaced switch and by a runaway engine, the last being probably due to a broken throttle valve.

THE headquarters of the Hurnai Railway are now placed at Quetta. Several thousand men are working on the section east of Hurnai, and their health is reported to be good, although a few cases of cholera have appeared. The route adopted for the extension from Shebo to the Khojak Pass is now being surveyed, and the requisite material has been ordered from England.

THE new East Railway Station at Bournemouth, to which we recently referred in this column, was opened last Friday for passenger traffic. It is a handsome and commodious structure, and has been built at a cost of some £40,000 by Messrs. Perry and Co., of Bow, from designs prepared by the engineer of the London and South-Western Railway Company. It is 350ft. long by 95ft. span, with a glass roof about 40ft. from the platform, carried on massive iron girders, each of which weighs over 17 tons. The platforms are 25ft. wide.

THE Great Eastern Railway Company is making special arrangements by means of its new steamers for visitors to the Antwerp Exhibition. The steamer Adelaide will leave Harwich for Antwerp at 11 a.m. on Saturday, August 1st, in connection with a special train from Liverpool-street station at 9 a.m., and return from Antwerp on Tuesday morning, giving passengers two clear days at the Antwerp Exhibition or in Brussels. The s.s. Norwich will leave Harwich on Friday evening and the Ipswich on Saturday evening for Antwerp, in addition to the ordinary steamers on each night to Rotterdam in connection with the continental expresses from London at 8 p.m. and Doncaster at 4.48 p.m.

IN answer to a question in the House on the 27th on the railway from Suakim to Berber, Mr. W. H. Smith said that no report had been received on the condition of this railway, but it was known that one portion had been damaged by heavy rains and another portion had been torn up by the Arabs. The total length laid down was 18⅜ miles, but this was not guarded beyond the western redoubt or maintained beyond 1½ miles from the landing place. About 15,000 tons of rails and 375,000 sleepers were provided, of which all the rails and 350,000 sleepers were despatched to Suakim. About one-sixth of the materials sent out were landed at Suakim, and were still there. The remainder would be brought back, and would probably be made use of at certain military stations where tramways were required.

AN extraordinary occurrence took place on the 16th inst on the Denbigh and Ruthin Railway. A butcher was driving home a fat bullock, when the animal escaped on to the railway. The driver of the four o'clock train came down upon the animal on leaving Denbigh. The whistle was blown and the brakes applied, but the engine struck the animal, hurling it forward helpless, but still on the line of rails. The engine, and several carriages jolted violently over the dead carcase, but the last carriage was turned completely over, and was dragged along in this alarming position for 300 yards, doing great damage to the permanent way. The passengers escaped without injury, but were greatly alarmed at the violent oscillation. The accident occurred on an embankment, and had the engine left the rails a terrible catastrophe must have occurred.

COLBURN'S wood and paper brake shoe, a shoe consisting of alternate layers of compressed paper and wood, of about ⅛in. each, has, the *Railroad Gazette* says, been recently tested on the New York Elevated Railroad, three cars on the Third Avenue line having been equipped. These cars are stated to have been in daily service for thirteen weeks, making a run of 9271 miles, against eight weeks and 6000 miles of the standard metal shoes of the road. This, it is claimed, would equal a run of 200,000 miles on an ordinary road, since the number of stops is about twenty times as many. Quicker stops can be made than with metal shoes, it is said, and naturally with much less wear to the wheel tread. The patentee is L. S. Colburn, of Oberlin, O. There is especial necessity for some other than a metallic shoe on the elevated roads, if it can be had, to avoid the annoyance and danger to eyesight of flying particles of metal.

THE *Railroad Gazette* record of train accidents in May contains brief accounts of 25 collisions, 34 derailments, and 3 other accidents, being 62 accidents in all, in which 8 persons were killed and 65 injured. Three collisions and 4 derailments caused the death of one or more persons; 5 collisions, 5 derailments and 2 other accidents caused injury to persons but not death. In all 7 accidents caused death and 12 injury, leaving 43, or 69 per cent. of the whole number in which there was no injury to persons serious enough for record. The 25 collisions killed 4 persons and injured 12; the 34 derailments killed 4 and injured 50, while in the 3 other accidents 3 persons were hurt. All the persons killed and 32 of those injured were railroad employés, who thus formed 49 per cent. of the injured and 55 per cent. of the whole number of casualties. No passenger was reported killed last month. As compared with May, 1884, there was a decrease of 14 accidents, of 24 killed, and of 85 injured.

BETWEEN eleven and twelve last Friday night an accident happened on the London and North-Western Railway at Chelford. About ten o'clock a goods train left Crewe for Manchester, and at 10.33 a passenger train followed. The night was very foggy, and both lights and signals were completely obscured. When the goods train was passing the signal-box at Chelford, the express passenger train, which was following, ran into the tail end of the goods train with great force. Portions of the wagons were sent flying in all directions. One was thrown against the signal-box, which it smashed up, and telegraphic communication was at once stopped. The lines were strewn with broken wagons and goods, including immense quantities of fruit. The passengers in the express were greatly alarmed, and a Manchester lady and gentleman complained of being hurt. The guard and signalman had remarkable escapes. The line was blocked until eight o'clock on Saturday morning.

As such instances as the following are somehow left out of the brake returns to the Board of Trade, it is necessary that they should be published elsewhere, for the lives of passengers on otherwise one of the best equipped and managed of British railways are endangered by the cause of the facts:—It seems that on the 6th inst., the 6.10 a.m. Midland train from London to Leicester, consisting of the equivalent of 19 vehicles, lost about half an hour in running owing to the difficulty in releasing the vacuum brakes, and in stopping at Leicester the train was broken into three pieces. Again on the 24th inst. the 9.15 p.m. Midland Scotch train from London was forced to be stopped at Thurmaston signal box, about two miles out of Leicester, owing to the tires on the wheels of a van being, it is said, red hot. The brakes could not be released, the luggage was transhipped to the ballast, and the van put back into Leicester station. These little incidents caused a delay of one hour and ten minutes to this important competitive train.

NOTES AND MEMORANDA.

A PAPER "On the Oxidation of Copper," by MM. Debray and Joannis, is given in *Compt. Rend.* 99, 688:—"Copper becomes oxidised by heating it in air from 350 deg. up to a temperature at which the dissociation of the oxide attains a tension of ⅓ atmosphere, when cupric oxide is formed without passing through the intermediate state of cuprous oxide. Cuprous oxide is oxidised at a moderate heat even more rapidly than metallic copper. At a very high temperature cupric is converted into cuprous oxide."

THE deaths registered during the week ending July 18th in twenty-eight great towns of England and Wales corresponded to an annual rate of 19·5 per 1000 of their aggregate population, which is estimated at 8,906,446 persons in the middle of this year. The six healthiest places were Halifax, Bradford, Brighton, Hull, Derby, and Bristol. In London during the week ending July 18th 2411 births and 1616 deaths were registered. The annual death rate per 1000 from all causes, which had been 16·3, 17·5, and 18·0 in the three preceding weeks, rose to 20·6, a higher rate than has prevailed in any week since April last.

IN the Inventions Exhibition, Stand 1092, West Arcade, is a most ingenious application of compressed air by Mr. Birch to the requirements of the artist and draughtsman. A supply of compressed air is provided by a foot pump, and this is led by a small pipe to an instrument held in the hand and containing a jet nozzle near the end of a small trough for containing ink or colour. In the trough a needle reciprocates, its point projecting more or less at every reciprocation. The point thus carries a small quantity of ink or colour, which is blown off by the air jet. Very remarkable and delicately shaded drawings are rapidly produced by its aid, and it has very numerous applications.

THE Concert Hall at the Albert Exhibition Palace, Battersea Park, in which the celebrated Holmes organ is erected, compares favourably as to the space apportioned to the audience, with some of the best-known buildings devoted to music throughout the world. Thus the largest buildings of the sort are at—La Scala, Milan, length 105ft., width 87ft., height 67ft.; San Carlos, Naples, length 100ft., width 85ft., height 103ft.; Grand Opera, Paris, length 103ft., width 102ft., height 73ft.; Covent Garden, London, length 89ft., width 80ft., height 55ft.; Metropolitan, New York, length 108ft., width 101ft., height 82ft.; Albert Palace Hall, Battersea, length 157ft., width 118ft., height 60ft. Thus it is seen that while the Albert Palace Concert Hall is 157ft. long, the average of the other five is 101ft.; while it is 118ft. wide, the average of the other five is 71ft.; but it is only 60ft. high, and the average of the other five is 76ft. The superficial area devoted to the audience is as follows:—At La Scala, Milan, 9135 square feet; San Carlos, Naples, 8500; Grand Opera, Paris, 10,506; Covent Garden, London, 7120; Metropolitan, New York, 10,908; and Albert Palace Hall, Battersea, 17,626 square feet.

FROM time to time some new hygienic scare is invented, reigns, and dies, and we are happy until some pessimistic scare-hunting sanatarian invents a new one. Some hobby riders will feel inclined to kill M. de Parville when they read his article in the *Journal des Débats*. If we listen to him, bacteria will soon be useless as a scare. The proportion of bacteria in a cubic metre of atmospheric air is, according to M. de Parville, 0·6 in sea air, 1 in the air of high mountains, 60 in the principal cabin of a ship at sea, 200 on the top of the Panthéon, 360 in the Rue de Rivoli, 600 in the Paris sewers, 36,000 in old Paris houses, 40,000 in the new hospital of the Hôtel Dieu, and 79,000 in the old hospital of the Pitié. In Ryder-street, St. James's, a cubic metre of air contains only 240 bacteria, whereas in the Rue Rivoli the same quantity of air contains 360. M. de Parville says the superiority of London air as compared with the air of Paris is shown not only by its containing fewer bacteria, but also by the rate of mortality being smaller. The greater purity or lesser impurity of the air of London is accounted for by London being nearer than Paris to the sea, by its covering a greater extent of ground in proportion to the population, and by its houses being lower.

THE following on the distillation of American petroleum is from a paper by M. D. Mendeléeff:—"On carefully fractioning the portion of Baku—Caucasian—petroleum, which boils between 50 deg. and 120 deg., the density of the fractions diminishes as the boiling point rises from 55—62 deg., from 80—90 deg., and from 105—110 deg. American petroleum shows the same peculiarity; thus, the sp. gr. of the fraction boiling at 80 deg. is 0·7347 at 17 deg., which is the same as the sp. gr. of the fraction boiling at 75 deg.; beyond this point the gravity augments as the temperature is raised until 104 deg., when the sp. gr. is 0·7543 at 17 deg., and again diminishes, being 0·7270 at 17 deg. for the fraction between 115 deg. and 117 deg., the same density as those boiling at 98 deg. and at 86 deg. The gravity then again augments with the temperature from 117—125 deg. American and Caucasian petroleums are therefore similar in this respect, but the densities of fractions boiling at equal temperatures are different; thus, the gravity of that fraction of Baku petroleum boiling at 80 deg. is 0·7486 at 17 deg., whilst that of American coming over at the same temperature is 0·7347 at 17 deg. The relative quantities of the fractions are also different for the two petroleums."

THE "Transactions" of the North of England Institute of Mining and Mechanical Engineers give the following results from a detailed report on an artesian well bored at Grissée, a town of 25,000 inhabitants on the north coast of Java. The bore reached a depth of 747 metres—2451ft.—and observations of temperature taken by Mr. J. Ph. Emerling, both during the progress of the boring and afterward, gave the following results, now published for the first time:—

Depth Metres.	Depth Feet.		Temperature.	
253	830	March 4th, 1869	30° C.	(86° F.)
275	902	,, 7th, ,,	30° C.	(86° F.)
303	994	,, 10th, ,,	30° C.	(86° F.)
310	1017	,, 15th, ,,	33° C.	(91·4° F.)
368	1207	,, 20th, ,,	36° C.	(96·8° F.)
400	1312	,, 24th, ,,	37° C.	(98·6° F.)
410	1345	,, 25th, ,,	38° C.	(100·4° F.)
416	1365	taken after the completion of the boring	45° C.	(113° F.)
422	1385	March 29th, 1869	40° C.	(104° F.)
472	1549	taken after the completion of the boring	48° C.	(118·4° F.)
510	1673	taken after the completion of the boring	50° C.	(122° F.)
730	2395	taken after the completion of the boring	58° C.	(136·4° F.)

M. ILINSKI and G. Von Knorre, writing on a new method of separating nickel and cobalt, in the *Chemical News* say: "The solution containing nickel and cobalt as sulphate or chloride—iron and chromium must not be present—is mixed with a few c. c. of free hydrochloric acid. There is then added to the liquid, previously heated, a hot solution of nitroso-β-naphthol in hot acetic acid. The precipitate is allowed to subside, and when cold the liquid is tested with a further quantity of the nitroso-naphthol solution. If the precipitation is complete, the deposit is filtered off after some hours, and washed with hydrochloric acid at 12 per cent., first cold and then warm, until the nickel is removed, and lastly with hot water. As the precipitate is very bulky, the filter used must not be too small; in other respects, the washing is easy. To the dry precipitate are added a few knife-points full of crystalline oxalic acid, free from ash; the filter is folded up and incinerated cautiously in a tared Rose's crucible at a gradually increasing heat. It is then ignited in a current of hydrogen, and weighed as metallic cobalt. In the filtrate the nickel is thrown down, apparently quantitatively, by heating with potassium hydroxide after the bulk of the acetic acid has been expelled by heat. It is preferable, however, to precipitate nickel and cobalt together in an aliquot part of the solution by means of potassium hydroxide, and to weigh the metal after reduction in a current of hydrogen. In another portion of the solution the cobalt is determined as above, and the nickel is found as difference."

MISCELLANEA.

THE London offices of the Chillington Galvanising Company are now at 4, Cullum-street, E.C., Messrs. Percival Sanford and Co. being the agents in London.

THE first visit of the Inventors' Institute to the International Inventions Exhibition at South Kensington will take place to-day. Members will assemble at 4 p.m. in the entrance vestibule from Exhibition-road.

GREAT preparations were made at Venice for the launch there, yesterday, of the new ironclad Francesco Morosini, in the presence of the King and Queen of Naples. People were flocking into Venice from all directions, and it was expected that the members of the Moorish Embassy would be present.

THE *City Press* states that the special committee appointed by the Corporation to report as to some scheme for the future administration of the metropolis will probably recommend that the Home Secretary be approached with a plan for creating separate municipalities for the districts represented by the old Parliamentary boroughs, with the addition, perhaps, of West Ham. The suggestion will include a central council at Guildhall for common purposes.

HER Majesty's ship Icarus was launched at Devonport Dockyard on Monday in the presence of over 10,000 people. The vessel, which was christened by Miss Phillimore, daughter of Admiral Augustus Phillimore, commander-in-chief, is of the Mariner and Racer class. She is 950 tons, and 1200-horse power, and will attain a speed of 14 knots without forced draught. She is armed with eight 5in. breech-loaders and four Nordenfeldts and Gardner guns. Her total cost when ready for sea will be about £50,000.

DURING the last few days a strike of a serious character has existed among the sailors and firemen employed in the Atlantic steamship trade. It appears that some of the large Atlantic companies have recently reduced the wages by 10s. per month per man. Firemen who formerly received £4 10s. for what is known as the "Western Ocean voyage" are now offered £4 per month. The pay for the sailors for the same voyage has been reduced from £4 to £3 10s. per month. Several of the companies have not yet made any reduction, but it is thought they will do so.

THE Southwark Foundry and Machine Company, of Philadelphia, has just completed and is preparing for shipment a pair of centrifugal pumping engines for the United States Navy Yard at Mare Island, Cal., which are claimed to be the largest ever made in America, and, with one exception, in the world. Each pump weighs 165,000 lb. The engine cylinders are 28in. in diameter by 24in. stroke. The pumps are over 11ft. in diameter, and each has a capacity of 40,000 gallons per minute. All the pump pipes are 42in. in diameter. Each engine drives a pump direct, and each acts independently of the other. The engines are supplied with the Porter-Allen link motion.

ABOUT a year ago extraordinary deposits of magnesite were discovered in Styria. As is well known, no material is so admirably adapted for furnace-lining, for durability and fire-resisting properties as magnesite. The composition of the material is approximately as follows:—Carbonaceous magnesia, 90·30 to 97·32 per cent.; carbonaceous limestone, 0·05 to 0·61 per cent.; argillaceous earth, 1·40 per cent.; iron oxide, 4·49 per cent.; insoluble residuum, 3·73 per cent. This residuum is found to consist of silicic acid, 0·93 per cent.; argillaceous earth, 0·21 per cent.; iron oxide, 0·18 per cent.; magnesia, 2·41 per cent. Magnesite, after being dead burnt, is chiefly employed in the form of magnesia stone for furnace bottoms, and already a considerable trade has sprung up for this and other purposes. The employment of magnesia stone is not, however, confined to the steel industry. Messrs. Zeitz and Co., Sheffield, are introducing it for the use of cement manufacturers and zinc smelters.

IN connection with the storm-water sewers now under course of construction by the Metropolitan Board of Works, is an aqueduct crossing the valley of the Wandle, between St. Anne's-hill, Wandsworth, and Merton-road, West-hill. Near St. Anne's Church the sewer comes out into the open high ground, after passing under Clapham Common and portions of Wandsworth Common. It is thence carried across the valley of the Wandle by an aqueduct consisting of fifty arches, being about three-quarters of a mile in length. Garrett-lane is crossed over by an iron girder bridge, above which is the sewer, formed at this point by iron cylinders. The remaining portion of the sewer, above the arches, is egg-shaped, and formed of concrete. Near Merton-road the sewer is again carried underground on to Putney and Roehampton. The contractor for the aqueduct, which is now almost completed, is Mr. J. Waddell, who is also executing those portions of the works between High-street, Clapham, and the terminus at Putney and Roehampton.

AT the meeting of the Liverpool Water Committee on Monday, a report from the engineer was submitted, stating that during the fortnight ending the 21st inst. the total volume of water at the Rivington reservoirs had decreased by 158,000,000 gallons. Compared with the corresponding fortnight of last year there was a decrease in the total quantity of water in store of 1,336,000,000 gallons. The chairman—Mr. Bowes—said the committee had foreseen this scarcity, and that was the reason they were so anxious to push on with the new works at Vyrnwy. The water was now so low that if there was not a good fall of rain they would practically be without water before October. A member said that the grass was growing down to the bottom of the Rivington reservoirs, which more resembled grazing ground than places for water storage. Water is supplied to the inhabitants during only twelve out of the twenty-four hours. It was resolved to use sea water for watering the streets instead of reservoir water. The new works will not be ready for at least three years.

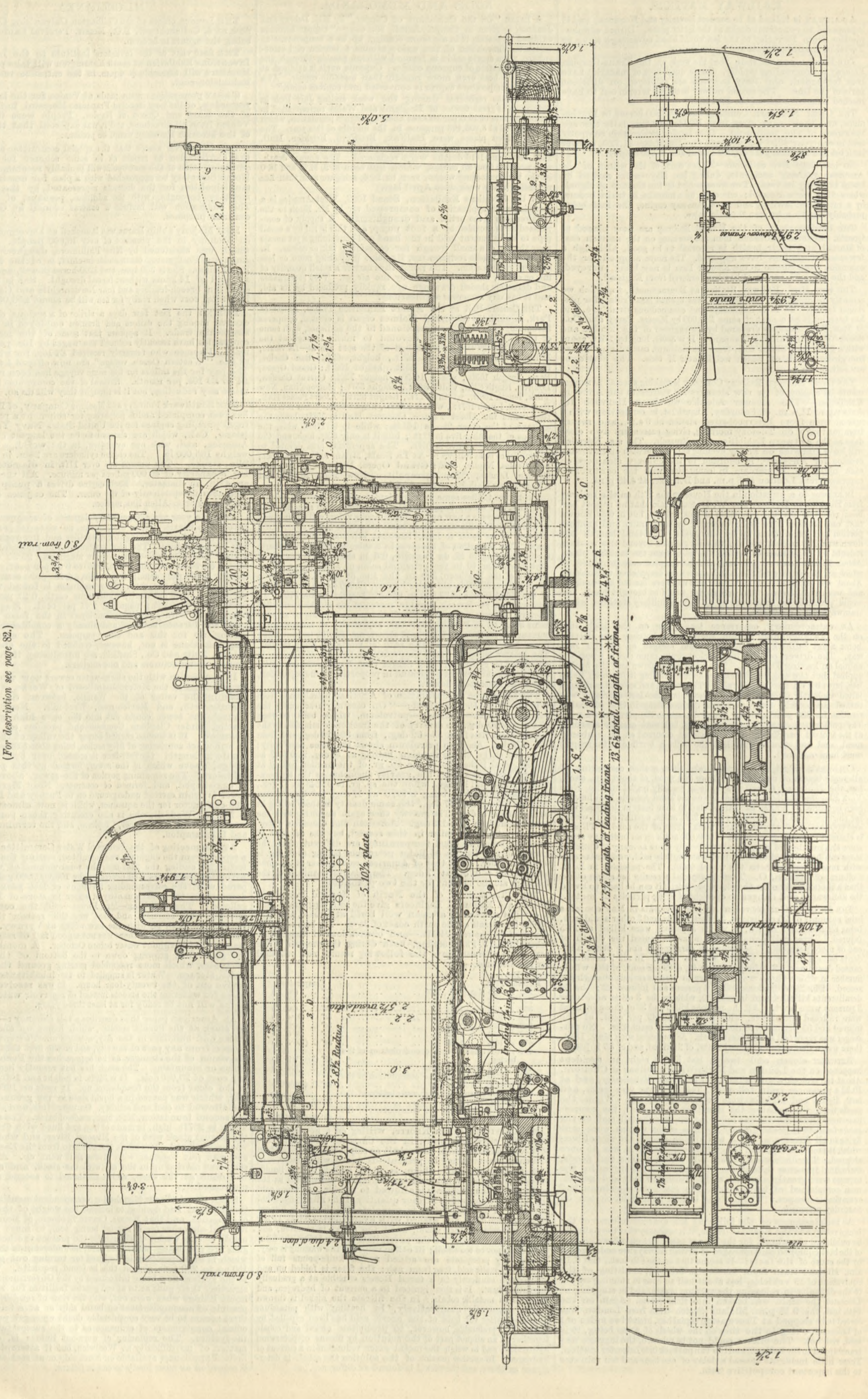
AN American paper thus describes a tall chimney:—"The large red stack at the Puebla smelter, which looms up above all other stacks and buildings in the city, attracts much attention. It can be seen from any part of the city, and is the first thing that meets the vision of the stranger as he approaches the Pueblos from the plains or mountains. The stack has but recently been completed at a cost of 20,000 dols. It is 319ft. in height and 10ft. in diameter in the clear from the foundation up. It rests on 16ft. of smelter slag, which was poured in a liquid state in the ground 16ft. deep, and allowed to cool and solidify. On top of this, and above ground, is a second foundation, 16ft. high, made of brick. The stack proper, which is 287ft. high, is made of iron and lined with fire clay. It is the largest stack west of the Missouri River, and when completed was painted red. The stack reached here from the East in sections, and was put together with rivets as it went up. A blacksmith shop was carried up in the air with the stack, and all the work was done at the shop, which continued to ascend as the work progressed."

SOME time back our Manchester correspondent mentioned that the Government had decided to increase the weight of the heavy class of ordnance, and that Messrs. Craven Brothers, of Manchester, had received an order for a special boring tool, to meet the requirements of this work. Although for the present the heavier type of guns are not being pushed forward, he understands that the plant which is in preparation is designed for turning out guns of from 150 up to 200 tons, should this be found requisite. With regard to the system now being introduced by the Government of so constructing their guns as to afford greater facilities for replacing the inside linings when worn out, with the view of rendering this work possible of accomplishment on board ship or at a foreign station, there seems to be very considerable doubt amongst practical non-official constructors of ordnance as to the successful working of the system. The replacing of worn-out linings is, of course, a matter of no difficulty at Woolwich, but if attempted with the limited appliances available on board ship or at stations abroad, it is regarded as most likely to end in failure.

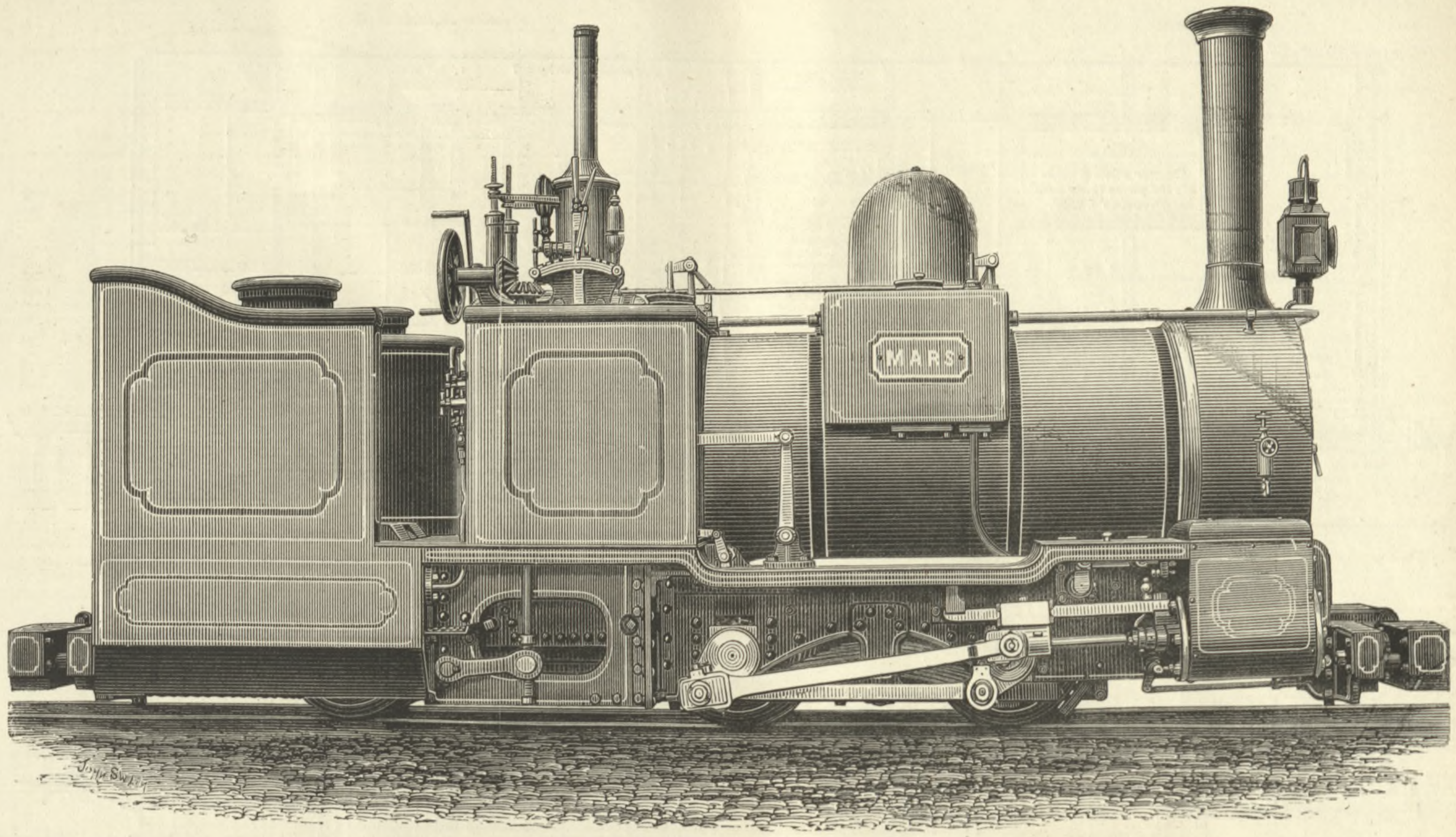
INVENTIONS EXHIBITION—SWIVEL BOGIE LOCOMOTIVE.

THE VULCAN FOUNDRY COMPANY, NEWTON-LE-WILLOWS, CONSTRUCTORS.

(*For description see page 82.*)

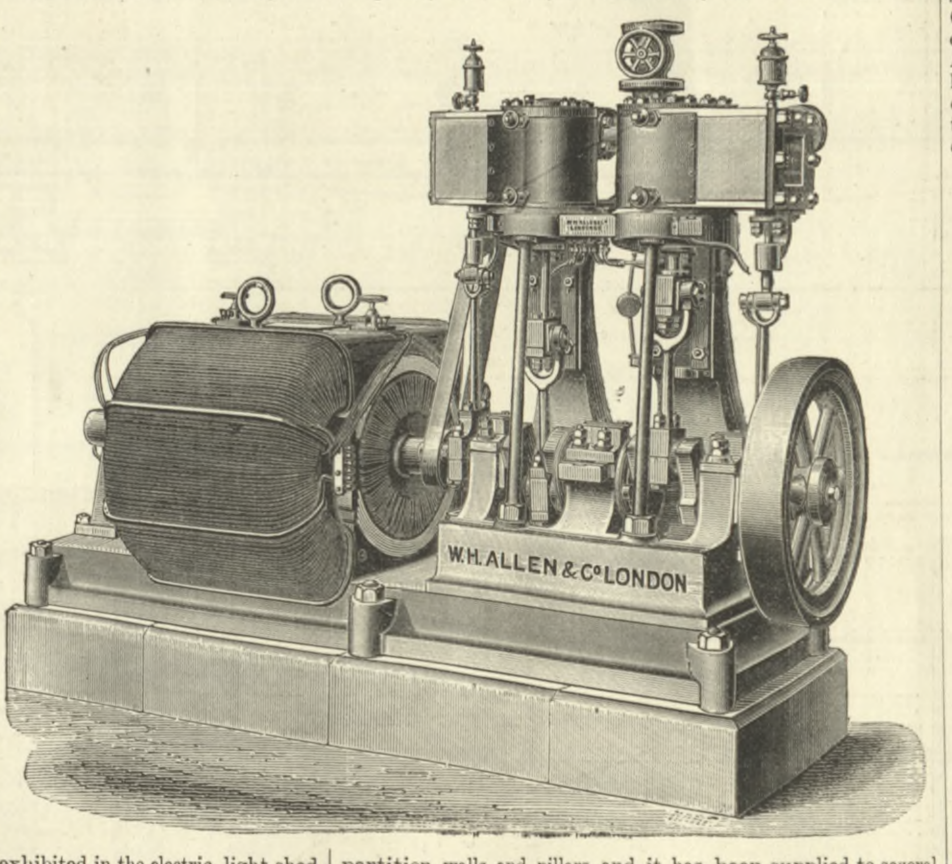


INVENTIONS EXHIBITION—LOCOMOTIVE BY THE VULCAN FOUNDRY COMPANY.



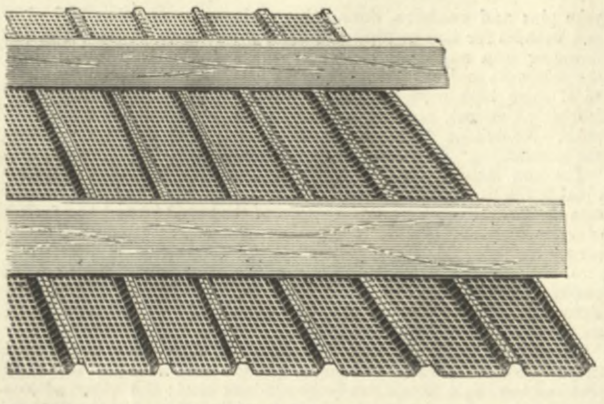
COMBINED ALLEN ENGINE AND KAPP DYNAMO.

ALTHOUGH within the last few years a large number of rotary engines specially designed for dynamo work have been brought out, there would seem still to be room for improvement in that direction, and Messrs. Allen and Co., makers of high-speed direct-acting engines, are manufacturing a combined engine and dynamo, which we illustrate in the annexed engraving. About the engine we need not say anything, as it is widely known. The dynamo, however, is new. The armature is wound on the Gramme principle, and is made exceptionally heavy and of large diameter in order to reduce the speed sufficiently for driving direct by reciprocating engines. Projecting through the external periphery of the winding is a number of gun-metal radii tipped with fibre, which transmit the driving power direct to the wires which do the work, thus preventing the latter from slipping on the core. The radii are cast in one piece with a perforated central gun-metal cylinder, the latter being keyed to the spindle by two sets of arms. Air is admitted to the interior of the core through the perforations and escapes at the outer periphery between the external wires, which do not completely cover the surface of the core. In this way the armature is ventilated and kept cool. As will be seen from our illustration, the field magnets are nearly semicircular, the object of this arrangement being to obtain a short magnetic circuit and a compact arrangement requiring little room. The plant which is exhibited in the electric light shed at the Inventions Exhibition is intended for 270 60-watt lamps, the maximum current being 150 ampères and the potential 110 volts at the terminals, with a speed of 340 revolutions a minute. The total weight of the engine and dynamo combined is three tons.



CORRUGATED WIRE LATHING.

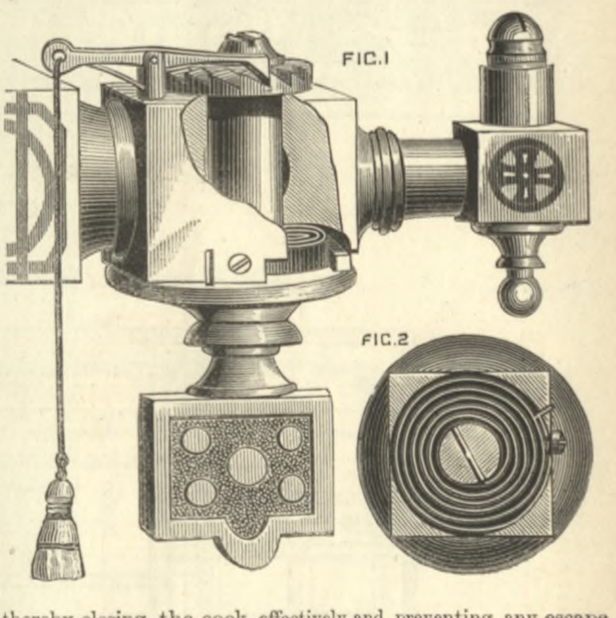
AN ever increasing field seems to be found for wove wire in its useful adaptability to a variety of purposes. As a substitute for the usual lath foundation for plaster ceilings it is now being introduced as an important element in fire-proof construction. The manner in which it is adapted for this purpose is very simple, as shown in the accompanying illustration. This arrangement of wire lathing, which is patented, is formed of sheets of galvanised wove wire cloth, 3ft. wide by 6ft. 10in. long, with an open mesh. These sheets have corrugations or grooves, ⅜in. deep, formed every 6in. to 8in., which make the cloth rigid and keep it from the under surface of the joists. From experiments which have been made as to the comparative merits of the wove wire and the ordinary wood lathing, it has been found that the plaster keys better on to the woven wire than on to laths, and that when the plaster is heated red-hot, and suddenly chilled as by a gush of cold air or a jet of water, it does not crack and break away as would usually be the case with a ceiling on ordinary lathing, but remains in its position, thus affording, in the case of fire, protection to the joists or flooring above. Another advantage, although of lesser importance, is the preservation of the ceiling from cracks by the absence of contraction or expansion on the wire lathing, and the abundant play allowed for any slight twisting of the joists by the manner in which it is fixed with staples to the beams above. The system, which is being introduced by Messrs. R. Johnson, Clapham, and Morris, of Manchester, can also be used for partition walls and pillars, and it has been supplied to several music halls in London, whilst in New York its use is rapidly spreading, and the fire insurance companies are abating their



premiums where the wire lathing is employed. It has also received the approval of the Metropolitan Board of Works, of Mr. Ewan Christian, the president of the Royal Institute of British Architects, and of Mr. Horace Jones, the City architect.

ATTACHMENT FOR GAS COCKS.

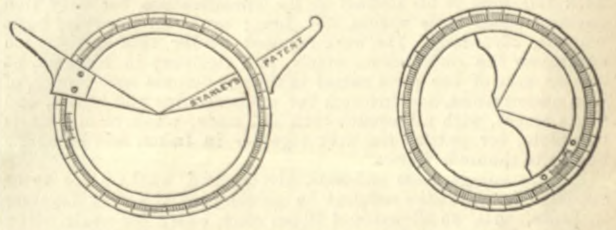
THIS attachment, invented by Mr. G. Doutney, and described by the *Scientific American*, closes the cock by means of a spring, and prevents it remaining partly open when the gas is turned off. It may be attached to any burner now in use. One end of a spiral spring, Fig. 2, is secured to the key and the other end to the casing surrounding the spring. The spring keeps the cock closed, and when the key is turned to open the cock the spring swings it back again, thus closing the cock automatically. On the upper end of the key is a disc formed with ratchet teeth engaged by a lever, Fig. 1, to one end of which a cord is secured. A spring keeps the lever engaged with the teeth. The key is locked in any position, whether the gas is to be turned on full or only partially, by the lever engaging with one of the teeth of the disc. To extinguish the gas it is only necessary to pull the cord, when the key is released and is turned by the spring



thereby closing the cock effectively and preventing any escape of gas. This attachment will prevent loss of life by careless persons leaving the gas key half way open, or by their turning off the gas and then turning the key partly open again.

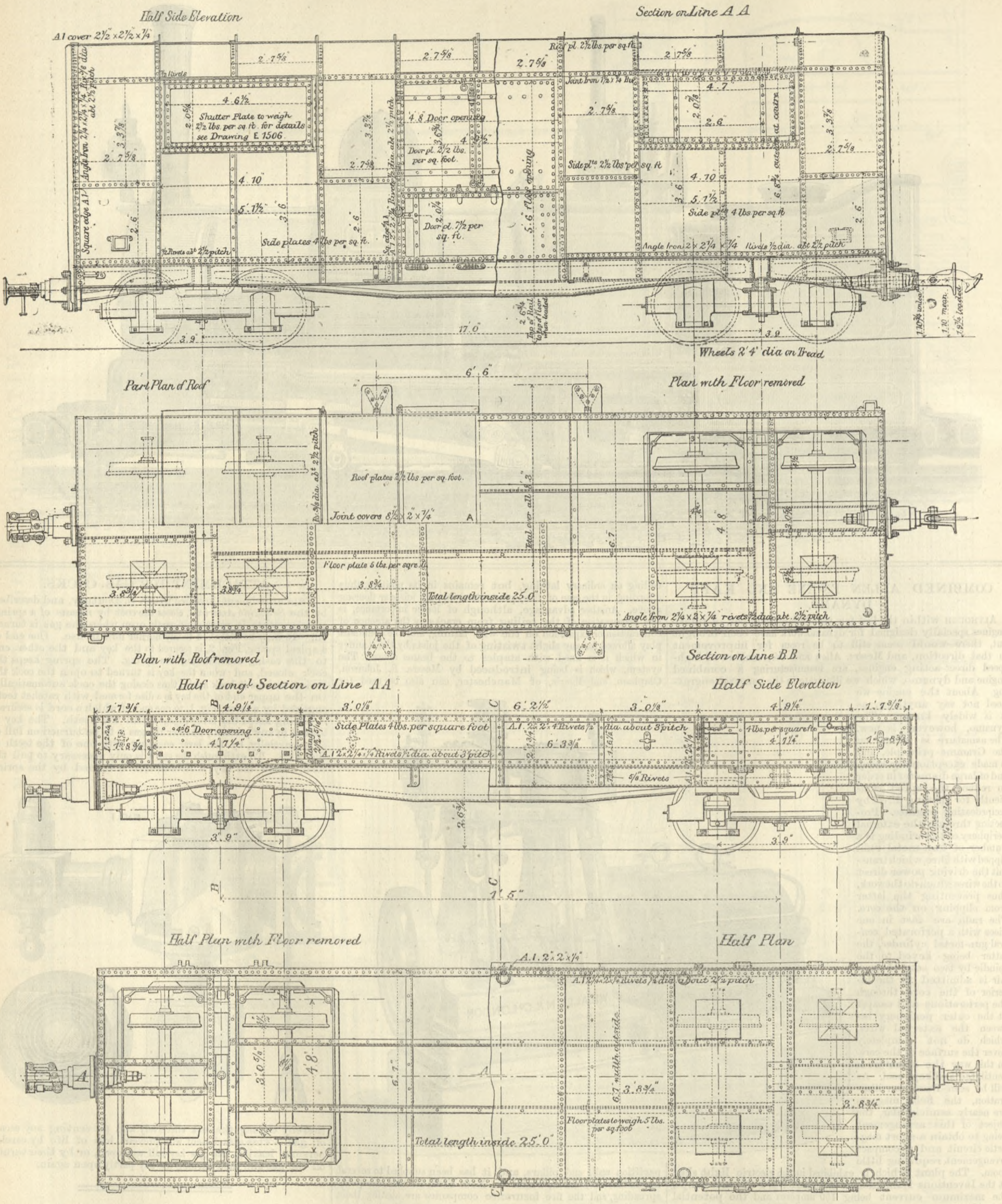
STANLEY'S NEW PROTRACTOR.

THE accompanying engravings show a new protractor possessing great merits. The edges forming the angle proceed quite up to the vertex. This improvement will be most important for the measurement of angles upon Ordnance plans



and plans of estates to small scales, where lines subtending any angle are generally very short. It will also be found convenient for measuring and plotting angles from solids, used as a goniometer for the measurement of crystals, planes of cleavage, &c. It is made by Mr. W. F. Stanley, of Great Turnstile.

CONTRACTS OPEN—IRON WAGONS, CAWNPORE-ACHNERA RAILWAY.



CONTRACTS OPEN.

INDIAN STATE RAILWAYS.—CONTRACT FOR IRON BOGIE WAGONS FOR THE CAWNPORE-ACHNERA RAILWAY.

The following is an abstract of the specification for sixty iron covered goods bogie wagons, 25ft. long; ten iron low-sided bogie wagons, 25ft. long. The work required under this specification comprises the construction, supply, and delivery in England, at one or more of the ports named in the conditions and tender, of iron underframes, and ironwork for underframes and bodies, and bogie trucks, with all requisite bolts and nuts, washers, and rivets complete, for putting the work together in India, and fixing the bodies to the underframes.

All fastenings, bolts and nuts, rivets, and washers are to be supplied in quantities sufficient for putting all the work together in India, with an allowance of 20 per cent. extra for waste. The contract does not include wheels and axles, bearing springs, and axle-boxes. All these parts will form the subjects of separate contracts. No woodwork is required to be sent to India. The whole of the materials to be of the best quality. No other material than wrought iron, india-rubber, or steel is to be used, except where specified otherwise, or shown on the drawings. All coupling hooks, coupling bolts, nuts, washers, and pins, coupling blocks, yokes, yoke pins and washers, connecting rods, and connecting rod pins and washers for the buffing and draw gear, are to be forged from Lowmoor iron supplied direct by the Lowmoor Iron Company; the yoke nuts and ferrules are to be of steel. All other iron is to be of some best best brand, of a quality to be approved by the Inspector-General, and is to be specially suited for smithing purposes. No iron of foreign manufacture is to be used throughout the contract.

The iron must be of such strength and quality that it shall be equal to the under-named several tensional strains, and shall indicate the several rates of contraction of the tested area at the point of fracture that follow, namely:—Bars and rods: Tensional strains per square inch, 24 tons; percentage of contraction of fractured area, 20. Plates: Tensional strains per square inch, 21 tons; percentage of contraction of fractured area, 10. Channel, angle, and T-iron: Tensional strains per square inch, 22 tons; percentage of contraction of fractured area, 15.

The channel bar in the sole and cross bars of the underframe and the middle cross bars of the bogie, and the end T bars and the side plates of the bogie truck are to be made of steel; the other plates and angle bars may be made of steel. All steel used in the manufacture of the wagons, except that in the volute springs, is to be of such strength and quality that it shall be equal to a tensional strain of not less than 27 tons or more than 31 tons per square inch of section, and shall indicate a contraction of 30 per cent. of the tested area at the point of fracture. The steel of which the volute springs are to be made is to comply on analysis with the following conditions, namely:—Its carbon must not exceed ·9 or be less than ·6 per cent.; and silicon, phosphorus, and sulphur must not be present in greater proportion than ·06 per cent. each. The manganese must not exceed ·6 per cent. One spring in each 300, or in the lot of springs if the lot be less than 300, will be selected by the company's engineer, and will be subjected to complete analysis. Should this analysis show the carbon, silicon, phosphorus, or manganese in the steel to exceed the specified maximum, or should the carbon fall short of the specified minimum, the 300 springs, or the lot of springs represented by the spring showing such defective analysis, will be rejected.

The india-rubber used for the work under the contract must be of the best quality and free from objectionable smell. The cast iron is to be of such strength and quality that a bar 3ft. 6in. long, 2in. wide, and 1in. deep, when placed edgeways on bearings 3ft. apart, will stand a weight of 30 cwt. suspended from its centre without breaking.

Every piece of work shall be manufactured with such accuracy that any piece may be used without dressing of any kind in the place for which it is designed in any of the wagons. To ensure this, every piece must be made from a metal template or gauge, and all holes in it, whether hereafter specially mentioned or not, must be drilled. It must further be drilled through the holes in the template, so that the corresponding parts of all the wagons may, without doubt, be exact duplicates of each other. The angle bars forming part of the middle bars are to be framed. All holes in the pieces of iron or steel which form the underframe and bogie trucks must be drilled, except those in the floor, middle bar headstock, and bogie cover plates, which may be punched, provided that all the holes in each plate are punched simultaneously, or through a template clamped and fixed to the plate which contains all the holes in the plate. If one or other of these systems of punching be not adopted, all holes in these plates must be drilled. The spring hanger brackets are to be forged out of the solid, and all holes through them are to be drilled, and the holes for the spring hangers bored out true; they are to be neatly squared up at the angles and the ends drawn down as shown in the drawings. The spring hangers are also to be forged out of the solid, the holes through them are to be drilled, and the pins turned. The standard length of the coupling hook, measured from the centre from which the rear bearing surface of the hook pin hole is struck to the inside of the nose at the tip, is to be 12in., and from the same centre to the bearing part at the root, 12¾in. The bend in the hook must be made so as to allow of effective contact on the proper surfaces of the hook and coupling block when the centre of one buffer head is 2in. lower or higher than the centre of the other buffer head, both buffers being placed horizontally in position for coupling. The buffer heads may be dabbed on to the jaws under a steam hammer, but great care must be taken to secure a thoroughly sound weld over the whole surface. The buffer faces must be faced up all over in the lathe. The buffer shanks must be forged solid with the jaws, without a weld in their length, and must be drawn down under a steam hammer true to the form shown, and the round part must be turned. The buffers must be forged from best hammered scrap iron. The yoke lever, sliding coupling block, connecting rod and coupling screw, coupling hooks, spring sockets, and plungers must be forged out of the solid, and all the holes for the pins must be drilled, and the pins must be turned. The yoke levers, sliding coupling blocks, and connecting rods may be left black, if in the opinion of the Inspector-General they are sufficiently neat and clean forgings. All other parts must be turned, bored, or planed where tinted red on the drawing. All holes must be drilled, but the joints and pins must be an easy fit. The end of the coupling screw which fits into the sliding block must be a sufficiently easy fit to allow the screw to angle and take up the several positions assumed by the yoke lever in passing from its extreme forward to its extreme backward position. All nuts are to be square, and must fit so tightly on their bolts that they cannot be turned by hand.

One wagon of each kind with its buffers and couplings is to be built and rivetted up complete, and approved by the Inspector-General as a sample, before the rest of the wagons are proceeded with. Should an examination of these samples lead the Inspector-General to order any alterations in the design of any of the parts, he is to be at liberty to do so without claim on the part of the contractor for loss on any parts which he may have made prior to the approval of the samples, or for any extra payment, except in regard to weight at the schedule rates.

Tenders, addressed to the Secretary of State for India in Council, with the words "Tender for Ironwork for Covered and Low-sided Bogie Wagons" on the envelope, must be delivered at the India-office, Westminster, S.W., before 2 p.m. on Wednesday, the 5th August, 1885. If delivered by hand, they are to be placed in a box provided for that purpose in the Store Department.

LETTERS TO THE EDITOR.

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

THE LAWS OF MOTION.

SIR,—"A Student" asked for a brief answer to his question and is dissatisfied at having got it. He argues that because a body cannot react or push against itself, therefore it is unable to react or push against anything else. This is a piece of bad logic to which I need only reply, *non sequitur*. "A Student" has only to live up to his *nom de plume* to become quite clear on such points as this. It is rather absurd for me to work out little elementary sums in your columns. Nevertheless, in case it is of service in clearing away fog, I will do one.

Question.—If a man weighing 160 lb. pushes horizontally against the ground with a force of 60 lb. weight, and at the same time pulls a rope with a force of 50 lb. weight, what is his acceleration?

Answer.—The resultant force acting on him is 10 lb. weight, or 320 absolute units, and his mass is 160, therefore his acceleration is 2ft. per second (*sic*) per second; and if he continues to steadily exert these forces by the muscles of his body, he will move 1ft. in the first second, 3ft. in the next, 5ft. in the next, and so on, as long as he maintains the inequality of forces unchanged.

Coniston, July 27th. OLIVER LODGE.

THE PROBLEM OF FLIGHT.

SIR,—My last paper, commented on by you in THE ENGINEER of February 6th, was written after I had made arrangements to continue the experimental part of the subject, which, unfortunately, I am again compelled to postpone. The financial factor is giving me more trouble than any other at present; and if I would remain within the limits of prudence, will abstain from all direct attempts to get the human race into the air. I spent about 5000 dols. in experiments, exclusive of time, in explaining a soaring bird, and, just as all the difficult part had been accomplished, was forced out of Florida to save myself from bankruptcy; and the finishing stroke still lingers.

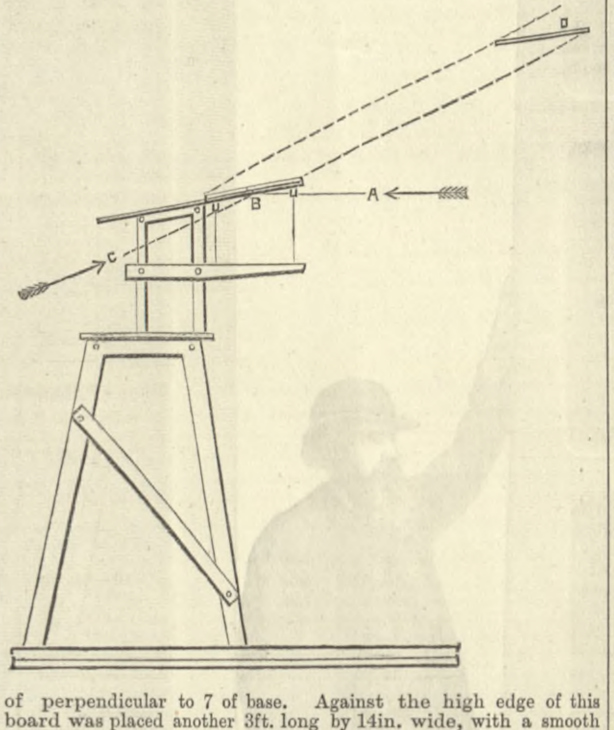
There is a method of presenting this matter which I have hitherto refrained from expressing, fully intending to put into practical shape a device capable of sustaining a person in air before doing so, which would have compelled attention to the significant features of the case.

In view of frequent disappointments and the uncertainty of the future, I send you herewith a printed statement setting forth in a direct manner what I consider to be the main truth of aeronautics for such disposition as you may see fit to make of it. I had provided myself with full-sized drawings in detail, and had purchased materials with which to proceed to Florida during the month of May last for the purpose of erecting a shed and supports, intending to begin operations at the termination of the rainy season, and expecting to complete the task before the ensuing summer. For many reasons that part of the country would be the best possible to experiment in on account of the surprising steadiness of the winds and the mildness of the climate particularly, and the freedom from inquisitive interruption. I expect to meet no serious difficulty with the remaining part of the work. So much by way of personal explanation, and to break the force of the relevant query, "Why, if it is so easily done, I do not do it." I do not expect to meet with any criticism which will impair the validity of the case as I have stated it. It is simply self-evident. I can put it in no more direct shape than to term the floating device a falling body which does not lose its energy of position. Had I been able to entertain that notion while in the experimental stage in Florida, it would have been the end of the discussion. It is the key which unlocks the whole problem, and why I did not get hold of it long before is as much a mystery as anything connected with the vexed subject.

A bird floats motionless in a horizontal breeze: Why does it not come down? It certainly gravitates towards the centre of the earth, and being in free air ought to come down. There must be something pushing it up as much as gravity pulls it down. What is that something? The disturbed air, of course. The surface kicks the air out of its course, condenses it, and otherwise disturbs it. The air kicks back, and the inclination of the surface determines the direction of this kick. It was gravity which did the kicking vertically downward, constituting the action of the surface on the air, the reaction of the air on the surface being vertically upwards, exactly opposite to the action. Hence the bird is falling flatways on the air with a speed equal to the velocity with which the wind meets it, when the creature is related to the reacting air which supports it, in order to determine its motion. The direct push of the wind is edgeways on the surface, and it is evident that more force is required to drive a flat body flatways on the air than edgeways with the same velocity.

This is the whole case. The air is completely neutral, so far as the motive force is concerned, its only function being to distribute the gravitating energy. I have shown how the disturbed air reacts at the rear of the surface to obliterate the direct push, and send you herewith an account of experiments supplementing that explanation.

In my first papers published in THE ENGINEER will be found the statement that the rear expansion matter was an approximate explanation only, as the precise manner in which the particles of air met the surface, and their consequent actions and reactions were not known to me. The width and inclination of surface are factors of importance, and it is possible to get a flow of air of such specific character in regard to velocity and steadiness as to produce on a definitely shaped and inclined plane an equilibrium of forces without resorting to any rear expansion whatever. The following experiment seems conclusive on that point:—Erecting a rude platform 20ft. above the flats on the gulf beach, I firmly secured a thin board to standards from the platform, so that it inclined about 1



of perpendicular to 7 of base. Against the high edge of this board was placed another 3ft. long by 14in. wide, with a smooth lower surface, and its upper one covered with ½in. thickness of sponge secured by a very light wire screen. It was supported on four wires tipped with rubber. Its inclination was the same as the other board, so that the under surfaces of both were in the same plane. The sponge surface was saturated with water which at once began to evaporate, thereby continually lessening the weight of the board. The breeze moved at the rate of about twenty-five miles an hour in the direction of the arrow *a* in the drawing.

After working and waiting several hours in one of those rare winds which promise good results, patience had its reward. The board would suddenly leave its bearing and move upwards and forwards for distances of from 10ft. to 40ft. in the direction *c* before it lost its steadiness and came down. Once having made the leap, it would keep on doing it as often as replaced on its bearings until the water would evaporate too much, when another wetting would set it off again. I never could get this action at an inclination of 1 to 6, or any other than 1 to 7, with the lower board in place. Remove that board, and the action would continue anywhere from 1 to 7 to 1 to 3, and nothing like the definiteness of weight was required. If the air had been visible the whole *modus operandi* would have been plain at once; but as it was invisible, I rest on Newton's third law, and imagine several ways in which it might be done until better informed.

Hence I do not claim that all the rear force must come from the rear expansions in every case of equilibrium, for the activities going on under and above the surface are competent under certain conditions to produce the result. But really all this is not the significant feature of the case. Whether it is done in this way or in that way is of importance, it is true, in working out results; but that it is within the scope of mechanical possibility to be done at all is the fruitful germ which must inevitably grow into vast proportions. The trouble is to get the attention on the significant aspects; once that is done, the entire thing is self-evident. I. LANCASTER.

July, 1885.

GWYNNE v. DRYSDALE AND CO.

SIR,—With reference to the report on this case appearing in your issue of 24th inst., I, having been engaged on the defence and present in Court at the time, wish to point out that no such "discussion" took place between the learned Judge and one of the pursuer's witnesses as you represent. What actually transpired was that pursuer's counsel put a question to the witness referred to which the Judge held to be a point of law for the determination of the Court. In so ruling he remarked to counsel on the impression the evidence, so far as led, had produced upon the Court. The witness thereupon interpolated an expression of opinion, which the Judge characterised as "most improper," and which the witness apologised for.

As to the alleged statement of the Judge that a patented machine would not be infringed if even a bolt had to be withdrawn in place of something in a competing machine being slackened, it would be quite needless, were it not for the seeming bias of your report, to say that no such rule as a general principle, but distinctly the contrary, was laid down.

Whether the judgment is or is not likely to have an important influence upon Patent Law is a matter of opinion; but in view of the fact that Mr. Gwynne's patent was held to be not for all forms of swivelling attachments, but strictly for a specific form, to which he entirely failed to prove the pumps as made by Drysdale and Co. could in any sense conform, the judgment would probably have been a good deal more "remarkable" than you represent it to be had the decision been the other way.

135, Buchanan-street, GEO. MACAULAY CRUIKSHANK.
Glasgow, July 28th.

COMPOUND ENGINES.

SIR,—We have been much interested by your article of June 26th on "Triple Expansion Engines," and that of July 3rd on "Efficiency of Steam Engines." Will you allow us to call the attention of your readers to our Kingdon's compound engine, of which we enclose a sketch showing valve and cylinder arrangement? We think the above articles go a long way to prove that a tandem engine without receivers is by far the most economical type that can be used. Our practice for some years past has, at any rate with engines up to 100 indicated horse-power, proved this to be the case. Taking as an example the engines of the Isa, as described by you, we should employ to indicate the same horse-power a pair of Kingdon's patent tandem engines, with two of high-pressure and two 17½in. low-pressure cylinders.

We think it is evident that there would be far less friction and cooling surface in this engine than in that of the Isa, there being no receiver or intermediate cylinder; moreover, the thrust on the crank would be more uniform throughout the stroke than is possible in any other type of engine, because as the steam is carried throughout nine-tenths of the stroke, when the high-pressure cylinder is doing the least the low-pressure cylinder is doing the most work, and *vice versâ*, and as only the net result of each pair of cylinders is applied to their respective cranks, it is quite immaterial which cylinder is doing most duty. This engine would have two cranks at right angles similar to the usual type of compound engines, each pair of cylinders being complete in itself, and the floor space occupied would be only that required for the low-pressure cylinders. We cannot help thinking that our engine combines many of the points hinted at in your very interesting articles, and that therefore it may be of interest to your readers to learn that an engine of this description has been in use for several years with most satisfactory results. SIMPSON AND DENISONS.

Dartmouth, South Devon,
July 21st.

TESTING FANS.

SIR,—With regard to the paper on fan-testing, read by Professor R. H. Smith before the Midland Institute, and published in your current issue, it seems to me that the formulæ given are all based upon a false foundation; for, if I remember rightly, in his original letter to THE ENGINEER, December 19th, 1884, Professor Smith set out from the equation $p_0 v_0 = p_1 v_1$ = a constant, which is only applicable in finding the logarithmic expression for the work done by compression or expansion. Now in a fan this function forms part of the lost work, and the equation $pv=c$ cannot therefore be used as an instrument to gauge the useful work done by the fan. How then does Professor Smith avoid shipwreck upon his fundamental formula? Simply by changing tack, and finally adopting a new expression $(p_2 - p_1) . V$, where $p_2 - p_1$ is the difference of pressures registered at the outlet and inlet, and V the volumetric discharge per second. The expression $(p_2 - p_1) . V$ involves the assumption that V is constant, and therefore that the air is incompressible; for, if the air were compressible, we should have the mass, and not the volume, a constant quantity.

Apart, however, from the inconsistency of the method, I have still to urge that the expression given for W does not correctly account for the useful work done, because in the term $p_2 - p_1$ Professor Smith must include the difference of static pressures, which in a fan represent waste, not useful, work. Indeed, it is only the difference in the pressures due to velocity which is a measure of the useful work done.

Further, after defining h to be the height of the outlet over inlet of fan, and implicitly therefore as so much lost head, Professor Smith nevertheless enters the quantity $0{\cdot}08\ V\ h$ with a plus sign as contributing to increase W, the useful work.

Lastly, I was really astounded upon reading the following passage in the paper:—"If A_e be the exit area where the current finally enters the free atmosphere, the average discharge velocity may be taken as $V - A_e$ ($V \div A_e$?). It is certain that nearly all, if not quite all, the kinetic energy corresponding to this velocity is lost. This kinetic energy is $\frac{0{\cdot}08}{2g} . \frac{V^3}{A_e{}^2}$."

It would appear, then, to judge by this passage, that Professor Smith actually believes the energy of discharge into the atmosphere to constitute so much lost work. He might as well say that the energy present in a jet of water leaving the nozzle of a fire hose represents so much waste energy, whereas it is of the very essence of a fire engine to discharge at a high velocity. I will make this clear, though it stands but little in need of further elucidation: by taking two fans with equal discharge areas and driving them at equal horse powers; then, according to Professor Smith, the fan which delivers with the greater kinetic energy, or, in other words, which discharges the greater volume of air per second into the ventilated space, or, if exhaust, into the atmosphere, is the less efficient and the lower in economical order of the two. This idea will not stand the light of day. In conclusion, I have to remark that the last two equations in the paper, if tested by the law of continuity, are not complete.

About the time of Professor Smith's first letter there also appeared in your columns a communication from Professor Unwin, in which he set out from a totally different hypothesis, supposing the air practically incompressible, and then stating the ordinary equation of steady motion. At the end, by way of complement, he inserted the logarithmic function of the work lost upon compression. Now, I am perfectly ready to allow that Professor Unwin's statement of the solution is satisfactory, so far as our present knowledge of the subject extends, but none the less, it appears to me to end just where the interest of the problem begins. Hence I scarcely think Professor Unwin meant to advance it as a final solution of the question under all its aspects, but only in the restricted sense of being adequate for all testing purposes. Let me try to explain what I conceive to be its insufficiency above and beyond the immediate object of simply testing a fan. In a channel of running water, prescinding from the work done upon constrictions, a given head is reduced either in giving velocity to the current or in overcoming frictional resistance upon the bottom and sides. Consequently, if we know the differences in head and velocity at two sections of the current, we can at once deduce the work done upon friction between these limits; but in a compressible fluid like air work may be lost in more than two ways, and therefore the problem how much is done in each way becomes indeterminate in the simple equational form explained above. It is the when and the where to apply the logarithmic function of work lost in compression that introduces this uncertainty. R. H. GRAHAM.

July 28th.

SIR,—Allow me to state that your report of a paper on "Testing Fans," read for me by the Secretary to the South Staffordshire Institute of Mining Engineers, is uncorrected by me. It contains mistakes, which render the sense unintelligible, and expressions which were struck out from the paper as originally written. R. H. SMITH.

Mason College, July 27th.

INTERNATIONAL INVENTIONS EXHIBITION.—The number of visitors to this Exhibition for the week ending July 25th was 145,801; total since the opening, 1,718,419.

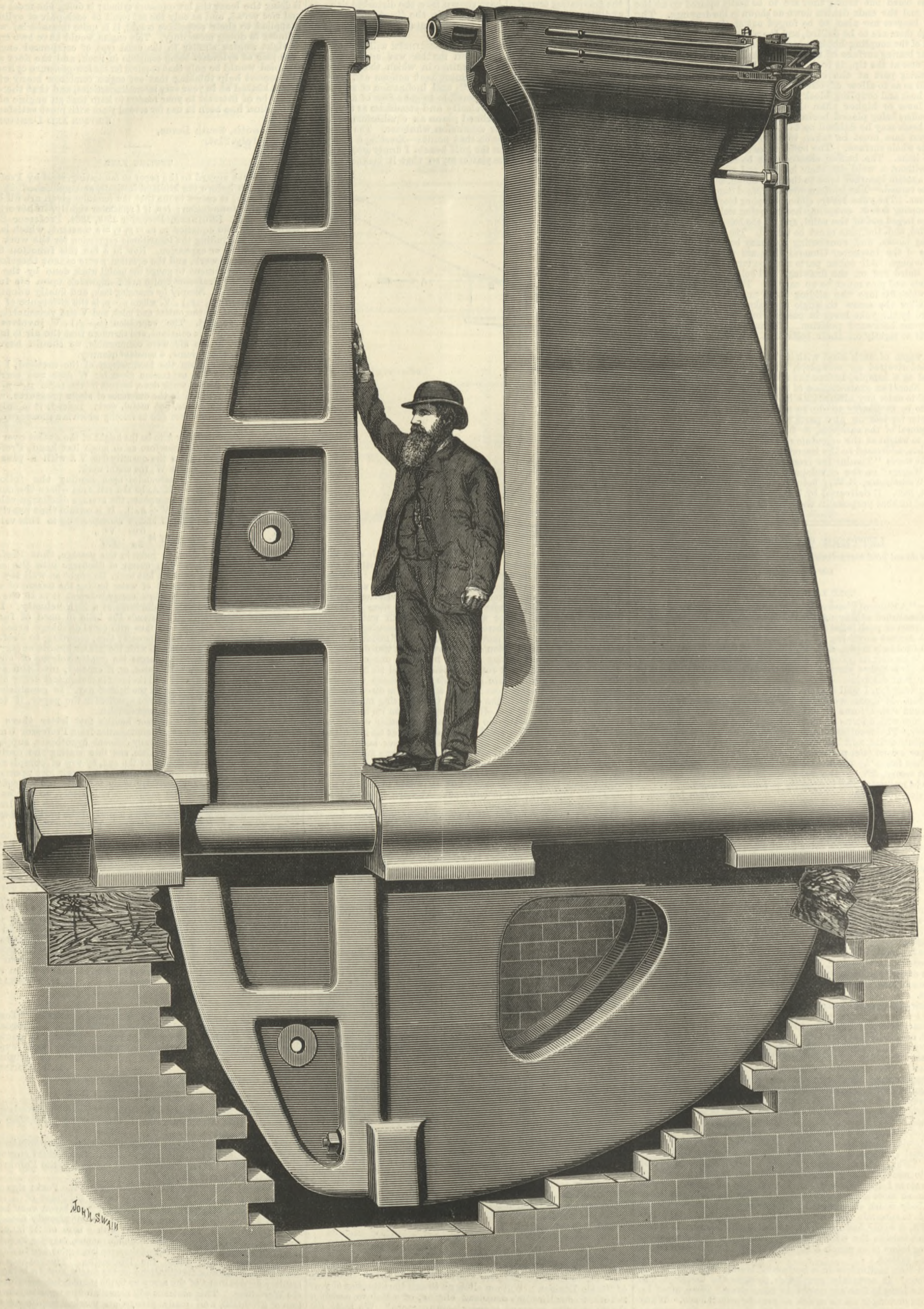
NAVAL ENGINEER APPOINTMENTS.—The following appointments have been made at the Admiralty:—Alfred Palmer, chief engineer, to the Mariner; Leonard Backler, chief engineer, to the Pembroke, additional, for service in the Euryalus.

ORDNANCE FOR TURKEY.—On Saturday last the Porte signed a contract with Messrs. Krupps' agents for the purchase of a large number of guns and projectiles. The order is for seven very heavy guns, of 35½ centimetres bore, similar to the one already mounted at the Dardanelles, twenty-two guns with a bore of 24·50 centimetres, and 400 field-pieces and mountain cannon, varying in calibre from 7 to 9 centimetres. Four of the seven large guns are to defend the Bosphorus and three the Dardanelles. The others are intended for various fortifications on the coasts, and to bring the artillery department of the army up to the standard determined by the War-office. This contract will necessitate the negotiation of a loan of £700,000, and many persons are puzzled to discover by what means the Government, in view of its financial difficulties, will obtain that sum.

TWEDDELL'S 150-TON RIVETTING MACHINE.

MESSRS. FIELDING AND PLATT, GLOUCESTER, CONSTRUCTORS

(*For description see page 82.*)



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*** *All letters intended for insertion in* THE ENGINEER, *or containing questions, must be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever will be taken of anonymous communications.*

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*** *In order to avoid trouble and confusion, we find it necessary to inform correspondents that letters of inquiry addressed to the public, and intended for insertion in this column, must, in all cases, be accompanied by a large envelope legibly directed by the writer to himself, and bearing a* 1d. *postage stamp, in order that answers received by us may be forwarded to their destination. No notice will be taken of communications which do not comply with these instructions.*

W. G.—*The new Patent Law imposes a penalty on any one who advertises an article as patent which is not the subject of Letters Patent.*

POWER-TESTING BRAKES.—*A correspondent writes to say that in the last volume of the Institution of Civil Engineers Mr. Thwaites has translated Mr. W. Meunier's excellent article "On the Brauer Brake."*

IRON.—*The loss of head at either of your stations,* A, *or* B, *or* C, *will be as stated in the second problem. Providing head at* S *be* 150*ft., the frictional loss at either place* 40*ft., then the head effective will be* 110 *at either. This will be true when but one of the three pipes is delivering. When all are delivering the effective head will be somewhat lessened.*

PLANT FOR MANUFACTURING GASOLINE FROM PETROLEUM.

(*To the Editor of The Engineer.*)

SIR,—I shall be obliged if any of your readers can tell me address of a firm manufacturing the above in England. M. L. H.

Birmingham, July 24th.

CRUSHING MANGANESE DIOXIDE.

(*To the Editor of The Engineer.*)

SIR,—I should be glad to know the names of any firms constructing small mills suitable for crushing manganese dioxide. C. H. S.

Sheffield, July 22nd.

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MEETING NEXT WEEK.

INSTITUTION OF MECHANICAL ENGINEERS.—The summer meeting of the Institution will be held at Lincoln on Tuesday, 4th August, and the following days of that week. The following papers have been offered for reading and discussion after the address of the president, Mr. Jeremiah Head:—"Description of Dunbar and Ruston's Steam Navvy," by Mr. Joseph Ruston, M.P. "On Recent Adaptations of the Robey Semi-Portable Engine," by Mr. John Richardson. "Description of the Tripier Spherical Excentric," by M. Louis Poillon. "On Private Installations of Electric Lighting," by Mr. Ralph H. C. Neville. "On the Iron Industry of Frodingham," by Mr. George Dove. "Description of an Autographic Test-Recording Apparatus," by Mr. J. Hartley Wicksteed. Arrangements have been made for several excursions and visits to works in the neighbourhood at Grantham and at Gainsborough. A *conversazione* will be held on the 5th, and the Institution dinner on the 6th.

DEATH.

On the 19th nst., at Boulogne-sur-Mer, GEORGE HOWARD FENWICK C.E., son of the late Major B. Fenwick, R.A., aged 74 years.

THE ENGINEER.

JULY 31, 1885.

THE EFFICIENCY OF DYNAMOS.

THE custom of estimating the excellence of dynamos by their electrical efficiency is now almost universally adopted by the makers of this class of machinery. The process by which the electrical efficiency is computed is extremely simple; in fact, so simple that the validity of the result might almost seem self-evident, and anyone daring to doubt the practical value of this method of judging dynamos lays himself open to an attack from those who think that an electrical efficiency of some 90 or 95 per cent. is all that is required to make a dynamo an economical machine. They reason that if a machine converts 95 per cent. of the internal electrical energy into external energy it cannot possibly waste much power, as the efficiency of conversion cannot surely be less than about 90 to 95 per cent., making the total commercial efficiency close upon 90 per cent. It is precisely this last assumption which deprives the statement of efficiency of its practical value, and to say that the electrical efficiency of a dynamo is 95 per cent. conveys absolutely no idea of the power necessary to work that particular machine. To explain our meaning, let us take the case of a compound dynamo designed for feeding, say, 250 60-watt lamps. Without fixing upon any particular type or drawing invidious comparisons between the machines of different makers, we can take it that several such machines could be obtained in the market at a moment's notice having all about 90 per cent. electrical efficiency. Some may require less energy for exciting the field magnets, others may have a lower resistance in the armature, but the general result will be in all cases about equally satisfactory. As a fair average we may take it that the armature will have about ·045 ohms, the main coils ·015, and the shunt coils 25 ohms resistance. At a speed of 1000 revolutions the external electro-motive force would be about 110 volts. These figures are not taken at random, but can be considered as mean values for a number of different commercial dynamos. The electrical efficiency of our machine is now obtained as follows:—Shunt current equals 110 : 25 = 4·4 ampères; main current, 136; total through armature, 140·4. Hence, loss of electro-motive force in armature $140{\cdot}4 \times {\cdot}045 = 6{\cdot}3$ volts; loss in main coils, $136 \times {\cdot}015 = 2{\cdot}04$ volts; internal electrical energy, $140{\cdot}4 \times 118{\cdot}34 = 16{,}630$ watts; external energy, $110 \times 136 = 15{,}000$ watts; efficiency $\frac{15{,}000}{16{,}630} = 90$ per cent. Suppose we were to rewind the armature, putting only one-half the number of turns on, but of twice the sectional area, thus reducing the resistance of the armature to ·01125 ohms, we could then obtain the same electro-motive force by doubling the speed. In that case the electrical efficiency of the machine would be nearly 94 per cent. But will the total power necessary to drive it be decreased by 4 per cent? Certainly not. On the contrary, it will absorb a good deal more power, because those hidden causes of loss which can hardly ever be correctly estimated, and which are comprised by the somewhat ambiguous term "efficiency of conversion," have, on account of the doubling of the speed, been enormously increased. We maintain that it is of far greater importance to reduce these losses than to gain a few per cent. more in electrical efficiency. If a dynamo is in full work, there exist a multitude of causes all operating the same way, viz., to absorb power and to create heat. Some of these causes are purely mechanical, as, for instance, the friction of the bearings, the slipping of belts, and the resistance of the air, or windage, as it is called by some electricians. Others are electro-magnetic, and these are the most serious. In estimating the friction of the bearings, the fact is generally overlooked that it is almost impossible to mount the armature mathematically central within the polar surfaces, and that in consequence the magnetic attraction is not perfectly balanced, throwing an additional pressure upon the bearings, and thus increasing the friction. But this is a small matter if compared to the power wasted in some machines by currents in the body of the armature core, and by the reaction which the armature exerts on the polar surfaces of the field magnets. If the number of bars in the commutator were infinitely large there would be no reaction, but as the number is always comparatively small, in fact, seldom more than 100, and generally about 50, the diameter along which the core of the armature is magnetised by the current in its coils is not absolutely fixed in space, but oscillates somewhat to either side of the line of commutation, the number of oscillations per revolution being equal to half the number of bars and their amplitude to their angular distance. The effect on the field magnets is the same as if a powerful magnet were kept rapidly vibrating between the pole pieces. As a necessary consequence local currents are generated in the metal forming the poles, and the metal is thereby heated. This heat has to be paid for by an increased driving power. In some cases, especially when the core of the armature is provided with iron teeth projecting between the coils, the reaction we have just described is so strong that it is impossible to take full advantage of these projections by allowing them to approach the polar surface with the least possible amount of clearance. If this were done the pole pieces would become so hot that it would be impossible to work the machine for any length of time, to say nothing of the waste of power. Yet the electrical efficiency of such a machine would be exceptionally high, since on account of the projections of the armature core the magnetic resistance of the field would be very low, and a comparatively small amount of exciting power would suffice to produce a very powerful field. But whether the core be provided with projections or not, a certain amount of heating does always take place, as our readers can easily see by examining a dynamo which has been at work for some hours. It will generally be found that the iron of the magnets, especially in that part of the polar surface where the armature coils leave it, is hotter than the magnet coils. The reason for this is simply that the maker, with a view to showing a high electrical efficiency, has put sufficient copper into the coils to prevent serious heating, whereas with regard to the magnets no precaution whatever has been taken. One very simple way to minimise the evil is to subdivide the iron of the pole pieces by narrow slots, and we would strongly recommend the adoption of this inexpensive remedy. Self-induction in the coils of the armature is another source of heating, and consequently of loss of power. Like the former, it can never be entirely overcome, but by employing a large number of bars in the commutator and a very powerful field, it can be considerably reduced. With machines intended for very heavy currents, where the coils on the armature are formed of copper bars, local currents in the mass of each bar are often generated unless the precaution is taken of subdividing each bar into strips. In all these cases the losses increase with the speed, or, to speak more correctly, with the square of the speed, and it is easy to see that in the example we cited above the slight gain of 4 per cent. in the electrical efficiency obtained by doubling the speed is very dearly paid for by the increased losses, the sum total of which is about four times the amount corresponding to the lower speed. What is the actual amount of power wasted in this way can only be determined by careful dynamometer experiments, but, unfortunately, very little has as yet been done in this direction. At South Kensington and elsewhere exhibitions follow each other in close succession, but in no case have any trials been made to settle the question of the efficiency of dynamos from a practical point of view, although there never have been, or probably will be, better facilities than exist at South Kensington. The small sum necessary for the purpose does not seem yet to be obtained, although public money is used to support these exhibitions, and large sums are made and disposed of somehow. The introduction of this most misleading conception of electrical efficiency is probably to some extent the reason why the practical aspect of this question, which alone is of value to the engineer, has been so much neglected. It is so easy and simple to figure out the electrical efficiency to at least two places of decimals, and to dazzle intending buyers with the astonishingly high coefficient—obtained, let us at once remark, in perfectly good faith—whilst trials with a dynamometer are costly and troublesome, and would certainly not show such highly encouraging figures. In saying this, we wish to be clearly understood. Nothing is further from our mind than to disparage generally the actual efficiency of dynamos. We have always held that good dynamos are, without exception, the most perfect machines for the transformation of energy. But we maintain that the so-called electrical efficiency is in no way a measure for the economy of transformation; nay more, that in some cases, especially with high speeds, it is positively misleading.

COLONIAL PATENTS.

WE have but recently directed attention to the delays attendant on the present course of procedure in our home Patent-office. That those delays have been productive of much hardship to those seeking protection for their inventions has been evidenced by correspondence upon the subject which ensued in our columns. It has since been brought to our notice that the disabilities so incurred extend in a considerable degree to the working of the patent system within our colonies. It is scarcely necessary that we should point out that difficulties and delays as regards protection afforded in the colonies mean a very grave restriction passed upon both home inventions and home trade. The colonies are certainly the largest customers for the productions of Great Britain, and anything which hampers the free export of these must react upon manufacturers in the three kingdoms. It is, therefore, most desirable in every interest, both home and colonial, that such a restriction should be reduced to a minimum. As arrangements stand at present, nearly every colony, however small, has its own department charged with the granting or withholding of local patents, and in many cases we fear the power of doing this is exercised either capriciously or under conditions conducive to delay, and, therefore, in many instances to considerable hardship.

We may consider as a typical case involving both these two last disabilities, one that has lately been brought to our knowledge, refraining, of course, from any such mention of particulars as might lead to the identification of the parties concerned or of the individual colony to which it refers. After a protracted examination of the specialities claimed by an inventor who applied for the protection of a patent, it was granted to him both in England and India. Further application was then made for similar protection in one of our colonies, wherein it was vitally necessary to the successful working of the invention that it should be safeguarded. It was but natural to expect, after the close investigation that had been made into its claims by the English and Indian Patent-offices, that there would have been little or no hesitation on the part of the colonial officer charged with a local decision in adopting that arrived at by those practised departments. This, however, did not prove to be the case. The colonial official declared his inability to pronounce as to whether the claims set forth by the inventor were new in a sense sufficient to justify his granting the patent sought for. Now with this course of procedure we cannot possibly quarrel. The officer referred to acted at least with perfect honesty. He confessed himself unequal to the situation, and further stated that it would be necessary for him to apply for the opinion of an expert to guide him as to his final determination. Now in our West Indian colonies, as in others of similar standing, we need not say that there must be, to begin with, an exceeding rarity of men who are specialists enough to be qualified to act as experts. But supposing such a man to be found, he is quite open to the objection to be taken that in an exceedingly limited society, the members of which may be—as they were in the particular case under reference—largely interested in the industry to which the invention was applicable, there is an extreme probability that he might be biassed by previous connection or personal interest. Indeed, we are aware that the circumstances under which such an one might give his opinion in the case cited render it almost impossible but that he should be open to the working of a bias so produced. To the inventor, therefore, there are presented two disabilities arising out of the conditions under which colonial patents are awarded. The first arises from the fact that the office staff dealing with such questions must be limited to an extent fatal to its possession of the knowledge required to deal with all branches of invention, a limitation certain to lead sometimes either to gross injustice or delay; while the second is imposed by the consequent necessity of referring to a local expert whose associations must tend towards the delivery of a biassed judgment. Such a position, we admit, may not be of frequent occurrence, but it is always possible, and such a possibility should, we think, lead to some alteration in the claim assumed by the smaller colonies with regard to their jurisdiction in the matter of patents. For if they cannot grant them wisely they may inflict much injury, not only on individuals, but on the great body of producers throughout the empire; and if, as in the case under notice, their officials are forced to pronounce themselves incompetent to fulfil the duties required of them, it is manifest that the privilege claimed had better be allowed to lapse into the hands of those who have fuller opportunities for capable decision.

It is certainly too much to expect of any one man that he can, unaided, pronounce upon the merits, or as to the novelty or its absence, of every project brought before him; and it may well be doubted if certain of our colonies are likely to be able to give him the aid he requires. Failing, therefore, to possess the means of full judgment, is it desirable that, for the sake of preserving a show of independent jurisdiction in patent matters, communities so situated should either desire or be permitted any longer to retain it? We should certainly say not. It need not be assumed, however, that we advocate the reference of all applications for patents to our English offices. There are some of our colonies so situated as to be as well able to pronounce upon the merits of an invention as is our own Patent Department. The colonies might, we hold, be so grouped as regards dealing with these matters that investigation could not fail of being entrusted to a staff alike capable as free from any possibility of being affected by local interests. The results of the present system cannot but be most unsatisfactory equally to the officers upon whom an almost impossible duty is imposed, as to the unfortunate applicants whose interests are made to suffer. If, as we have heretofore pointed out, there are delays in our own extensively officered department, supplied as it is with every means for fully testing the relative advantages or novelty of every claim made, which cannot be justified, what may we expect from a system which is so heavily handicapped by the total absence of such aids? We doubt if our typical case is by any means singular. It appears almost impossible from the facts that it can be, and the sooner some remedy is applied and the excessive subdivision of jurisdiction is ameliorated the better for the interests both of the public and of patent seekers generally.

UNSANITARY BURIAL PLACES AND METHODS.

AGAIN cholera is within a measurable distance of us, and should it visit us with serious or deadly effect those having more or less control of all sanitary administration will have much to answer for; want of sufficient warning cannot be pleaded in excuse. Last year we had very sufficient reason to dread a visitation of this epidemic, and much was said and written as to the expediency of setting our house in order to avert it. Something was actually done, too—not so much as should have been, perhaps, but still, something. With the advent of winter came a renewed feeling of safety, and it is to be feared that the steps then being taken to abate nuisances, to cleanse courts, lanes, and slums, to prevent over-crowding of tenement houses, and generally to improve urban sanitation, were checked. The healthy housing of the poor has long attracted public attention, and it is pleasant to see that the subject continues to receive notice. It is, however, a problem, the best solution of which it is difficult to attain. Other urban and suburban practices equally influencing public health, however, receive but small attention, and one of these is the disposal of our dead. Parliament, since the enactment of the law forbidding interments within towns or cities, has not dealt with the subject; yet it is one that must at no distant date again form subject matter for legislation. As regards London in particular, it is increasing so rapidly in size that some of its cemeteries, sufficiently distant from metropolitan boundaries when they were first opened, are being so surrounded by inhabited houses as to bid fair to render them as much intramural in position as ever were those long since closed in the heart of the City of London. Certainly intramural burials, if effected in a proper manner, need not cause danger to public health, but motives of economic expediency, as well as those of sentiment, do not permit of burials being so effected. For example, in the interests of public health all interments should be to a certain depth, in order that the poisonous gases generated by decomposition will be thoroughly filtered and rendered innocuous by passing through a sufficient depth of earth before reaching the atmosphere; but economic and sentimental inducements very constantly cause an infraction of this safeguard. Another source of danger to public health exists in the practice of interments in vaults or graves within the walls of churches. Perhaps no mode of interment is so dangerous or objectionable as this, for here we have the living periodically breathing air which must, owing to the absence of disinfectants, act as a poison more or less rapid in its injurious action on those inhaling it. An example of this can be found in a certain Roman Catholic cathedral, where constant interments take place in vaults beneath its floor, and clergymen who enter on their duties of daily performance of mass there healthy and vigorous, gradually sink into pallor, debility, and general lowering of constitutional tone. The same effect takes place with the frequenters of that place of worship, in degrees varying with the constitutional abilities of those exposed to poisoned air to resist its influence—an influence which may not prove at any time directly fatal, but paves the way for cholera and other diseases by lowering general health and tone, and thus rendering persons so lowered more easy victims, as being more likely to receive infection.

Another method of disposing of the dead cannot be too strongly deprecated; we refer to the practice of sealing them up in lead, without the precaution of introducing any chemical qualified to neutralise the poisonous gases generated by decomposition—gases generated as a rule in such volumes as to render the drilling of the lead necessary to prevent the bursting of the coffin. These gases are deadly in this concentrated form, and are only reduced to slow poison by dilution with the atmosphere. Certain preparations of zinc, as well as other things well known to all chemists, inexpensive and capable of easy application, are readily obtainable, but are, it is to be feared, seldom or ever used. To illustrate our remarks we may refer to a certain cemetery, large in extent and beautifully kept, which contains a place called the Mound, and which consists of, as its name indicates, a knoll or rising ground. Round this a wide, deep trench, or dry moat, is dug, and the inner side of this trench is excavated all round at close and equal intervals with what we must designate as open vaults, because they are only closed with iron gates, through the bars of which the coffins are visible. At certain times, or as need arises, an official, with no better personal safeguard, we believe, than a sponge dipped in vinegar, goes round with a drill piercing sealed coffins, to allow the confined gases to escape; and so deadly are these gases, once the drill is through he has to fly the vault. So simple a matter as injecting a preparation of zinc does not seem to be adopted, thus showing the careless indifference displayed by those concerned for the laws of health.

Quite recently steps have been taken to effect the closing of a churchyard, not in the mere suburbs, but in the centre, or near the centre, of the north side of Dublin—the reason for the demand being the all-sufficient one that it is overcrowded to such an extent that the greatest depth now attainable is 18in., a depth insufficient even in pure earth, and perfectly useless as a disinfectant where the soil is already so saturated and impregnated with decomposed and decomposing organic matter. The labour of cleansing dwellings, streets, or sewers will be labour thrown away until we dispose of our dead in such a manner that no decay shall have to take place, or so that their decay shall do no injury to the living.

THE POWER OF FUEL.

WE directed attention some months ago in THE ENGINEER to a series of returns made to one of the water corporations in the North, and showing the relative pumping power of coals. These returns continue to be made from time to time, and it is well worth while returning to the subject. Over a period of about five months this year, there were pumped more than 1154 million gallons of water—a sufficiency to establish a good average. For every thousand gallons the coal consumed was 4·36 lb., whilst for the corresponding period of the past year the average over the same period, and with a slightly larger consumption, was 4·56 lb. per thousand gallons. In the last month reported on, ending in June, the average consumption of fuel this year was 4·25 lb. per thousand gallons, whilst for the same period last year it was 4·54 lb. per thousand gallons. The actual cost of the pumping alone is not given in the report before us, but the cost of the engine expenses, with that of the filtration added, was ten years ago ·372 per thousand gallons of the water pumped, and for the past half-year it has been ·285—a very considerable reduction, which is partly accounted for by the increased demand for water. The water corporation referred to is that of the Stockton and Middlesbrough Water Corporation Board. The coal consumption seems to have been this year at about the rate of 118 tons per week, and Durham coal is used; there is a considerable variation in the quantity of coal used—the amount pumped in the month of May last, for instance, varying from 57 to 61 million gallons per week. The particulars above given may be advantageously compared with those in the previous article, but they are not sufficiently complete to make it desirable to draw deductions of any moment therefrom. They point, however, to the need for much fuller information on the subject and on allied ones—the extent of the use of various kinds of fuel for pumping and other power purposes—and they show that there is a variation in the use of the fuel to possibly a greater extent than some have been wont to believe. How far in the case we give the changes may be due to other causes—to alterations in the pumps—we have no means of knowing, but the whole question suggests the desirability of the investigation of the duty and the use of the various kinds of fuel.

MIDLAND TRADERS AND THE RAILWAY RATES.

THE midland traders are determined not to give up the battle with the railway companies. Although they have already expended heavy sums in opposing the Railway Rates and Charges Bill, 1885, and have incurred heavy liabilities in testing the question of terminals in the recent case of Kempson *v.* the Great Western Railway, they are yet fully prepared to continue the agitation. The local committee formed in Birmingham for opposing the late Bills have a guarantee fund of nearly £1000, and beyond doubt additional guarantees could be raised if it were necessary. At an important meeting of the Birmingham Committee towards the close of last week, held in the Town Hall, it was urged that in consequence of the latest decision of the judges in the case above referred to, and the second case of a similar nature which accompanied it in the courts, the traders were now in a worse position than before the Bills were introduced. The companies had now a decision at law to proceed upon, unless it should be upset on a further appeal. The principle was now acknowledged that terminals might be charged, and the companies would, it was argued, "charge what they pleased." Some of them had, in fact, already begun to do so. The committee came to the conclusion that the present was a juncture when unity of action was more than ever needed, and that to rest quiescent just now would be suicidal policy. They have therefore determined to take steps to form themselves into a permanent body, and so assist the other previously established bodies of traders in various parts of the kingdom for agitating for a repeal of railway rates legislation. It is understood that shortly Lord Henneker's London Committee, which consists of forty-four peers and more than an equal number of commoners, the various railway rates associations throughout the country, the different Chambers of Commerce, and the municipal bodies in certain of our principal manufacturing centres, will attempt to formulate united action on this all important question.

STREET RENEWALS.

IT is always an annoyance—to which, unless much more stringent rules are applied than are at present enforced, it is to be expected we shall perpetually be exposed—to see the surface of our streets pulled up for the constant repairs required to "underground London." The necessities of our present unscientific method of conducting our drainage and gas and water supply leave us without any hope that such annoyance can be obviated. But these might at least be to a considerable extent reduced if those charged with the care of our highways did what we cannot but consider to be their manifest duty. We have recently had under our notice several instances of the most careless relaying of the stone pavement removed for the execution of needed repairs below ground. It would be invidious were we to name such special instances. Indeed, they are too widespread, too general, to render it necessary for our object to indicate individual cases; but we have seen and heard of so many accidents arising from the careless relaying of the pitchers after such repairs, that we hold it to be most desirable to request the attention of the several London vestries to what is a serious public nuisance. So far as our own observation has gone, it would appear to be thought necessary, when relaying pavements that have been disturbed, to do nothing more than roughly replace the stones and cover them loosely with sufficient binding material to fill the interstices between them when some weeks of traffic have worked it in. As for attempting to reproduce the destroyed level of the roadway, that appears scarcely ever to be dreamed of, and it would seem as if any number of horses may be allowed to break their knees and eject occupants from the vehicles drawn by them, until the traditional bishop or a Cabinet Minister comes to grief.

THE FORTHCOMING INDIA AND COLONIAL EXHIBITION.

EACH mail brings in intelligence of steps taken by the various British communities abroad to ensure success to the show which is next year to occupy the grounds at South Kensington. It occurs to us to offer a suggestion to those to whom the preparation of Indian exhibits may be entrusted, which, we hope, may be acted upon. There are not many subjects included in the range of engineering science perhaps as to which we may look to acquire information of a special character from Indian or Colonial experience; but there is one undoubtedly that has an interest for all engineers, and as to which India has had an experience extending over many ages, which has made her workmen surpass in aptitude for it that possessed by the similar classes in England. We allude to the system of foundations built upon sunken brick wells, which has entered so largely into all the hydraulic works of our Indian Empire. We desire to see that system most fully represented next year by models upon a large and most complete scale. Its application to the foundations of the abutments and piers of bridges, and more especially to those dams which form so large an experience in Indian engineering, should be illustrated to the fullest possible extent. Roorkee may well come to the front in representing this branch of construction in its every possible form, and then the English engineer and mechanic may be able to learn a lesson in a branch of practice which might more often be usefully employed in work at home than it is at present.

THE CLEANLINESS OF LONDON TERMINI.

THE intense heat with which we have lately been visited has brought prominently under our notice several instances of a want of that attention to the scavengering of the roads within our London termini which public health and comfort both demand. In nearly every instance such roads are paved with wood, and on more than one occasion we have found ourselves quite sickened by the noisome effluvia which they have given off during the high temperature of the past few weeks. When subjected to some delay while waiting for trains we have been absolutely compelled to quit the stations and seek a purer air in the streets outside. We should presume that there is no railway company the managers of which have not issued permanent instructions and provided means for guarding against such an intolerable nuisance by the speedy removal of all horse-droppings. It has been disagreeably apparent to us, however, that if such orders have been given and means provided, those charged with seeing them duly carried out and availed of have greatly neglected their duty. The glass roofs of the termini almost increase rather than diminish the power of the sun's rays, and the effect of them upon the wooden pavement which serves as an extended cab-stand is most deleterious.

LITERATURE.

The Torpedo Scare. By HOBART PACHA. William Blackwood and Sons, Edinburgh.

THE small pamphlet bearing this title has naturally attracted attention. Torpedo attack is at present regarded as the most formidable danger a ship has to encounter in war. The writer is one of the few men who has been called upon to meet it; what he says must therefore carry much weight. He takes a position which may be described briefly as follows:—The Russian Navy possessed the newest kinds of torpedoes and boats then designed. They were handled by "as active and gallant a set of men as ever stepped a ship's deck." The result of all their efforts was only to blow up two small wooden gun-boats in the Danube. These were commanded by careless Turkish commanders. In all other attacks they failed. The Turkish fleet was not provided with the latest means of protection, yet, with the above exceptions, it never failed to frustrate the Russian attack by very simple precautions, or it took its chance, and suffered very little. Consequently, it may be concluded that the powers of torpedoes such as have hitherto been employed have been greatly over-rated, and they are not likely to effect anything that need be viewed with alarm. This, without further examination, sounds reasonable and strong. The Russians being what they are here described and the Turks such as we know them to be, we should certainly not have expected such barren results. We naturally picture to ourselves a daring crew of Russian sailors in the torpedo boat and an effete old fatalist commanding the Turkish ship attacked; a combination of circumstances singularly conducive to a tragic end for the latter, we should suppose. If success was not achieved under such circumstances, we may well ask when could it be looked for? We may say at once, however, that Hobart Pacha's premises are not accepted as representing fully the state of the case, and consequently his conclusions are not generally adopted. He is considered to over-rate the Russian attack. To give an example. It is stated on high authority that the Russians insisted on having safety caps fixed on all their Whitehead torpedoes, and that it turned out that in the war the whole of their torpedoes were discharged without removing them; consequently, they could hardly be expected to explode. Then, further, it may be urged that the Russians, who were so imperfectly instructed in the details of most vital importance of the weapons they received, were unlikely to understand their use generally. If the main fact—that is, the existence of the safety cap—is correct, the bearing of the second objection is limited to the position where torpedoes were picked up and the like. The failure to explode seems to be secured by the safety cap. The discussion of any further hindrance, then, suggests the case of the captain who had sixteen good reasons for his ship not firing a salute to Nelson, the first being that he had no powder—a reason of weight to make Nelson say that he did not wish to hear the remaining fifteen reasons.

To come, however, to Hobart Pacha's book in more detail. He appears to have depended a good deal on the difficulty of finding ships at night when no lights are allowed to be shown. Not being provided with sufficient means of illuminating and watching the space round the fleet or harbour in which he lay, he adopted the alternative of trusting to darkness. He objects that experiments showing that English torpedo boats found English ships in English waters do not altogether bear on the point any more than a man ought to argue that because he can find things in the dark in his own house he could do the same in a strange house. When he lay in the harbour of Batoum he bastinadoed any "old rascal" he caught showing a light in the town at night, and he learned that Russian boats coming 200 or 300 miles found it extremely difficult to find Batoum itself at night, and utterly failed to make good an entrance into the harbour. Ships, whether in harbour or laying at anchor in any position, were guarded by a cordon which was formed according to circumstances of boats and wire rope, or trees, spars, and planks, the former being used at sea, the latter to a great extent in harbour. At sea an example is given of a circle formed of twenty-four boats connected with wire rope, having a radius of 550 yards, and allowing four ships in the centre to lie 400 yards from the circumference of the circle. The wire ropes, 2ft. below the water, caught the screw of any torpedo boat so as to capsize her. An instance is given of a boat thus failing and being capsized and sent to the bottom with most of her crew, though commanded by a peculiarly cool and daring officer who was picked up in a drowning and very perplexed state. Another case is given of a Harvey torpedo getting a singularly good opportunity of acting during an eclipse which attracted the attention of the superstitious Turkish crew of a man-of-war. Nevertheless, the Harvey torpedo did no appreciable damage, although they reported that the ship had doubtless been destroyed.

Hobart Pacha considers the pole or spar torpedo more trustworthy than the Harvey. He considers that a ship might run from torpedo boats when they were perceived to be moving sufficiently fast to make their approach, the rate of which of course would be the difference of speed between them and the retiring ship; very dangerous to the torpedo boats, inasmuch as the ship would bring all available fire to bear on them while they gained at the rate of, say, 5 knots an hour only. Of course, it is to be replied that in some cases it would be a great point to drive a ship to fall back thus, and if she is obliged to do so while the torpedo boats are at a long range, it appears to give them a power which might be awkwardly used in case of a blockade. Further, the writer thinks that torpedo boats are open to the grave objections of being liable to attack friends by mistake, to deteriorate and get out of order very quickly, and to go to pieces or become much dilapidated in a gale. Fish torpedoes, on the other hand, fired from a ship's deck, or any height above the water exceeding 2ft. or 3ft., are thought to be very wild and likely to endanger the firing ship. In the American War undoubtedly ships were damaged or sunk by submerged torpedo boats which were allowed to creep up unperceived. But this was at the cost of generally drowning the crew of the attacking boat. In the instance that fell under the personal observation of the writer it is questionable whether the loss of the boat and nearly all the crew was not far too great a price to pay for a hole which only caused the ship to go into shallow water and repair damages. The Ley torpedo, steered by electricity, the writer thinks has a future before it—in fact, that it may be the "weapon of the future" if its want of speed and immersion can be overcome. At present it would present too easy a mark to escape destruction. This nearly completes the tale of torpedoes proper. Submarine mines, however, the writer thinks can be made invaluable for defensive purposes if systematically laid down. He thinks, for example, that a system proposed by Latimer Clarke and Co. might be so applied as to render England and her Colonies safe against attack and invasion. The writer, however, concludes by wisely reminding us that our commerce cannot thus be protected. As we have already said, while the practical experience of a naval officer of ability and in the altogether exceptional position of the writer, is extremely valuable, we believe that our naval officers generally consider that the Russian attack was much too crude in its character and too imperfectly conducted to be a fair sample of what might be expected in any future war. Moreover, while the motto of the book seems to make light of torpedo attack, the writer occasionally shows that he would regard it as not only very formidable, but under certain circumstances irresistible if certain improvements were well worked out. Some will remark that the first of these is to fire torpedoes without safety caps on them.

INAUGURATION OF THE ANTWERP QUAYS.

THE two miles and upwards of quay wall in Belgium's commercial metropolis, the fourth port of the world, with the new south docks and subsidiary works, which will eventually cost about eighty millions of francs, or £3,200,000, were inaugurated last Sunday, 26th inst., by the King of the Belgians. His Majesty Leopold II., with the Queen and Princess Louise of Belgium, left Ostend in a special train for Tamise, on the Scheldt, where the royal party, met by the Corps Diplomatique, embarked on board the Prince Baudouin. This steamer, preceded by the Ranée yacht, carrying the official committee, passed between a double row of about eighty steamers, including the England and John Bull, which, falling in one by one, followed the royal steamer in its passage down the stream for Antwerp, which was reached a little before three o'clock. The squadron steamed slowly along the new quays, thronged with enthusiastic spectators, and then put about, steaming up stream, the hydraulic cranes swinging out their loads simultaneously by way of salute. The royal party was set ashore in about the middle of the length of quay wall, between the Canal au Sucre and the old Steen, a fortress dating from the Middle Ages. Amid loud hurrahs from the shore and the manned yards of the gaily dressed vessels alongside, with the sounds of the Brabançonne, the Belgian national anthem, the king mounted the dais, and was addressed by M. Beernaert, chief of the Cabinet, to the following effect:—

On the 17th August, 1874, the first breach was made in the Citadel du Sud, on the site of which a populous quarter has now arisen, where the industry of both hemispheres is now united (at the Exhibition) and along the Scheldt for 3 kilometres the quays are accessible to the largest vessels. The important work which has been accomplished proves the vitality of our little country, and its confidence in the future. Antwerp now possesses 50 square kilometres of floating docks and 40 square kilometres of quays, 14 of which are covered in by shedding—a result of which our nation may well be proud.

M. De Wael, Burgomaster of Antwerp, followed with a speech in which he recalled the origin of the works. In 1873 the Municipality pointed out to the State the insufficiency of its maritime installations. This led to the agreement of 1874, which had been faithfully kept on both sides; and when the city asked for a quay width of 100 metres instead of 60 metres, the State did not hesitate to acquiesce There was now a minimum depth of 8 metres at the foot of the quay wall, the works having been carried out in the best possible manner.

At the conclusion of his reply, the king shook the Burgomaster cordially by the hand, then witnessed the last races of the regatta, and subsequently the "Cortège of the Nations." "The Nations" was a term given, as early as the fourteenth century, to corporations of men who unloaded vessels, and who assumed the name of the country from which the produce was imported. Among the cars, drawn by sturdy Flemish horses, taking part in the procession, that of the Noord-Natie, or Northern Nation, contained an immense block of granite; the Rijn-Natie being represented by a large mahogany log, and so on, the Exhibition car bringing up the rear.

Probably the best point of view was that selected by the present writer, viz., the top of the Cathedral tower, 123 m. or 407ft. high, with 616 steps altogether. The scene was exceedingly animated, with the crowds thronging towards the quays, while bunting was displayed from every possible point. The Belgian tricolour, black, yellow, and red—the gayest flag that flies—was, of course, predominant, while the colours of Antwerp—red and white—with those of the new Congo State—a gold star on blue ground—gave variety. To the left, facing the river, the International Exhibition, with its large open-work iron globe, was a prominent object. The Three Brothers, said to be the largest sailing vessel afloat, lay alongside; while to the right, the Westernland, largest and newest of the Red Star liners, 5000 tons burden, 8½ m. or 28ft. draught, and 145 m. or 476ft. long, left her moorings by the side of the quay, swung round to the stream, and slowly entered the dry dock for overhauling previous to her next voyage to New York.

In the new quays, viz., Quai Jordaens, Quai Van Dyck, Quai St. Michel, Quai Cockerill, and Quai de la Station, the names of some of Belgium's most famous men are perpetuated, while honour is also done to our countryman, John Cockerill, the founder of mechanical construction in Belgium. On the Quai Cockerill is established the new wharf of the enterprising Great Eastern Railway Company, whence their boats leave daily, and now frequently twice a day, for the new Parkestone Pier, Harwich. While the improvement of Antwerp's quays has contributed not a little towards developing the Great Eastern Company's continental traffic, especially that of Italy, since the opening of the St. Gothard Tunnel, it is not too much to say that the English company has had an appreciable share in increasing the commerce of Antwerp. Both have made spirited efforts; and the encouraging success which is now rewarding them is equally deserved.

The ground on which Antwerp stands, as its name implies—*aan 't warp*, on the alluvion—was originally formed by accumulations of alluvial soil between the two mouths of the Schyn, a tributary of the Scheldt, Pliny speaking of its being covered by the sea twice in the twenty-four hours. It is not a little singular that the same natural cause which formed Antwerp destroyed Bruges as the emporium of the West, the hopeless silting up of the Zwyn in 1470 having diverted trade to the city on the Scheldt. The fortunes of Antwerp have, however, undergone considerable vicissitudes; and the treaty of Munster, signed in 1648 between Spain and Holland, which closed the Scheldt, was the signal for Antwerp's decadence, which lasted until 1792, when the navigation was again made free. In 1803 Napoleon I. noticed the remarkable natural advantages of the port, and endowed it with new quays and shipyards, and a wet and dry dock, making the city, as has been said, "a loaded pistol pointed at England's heart." The old quays—now destroyed—which edged the river, were made in 1818 and 1819; while between 1859 and 1869 important works, including the Kattendyk basin, were carried out.

In 1870, a special Commission, appointed by the Minister of Public Works, prepared the plans for a comprehensive scheme of new quays on the right bank of the river for a length of 1550 metres, or about a mile, with a depth at low water of 8 metres, or 26ft., accessible to Transatlantic liners. The Commission also recommended the demolition of a projection into the stream, called the *Tête de grue*, from its having been the site of a large revolving crane, served by the ancient corporation of Kraankinders. This projection, interfering with the stream and tide, prevented the scour which should keep the channel clear. The general project was adopted by the Municipal College in 1873, the Government undertaking the regulation of the river and the construction of the quays; and the works were begun in 1877.

In the meanwhile the Government had conceded the Citadel du Sud, originally built by Pacciotti by order of the Duke of Alva, and lands adjoining, to Dr. H. Stronsberg, from whom they eventually passed into the hands of the Société Anonyme du Sud. The land thus obtained, amounting to 98 hectares, or 242 acres, has served for the new Southern railway station, three basins for small craft, and an entirely new quarter of the city, the International Exhibition building having also been erected on the portion not yet built over.

The quay wall, in round numbers 2500 metres or 2734 yards long, presents a concave face to the river, being composed of several arcs of different diameters.* It has a batter to the river of 1 in 20 from the coping to low-water mark, and of 1 in 10 from that point to the foundation base. The foundations have been carried down to solid ground without any piles or framing; and the works have absorbed 375,000 cubic metres of brick and concrete masonry, with 25,000 cubic metres of tooled stone, while necessitating more than 2½ million metres of dredging and earthwork. The foundations have a uniform width of 9 metres, or nearly 30ft., the depth varying with the bed and the nature of the ground between 2½ and 5 metres, which brings the base line to from 10½ to 13 metres below low-water mark. On account of the great depth of the wall near the Kattendyk basin, it has there been strengthened by three counterforts, which project nearly 3 metres from the back of the wall. From the last counterfort up-stream to the dock entrance, the back of the wall has been carried up vertically from the outside of the footings, thus considerably increasing its thickness.

On account of the sandy bottom of the river, the swift current, and the great rise and fall of the tide—about 4 metres, or 13ft.—there was exceptional difficulty in executing the work below high-water mark; but the contractors, MM. Couvreux et Hersent, of Paris, devised a system of caissons and cofferdam, for working in compressed air, which was fully described in M. Royers' paper before the Mechanical Engineers, read during their visit to Antwerp in 1883, and reprinted in THE ENGINEER of the date already given.

On account of an unexpected rise in the Scheldt, which occurred last year, an extra course of 30 centimetres, or 1ft., has been given to the wall, making the height 6·65 metres, or nearly 22ft., above ordinary low-water mark, and the total height of wall 14·65 metres, or 48ft., from the foundation. The width is 2 metres, or 6½ft., at the coping; 6½ metres, or 20ft., at ordinary low-water level; and 7 metres, or 23ft., at the base or foundation line; the foundations themselves being 9 metres, or nearly 30ft., wide, as stated above. There are three landing pontoons, which rise and fall with the tide, the largest measuring 100 metres by 20 metres, or 328ft. × 65ft., being connected with the shore by a gangway bridge, 35 metres by 6·7 metres, or 115ft. × 22ft. While the cost of regulating the river and making the quay wall has been borne by the State, that of erecting the shedding and providing the cranes and other appliances has fallen upon the city of Antwerp. The travelling hydraulic cranes have been supplied by Sir William Armstrong, Mitchell, and Co., of Newcastle, to all but the fourth and last section of the works between the Canal au Sucre and the old docks, for which the shedding has not yet been erected; but it is expected that this portion will shortly be completed. Loading and unloading goes on by night as well as by day. At present gas is the illuminant, which will, however, before long give place to the electric light. The port dues are not high; and the quay dues, as to which an outcry was made, are now in abeyance, while the Customs regulations are not carried out with severity.

To complete the whole project there still remains to embank the convex or left bank, and to afford communication between the two sides of the river. A bridge forming a continuation of the State Railway from the southern station, and joining the Pays de Waes line, has already been decided upon by the Chambers; but, on account of the slight elevation of the shores, it would have to be carried at a level of only 15 metres, or 49ft., above low-water mark. Great opposition, therefore, has been made to this scheme, on account of the interference with navigation; but the objection would be met by substituting a tunnel, as proposed by M. Matthyssens, civil engineer, or by making a by-pass canal, as designed by M. de Mathys, Ingénieur, Directeur des Ponts et Chaussées, who has had the supervision of the works all through. In 1870 this gentleman got out a project of extensive docks on the left side of the river, which would have made Antwerp the first port in the world; but it was not carried out, on account of the fear that trade would be diverted from the city proper. The separation of Belgium from Holland in 1830 caused a temporary decrease of trade; but the number of vessels entering the port has increased from 1250 of 150,264 tons in 1832, to 4342 of 3,470,873 tons in 1884, the mean tonnage of vessels having increased from 140 tons in 1836 to 799 tons in 1884. The first steamer, the Prins van Oranje, began to trade between Antwerp and Rotterdam in 1817, the first iron vessel arrived in 1838, and the first screw steamer in 1840.

Before the regulation of the river and the removal of the projecting *Tête de grue*, the direction of the set of the stream formed with that of the rising tide a figure like a very depressed letter X; and the consequence was a silting up of the bed, in fact a continuation of the action which formed the ground on which the city stands, rendering continual dredging operations necessary. But since the banks have been made parallel, though on a curve, soundings taken constantly at one point or another show that this action has ceased, and that the scour is sufficient to keep the channel clear. The previsions of the engineers have, therefore been borne out; and warm congratulations are due to all concerned on the successful achievement of a work which is truly gigantic for a country with a population scarcely greater than that of London.

SOUTH KENSINGTON MUSEUM.—Visitors during the week ending July 25th, 1885:—On Monday, Tuesday, and Saturday, free, from 10 a.m. to 10 p.m., Museum, 8524; mercantile marine, Indian section, and other collections, 2628. On Wednesday, Thursday, and Friday, admission 6d., from 10 a.m. to 6 p.m., Museum, 1682; mercantile marine, Indian section, and other collections, 688. Total, 13,522. Average of corresponding week in former years, 17,972. Total from the opening of the Museum, 24,166,366.

* A plan and sections were published in THE ENGINEER of 10th August, 1883, in connection with the paper by M. Royers.

ELECTRICAL ENGINEERING AT THE INVENTIONS EXHIBITION.

No. IX.

Messrs. Elwell-Parker, Limited, of Wolverhampton, show a large display of their dynamos, ranging from machines for an output of 1500 watts up to 50,000 watts. With exception of the largest machine, which has four poles, all the others are of the Gramme type with two poles, and are now being manufactured in almost every detail according to the original patents taken out by Messrs. Elwell and Parker in 1883. It is not often that we find the whole process of manufacture of any machine covered by the original specification. On the contrary, in most cases the first patent is merely the starting point for the practical development of the invention, and manufacturers find it necessary to continue patenting details until the final shape taken by the invention is, on the one hand, shorn of a good deal that was considered most important at first, and, on the other hand, contains some salient features which were not even hinted at in the first patent. Messrs. Elwell-Parker's specification—1883, No. 770—is an exception to this rule, and possesses, therefore, considerable interest. It would be perfectly correct if we were to describe their dynamos by simply quoting parts of their original specification; but as this does not contain any numerical data, we prefer to give the description in our own words, and to add such figures and practical information as, by the courtesy of the firm, we are able to lay before our readers.

FIG. 3

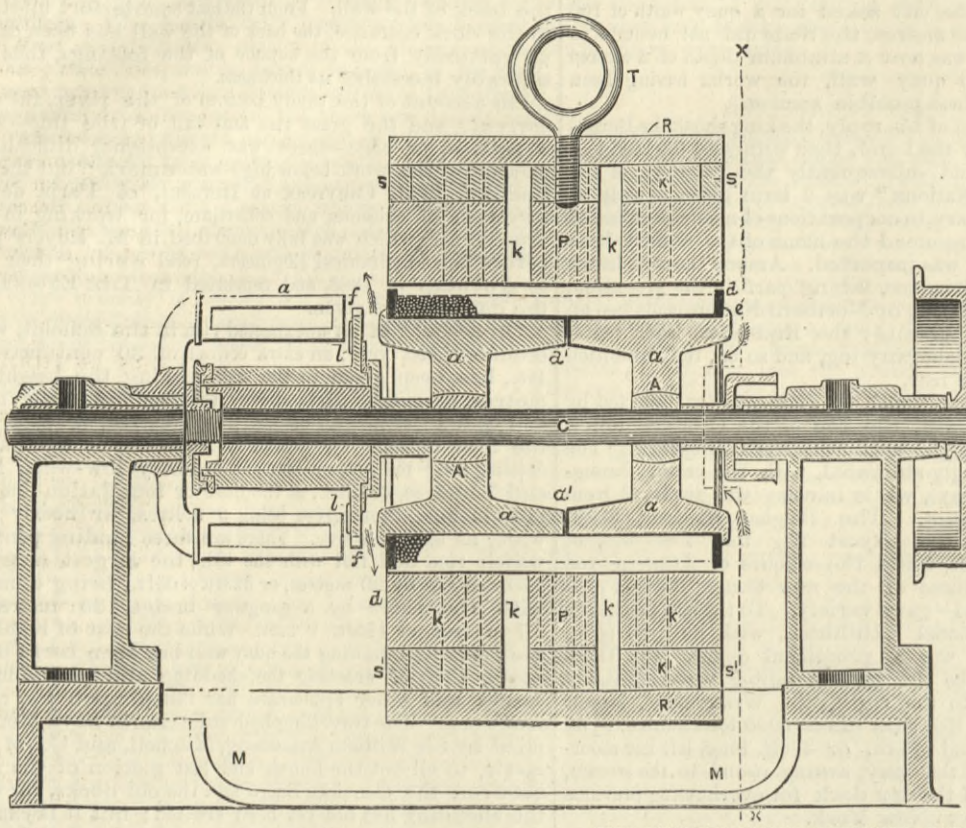
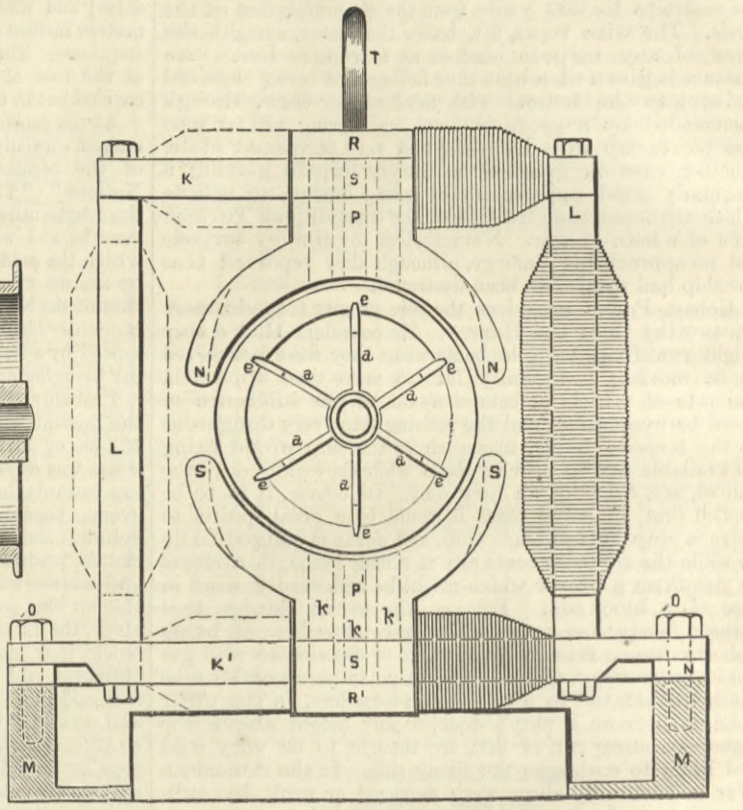
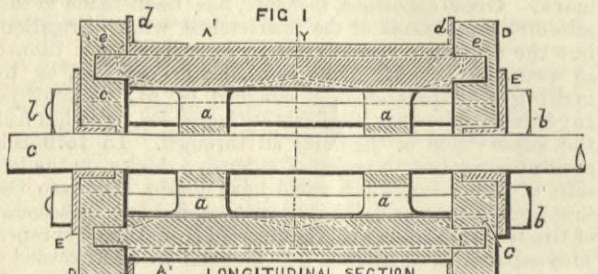


FIG. 4



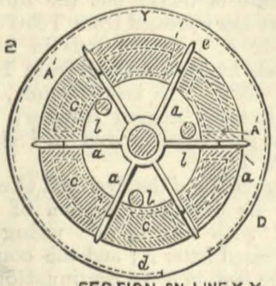
THE ELWELL-PARKER DYNAMO ELECTRIC MACHINE.

FIG 1



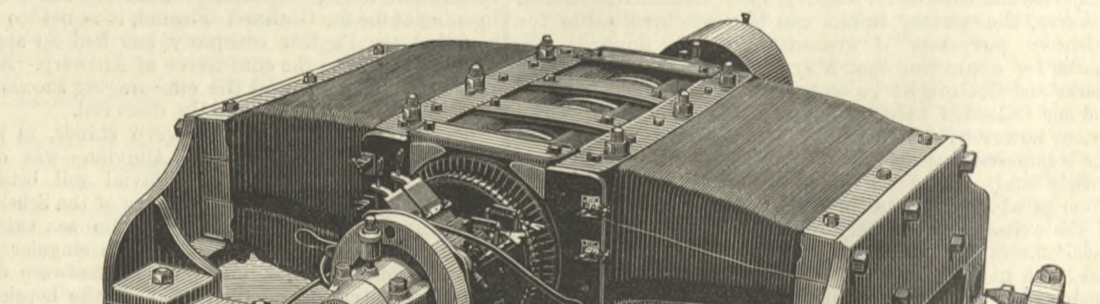
LONGITUDINAL SECTION

FIG 2



SECTION ON LINE Y.Y

It might be said that the Elwell-Parker dynamo was invented to order. The firm commenced their electrical work by the manufacture of an improved form of Planté accumulator; and as in the "forming" of the cells dynamos were required, they used at first what machines they could obtain in the market. This was two years ago, and our electrical readers who have had experience in similar work will not be surprised to hear that none of the machines obtainable at that period could satisfactorily be used for charging accumulators. Sparking at the brushes, worn out commutators, waste of power, reversal of polarity, burned up armatures, and other like evils were the order of the day. All this has been changed since then, and perfectly satisfactory machines can now be obtained from dozens of makers; but then it was not so, and Messrs. Elwell-Parker resolved to satisfy their wants by making their own machines. The first machine was finished in October, 1883, and has been used continually since that time in the company's works partly for lighting and partly for charging. Its armature can be described as a compromise between the ordinary Gramme ring and the Bürgin hexagon. It shares with the former the circular shape and the winding which completely covers the external surface of the core, and at the same time it has the mechanical advantage of the latter—the way the core is supported on metal arms. In the Bürgin machine the arms are forced into the ring after the same is wound, and they take a bearing in the corners of the hexagon. Since there can only be six distinct coils on each ring, it is necessary to employ a number of these rings so as to get an even current and to avoid sparking. This limits the width of each ring to about 2in. to 3in. Now in the Elwell-Parker armature any desired number of coils may be wound on to the core to ensure an even current without the necessity of employing several rings on the same spindle, and the width of the ring is not limited by any other consideration but that of obtaining the desired output. Since the forcing of the arms into a circular ring would necessarily deform the ring, Messrs. Elwell Parker have introduced the improvement of coiling the wire direct over the arms, and not into a dummy as was done by Bürgin. They insert segments of wood between the arms, so as to preserve to the ring a true circular shape, although the wire be coiled with a considerable amount of tension. We illustrate in Figs. 1 and 2 the method adopted for coiling the core. The supporting arms *a a* are keyed to the spindle C, and after having been insulated with tape and fibre—the latter to prevent metallic contact between the core and the arms—the wood blocks A' are inserted and held in place by discs D D, into which they are morticed. Three bolts *b* keep the whole frame together. To prevent the small lugs or projections *e* coming in metallic contact with the iron of the core, washers *d d* of vulcanised fibre are placed one at each end, and the space between them is now completely filled with iron wire coiled on as evenly as possible. In the process of coiling a bituminous compound is applied, which is intended to insulate to a certain extent the wires from each other. In our article of last week we had occasion to speak of the value of that kind of insulation, and need not reopen the subject. The application of bitumen has, however, this important advantage, that it renders the core more like a solid mass of metal, which can be turned up true in the lathe. In fact, that is what Messrs. Elwell and Parker do. After a few layers of wire are coiled on the surface is tested, and if found out of truth a cut is taken over it. We need hardly mention that the depth of a cut never equals the diameter of the wire, and usually is only a fraction of it. A few more layers are then coiled, and if necessary a cut is taken again, and so on until the core is completed to the right radial depth. In this way a true cylindrical core is obtained. After removing the blocks of wood and insulating the core, it is wound with double silk covered copper wire in the usual Gramme fashion, but only one layer of wire is used on the outside of the core; and this rule is not departed from even if the electro-motive force required be 1000 volts. No such high tension machine is, however, shown at the Exhibition, the maximum electro-motive force reached by any of the exhibited machines being 300 volts. This is a 6000-watt machine used in conjunction with B. T. K. accumulators for lighting the East Quadrant. It has been already remarked in a previous article that most of the modern dynamos contain only one layer of wire on the armature; the Crompton, Edison-Hopkinson, Mather and Platt, and several other machines are constructed in this way; but Messrs. Elwell-Parker have pushed the principle to its utmost limit by making this layer exceptionally thin; in other words, by allowing a high density of current in their armature coils. Most makers regard 3000 ampères per square inch of conductor a sufficient strain, but in the dynamos under consideration the density is frequently as high as 6000 ampères. Roughly speaking we may say that the thickness of the single layer in the Elwell-Parker machine is about one-half that found in other dynamos, and in this sense the firm have pushed the single layer principle further than other makers. They maintain that by making the core of small radial depth, so that even the inner coils do not completely fill two layers, the carrying capacity of the wire is considerably increased. The interior of the core is not ventilated, but by a peculiar arrangement on the commutator a current of air is kept flowing into the cavity of the armature at the pulley end, and out between the wires which join the armature to the commutator. This serves to cool the inner wires, whilst the outer turns are kept cool by being whirled through



THE ELWELL-PARKER FOUR-POLE DYNAMO ELECTRIC MACHINE.

the surrounding air at considerable speed. How far this object is obtained we are unable to say; the point can only be settled by the actual experiment of working a machine with a full current, say, for fifty hours continuously. It should be remembered that doubling the density of current means quadrupling the heat generated, and that would require four times the cooling power. If Messrs. Elwell and Parker are able to do this, we see no reason why other makers should not do the same by the applications of a fan or other special device, and thus double the output of their machines. But we must return to the general description of the Elwell-Parker dynamo. In Figs. 3 and 4 we illustrate this machine by a longitudinal section and an end view. The supporting arms or "spiders" are keyed to the spindle C by the hubs A A. Part only of the core is shown, and the armature coils are left out for clearness of illustration. The dark lines represent the insulation between the arms and core. No special description of the commutator is required, as its construction is clearly shown in our drawing. We must mention, however, that the lugs are considerably extended, forming a large disc, to the front end of which is attached a fibre disc *l*, and this arrangement serves partly to prevent copper dust from being drawn into the armature, and partly acts as a fan by which a current of air is sent through the armature in the direction of the arrows. The field magnets consist of flat wrought iron slabs K L bolted together in the shape of a rectangle, with cast iron pole pieces pinned on in the middle of the top and bottom slabs. A large number of pins K K is used, these pins being driven tightly into holes bored out in the pole pieces so as to be in close contact with the metal. By this arrangement it is intended to obtain the magnetic conductivity of wrought iron whilst still retaining the cheaper material, viz., cast iron for the bulk of the pole pieces. In small machines the frame M M is made of Parker's metal, but in larger machines it is made of cast iron, and packing pieces of non-magnetic metal are inserted between frame and field magnets. It is of interest to note that the thickness of these pieces need not be very great; at any rate much less than would be required in an Edison machine of equal size. In the latter the pole pieces themselves have to be kept off the frame by non-magnetic packing, and since the free magnetism is greatest at the poles the magnetic insulation must be correspondingly high. In the Elwell-Parker machine, however, the two portions of the field magnets which come nearest the frame both belong to the lower pole, and are therefore magnetically at a comparatively low difference of potential. Even if the packing were omitted the machine would still continue to work. The only effect would be a very slight drop of electro-motive force, due to the partial muffling of the two lower half coils by direct contact with the frame. The rest of the magnetic circuit would, however, not be altered. The arrangement of magnets adopted by Messrs. Elwell-Parker is certainly very compact, but we think that it might be improved by keeping the vertical magnets a greater distance from the polar extensions N S. As is well known, magnetism is always densest at the corners, and a considerable number of lines of force must be wasted by leakage from these corners to the core of the magnet. Some slight improvement might also be effected by shaping the extensions as shown in dotted lines.

The first armature made by the firm is exhibited in the East Arcade, and is a very creditable piece of workmanship. Although it has been continuously at work from October, 1883, until the opening of the Exhibition, and has been used hard, it does not show any signs of this except a slight bulging of the external wires, which is doubtless due to the fact that they are held in place by friction only, and at some time or other, probably when giving an excess of current, have slightly shifted on the core. The core is 7in. diameter, 9in. long, and 1in. thick. The effective area of iron is therefore $\frac{\pi}{4} \times 9 \times 1 = 7 \cdot 07$ square inches. The field magnets are wrought iron slabs 8in. by 1¼in., having a cross sectional area of 10 square inches, or about 30 per cent. in excess of that of the armature. The latter is wound with 225 turns of ·083 wire, total length about 130 yards. At a speed of 1600 revolutions per minute the external electro-motive force is 60 volts, being at the rate of 2·16 yards per volt. The field magnets are shunt wound, and contain 46 ohms of ·058 wire. This corresponds to about 4700 yards, and since the mean perimeter of magnet coils can be taken as about ·83 yards, we find the total number of turns = 4700 : 0·83 = 5660. The exciting power on one half of the machine is therefore 2830 × current through shunt wire. The latter is 60 : 46 = 1·3 ampères and the exciting power 3680 ampère-turns. This is a remarkably low figure, and is probably due to the fact that the clearance between the armature and pole pieces has by careful workmanship been reduced to the very lowest possible limit. From the figures given above we calculate the electrical efficiency of the machine as follows:—Resistance of armature, ·152 ohms; with an external current of 65 ampères the current through the armature is 66·3, and the loss of pressure about 10 volts; internal energy, 70 × 66·3 = 4640 watts; external energy, 60 × 65 = 3900 watts; efficiency, 86 per cent. The resistance of the armature is calculated at ordinary temperature, but with a density of 6150 ampères—which corresponds to 65 ampères output—and it is probable that the temperature of the wire will rise considerably, increasing at the same time the resistance of the armature. This would, of course, slightly lower the efficiency. There are 6·8 lb. of copper on the armature, and 142 lb. on the magnets; total, 148·8 lb. With a speed of 1600 revolutions the output is therefore at the rate of 26·2 watts per pound of copper. With our standard speed of 1000 revolutions the output would be at the rate of 16·3 watts per pound of copper.

A word of explanation is necessary as regards the number of yards of armature conductor per external volt. Some makers, and amongst them Messrs. Elwell-Parker, argue that since at any moment both halves of the armature lying on either side of the diameter of commutation are coupled parallel, the electro-motive force is produced in one-half of the wire, and it is therefore right to take only one-half the total length when figuring out the number of yards per volt. This argument is perfectly logical, and can be upheld on scientific grounds. But since an armature only half wound with wire is practically useless, we prefer to adhere to our plan of always counting the whole of the wire when the machine has two poles. With a four-pole machine the case is different. Here we are quite justified in counting only half the total wire, because it is practically possible, though not advisable, to work the machine by allowing only one-half the armature to be active. The current will thereby be diminished to half its normal strength, but the electro-motive force will remain the same. Similarly in a six-pole machine, we would only count one-third of the total length of wire coiled on the armature, and so on.

Messrs. Elwell-Parker exhibit a very interesting four-pole machine, which we illustrate in the annexed engraving. The armature is constructed precisely as that of their first machine described above, but is of much larger dimensions. The core is 16in. in diameter, 36in. long, and 2in. deep. It is wound with 186 turns of double ·120 wire, the perimeter of each turn being 2·14 yards. This gives a total of 398 yards of double conductor. At a speed of 450 revolutions per minute, the external electro-motive force is 110 volts, being at the rate of 1·81 yards per volt.

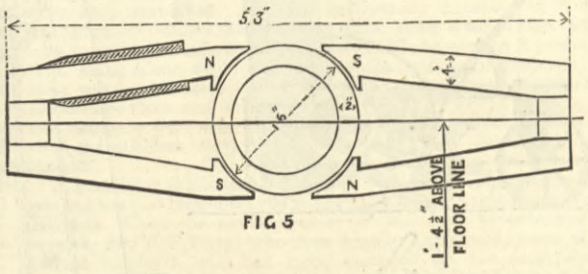


FIG 5

We give in Fig. 5 a transverse section through armature and magnets, omitting, however, all constructive details, as our sketch is only intended to show the grouping of the pole pieces. To each side of the armature is fixed a complete horseshoe magnet, which is supported at the yoke in the cast iron framework—as will be seen from our perspective illustration—and at the poles by gun-metal bolts tapped into a central girder. The distance between the girder and any part of the magnet is at least twelve times the clearance between the surface of the armature core and the face of the pole piece. The exciting coils, of which we only show one, are 17in. long, and each contains 2 cwt. of ·058 wire, having a resistance of 72 ohms. The four arms are coupled parallel. Each contains about 3430 turns, and is traversed by an exciting current of 1·53 ampères. The exciting power in one of the magnets is therefore 2×3430×1·53 = 10,500 ampèreturns.

The resistance of the armature—cold—is ·0278 ohms. We must mention that this figure is not from measurement, but is obtained by simply dividing the resistance of 398 yards of double ·120 wire by 16. The effective area of iron in the armature is 56·4 square inches, whilst the cross sectional area of the magnets, which are slabs 4in. by 32in., is 128 square inches, or more than double the former figure. This is, however, perfectly correct and as it should be, for with the arrangement chosen each magnet must supply sufficient lines for filling twice the area of the armature core; and if the lines shall not be throttled in any part of the magnetic circuit, the area of the magnet cores must be at least twice that of the armature core. The machine is classified as a 50 unit dynamo; electro-motive force, 110 volts; current, 460 ampères; current in shunt coils, 6·12 ampères; loss of pressure in armature, 13 volts; internal electrical energy, 466·12 × 123 = 57,200; external energy, 50,600; efficiency, 88·3 per cent. The density of current is 5150 ampères in the armature coils, and 580 ampères in the shunt coils. The weight of copper used is 104 lb. in armature, 896 lb. in field; total, 1000 lb. At 450 revolutions the output is therefore 50·6 watts per pound of copper; at our standard speed of 1000 revolutions per minute it would be 112 watts per pound of copper.

If the coils on the field magnets be joined up in such way as to make both poles above the centre line N and both below it S, the machine will work like any ordinary two-polar dynamo. Two brushes only will in this case be employed. Messrs. Elwell-Parker have made that experiment, and have found that the electro-motive force is thereby only increased by about 30 per cent., whilst, of course, the current is halved. On purely theoretical grounds we would expect that the electro-motive force should be doubled; but in practice a point of saturation, as regards the density of lines in the armature core, is soon reached, and that prevents the full advantage being obtained from the two-polar arrangement. To make our meaning clear, let us assume for sake of argument that in the four-polar arrangement there are 112,000 lines emanating from each polar surface. We choose this figure simply by way of illustration, as it is a convenient multiple of the area of armature core. Through each square inch of it there will, therefore, be 1000 lines. In order that the electro-motive force may be doubled by the two-polar arrangement, the total number of lines emanating from the four poles must remain the same, and to make this possible the density of lines would have to be 2000 per square inch of core. This is probably more than the core can carry; or, in other words, saturation sets in and prevents the full number of lines from being created. Messrs. Elwell-Parker have supplied two dynamos like the one just described to the Blackpool Electric Tramway Company, as well as seven motors for propelling the cars. A similar motor is exhibited working Mr. Holroyd Smith's car on the South Promenade. We hope to give a full description of this system of electrical propulsion shortly, and for the present must content ourselves to lay before our readers a few data regarding the motor only. It is shunt wound, and intended to work with a potential of 200 volts. The current is supplied by an Elwell-Parker dynamo, driven by a high speed engine also made by that firm. With a current of 30 ampères through the armature of the motor, it exerts a statical torque of 56 lb. on a radius of 16in. We can, with sufficient approximation, assume that the dynamic torque is the same—the field-magnets being shunt wound and the strength of field therefore independent of the current through the armature—and in that case the motor would give off about 8-horse power at a speed of 600 revolutions a minute. The resistance of the armature is ·75 ohms, that of field magnets 200 ohms. The motor weighs 6 cwt. Its field magnets resemble somewhat those of a Siemens machine, which form has been adopted in order to be able to get the motor into the confined space under the floor of the car.

In all there are eleven dynamos and one motor exhibited by Messrs. Elwell-Parker; their list is as follows:—One 50,000 watt machine, driven by Tower engine, and lighting the Club dining room; one 20,000 watt machine as a reserve to the above; one 12,000 watt machine, for charging accumulators, lighting the Royal Pavilion; one 6000 watt machine, charging B. T. K. accumulators, for lighting the East Quadrant; one 6000 watt machine, driven by Willans' engine, and lighting the Subway; one 6000 watt generator, driven by Elwell-Parker engine, and supplying current to electric tramway; one 3000 watt machine, driven direct by three-cylinder Elwell-Parker engine, intended for train lighting; one 3000 watt machine, driven by 3½-horse power Otto gas engine, charging 26 cells at Mr. Taylor Smith's stand; one 3000 watt machine, driven by Beachy gas engine, and lighting Messrs. Woodhouse and Rawson's stand in East Arcade; one 1500 watt machine, driven by Gramme motor; one 6-horse power motor, driving electric tram-car.

THE MERCHANT VENTURERS' SCHOOL, BRISTOL.

On Saturday last the new school of the Bristol Merchant Venturers was formally opened by Sir Frederick Bramwell, in the presence of a large and representative gathering, including the Bishop of the diocese, the Members of Parliament for the city, the Mayor, Sheriff, and other local magnates, the Master and Wardens of the Merchant Venturers, Colonel Donnelly, representing the Science and Art Department, Mr. Philip Magnus, representing the City Guilds, Mr. Owen Roberts, the Clothworkers' Company.

The history of this school may be said to date from the founding of the Bristol Trade School in the year 1856, which was established principally through the exertions of Canon Moseley. The object of the school was to provide an education in the applied sciences; and thus there was founded one of the first institutions in this country where systematic teaching was undertaken with that aim in view. Considerable success attended the working of the scheme, and in the year 1866 the results were specially referred to in the report of the President of the Council of Education as follows:—"That the Trade School of Bristol should, with its 120 pupils, carry off four out of the eight gold medals awarded, besides two silver and four bronze medals and 97 prizes, redounds greatly to its credit, and places it decidedly at the head of the science schools."

About ten years ago the direction of the school was transferred by the body of gentlemen who had managed it from its commencement to the governors of the Colston Trust. It has from that time until now been managed under the scheme framed by the Endowed Schools' Commission, at an annual cost to the Trust of from £500 to £600. The success of the school both in point of numbers and results has continued to increase, and has for some time suggested to the Merchant Venturers, whose influence largely preponderates on the Colston Trust, the desirability of its still further development. The first step towards this was obviously the substitution of more suitable buildings for the cramped and insufficient premises, to which, according to one of the speakers at the opening, the students came in irrepressible numbers, but which for nearly thirty years had been the home of the school. This was too great an enterprise for the Colston Trust alone to undertake, and thus it was determined by the Merchant Venturers to take this first step themselves, and upon the change of location of the school to take over its entire management, and become in future responsible for its maintenance. The site of the old Grammar School was accordingly secured, and a truly magnificent structure has been erected at a cost of between £40,000 and £50,000. With the formal opening of this building, and its dedication to the use of the citizens of Bristol under the name of the Merchant Venturers' School, the Bristol Trade School as such has ceased to exist.

We must now briefly describe the nature of the instruction provided by the school, and afterwards the building itself. The school comprises:—(I.) A primary department for boys of nine years old and upwards. (II.) A secondary department for boys under eighteen years of age. This is subdivided into (1) a division intended for boys whose careers will be connected with manufactures and the constructive arts, and for those who wish to proceed to the higher departments of the school, the subjects of study being chiefly mathematics, applied science, and the modern languages; (2) a division for mercantile or commercial studies. The foregoing courses are arranged to be completed by the time a boy has reached sixteen years of age. (III.) The mining and technical department, for students above sixteen years of age. (IV.) The chemical and metallurgical department. (V.) The evening class department, open to all persons above sixteen years of age without distinction of sex.

The building itself, which is in the fourteenth century Gothic style of architecture, is a result of careful study of all the wants of a technical school, and embodies the experiences gained by a special deputation, who visited the best and most recent schools at home and on the Continent. It is four stories in height, and covers an area of 26,000 square feet. The basement contains a range of lofty rooms 102ft. long and on an average 40ft. wide, intended to be used partly as workshops and partly as a gymnasium, but which is not yet fitted up. It is possible that the teaching of trades in connection with building and carpentering will be commenced for the ensuing winter. There is also a dining room 75ft. by 22ft., communicating with a kitchen and offices, and in this room a good mid-day meal will be supplied. The gas engine, ventilating fan, hot-water warming apparatus, and an exercise court 116ft. by 52ft. occupy the remainder of the basement. The ground floor contains the library—in which are already several hundred volumes, the waiting room, the assistant masters' common room, and the museum. The museum, which is 44ft. by 35ft., is intended to be chiefly technological; but contributions are invited of all specimens which have a bearing on the work of the school, the Merchant Venturers rightly believing that such a museum, if supplied with examples exhibiting the process of manufacturing and mining operations, and the applications of the discoveries of science to the industries of the world, will be of invaluable service in developing the intelligence and interest of the students. It is stated in the prospectus, from which some of the information concerning the work of the school has been drawn, that it is intended to open this museum freely to the general public, and as Bristol has at present no collection of the kind in view, such a course is highly to be commended. There are also on this floor four class-rooms, the porter's residence, and an examination hall, 80ft. by 44ft. and 26ft. in height, having a very handsome oak ceiling of carved work, the execution of which reflects the highest credit upon the builders, Messrs. Brock and Bruce, as its design does upon the architect, Mr. Robins, F.S.A. Upon the first floor, and fronting the two streets which run parallel to the two front sides of the building, is the artificers' drawing-room, 85ft. by 20ft., divisible, as occasion serves, into two rooms by means of a sliding shutter. The room has been arranged so as to afford the best possible light to the students working there, and is fitted with convenient drawing tables. Beyond this room is the diagram room and engineering lecture room, the latter 30ft. by 27ft., also cloak room, lavatories, art drawing room, and side gallery of the examination hall.

The second floor at the top of the building has the chemical and physical laboratories, lecture-rooms and class-rooms, also the metallurgical laboratory. The completeness and thoroughness with which these are fitted up can only be estimated by a personal inspection. The large chemical laboratory, which is 52ft. by 30ft., has accommodation for forty students. The size of the other rooms are: Physical science laboratory, 31ft. by 21ft.; metallurgical laboratory, 30ft. by 20ft.; physical science lecture-room, 42ft. by 31ft.; besides which are a gas and water analysis room, a balance-room, combustion-room, and head master's private room.

In conclusion it must be remarked that the fittings and workmanship are throughout of the most perfect kind, and, indeed, the beauty and elegance of the work on the building itself, back as well as front, on the various rooms, laboratories, halls, and even passages, is not less conspicuous than the substantial and durable nature of the materials employed. We venture to affirm that in this respect, at any rate, the new school is not surpassed and probably not equalled by any technical school at home or abroad, and after a very careful examination of the whole, we are not surprised at the statement made in a speech at the opening ceremony, by Mr. Philip Magnus, who, as a member of the Commission on Technical Education, has recently visited all the colleges and schools of importance in this country and on the Continent, to the effect that he had never seen a school better adapted to the purpose for which it was built than the Merchant Venturers' School. We have no doubt but that the greatly increased advantages of the new building will give renewed impetus to the work of the school; and we trust that the citizens of Bristol will duly reap the reward of the enterprise they have shown in their latest educational undertaking.

LOSSES FROM SOUTH YORKSHIRE COLLIERY STRIKES.

EVERY week brings fresh reminders of the appalling losses sustained by the recent sad strikes in the South Yorkshire coal trade. To those not connected with collieries and colliery work the losses sustained may seem incredible. The loss in wages which the working man and his family sustain is as nothing compared with the loss which coal-miners, railway companies, and the public experience. The past few days has witnessed arrangements which it is hoped will terminate two lengthy and disastrous strikes. At the Church Lane Colliery, near Barnsley, belonging to the Old Silkstone Coal and Iron Company, the men have agreed to resume work, after being out about three months, and losing from £10,000 to £12,000 in wages. This colliery has during the past ten or twelve years been the scene of several costly strikes, in some of which the firm imported and lodged fresh hands at the works at great expense. Some idea may be formed of the losses sustained from the statement of Mr. Ogden, the chairman of the company, who in a recent address to the men declared that the losses sustained by the present and former companies during the past ten years was not covered by half a million of money. At one time the colliery was closed for a year and a-half. The present disastrous struggle for the most part being against what the men term a "Billy Fair Play," but which is simply a testing machine, over which the coal passes in order to make it marketable. With respect to the Denaby Main struggle, which has extended from December, 1884, down to the present week, it is estimated by competent authorities that over £11,500 has been sacrificed in wages; whilst the Manchester, Sheffield, and Lincolnshire Railway Company has lost £9000 by the strike. The loss sustained by the company—which prior to the stoppage sent from 12,000 to 15,000 tons of coal per month to Hull alone—the setting down of the pits, the procuring of fresh hands, and the expense of sustaining the underground workings have been almost unconceivable. Referring to the struggle of 1880 and 1881, Mr. Chappell, miners' agent, who played so conspicuous a part in connection with the Denaby strike, and forfeited his position owing to his firmness, declared that the cost of that strike was not less than £783,000 in wages alone, in addition to which the Miners' Association had paid to the men £77,000. In the twelve years previous to 1881 the association, he said, had paid £52,000 to men on strike, and had caused a loss in wages alone to the extent of £450,000. Such facts as these speak for themselves, and ought to convince the men that there is nothing to be gained by strikes.

LAUNCHES AND TRIAL TRIPS.

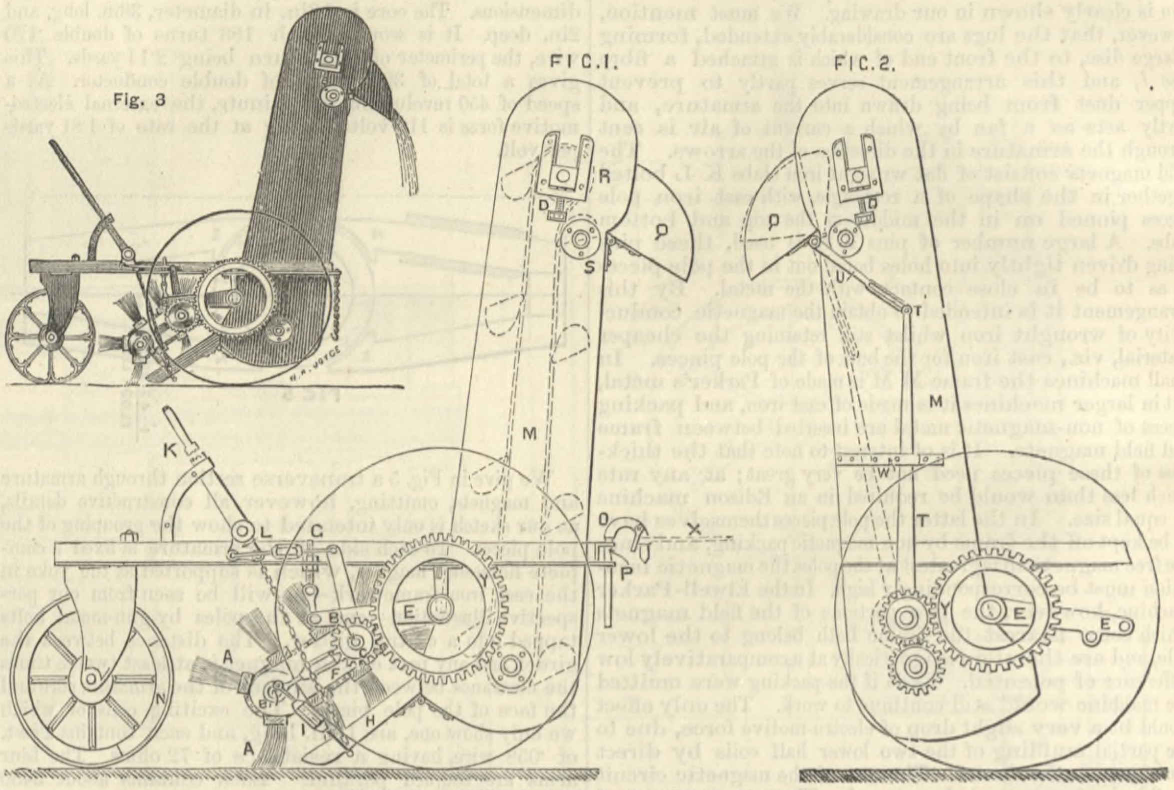
ON the 25th inst. Messrs. Edwards and Symes successfully launched from their shipbuilding yard at Cubitt Town a sea-going steam launch for the Corporation of the City of London and Port Sanitary Committee, for the use of Dr. Collingridge between Teddington and the Nore. As soon as the launch was afloat it was taken alongside the wharf and the boiler and machinery put on board. Its dimensions are—55ft. long between perpendiculars, 11ft. beam, and 6ft. deep. The machinery is of the compound surface condensing type, with extra large boilers. The expected speed is from ten to eleven miles an hour.

One of the steam trawlers for supplying fish to Para was launched from Bidston Wharf, Birkenhead, by Messrs. Cochran and Co., at noon on Tuesday last. These vessels are being built to the order of Messrs. Castel Pontet, under arrangement with the Provincial Government of Para, North Brazil, and are fitted with every appliance for carrying on the projected work successfully. The machinery is also being made by Messrs. Cochran and Co. The launch was in every way successful, and the vessel was named the Esperança.

ON Saturday an iron brow at Chatham pier gave way and precipitated a large number of people into the water. The cause of the failure is not yet known, but Mr. Henry Law has visited the scene of the accident. It is expected that a Board of Trade inquiry will be made.

MARCH'S STREET SWEEPER AND ELEVATOR.

A MACHINE for sweeping streets and taking away the sweepings has long been much wanted in every town of any size. Sweeping machines have been in use many years, but none have yet been made which satisfactorily sweep and remove the sweepings, although hundreds of patents have been taken out in this country and America for the purpose. Mr. W. March has, however, produced such a machine, and overcome the numerous practical difficulties that beset the task, and exhibits one of his machines in the Inventions Exhibition. During all last week one of these machines, as illustrated in our engravings, was at work on London Bridge throughout the day in the midst of the traffic, and its action witnessed by large numbers of people. The machine used was the form shown at Fig. 3, and its action was so successful that the Commissioners of Sewers have determined to adopt the machine for the purpose. Hitherto the Bridge House Estate has paid about £750 to keep this bridge swept, the whole of the roadway part of the bridge will now be kept clean all day instead of being cleaned once a day, and probably at a lower cost. The great advantage which the machine will secure of keeping the bridge free of the great collections of mud which at some parts of the year cover the bridge after a few hours of traffic, will be very highly esteemed.



MARCH'S SWEEPING AND ELEVATING MACHINE.

Our engravings show the machine as now adopted by the City Commissioners, Figs. 1 and 2, and as combined with a wagon. Referring to Figs. 1 and 2, it will be seen that two short endless Ewart chains, with brushes *a*, are fitted upon the shafts *b* and b^1. The upper shaft is driven by a pinion *c* which gears into a spur ring *y* bolted to one of the large road wheels. The brushes sweep the refuse up an inclined brush-pan into the elevator case, to which the pan is hinged. Two short taper bars *e*, one on each side of the machine, are centred at their large ends upon the axle collars. One of these levers carries one end of the front shaft *b*. The other end of this shaft revolves in the lower end of a small upright lever, which, being pivotted by a bolt passing through both, enables the aforesaid pinion to be thrown in and out of gear. The two shafts of the chain of brushes are connected by a set of right and left threaded rods and elongated nuts *f*, the rods being terminated by eyes in which both shafts revolve. The rear end of each of the levers is suspended from the angle iron frame by means of a screwed eye bolt *g* which passes loosely through the frame and has one nut above and one below the frame, whereby the brushes can be lowered to the pan as they wear away. The lower end of the brush pan *h* is suspended at both sides by chains fastened to cranks which are keyed to the rocking shaft above. The brush pan *h* supports both ends of the hind shafts b^1 by means of another set of right and left threaded rods and elongated nuts *i*, so that not only both the pan and brushes are raised simultaneously by depressing the hand lever *k* of the rocking shaft, but both pan and brushes are likewise free to rise over any unusual obstruction in the road. The rocking bar crank *l*, on the right-hand side of the machine, has a perforated boss at its rear side about half-way down. A rod connects this boss to the top of the small upright lever, whereby the pinion is thrown into and out of gear as the brush pan is either lowered or raised by the hand lever. The elevator *m* consists of an inclined case, containing a series of buckets which work inside or between the two chain wheels $r\ r^1$ and their chains; the buckets, like the brushes, being attached to the chains by ears cast on the links. The elevator is driven by a spur ring on the left-hand large wheel, and the pinion is thrown in and out of gear in the same way as that of the brushes, the necessary intermediate pinion being keyed on to a short shaft revolving in the lever *t*, while the lower end of the lever is centred upon the lower shaft of the elevator, or upon the circular bearing of that shaft, as shown in Fig. 2. The upper end of this lever has a pin t^1 fixed into it which slides in a slot in the shoot lever *u*, so that when the pinion lever is drawn back to disengage the gear, it at the same time raises the shoot *q*, the slotted lever *u* and eyes of the shoot being keyed to the rocking shaft working in eye straps fastened to the case. The lever *t* is held in position by a movable pin which passes through the guide frame *w* in which the lever works. The machine is supported at its rear end by a small castor wheel *n*. The machine is coupled to the wagon by an upright hook *o*, the rear part of which slides freely up and down in a round hole of a block or jaw piece *p* fastened in front of the case. The fore part of the hook is square, and enters a square hole of compensating lever gear attached to the under part of the mud or dust wagons, the end of the attachment being indicated by dotted lines.

The brushes of the machine we have seen at work are 4ft. 7in. long, so that the machine moving at three miles per hour, or 264ft. per minute, would sweep and collect from 1210 square feet per minute, although the actual area swept per hour would, of course, not be at this rate, as in sweeping width after width the one brush track would have slightly to overlap the other in order to leave no line of unswept area. The machine works well on any street, and is not affected by refuse, such as straw, cabbage leaves, paper, and so on.

The elevator is capable of working any quantity that may be swept, and will, in fact, load a 2½ yard wagon in a few minutes. The machine can be attached to any wagon, and thus the mud heaps along the sides of streets may henceforth be wholly avoided; horses will not have to haul and stop every few yards a wagon containing, perhaps, over two tons—very heavy work—and the work of cleaning may always go on at any time without any hindrance to traffic. The machine is made by Mr. W. March, of St. Mary-axe, London.

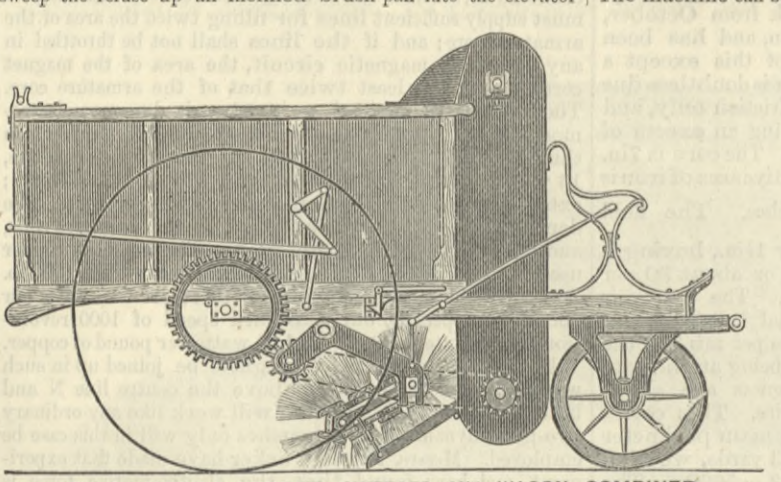


Fig. 4—MARCH'S STREET SWEEPER AND WAGON COMBINED.

THE PANAMA CANAL.

THE report which M. de Lesseps read at the annual general meeting of shareholders on Wednesday is of length and of interest. M. de Lesseps admits that modifications of detail, necessitated by circumstances, have been introduced into the original programme of the work, but the leading principles of that programme have not been altered. That programme consisted, first, in the cutting of a canal from Panama to Colon, 9 metres deep, below the average height of the waters in the two oceans; second, the width of the canal was to be 22 metres at the bottom; third, the canal between the two oceans was not to comprise any tunnel, but to be an open cutting in its entire length; fourth, at Panama a lock was to be established, to prevent the tide creating a swift current in the canal; fifth, in the middle of the course of the canal a long station, or siding, 5 kilometres in extent, was to be created; sixth, at Ha Gamboa an immense dam was to be constructed, so as to intercept the waters of the Rio Chagres, and to give them another course. The execution of this programme has been proceeded with during the current year, and the machines necessary for the completion of the works of the canal have already reached the Isthmus, or are in course of construction. In support of this assertion M. de Lesseps quotes a passage from a report received from the director-general of the works to that effect, and which concludes thus:—"It therefore follows that, even if we had only commenced the dry excavation work on the Isthmus on 1st January, 1885, and only begun the dredging work on the 1st January, 1886, the canal could be completed on the 1st January, 1888. To be provided against all possible accidents, there is all the dry excavation work executed before the 1st January, 1885, and all the dredging which was to be done before the 1st January, 1886." M. de Lesseps goes on to say that there is no doubt that half the effort necessary for the cutting of the canal has already been made. M. de Lesseps says:—"The regular continuation of the piercing of the Isthmus and the completion of the canal in 1888 are the best replies that can be opposed to the adversaries of the canal. We will not do our partners in the work—the shareholders—the injury of supposing that they are moved by such manœuvres."

To show the Panama shareholders that they need feel absolutely no alarm, the president of the company relates how, in 1860, the Suez Canal Company was attacked in precisely the same way. At that time the public was warned against taking up the little shares of the Suez Canal Company. The progress of the works was described as such as to show the impracticability of the enterprise. "It is," says M. de Lesseps, "in precisely similar terms that the

Panama Canal is now sometimes spoken of. The little shares of the Suez Canal, issued at 500f., have become big shares of 2200f. The Egyptian Bosphorus has been created. The little shares and obligations of the Panama Canal will have the same destiny; for the American Bosphorus will be completed, as was its predecessor." Referring to the little mishaps which have occurred, M. de Lesseps says it would have been puerile to imagine that the gigantic work of piercing the Isthmus could be accomplished without any such accidents, and that the execution of each portion of the works could be regulated like clockwork. The number of cubic metres of soil removed every month is steadily increasing. In January, 1885—quoting the report—it was 550,000 cubic metres; in February, 590,000 cubic metres; in March, 627,000; in April, 775,000; in May, 795,000. In April, 1885, there were 17,881 persons occupied on the works; but in October there were 20,368 persons employed on them. Since that time the number of men employed has been maintained at about that figure. The deaths on the works continue very high. The official returns of the deaths that have occurred on the works during the year ending March last are as follows:—1884: April, 59 deaths, of which 9 were Europeans; May, 41 deaths, 3 Europeans; June, 60 deaths, 12 Europeans; July, 87 deaths, 26 Europeans; August, 119 deaths, 35 Europeans; September, 132 deaths, 25 Europeans; October, 163 deaths, 42 Europeans; November, 154 deaths, 48 Europeans; December, 142 deaths, 59 Europeans. 1885: January, 91 deaths, 35 Europeans; February, 46 deaths, 13 Europeans; March, 49 deaths, 21 Europeans—a total of 1153, and death rate of 51·7 per thousand.

With regard to the insurrection which took place at Colon and Panama in May, it had not entailed any great loss on the company. At the Calebra, where the most serious incident occurred, the loss fell on the contractor. In that chapter of M. de Lesseps' report which is headed "The Cost of the Canal," he explains that his chief engineer has calculated that, by certain modifications, it would be possible to reduce the total number of cubic metres of soil to be removed to construct the canal, from 120 millions, the estimate of the Technical Commission, to 90 or 95 million metres. Nevertheless, M. de Lesseps prefers to take the original estimate as the base of his calculation. The contractors now engaged in cutting the canal have undertaken to remove 62,691,595 cubic metres of soil for a total sum of 219,295,974f. Moreover, contracts have been entered into with two other contractors who have undertaken to complete the remainder of the works for a sum of 480,000,000f. The total cost of the actual piercing of the Isthmus will, therefore, amount to 700,000,000f.—£28,000,000 sterling. To this sum must, of course, be added the cost of the canal administration, and the annual interest paid on capital. The International Congress estimated the expenditure for the creation of the canal at 1,070,000,000f., but the company has purchased the Panama Railway and land in the vicinity of Colon and Panama. Evidently the company will require an extension of its borrowing powers to cover these expenses, which were not included in the original estimate. At the end of his report, M. de Lesseps says he has demanded of the French Government authority to borrow 600,000,000f., by the issue of bonds with annual prize drawings. Having obtained the approbation of the shareholders he will take the necessary steps to obtain that authorisation.

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

(*From our own Correspondent.*)

THE outturn of finished iron this week has been curtailed somewhat by the excessively hot weather, and works' proprietors started their mills and forges later than usual.

The orders given out at the present time, generally speaking, go no further than immediate requirements, although a little impetus has here and there been given to some of the works by the receipt of orders for sheets, and bars and hoops, on account of Australia, Canada, South America, India, and some markets on the European continent. The aggregate of merchant orders under execution in the district is considerable.

A few sheet concerns are able to boast having made full time for ten weeks past, but these are in a minority.

The Greet's-green Sheet Ironworks, West Bromwich, have this week passed into the hands of Mr. Geo. Onions, of the Regent Ironworks, Bilston, whose capability of rolling sheets for galvanising is now increased from four to six mills. To-day—Thursday—Regent sheets were quoted £7 for doubles, £8 for lattens, and 10s. on for 28 gauge. Indian and Russian inquiries for sheets are upon the market in good numbers, but the prices offered are in many cases too low to tempt makers.

The list price for Staffordshire bars remains at £7 10s., but most of the marked bar firms are quite content to get £7, while for second-class qualities they are freely accepting £6 10s., and even £6. At the latter price a large trade is being done with Australia and Canada. Hurdle bars are to be had at £5 5s.

Quotations on the open market for merchant iron of an ordinary quality appear from the list of the Pelsall Coal and Iron Company. This concern quotes at date:—Bars, $\frac{1}{2}$in. rounds and squares, and upwards, £5 10s. per ton; hoops and strips, 1in. by 18 b.g., and upwards, £5 15s.; superior bars, £6; horseshoe bars, £6; superior hoops and strips, £6 5s.; hinge strip, £6 10s.; nail strip of from 12in. to 24in., and from 14 to 12 b.g., £5 10s.; gas strip of $6\frac{3}{4}$in. wide, £5 10s.; 7in. to $8\frac{1}{2}$in., £6; $8\frac{3}{4}$in. to $12\frac{1}{2}$in., £6 10s.; angles, $1\frac{1}{4}$in. to $4\frac{1}{2}$in., £5 15s. to £6 5s., according to quality; tees, $\frac{7}{8}$in. to $2\frac{1}{4}$in., £7 to £7 10s.; sash iron, £7 15s.; sheets—singles—and tank plates, £7; and steel hoops and strips, 1in. by 18 b.g., £6 15s. per ton.

Bar makers spoke yesterday and to-day of the increased competition of Belgium in foreign markets, and instanced the further reduction of 5s. per ton which has just been announced by the Belgian firms. Belgian bars may now be had at £4 5s. per ton, f.o.b. Antwerp, while local makers require pretty nearly £6 per ton for similar iron f.o.b. in the Thames. Some Shropshire bars, however, may be had, delivered in London, at £5 10s. per ton.

Steel is competing sharply with iron in all departments. Siemens-Martin billets and blooms of Welsh makes are offered at £5 10s. delivered into this district. Steel boiler plates from the North of England are to be had at £7 10s. delivered, and Thomas-Gilchrist steel of local make is quoted at £5 5s. for tin bars, £4 17s. 6d. for blooms and billets, and £7 10s. for boiler plates.

There has this week come into the district a specimen of rolled steel which promises, it is claimed, something like a revolution in the highest branches of the tube trade. It is in the form of strip rolled down to feather edges. For this a patent has been secured, and its sole use by steelmakers, so far as it relates to South Wales, has just been acquired by the Dowlais Company. This company are understood to have ordered from an engineering firm at West Bromwich a new three-high mill in which to roll the strip. The economy to the tube maker of strip in that shape is very great, since there are in some tube works extensive plants of machinery solely for producing the feather edge. The price at which it seems likely the strip will be procurable in Birmingham and the Staffordshire district is about £7 5s. The patent is equally applicable to the rolling of strip iron for iron tube making, and there seems to be little room to doubt that iron tube strip with feather edges will soon become a commodity of local iron manufacture.

In pig iron stocks of most makes of all-mine sorts continue large. Two firms in the Bilston district are currently reported to hold stocks of 12,000 and 15,000 tons respectively, much of which was made when prices were 10s. a ton higher than current rates. All-mine iron is quoted at £4 for cold blast sorts, and £3 for hot blast sorts, but about £2 17s. 6d. for the latter is really the top selling price. Part-mine pigs are £2 to £2 5s. nominal, and cinder pigs £1 13s. to £1 16s. 3d. per ton.

Ulverstone hematites are changing hands at 53s., and other hematites are quoted 54s. and 55s. delivered. Northampton and Derbyshire pigs went off to-day upon the basis of 37s. 6d. to 40s. per ton.

Most of the bridge building works are amply employed on colonial and home contracts, though there are some of them who are not anything like busy. Competition for the work offered is keen, and values are therefore lower than for a long time past.

One of the latest contracts which has come into the market for ironwork is for bogie wagon ironwork needed by the Indian State Railways; and 200 wheels and axles are also required by the Danish State Railways.

The deputation from the operative Nailmakers' Association, which has recently waited upon the masters to request them to revise the present scale of wages, have presented a report to their association which is in every respect satisfactory. The masters, it is said, informed the deputation "that they were quite willing to return to the 1879 list in conjunction with the up-country." A meeting of the masters will shortly be held, and it is hoped that the settlement arrived at will be satisfactory.

A private meeting of operative vice-makers was held in Dudley on Monday to endeavour to settle the strike which is now going on at one of the works. The result is believed to be unsatisfactory.

The quarterly meeting of the workmen's executive of the Nut and Bolt Makers' Association was held at Darlaston on Monday. The financial report of the late strike showed that the income had been £1459, and the expenditure £1445. The meeting decided that in order to strengthen the association a series of factory meetings should be held throughout the district.

The Railway Rolling Stock Company, Wolverhampton, are in a peculiar position, and it is believed that the ultimate result will be voluntary liquidation. At their half-yearly meeting in Wolverhampton on Tuesday the chairman said that a large reserve fund was upon their hands, but they were unable to employ it profitably. One thing alone would save the company from liquidation, and that was for the shareholders to sell to the directors their permanent debenture stock, and for this a fair premium would be given. If the company were wound up the reserve fund, which belonged to the shareholders only, would, he was sure, be found to be intact.

A gratifying exhibition of goodwill between employer and employed has just been displayed at the Highfields Engineering Works, Bilston. Upon the recent decease of the late proprietor of the works, Mr. T. J. Perry, who was highly esteemed, some of the oldest employés, who had been engaged at the establishment between forty and fifty years, expressed a wish to possess a portrait of their late employer. This week all the operatives have been presented by Mr. Perry's family with a handsomely-framed portrait of the deceased gentleman, together with an address.

In order to illustrate the working of its system, the Empire Telephone Company has just fitted up, in offices of the Great Western Arcade, Birmingham, a pair of its patent telephones.

At Stafford Assizes on Wednesday, the Hanley Colliery Company were sued by Mr. T. B. Shufflebotham for £1000, damages to property consequent upon defendants' mining operations. The plaintiff is the owner of fifteen houses at Hanley and defendants' mines run underneath them. Between January and March this year a subsidence took place, and the houses were so disturbed as to have now become uninhabitable. The colliery was entered upon by the defendants at the latter end of 1883, having previously been in the hands of many owners.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—The condition of trade continues without improvement, and the position, so far as makers of iron are concerned, is rapidly becoming critical. At the very best, the prices obtainable barely cover the cost of production, and with regard to many commodities, the choice lies between going on at a loss or stopping works entirely at a still greater loss. There is, however, a limit to the production of iron at a loss, and the probable closing of some of the works is already being looked forward to as a possibility in the near future. There are certainly no prospects of any early improvement in trade to encourage makers to continue operations at a serious loss as a temporary expedient to carry them over to better times. So far as many of the large iron using branches of industry in the engineering trades are concerned the prospects are rather of lessened activity, and users of iron who have entered into at all heavy contracts, in anticipation of work coming forward, are in many cases now finding themselves largely over bought for their actual requirements.

There was a very flat market at Manchester on Tuesday. For pig iron there was comparatively little or no inquiry, and quoted prices were, if anything, a trifle lower than those of last week. This, however, represents rather a receding of the nominal quotations to previous actual selling rates than really any further material reduction in prices. Lancashire pig iron now averages 38s. 6d., less $2\frac{1}{2}$, delivered equal to Manchester, and district brands 37s. 6d. to 38s. 6d., less $2\frac{1}{2}$, but the business doing is extremely small, and where buyers have any orders of weight to give out, they hang back for still even lower figures. Outside brands, such as Scotch and Middlesbrough, remain very low in price, notwithstanding the continued upward tendency shown by the Glasgow warrant market.

Hematites are without change; the demand continues extremely poor, and good foundry qualities are to be got without difficulty at about 51s., less $2\frac{1}{2}$, delivered equal to Manchester.

The manufacturing iron trade continues in a very unsatisfactory condition. One or two of the large firms are able to keep their works on full time, but generally the forges throughout this district are very indifferently employed, and the prices ruling for all descriptions of finished iron are extremely low. Delivered into the Manchester district, ordinary merchant bars average £5 5s. per ton; hoops, £5 15s. to £5 17s. 6d.; and sheets, £6 15s. to £7 per ton.

Ironfounders complain of an absence of orders generally, whilst prices are excessively low, with a keen competition for any work that does come into the market. In builders' castings there is comparatively no work of any weight giving out, and cast iron columns, delivered into the Manchester district, are to be got at about £4 15s. to £5 per ton, and cast iron girders at £4 10s. to £5 per ton. For cast iron pipes prices rule exceptionally low, and ordinary sections, with bored and turned ends, are to be got at about £4 5s. per ton, delivered here.

A slackening off is still generally reported throughout the engineering trades, and the returns as to employment show an increasing number of men coming out of work. The leading tool makers are moderately well employed, and in heavy engineering work some of the local firms are tolerably busy on orders for Elswick and Sheffield for steel ordnance purposes. Cotton machinists are in some instances rather better off for work than they were, and a tolerably large order in connection with the re-fitting up of the Great Western Cotton Manufacturing Company's mills at Bristol has been secured by firms in this district. General engineering work is, however, very quiet; small engine builders are but very indifferently employed, boiler makers are working on old orders, with very few new ones coming forward, and although locomotive builders are kept fairly busy, the new work coming forward is very small, and there is a keen competition for any orders giving out.

A special plant for the recovery of the residual products, tar and ammonia, from the blast furnace gases, has just been completed from the designs of Mr. John Dempster, of R. and J. Dempster, Gas Plant Works, Manchester, at the Staffordshire Ironworks of Messrs. Robt. Heath and Sons. This plant, which is the first of its kind that has been put down in England, is to a large extent somewhat similar to that used in ordinary coal-gas works. A very powerful condenser of 200 wrought iron tubes, 40ft. long, fixed vertically, has cold water flowing down the outside of each pipe; the gases are drawn from the furnaces and forced through the apparatus by four exhausters. After leaving the exhausters the gases pass through four specially designed washers, and thence forward through four scrubbers of large dimensions. These scrubbers are filled with material specially arranged to expose a large surface, and to each scrubber there is a separate pump; these pumps maintain a constant flow of ammoniacal liquor through the scrubbers, except in the last one, through which clear water is flushed to remove the last traces of ammonia. In all the apparatus precautions have been taken against accidents by explosion by having escape valves fixed, so that any sudden rush of gas would find easy exit. In designing the plant one indispensable object has had to be kept in view, and this has been that in utilising residuals the gases should not suffer in their main object as a heating power, and that provision should be made against any waste of gas in the process, as the whole of the gases from the blast furnaces is utilised for raising steam for the blast engines, forges, and pits. This plant was successfully set to work last week by Mr. John Dempster in the presence of the proprietors and managers of the works, and the result of the trial so far has been sufficiently satisfactory as to fully justify the anticipations of the proprietors and the patentee. The successful operation of this plant will be a matter of considerable interest to the iron trade generally, especially in these days of keen competition when practically the only source for an increased margin of profit has to be found in increased economy in the means of production.

A further development of the various types of gas engines now in the market has just been introduced by Messrs. Greenall and Co., Manchester, and I have had an opportunity of inspecting the first engine of this new type that has been made. The new engine is termed the Simplex, and a very simple form of construction, with very few working parts, has been secured. The engine is worked by non-compressed gas and air, and one of the chief features is in the arrangement for regulating the supply of gas. To the side of the engine a catch-wheel is fixed, with four, six, or more teeth, and a rocking disc motion is conveyed to these by an excentric driven from the engine shaft. At every revolution the catch-wheel alters its position one tooth by means of a catch, and the bottom tooth then presses down a lever connected with the gas valve, thus admitting a charge of gas, which is mixed with air obtained through a valve at the back of the engine. The air and gas then pass into the cylinder, and ignition is conveyed through a passage at the opposite side near to the end of the cylinder. A hanging valve is adjusted to this passage, which is opened by the suction as the piston travels forward, and the flame constantly burning in front is drawn in, thus communicating with the charge in the cylinder, and an explosion having taken place, the valve is immediately closed by the force produced. The rocking disc, which is provided for opening or closing the ejector or exhaust valve, is regulated in its action by a governor on the engine, which is arranged to act upon a stud connected to the catch, so that, in the event of the engine attaining an excessive speed, and the governors are thrown full open, the catch is lifted free from the catch-wheel, and no further charge of gas is taken in until the engine resumes its normal speed, when the catch drops into its proper position. By this arrangement the engine is only supplied with gas in proportion to the work it is doing, and it is claimed that an impulse every revolution is secured.

The local reception committee appointed in connection with the recent meeting of the Gas Institute in Manchester have brought their labours to a close in very handsome fashion. The concluding meeting was celebrated by a dinner at the Brookland's Hotel on Thursday, and Mr. Alderman W. H. Bailey, who occupied the chair, was able to announce that out of the surplus funds left in the hands of the committee, they had contributed £10 to the Clifton Colliery Accident Fund and £10 to the Widows' and Orphans' Fund of the Gas Institute. But this was not all; afterwards, on behalf of the committee, a very handsome clock and vases were presented to Mr. Thomas, the hon. sec.; a similar presentation was made to Mr. Hutchinson, the assistant hon. sec., and gold medallions specially struck in honour of the visit of the Institute to Manchester were presented to Mrs. Newbigging, the wife of the president, and to Mrs. Bailey, the wife of the chairman, for the services she had rendered in receiving the guests at the reception given to the members of the Institute in the Manchester Town Hall.

Throughout the coal trade of this district a general stagnation of the demand is reported in all descriptions of fuel, and with pits not working more than three to four days a week there is an accumulation of stocks not only of house-fire coals, but of steam and forge coals and engine fuel. Quoted rates are nominally without alteration, but there is a great deal of underselling to secure orders, and where colliery proprietors have to move away quantities extremely low prices are frequently taken. At the pit mouth the average prices remain at 8s. to 8s. 6d. for best coals, 6s. 6d. to 7s. for seconds, 5s. to 5s. 6d. common, and 4s. 3d. to 4s. 9d. burgy, 3s. 6d. to 4s. best slack, and 2s. 6d. to 3s. per ton for common sorts.

In the shipping trade there has been rather a falling-off, but prices are without alteration, good qualities of steam coal delivered at the high-level, Liverpool, or the Garston Docks, averaging 7s. to 7s. 3d. per ton.

Barrow.—There is a growing impression that we have not yet seen the worst of the depression which has characterised the hematite pig iron trade of this district, in common with the pig iron trade of the country generally, for several months past, and the opinion I have proved is alike supported by those whose business it is to make iron as well as by those who buy either for use or for re-sale. The immediate prospects are gloomy, and the probability seems to be that a much less active winter will follow the summer months we are now passing through, and which in themselves are less active than any previous period during the past ten years. Prices are exceedingly low; but these do not tempt either consumers or speculative dealers, who are alike apprehensive of an indefinite continuance or intensification of the present lifeless state of trade. Mixed numbers of Bessemer pig iron were never known so low in value as 42s. 6d. per ton net for prompt delivery, or 43s. 6d. for forward delivery. The indifference of buyers to negotiate for forward deliveries at extremely low prices is in itself indicative of the position now existent. Steel makers are very short of work, and their mills are working very irregular time. The demand for rails and merchant material is very weak, while special steel of the hard and mild types, rods, bars, hoops, wire, axles, tires, and plates are in such limited request that makers in no instance are in a position to keep their mills regularly at work. Shipbuilders not only join in the general tone of inactivity, but they are cognisant of a definite cause which contributes largely to the paucity of demand for steamships and sailing vessels, and that is the fact that the largest and even the smallest carrying companies in the country, and in the world in fact, find it necessary to lay up for an indefinite period a fair percentage of the vessels which ordinarily carry on their trade. There are no new features in engineering, either in the marine or the general departments.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

INSTRUCTIONS have been issued by the Admiralty authorities for the immediate completion of the armoured cruisers, to which reference has already been made in THE ENGINEER. It is desired that all the armour for these vessels should be ready by the end of March next, which will keep the mills pretty briskly employed, with the other orders now in hand. The Lancashire and Yorkshire Railway Company are inviting tenders for a thousand pairs of wheels and axles, a considerable portion of which will no doubt be placed in this district. A heavy order for locomotives—between fifty and sixty—has been placed by the Indian authorities in Glasgow. Work in connection with this important line will follow the usual course of finding its way to Sheffield firms. In the lighter departments of industry, the prevailing features of stagnation remain unchanged.

At the half-yearly meeting of the Manchester, Sheffield, and Lincolnshire Railway last week, Sir Edward Watkin, the chairman, stated that the loss to the company through diminished trade during the half-year was £26,600, added to which there was £9000 solely caused by the Denaby Main stoppage, and £5500 by falling off in general merchandise. There was an estimated saving of £6000 in expenses, leaving £35,000 as the undoubted bill of the company for the languor of the industries in the districts, particularly the Sheffield district, traversed by the company.

The Manchester, Sheffield, and Lincolnshire Railway Company has been successful in the only case which has as yet been publicly tried arising out of the disaster at Bullhouse Junction, near Penistone, in 1884. Among the victims of the memorable calamity was a Mr. Woodhead, a civil engineer; and his widow, at Manchester Assizes, sought to recover £10,000 damages. Mr. Justice Manisty put two questions to the jury. The first was: Were the company guilty of negligence in not having an automatic brake attached to the train; the second was, whether the company were negligent in not discovering the flaw in the crank axle, the breaking of which was the primary cause of the accident. The jury replied in the negative to both these questions, and the judge therefore directed a verdict to be entered for the defendant with costs, and certified for a special jury.

Nothing is yet decided as to the ultimate fate of the Elsecar Ironworks, which are built on ground leased from Earl Fitzwilliam. It is expected that the famous establishment, though it may not be revived in the name with which it has for years been worked—Dawes—will yet be resuscitated. The slightest upward movement in the iron market would hasten operations in that direction. At Wakefield, the site of the well-known Normanton Ironworks—now dismantled—was offered for sale on the 25th inst. The site, which is close to the Normanton Railway Station, and has siding accommodation on the Midland Railway, extends to 31,000 square yards of freehold building land, and therefore affords every facility for development. Only one out of three lots was sold—a plot, consisting of 16,577 square yards, with a frontage to the Midland Railway, and forming part of the ironworks' site. The bidding started at 1s. per yard, and rose gradually to 3s. 2d., at which price the lot was sold to a Leeds solicitor. For another lot no bid was made, and a third was withdrawn at 2s. 8d. per yard.

Another colliery dispute, I am glad to say, has been satisfactorily arranged, after the men had stood out for three months. The Church Lane Colliery of the old Silkstone Coal and Iron Company, at Dodworth, near Barnsley, accepted the 10 per cent. reduction, in common with the remainder of the men in the district, but they refused to resume work in consequence of a "Billy Fair Play" having been put on the pit bank. The owners declared that the machine was not a "Billy Fair Play," but a machine riddle, with a ⅝in. mesh, which, they held, would not make any difference whatever to men who did their work honestly. Various meetings were held for the purpose of settling the dispute, but all efforts were fruitless until the 27th, when an arrangement was made to resume work on Thursday. About 1000 men were affected when the strike commenced, but a large number have got work elsewhere, and the others have been supported by the Yorkshire Miners' Association.

Mr. W. H. Chambers, the manager of the Denaby Main Colliery, has written to explain why the company, now that the dispute is at an end, has not at once employed the whole of the late workmen. He points out that the men have no more claim on the Denaby Colliery than on any other colliery in Yorkshire, having deliberately given notice and left the company's employment more than six months ago. Mr. Chambers further points out that the men allowed themselves to be removed from their houses "rather than accept the ample wages offered," and subsequently refused to work at a guarantee of 5s. 6d. a day. "They deliberately stood by and saw the horses sold, and the pits closed for an indefinite period, without a single man offering his services at the sum named." The company thus having no alternative but to bring men from a distance, had done so, and now the old men desire to be taken on. At present the company has not been able to employ more than fifty of the old hands, having already engaged Staffordshire men, who broke up their homes on the faith that the company would find them employment. And Mr. Chambers very properly declines to send to the right-about the men from a distance who helped him in the time of trouble. "Besides the Staffordshire men already here," he says, "many more were engaged before the Denaby men made any intimation. These people have given notice to leave their works, and have broken up their homes, trusting to that engagement, which the company are bound to fulfil on their part."

The Nunnery Colliery Company is now quoting hand-picked Silkstone branch at 13s. per ton, "hards" at 11s., screened at 10s., seconds at 9s., and nuts at 7s. per ton.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

THE Cleveland iron market, held at Middlesbrough on Tuesday last, was somewhat better attended than it has been of late, and the tone, so far as pig iron was concerned, was a shade firmer. During last week merchants were selling No. 3 g.m.b. for prompt delivery at 31s. 10½d. per ton, and even 31s. 9d. was accepted by some for small lots. On Tuesday last the lowest price at which No. 3 could be bought from either merchants or makers was 32s., and the leading makers quoted 6d. to 1s. per ton more. Forge iron is in poor request, owing to the diminished consumption at the finished ironworks, and the price is weaker. There is now no difficulty in obtaining it at 31s. per ton, but some makers hold out for 31s. 3d.

Holders of warrants continue to increase their stock, and will not accept less than 32s. 9d. per ton for No. 3.

During the past week 1581 tons of pig iron were sent into Messrs. Connal and Co.'s store at Middlesbrough. The total stock held by them on Monday last was 59,263 tons.

This month's shipments of pig iron from the Tees fall considerably behind those of last month, owing principally to the smaller quantity required for Scotland. Up to Monday last only 58,729 tons had been sent away, as against 70,980 tons during the same number of days in June.

Quotations for finished iron are unaltered. Ship plates are £4 15s. per ton, girder plates £5, angles £4 10s., and common bars £4 17s. 6d., f.o.t. at makers' works, cash 10th, less 2½ per cent. Puddled bars are £3 per ton net at works. There is no improvement in the demand. Slight reductions on the above prices are made to secure large and favourable contracts, but there are not many to be had just now. It is scarcely likely prices will fall lower, as it is well known that most makers are working at a loss.

The directors of the Consett Iron Company will recommend to the general meeting to be held on the 15th prox. the payment of a dividend of 10s. per share on ordinary shares, and 4s. 3d. per share to shareholders in the Consett Spanish Ore Company.

The Hull and Barnsley Railway was opened for passenger traffic on the 27th inst.

The depression in the steam shipping trade continues on the Tyne, and the number of idle vessels is being increased daily. The River Wear Commissioners' returns for June show an increase of £1294 in revenue compared with June last year.

The accountant to the North of England Board of Arbitration has issued his report for the two months ending June 30th. It shows that the net average selling price of plates, bars, angles, and iron rails, was £4 17s. 5·17d. per ton. This is 6d. per ton less than for the two months ending April 30th, and 5s. 10d. below the lowest price reached in 1879.

Chief-Justice Waite, of the United States, and Mrs. Waite visited Newcastle-on-Tyne on Monday last and inspected the old castle, the Museum of Antiquities, and other places of interest. They then went on board a steamer and made a voyage down the river to Tynemouth. The honourable gentleman seemed deeply impressed with the activity apparent on either bank, and with the large amount of shipping afloat. He said the Tyne was the most wonderful river he had ever seen, and certainly the most interesting sight he had witnessed in England. To Tynesiders who are so used to the coaly river, and who often revile it as dirty and unpicturesque, it must be extremely interesting to know what so distinguished a foreigner has to say on the matter.

A meeting of the Board of Arbitration for the manufactured iron trade was held at Darlington on the 27th instant for the purpose of considering further the possibility of re-establishing a sliding scale which should be satisfactory both to employers and operatives. Mr. David Dale, referee of the Standing Committee, attended, and after some preliminary business had been disposed of, presided over the meeting. He was not empowered to decide between the contending parties, but was merely invited to give his views, and to promote a settlement so far as lay in his power. At the arbitration held in January last, Dr. Spence Watson, the arbitrator, had suggested that the amount above shillings for pounds payable to the operatives should not be a fixed amount, but variable, according to the state of trade. When this proposition came to be discussed, it was found that the views of the employers and those of the operatives were exactly opposite, as to whether the difference should be greatest when prices were high or when they were low. The employers argued that according to economic laws the former was the correct view; while the workmen argued that they would expect the greatest difference—that is, the highest relative wages—when trade was at the worst. Without favouring one view or the other, Mr. Dale did not approve of the introduction of this new source of contention. He considered that Dr. Watson's suggestion offered no advantages which would compensate for the probable disadvantages, and he therefore advised the Board to settle upon a fixed and unvariable sum above shillings for pounds. This was then put to the meeting and carried unanimously. After conferring privately and separately with the employers and the operatives, Mr. Dale announced that both parties adhered to their previous offers. The employers then stated that they were willing to refer the whole matter to the final settlement of Mr. Dale, and the operative delegates assenting to this on their own behalf, promised to do their best to get their constituents also to agree to abide by any award which Mr. Dale might give. The question for decision will therefore be whether ironworkers' rates shall be on the basis of 1s. 6d. above shillings for pounds without a minimum, or 2s. with a minimum of 7s. per ton.

A proposition has been made that Mr. Edward Backhouse, banker of Darlington, and formerly M.P. for that borough, should be placed on the new Commission to inquire into the depression of trade. Mr. Backhouse is a good deal more than a mere banker. He has been accustomed to watch with the eye of a financier the cause of the variations and changes in the great industries of the North. His shrewdness and foresight are well known and highly esteemed, and there is no doubt that his appointment on the Commission would give the greatest satisfaction not only in the town where he resides, but throughout the whole of the northern counties.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

THE past week has been another quiet one in trade circles, as in some cases work has only just been resumed after the holidays. In the warrant market there has been a firmer feeling than of late, and the quotations exhibit a considerable improvement, due chiefly to holders reducing their overseales. The shipments of the past week amounted to 9571 tons as compared with 8081 tons in the preceding week, and 10,315 in the corresponding week of 1884. During the week there has been an addition of 2000 tons to the stock in Messrs. Connal and Co.'s stores. There are ninety-one furnaces in blast against ninety in the preceding week and ninety-four at the same date last year.

Business was done in the iron market on Friday at 41s. 6½d. to 41s. 6d. a ton. On Monday, transactions occurred at 41s. 5½d. to 41s. 7d., closing at 41s. 6d. cash. The quotations were practically the same on Tuesday. Yesterday's iron market was flat, with business ranging from 41s. 6½d. to 41s. 4½d. cash, and 41s. 8½d. one month. To-day—Thursday—business was done from 41s. 4½d. to 41s. 3d. cash, and 41s. 5½d. one month, closing sellers 41s. 3½d. cash, and buyers a halfpenny per ton less.

The market values of makers' iron are as follow:—Gartsherrie, f.o.b. at Glasgow, per ton, No. 1, 46s. 6d.; No. 3, 44s.; Coltness, 48s. 6d. and 45s.; Langloan, 48s. and 45s.; Calder, 52s. 6d. and 44s.; Summerlee, 47s. and 44s.; Carnbroe, 46s. and 44s.; Clyde, 46s. and 43s.; Shotts, at Leith, 48s. and 47s. 6d.; Kinneil, at Bo'ness, 44s. and 43s.; Carron, at Grangemouth, 48s. and 47s.; Glengarnock, at Ardrossan, 46s. and 41s.; Eglinton, 41s. and 38s. 3d.; Dalmellington, 43s. and 40s.

The adverse report issued by the Arbitration Board of the North of England, although it is very unsatisfactory, has occasioned no surprise here. There has of late been a fair output of malleable iron in the West of Scotland, chiefly for export, but it has not been possible to obtain adequate prices.

The shipments of iron and steel manufactures from Glasgow in the past week have been necessarily small, owing to the suspension of labour. They embraced three locomotives, valued at £5100, for Calcutta; £1150 worth of machinery, chiefly for India; £1600 steel goods; £1584 sewing machines; and £25,500 worth of other articles.

In the coal trade business has been quiet in the course of the week. The shipments from Glasgow amounted to 21,886 tons; Grangemouth, 13,092; Ayr, 7926; Troon, 7695; Irvine, 2612; and Greenock, 2373 tons. The shipping trade for the next week or two on the west coast will be considerably augmented by the demands of the Quebec fleet, which is now being supplied with cargoes. At Bo'ness twelve cargoes of coals were sent away during the week, including one steamer which carried over 1000 tons for a German port. In Fifeshire business has been quiet, owing to holidays; but orders are reported to have accumulated, so that a better export business may be anticipated in the next few weeks. There was comparatively little doing at Leith, but the coal trade at Grangemouth has been active, and there is a total increase since the 1st of January of 55,897 tons of coals exported, as compared with the quantity despatched in the same time last year.

Efforts are being made by one or two of the old miners' agents to get up a wages agitation in the Hamilton mining district, but it is not expected that much success will attend them. The men have had very steady employment, although at low wages, and have therefore done better than if they had lost time through strikes. As is usual at this season, however, the probability is that there will be a considerable amount of idle time at the collieries during the next few weeks. Mr. H. M'Neil, one of the speakers at the meetings referred to, urged upon the miners the desirability of returning a labour candidate to Parliament, but he admitted that in the present disorganised state of the miners such a thing was out of the question.

The twenty-fourth annual meeting of the North British Association of Gas Managers has just been held at Dundee under the presidency of Mr. John M'Crae, the manager of the local gasworks. In the course of his address the chairman gave it as his opinion that the regenerative system of heating retorts was the best, although there were several defects still to be remedied, the most noticeable of these being the want of a proper distribution of heat over the whole setting, and the inability to reach certain parts of the furnaces at certain times and in certain circumstances. With reference to gas meters, he thought it should be obligatory on makers to certify the correctness of the registering part as well as the measuring part of every meter. He saw no reason why Scotch gas, which is so rich in hydrocarbons, should not be compressed into cylinders and used in lighting tram-cars, omnibuses, railway trains, and for other purposes. Mr. Hyslop, of Maryhill, was elected president for next year, and Mr. Dalzell, Kilmarnock, and Mitchell, of Edinburgh, vice-presidents; and it was agreed that next meeting take place at Edinburgh. A number of interesting papers were read in the course of the day, including one by Mr. Mitchell, of Edinburgh, on the regulation of pressure in street mains, especially in elevated districts, and the duties of gas companies and corporations to their consumers in this respect.

The report of the Arizona Copper Company for the half year ending 31st March has just been issued to the shareholders, a large proportion of whom are resident in Edinburgh. It states that during October, November, and December the cost of producing the copper at Clifton was in excess of the price that could be realised. The directors are of opinion that the company can continue its business, and so far pay its way even at present prices; but that any material fall in price, unaccompanied by a corresponding fall in wages and freights, which is hardly to be anticipated, would prove very embarrassing.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

APART from a lessened demand for coal, there have been severa awkward interruptions to the once easy flowing condition of things. The most serious last week was the fracture of the crank of the engine at No. 1 pit, Merthyr Vale, which has led to a complete stoppage of operations in No. 1. This has thrown a large number of men out, as it was a very busy colliery, but by working three shifts per diem in No. 2 some modification of the difficulties has been brought about, though this must be, I should imagine, at some hazard with regard to ventilation. The engine, an old naval one I believe, was a fine one and the largest in the country, and the replacement must be costly, possibly £2000. At the same colliery a misunderstanding amongst the workmen has also been extant; but, fortunately, Mr. W. T. Lewis and "Mahon" brought about a peaceful settlement on Saturday. Mr. Lewis and the workman's representative were also equally successful at Mountain Ash in settling what is called the pitwood dispute.

At Dowlais on Friday last the colliers were informed that they would not be required the next day, and it was not until Tuesday that anything like operations were resumed, coal to the extent of several thousand tons in excess of demand having been raised. In addition, I have heard of important collieries in the Rhondda having only worked one or two days in the week, and three days in the week appear to be about the best. Ocean collieries, too, have been slack. The result has been more inanimation at the ports than one likes to see, but shippers and coalowners are hopeful, and believe the quietness is only temporary.

Last week I referred to several Admiralty contracts which were about to be placed, and am glad to hear that Dowlais has secured one for Gibraltar, and the Glamorgan, and Lockett and Judkins the others for Portsmouth and other depôts.

Prices remain about the same, notwithstanding the falling off in demand, and small steam is firm at 5s. per ton. Swansea suffers more for lack of tonnage than weakness in demand; generally speaking the coal trade there is moderately good. For patent fuel enquiry is not quite so brisk, and shipments have been limited.

In iron and steel there is not much to chronicle. Dowlais has an order for steel sleepers from Hindustan, but this will have to await the completion of the new pressing engine. The shipments of rails, &c., from the district have been limited, and principally confined to consignments for Sundswall and Smyrna. Foreign ore is coming more freely into Cardiff and Newport, though I have a strong impression that this is not so much due to present requirement as to fear of possible complications between port and sanitary authorities. The probable advance in price may lead for a time to more buying for stock, a prudent measure in the view of prices getting into better tone.

In tin-plate ware good cargoes have left Swansea during the past week, notably 3000 tons by the steamers, Warwick and Brooklyn City, for New York.

Prices are certainly firmer. Cokes are bought from 14s. 3d. to 15s., and some brands are quoted as high as 15s. 9d. Steel, best coke, fetched readily from 15s. to 15s. 6d. Altogether the united action of makers seems to be bringing about a better tone, and the stop week, which is now on, may do good. A little time will show. The stop is being well carried out in cokes. Charcoals are being made, as that kind of plate is not in abundance.

The carriage shed of the Taff Vale Railway was destroyed by fire at Ferndale this week, and £5000 of damage caused.

Great progress is reported with the Barry Docks. During the last few days the work of shutting out the tide from the new docks was successfully accomplished. This was done under Mr. Walker's personal superintendence, ably supported by Mr. C. H. Walker. The heavy work at Wenvoe Tunnel is being pressed forward, and it is expected that in a short time 3000 men will be at work.

Colliers' recklessness has again come to the front of late. This week one collier was fined for having matches in his possession, and another for deliberately smoking in Penrhiwceiber colliery.

The wages at the Ocean collieries are to remain unchanged according to the action of their scale.

THOSE PLAGUY BELTS.—The American *Lumber World* says:—How many pounds of lace leather do you use in a year? Figure it up and see what it costs you. Figure up how many inches of belting you waste every year by cutting off the ends where the hooks or lacing has broken out, and then figure up how many hours have been wasted in stopping to lace belts. Get all these figures down fine and then go to town and learn to make a cement joint. Get some leather cement if you want to, or get some "isinglass" or fish glue, and make the cement yourself. Use one part fish and two parts of common glue. Cut the belt just once and a half its width too long. Scarf the ends a distance equal to the extra length. Make the scarfe very smooth by finishing with a smooth plane. Take a very little hot cement on the brush, and work it into the splice. Rub both ends until it is just wet—not covered. The less cement you get into the joint the stronger it will be. Put the splice together on a hardwood board, or better still, a smooth iron. Hammer lightly with a round faced hammer and then drive a row of shoe pegs all around the splice. Don't try to drive the pegs with the belt on iron. You want a soft pine board for this business. After pegging trim with a sharp knife. Cut all the pegs off close to the leather. In ten minutes the belt will be ready to go to work. It would be better if it could stand an hour or two after splicing, but the glue sets very quickly, and a joint seldom comes apart. Try the cement joint and see how much nicer everything runs. Put a cemented belt on one pulley of an upright moulder and run the other spindle with a big laced joint. What a difference you find. The laced belt makes you think of the shaker to a grist mill, while the cemented belt runs smooth and nice, and you don't hear it at all. Try cement joints. Put them in big belts, little belts, old belts and new belts, and you will never use another piece of lacing or another belt hook. It takes longer to make a cement splice. You can lace three belts while you are cementing one, but you have to lace that same belt four or five times before one cement splice gives out. Figure that up, too, and put it beside the pile of lace leather and torn belt ends, belt hooks and malleable iron clasps.

NEW COMPANIES.

THE following companies have just been registered:—

Anglo-Continental Gas Lamp Company, Limited.

This company proposes to manufacture gas lamps and apparatus of all kinds for light, heat, motive power, ventilation, or other purposes; also to carry on the business of mechanical and gas engineers and manufacturing chemists. It was registered on the 16th inst., with a capital of £90,000, in 6000 redeemable preference shares of £10 each and 30,000 residuary shares of £1 each; the company is also limited by guarantee to £1 each member.

	£1 shares.
A. McGechie, 21, Sparshold-road, Crouch-hill, accountant	1
J. H. Sheldrake, 44, Stockwell Park-road, accountant	1
H. Heyburn, 16, Upper Montague-street, optician	1
J. G. Greig, 22, Austin Friars, accountant	1
J. B. Stacey, Elmhurst, Tottenham	1
C. W. Craig, 75, St. James-road, Croydon	1
J. H. Richmond, 100, Landell-road, East Dulwich, clerk	1

The number of directors is not to be less than three, nor more than seven; the subscribers are to appoint the first and act *ad interim*; qualification, £100 in shares or stock; remuneration, £200 per annum.

Bridge Cement Company, Limited.

This company proposes to adopt an unregistered agreement (of which no particulars are given) made with Messrs. T. C. Hooman, C. Chapman, and B. P. Harris. The company was incorporated on the 21st inst., and proposes to carry on business as cement and cask manufacturers, and coopers. The capital is £16,000 in £5 shares, and the following are the first subscribers:—

	Shares.
*B. P. Harris, Southfleet, Kent, farmer	1
*F. C. Hooman, 69, King William-street, cooper, &c.	1
*C. Chapman, 69, King William-street, cooper, &c.	1
H. Parkinson, 20, Rylett-road, W., accountant	1
W. Slack, 6, Serle-street, W.C., solicitor	1
J. H. East, Southfleet, Kent	1
E. Chapman, 34, Great St. Helens, metal merchant	1

The number of directors is not to be less than two, nor more than four; the first are the subscribers denoted by an asterisk. The company in general meeting will determine remuneration.

Intercolonial Steam Navigation Company, Limited.

This company proposes to trade as general carriers and shippers from England to and from the Island of Mauritius, Madagascar, Diego Garcia, and other islands and dependencies of Mauritius; and between Mauritius, Madagascar, and the East Coast of Africa. It was registered on the 17th inst., with a capital of £250,000 in £5 shares. The subscribers are:—

	Shares.
Sir Gilbert Edward Campbell, Bart., 5, Mitre-court, Fleet-street, accountant	10
*Thos. John Killeen, 38, Baron's-court-road, S.W.	10
W. J. Elrington Herbert, 23 and 24, Wormwood-street, secretary to the Patent Porous Carbon Company	10
Oswald Hy. Swan, 76, Charlotte-street, Fitzroy-square	10
*Malcolm Murray, 21, Lime-street-chambers, merchant	10
G. J. F. Tate, Fonthill, Exeter, engineer	1
J. Daws Chew, 24, Wormwood-street, surveyor	1

The number of directors is not to be less than five, nor more than twelve; qualification, 50 shares; the first are Sir Francis Knowles, Bart., Major-General Charles Frederick Browne, Admiral Roys, Captain T. P. Harper, Messrs. A. Bremen, F. P. de la Giroday, Edgar Edwards, Robert Barnard, and the subscribers denoted by an asterisk. Each director will be entitled to two guineas for every board meeting attended, also to a salary of £100 per annum. The board will be further entitled to a sum equal to the same rate per cent. upon the annual divisible profits, as such divisible profits bear to the capital upon which they are declared. Pursuant to an agreement of the 14th inst. Mr. T. J. Killeen is appointed managing director, and is to receive 2000 fully-paid shares and a salary of £1200 per annum; this appointment is for life, provided the managing director continues to hold 1000 shares. Sir Gilbert Edward Campbell, Bart., is appointed secretary.

Self-threading Needle Company, Limited.

This company proposes to purchase and work a certain invention referred to in an unregistered agreement of the 20th inst., between William Rutton May and Charles Grant. The company was incorporated on the 22nd inst., with a capital of £30,000 in £1 shares. The subscribers are:—

	Shares.
R. F. Gladstone, 16, Regent street, W.	1
A. Elliott, Carlton Villas, South Lambeth, clerk.	1
W. Maxwell Gow, 307, Vauxhall Bridge-road	1
F. Hunn, Watford, Herts, clerk	1
F. Wingrove, 33, Ashchurch-grove, Shepherd's-bush	1
W. Wilson Alexander, 10, Arthur-street West., hardware merchant	1
Charles Grant, Percy Cottage, Leytonstone, secretary to a company	1

The number of directors is not to be less than three, nor more than seven; the subscribers are to appoint the first and are to act *ad interim*; qualification, 200 shares; remuneration, 7½ per cent. upon the profits declared and divided.

Van Gelder, Apsimon, and Co., Limited.

This is the conversion to a company of the business of mill engineers, millwrights, and machine makers, carried on by Messrs. Van Gelder and Apsimon, at Victoria Works, Sowerby Bridge, York, and 3, Old Ropery, Liverpool. It was registered on the 17th inst., with a capital of £40,000, in £10 shares. The subscribers are:—

	Shares.
Thomas Apsimon, Birkdale, milling engineer	500
William Darby, 6, Rumford-place, Liverpool, iron merchant	1
J. J. Williams, 6, Rumford-place, Liverpool, iron manufacturer	10
*L. Greening, Warrington, wire manufacturer	50
P. Van Gelder, Sowerby Bridge, milling engineer	900
*W. H. Berry, Sowerby Bridge, milling engineer	20
James Duff, Halifax, chartered accountant	1
Mrs. M. V. Humphreys, Halifax	5

The number of directors is not to be less than three, nor more than five; qualification, 20 shares; the first are the subscribers denoted by an asterisk, and Mr. H. Stopes, of Messrs. H. Stopes and Co., 24A, Southwark-street. The company in general meeting will determine remuneration. The vendors are appointed managing directors, and each will be entitled to £300 per annum, with an additional £50 for every 1 per cent. dividend beyond 5 per cent. per annum.

Marine Biological Association of the United Kingdom.

This association was registered on the 17th inst. as a company limited by guarantee to 5s. each member, with Board of Trade licence to dispense with the word "limited" in the title. Its object is to promote the investigation of the biology (in its widest sense) of the animals and plants found on the coasts of the United Kingdom, and for such purpose to establish and maintain laboratories efficiently equipped with the boats, dredging implements, and other apparatus required for scientific investigation of marine life. The subscribers are:—

Professor E. Ray Lankester, University College.
Professor H. N. Moseley, 14, St. Giles-street, Oxford.
W. T. Thistleton Dyer, Kew.
W. P. Sladen, Ewell.
Sir John Lubbock, Bart., Down, Kent.
Professor F. J. Bell, King's College.
Frank Crisp, 6, Old Jewry.

The management will be vested in a council consisting of the governors, the officers, and fourteen other members.

THE ELECTROLYTIC REDUCTION OF FINE COPPER FROM ITS ORES.*

THE Italian Copper Mining and Electro-metallurgical Company, of Genoa, which received the second prize of 5000 lire, describes—*Dingler's Polytechnisches Journal*—the process which has been adopted for some time past at their works at Casarza, near Sestri-Ponente, as follows:—The plant includes twenty Siemens electrolytic dynamos, giving a current of 250 ampères at 15 volts tension, each of which serves twelve reducing baths. Part of the ore, varying in amount according to circumstances, is smelted to a coarse metal, containing copper 30, sulphur 30, and iron 40 per cent., which serves as the anode. Another part of the ore is roasted and lixiviated to form a solution containing as much copper sulphate as is required to render the ferrous sulphate of the anode useful for the electrolytic decomposition of the copper salt. The order of the operation is as follows:—

Preparation of the anodes.—The ore intended for this purpose is smelted for coarse regulus in the usual way. The regulus is cast into thin slabs, a strip of copper being placed in the mould to form the conductor for the current. The anodes so prepared are placed in the decomposing cells, thin sheets of copper being used as cathodes.

Preparation of the solution.—The ore roasted so as to produce the necessary sulphate for the bath is systematically lixiviated with an addition of sulphuric acid to dissolve any oxide of copper formed in roasting the liquor, containing copper and iron sulphate, is kept in tanks and added to the bath as required. The copper sulphate is decomposed by the electric current, copper being deposited on the cathode, while the anode is attacked with the formation of iron salts and sulphuric acid, which prevents the deposit of iron and the evolution of hydrogen, so that the copper deposits in a compact form and chemically pure. The saturation and proper composition of the solution is maintained by connecting the baths by pipes with the lixiviating vats, so that a constant and regular circulation of the liquor is kept up. The solution has a sufficient oxidising power to dissolve up metallic sulphides, in some cases without requiring a preliminary roasting. The greater part of the electro-motive force necessary for the decomposition of the copper sulphate is furnished by the oxidation of iron in the anode, so that for the remaining work in the bath an electro-motive force not exceeding one volt is sufficient. The exhausted anode may be utilised for the reproduction of sulphur or sulphuric acid. When the solution is overloaded with iron vitriol it is removed from the bath, and the last traces of copper are recovered by precipitation with sulphuretted hydrogen, which is produced by adding regulus to the acid liquor. At the same time the iron salts are reduced to ferrous sulphate, and the free sulphuric acid is neutralised. The iron vitriol may be recovered by crystallising, otherwise the liquors containing it, when freed from copper, are run to waste. If the baths are properly arranged, and care be taken to keep the liquors in circulation at the proper strength, a maximum yield of 44 lb. of copper per horse-power employed may be obtained daily. The process appears to be particularly well adapted for mines in mountain districts where water-power is readily obtainable, but which, owing to the difficulty of obtaining, and the high cost of mineral fuel, are unfavourably placed for smelting operations.

SILVER MINES OF BOLIVIA.—The Bolivian Government levies a tax of 4s. 6d. for each ounce of silver, and this, says the United States Minister at La Paz—has been farmed out. The product of the mines of Bolivia is estimated at 16,000,000 oz., and this amount appears to be increasing as new machinery and methods are being introduced. The Huanchaca mines, situated in the southern part of Bolivia, in lat. 20 deg. S. and long. 67 deg. W., in a south-western direction from Potosi, are considered the richest, and produce about 5,600,000 oz. Potosi is still productive after being worked over 250 years, and yields annually about 1,200,000 oz.; and the mines of Oruro produce about 1,200,000 oz. The Guadelupe, situated about 100 miles south of Potosi, yields about 1,300,000 oz., making a total of 9,300,000 oz. The Colquechaca mines in the province of Aullagas, about lat. 18 deg. S., directly north of Potosi, are considered the richest after those of Huanchaca, and it is estimated that they yield about 3,200,000 oz. There are many small mines distributed over the Bolivian-Andean plateau which produce well, the estimated quantity for the year 1883 being 3,500,000 oz., making a grand total of 16,000,000 oz.

* "Proceedings" Inst. Civil Engineers.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

*** *It has come to our notice that some applicants of the Patent-office Sales Department, for Patent Specifications, have caused much unnecessary trouble and annoyance, both to themselves and to the Patent-office Officials, by giving the number of the page of* THE ENGINEER *at which the Specification they require is referred to, instead of giving the proper number of the Specification. The mistake has been made by looking at* THE ENGINEER *Index, and giving the numbers there found, which only refer to the pages, in place of turning to those pages and finding the number of the Specification.*

Applications for Letters Patent.

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

21st July, 1885.

8757. STOCKING SUSPENDER, &c., F. E. Taylor, Birmingham.
8758. TELEPHONIC CONNECTIONS, A. C. Wells, Manchester.
8759. INCANDESCENT GAS FIRES, T. Fletcher, Manchester.
8760. CIGARETTE PAPERS, S. S. Sugden, Woodford.
8761. COMBINETTE INFANT CARRIAGE, A. Harvie, London.
8762. RAKE, H. Pritchard, Swansea.
8763. MAKING TERRA-COTTA SEPULCHRAL MEMORIALS, W. W. Woods and H. S. Grimsley, Reading.
8764. HAT REST and GUARD, C. R. Chichester, Roscommon.
8765. SEPARATING METALLIFEROUS ORES, J. Davis, Aberystwith.
8766. BALL BEARINGS for BICYCLES, &c., J. Bradley, Birmingham.
8767. LAMPS, C. G. Gill, Gravesend.
8768. SPINNING, T. H. Brigg, Bradford.
8769. YIELDING CORD or BAND, J. Cadbury and J. G. Rollason, Birmingham.
8770. PENCIL-CASES, A. H. Woodward, Birmingham.
8771. VALVES, J. C. Kay and J. Kay, Manchester.
8772. ATTACHING DOOR KNOBS to their SPINDLES, E. Webb, Birmingham.
8773. STEAM WHEELS, J. T. Howson, London.
8774. HARVESTING MACHINES, W. P. Thompson.—(*D. M. Osborne, U.S.*)
8775. MICROPHONES, W. P. Thompson.—(*K. S. Dembinski, Belgium.*)
8776. REFRIGERATORS, W. P. Thompson.—(*J. F. Hanrahan, Canada.*)
8777. NEUTRALISING INDUCTIVE DISTURBANCES in TELEPHONE CIRCUITS, W. P. Thompson.—(*W. A. Jackson and J. C. Chambers, United States.*)
8778. STEAM ENGINES, H. Otway, F. S. Snowdon, W. H. Wheatley, and J. W. MacKenzie, London.
8779. SOAP DISHES, N. Fellows and W. Dangerfield, London.
8780. FLUSHING WATER-CLOSETS, A. Paine, London.
8781. TRAMWAY, &c., WHEELS, R. Hadfield, London.
8782. TELEPHONIC TRANSMITTERS, &c., R. H. Ridout, London.
8783. SUGAR CRUSHERS, R. Bateman, Birmingham.
8784. POCKET KNIVES, F. Bosshardt.—(*A. E. Albert and A. Barrier, France.*)
8785. ATTACHING NETS to their SUPPORTS, W. H. Power, London.
8786. VULCANISED KERITE COMPOUNDS, H. J. Allison.—(*A. G. Day, United States.*)
8787. VULCANISED KERITE COMPOUNDS, H. J. Allison.—(*A. G. Day, United States.*)
8788. ELECTRIC CABLE RECORDERS, M. G. Farmer, London.
8789. BLAST DUST COLLECTOR, W. Ince, London.
3790. PROPELLING SHIPS, &c., W. Scantlebury, London.
8791. STRAP FORKS or BELT GUIDES, W. W. Cobbett, London.
8792. VELOCIPEDE, H. M. Nicholls, London.
8793. TREATING TEXTILE MATERIALS with GASES, &c., W. Mather, London.
8794. BLEACHING VEGETABLE TEXTILE FABRICS, W. Mather, London.
8795. REMOVING IMPURITIES from WOOL, &c., C. D. Abel.—(*La Société Dubus, Coget, et Cie., France.*)
8796. VESSEL for CONTAINING SEPARATELY the SOLUTIONS COMPOSING DRINKS, W. Reid, London.
8797. BURNISHING MACHINES, J. H. Johnson.—(*M. Goetz, Austria.*)
8798. SCARF JOINT for UNITING PIECES of IRON, J. C. Mewburn.—(*C. A. Thuron and V. L. M. Renard, France.*)
8799. RESERVOIR DAMPERS for PRESS COPYING BOOKS, &c., L. B. Bertram, London.
8800. GALLERIES and TRIANGLES for LAMP GLASSES, J. Boam, West Brighton.
8801. UTILISING the RESISTANCE OFFERED by the ATMOSPHERE to RAILWAY TRAINS, W. F. B. Massey-Mainwaring, London.
8802. DUMPING BOATS, H. E. Newton.—(*G. D. Barney, United States.*)
8803. BOILER FURNACES, W. Noble and A. Mackie, Sutton.
8804. BOILER FURNACES, W. Noble and A. Mackie, Sutton.
8805. SHEEP SHEARS, W. Clark.—(*E. Kellogg, United States.*)
8806. GAS ENGINES, A. Davy, jun., London.
8807. COMPASSES, A. J. Boult.—(*C. W. Stuart, United States.*)
8808. TREATING VEGETABLE FIBRE by ELECTICITY, W. B. Nation, London.
8809. TOY TOPS, H. Eckhardt.—(*F. Martin, France.*)
8810. EXTRACTS and BEVERAGES from the LEAVES of the COCA PLANT, G. Brownen, London.
8811. SYNCHRONOUS MOVEMENTS and TELEGRAPHY, P. B. Delany, London.
8812. SYNCHRONOUS MULTIPLEX PRINTING TELEGRAPHY, S. Pitt.—(*P. B. Delany, United States.*)
8813. TELEGRAPHIC RELAYS, P. B. Delany, London.
8814. UNDERFRAMES for FOUR-WHEELED VEHICLES, Count di Tergolina, London.
8815. FLAT SCARVES, G. E. Smith, London.
8816. CARBURATION of GAS in LAMPS, &c., P. Jensen.—(*J. E. Dery, Belgium.*)
8817. STAND-PIPES, P. J. Davies, London.
8818. LIFTS, W. L. Wise.—(*A. J. C. V. den Staepele, Belgium.*)
8819. PURIFYING IRON and STEEL, W. R. Lake.—(*W. H. Purdy, United States.*)
8820. BRACES, &c., W. R. Lake.—(*T. O. Potter, United States.*)
8821. CENTRIFUGAL MACHINES, W. R. Lake.—(*W. H. Tolhurst, United States.*)
8822. THROTTLE VALVES, W. R. Lake.—(*C. C. van der Valk, Holland.*)
8823. PRIMARY BATTERIES, J. Noad, London.

22nd July, 1885.

8824. PELERINE MACHINES, A. W. C. Shuttlewood, London.
8825. SLEEVE-LINK, G. Davis, Birmingham.
8826. METAL WHEELS, E. W. Warriner and A. H. Marriott, Sheffield.
8827. ELECTRIC CLOCKS for ADVERTISING PURPOSES, J. Allen and F. Lorrimar, Cheltenham.
8828. SHIRTS and CUFFS, O. Wilkinson and W. H. L. Cameron, Manchester.
8829. WAR VESSELS, C. B. Phillips, Chester.
8830. HOLDING STOCKINGS during DARNING, W. Sidle, Oldham.
8831. CARPETS, &c., G. W. Oldland, Birmingham.
8832. BOOTS and SHOES, J. Vickers, London.
8833. ADVERTISING, C. H. Cohen, London.
8834. TIPS and PLATES for BOOTS and SHOES, W. Freeman, Leicester.
8835. ACTION for SHOW STANDS, &c., F. F. Smart, Birmingham.
8836. WASHING, &c., MACHINES, E. Taylor, Blackburn.
8837. JOINTS for CONNECTING BOARDS, G. B. Dorning, Liverpool.
8838. OBTAINING SILICATES of ALKALIES, &c., W. P. Thompson.—(*J. and F. Weeren, Germany.*)
8839. SELF-ADJUSTING BOTTLE HOLDER, T. White, Birmingham.
8840. WRINGING and MANGLING MACHINES, W. Lewis and W. J. Harper, Manchester.
8841. ELECTRIC RAILWAY SIGNALS, W. E. Langdon, Derby.
8842. MECHANICAL NURSE CHAIR, L. L'Hollier and J. J. J. Rochford, Birmingham.
8843. TREATING SUGAR, &c., G. M. Newhall and J. H. Tucker, London.
8844. ROTARY HAIR BRUSHES, A. L. Cornu, London.
8845. PICKING STICK and STRAP for LOOMS, G. Bartle and T. Myers, Wilsden.
8846. FASTENERS for GLOVES, &c., G. R. McDonald, London.
8847. STOPPING and STARTING VEHICLES, T. Morris, London.
8848. HEATED HAT BRUSH, L. Courlander, Croydon.
8849. BILLIARD CUES, W. Buttery, London.
8850. SUSPENDING PICTURES, E. Tonks, London.
8851. BREECH-LOADING SMALL-ARMS, G. Hackett and E. Belcher, London.
8852. SERVICE CISTERNS, &c., for WATER-CLOSETS, A. Deas, Glasgow.
8853. GAME of SKILL, Vincenzo, Count di Tergolina, London.
8854. GAME of SKILL, Vincenzo, Count di Tergolina, London.
8855. BRAKES for REVOLVING SHAFTS, R. Lüders, London.
8856. BOXES for DELIVERY of PREPAID ARTICLES, C. H. Russell, London.
8857. CLEANSING SUGAR, C. and J. Lyle, London.
8858. COCKS and TAPS, A. C. Hattatt, London.
8859. SPRING BUFFERS, A. Wilson, London.
8860. INSULATOR for ELECTRICAL APPARATUS, B. Pell, London.
8861. ELECTRIC GENERATORS, E. and A. E. Jones, London.
8862. LACE CURTAINS, R. F. Carey, London.
8863. HONEY SUBSTITUTE, C. Lyle and J. J. Eastick, London.
8864. LIFTING, &c., BOATS, P. G. B. Westmacott, London.
8865. TRAM-CARS, S. Seelig, London.
8866. RETORTS and SEALS, D. Jarves, London.
8867. JOINTS for FISHING-RODS, H. Wilkes, London.
8868. OPENING and CLOSING the DOORS or COVERS of COAL-BOXES, &c., C. Sims, London.
8869. VELOCIPEDES, J. A. Griffiths, London.
8870. INSTRUMENTS for ESTABLISHING the REFRACTIVE ERRORS of the EYE, A. M. A. Fournet and W. C. Wood, London.
8871. SIEVE or STRAINER, W. R. Lake.—(*A. H. Frauciel, France.*)
8872. BOOTS, G. M. Tebbutt, London.
8873. DRAWING BOARD, &c., J. Wellett, Bradford.
8874. PREPARING and BURNING BRICKS, &c., R. Stanley, London.
8875. FASTENING TIPS or STUDS to BOOT HEELS, &c., J. P., and A. Cave, London.

23rd July, 1885.

8876. WATER-CLOSET PAN, J. Hookham, Eastbourne.
8877. FLUSHING WATER-CLOSETS, J. Sturrock, Dundee.
8878. OPERATING the HEALDS of LOOMS for WEAVING, C. Hahlo, C. E. Liebreich, and T. Hanson, Halifax.
8879. GAS ENGINES, F. Mori, Halifax.
8880. HYDRAULIC MAINS, J. Hanson, Yorkshire.
8881. SECONDARY BATTERIES, W. P. Thompson.—(*E. Julien, Belgium.*)
8882. APPLICATION of GASES to METALLURGICAL and other PURPOSES REQUIRING HIGH TEMPERATURES, J. Bromilow, Liverpool.
8883. FIXING TOILET GLASSES, H. Bessell, Bristol.
8884. DUPLEX SHARPENER or STEEL for KNIVES, J. F. Lashbrooke, Liverpool.
8885. FISHING RODS, J. H. Brierley.—(*E. Foucault, France.*)
8886. TRACTION ENGINES, E. Foden, Manchester.
8887. PUNCHING MACHINES, J. McMurdo, Manchester.
8888. TAPS for WATER and other LIQUIDS, H. Curwen, London.
8889. KEYLESS RAILWAY CHAIR, C. J. Howe and J. W. Proom, Monkwearmouth.
8890. TREATING and WEIGHTING SILK, J. C. Siegerist.—(*E. Mittler, France.*)
8891. WHIRL for SPINNING PURPOSES, W. Skett and G. Asher, Birmingham.
8892. CLEANING COTTON, &c., SUBSTANCES, M. Garfitt, Oldham.
8893. BICYCLE LAMPS, J. S. Edge, jun., and S. Snell, Birmingham.
8894. TOBACCO PIPES, E. I. Friedlander, Birmingham.
8895. ELECTRIC PILOT, H. C. Bull, Liverpool.
8896. CRANES, J. Brown and T. A. Porter, Liverpool.
8897. GAS ENGINES, T. Sturgeon, London.
8898. CLOCK MOTOR, W. Clough, London.
8899. SEATS of CLOSETS, E. G. Colton and D. T. Bostel, London.
8900. ACTUATING FLUSHING VALVES of WATER-CLOSETS, &c., D. T. Bostel, London.
8901. STEELS for CRINOLINES, &c., E. Rosenwald.—(*E. Rosenwald, France.*)
8902. HYDROCARBON ENGINES, J. J. R. Humes, London.
8903. DRILLING, &c., ROCK, &c., A. E. Stainer and M. Wainwright, London.
8904. LAWN TENNIS BATS, R. G. Owen, London.
8905. FIRE-ALARM SIGNALLING APPARATUS, E. W. Beckingsale, London.
8906. ROLLING and FORGING METALS, H. W. Hollis, London.
8907. DRIVING BELTS and ROPES, H. J. Haddan.—(*F. Wegmann, Switzerland.*)
8908. PURIFYING YEAST, J. J. W. Peters, London.
8909. CARBONS for ELECTRIC LAMPS, F. Wynne and L. S. Powell, London.
8910. AMBULANCE STRETCHERS, W. Reid, Glasgow.
8911. SEATS for INDOOR and OUTDOOR USE, R. C. Hope, London.
8912. TREATMENT of SEWAGE, J. B. Spence, London.
8913. SCARF PINS, BROOCHES, &c., A. S. Bishop and F. Down, London.
8914. RETARDING, &c., SPINDLES, P., R., and J. Eadie, Manchester.
8915. BOOTS and SHOES, F. Brown, London.
8916. OBTAINING PHOSPHORIC ACID, C. F. Claus, jun., London.
8917. COATING PHOTOGRAPHIC PLATES, B. J. Edwards, London.
8918. NET and other HAULING MACHINE, T. Cain, London.
8919. DISC VALVE, W. Ross, London.
8920. SLIDE VALVE, W. Ross, London.
8921. SCRAP ALBUMS, G. E. Chapman, London.
8922. FIRE-ESCAPE, J. M. de A. y Lizaola, London.
8923. MEASURING ELECTRIC CURRENTS, A. G. Brookes.—(*J. L. Huber, Germany.*)
8924. PREPARING SYRUPS and MOLASSES, A. Ralu fils, J. Grathvohl, and H. A. Browne, London.
8925. PREPARATION of SWEET POTATOES, &c., A. Ralu fils, J. Grathvohl, and H. A. Browne, London.
8926. DRYING PREPARED COCOA-NUT, &c., W. T. Linton, London.

24th July, 1885.

8927. TESTING YARNS OF THREAD, R. Wallwork, Manchester.
8928. HIGH-PRESSURE FILTER, W. J. Baker.—(*J. H. Bleasdale, U.S.*)
8929. PORTABLE COPYING PRESS, D. Appleton, Manchester.
8930. HOLDING-DOWN SPINDLES, J. Macqueen, Manchester.
8931. WATER-CLOSET APPARATUS, W. Bruce, Edinburgh.
8932. GIRDLE for HOLDING TROUSERS, J. Adler, Paris.

8933. Candlesticks, W. Green, Harborne.
8934. Thrashing Machines, E. Foden, Manchester.
8935. Locking Nuts on Fish-plate Bolts, T. V. Riordan, London.
8936. Steering Ships, C. Colwell, Great Yarmouth.
8937. Hydraulic Clothes Washing Machine, C. Harvey, Preston.
8938. Photographic Printing Apparatus, C. D. Durnford, Edinburgh.
8939. Ruling Indicator Diagrams, F. H. Livens, Lincoln.
8940. Safety Stirrup, E. Allen, Harden, and B. Cope, Bloxwich.
8941. Railway Chairs, M. Murray and A. Macredie, London.
8942. Cigar and Pipe Light, O. Polenz.—(*N. B. Dennys, Singapore.*)
8943. Coupling, &c., Railway and other Vehicles, D. Davies, Sheffield.
8944. Settling, &c., Hat Bodies, J. E. Mills and T. Ashworth, London.
8945. Solitaires, C. H. Brigg and T. Ainley, Elland.
8946. Knitting Stockings, &c., W. Rothwell, London.
8947. Organ Pianos, O. Böhmer.—(*F. Thürmer, Germany.*)
8948. Needle Threaders, J. Darling, Glasgow.
8949. Producing Electricity, J. M. Pates.—(*H. W. Cook, Switzerland.*)
8950. Capsuling Bottles, &c., C. Cheswright, London.
8951. Explosives, D. Johnson, London.
8952. Locking Ladders or Steps, J. W. Cowland, London.
8953. Bridges of Double Eye-glasses, W. Curry and J. F. Pickard, London.
8954. Gas Regulators, J. and W. Goodson, London.
8955. Varnishing and Printing Paper, G. Newsum, London.
8956. Preventing Explosion of Steam Boilers, B. Meyer, London.
8957. Finings-making Machines, J. Pacey, London.
8958. Ventilating, C. Ching, London.
8959. Governing the Speed of Engines, E. F. Piers, London.
8960. Governing the Speed of Engines, E. F. Piers, London.
8961. Wire Rope, G. R. Cooke and S. R. Millen, London.
8962. Primary Electrical Batteries, C. D. Barker, London.
8963. Substitutes for Leather, M. Zingler, London.
8964. Powder, &c., for Parquets, &c., A. J. Boult.—(*C. Wittkovsky, Germany.*)

25th July, 1885.

8965. Extracting, &c., Gold, &c., W. H. Duncan, Coalbrookdale.
8966. Warming Apparatus for Greenhouses, &c., E. A. Rippingille, London.
8967. Copeing, W. Brown, Birkenhead.
8968. Water-closets, W. F. Buchan, Edinburgh.
8969. Advertising, R. Crawford, Southsea.
8970. Regenerative Hot Blast Stoves for Heating Air, &c., A. C. Hill, Middlesbrough.
8971. Folding Lamp for Photographic Work, &c., W. J. Lancaster, Birmingham.
8972. Taps or Cocks, C. H. Ancill, Birmingham.
8973. Separation of Ammoniacal Products, L. Mond, Liverpool.
8974. Dust Collector, &c., for Corn, &c., Mills, G. F. Thompson, Warwick.
8975. Improved Stopper, J. Lees, Manchester.
8976. Adjustable Window Blinds, J. E. Walsh.—(*M. G. Mitter and R. Ehlert, Germany.*)
8977. Spinning and Doubling Machine, J. W. Shepherd, W. Ayrton, and C. Siddall, Manchester.
8978. Economic Bottle, C. Gaul and T. Wolstenholme, Bradford.
8979. Slotting Machines, S. Dixon, Manchester.
8980. Fire-grates, J. J. Sumner and E. Higginbotham, Manchester.
8981. Casting Steel Ingots, T. Hampton and J. Facer, Manchester.
8982. Articles of Jewellery, W. L. B. Hinde, London.
8983. Shuttle-boxes of Looms, N. Wood and W. Harris, London.
8984. Dress-cutting, S. A. Cooke, London.
8985. Straw Shoe Soles, E. Edwards.—(*M. Serra, France.*)
8986. Filters, James Clayton and Joseph Clayton, Manchester.
8987. Galvanic Plant Invigorator, &c., R. G. Owen, London.
8988. Cigar Cases, &c., A. Whowell and E. Chadwick, London.
8989. Brick Kilns, O. Hertrampf, London.
8990. Lamps, O. Ney, Berlin.
8991. Ornamental Lanterns, L. A. Groth.—(*F. E. Berta, Germany.*)
8992. Mechanical Lift, L. A. Groth.—(*G. Bregoli, Italy.*)
8993. Carbonate of Potassium, F. Brunjes, London.
8994. Preparing "Hopeine," F. Springmuhl, London.
8995. Electro-magnetic Type-setting Engine, W. Dreyer, London.
8996. Carriages for Machine Guns, T. Nordenfelt, London.
8997. Feeding Yarn to Machines, W. Sanders and L. Slowin, London.
8998. Breech - loading Fire - arms, H. Schlund, London.
8999. Antiseptic Compound, F. G. Broxholm, London.
9000. Automatic Gas Governor, A. Kinnear, London.
9001. Self-lighting Gas Burners, A. Kinnear, London.
9002. Cartridge for Mines, J. Mitchell and J. Sinclair, London.
9003. Limiting Explosions, J. Mitchell and J. Sinclair, London.
9004. Storm Lantern, E. Jehu, Welshpool.
9005. Brake for Perambulators, &c., J. Main, Brixton.
9006. Utilising a Substance for Making Gloves, W. Walton, Bishopwearmouth.
9007. Pavements for Footpaths, E. B. Ellice-Clark, Glasgow.
9008. Fringing Machines, W. Fairweather and R. F. Peel, Manchester.
9009. Preventing the Unequal Wear of Leathers of Drawing-off Rollers of Combing Machines, W. H. Greenwood and F. Farrar, Bradford.
9010. Winding Yarns or Thread, J. Binns, Leeds.
9011. Rollers for Wringing, &c., Machines, J. Thornton, Halifax.
9012. Slate Pencil Sharpeners, J. Putnam, U.S.
9013. Fish-plate for Rails of Tramways, &c., R. H. Twigg, London.
9014. Improving the Tone of Stringed Instruments, C. V. Burton, London.
9015. Preparing, &c., Infusions from Tea, &c., G. H. Hobbs, Hanley.
9016. Handle Bars for Velocipedes, F. J. J. Gibbons, London.
9017. Ovens for Drying Slurry, &c., J. H. Wood, London.
9018. Box for Developing, &c., Photographic Dry Plates, J. Burke, London.
9019. Umbrella Stick, H. Cintrat, London.
9020. Salting Cattle, &c., T. V. Rurdan, London.
9021. Roofs, J. B. Spence, London.
9022. Receptacle for Hygroscopic Explosives, H. E. Newton.—(*A. Nobel, France.*)
9023. Explosive Compounds, H. E. Newton.—(*A. Nobel, France.*)
9024. Machinery for Sifting, &c., Grain, E. P. Alexander.—(*A. Millott, France.*)
9025. Wheeled Vehicles for Rails, &c., T. E. Knightley, London.
9026. Seats for Perambulators, G. Pounce, London.
9027. Cocks or Valves, A. G. Brookes.—(*C. H. Gerson, Germany.*)
9028. Registering Apparatus, G. Binter, London.
9029. Electrical Arc Lamps, A. F. Link.—(*L. Scharnweber, Germany.*)
9030. Lawn Tennis Bats, C. Malings, London.
9031. Keys, &c., for Securing Railway Rails, E. W. Stoney, London.
9032. Starting, &c., Wheeled Vehicles by Traction, L. Duhamel, London.
9033. Regulating Supply of Grain to Milling Machinery, W. Henneberg, London.
9034. Combing Wool, &c., J. W. Bradley, Bradford.
9035. Loose Head for Sunken Bolts, A. B. Perkins, London.
9036. Fire Alarm, G. F. Redfern.—(*A. Bruynell, Belgium.*)
9037. Hair Curler, A. M. Clarke.—(*G. A. Scott, U.S.*)
9038. Feed-water Heater, A. M. Clark.—(*J. J. Imbs, France.*)

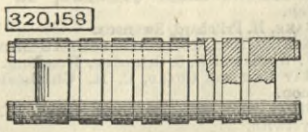
SELECTED AMERICAN PATENTS.

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

320,158. Core for the Armatures of Dynamo-electric Machines, *Hans J. Müller, New York, —Filed January 20th,* 1885.

Claim.—A Siemens armature core formed of a single block of metal, provided with a series of transverse ventilating apertures extending from side to side and dividing the central portion into transverse gridiron

320,158

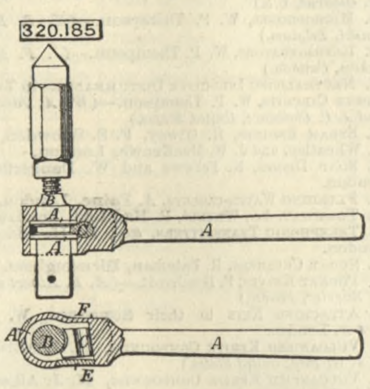


bars, the said transverse apertures between the bars having the same cross section from the outer surface of one side of the armature core to the outer surface of the opposite side, substantially as herein shown and described.

320,185. Friction Drill Brace, *Richard S. Solomon, Cape Town, Cape of Good Hope.—Filed April 8th,* 1885.

Claim.—The combination, in a drilling brace, of the collars A A, forming a tapered or V-shaped groove on the spindle B, with the pawl C, set at an angle to the

320,185

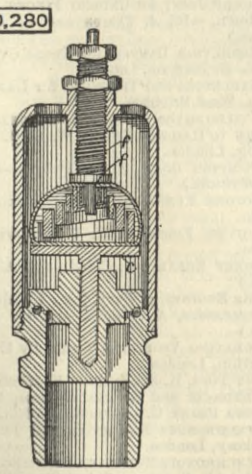


spindle in the angular chamber or recess F in the stock D, the whole constructed, combined, and arranged to operate the brace by friction, substantially as described.

320,280. Pop Safety Valve, *William E. Pearson, Saugus, Mass.—Filed April 25th,* 1885.

Claim.—In a pop safety valve, the combination of the valve having a spring-supporting surface, a casing having a stud or bearing for the spring independent of the valve, and a volute spring interposed between the valve and bearing, the form of the spring enabling a guiding spindle to be dispensed with, and the length of the casing to be reduced to the minimum, as set forth. (2) In a pop safety valve, the combination of the valve, the disc or plate *c* above the valve and supported thereby, the casing over the valve, the adjust-

320,280



able stud in the top of the casing, and the interposed volute spring, the form of the spring enabling it to operate without a guide or spindle. (3) In a pop safety valve, the combination of the valve-supported disc or plate *c*, the stud *f*, the interposed volute spring, and the flexible diaphragm clamped centrally between the upper end of the spring and the stud *f*, and at its margin between the lower end of the spring and the plate *c*, as set forth.

320,285. Electric Igniter for Gas Engines, *D. S. Regan, San Francisco, Cal.—Filed December 6th,* 1884.

Claim.—(1) In an electrical igniter for gas engines, the combination with a gas chamber of terminals normally in circuit located within the same, and a finger carried by the piston head for breaking the circuit, substantially as set forth. (2) In an electrical

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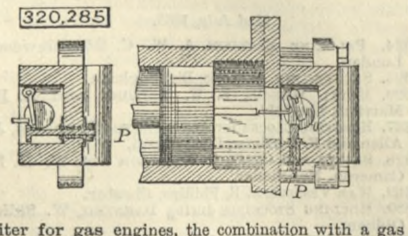
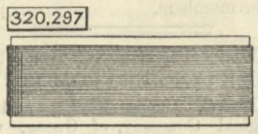


igniter for gas engines, the combination with a gas chamber of terminals normally in circuit located within the same, one of said terminals being movable and the other stationary, and a finger carried by the piston head and adapted to break the circuit, substantially as set forth. (3) In an electrical igniter for gas engines, the combination with a gas chamber of a pivotted lever, a stud, said stud and lever being normally in contact, and located within the gas chamber, wires connecting with the dynamo, and means for breaking the contact of the stud and lever. (4) In an electrical igniter for gas engines, the dynamo O and insulated stud, in combination with a pivotted lever, the connecting wires P Q, and a finger carried by the piston head, substantially as set forth. (5) The dynamo O, connected by a wire P, with an insulated stud having its contact end located within the gas chamber and the connecting wire Q attached to the engine, in combination with a movable lever within the gas chamber, pulley J[1] and N[1], located as described, a belt connecting said pulleys, and means for breaking the contact of the stud and lever, substantially as set forth. (6) In an electrical igniter for gas engines, the combination with the gas chamber of an insulated stud, a pivotted lever, said stud and lever being normally in circuit, and a finger carried by the piston head and adapted to break the contact of the stud and lever, substantially as set forth. (7) In an electrical igniter for gas engines, the combination with the gas chamber of terminals normally in circuits located within the same, one of said terminals having a slot and a finger having a bent end, and carried by the piston head to engage the same, substantially as set forth.

320,297. Manufacture of Filaments for Incandescent Lamps, *Frederic Schaefer, Boston, Mass. —Filed November 26th,* 1884.

Claim.—(1) That improvement in the art or method of manufacturing filaments for electric lamps which consists in laying a thread over a yielding carbonisable former, the said former receiving its shape from a mould, which is removed from the former after the thread has been wound thereon, then simultaneously carbonising the thread and former, whereby the molecular structure of the thread or filament is in no

320,297

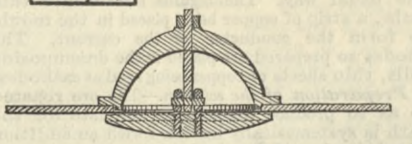


way subjected to a strain, the former yielding in the carbonising process, thus obviating the breaking of the filaments, substantially as described. (2) That improvement in the art or method of manufacturing filaments for electric lamps which consists in laying a thread in a series of turns over the surface of a yielding carbonisable former, and simultaneously carbonising the thread and former located within it, thus preserving the thread upon the former in a convenient form for shipment, substantially as described.

320,512. Manhole Covers for Boilers, *Frank Trowbridge, Fond du Lac, Wis.—Filed March 9th,* 1885.

Claim.—(1) In a man or hand hole cover for steam boilers, sewers, &c., the combination of the cover, screw eyes, a pivotal bolt, and cover-securing bolt, substantially as described. (2) A man or hand hole cover comprising the following elements:—A flanged

320,512

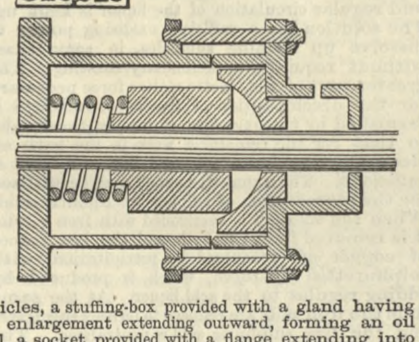


cover having a gasket or packing ring, screw eyebolts, a pivotal bolt, and a securing bolt having screw-threaded end, in combination with a bridge or arch and nut, substantially as described.

320,525. Packing for Piston-rods, *Willis Augustus, Keokuk, Iowa.—Filed February 4th,* 1885.

Claim.—(1) In a packing for piston-rods and similar articles, a metallic packing ring provided with a rectangular end operating within a spherically concaved socket, for the purpose substantially as described. (2) In a packing for piston-rods and similar

320,525

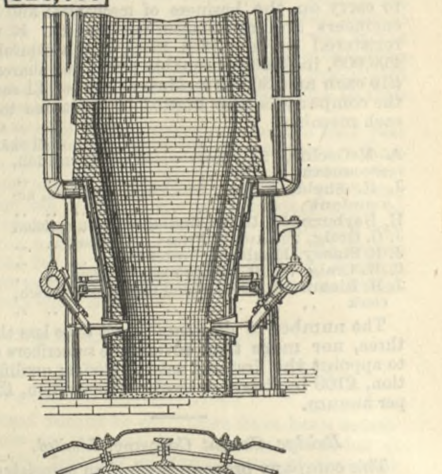


articles, a stuffing-box provided with a gland having an enlargement extending outward, forming an oil cell, a socket provided with a flange extending into said cell, and a metallic packing ring constantly forced into the socket by a spring, all adapted to operate as described.

320,605. Blast Furnace, *Peter L. Wiemer, Lebanon, Pa.—Filed April 13th,* 1885.

Claim.—(1) The combination, with the crucible and bosh of a blast furnace, of a cooler or refrigerator operating automatically to admit air in varying quantities at different points in the height of the structure upon the outer surface of the masonry forming the wall of said crucible and bosh, substantially as described. (2) The combination, with the crucible and bosh of a furnace, and a binding consisting of beams of metal separated and connected as shown, of an air chamber formed by the wall of the stack and an outer casing, to which air is admitted automatically and in varying quantities, substantially as described. (3) The combination, with the crucible and bosh, of a series of air chambers formed by the vertical beams, connected as shown, the outer surface of the masonry, and the casing, substantially as described. (4) In a blast furnace, the combination, with the binders for the crucible and bosh, consisting of beams of metal separated and connected as shown, of a casing having annular air inlets, substantially as described. (5) In a blast furnace, the combination of the stack and an inclosing jacket or casing composed of separate horizontal sections having annular air inlets formed between them, substantially as described. (6) A blast furnace stack, in combination with an inclosing jacket or casing provided with air inlets arranged in different horizontal planes below the mantle, and an outlet or outlets communicating with the annulus formed by the wall of the stack and the casing, substantially as described. (7) The combination of a blast furnace stack and a surrounding casing or jacket provided with air inlets arranged in different horizontal planes, and outlets open to the atmosphere, adapted to apply air directly to the outer surface of the masonry forming the walls of the crucible and bosh automatically in quantities varying as the temperature of the furnace rises and falls, substantially as described. (8) A furnace stack composed of a single wall of masonry surrounded by a metallic casing open to the atmosphere at both ends and provided with a series of intermediate air inlets, the supply of air being controlled automatically by varying degrees of heat in the crucible and bosh and operating to change the temperature of the ascending column of air, substantially as described. (9) A furnace stack, in combination with a casing provided with a series of annular air inlets arranged in different horizontal planes, the supply of air being controlled automatically by varying degrees of heat in the furnace and the ascending column of heated air supplied with cold air at different points in the height of the stack. (10) The combina-

320,605



tion of the furnace stack, the air chambers, and the casing formed in sections, curved, substantially as shown, to provide for expansion of the casing. (11) The combination of the stack, the I-beams, the horizontal coupling rods, the casing, and suitable means for connecting the casing to the flanges of the beams, substantially as described.

320,607. Cultivator, *Albert Wilhelm, Pleasant Hill, Tex.—Filed March 16th,* 1885.

Claim.—In a combined cultivator and sweep stock, the combination of a beam, a double stock strapped to the beam, and having a diamond-shaped point bolted

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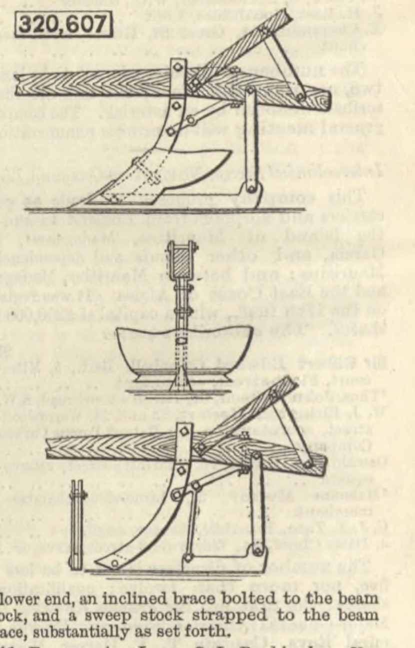
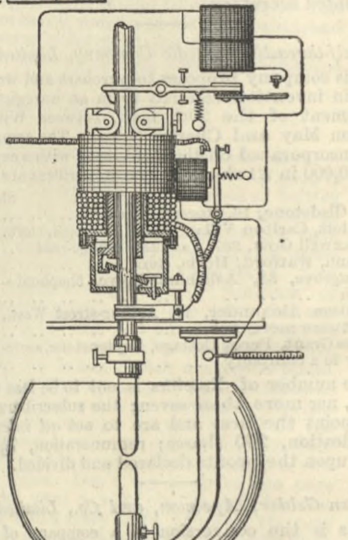


to the lower end, an inclined brace bolted to the beam and stock, and a sweep stock strapped to the beam and brace, substantially as set forth.

320,841. Electric Arc Lamp, *C. L. Buckingham, New York, N.Y.—Filed August 26th,* 1884.

Claim.—In an electric lamp, the combination of a lifting electro-magnet for establishing an arc, a clamping apparatus for supporting the carbon against the action of gravity which is independent of the lifting and feeding apparatus, and a second electro-magnet and feeding apparatus, which are independent of the lifting and supporting devices. (2) In an electric lamp, the combination of an arc branch electro-magnet, a shunt branch electro-magnet, which is called into action when the normal arc is established, and a clutch for establishing the arc through the agency of the arc branch electro-magnet, which clutch is unlocked from the carbon holder, and returned to its normal position under the control of the shunt

320,841



electro-magnet, and which remains in readiness to re-establish the arc in case of an overfeeding of the carbon holder. (3) In an electric lamp, the combination of a clutch and mechanism for causing the clutch to first lift the carbon apparatus, to then cause the clutch to release the carbon, and to immediately return said clutch to a position to again lift said carbon upon an abnormal diminution of arc resistance. (4) In an electric lamp, the combination of a lifting electro-magnet and a clutch, a short circuit for said lifting electro-magnet, and a shunt electro-magnet for opening and closing said short circuit, whereby the clutch is adapted to lift and release the carbon and to be returned to its original position upon the establishment of a normal arc.