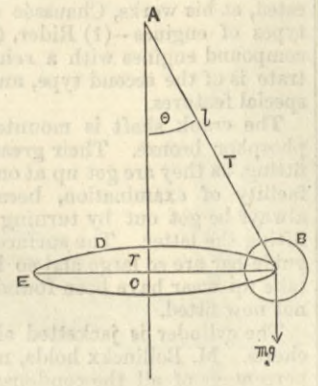
A POINT IN THE THEORY OF THE CONICAL PENDULUM.

By JAMES LYON, M.A., Superintendent of the Engineering Department, Cambridge University.

THE discussion of the conical pendulum, of which Watts' governor is a case, is usually given in text-books thus:—



Let T be the tension of the rod, or string, in British units of force.
m = the mass of the bob in pounds,
l = length of pendulum in feet,
n = number of revolutions per second,
v = linear velocity of bob in feet per sec.

Then $T \cos. \theta = m g$;

$$\therefore T = \frac{m g}{\cos. \theta} \quad . \quad . \quad \text{i.}$$

$\frac{v^2}{r}$ is acceleration of bob along B C.

$$\text{ii.} \quad \therefore \frac{m v^2}{r} = T \sin. \theta = \frac{m g \sin. \theta}{\cos. \theta} \quad . \quad . \quad . \quad . \quad \text{i.}$$

Now, $v = 2 \pi r n$, and $r = l \sin. \theta$;

$$\therefore \text{ ii. becomes } m\, 4 \pi^2 n^2 l \sin. \theta = \frac{m g \sin. \theta}{\cos. \theta},$$

$$\text{or } \cos. \theta = \frac{g}{4 \pi^2 n^2 l}.$$

It appears, therefore, that $\frac{g}{4 \pi^2 n^2 l}$ cannot be greater than 1, and when it has this value n will have its least value. Hence the least possible value of n is given by

$$n = \frac{1}{2 \pi} \sqrt{\frac{g}{l}}.$$

If t is the time of a complete small oscillation of a simple pendulum of length l,

$$t = 2 \pi \sqrt{\frac{l}{g}},$$

$$\text{and } \frac{1}{t} = \text{number of oscillations per second}$$

$$= \frac{1}{2 \pi} \sqrt{\frac{g}{l}}.$$

Thus the least number of revolutions which the pendulum can make, unless it hangs vertically, is the same as the number of small oscillations of the simple pendulum of same length as arm.

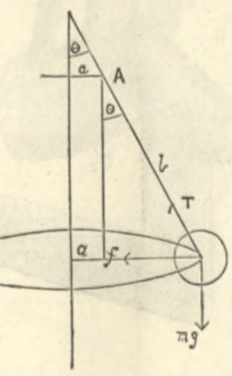
Taking equation ii., viz., $\cos. \theta = \frac{g}{4 \pi^2 n^2 l}$, and differentiating it with respect to n, we get

$$\sin. \theta \frac{d \theta}{d n} = \frac{2 g}{4 \pi^2 l n^3};$$

$$\therefore \frac{d \theta}{d n} = \frac{g}{2 \pi^2 l n^3 \sqrt{1 - \frac{g^2}{16 \pi^4 n^4 l^2}}}$$

$$\frac{d \theta}{d n} = \frac{2 g}{n^3 \sqrt{16 \pi^4 n^4 l^2 - g^2}}$$

It is evident from this that the ratio of the increase in θ to the increase in n gets continually less as n increases—that is to say, the governor is less sensitive the higher the normal speed; and it follows that a governor should be speeded so as to cut off steam entirely before θ is large—under 45 deg. if possible.



In the case of an ordinary Watts governor, where the point of suspension is not in the vertical axis, the above equations require some modification.

Suppose the arm of the governor to be suspended at A at a distance a from axis;

$$\text{then } \frac{v^2}{r} = 4 \pi^2 n^2 (l \sin. \theta + a);$$

$$\therefore m\, 4 \pi^2 n^2 (l \sin. \theta + a) = T \sin. \theta$$
$$= m g \tan. \theta;$$

$$\text{or } 4 \pi^2 n^2 (l \sin. \theta + a) = g \frac{\sin. \theta}{\cos. \theta};$$

$$\therefore l \cos. \theta + a \cot. \theta = \frac{g}{4 \pi^2 n^2}.$$

It appears, therefore, that n can be as small as we please, for a cot. θ increases continuously to infinity as θ decreases to 0, *i.e.*, both sides of equation will increase without limit if n decrease and θ decrease at the same time.

SOCIETY OF ENGINEERS.—The annual general meeting of the Society of Engineers was held on December 14th, in the reading-room of the Society, 6, Westminsters-chambers, S.W. The chair was occupied by Mr. Charles Gandon, president. The following gentlemen were balloted for and duly elected as the council and officers for the ensuing year, viz.:—As president, Mr. Perry F. Nursey; as vice-presidents, Professor H. Robinson, Mr. A. T. Walmisley, and Mr. W. Schönheyder; as ordinary members of council, Messrs. R. Berridge, W. Barns Kinsey, W. Macgeorge, Arthur F. Phillips, M. Ogle, Tarbotton, Jonathan R. Baillie, R. W. Peregrine Birch, and John Standfield, the three latter gentlemen being new members of council; as honorary secretary and treasurer, Mr. Alfred Williams; and as auditor, Mr. Alfred Lass. The proceedings terminated by a general vote of thanks to the council and officers for 1885, which was duly acknowledged by the chairman.

INCLINED SHAFT ROTARY ENGINES.

AT the close of the Inventions Exhibition it is not inappropriate, and may be acceptable to many of our readers, to pass in review a class of machinery upon which inventors have lavished a wealth of ingenuity. Rotary engines, as we have before remarked, are full of attraction to many people, and an examination of a selection of them cannot be without instruction to the engineer and to the inventor.

An important class of these motors, which has gained the admiration and puzzled the understanding of thousands, is based upon the mechanical gearing necessary to couple up revolving shafts converging towards each other. One method of connecting up such a pair of shafts is by what is known as the "Hooke joint," or as it is sometimes called, the "universal joint." To introduce two of the most effective rotary engines, we have attached a sketch, Fig. 1, of this joint, as to properly understand them the movements that occur in the Hooke joint should be clear in the mind. In this mechanism, the inclined shafts are steadied in bearings secured to the foundation plate D, the locus of convergence being at some intermediate point C. At the ends of the shafts, which terminate at equal distances from this point, are formed cranks or arms B B, A A, fitted with cylindrical holes $a\,a$, $b\,b$, at their extremities, converging also to C. These holes are in such a position that those on one shaft are at opposite ends of the diameter of a circle whose centre is at C, and those on the other shaft on a diameter perpendicular to the first. The four orifices thus provided are paired with pins connected to a plate C, which in this case is circular.

The peculiarity in this connection, which makes it suitable for being set in action by a pressed fluid, is the reciprocating movement of the intermediate piece C which occurs when the mechanism is set in motion. Upon turning one of the shafts, this plate, to accommodate itself to the varying positions of the shafts, rocks backwards and forwards, at the same time revolving, at one time decreasing the space between a semicircular half on one side and the arms on one shaft, and increasing the similar space on the other side of the same shaft; similar actions occur also in the spaces towards the other shaft. The locus of the periphery of this rocking plate is a sphere whose centre is at C. And therefore if it be enclosed in a sphere of such a diameter that its surface may pair with the edge of the plate, and if the arms of the shafts be filled in by a plane touching against the plate across the diameter $a\,a$, $b\,b$, the outer parts of these arms being so formed as to revolve in the same sphere, it will be seen that the spaces spoken of become closed in for every position of the mechanism, each space alternately expanding and contracting in volume. If, instead of turning a shaft and obtaining as a consequence the increase and decrease of the chambers, a pressed fluid be allowed to enter and increase the chambers and escape when they contract, then we have as a consequence the revolving movement of the shaft. Such is the action taking place in the Towers engine.

Another method of chambering may be followed. We notice that when this gear is in motion, the points $a\,a$ describe circles towards the shaft B, the planes of these circles being perpendicular to the arms of the shaft. Also the points $b\,b$ make similar circles towards the shaft A. Supposing, now, two cylinders are constructed, whose bases are secured flat on the arms of one shaft B, and whose axes are circles coinciding with that in an arc of which aa move. Then if we construct on the rocking plate circular arms, whose axes still coincide with the circle mentioned, and cause them to enter the cylinders on the shaft, making the connection steam-tight by pistons, we have chambers which enlarge or diminish as the arrangement is put in movement; similar cylinders being fitted on the arms of A and paired with pistons at the ends of curved rods from $b\,b$. This is the mechanism of Fielding's engine.

A closer view of the Towers engine can be obtained from Fig. 2. The letters will serve to identify its construction with that of the Hooke joint. In this engine, the shafts, steadied in fixed bearings, are usually inclined at an angle of 135 deg. The arms at the ends of the shafts A, B, are, broadly, segments of a sphere; the faces towards the rocking piece are flat, the back, where joining with the shaft, being flat also, for the greater convenience of fitting the steam entry and escape channels. These segments have to be made substantial in size in order to fill in that part of the spherical casing through which the piston does not sweep, and so avoid large clearance spaces. The rocking piston is paired to the shaft arms, as in the universal joint, by the joints at $a\,a$ and $b\,b$. The spaces on each side of the crank arms are kept distinct by rounding the inner edges of the segments and fitting them against similarly-rounded projections on the piston. No sphere is shown in the sketch in order to avoid confusion; from the form of the parts it can readily be seen how it envelopes the whole, rocking piece and segments.

The distribution of steam at the proper times is carried out in very similar ways in the majority of this class of engine. In the engine under consideration channels are cut in the faces of the segments as shown, thus entering fairly into each of the four chambers; the channels run back into the annular surface behind the segments, and are bounded by radial lines. This annular surface thus provided with ports—one to the space on one side the segment, and one to the space on the opposite side—revolves against faces constructed in cylindrical pieces Z Z, shown drawn back in the sketch for the sake of clearness, but which are forced up against the revolving segments when the engine is ready for work. The large ports E are the exhaust ports, and are permanently connected to an exhaust pipe; the steam ports S are the smaller ones, and permanently connected to the supply pipe; and all are shown in their relative positions. At the present moment the space a B is exhausting; the chamber a^1 B is on the point of receiving steam; the chamber b A has just received a full supply, which is now cut off, and is on the point of being worked expansively; the chamber b^1 A is exhausting. The resultant effect of the action is such therefore as to produce a force on the rocking piece in the direction of the straight arrow tending to turn the intermediate piece about the diameter $a\ a$, and consequently so acting on the shaft B as to turn it in its bearings in the direction of the curved arrow. Further movement will result in the other openings admitting and exhausting the steam at the proper time, and keep up a continuous rotation in the same direction.

There are many internal joints in this device to keep steam-tight. The piston should be tight with the spherical chamber, the piston with the ends of the shaft segments, the sides of the shaft segments with the spherical chamber, and also with the valve face. One great feature here is that all the joints are surface joints, and therefore not nearly so untrustworthy as when only a bare line forms the contact. Some of these joints are treated only by excellent fitting, and by their comparative largeness of surface. The most important are fitted in the ordinary way, by letting in strips of phosphor bronze, pressed against the working face by springs. Such are the long lengths at the edges of the two segments where touching the rocking piece, and extending from joint to joint. Each quadrant of the piston periphery has slips of phosphor bronze included between two collars, and extending from joint to joint. At the joints steam-tightness is carried across by means of the horseshoe-shaped pieces at h.

The expansion of steam in some of these engines is about two or two and a-half times, but as in many cases compounding is resorted to, a much greater expansion, and consequent economy, may be obtained. For the class of high-speed engines these engines burn comparatively little coal, a simple non-condensing engine requiring about 5½ lb. or 6 lb. of coal per hour per effective horse-power. From the nature of the valve gear, such a high degree of expansion cannot be so effectively carried out as with the direct-acting engine. In the direct engine the operation of admission is promptly carried out, as when this occurs the valve is moving at its greatest speed while the piston is at its slowest. In the rotary engines in question, the valve face moves at the uniform speed of the shaft, and the admission is started in a gradual and comparatively leisurely manner. Thus, if a very early cut-off be attempted the steam would not have attained its full pressure in the cylinder before being cut-off. If these engines were fitted with separate valve gear, they would afford just the same facility for a higher degree of expansion as does the direct-acting engine running at the same speed. Such fittings, however, would interfere with the compactness and handiness of this class of engine, requiring more space, and demanding more care in its management.

A great feature in the Towers engine is the great amount of power developed in a small space. In the course of a revolution, each of the four chambers has been entered by the steam and the moving piece in each chamber swept through one quarter the volume of the sphere. Thus the steam fills in the course of a revolution a volume equal to the volume of the whole sphere. The power estimated from this consideration is about 20-horse power, taking a mean pressure of 30 lb., a sphere of 10in., and 500 revolutions per minute. The mean pressure would generally be higher—about in such a proportion as to give 20 effective horse-power in the above case.

The Fielding engine can almost be followed from Figs. 3 and 4, and the letters indicating those parts identical with the fittings of the universal joint. The arms B_1 B_1 of the shaft B are geared with the intermediate piece by means of the pin joints $b\ b$; the arms A_1 A_1 of the shaft A are similarly connected at $a\,a$ with the same piece, the line $a\,a$ being perpendicular to $b\,b$, both passing through the point towards which the shafts converge. In addition to this gearing, there are four curved arms rigidly attached to the intermediate piece in the neighbourhood of the joints $a\,a$, $b\,b$, and by means of pistons are paired to the short cylinders curving outwards from each shaft. The cylinders are placed perpendicularly to the arms of the shaft on which they are secured, their axes being curved, as shown, to accommodate to the movement of the four pistons. Fig. 4 shows the positions of the pistons at one period.

When the whole mechanism is set in action the four pistons move backwards and forwards in their respective cylinders, alternately enlarging and contracting the enclosed spaces. To allow of steam entering and escaping from these four spaces, valve gear very similar to that employed in the Towers engine, is adopted. Channels run from the base of each cylinder, and appear as annular segments on a flat circular face as shown at V V. Pressed against this face and a similar face on the other shaft, are two fixed port pieces like those described in the previous engine. The action of the steam on entering and exhausting is identical. At the position of the mechanism shown in the picture steam is about to enter the cylinder $B_1{}^1$; about to exhaust from B_1; is exhausting from A_1; and on the point of working expansively in $A_1{}^1$. Thus the effect is to produce a force in the direction of the straight arrow, turning the shaft B in the direction of the curved arrow, and the whole mechanism revolves. Each piston comes in at the proper time to keep up the rotation.

The joints to be kept steam-tight are the four pistons and the two valve faces. The valve faces are only fair surfaces pressed against by the port blocks; a screw-piece is provided and worked from the outside so as to set the blocks properly up against the revolving valve surfaces. These blocks are, of course, prevented from turning with the machinery. The pistons are of an awkward shape, being of double curvature; but it is still of such a character as to allow of the formation of wide surfaces of contact with the cylinders in which they reciprocate. A simple packing hoop is employed, as shown at P in Fig. 4, of the same construction as that used in many ordinary pistons. This hoop is set in between collars, and kept pressed outwards by its own elasticity. The mechanism completed as described is covered in by a casing to protect the working parts from damage and dirt.

As far as the valve gear is concerned, about the same expansion of steam is provided for as in the Towers engine. A peculiarity of the Fielding is, however, that two of the cylinders on one of the shafts are made of larger diameter than those on the other, and the steam pipes so arranged as to work as a compound engine. By this means a considerable economy is obtained. The sketches given of this engine do not represent the actual detail of construction; it is intended to be only explanatory. The actual engine has its rocking piece recessed, so that in its movements it may work well clear of the cylinders towards which it rocks. In principle, the sketch and the engine are identical. For finished drawings of both the Towers engine and the Fielding, showing the construction of the parts in detail, readers are referred to previous numbers of this journal—10th August, 1883, and June, 1885.

The ordinary method of communicating motion from one revolving shaft to another inclined to it is by bevelled cog-wheels, but this movement has been so accompanied by suitable mechanism as to obtain the conditions necessary for producing the rotary motion of a shaft from the expansive energy of steam. A specimen of this character was exhibited, as represented in Fig. 5. Any two points situated in the faces of such revolving wheels, and which are opposite to each other, must evidently alternately approach and recede along the some straight line. They are nearest together when nearest to the point of contact of the wheels, and farthest apart after having moved

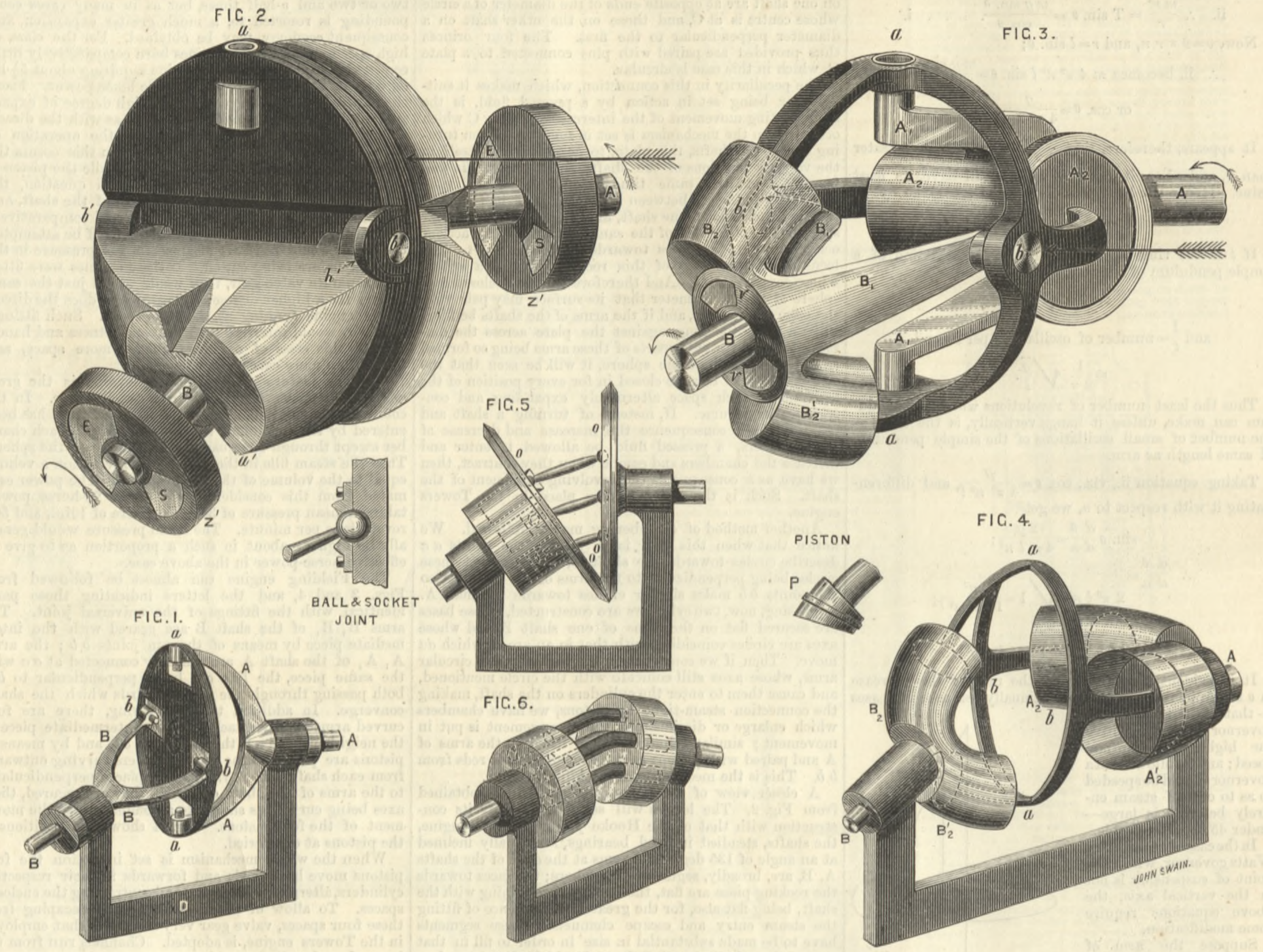
The joints to be made steam-tight in this engine are very simple. They are the pistons working in fair cylinders and the port face. The pistons are fitted as are those of the direct-acting engine. The difficulty is in the ball joint, which, although not a steam joint, is a kind of connection not possessing a reputation for durability and simplicity.

It is impossible to mention this last engine, or to dismiss the consideration of inclined shaft engines, without another reference to the Cameron mechanical movement. By this arrangement the shafts would be connected up by knuckle pieces working into cylinders constructed in similar positions to the preceding—Fig. 5—but would require a second series symmetrically placed in the second shaft. This is shown in Fig. 6. The plane passing through both arms of each connecting piece is always parallel to the plane passing through the axes of the revolving shafts. As the mechanism is turned the knuckle pieces pass in and out of their cylinders, as pointed out in the previous engine, the action being the same for both the sets of cylinders in the two wheels or shafts. If steam were admitted to these spaces as in the other engines, the whole system would be compelled to move, the shafts revolving. In turning this into a rotary engine it might be necessary to gear up the shafts by bevelled cogs so as to relieve the

that the cranks are fixed on the shafts and levers on weigh shafts without any keys, the parts being forced into their places. More noteworthy still, the fly-wheels are forced on the shafts and have no keys. We believe that M. Bollinckx is the only engineer who has had the hardyhood to pursue this system so thoroughly, and in all cases his practice has been successful. M. Bollinckx makes no secret of his methods, which can be seen by anyone interested, at his works, Chaussée de Mons. He builds three types of engines—(1) Rider, (2) Corliss jacketted, and (3) compound engines with a reheater. The engine we illustrate is of the second type, and we propose to describe its special features.

The crank shaft is mounted in cylindrical brasses of phosphor bronze. Their great advantage is cheapness of fitting, as they are got up at one operation in the lathe, and facility of examination, because the bottom brass can always be got out by turning it round the shaft without lifting the latter. The surfaces of the crosshead guide and guide-bar are so large and so hard that adjusting pieces to take up wear have been found quite unnecessary, and are not now fitted.

The cylinder is jacketted all over, and so are the valve chests. M. Bollinckx holds, no doubt rightly, that a great percentage of all the condensation that takes place occurs



INCLINED SHAFT ROTARY ENGINES.

through half a revolution, as at O O in the sketch. This motion being embodied in chambers and joints, gives the enlargement and contraction of closed spaces as a result, which may be made use of for utilising steam pressure.

In the sketch four cylinders are seen to be constructed in the body of one of the cog-wheels. The axes of these cylinders are parallel to the shaft, and are situated at equal radial distances from the axis of the shaft. These cylinders are paired with pistons which are secured to piston-rods, the opposite ends of these rods being jointed to the face of the opposite wheel. The points at which these ends of the piston-rods are attached are situated symmetrically to the cylinders in the other wheel. To accommodate this mechanism to the varying positions of the shaft, ball joints have to be introduced, as shown, both at the junction of the piston-rod and piston and piston-rod and wheel. By referring to the sketch it will be seen that the space between the bottoms of the cylinders and the pistons becomes larger and smaller as the shafts are turned. Steam is admitted to these cylinders by channels constructed as in the Towers and Fielding, and produces as the effect of forcing open the chambers and the revolution of the cog-wheels. Comparing this contrivance for a moment with the spherical engine, we see the extraordinary compactness of the latter. It is almost identical in action, but in the former four separate single-acting cylinders are used, while in the spherical engine one chamber, in the form of a sphere, is so divided as to result in two double-acting compartments, which, as regards the working of the steam, are equivalent to four single-acting cylinders.

working pieces upon which the steam would act from too much strain. The pairing of the sliding pieces with the cylinders is of such a nature as to require only the ordinary piston packing; but it should be noted that these pistons do not merely pass in and out of the cylinder, but turn in them at the same time. With this double movement set up, it would seem that greater wear must be looked for. R.

THE ANTWERP EXHIBITION.

No. XII.

AMONG the most noteworthy engines exhibited at Antwerp are those by M. H. Bollinckx, of Brussels. Like almost every engine exhibited this is of the Corliss or trip gear type. M. Bollinckx, like most first-class engine builders, goes in for extreme accuracy of fit and surface. He gets up his work in a way not as yet nearly as extensively adopted as it deserves to be in this country, mainly by the use of emery grinders. All the steel work having been brought nearly to shape and size, is then hardened and subsequently gone over with emery wheels fitted in special machine tools designed for the purpose. When the steel is carefully finished first, if it is subsequently hardened a certain amount of distortion is sure to take place which is fatal to accuracy, and the result is that steel unhardened is only too often used. The emery grinder gets over this difficulty, and surfaces of extreme hardness can be adopted, and thus their durability is much augmented. M. Bollinckx's standard of permissible error is $\frac{1}{100}$ of a millimetre, or about $\frac{1}{2500}$ of an inch. The precision attained is so great

in the ports and valve chests. The jacketting is so arranged as to permit the metal to expand and contract without risk of cracking the cylinder or the jacket. To prevent water being taken into the cylinder with the steam, the well-known system of "knocking the water out of it" is used. The steam before entering the cylinder passes into the jacket—it enters at the top, and striking the metal of the liner, it has the water knocked out of it—dry steam passing right and left to the admission valve. The water falls to the bottom of the jacket, and the result is such that drain cocks are not needed. M. Bollinckx, it is worth notice, attaches the greatest importance to taking steam in at the *top* of the jacket. It is to a neglect of this precaution, he holds, that the unsatisfactory results now and then obtained with jackets is due.

The valves are of the cylindrical semi-rotary type. They are of special construction recently patented by M. Bollinckx. They are independent, in one sense, of the rod from which they obtain their motion. As will be seen from the detail sections, the working faces are distinct pieces lying in grooves in the main body of the valve, and kept up to their work by springs. It will be seen from our engravings that the valves are very close to the cylinder. M. Bollinckx claims that he works with less clearance than any other maker; a clearance of 3 per cent. is considered very small, but he works with 2 per cent. only. "Thanks to this," he says, "I am able to work almost without the dangerous remedy compression, without augmenting the consumption of steam. The pistons are made without any separate pieces which may become loose and cause trouble. They are made each of a single piece,

CONDENSING ENGINE, ANTWERP EXHIBITION.

MONS. BOLLINCKX, BRUSSELS, ENGINEER.

FIG. 1

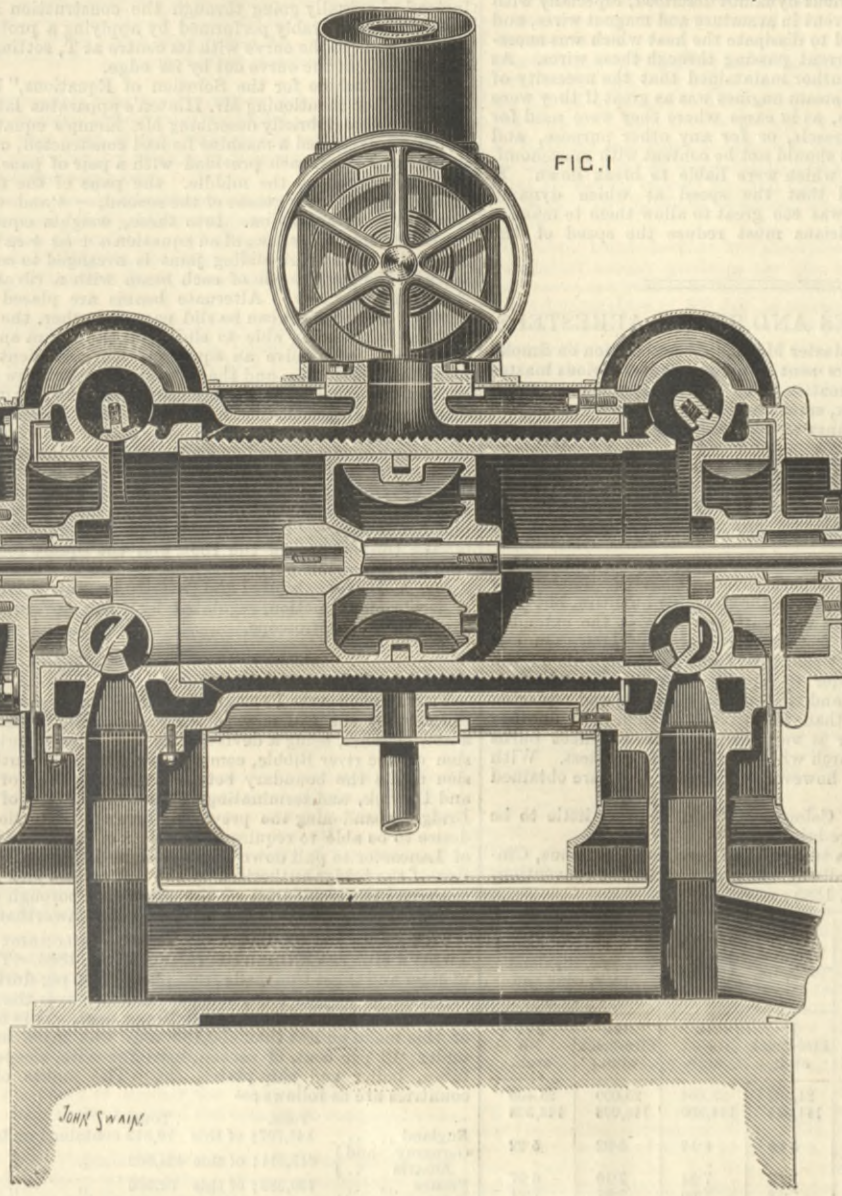
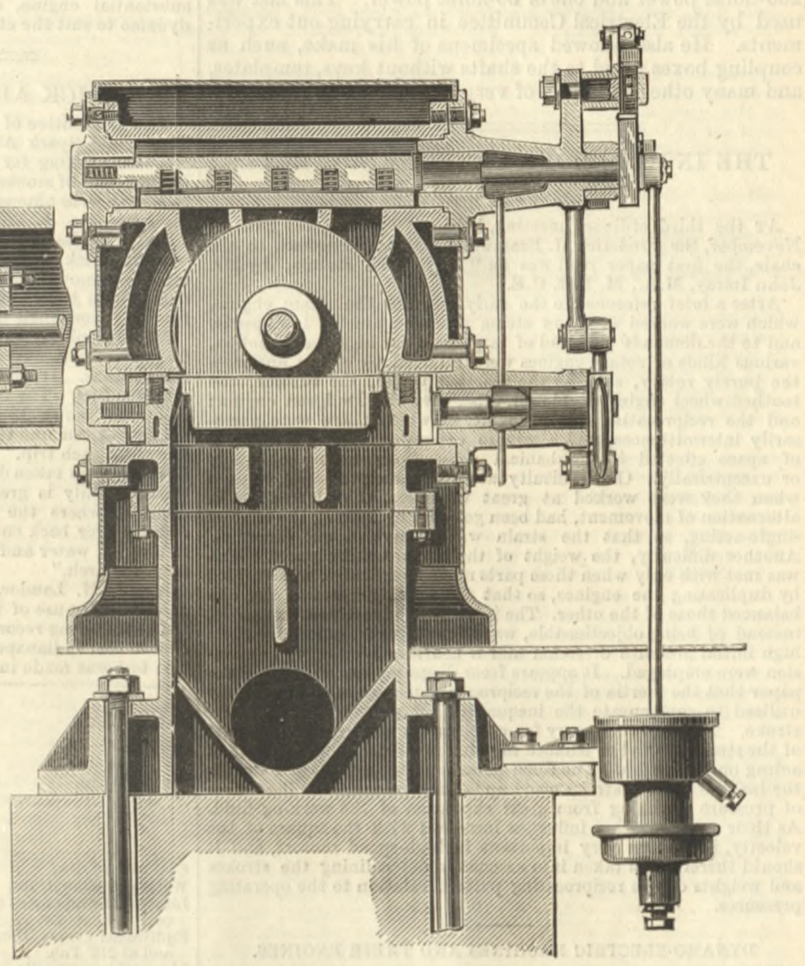
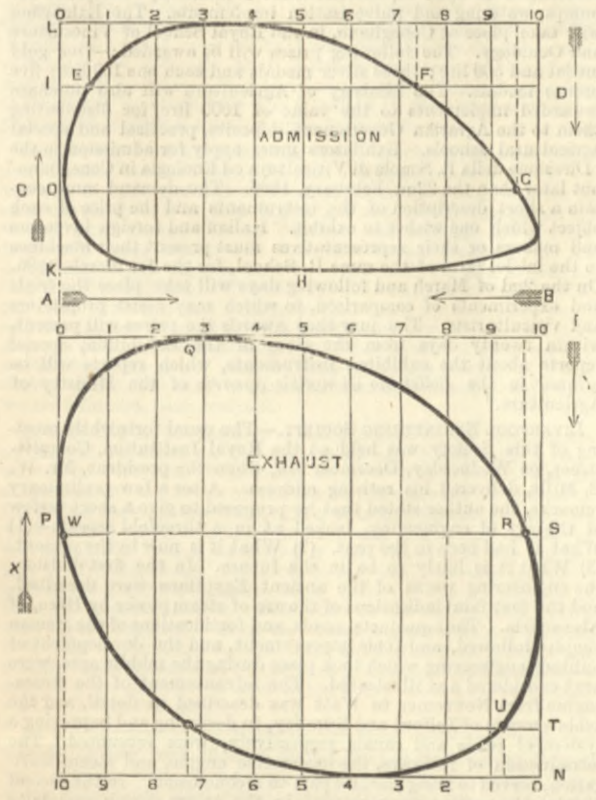


FIG. 2

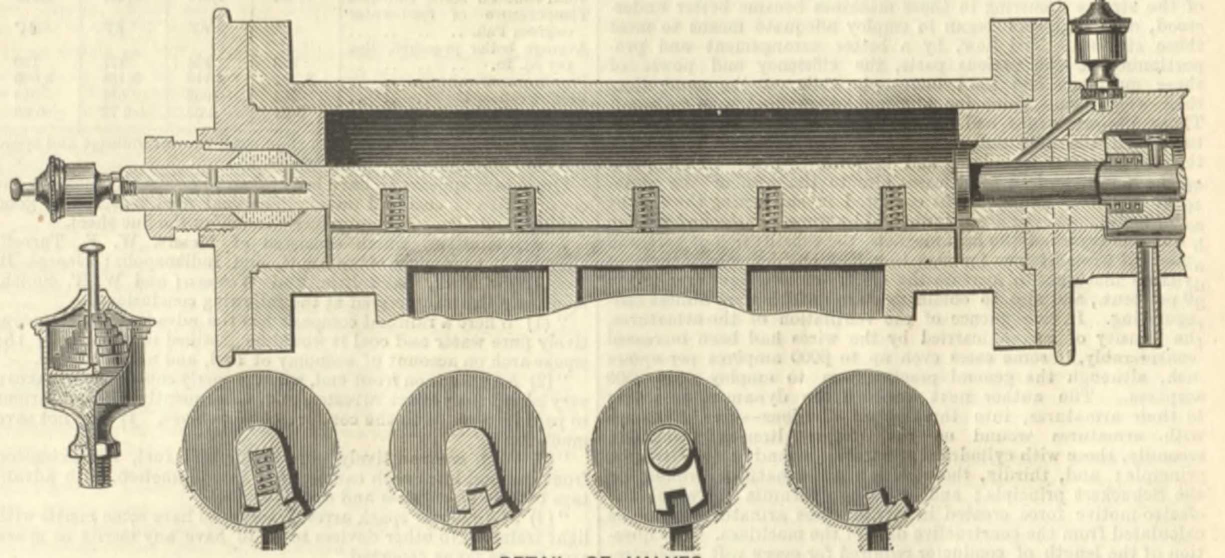


with phosphor-bronze rings. The pistons are very thick so as to provide a large rubbing surface, and so prevent the cylinder wearing oval. The holes shown on our engraving are fitted with screwed plugs.

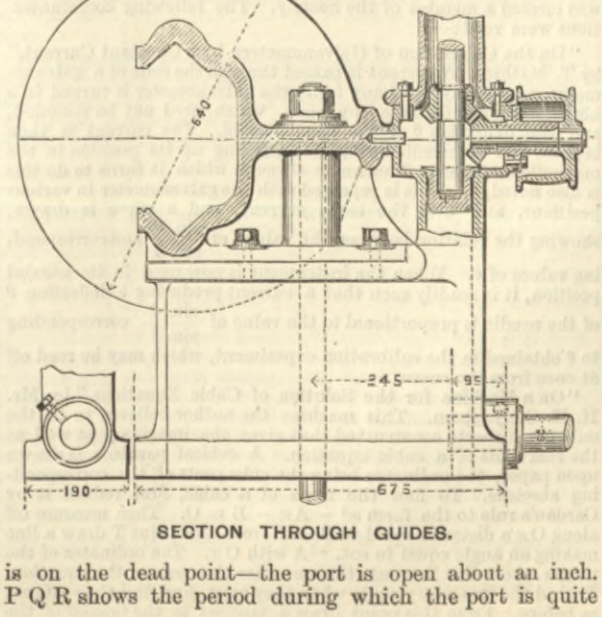
The valve gear is of the Trip type controlled by the governor. We do not think our readers will have any difficulty in mastering its details from our drawings. A disc concentric with each valve spindle has an oscillating rotary motion imparted to it. A hook on this pulls the valve round until the hook is tripped by a tail piece whose position is settled by the governor. The



accompanying diagrams illustrate the action of the valves. There are, it will be remembered, four distinct valves; two for admission and two for exhaust. In the diagrams, the arrows A B show the stroke of the piston, A being the direction of motion during the steam stroke, and B its direction during the exhaust stroke; C shows the direction of motion of the steam valve during admission, D its direction during the time it is closing, O position of rest while the crank is at the dead point, E the position of the piston when the admission port is full open—the piston traverses only 7 per cent. of its stroke to attain this result—E F the portion of the stroke during which the valve is full open; at F the valve begins to close the port again, at G it is fully closed; G H O represent the period during which the valve is shut, O to I shows the time during which the valve is opening the port, K to L the total stroke of the valve. In the exhaust diagram, X shows the direction of motion of the valve during the time the port is closed, Y its direction during the time the port is open, P the position of rest when the crank is on the dead point—the port is open about an inch. P Q R shows the period during which the port is quite closed, and may be compared with advantage with the line O E F G in the upper diagram. R is the position of the piston when the exhaust port begins to open. R S is the period of exhaust lead; U the position of the piston when the exhaust port is full open—this is 7 per cent. of the whole stroke of the piston; V the position of the piston when the valve begins to close. The port is not quite closed until the piston is within about 1in. of the end of its stroke. S T shows the width of the exhaust port, and M N the total movement of the valve. It will be understood, of course, that the action of the governor will close the admission port earlier than the point F. The diagram shows the action of the valves when the engine is taking full steam, and we think it would be very difficult to improve on the setting of these valves. The action of the governor is such that if the belt driving it were to break the engine would stop at once.



DETAIL OF VALVES.



SECTION THROUGH GUIDES.

The arrangements for lubrication are very complete, the Mollerup lubricator being used throughout. This consists of a brass cylinder in which is a piston, the rod of which is screwed with a fine thread. This being driven by means of a ratchet and click forces down a drop of oil into the cylinder at each revolution of the crank shaft. The inconvenience of this is that it lubricates only one end of the cylinders. M. Bollinckx has made an improvement by which the action of the lubricator is doubled in rapidity, so that a drop of oil is forced in twice during each movement, and the oil is dropped first at one side and then at the other of the piston, and so both ends of the cylinder are equally well greased. The arrangement is independent of the engine driver and of temperature, and gives, we understand, the most satisfactory results.

The condenser is shown in section on page 476. The form of the plunger is one, we believe, first used in the Allen engine in 1862. M. Bollinckx will have nothing to do with india-rubber valves, using instead phosphor bronze, which, he says, never give any trouble.

We have described this engine at considerable length, because we are desirous that our readers should know as much as possible about the work with which they have to compete abroad. We think it will be admitted that a good many English engineers have something to learn. Our fathers taught the whole world at one time how to build steam engines; the sons of their fathers need not be ashamed to take a lesson from the world.

M. Bollinckx showed two engines at Antwerp, one of 200-horse power and one of 60-horse power. This last was used by the Electrical Committee in carrying out experiments. He also showed specimens of his make, such as coupling boxes fitted to the shafts without keys, templates, and many other examples of very high-class workmanship.

THE INSTITUTION OF CIVIL ENGINEERS.

HIGH-SPEED MOTORS.

At the third ordinary meeting, held on Tuesday, the 24th of November, Sir Frederick J. Bramwell, F.R.S., President, in the chair, the first paper read was on "High-speed Motors," by Mr. John Imray, M.A., M. Inst. C.E.

After a brief reference to the early forms of the steam engine, which were worked with low steam pressures and at low speeds, and to the demands that had of late arisen for high-speed motors, various kinds of rotary engines were referred to by the author—the purely rotary, such as the reaction wheel, the turbine, the toothed-wheel engine of blower type, and the Dudgeon engine; and the reciprocating rotary engine, in which there were necessarily intermittences, and alternate expansions and contractions of space effected by mechanical connections acting obliquely or eccentrically. One difficulty attending reciprocating engines when they were worked at great velocities, the blow at each alternation of movement, had been got over by making the engines single-acting, so that the strain was always in one direction. Another difficulty, the weight of the reciprocating parts, which was met with only when these parts moved vertically, was avoided by duplicating the engines, so that the moving parts of the one balanced those of the other. The inertia of the reciprocating parts, instead of being objectionable, was advantageous, especially when high initial pressure of steam and a considerable range of expansion were employed. It appears from diagrams accompanying the paper that the inertia of the reciprocating masses might be largely utilised to compensate the inequalities of pressure during the stroke. The force necessary for acceleration during the first part of the stroke tended to balance the high pressures which were then acting on the piston. The force given out by retardation during the last part of the stroke made up in some measure for the defect of pressure resulting from great expansion of the working fluid. As their compensating influence increased with the square of the velocity, it became very important in high-speed motors, and it should therefore be taken into account in determining the strokes and weights of the reciprocating parts in relation to the operating pressures.

DYNAMO-ELECTRIC MACHINES AND THEIR ENGINES.

The second paper read was on "Dynamo-electric Machines and their Engines," by Mr. Gisbert Kapp, Assoc. M. Inst. C.E.

In this paper the author summarised the improvements which had been made within the last few years in the design and construction of dynamo-electric machines and engines used to drive them. Starting with the mechanically imperfect machine first introduced by Gramme, he showed how, by degrees, the nature of the strains occurring in those machines became better understood, and engineers began to employ adequate means to meet those strains. Also how, by a better arrangement and proportioning of the various parts, the efficiency and power of these machines had been increased, while at the same time their weight and price for a given power had been reduced. Those improvements had mainly been effected in the armatures and the field magnets. The former consisted in holding the wires firmly in place, and in admitting air to all parts of the wires, and in some cases also to the core of the armature. Another improvement consisted in supporting the core by solid metal spokes or arms, instead of by the old-fashioned wooden hub. As regarded the field magnets, the substitution of soft well annealed wrought iron for cast iron had enabled the makers of dynamo machines to increase the electro-motive force from 20 to 30 per cent., and also to obtain machines which were almost self-regulating. In consequence of the ventilation of the armatures, the density of current carried by the wires had been increased considerably, in some cases even up to 6000 ampères per square inch, although the general practice was to employ only 2500 ampères. The author next classified the dynamos, according to their armatures, into three great divisions—first, dynamos with armatures wound on the Hefner-Alteneck principle; secondly, those with cylindrical armatures, wound on the Gramme principle; and, thirdly, those with disc armatures, wound on the Schuckert principle; and he gave a formula by which the electro-motive force created in any of these armatures could be calculated from the constructive data of the machines. The question of the length of conductor required for every volt of electromotive force produced in the external circuit was next inquired into, and after certain assumptions, which were fairly in accordance with general practice, he found that the length of the conductor required to produce one volt was in the—

		Inches.
1.	Drum, long	6·5
2.	,, short	16·4
3.	Cylinder, long	21·8
4.	,, short	26·1
5.	Disc, square core	26·3
6.	,, circular core	26·3
7.	,, flat core	78·8

Speaking of the intensity of the magnetic field in a dynamo machine, the author established the relation, that the total number of lines of force passing across the armature could be represented as the ratio of the exciting power and magnetic resistance, the latter consisting of three parts: that properly due to the field-magnets, that due to the armature core, and that due to the air space between the paler surfaces and the surface of the armature coil. The latter was assumed to be constant for all degrees of magnetisation, but the two former were supposed to increase in a certain way with the intensity of magnetisation; this increase, however, not being taken into account for low intensity. Formulas were then given for the magnetic resistance, from which it was found that dynamo machines with single horseshoe magnets required about 25 per cent. less wire than those with double horseshoe magnets. With regard to the influence of the size of dynamos on the electrical energy which could be obtained from them, the author found that in small and medium size machines the latter varied as the $3\frac{1}{2}$ power of their linear dimensions, and that the cost of manufacture varied as the $2\frac{1}{2}$ power, thus making the cost of the dynamo per lamp inversely as its linear dimensions. The influence of the electro-motive force on the cost of dynamos was shown by an example, which proved that, for economical reasons, it was better to work with average electro-motive force, and that very high tension should only be employed if the expense for cables in the external circuits became very considerable. Detailed descriptions were given of nearly all the improved dynamo-machines now manufactured in England, including the Edison-Hopkinson, Mather and Platt, Paterson and Cooper, Elwell-Parker, Crompton, Greenwood and Batley, the Brush Company, the Gülcher Company, and the author's dynamos. A table was also given which contained some of the more important constructive data of the various dynamos described, especially with regard to the density of current in armature and magnet wires, and the cooling surface provided to dissipate the heat which was necessarily generated by the current passing through those wires. As regarded the engines, the author maintained that the necessity of durability and economy in steam engines was as great if they were required to work dynamos, as in cases where they were used for driving mills, propelling vessels, or for any other purpose, and that, therefore, electricians should not be content with uneconomical engines, or with those which were liable to break down. If engine makers maintained that the speed at which dynamo machines must be driven was too great to allow them to make a substantial engine, electricians must reduce the speed of the dynamo to suit the engine.

FIRE-BRICK ARCHES AND SPARK ARRESTERS.

The Committee of the Master Mechanics' Association on Smoke Stacks and Spark Arresters sent a circular to the various master mechanics asking for information as to results obtained with different forms of smoke stack, smoke arch, and fire-brick arch. The following were among the answers received to the inquiries of the committee:—

Mr. J. D. Barnett, Grand Trunk: "A long and thorough test with fire-brick arches has shown that their expense in first cost, in repeated renewals, and in occasional injury to side sheets of furnaces more than counterbalances any reduction in the fuel bill resulting from their use."

Mr. Joseph Wood, Pennsylvania Company: "The extended front gives better results as a spark arrester than the diamond or Smith stack. It slightly improves the steaming qualities, but does not save fuel. The fire-brick arch with and without the extended front has shown 12 to 15 per cent. economy of fuel. On one division of our line the dirty coal used forms large deposits on the flue sheet each trip. In order to remove these deposits, the fire-brick must be taken down, and the cost of removing and replacing the arch daily is greater than the saving of fuel. On another division, where the water is very bad, the crown sheet burns directly over back end of arch where the heat is greatest. With fairly good water and coal, however, very good results are obtained from the arch."

Mr. J. N. Lauder, Old Colony: "Could see very little to be gained by the use of the fire-brick arch."

The following record of a test on the Cleveland, Columbus, Cincinnati and Indianapolis Railway was presented at the convention. The test was made in May, 1885:—

	Extended front, high compound nozzles, straight stack.		Ordinary smoke arch, low compound nozzle, diamond stack, cone and netting.	
	I. Fire-brick arch.	II. No arch.	III. Fire-brick arch.	IV. No arch.
Coal burned, lbs.	24,532	23,664	25,000	28,400
Water evaporated, lbs.	144,844	144,800	148,068	148,528
Lbs. water evaporated per lb. coal	5·90	6·12	5·92	5·22
Equivalent evaporation from and at 212° Fah.	7·07	7·34	7·10	6·27
Lbs. coal per car mile	7·78	7·60	7·87	7·71
Lbs. water per car mile	45·95	46·52	46·73	40·36
Coal burned per sq. ft. of grate per hour	75·80	76·37	84·66	96·46
Water evap. per sq. ft. of grate per hour	447·65	450·54	501·44	504·50
Running time, minutes	1,100	1,092	1,004	1,001
Time for stops, minutes	200	208	176	214
Total time on tests, minutes	1,300	1,300	1,180	1,215
Temperature of feed-water degrees Fah.	63°	63°	62°	64°
Average boiler pressure, lbs. per sq. in.	126	128	127	120
Passenger car mileage	3,152	3,112	3,168	3,680
Engine mileage	552	552	552	552
Average No. cars per train	5·71	5·63	5·73	6·66

Note.—On account of change in time card, the car mileage and speed of train were both increased in test No. 4.

Great care appears to have been taken to accurately measure the consumption of coal and water. The coal used was not of good quality, and formed a heavy incrustation on the flue sheet.

The committee, which consisted of Messrs. W. F. Turreff, Cleveland, Columbus, Cincinnati, and Indianapolis; George B. Ross, New York, Lake Erie, and Western; and W. T. Smith, Kentucky Central, arrived at the following conclusions:—

"(1) Where a railroad company has the advantage of comparatively pure water and coal it would be justified in the use of the smoke arch on account of economy of fuel, and not otherwise.

"(2) An extension front end, when properly constructed, makes a very satisfactory spark arrester, and, consequently, is less injurious to paint, and adds to the comfort of passengers. It does not save much fuel.

"(3) With comparatively pure water and fuel, the extension front end and brick arch can be used in conjunction, with advantage both in cleanliness and saving of fuel.

"(4) The Hunter spark arrester seems to have some merits with light trains. No other devices seem to have any merits as spark arresters as far as reported."

THE PHYSICAL SOCIETY.

At the meeting of this Society held on November 28th, 1885, Professor F. Guthrie, president, in the chair, Mr. T. H. Blakesley was elected a member of the Society. The following communications were read:—

"On the Calibration of Galvanometers by a Constant Current," by T. Mather. A current is passed through the coils of a galvanometer, which may be of any form, the galvanometer is turned in a horizontal plane through any angle, which need not be recorded, and the deflection θ of the needle noted. The current is then broken, and the needle swings back, taking up its position in the magnetic meridian. The angle through which it turns to do this is also noted, δ. This is repeated with the galvanometer in various positions, and with the same current, and a curve is drawn, showing the relation between the values of $\frac{\sin. \theta}{\sin. \delta}$ and corresponding values of θ. When the instrument is now used in its normal position, it is readily seen that a current producing a deflection θ of the needle is proportional to the value of $\frac{\sin. \theta}{\sin. \delta}$ corresponding to θ obtained in the calibration experiment, which may be read off at once from the curve.

"On a Machine for the Solution of Cubic Equations," by Mr. H. H. Cunyngham. This machine the author believes to be the only one hitherto constructed that gives the imaginary as well as the real roots of a cubic equation. A cubical parabola is drawn upon paper, the ordinates being the cube roots of the corresponding abscissæ. To find the roots of a cubic, first reduce it by Cardan's rule to the form $x^3 - Ax - B = O$. Then measure off along Ox a distance equal to B, and from this point T draw a line making an angle equal to $\cot.^{-1}A$ with Ox. The ordinates of the points where this line cuts the curve are the roots of the equation. To find the imaginary roots when they exist, first find the real root as before. From this point draw a tangent to the branch of the curve the other side of Oy; then if this line cut the axis of x at a point Q, and a be the real root, the two imaginary roots are

$$-\frac{a}{2} \pm \sqrt[2]{\frac{QT}{a}}$$

Instead of actually going through the construction as above, the operation is preferably performed by applying a protractor with a tangent scale to the curve with its centre at T, setting and reading off the point of the curve cut by its edge.

"On a Machine for the Solution of Equations," by Mr. C. V. Boys. After mentioning Mr. Hinton's apparatus lately shown to the Society, and briefly describing Mr. Kemp's equation machine, Mr. Boys explained a machine he had constructed, consisting of a system of beams, each provided with a pair of pans, and working upon a fulcrum at the middle. the pans of the first beam are marked $+a$ and $-a$; those of the second, $-b$ and $+b$; the next, $+c$ and $-c$; and so on. Into these, weights equal in value to the coefficients a, b, c, &c., of an equation $a + bx + cx^2 + \ldots . = 0$, are to be placed. A sliding joint is arranged to connect a point opposite the positive pan of each beam with a rib at the back of the next lower one. Alternate beams are placed opposite one another, and each set can be slid past the other, the peculiar connecting joints being able to slide past the fulcra and the pans on each beam. To solve an equation, the coefficient weights are placed in their pans, and the two sets of beams are made to slide past one another. At certain positions the beams change the direction of inclination. These positions of balance are noted on a scale, the readings of which are roots of the equation. When there are not more than two impossible roots the machine will find them. For this purpose the real roots are first found and divided out, the resulting quadrations being placed on the machine. Instead of a change of inclination of the beams, a maximum or minimum of pressure is observed by a spring balance. The reading of the scale is then the real part of the root, and the square root of the pressure the impossible part.

Mr. A. Hilger exhibited and described a new driving clockwork, of isochronous motion, regulated by a fan governor; and a new direct vision spectroscope.

The Ribble and Preston Docks.—The Preston Corporation propose, by the Bill now before Parliament, to have authorised a new channel, being a deviation of the already authorised diversion of the river Ribble, commencing where the authorised diversion meets the boundary between the township of Penwortham and Howick, and terminating at the western face of Penwortham Bridge, abandoning the previously arranged diversion. They also desire to be able to require the justices of the peace for the county of Lancaster to pull down Penwortham Bridge after the completion of the bridge authorised by the Act of this year; and further, to extend the boundaries of the municipal borough of Preston, so as to include portions of the township of Penwortham.

The Progress of Basic or Thomas-Gilchrist Process for Twelve Months Ending September 30th, 1885.—The total make of steel and ingot iron made from phosphoric pig during this period amounts to 945,317 tons, being an increase over the makes for the previous twelve months of about 10 per cent. It is noticeable that of this make no less than 600,183 tons was ingot iron containing under ·18 per cent. of carbon, used for wire, sleepers, tin-plates, tubes, boiler and ship-plates, &c. The makes of the various countries are as follows:—

	Tons.		Tons.	
England	145,707;	of this	70,813	contained under ·18°/ₒ carbon.
Germany and Austria	617,514;	of this	424,862	,, ,, ,,
France	130,582;	of this	62,390	,, ,, ,,
Belgium and other countries	51,514;	of this	42,118	,, ,, ,,
	945,317 tons		600,183 tons	

International Exhibition of Implements for Killing Parasites on Vines.—The following circular has been issued. We are not responsible for the grammar:—"H.E. the Minister of Agriculture, Industry, and Commerce in Italy, in order to favour and facilitate the application of the remedies in solution, powder, or mixture against the cryptogams and parasites of the cultivated plants, and especially the use of the milk calx against the peronospora—mildew—of the vines, by a decree of the 9th November established to open an International Exhibition, with prizes for pumps, watering and pulverisation implements. The Exhibition will take place at Conegliano, in the Royal School of Vineculture and Oenology. The following prizes will be awarded:—One gold medal and 500 lire; three silver medals and each one 150 lire; five bronze medals. The Ministry of Agriculture will also purchase rewarded implements to the value of 1000 lire, for distributing them to the Agrarian Government deposits, practical and special agricultural schools. Exhibitors must apply for admission to the 'Direzione della R. Scuola di Viticoltura ed Enologia in Conegliano' not later than the 22nd February, 1886. The demand must contain a short description of the instruments and the price of each object which one wishes to exhibit. Italian and foreign inventors and makers or their representatives must present their machines to the model farm of the same R. School, for the 1st March, 1886. On the 2nd of March and following days will take place the trials and experiments of comparison, to which may assist proprietors and viticulturists. The jury that awards the prizes will present, within twenty days from the close of the Exhibition, special reports about the exhibited instruments, which reports will be printed in the *Bollettino di notizie agraric* of the Ministry of Agriculture."

Liverpool Engineering Society.—The usual fortnightly meeting of this Society was held at the Royal Institution, Colquitt-street, on Wednesday, December 9th, when the president, Mr. W. E. Mills, delivered his retiring address. After a few preliminary remarks, the author stated that he proposed to give a short review of the art of engineering, looked at in a threefold aspect:—(1) What it had been in the past. (2) What it is now in the present. (3) What it is likely to be in the future. In the first division, the engineering works of the ancient Egyptians were described, and the first faint indications of the use of steam power by Hero, of Alexandria. The aqueducts, roads, and fortifications of the Roman Empire followed, and their improvement, and the development of military engineering which took place during the middle ages, were next considered and illustrated. The advancement of the steam-engine from Newcomen to Watt was described in detail, and the achievements of Telford and Brindley, in designing and improving a system of roads and canals respectively, were recounted. The introduction of railways, the locomotive engine, and steam navigation, served to bring the first part to a conclusion. In the second division the various improvements in the steam engine, especially in its application to agriculture, and the design of structures, such as bridges and roofs of large span, were touched upon. The development of electricity in its applications for lighting and motive power was traced, together with its attendant inventions of the telephone, microphone, and photophone, while the extended use of hydraulic power received special mention. The third division was occupied with speculations on the probable nature of the future direction and scope of the various subjects treated of in the preceding. The conclusion of the address was devoted to considerations on the education best fitted for those who intend to become engineers. The want of technical schools throughout the country, of which Sir William Fairbairn had pointed out the necessity more than thirty years ago, was strongly commented upon, while the appointment of a Professor of Engineering at University College was regarded with much satisfaction as a step in the right direction, and all—especially students—were urged to avail themselves fully of the advantages offered by means of the classes and lectures now set on foot.

RAILWAY MATTERS.

THE Transcaspian Railway has been opened for traffic as far as Askabad.

THE extension of the interlocking of points and signals on the block system has made considerable progress on the Victorian railways. The Westinghouse brake system and the Wood system are to be permanently adopted. Wood's brake especially is to be used in mixed traffic.

DURING the six months that the Inventions Exhibition was open about 3,700,000 visitors passed the turnstiles, and the *South-Western Gazette* says that of this number one out of every hundred, or 37,000, travelled by the South-Western Railway, taking tickets which included admission.

THE new railway proposed by the St. Helens and Wigan Junction Railway Company will join the company's lines with those of the Cheshire Lines Committee, and affect Lowton, Haydock, Ashton-in-Makerfield, Windle, Eccleston, Knowsley, Kirby, West Derby, Fazakerley, Croxteth Park, Prescot, Heston, and Walton-on-the-Hill.

THE Salford Corporation Bill, now before Parliament, is another amending Bill of the Manchester Ship Canal Act, giving to the Corporation of Salford power to contribute towards the funds of the Canal Company and nominate one or more directors on the Board of the company, also empowering agreements between the corporation and the company.

FROM the latest returns to hand, we learn that the total number of passengers carried on the Rangoon Tramways since the opening in March, 1884, is 3,622,936. Only one accident has occurred, and that was of such a trivial nature that no compensation was claimed. Three cars are usually attached to each engine, conveying some 200 people. The average coke consumption is less than 9 lb. per mile.

THE American *Railroad Gazette* reports the construction of 128 miles of new railroad, making a total of 2258 miles thus far this year, against 3192 miles at the corresponding date in 1884, 5279 miles in 1883, 8731 miles in 1882, 6008 miles in 1881, 4946 miles in 1880, 2987 miles in 1879, 1777 miles in 1878, 1867 miles in 1877, 1931 miles in 1876, 1128 miles in 1875, 1594 miles in 1874, 3288 miles in 1873, and 6106 miles in 1872. The new track reported is still below that of any year since 1878, and appears likely to continue so until the end of the year.

AN electric tram-car with Mr. Reckenzaun's motor made its first appearance in Berlin on the 12th inst. with great success. The first trial run on the line to Moabit took place at night, in presence of the engineer and directors of the Berlin Street Tramways Company, and officers of the municipality and police. In spite of the unfavourable state of the road, the rails being choked with snow and ice, the car proved to be under perfect control, starting, stopping, and reversing at will, and passing the sharp curves and inclines with perfect ease.

ACCORDING to a recent report on Victorian railways, rates have been considerably reduced to give accommodation to agricultural, mining, building, and other industries, but it is worthy of note, in view of the introduction of a Railway Freights and Charges Bill in the United Kingdom, that the "equal mileage rate," so often demanded by our own Railway and Canal Traders' Association, has not stood the test of practice in the southern hemisphere. It has been found necessary to modify the scale, so as to enable the producer in the more distant part of the country to compete in the market.

ENTRANCE to the Victorian Government Railway service can only be attained by open competition. Four examinations have been held; at the last one there were 1780 applicants for 200 places. From the number of applicants about one-third are selected by ballot and are allowed to compete. Experience has shown that 41 per cent. of those examined satisfy the requirements. The right to pick the best men from the whole number of applicants was thus abandoned, but the Commissioners now state that the system has worked fairly well, and that the ballot, combined with subsequent competition, secures a fair average of ability.

ON the narrow gauge track between Paw Paw and Lawton, Mich., a telephone line has been constructed with the object of placing a moving train in communication with stations in either direction, or with other moving trains. One question had to be settled by trial, namely, whether the contact of a rod moving swiftly along the wire would be steady enough to transmit an even current. The working of the apparatus described proved satisfactory. American papers say conversation in the cars while running at a rapid rate was held with the stations on either side with no more difficulty than between two common telephone stations. It is reported that the Union Pacific officials are coming there shortly to investigate the workings of the apparatus, preparatory to putting it into use upon their road.

DURING the twelve months the North London Tramways Company's steam line has been opened for traffic, there has not been, we are told, a single accident on the road, although a large number of carts drawn by two or four horses are continually passing along to and from Covent Garden Market and Enfield, the drivers frequently being asleep. In fact, the horses gradually get so accustomed to the engines that they move off the line as soon as they hear the bell ring. The average consumption of coke is 9 lb. per mile. The line has been extended from Seven Sisters'-road, and the engines have given such satisfactory results that ten new ones are to be ordered, making twenty-five in all. This line when worked by horse power was, we believe, always worked at a loss during winter, but since steam has been introduced a profit has, we are informed, been realised.

IN reporting on the accident which occurred on the 24th August at Larbert Junction, on the Caledonian and North British Railways, Major-General Hutchinson says:—"This accident was, in all probability, the result of the fracture of the steel crank axle of the engine drawing the train. The axle had certainly done good work, having run over 210,000 miles, nearly double the number of miles—120,000—which are stated in the 'Minutes of the Institution of Civil Engineers,' vol. xxx., to represent the average life of a crank axle, and 24,000 miles more than the average mileage of the forty steel crank axles which broke in the nine months ending 30th September, 1885. It is, he thinks, a grave question whether it is wise to continue to run crank axles after their mileage has reached a certain amount—to be fixed after careful consideration—especially in the case of steel axles, which often give such little warning before fracture."

OF the 640 tires which failed on our lines during the first nine months of this year, 13 were engine tires, 9 were tender tires, 2 were carriage tires, 12 were van tires, and 604 were wagon tires; of the wagons, 446 belonged to owners other than the railway companies; 568 tires were made of iron and 72 of steel; 19 of the tires were fastened to their wheels by Gibson's patent method, 6 by Mansell's, and 2 by Beattie's, none of which left their wheels when they failed; 604 by bolts or rivets, 2 of which left their wheels when they failed, and 9 by other methods, one of which left its wheel when it failed; 21 tires broke at rivet-holes, 4 at the weld, 89 in the solid, and 526 split longitudinally or bulged. Of the 269 axles which failed, 158 were engine axles, viz., 132 crank or driving, and 26 leading or trailing; 11 were tender axles, 4 were carriage axles, 93 were wagon axles, and 3 were axles of salt vans. 40 wagons, including the salt vans, belonged to owners other than the railway companies. Of the 132 crank or driving axles, 92 were made of iron and 40 of steel. The average mileage of 91 iron axles was 221,487 miles, and of 40 steel axles 186,352 miles. Of the 206 rails which broke, 103 were double-headed, 94 were single-headed, 8 were of the bridge pattern, and 1 was of Vignoles' pattern; of the double-headed rails, 56 had been turned; 39 rails were made of iron and 167 of steel.

NOTES AND MEMORANDA.

IN London, last week, 2504 births and 1474 deaths were registered.

IN Greater London, 3292 births and 1857 deaths were registered last week, corresponding to annual rates of 33·0 and 18·6 per 1000 of the population.

IN a well-known engraving and litho-zincographing establishment, where electric lights are largely used for photographing, the gas is often lighted by simply holding a piece of wire from a speaking tube to gas burner or from another gas pipe to gas burner.

M. ROTONDI, according to a paper in *Dingl. Polyt. J.*, cclvii. 210, finds that fats may be saponified by means of sodium chloride, by passing an electric current through the solution, and using suitable electrodes. The products obtained are soap, glycerol, and free chlorine.

M. FAYOL concludes that the absorption of atmospheric oxygen by coal-dust usually produces the rise in temperature to which spontaneous combustion is due. He finds that lignite is ignited at the low temperature of 300 deg., anthracite at 575 deg., and other varieties of coal, in powdered form, at intermediate temperatures.

THE deaths registered during the week ending December 12th in twenty-eight great towns of England and Wales corresponded to an annual rate of 20·3 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 Bradford, Brighton, Leicester, Sunderland, Bristol, and London.

THE casualties at sea during the years 1883-4 resulting in serious damage arising from the same causes were as follows:—Through defects, 37; errors, 96; weather, 380; breakdown of machinery and explosions, 138; other causes, 78; while the cases of minor damage were—through defects, 115; errors, 190; breakdown of machinery and explosion, 113; stress of weather, 909; and other causes, 217.

IN a paper on the "Elementary Analysis of Gases by Combustion," by A. Ehrenberg, given in abstract in the *Journal of the Chemical Society*, it is said that mixtures of gases containing oxides of nitrogen, and therefore not giving good results on eudiometric analysis, yield satisfactory results as regards the percentage contents of carbon, hydrogen, and nitrogen, if burnt in the usual way for nitrogenous substances. The author figures and describes a gas pipette especially designed for the measurement and transference to the combustion-tube of such gaseous mixtures or substances.

THE Trieste papers give accounts of a very interesting though startling occurrence at the beginning of this month at the little village of Grahovo, near Fiume. The following might be advantageously supplemented by more definite particulars:—"At eight o'clock in the evening the people felt the ground slipping away from under their feet, and cracks began to appear in the walls of the houses. Those who were indoors rushed out, taking with them whatever they could carry, and thus no life was lost. About midnight a great moaning sound was heard from underneath, while the ground continued to slide away slowly. This, mingled with the sound of the falling houses, created great terror among the inhabitants. Next morning only two houses were still standing, and the sliding of the ground continued during great part of the day, varied by clefts in the soil and dull detonations."

THE total output of steel and ingot iron made from phosphoric pig by the Basic or Thomas-Gilchrist process during the twelve months ending September 30th, 1885, amounts to 945,317 tons, being an increase of about 10 per cent. upon the make of the previous twelve months. Of this year's make no fewer than 600,183 tons were ingot iron, containing under 0·18 per cent. of carbon, and were used in the manufacture of wire, tin-plates, tubes, sleepers, boiler and ship plates, &c. The makes of the various countries included under the above gross total were:—England, 145,707 tons; Germany and Austria, 617,514 tons; France, 130,582 tons; Belgium and other countries, 51,514 tons; total, 945,317 tons. Out of the foregoing England made 70,813 tons containing less than 0·18 per cent. of carbon; Germany and Austria, 424,862 tons; France, 62,390 tons; and Belgium, &c., 42,118 tons, giving the total of 600,183 tons.

IN an article on "The Use of Oil at Sea," by Lieut. John P. Holditch, R.N.R., the author says:—"The results I have obtained are these. Fish or colza oil only is of any good, it does not matter how dirty it is, as long as it is not thick. Paraffin is too thin; paint oil too thick. Running before a gale naturally expends much more oil than 'laying to,' you have so much more water to oil. Carefully expended, one quart in three hours for running, one pint in four hours for laying to, will be sufficient. The means I used was a canvas bag (No. 6) with large holes stabbed with a needle. I have heard of a bundle of oakum being saturated with oil, and then put in a coarse gunny bag, which I think would admit of a thicker oil being used for the time. The place for towing is undoubtedly forward, not aft. Whether in head-reaching oil could be used successfully I cannot say, but I doubt it. When running dead before the wind tow from each cathead, and the ship is as safe as anything can be at sea."

THE usual nonsense about priority of invention has attacked the incandescent lamp. It is claimed for Belgium that in 1838 Jobard, of Brussels, proposed as a source of light a small carbon in an exhausted receiver, and rendered luminous by means of an electric current. De Chanzy, in 1844, repeated these experiments, and patented the divisibility of the electric light. About the same time Starr, of Cincinnati, constructed a lamp with a platinum wire, which King afterwards replaced by a filament of carbon. Staite employed iridium in 1848, and in 1859 Du Moncel indicated the different tissues that, when carbonised, gave the best effects of incandescence. Finally, M. Somzee, on November 5th, 1879, obtained a patent in which, it is claimed, are given all the essential conditions for the glow lamp as now known, as to the kind of carbon employed, the form and section of conductor, the means for its preservation, and the nature of the receiver or globe. It is always the case when a man succeeds in overcoming the practical detail difficulties that your men of generalities come forward and say the *same* thing was done by so-and-so, though it's rarely true.

IN a paper on the "Relation of Expansion of Substances in the Gaseous, Vaporous, and Liquid States to Absolute Temperature," by C. Schall—*Ber.* xviii. 2063-2067—the author says that, according to the molecular theory of gases, the relation of pressure, volume, velocity of molecule, and absolute temperature, is expressible thus: $\frac{p}{p'} = \frac{v}{v^1} = \frac{u^2}{u'^2} = \frac{T}{T'}$, supposing Mariotte's law to be rigidly exact. But gases are far from being ideally perfect, especially near their points of condensation; for the vapours of liquid, when superheated, have a higher coefficient of expansion than perfect gases, and the above relations are expressed by the formula $\frac{d}{d'} = \frac{v_1}{v} = \left(\frac{T_1}{T}\right)^2$ or $d' = d\left(\frac{T}{T_1}\right)^2$. However, this can only be considered as an approximation, inasmuch as vapours near their liquefaction point quickly decrease in volume up to a certain temperature, and from thence more slowly decrease. In this paper this last point is more particularly illustrated, especially in the case of liquids which dissociate either into heterogeneous or less complex molecules at temperatures slightly above or at their boiling points—such as acetic and formic acids, halogen-derivatives of paraffines, &c. Again, if perfect gases expand according to the first of the above equations, and superheated vapours according to the second, then the increase of volume of liquids is approximately represented by the formula $\frac{v}{v_1} = \left(\frac{T}{T_1}\right)^{\frac{1}{3}}$, which is illustrated in the case of phosphorus trichloride—Comp. Mendeléeff, Trans., 1884, 126-135; Thorpe and Rücker, *ibid.*, 135-144.

MISCELLANEA.

IT appears that the serious lift accident in Birmingham was due entirely to the action of the eleven men who rushed into what was merely a light goods, or 10 cwt. lift.

SEVERAL gangs of men are now engaged in digging trial shafts in Cheshire along the line proposed to be taken by the Manchester Canal between Eastham and Runcorn. The engineers are staking out the course of the canal through Cheshire.

MR. FRED. W. BREAREY, F.S.Sc., Hon. Sec. of the Aeronautical Society of Great Britain, has been commissioned by the executive of the Liverpool International Exhibition to aid them in organising an Aeronautical Exhibition in connection therewith, for the opening in May, 1886.

A COPY of the City Diary and Almanack for 1886 has reached us. It is a very handy little octavo diary with a week on a page, and containing a good deal of information of the usual diary guide kind, added to information concerning City affairs and institutions which is not to be found in other diaries.

THE transfer of the works of the Blackpool Water Company is to be provided for by the Blackpool Improvements Bill, enabling the Corporation to carry on the business of the company, and to supply good water, in addition to the district supplied by the company, to Marton, so far as it lies in the parish of Poulton-in-the-Fylde.

THE contract for making the reservoirs for the Cardiff Corporation in the Taff Valley has been given to Mr. Jones, who, in connection with Mr. Upson—Jones and Upson—has done good work in the district. The question of conveying materials will be one of importance, and it is suggested that either a short railway or a tramway along the highway will be imperative.

TELEPHONIC communication between Paris and Rheims has been opened to the public. The distance is 172 kilos., but the electric resistance to be overcome between the two points is estimated at 217 kilos. The ordinary telegraphic wire is utilised for the purpose, but there is a special telephonic station in the Plain of St. Denis, at the Pont de Soissons. The tariff is one franc for five minutes' conversation.

THE Manchester Ship Canal Bill will raise again the principle which has already been so much discussed in both Houses of Parliament as to the advisability of permitting companies to pay dividends out of capital. It is proposed to ask for this power—which, it will be remembered, was granted this year in the case of the Regent's Canal scheme, after, however, some debate and several divisions—in connection with the Manchester Ship Canal.

THE awards of the international juries of the Inventions Exhibition have been published, "Confirmed and issued by the Jury Commissioners;" but as the revised awards are not indicated, we must refer our readers to the pamphlet. It is not clear what is meant by the word "confirmed" in the above quoted sentence, inasmuch as the Jury Commission was appointed to reconsider the awards, and did revise a large number of the obviously unfair, and some of the glaringly unjust awards.

AT the last meeting of the Metropolitan Board of Works, a report was presented recommending "That the committee be authorised to expend a further sum of £3260 in respect of the deodorisation works for the treatment of sewage in progress at Crossness Pumping Station. That 2000 tons of manganate of soda and 1000 tons of sulphuric acid be obtained for the purposes of deodorisation and treatment of sewage next year, and that an advertisement be forthwith issued inviting tenders for the supply of those quantities; and also for the supply, under the authority of the preceding recommendation, of 100 tons of caustic soda; and that the tenders be opened at the meeting of the Board on the 8th of January, 1886." It was stated that the chief engineer and chemist to the Board had reported that, in pursuance of the experiments which had been carried out at the sewage outfalls at Crossness, 494 tons of solid matter had been pressed from the sewage, of which quantity 183 tons had been taken away by those to whom it was given, at their own cost, and 128 tons had been used in burning and other experiments, there being left at the pumping station at the present time upwards of 180 tons. The recommendation was agreed to.

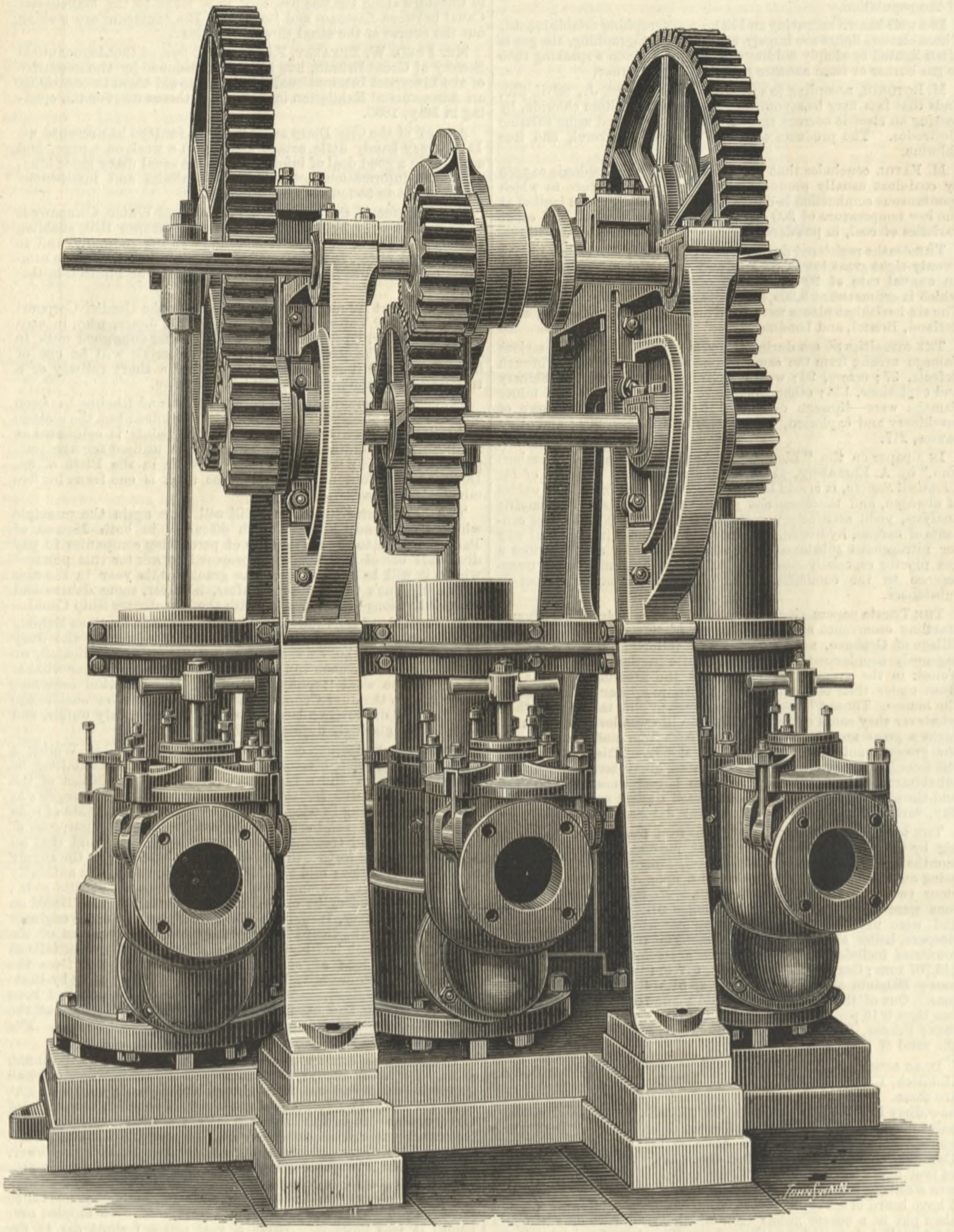
THE following concerning the electric light towers of Savannah is an interesting record of the permanent character American electrical engineers seem to think it necessary to give their light towers. The high electric light tower at the intersection of Liberty and Habersham-streets, says the *Savannah News* of November 16th, fell with a tremendous crash at six o'clock last night. The fall was caused by a runaway mule striking the tower. No one was hurt. The towers were put up about three years ago. They are anchored in a foundation of brick and cement, and were considered very strong. This tower is the third one that has fallen in Savannah. One at Huntingdon and Price-streets toppled over before it was finished. About a year ago a freight car in the Central Railroad yards jumped the track and crashed against the tower by the passenger shed, bringing it down. Two or three of the structures are 185ft. high. They are ascended by an automatic elevator, which, when not in use, is kept locked a few feet above the ground. Some months ago a painter who had been coating one of the towers got out of the elevator cage before fastening it. The cage at once started for the top, gaining in speed the higher it went. When it struck the top platform the whole top was broken off. Not long ago a tower in Macon was knocked down by a mule.

THE annual meeting of what has hitherto been known as the Manchester Association of Employers, Foremen, and Draughtsmen, but which by special resolution passed at the above meeting, the members have decided shall in future be designated as the Manchester Association of Engineers, was held on Saturday at the Grand Hotel, Manchester. Alderman W. H. Bailey, C.E., the president of the Association, who occupied the chair, was unanimously re-elected to fill the office of president during the ensuing year, and, in briefly thanking the members for the honour they had conferred upon him, said the office of president of that society was a position of which any man ought to be proud. Amongst their members was the Mayor of Salford, and two others—Messrs. Mather and Peacock—had been elected members of Parliament. During the past twelve months the society had made most gratifying progress; they had had a greater accession of members than during any previous year; financially they were also in a better position than at any former period, and in every respect the society was stronger and healthier than at any time during its existence. With the re-election of Mr. Alderman Bailey as president, Mr. Thos. Ashbury, C.E., remains the past-president, and the remaining offices were filled up.

THE *Electrical World* makes some remarks on secondary batteries, which are, to a great extent, true also in this country. It says: "There has for some time been very little activity manifested here in the domain of the storage battery, and this seems all the more strange in view of the progress which had been predicted to take place. It would appear, however, that this is only the calm preceding the tempest, for we understand that a powerful syndicate has taken up the subject, and judging from the stamp of the men included in it, great things are in store for the 'storer.' It would be premature to announce anything definite, but we are informed that active preparations are now being made for a thorough working of the accumulator field, and by men who have made their mark in other electrical enterprises. The storage battery in the past has perhaps suffered most at the hands of its friends in predicting too much and too early. As a consequence, the true performance of the cell, being behind the predictions, has caused it to be looked upon with distrust. We regret the weakness of some interested men who make statements regarding the application and power of storage batteries knowing them to be untrue. It is such men who undermine public confidence, and one failure due to them is scarcely remedied by a dozen successes of more conservative workers."

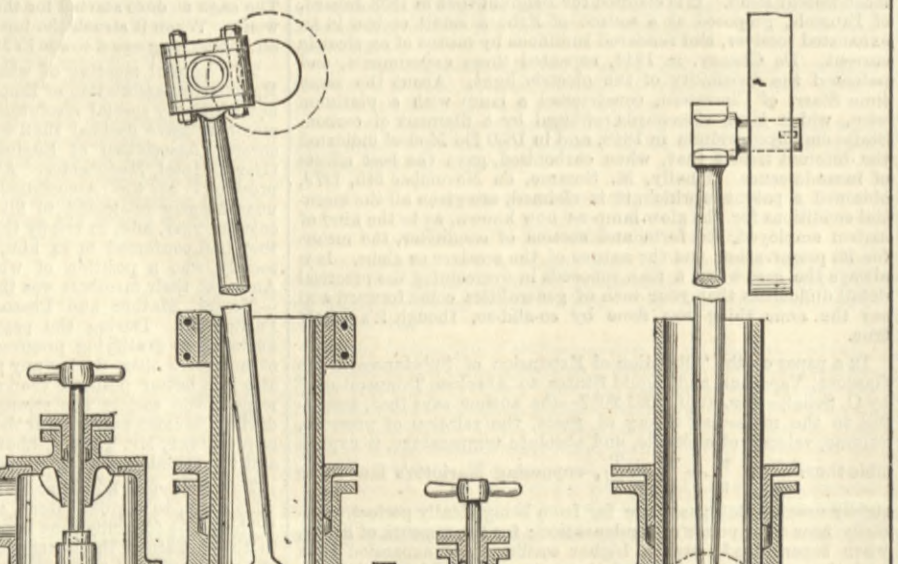
LARGE THICK SLURRY PUMPS.

MR. A. H. BEASLEY, UXBRIDGE, ENGINEER.



BEASLEY'S LARGE THICK SLURRY PUMPS.

The accompanying engravings show a massive set of three-throw thick slurry pumps designed and made by Mr. A. H. Beasley, engineer, of Uxbridge, for Messrs. Coles, Shadbolt, and Co., Portland cement manufacturers, of Harefield and Caledonian-road, London. They are of very massive construction, designed to work at a pressure of 120 lb. per square inch. They stand on very heavy bed plate, the bed plate having raised flanges with pockets cast in, as shown, to carry the holding-down bolts of the pump barrels and also for the A frames, thus enabling bolts to be used instead of studs. The plungers are 13in. diameter, 12in. stroke, working through steadying brackets bolted to the A frame, the centre bracket thus connecting the frames together as shown. The connecting rods are of forged scrap iron 3in. in diameter. The main shaft is of steel 6in. diameter. The bearings, which are of gun-metal, are all made of unusual length, and the valves are of a new construction, and made so that they may be seen at work and of easy access, the covers through which their stems pass being fitted with hinged bolts turning on a pin as shown. These pumps stand about 10ft. in height, and the whole weight is over 10 tons. They are capable of pumping fifty cement tons of slurry, equal to about 150 tons liquid slurry, in about three hours driven at the slow speed of eight strokes per minute, and have given great satisfaction. The plunger guides are of the full size of the plungers, thus giving large wearing surface. The caps of the bearings of the pinion shaft are made specially light, so that in case of anything getting between the gearing the caps may give way in preference to anything else. It is particularly noticeable that the pumps are used for pumping thick slurry from the backs into the drying chambers.



STEVENS' RAIL FASTENINGS.

The fastenings illustrated by the engravings below have been made by Mr. F. W. Stevens, Exec. Eng., and are being tried on the Great Indian Peninsula and the Bombay and Baroda Railway. In the place of the ordinary wedge Mr. Stevens uses a cast iron box in two pieces. In Fig. 1 is the elevation of the cast iron box on the right-hand side, and E, a wrought iron split wedged key. The box is divided into two parts, the inner part having one tooth on the top, and the outer part having two teeth on the top, the former working into the latter, as shown in Figs. 2, 3,

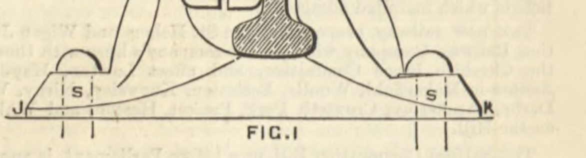


FIG. 1

and 4. The two outer teeth project slightly on the upper outer side, and rims are placed at the sides to secure the box from sliding laterally. The space between the two rims is about $\frac{1}{8}$ to $\frac{3}{16}$ of an inch wider than the width of the jaw of chair, to

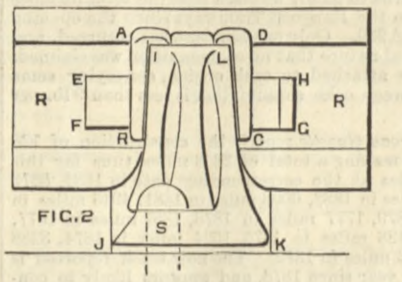


FIG. 2

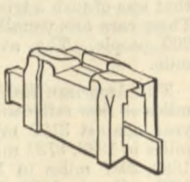


FIG. 3

ensure the box keys fitting all chairs, which are supposed to be of one pattern, but which vary in size by that amount. The outer part with two teeth, Figs. 3 and 4, is made to slope and fit the profile of the jaw of the chair; the inner portion of box at

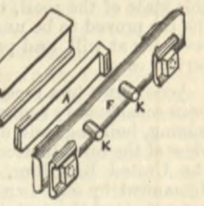


FIG. 6

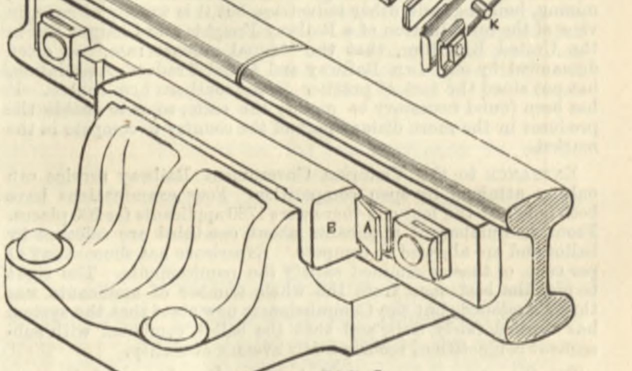


FIG. 5

bottom has a fillet on each part, and the interior of the box is wedge-shaped longitudinally to take the wrought iron key, which is split up about one-fourth of its length, and which is also wedge shaped to fit the box, as shown in Fig. 3. The box

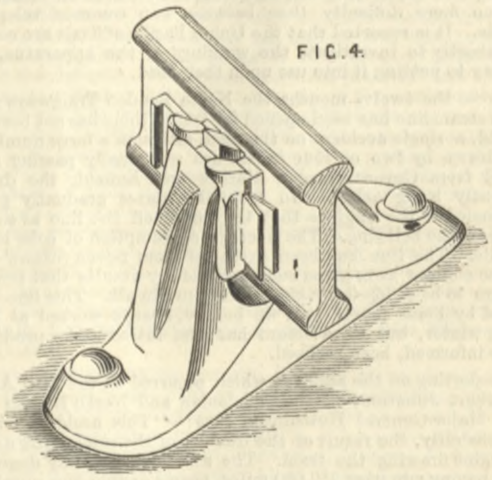


FIG. 4.

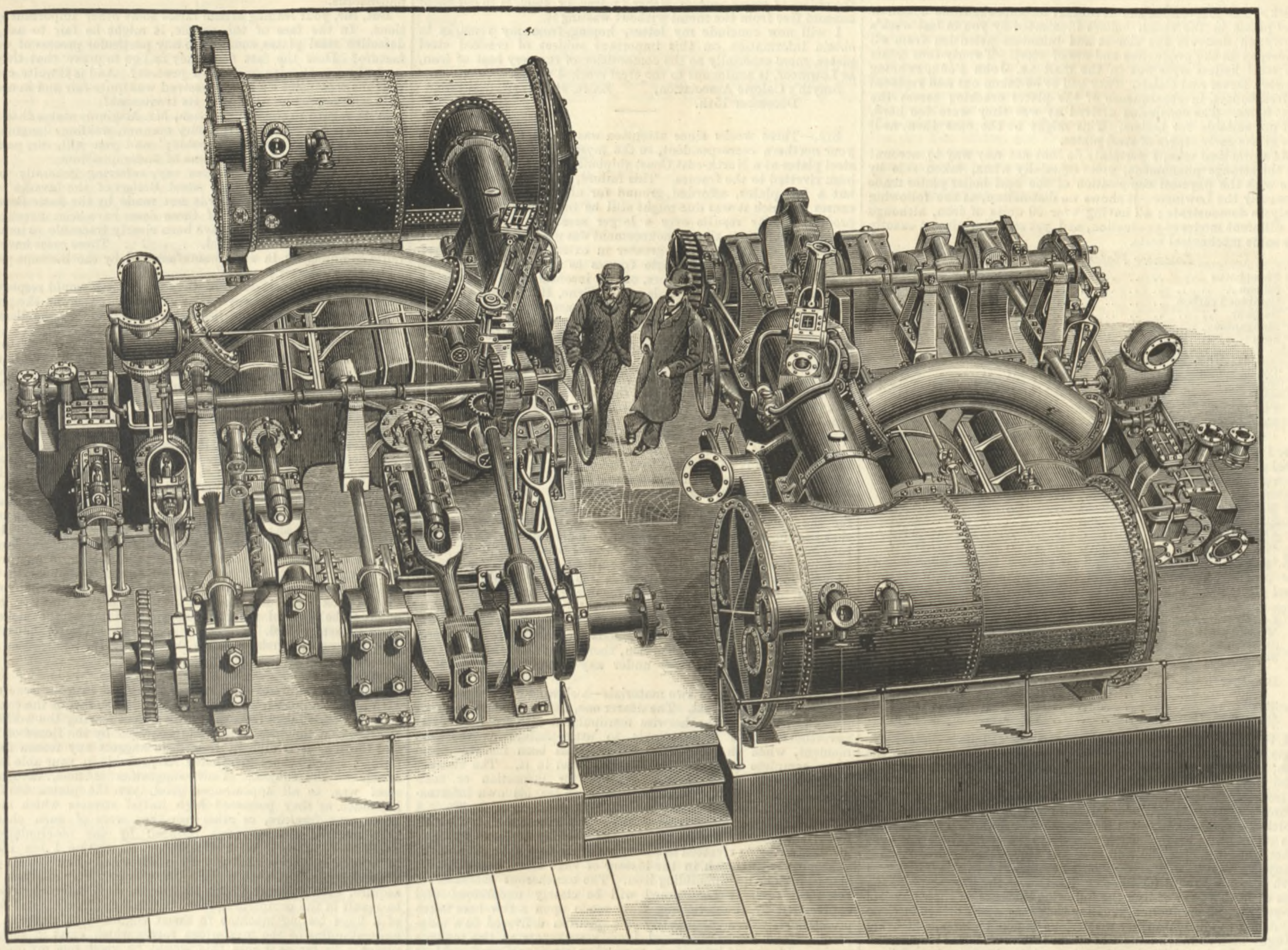
is placed between the chair and rail, after which the wedge or key is inserted and driven "home," and the split end of the same opened about half an inch, making the whole secure. An alternative form is the cast iron block piece for connecting rails, shown at Fig. 4, as employed as a joint chair, but the same form is used in a small width for ordinary purposes. Fig. 6 shows the fish plate with steel stud pins screwed and rivetted in, the block, and the key.

The Late Sir William Siemens.—A biography of this eminent man is being prepared at the desire of the executors by Dr. William Pole, F.R.S., Honorary Secretary of the Institution of Civil Engineers, and author of the Life of Sir William Fairbairn, Bart. Dr. Pole will be grateful for the loan of any of Sir William's letters or for any information of importance. Address, Athenæum Club S.W.

A Large Torpedo Boat.—A large torpedo boat of a distinctly new type, having rotating conning towers, to each of which is attached a couple of Whiteheads, and built by Thornycroft and Co., has just been tried for speed at Portsmouth. She is 125ft. long, the largest torpedo craft of the kind received, and is one of the fifty first-class torpedo boats ordered by the Government from Messrs. Thornycroft, Messrs. Yarrow, and Mr. White, of East Cowes. Some slight defect in the steering gearing, which caused the double rudder to jam, arrested the trial for endurance, but the runs on the measured mile were completed, the mean of six giving the extraordinary speed of 20·9 knots per hour. As soon as the defect has been remedied the boat will be driven continuously for six hours for the purpose of ascertaining the amount of fuel consumed per hour with the engines working at full power.

TWIN SCREW ENGINES OF H.M.S. SCOUT.

MESSRS. J. AND G. THOMSON, CLYDEBANK, ENGINEERS.



ENGINES OF H.M. TORPEDO CRUISER SCOUT.

These engines were constructed by Messrs. James and George Thomson, of Clydebank. They are two independent sets driving twin screws. They are each two cylinder compound, working with 120 lb. boiler pressure. The diameters of the cylinders are 26in. and 46in., and the stroke 30in. The framing throughout is of cast steel, the only cast iron in the engines being the cylinders. The liners are made of fluid-compressed steel. The shafting throughout is of steel. The valves are all of the piston type, and we believe these are the first engines which have been made for H.M. service in which flat valves have been entirely dispensed with. The condensers are made of rolled brass. The air pump is the only auxiliary worked from the main engine. The circulating, bilge, and feed pumps are independent.

These engines developed on the official trials under natural draught a mean indicated horse-power of 2150 for four hours. The revolutions were 138, and the steam pressure 112 lb. Under forced draught, when running at 158 revolutions, 3600 I.H.P. were developed, and the mean of four hours' run gave 3350 indicated horse-power. The boilers are four in number, of the Navy type, each having three furnaces. The total grate surface is 204 square feet, and the horse-power per square foot of grate reached 17·6 times, and was for four hours at a mean of 16·4 times. The total weight of machinery and spare gear is 300 tons, which is more than 11-horse power per ton of weight, or about 1·8 cwt. per indicated horse-power. This is about twice the amount of power which ten years ago could be developed per ton of weight. We believe that for Admiralty seagoing ships this result has not been surpassed.

Messrs. Thomson have six sets for six other vessels of the Scout class building, in which it is anticipated that these results will be surpassed. Our engraving has been prepared from a photograph taken from a gallery in the erecting shop, so that it presents nearly a bird's-eye view.

THE DETERIORATION OF BOILERS.

Some remarkable cases of corrosion and deterioration of boiler and fire-box plates have lately come under our notice, and a brief account of some of these cases may be of interest to our readers.

A locomotive boiler, built seventeen years ago, had been for some time employed in a forge supplying steam to the heavy steam hammers. When the boiler was finally broken up, the plates were tested to ascertain whether their strength had diminished by use. The dome plate, on being flattened out for testing, cracked through the rivet holes of the dome ring, and proved to be quite brittle, the fracture being wholly crystalline, with no trace of fibre. The dome is believed to have been originally made of good Sligo iron, and was therefore originally fibrous, and has doubtless been crystallised by use. The crystallisation has probably been produced by a combination of causes giving a frequent variation of strain on the metal. Crystallisation is very frequently found in structures having frequent and considerable changes or reversals of strains, such as members of bridges, axles, &c. In such cases crystallisation appears to be the natural effect of known causes, and does not excite surprise; but the strains on the shell of a boiler are tolerably steady, and vary little in amount or direction during working hours, and any increase of pressure must be more gradual than the sudden application of a load on a bridge caused by the passage of a fast train. Cases of brittle plates in old boilers may generally be assigned to the use, in the first instance, of bad material. This, however, is believed not to be the case in the present instance. The crystallisation, therefore, is probably caused by the vibrations due to the working of the hammers, being concentrated at the junction of the heavy dome ring and the dome plate. The pressure of steam in forge boilers is liable to considerable fluctuations, the working of the hammers consuming a considerable quantity of steam in a short space of time, and then rapidly reducing the pressure, which, of course, rises again when the hammer stops working. These fluctuations in pressure may have assisted the crystallisation of the metal. When employed in the forge, the boiler was worked at a moderate pressure, about 60 lb. per square inch, and even though the iron in the dome was brittle, the weakest point of the boiler was probably elsewhere, where the plates had suffered from corrosion. The dome, as usual with plates in the steam space, retained its original thickness.

A more unusual and instructive case of the deterioration of boilers was shown by the lower corner of an inside locomotive fire-box. The side of the plate exposed to the water was still covered with the black scale—magnetic oxide of iron—and was coated in places with a thin incrustation from the water used. No corrosion was visible on this side of the plate, but on the side exposed to the fire the plate was nearly eaten through, especially against the mud ring. The heads of the mud ring rivets appear to have protected the plate, but between the heads of these rivets the plate was eaten nearly through. As this action was worst at the level of the mud ring, and therefore below the action of the fire, it was evidently not caused by the fire, but by ashes being allowed to lie against the sides of the box, especially at the corners where they could not be easily got at. This case shows the importance of having the ashes thoroughly removed, especially where they are washed out of the ash-pan and grate with a hose. In such a case, the damp ashes left in contact with the fire-box plates soon prove very destructive.

In examining old locomotive boilers it will often be found that a deep horizontal groove or furrow is found on the waterside of the fire-box plates just above the mud ring. This groove is generally most marked near the corners of the box, but in some cases will be found in isolated spots the whole length of the plate close to the mud ring. It appears probable that these grooves are caused in the first instance by the action of the cleaning rods, which scratch the surface of the plate. The freshly exposed metallic surface rusts, and as the plate bends under pressure, the scale of rust is detached, and this operation being repeated every time the boiler is washed out, or say 200 times in five years, the plate is ultimately half worn through. The bend in the plate starts naturally just where the strength or stiffness to resist a bending action is suddenly greatly diminished, in this case just above the mud ring.

Careful measurement on one of our trunk roads has shown that some of the long fire-boxes with water-tube grate have widened ⅝in. in service. This widening is greatest in the centre of the length of the box, and diminishes to nothing at the corners. This bulging affects the mud ring equally with the sides of the box. It is difficult to assign a cause for this deformation, and it would be interesting to know if a similar change of form has been noticed in similar fire-boxes elsewhere.—*Railroad Gazette.*

Floating Irrigating Plant.—The *Eshuca and Moama Advertiser* thus describes the trial of the Floating Irrigation Plant:—"Mr. Wentworth, owner of Burrabogie and Uardry stations, on the Murrumbidgee river, a few miles above Hay, having come to the conclusion that he would have to place water by artificial means upon his land, decided to have a floating plant constructed, and accordingly had plans of a barge and machinery prepared in England and sent out to this colony. On the arrival of the plans for the barge experts at once pronounced them unsuitable, and Mr. Whitehead, of Echuca, expressed an opinion that a vessel of much stronger proportions would have to be built to carry such a powerful pumping plant, and his suggestions as to strengthening the vessel were duly carried out. The original plans provided only for bilge keelsons and an ordinary floor, but six additional keelsons were put in the boat, the main or centre keelson being 9in. by 10in., and the sister keelsons 7in. by 7in.; diagonal beams 8in. by 7in., strapped with 3in. by 5in. flat iron from top to bottom, were also added, and it is now seen that these additions were very necessary. Messrs. John and Henry Gwynne, of Cannon-street and Hammersmith, London, who have achieved the greatest successes in the construction of irrigating plants, were selected by Mr. Wentworth as the makers of the boiler, engines, and pump. The work of fitting up the machinery in the barge was placed in the hands of Mr. Whitehead, and this having been completed, a public trial of the plant was made in the dock, in the presence of about one hundred persons. The engines, which are made to run at a maximum speed of 350 revolutions per minute with 100 lb. pressure of steam, were tested with 95 lb. of steam on October 2nd, which resulted in 320 revolutions per minute, and the throwing of a volume of water of 12,000 gallons per minute, equal to about 50 tons, a height of 10ft. The engines are on the compound inverted principle, and the high-pressure cylinder is 8½in. in diameter and the low-pressure cylinder 14in., the engine stroke being 12in. The boiler is of the locomotive type, and capable of carrying 130 lb. of steam. The centrifugal pump is 15in. in diameter, and possesses all the latest improvements, being fitted with ejector, sluice valve, and suction grating, and it is guaranteed to throw 5000 gallons—about 22 tons—per minute to a height of 30ft. The plant will not always remain at one spot in the river, but will be removed to several different sites if found necessary, but at one high spot, situated on Uardry station, where the most water will be required to irrigate a cultivation area of some 10,000 acres, a set of cast iron pipes with junction pieces fitted to each length will be laid down from the top of the bank to below the lowest level of the river, so that by means of flexible piping, which can be attached to any of the junction pieces, the irrigation can be carried on at any level of the water. Should it be found necessary to fill tanks or dams any distance away from the site at which the cast iron pipes will be put down, the plant can be removed, and flexible piping will be laid from the top of the bank into the water, and the water, which will thus be raised, can be conveyed along channels to any part of the property."

The New Sewage Pumping Machinery designed and constructed for the Twickenham Local Board by Messrs. Hayward Tyler and Co., of London, started with entire satisfaction a few days ago. This engine is arranged to raise one million gallons of sewage matter per day 55ft. high, and is intended as an auxiliary to the two pumping engines with treble vertical plunger pumps, erected by the firm about six years ago, which have worked with perfect success. In the present engine the arrangement is horizontal, the steam cylinder, pump, and condenser being all in line. The pump valves are similar to those which have proved so satisfactory in the existing engines. The horizontal arrangement has been adopted in this case as less expensive than the vertical plunger pumps, but in the former engines it was necessary to adopt the more costly system owing to the distance of the engines from the water level. Messrs. Hayward Tyler and Co. are now building a pair of sewage pumping engines of precisely similar arrangement to the one just started at Twickenham for the Luton Corporation. In this case the quantity to be raised is 1½ million gallons daily to a height of 200ft.

LETTERS TO THE EDITOR.

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

THE PECULIARITIES OF STEEL.

Sir,—The marvellous and at present incomprehensible action of steel plates in the steam boilers illustrated by you in last week's Engineer deserves the closest and minutest attention from all concerned in the production and use of steel. Twenty-four years ago steel boilers were put in the mail s.s. John Penn, running between Dover and Calais. They had to be taken out and replaced by iron boilers, in consequence of the plates cracking across the rivet holes. The conclusion arrived at was they were too hard, and not suitable for boilers. This might be the case then, as it was in the early stages of steel plates.

As a practical man, I certainly do not see any way to account for the strange phenomena, more especially when, taken side by side with the physical composition of the best boiler plates made—namely the Lowmoor—it shows no distinction, as the following analyses demonstrate; all having over 99 units of iron, although by different modes of production, and yet standing almost exactly the same mechanical tests.

Lowmoor Plates, Wrought Iron.

Phosphorus	0·106
Silicon	0·122
Combined carbon	0·016
Sulphur	0·104
Manganese	0·280
Iron	99·372

West Coast Hematite Plate, Wrought Iron.

Combined carbon	0·190
Silicon	0·074
Sulphur	0·010
Phosphorus	0·091
Manganese	trace
Iron	99·533

No. 1 analysis is from The Engineer, December 11th, of cracked steel plates in the boiler.

Carbon	0·125
Silicon	0·005
Manganese	0 320
Sulphur	0·051
Phosphorus	0·060
Iron	99 449

I tabulate the units of iron and carbon, for the consideration of the practical producer, for him to solve the question of cracked steel plates:—

	Iron.	C. Carbon.
Lowmoor best iron plate	99·372	0·016
West Coast best BB plate	99·533	0·190
Steel from cracked plate	99·449	0·125
Siemens mild steel	99·352	0·280
do. do.	99·465	0·196
Bessemer do.	99·285	0·298
do. do.	99·596	0·235
Styria do.	99·579	0·164
Dannamora iron—bars	99·569	0·104

I think, judging from these analyses, it will be a difficulty to state which is really steel or which is really iron. Such being the case, how is it possible to account for the action of the cracked steel plates, or steel plates formed almost of exactly the same unit of iron and metalloids as the iron plates of tried quality?

Steel, what is it? A name given to an alloy whose base is iron, which has compounded with it various other materials for which it has an affinity, or for which the alloys have affinities for each other, thus altering the nature of the base, thereby producing so many grades or qualities of steel, whose broad name is "iron." I with pleasure submit for the consideration of the producer and the user of both steel and iron the following remarks on their physical properties and production, trusting they may assist others in these industries to elucidate these mysterious cracked plates, which are fraught with so much danger in steam boilers on board ship:—

I deal with iron in its liquid state, and, in the first place, I have no doubt iron obeys the same laws as any other liquid in its molten or liquid condition under the action of heat, and could it be possible to boil it up from its bottom, as in a still, it would take its heat by convection; that is, as the atoms or globules receive their heat and expand, they are forced up to the surface by the more condensed globules, atoms, or whatever name it may suit to call them, the colder ones taking their place, and, on receiving their modicum of heat, they ascend likewise, thereby purging the metal and refining and breaking up its atoms by its own gravity and heat. This action takes place in the crucible process. Its action may also be seen on the surface of a large ladle of metal cleared of its slag, as on the surface is collected the slag which is being purged or forced to the surface by the colder or denser atoms at the surface falling to the bottom of the ladle. It is this operation which produces the soundest part of any casting, whether it be an ingot or an iron casting. The bottom parts are always the densest and soundest.

For large quantities of metal it has not been possible to get a still or crucible large enough, or with refractory material strong enough, to boil up the metal. To distil over its lighter metalloids, recourse has been had to invention, and this has been effectually carried out with a still having holes in its bottom, where the operations of a still are carried on as in a converter, with the difference that the metal is directly heated, the consequence being whatever is forced into and through the liquid metal becomes a part of the metal itself. Could it be possible to make a charge of metal transparent as water, it would show, like water, when a drop of colouring matter is dropped into it, as ink, by the blending or mixing of the matter added, and in my opinion the addition of any element to liquid iron acts exactly the same; and in the treatment of the metal in a converter by the oxidation of its metalloids, the oxide of all the metalloids in the metal are distributed between its atoms, and it is in accordance with the nature of, or of the preponderance of, any one of them, the difference in the same metal occurs not so much in themselves as by and in their combination with oxygen.

It is this great element "oxygen" which is the master of all matter. It devours or combines in different ways, and in shorter or longer periods, in accordance with the density of the material acted upon; by its oxidising everything it comes in contact with, as is the case with a charge of molten iron, the oxygen combines with it, it is its greatest affinity, and so long as any oxygen, which forms an oxide between the atoms of the metal, remain, so will the metalloids as oxides be drawn or taken up between the atoms of the iron of the charge, in accordance with the degree of their affinities and densities, the most volatile being the last to leave the metal, as the phosphorus and sulphur, whose affinities for oxygen are well known. The other metalloids of the metal, as silicon, alumina, and calcium, &c., all having affinities for oxygen—the silicon the most—combine together into a pasty liquid and flow to the surface of the metal, as their densities are lighter than the iron or the graphite. In the passage of the air or oxygen through the metal it must not be supposed the whole of them are freed from the metal, although a great portion of them are, the silicon will become oxidised and the alumina and calcium will combine with the oxygen; in fact, some portion of all the metalloids will remain—should I say in a gaseous state?—between the atoms of the metal.

Iron in its liquid state, caused by heat, is of a globular form, and owing to the removal of its impurities and the condensation of its atoms in cooling, they form a prismatic or crystalline form, and the strength of the metal depends on the fineness of these prismatic atoms and upon the number of the faces of each atom facing the corresponding faces of other atoms by close compact, the grand disintegrator being heat and the crystalliser carbon. Now anything which impregnates between these atoms of iron, let them be ever so infinitesimally small and divided, will alter the nature of the metal, which will vary according to the nature of their impregnation between the atoms of iron. Thus sulphur makes the metal hot-short, phosphorus cold-short, silicon cold-short or brittle, carbon cold-short, carbonic oxide also oxide of iron rotten and cold-short. There can be no perfect adhesion of the atoms of iron whilst these oxides are present between them, and the object of every process, either in iron or steel, is to get them out and free from the metal without wasting it.

I will now conclude my letter, hoping from my remarks to obtain information on this important subject of cracked steel plates, more especially as the composition of the very best of iron, as Lowmoor, is analogous to the steel cracked plates.

Smyth's Caloric Association, Saml. R. Smyth, C.E., &c.
December 15th.

Sir,—Three weeks since attention was called, in the letter of your northern correspondent, to the mysterious failure of certain steel plates at a North-east Coast shipbuilding yard, after they had been rivetted to the frames. This failure, although it extended to but a few plates, afforded ground for alarm lest the unknown causes to which it was due might still be in operation, and might produce similar results over a larger area. It is deeply to be regretted that since that announcement was made, further failures, similar in kind, but much greater in extent, have taken place. They now include steel angle frames as well as steel plates. Rejections by Lloyd's surveyors, on no inconsiderable scale, have, it appears, taken place at yards on the Tyne, Hartlepool, and elsewhere, and the loss which someone will have to sustain is not a small one. It is not clear yet whether the condemned steel has been made by the Siemens, the Bessemer acid, or the Bessemer basic process. But it is quite clear that whenever and however it was made, it was duly inspected and tested at the maker's works by Lloyd's surveyors, and passed their severe scrutiny faultlessly. A few years since when steel as a ship and boiler-building material was still fighting its way into public favour, in competition with iron, and at a greater disadvantage than now as regards price, many of its advocates strenuously demanded that the tests so rigidly enforced by Lloyd's and the Board of Trade surveyors should be relaxed. Is it not strange that these tests, which, in spite of all remonstrance, have been maintained, and which have been even increased in severity, should nevertheless be now found utterly inadequate to indicate with certainty the suitability of the material for the purpose intended? Moreover, is it not equally strange that the cheaper and supposed inferior material iron should now turn out to be virtually superior as regards trustworthiness? Shipbuilding iron is rarely inspected at all at the makers' works by Lloyd's surveyors. At the shipyards it is never tested for tensile strength, and only in a rough way for ductility and soundness. It is held, and always has been held—and the opinion has been justified by several decades of experience—that if it passes the moderate survey described above, and withstands without failure the operations incident to ship construction, there is no fear whatever that it will afterwards give way under any circumstances short of violent collision.

Here, then, we have two materials—a cheaper one and a dearer one—in marked contrast. The dearer one, although manufactured, inspected, tested, and otherwise manipulated with cruel care, has nevertheless been found liable to utter failure at the last moment, when the maximum expense has been incurred, and when complete confidence has been placed in it. The cheaper material, with scarcely any expense for inspection or testing, beyond what the manufacturer does for his own information and satisfaction, enters into the construction of a ship. A certain small percentage is no doubt rejected prior to fixing, owing to obvious defects; but such a thing as cracking across or flying to pieces after being rivetted in place, from its own internal strains, is absolutely unknown in the history of that often, but unfairly, abused material, shipbuilding iron. The treacherous character of the steel recently condemned will be clearly understood and appreciated by the following tests made upon a few bars taken promiscuously from a quantity of angle-iron delivered to a shipyard. These bars had passed Lloyd's surveyors at the maker's works. At the shipbuilder's yard they were subjected cold to hammering. For two or three feet from the end they were opened out and flattened down. There were no signs of giving way. They were then folded double, unfolded, flattened out, and refolded without apparent effect. They were then left alone. Next morning the portions so tested of these angle bars were found broken in pieces—a result due, no doubt, to the internal strains set up by the cold bending. Had they been of iron they would have given way at once, when tested beyond power of endurance. They certainly would not have waited, as it were, deceitfully until some hours had elapsed.

No doubt some makers of steel will be found eager as often heretofore to relieve the particular process adopted by themselves from all responsibility as regards what may be termed the recent revelations, and they will seek to fasten it entirely and exclusively upon those who work by other processes. Any such repudiations of responsibility ought, however, to be received with great caution by engineers, shipowners, and the general public. In the first place, it is not yet clear whether the treacherous steel was made by one process or by more than one; secondly, if it was all made by one process it is not yet ascertained which of the well-known processes has been in fault; thirdly, immense quantities of satisfactory steel have been made by each of the processes alluded to, sufficient, indeed, equally to enable those interested to point to and claim well-established and high reputations; fourthly, it cannot be too well borne in mind that the treacherous steel has all withstood Lloyd's tests, and that the fault has been the development of unreliability some time after full reliance has been placed upon it. All that those interested in the processes which may prove not to have been involved can fairly contend is, that their products, which have also withstood all preliminary tests, have in fewer cases, or possibly in no case, yet proved treacherous afterwards. Mr. Maginnis' interesting history of certain steel boilers, which appeared in last week's Engineer affords sufficient ground for the certain belief that the interval between good behaviour and bad behaviour in treacherous material may be delayed as long as two and a-half years in a boilers, and perhaps longer in a ship. The conclusion of the whole matter seems to be this. There is much truth in the oft-repeated assertion that "we know comparatively nothing about steel;" whereas ship and boiler-builders, steam users, shipowners, and steel makers have for some time been going to work as if they knew all about it. What is now wanted is evidently more careful research into the molecular condition of steel when finished and secured in the position it is ultimately intended to occupy. We know plenty about it in small samples before it is put to use. We know little about it and its internal condition when it is actually in place and in use. Snap.

Middlesbrough, December 15th.

Sir,—The account of the strange failure of steel boilers recorded in your last week's issue, preceded as it was by another account of a similar failure of some steel ship plates the week before, need not, perhaps, have created the slightest uneasiness in the minds of those who manufacture their steel by what is known as the basic Bessemer process had these accounts not been followed up by your leading article, in which your reference to them might lead many to suppose that they were responsible for the failure of these plates. I daresay, Sir, that basic Bessemer steel will have to stand or fall on its merits, but it is hard and it is unjust if it has thus early in its life to be punished, not only for its own sins, but for those of its rivals.

I do not know by what process the ship plates were made, and your article did not say, but Mr. Maginnis states that the boiler plates were made by the Bessemer process at the works of a well-known East Coast steel and iron company, and if further evidence was wanted that it was not basic Bessemer steel, the analysis of the steel amply supplies. First—Had the steel been made by the latter process silicon would not have been present, the absence of this being a distinguishing feature of basic steel; and secondly, the sulphur present is a very different figure from that occurring in basic steel as made at the North-east Coast, and is exactly the amount present in Bessemer or Siemens steel made from good hematite iron, and this is also the case with regard to the phosphorus.

But, Sir, your leading article raises some other important questions. In the face of the article, it might be fair to ask, Are defective steel plates confined to any particular process of manufacture? Does the fact that they fail go to prove that they are made by a particular or certain process? And is it quite certain that the treatment the steel received was quite fair and in accordance with a good knowledge of its treatment?

With regard to the last question, Mr. Maginnis states that "the steel worked in a most satisfactory manner, welding, flanging, and bending without the least trouble;" and you will, Sir, perhaps, allow me to reply further to some of these questions.

Lloyd's surveyors themselves say, referring generally to this question in a paper "On the Steel Boilers of the Livadia"—the steel for which, by the way, was not made by the basic Bessemer process—"A great number of these cases have been investigated, and in every instance they have been clearly traceable to improper manipulation of the material. . . . . These cases have been quite as numerous in steel manufactured by the Siemens process as by the Bessemer process."

In their first report in 1877 they say—"We would respectfully submit that there does not appear to be any reason, at the present time, to make a distinction between those made by the Bessemer and those made by the Siemens process."

Quoting the same authorities again, they say in reference to some plates which broke in quite as strange a manner—"We have no reason to doubt that the material was made by the Siemens process." At the spring meeting of the Institution of Naval Architects, Mr. Parker narrated the history of some marine steel boiler plates, which differed little from those tested at the North-east Coast. The plates were tested at the steel works and were satisfactory, fulfilling the requirements of both Lloyd's Register and the Board of Trade, were built up into a boiler by a company having an extensive experience in the manipulation of steel, and every care taken with the material, yet on testing the boiler it it ingloriously failed, the steel not standing one-fourth the strain originally stood. Yet, Sir, these plates were neither made by the Bessemer nor by the basic Bessemer, but were made entirely by the Siemens-Martin process, and that by a firm of standing and repute.

Into the question why these steel plates failed I do not propose to enter; you, Sir, say "you have no reason to suppose that the steel was not good when it went into the boilers," and you ask "what took place subsequently?" A very proper question, but it ought to be asked of the boiler-maker, and not of the makers of basic Bessemer steel. Wm. Galbraith.

Glengarnock, Ayrshire, N.B., December 15th.

Sir,—The failure of steel boilers described in your issue of the 11th inst. is a most remarkable one, and in the face of the complete record of tests taken from the plates before leaving the works, and the fact that they passed all tests required by the Board of Trade and Lloyd's, it is difficult indeed to suggest any reason for the failure, beyond those mentioned as probable in your able leading article on the subject. Your suggestion is that, though the steel was, to all appearances good, yet the plates were bad, inasmuch as they possessed high initial stresses which induced subsequent fracture, or otherwise they were of such character that internal stresses were induced by the manipulation at the boiler shops. With this latter suggestion I am inclined to agree, but it is difficult to understand how steel plates showing such moderate tensile strength and fair analysis could acquire, even by most severe treatment, such internal stresses as to result in the complete failures indicated. You suggest the use of a huge testing machine to assist engineers to arrive at some understanding of the mysterious forces which exist in such steel plates. As far as it goes this would be good, but my opinion is that probably none of the boiler plates in question would have failed under such tests if they were made at the makers' works; that is, if the plates were annealed before testing, as I presume they would be before the maker sent them out of his works. No matter in what way steel boiler plates are to be subsequently treated, they ought to be thoroughly annealed before leaving the makers' works so as to minimise the danger arising from putting plates possessing internal stresses into boilers. At these works we anneal all steel boiler plates, and we believe that by the little extra expense we send out a much more satisfactory plate than if we left it unannealed. Plates, however, of mild steel made by the ordinary Siemens process do not appear to be so liable to those mysterious failures such as you record from basic Bessemer steel.

As I write I am reminded of a failure of some steel ship plates which took place after being rivetted up, and which was mentioned in your North of England trade notes on November 27th. It would be interesting to know by what process this steel was made, and whether the cause of the failure was traced.

Referring again to the failure of the boilers described last week, a close examination of the drawings shows that most of the cracks occur at, or adjacent to, lines of rivet-holes, and this leads me to offer the opinion that local heating is the sole cause of the failure; but, as I have before intimated, I cannot suggest a reason why such apparently mild steel should be deteriorated by local heating.

The cracks in the plates have nearly all occurred within the furnaces and combustion chambers, and mostly at, or close against, those lapped joints that would be subject to greatest heat. The failure at A—Fig. 2—is most probably also due to local heating, since it is the crown of the furnace. The connecting pipes to steam chest seem to have been deteriorated by the local heating during flanging and rivetting, and I believe that even the fracture in the shell plate shown at Fig. 15 may have been induced by the local heating when putting in the two rows of rivets.

Steel is almost universally acknowledged by engineers to be really the most excellent material for most constructive engineering work and for machinery, and undoubtedly there is nothing to equal it. It has, however, some disadvantages, as are demonstrated from time to time by the sudden and unexpected failures of boiler-plates, crank-shafts, &c. &c. As you show in your leading article of last week, its very homogeneousness, which enables it to withstand most severe treatment without giving way, becomes a source of weakness in some cases. Referring to the reason why "iron does not manifest the treacherous properties of steel," you say: "There need be no doubt or uncertainty. It is the fibrous nature of iron that mainly contributes to give it a trustworthiness which is not possessed by steel;" and I believe all engineers who have given the subject the least consideration will readily agree with you.

What, then, is the means of obtaining trustworthiness in steel? To make it fibrous is a suggested reply. But this cannot be done. The material is too pure—regarded as a mechanical mixture—its crystals are practically free from cinder, and no practical amount of rolling will roll the crystals into fibre. The amalgamation of iron with steel is a means which naturally suggests itself, and I believe you will be interested in knowing that at this works we have for the last twelve months been manufacturing compounded steel and iron in such a way as to obtain the tensile strength and ductility of the one combined with the fibrousness and trustworthiness of the other, and also excellent welding properties, owing to the presence of iron.

The remark you make that "a rent may take place through one or more fibres of a bar of iron, but it will not necessarily extend," is one which carries with it full justification for the compounding of iron and steel. And in the composite bars, boiler plates, &c., we obtain a condition precisely similar to that existing in a bar of iron. By same post I send you a piece of composite boiler plate, so that you may better judge its thoroughly practical character. Its tensile strength is about 27 tons per square inch.

If it will interest yourself or your readers I shall be pleased to forward you further particulars, and the results of the physical and other tests we have made from time to time.

Corngreaves Iron and Steel Works, near Birmingham, December 16th. THOS. TURNER.

SIR,—Referring to the article in your issue of the 11th inst., "A Strange Failure of Steel Boilers," the case is altogether so peculiar and the matter so serious, that it is to be hoped some further information will be forthcoming as to the manufacture of the steel and its subsequent treatment in the boiler-yard. It is stated that the steel was made by the Bessemer process, from which one would assume that the ordinary or acid Bessemer process is meant, yet in the editorial note on the article reference is made to basic Bessemer steel, as though that were the metal in question. I believe, however, I am right in stating that at the time this steel was made no firm on the East Coast was making plates of basic steel, so we may take it for granted that the ordinary Bessemer process was the one employed.

Adverting to the faulty plates, I notice that these vary in thickness from ½in. to ⅞in., or thereabouts. It would be interesting to know whether the ingots from which these plates were made were hammered or cogged, and were the plates annealed before leaving the works. As all, or nearly all, of the fractures seem to have started from the rivet holes, it is also important to know whether, in the case of the plates where the holes were punched, the holes were rimered out, or if the plates were annealed after punching.

Judging from the table of "Tests of Plates before leaving Works," the steel seems to have been of tolerably uniform quality, and the tests for tensile strength made on pieces A and B cut from the faulty plates agree with the original tests, but the piece C, also cut from the faulty plates, seems to have been hardened to an extent that has increased its tensile strength from 27 to 46 tons per square inch, and of course reduced the elongation of the piece under test, although this latter varies to a greater extent than is accounted for by the different lengths tested.

December 17th. A. B.

SIR,—I have read with interest Mr. Maginnis' paper on "Steel Boilers" reported in your last impression, as well as your leader on the same subject, the latter not without some feelings of alarm, representing, as I do, one of the only two basic steel works on the North-east Coast, for I feel sure that your opening remarks in that article, in conjunction with the above paper, are calculated to give your readers the impression that the boilers which appear to have failed so completely were made of basic steel supplied by a North-east Coast firm. As far as my company is concerned, I would say that we did not commence to make steel until June, 1883, and no steel was supplied by us for such purposes as boiler plates until the early part of 1884; and as Mr. Maginnis states that "each set of boilers worked most satisfactorily at sea for a period of two and a-half years," it is quite clear that the steel could not have been supplied by the North-Eastern Steel Company.

Will you kindly publish this letter in your next impression? Otherwise, I fear that, although unintentionally on your part, our present good reputation will suffer.

ARTHUR COOPER,
General Manager for the North-Eastern Steel Company.
Middlesbrough, December 15th.

SIR,—Referring to the leading article in THE ENGINEER of last Friday, and to your remark that the makers of Bessemer basic steel will read without satisfaction the remarkable narrative of Mr. Maginnis, described and illustrated on pages 447-8-9, of a strange failure of steel boilers, I feel sure that the narrative will be read by all makers of mild steel without satisfaction.

Mr. Maginnis states that the steel which behaved in such an inexplicable manner was made by the Bessemer process at the works of a well-known East Coast steel and iron company. I beg to say that the steel in question was not made at the works of Messrs. Bolckow, Vaughan, and Co.

Middlesbrough, December 15th. E. WINDSOR RICHARDS.

SIR,—From the interesting leader in your issue of 11th inst., the natural inference would be that the boilers were made from basic steel. As this is an inference that I know you would be the first to withdraw if it were incorrect, will you permit me to state that they were not made from basic steel. I hope the questions of whether the design of the boilers included a sufficient allowance for the inevitable difference in expansion and contraction of the various parts, and whether the steel was injured in the course of its manufacture into a boiler, will not be lost sight of by either yourself or your correspondents. PERCY C. GILCHRIST.

Palace-chambers, Bridge-street,
Westminster, Dec. 17th.

SIR,—Mr. Maginnis's article claims the attention of all steel makers, and I think it would be but fair that he should state from whence the plates were obtained. I see that in your leading article you adopt the view held generally in Sunderland and Newcastle; namely, that the boilers were of basic steel. I fancy this is an error, for basic steel has not been a marketable commodity in the shape of boiler plates for two and a-half years. On this point, however, I may be wrong. I hope to see the question settled at once by Mr. Maginnis or some other competent authority.

Bradford, December 14th. LOW MOOR.

SIR,—Is it quite certain that Mr. Maginnis' experience with steel plates is quite unique? I venture to think not. What about the mild steel plates of the Livadia, now lying as a coal hulk in the Black Sea?

Is is not a fact that the plates taken from her bottom and tested by a competent authority gave such results that the tests were never made public? Is this true or not?

Is it a fact or not that Lloyd's much regret having reduced steel scantlings in ships because of recent failures of such ships?

Is it not a fact that they contemplate remodelling their steel rules?

It is highly desirable that the truth should be known. I do not hesitate to say that much more is known about steel than it would serve manufacturer's purposes to make public.

Merthyr, December 15th. W. T. W.

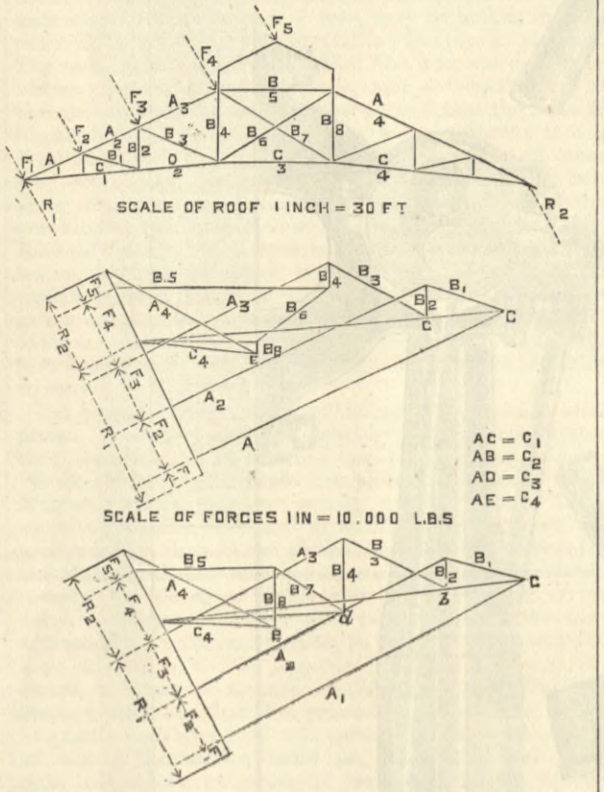
INCOME TAX ASSESSMENTS.

SIR,—We are one of those unlucky firms who have thought it necessary to appeal against the arbitrary assessments made by the local surveyor of taxes under Schedule D. Our accounts as rendered are not disputed, but the question that is now arising between the commissioners and ourselves is that of depreciation. Our auditor is of opinion that certain percentages for depreciations must be written off in order to produce a sound profit and loss account. We are likewise of the auditor's opinion, but the commissioners are of a different opinion, and object to our taking off the ordinary trade allowances for depreciation. We should be obliged, therefore, if firms engaged in engineering matters in various districts would kindly say through your columns what the percentages are that are allowed by the commissioners in their districts off the following:—(1) Off manufacturing buildings, such as foundries and tool shops; (2) off fixed plant, such as engines, lathes, tools, &c.; (3) off movable plant, *i.e.*, the ordinary loose plant of an engineering establishment; (4) off ordinary railway coal trucks; (5) off office furniture. We do not ask the firms replying to give their names, but if in place of the name the town their works are in is given it will suffice. As this question in these days of keen competition is a serious one, we hope that engineers throughout the country will kindly enter into this correspondence. We are of opinion that the commissioners, in various districts differ in their decisions, and why we say this is that a few years ago we appealed to the special commissioners and find that the local commissioners this year object to be guided by the decisions made by the special commissioners. Consequently, it is impossible for us in preparing our balance sheets to know at what figures to assess the depreciations. VULCAN.

Derby, December 16th.

HUDDERSFIELD STATION ROOF.

SIR,—Mr. Gribble's diagram in THE ENGINEER of December 11th appears to be incomplete and inaccurate. As it may possibly mislead students, I venture to submit the two solutions of the



problem, No. 2 being discarded as tie rods are used for counterbracing. R. E. ELLIS.

Paddington, December 15th.

PATENT-OFFICE ADMINISTRATION.

SIR,—I shall feel obliged if you will allow me to offer a few words of explanation with respect to the case noticed by you in THE ENGINEER of December 11th, in which two applications for patents were made through me as agent, namely, one by Mrs. Swainson and one by Messrs. Hall and Clanchy. At first sight it may seem strange that I should have acted as agent in both cases, but the circumstances were peculiar. Mrs. Swainson's application was prepared by a well-known and competent practitioner in the provinces—for whom I act as London agent—and was sent in through my office. Subsequently the application of Messrs. Hall and Clanchy was prepared by me and filed.

There was nothing whatever in Messrs. Hall and Clanchy's specification that appeared likely to clash with Mrs. Swainson's application so far as could be judged from her provisional specification. No interference was declared upon the two provisional specifications. Messrs. Hall and Clanchy instructed me to complete their patent, and, accordingly, I prepared and lodged their complete specification, and the patent was sealed in due course, no interference being declared. After Messrs. Hall and Clanchy's complete specification had been accepted and published, and their patent had been sealed, I received from my client in the provinces, who was acting for Mrs. Swainson, her complete specification, which I immediately filed, and which was in due course accepted by the Comptroller. Then—that is to say, after both complete specifications had been accepted and the patent of Messrs. Hall and Clanchy had been sealed—notices of interference were received from the Patent-office. This naturally placed me in a delicate position, and I had to consider what would be a proper course for me to adopt. The application by Mrs. Swainson for leave to amend was lodged under instructions with a view of removing the doubt, if any existed, and of making it perfectly clear that her invention was independent of Messrs. Hall and Clanchy's.

However, I was afterwards instructed to withdraw the application for leave to amend, and the course I subsequently adopted was based upon the consideration that as at the time of taking instructions from Messrs. Hall and Clanchy there was nothing of Mrs. Swainson's known to me which, in my opinion, should clash with Messrs. Hall and Clanchy's application for a patent, therefore I could not—because of an interference declared by the Patent-office, presumably on her complete specification—take up a position in antagonism to Messrs. Hall and Clanchy. This will explain how it happened that when the matter came before the Deputy-Comptroller I had ceased to act for Mrs. Swainson. I may add that at this time her interests were no longer in the keeping of the gentleman who originally instructed me on her behalf.

W. LLOYD WISE.

46, Lincoln's-inn-fields, London, W.C., December 15th.

DR. LODGE'S MECHANICS.

SIR,—Mr. Donaldson's letter of November 26th, published on page 442 of THE ENGINEER, contains several questions which I hasten to answer.

(1) Dr. Lodge's definition of motion is contained in the following words:—"A body is said to move when it is in different places at different times."

(2) Mass is usually and conveniently expressed in terms of weight, but this has nothing to do with the fact that inertia is independent of weight. Boards are measured by a two-foot rule, but a two-foot rule is not a board, nor a board a two-foot rule.

(3) I have to thank Mr. Donaldson for calling my attention to a slip of the pen in my letter of the 10th ult. If he will eliminate the word "double" in the thirteenth line from the end, and substitute what the context plainly implies should be there, my statement will become quite clear.

(4) My intelligence is not able to grasp the meaning of his last question. I must beg him to let me have an explanation.

London, December 3rd. Φ. Π.

FRICTION AND LOST WORK.

SIR,—My attention has been called to a review of Professor Thurston's "Treatise on Friction and Lost Work in Machinery and Millwork," which appeared in your paper October 16th last. In it the reviewer says that I give more information in my short papers on "The Best Modes of Lubricating," than is contained in all Professor Thurston's book. Now while thanking the reviewer for his appreciation of my work, I think he has hardly done Professor Thurston justice, because his book contains all the results given in my papers, so that practically what is contained in my papers is also contained in Professor Thurston's book.

19, Great George-street, Westminster, S.W., December 9th. BEAUCHAMP TOWER.

[We are as desirous as Mr. Tower can be of giving Professor Thurston full credit for the high value which characterises the information contained in a large part of his book, but we maintain that the facts given by Mr. Tower in his report concerning the best means of getting the oil to bearings, especially when the top bearing receives the greater pressure, and as to when oil will make a bearing run cool or allow it by misapplication to run hot, are of more value to an engineer than all the facts on this part of the subject given in Professor Thurston's book, which may contain all the results as regards coefficients and friction figures of Mr. Tower's papers, but it contains very little of the facts that cannot be put into tables, and it contains none of the illustrations. A very important fact concerning the pressure at which oil will accumulate in a central lubricating hole is fully interpreted in Mr. Tower's paper, but only half so in Professor Thurston's book, and this is misleading.—ED. E.]

ENGINEERS FOR CAPE COLONY.

SIR,—Yours dated October 9th contains a letter signed "William Hay, late editor *Cape Mercury*," written, I imagine, with the view to induce "practical engineers" with money to invest it in this colony. There is an air of truth all through his letter, but apparently Mr. Hay has forgotten to let you know that trade is simply in a state of stagnation here. Men of all kinds are seeking employment. Very many are weekly discharged from the Government service, who are the largest employers of mechanical labour, the batch for this week being twenty-two. The diamond fields are glutted with men, and engineers of very considerable scientific, practical, and colonial experience would be glad to give assistance and advice for small remuneration to farmers were they able and willing to pay for it. One of our large importers of machinery has been selling at 20 per cent. below cost.

With regard to Mr. Hay's friend who "recently supplied water to arable land, and let it at 20s. per annum per acre more than freehold value," I extract from *East London Advertiser*, November 10th: "We learn that Mr. Irvine will in a measure relinquish his farming pursuits for the purpose of taking command of his large business connections again." Is this Mr. Hay's friend? That Mr. Irvine may have made his engineering farming pay profitably I do not doubt, but it is evident that the shop-keeping is the main stay. One local engineering establishment has recently been closed for want of support.

I do not say that "practical engineers" may not make a good thing by coming out in an instance or two, but this I do assert, that the colonial market is over-stocked with engineers and machinery, and does not warrant such a letter as Mr. Hay's.

East London, Cape Colony, November 10th. TURBINE.

COAL SUPPLY TO LONDON.

SIR,—Referring to a paragraph in THE ENGINEER of November 13th, headed "Fifty Miles of Coal Wagons," I am surprised that no one has pointed out the fact that 15,000 wagon loads of coal, even if reaching fifty miles, is but one week's consumption of railway-borne coal in London, so that it is ridiculous thus to point out how bad trade is, and say that therefore there is a glut of coal in the London market. There may be too much coal in the market, but to point to four days' supply, and to say that it is too much, is, I repeat, ridiculous. The following are some of the facts as to the London coal trade:—The quantity of coal brought to London in 1884 was 11,140,576 tons, of which 6,836,617 tons was brought by rail, 10,108 tons by canal, and 4,293,851 tons by sea, so that if these 15,000 trucks contained 8 tons each, we have 120,000, which multiplied by 52 amounts to 6,240,000, or something less than one year's supply per railway. According to the returns just published, the increase for November, 1885, as compared with November, 1884, amounts to 120,497 tons, and the increase for eleven months of 1885, as compared with 1884, is 432,310 tons. W. TAYLOR.

December 9th.

THE ROYAL ENGINEERS.

SIR,—By your article in last week's issue you seem to ignore the existence of the non-commissioned officers of this corps and their claims for promotion to the commissioned ranks. Now, when it is considered that some of those non-commissioned officers are university graduates, and a large proportion have been trained as civil and mechanical engineers, surveyors, draughtsmen, &c., and must consequently have laid at least the groundwork of a scientific education, it would seem to any unprejudiced person that material would be found amongst this class from which, by careful selection and training, fair engineer officers might be evolved. Seeing that it requires two years' instruction at Chatham to render Woolwich cadets efficient as engineer officers, it will obviously take a much longer period to train officers that receive their commission under this new regulation. Why could not a number of non-commissioned officers be put through this course of instruction? Many of them fill highly responsible positions in our Survey, Postal Telegraph, and Royal Engineer Departments; and I venture to say that if such a plan is adopted they will be found in every way qualified for commissions, and no more shall be heard about the dearth of candidates for officers in the Royal Engineers.

December 14th. A NON-COMMISSIONED OFFICER R.E.

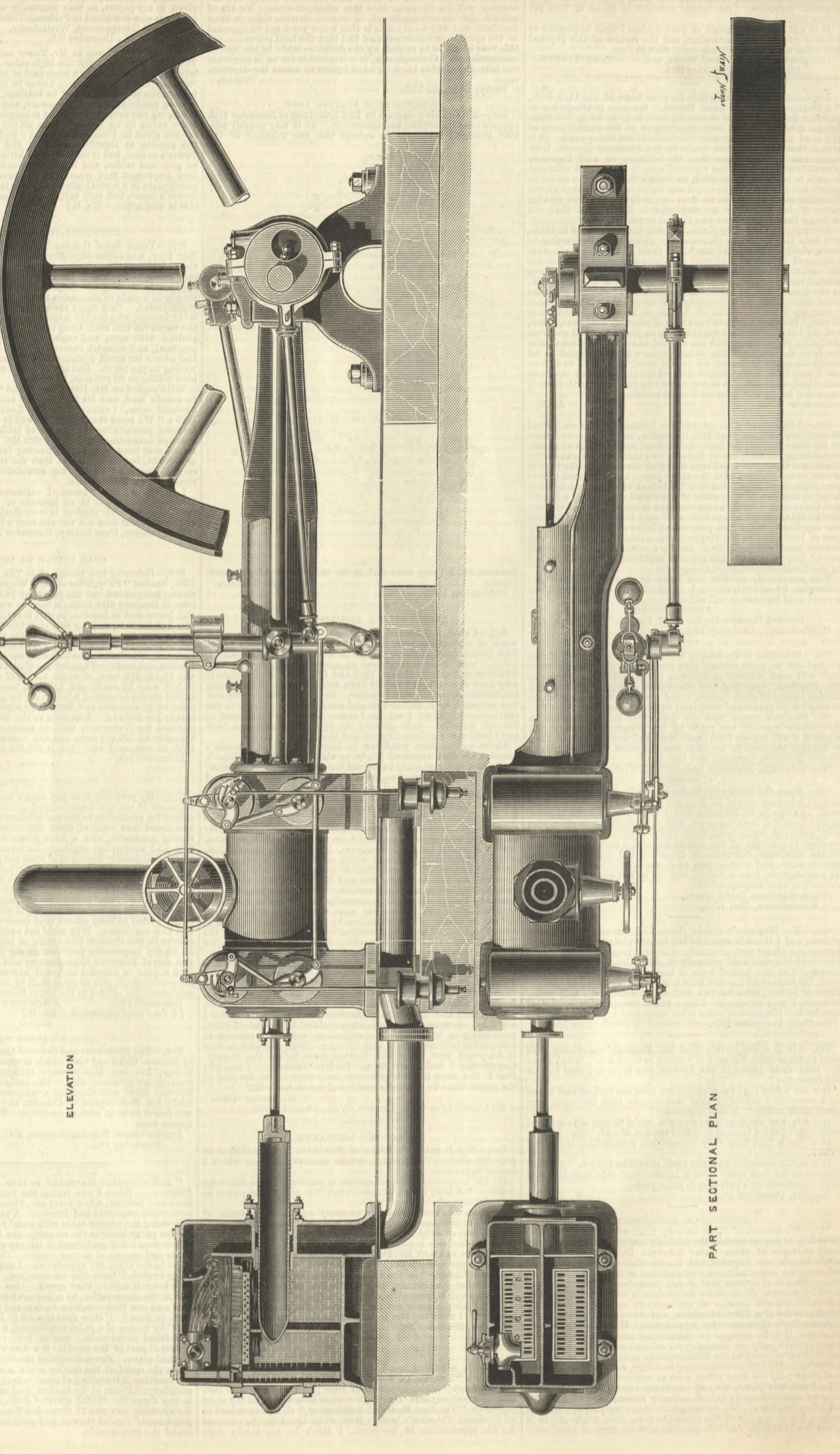
[A very good suggestion.—ED. E.]

CHURCH'S SLIDE VALVES.

SIR,—The Peninsular and Oriental Company's s.s. Bengal, built by Messrs. Caird and Co., which is running her full-powered trial to-day, has her high-pressure cylinder fitted with my patent rectangular balanced slide. The sister-ship, the Coromandel, is likewise fitted with the same arrangement of balancing; she has made her first voyage to Calcutta and back, and on examination was found to be in perfect condition. The pressure is 145 lb. per square inch. W. C. CHURCH.

London-street, Fenchurch-street, E.C.,
December 15th.

"A WONDERFUL MACHINE" is thus described by *Mechanical Progress*:—When I was laying the foundation of my mechanical fame and fortune, a few years ago, I boarded in a house filled with locomotive engineers and firemen. A practice prevailed there, of enlivening the supper table with social conversation, and the locomotive party being in the majority, the leading theme of talk was stupendous feats performed in railway runs, varied by minor incidents and records of narrow escapes. George Dewhirst, who ran a lathe in the shop, sat opposite me at the table, and he got tired of being excluded from the conversation. He became ambitious to hear himself talk in that crowd. One evening, catching on in a lull in the conversation, he called out loudly to me; "Well, I went over and saw that machine to-day, and it is astonishing the fine work it does." "How does it work?" I inquired. "Well," said he, "by means of a pedal attachment, a fulcrumed lever converts a vertical reciprocating motion into circular movement. The principal part of the machine is a disc which revolves rapidly on a vertical plane. Power is applied through the axis of the disc, and when the speed of the driving arbor is moderate the periphery of the machine is travelling at great velocity. Work is done on this periphery. Pieces of the hardest steel are by mere impact reduced to any shape the skilful operator desires." "What in thunder is the machine, any way?" demanded Tom Jones. "Oh, it is a new grindstone," replied George, and a silence that could be felt passed round the supper table.



CONDENSING ENGINE, ANTWERP EXHIBITION.

MONS. BOLLINCKX, BRUSSELS, ENGINEER.

(*For description see page 468.*)

FOREIGN AGENTS FOR THE SALE OF THE ENGINEER.

PARIS.—Madame Boyveau, *Rue de la Banque.*
BERLIN.—Asher and Co., 5, *Unter den Linden.*
VIENNA.—Messrs. Gerold and Co., *Booksellers.*
LEIPSIC.—A. Twietmeyer, *Bookseller.*
NEW YORK.—The Willmer and Rogers News Company, 31, *Beekman-street.*

PUBLISHER'S NOTICE.

*** *The Publisher begs to announce that Next Week* The Engineer *will be published on* Thursday, *instead of* Friday—*Christmas Day. Advertisements intended for that Number must arrive at the Office before Six o'clock on Wednesday evening.*

TO CORRESPONDENTS.

Registered Telegraphic Address—"ENGINEER NEWSPAPER, LONDON."

*** *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.*

*** *We cannot undertake to return drawings or manuscripts; we must therefore request correspondents to keep copies.*

*** *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.*

X. Y. (Clonmel).—*You are late. The examinations began on the* 15*th. The conditions were advertised long ago.*

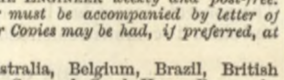
A. S. B.—*The answer to all your questions is yes. We have not seen the article to which you refer by General Anstruther, and consequently we cannot say whether it is right or wrong. Perhaps the author's meaning has not been grasped.*

J. H. (Bury).—*Pure water boiling in an open pan cannot be raised above* 212 *deg., the barometer standing at* 30*in. If the barometer is higher or lower, the water will be hotter or colder when it boils, but so little that a delicate thermometer would be required to test it. By adding salt or sugar the temperature can be raised very much, but we presume that your inquiry applies to pure water only.*

SCOTCH IRON.

(*To the Editor of The Engineer.*)

Sir,—Can any reader tell me if there is any brand of Scotch pig iron, or any mixture of Scotch pigs, that will stand a bending strain of 800 lb. to the square inch with a bearing of 3ft., thus—or could any one refer me to the required information, or to any book that would give me reliable breaking strains of various mixtures of Scotch and Staffordshire iron?



J. C.

London, December 11th.

SUBSCRIPTIONS.

The Engineer *can be had, by order, from any newsagent in town or country at the various railway stations; or it can, if preferred, be supplied direct from the office on the following terms* (*paid in advance*):—

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ADVERTISEMENTS.

Letters relating to Advertisements and the Publishing Department of the paper are to be addressed to the Publisher, Mr. George Leopold Riche; all other letters to be addressed to the Editor of The Engineer, 163, *Strand.*

MEETINGS NEXT WEEK.

The Institution of Civil Engineers, 25, Great George-street, Westminster, S.W.—Tuesday, Dec. 22nd, at 8 p.m.: Ordinary meeting. Paper to be read and discussed, "On Construction in Earthquake Countries," by Mr. John Milne, F.G.S.

Chemical Society.—Thursday, Dec. 17th, at 8 p.m.: Ballot for the election of Fellows. Papers to be read: "The Action of Steam on Carbonic Oxide," by Mr. H. B. Dixon. "On Multiple Sulphates," by Miss E. Aston and Mr. S. U. Pickering.

THE ENGINEER.

DECEMBER 18, 1885.

TESTING STEEL.

We stated last week in commenting on Mr. Maginnis' account of the failure of six steel boilers, that Mr. Kirkaldy had shown that iron could be instantaneously rendered crystalline. He requests us to state that he has never said this, and that he holds entirely opposite views. We hasten to express our regret for inadvertently attributing to him opinions which he does not hold. Our statement was based on the following passage which will be found on page 53 of his well known book "Experiments on Wrought Iron and Steel":—"A few examples will now be given to prove that the appearance of the same bar may be completely changed from wholly fibrous to wholly crystalline without calling in the assistance of any of those agents already referred to, viz., vibration, percussion, heat, magnetism, &c., and that may be done in three different ways—(1) by altering the shape of the specimen so as to render it more liable to snap; (2) by treatment making it harder; and (3) by applying the strain so suddenly as to render it more liable to snap from having less time to stretch." However, on page 57, after referring to a passage by Mr. Clay, Mr. Kirkaldy says "although 'it was found that the strongest and most fibrous plate iron when struck by shot' presented a crystalline appearance. It does not necessarily follow that it instantaneously crystallised. The difference according to the writer (Mr. Kirkaldy) was merely in appearance, not in reality, and was consequent on the plate being fractured so suddenly that no time was allowed for stretching, and hence it was impossible that the fracture could be anything else but crystalline." We believe this latter passage fully sets forth Mr. Kirkaldy's views, and correct the statement we made concerning him by saying that it is very generally held that a bar of iron may be broken so as to show either a fibrous or a crystalline fracture at pleasure. The usual deduction drawn is that the iron was originally fibrous as it came from the rolls, and so remained up to the moment when it was fractured; and that the force of impact or some other cause converted the fibrous into a crystalline structure in an instant. There is no other way out of the dilemma, unless we assume that a bar, being originally crystalline, can be rendered fibrous by breaking it quietly and slowly instead of violently. Mr. Kirkaldy also takes exception to our statement that the testing machine can teach nothing. We hasten again to explain that we did not at all intend our words to be taken in the comprehensive sense which Mr. Kirkaldy attaches to them; and as others may have misunderstood us as well, it is worth while to explain more fully what we intended to convey.

Six large boilers are made in the usual way, and of steel plates. These plates are all tested by taking samples from them, bending and hammering and pulling them asunder. We do not know who made the plates in question. Mr. Maginnis has kept his own counsel on this point. There were two parties interested in showing that the steel was good, namely, the makers of the steel and the makers of the boilers. There were two others entirely disinterested, namely, the Board of Trade and Lloyd's. Even if we dared to suppose that the first two conducted the tests erroneously, or with set purpose to deceive, we should still have to deal with the apparent impossibility that the Board of Trade or Lloyd's could be taken in. We must assume, therefore, that it is proved that the boiler plates in question withstood all the usual tests; and that, as far as human knowledge could go, the plates were very good. Shall we be wrong if we say that the testing machines actually used left nothing untold that they could tell? These boilers are worked for two years and a-half, and then they literally tumble to pieces. Samples are cut from the fractured plates, and the samples pass the testing machine again, and the machine gives us no clue whatever to the cause of the disaster. Under these circumstances, we hold that we are quite justified in saying that the testing machine may be quite unable to give us adequate information concerning the strength of a steel boiler; and we go on to repeat what we have already stated, namely, that the result got out of test strips and bars indicates the quality of the *steel*, but it does not tell us the strength of the *plate*, regarded as a whole, from which the sample was cut. We have here a plate, for example, which of itself splits from top to bottom; but strips cut from each half of this are not brittle but tough. Obviously the strip is under entirely different conditions from the plate. The influence of size and form come in here, and the testing machine supplied no information whatever on this point. So far as any one can tell, a very brittle steel, with a strength, let us say, of 45 tons, and an extension of but 10 per cent., might have made far better boilers than those actually proved to be. It is not known at all that the *metal* of the plates which cracked was brittle. The evidence goes to show that the plates and rings as a whole were brittle; but that, we contend, is quite another matter. With the experience of Mr. Maginnis before us, and some others of nearly as recent date, no man in his senses can assert that, because strips cut from a steel plate manifest every good quality under the sun, therefore the plates are in all respects thoroughly trustworthy. They are nothing of the kind, and the only guarantee that we have at this moment that steel *plates* in a boiler or a ship are likely to turn out well must be sought in the method of manufacture and working. This we say without desiring to assert that any one system — Bessemer, Siemens-Martin, or Basic — is better or worse than another. We have not the least intention of arguing that the testing machine is useless; far from that, we hold that, properly used, it is simply invaluable; but the testing machine cannot do everything, and it has notably failed in more than one instance to predict the failure of steel boiler plates. As was to be expected, the publication of Mr. Maginnis' article has evoked a large correspondence, and we publish this week several letters on the subject. One of these contains an account of the failure of ship's plates mentioned already by our Middlesbrough correspondent. From this letter it appears that the case is worse than was at first supposed, but the most remarkable fact about the matter is that specimens which bore every test, with success, were subsequently found to have broken during the night. We are naturally led to ask, Is this a new experience? We have not before heard of the existence of such a phenomenon. It is quite true that boiler plates have been flanged during the day, and the flanges have come off in a complete ring during the night. But the self-fracture of comparatively small specimens has not been mentioned in any discussion on the subject, nor has it been alluded to by any writer. If the things mentioned by our correspondent are entirely novel experiences, then no man can say where the vagaries of steel will stop. It has done much to establish a character as a most extraordinary material; and its recent performances will add force to opinions taking this direction.

We cannot leave so important a subject here. There is more to be said. There are testing machines and testing machines. There are tests and tests, and before we condemn the system even partially, it is well to know that we condemn it fairly. All that we have just written is based on the assumption that the plates of Mr. Maginnis's boilers were tested by a thoroughly trustworthy machine in a perfectly trustworthy way. Was this the case? Mr. Maginnis can say. As to bending strips, it is quite well known that according to treatment nearly any result can be got. Mr. Maginnis says that by striking a given portion of the boiler a blow with a heavy hammer, it flew off like so much glass. It is quite on the cards, however, that if this same piece had been taken quietly it would have bent kindly. If we wish to bend a bit of brittle steel, that can generally be done by giving it a little time, and bending it slowly. We do not say that Mr. Maginnis's tests were not carried out with due care and in a proper manner, but plenty of people will say that they were not; and it is but right that the whole truth about these boilers should be made public. Very large interests indeed are at stake, and we think it would be well that samples of the plates should be submitted for test to Mr. Kirkaldy, and that the results he obtains should be published. His reputation for impartiality stands so high that no possible exception could be taken to his figures. It might be possible to get samples of the original lot of plates from which the boilers were made, and it would be of transcendent interest to ascertain whether they are or are not now able to withstand what they before endured. If Mr. Kirkaldy's tests bear out the conclusions already formed, namely, that the steel was of good quality, then our arguments will be converted into proved propositions, and the verdict of the testing machine will no longer be accepted as final testimony to the strength of a boiler *plate*. If, on the contrary, the results he obtains are quite different from those reported to have been obtained, then a new field for speculation is opened. We shall not contemplate such an untoward event, however.

MR. J. O. PHILLIPS AND THE METROPOLITAN BOARD.

We published last week a letter addressed to us by Mr. J. O. Phillips, the secretary and general manager of the Gas Light and Coke Company, explanatory of his plans for dealing with the sewage of London. Mr. Phillips first came upon the scene in reference to this subject with a proposal for taking the semi-dried sewage sludge, when compressed into cakes, and stowing it away on board the steam colliers on their return voyage from the Beckton Gasworks, the cargo so obtained being thrown into the sea on the way to the Tyne. On the face of it, this seemed to offer a cheap method for getting rid of that troublesome incubus—the sludge deposited in the precipitating tanks when sewage is treated chemically. We discussed the salient features of the plan in The Engineer of October 23rd, but in the communication which we published last week Mr. Phillips entered into a variety of considerations, and extended his proposals over the whole of the sewage problem as connected with the metropolitan outfalls. It was in this form that Mr. Phillips' plan appeared before the Metropolitan Board, and, novice as Mr. Phillips must be in regard to this particular subject, he has succeeded to a remarkable extent in grasping the leading data. The reply of the Board has been that the plan proposed by Mr. Phillips involves an outlay much larger than in their judgment appears to be necessary, supposing it were finally decided to carry the sludge to sea. In order to test this view, the Board have invited designs and estimates for the construction of one vessel capable of taking out to sea 1000 tons of settled sludge daily. The question, therefore, which affects Mr. Phillips is one of cost, and this point was very distinctly raised in a memorandum drawn up by Sir Joseph Bazalgette. In that document the question was thus put to Mr. Phillips: "On what terms would the Gas Light and Coke Company undertake the removal from the Barking and Crossness outfalls to twenty miles outside the Nore of 1000 tons per diem of pressed sewage cake?" A second query ran thus: "For what sum would the company undertake the removal in like manner of 3000 tons per diem of sewage mud, after treatment with lime and iron, the Metropolitan Board of Works providing the necessary appliances and delivering it into the ships?"

Very ingenuously, though perhaps to his own detriment, Mr. Phillips proceeded to answer Sir J. Bazalgette's questions from the standpoint of the Board. In his figures he includes everything, whether forming part of the service which he is to render or not. Mr. Phillips was simply asked to take the sludge away, whether in the form of pressed cake or as mere settled sludge. But he calculates the cost of all the preliminaries, and makes a variety of suggestions, which may or may not be adopted by the Board. The project is marvellously complete, but inevitably complex. Mr. Phillips is asked to be a carrier, whereupon he proceeds to show how the merchandise is to be prepared, and how it is to be brought to the wharf. It is necessary to bear this in mind when looking at his figures, and it is possible that Mr. Phillips would have been a little less disposed to commit himself had he known that there was an estimate by Sir J. Bazalgette a year old already before the Board. The figures can be compared, so far as the sum total is concerned, and Mr. Phillips appears as asking decidedly the larger sum. For carrying out what may be called the dry system—that is to say, the removal of the sewage in a compressed condition, as proposed in the first question—Mr. Phillips reckons on a capital outlay of £562,000, and an annual expenditure, including interest and depreciation, of £252,151. Superficially considered, it would look as if Mr. Phillips required a quarter of a million a year in order to carry the pressed cakes twenty miles beyond the Nore. Yet when we examine the estimate we find that the freight is simply a matter of £36,000 per annum. It is singular that Sir J. Bazalgette in November, 1884, estimated the cost of barging the sludge out to sea at £37,000 per annum. That was for sewage in the semi-liquid form, such as we find referred to in the second question. Consequently there would be no expense for pressing, though, on the other hand, there was to be an outlay of £131,000 for barges, whereas the gas company would themselves find the ships to carry the compressed cakes. For the removal of the sludge or sewage mud, requiring vessels specially constructed, Mr. Phillips reckoned on a capital outlay of £380,000, and an annual charge of £267,400. In all cases he charges two shillings per ton for freight. Sir J. Bazalgette's sludge estimate shows a first cost amounting to £1,140,000, and an annual outlay of £94,000 for precipitation and barging. His figures are on an assumed prospective population of 5,200,000 persons. It is a little coincidence that Mr. Phillips' capital account for the sludge system is exactly one-third that of Sir J. Bazalgette. But his annual outlay is much the heavier. This partly arises from the fact that he charges 8 per cent. for interest and depreciation, whereas Sir Joseph makes no such allowance. If he did, this would add £91,000 per annum as a charge in respect to his capital of £1,140,000. Other discrepancies arise, as, for instance, where Mr. Phillips allows £105,000 per annum for precipitation, and Sir J. Bazalgette only £22,000. For pressing the former allows £45,000, and the latter £36,500.

Taking all things into consideration, and looking at the completeness of the system proposed by Mr. Phillips, it is not quite certain that his plan is essentially dearer than the project which has been worked out by Sir J. Bazalgette. With the latter we must associate Mr. W. J. Dibdin, whose chemical designs have naturally moulded the engineering plans. Mr. Phillips offers such advantages, owing to the contiguity of Beckton to the Barking outfall, that his proposals cannot be readily set aside. Out of his estimates we fancy something might yet be framed that would present a satisfactory aspect. Clearly it ought to be so, and we cannot conceive why it should be otherwise. The only question is whether it will be cheaper to remove sludge than the cakes, remembering the cost involved in pressing the sewage deposit. On the other hand, there is enormous difficulty and expense connected with the storage of sludge when it happens that the vessels are detained by the weather. The pressed system may prove the safest and the cheapest, all things considered. It also seems strange that ships solely engaged in carrying sewage sludge out to sea and coming back empty, should do the work more cheaply than ships which are freighted with coal on their voyage to London, and which only carry the refuse article for a short distance on the way out. In one case all the capital account devolves on the sewage; in the other only a part of it. Moreover, if there is an idea of carrying sewage mud twenty miles beyond the Nore, three times the cargo capacity will be required which would suffice for the pressed cakes. Of course, there is a previous question whether it is right to carry the sludge to sea at all, whether as mud or in a more solid state? If it is taken to sea, will twenty miles beyond the Nore be sufficient? Already we hear mutterings as of a coming storm with regard to the deposit of refuse material near the estuary of the Thames. We hear that the authorities of the Trinity House are on the alert. We read in the *Standard* some rather suspicious letters bearing on this subject. The question is put at the head of these letters, "What are we coming to?" It may not be long before this will be clearly understood. A complaint is said to have been laid before the Board of Trade respecting the practice of contractors for the removal of London refuse discharging barge loads on the fishing grounds at the mouth of the Thames. The oysters are in danger, and other edible denizens of the water. Another correspondent, Sir Sherston Baker, of the Middle Temple, invokes the Lords Commissioners of the Admiralty, who are alleged to possess certain powers capable of being exercised for the defence of the home waters against improper treatment. The method anciently pursued was that of appointing "Vice-Admirals of the Coast," these individuals being in reality civil magistrates charged with special functions. In 1638 a Sussex jury were required to make presentment to the Vice-Admiral of "all those persons which have thrown any dung, chalk, rubbish, or noisome thing into the sea, or any sea passage, to the hurt of the same, within the aforesaid jurisdiction." We may imagine the resuscitated Vice-Admirals of the Coast keeping a very sharp look-out upon Sir J. Bazalgette's sewage barges or Mr. Phillips' cake-laden steam colliers. At least, in some form or other, we may expect that the proposal to take the solid residuum of the London sewage, and throw it into the sea beyond the Nore, will excite considerable criticism, if not downright opposition. If the pressed system is adopted, what is to become of the essence of sewage squeezed out? Whether a range of twenty miles will satisfy is doubtful. It will be expected that some mischief will follow, and if ever the sludge were thus discharged, there would soon be evidence brought forward to prove that sewage banks were forming where no banks of any sort existed before. It would be asserted that the flavour of the "natives" was being impaired, that the fishing grounds were going to the bad, and that the latter state of things was worse than the first. Yet the Metropolitan Board are compelled to move on, for a Royal Commission has pronounced against the outfalls, and every Home Secretary feels it his duty to back up what the Commissioners have reported. Mr. Phillips and his company are to be thanked for coming forward at such a crisis with proposals which cannot but command respect, and which may be found more practical than they were at first thought to be.

THE LOSS OF THE INDUS.

In our issue of October 2nd last we directed attention to the unsatisfactory position in which the surveys of our Indian coasts stand at the present time. The circumstances attending the loss of the Indus, belonging to the Peninsular and Oriental Steam Navigation Company, off the coast of Ceylon, furnish us a very striking illustration of the results to be apprehended from that position on which we dilated at the time of so writing. We desire to say nothing which may in any way prejudge the case as against the captain of the wrecked steamer, because we have as yet heard but one side of the story of her loss. Still, sufficient has reached us on the authority of well-informed correspondents to show that from the charts in the master's possession at the time of the disaster, and upon the data afforded by which he was navigating his ship, there was nothing to be learned which led him to suppose he was in the immediate neighbourhood of danger. According to information received by the *Times*, those charts were not of the latest issued, it appearing that the captains of the Royal Navy navigating in those seas have a more recently supplied chart, upon which instructions are given to keep the lead constantly going when approaching within a certain distance the coast of Ceylon at the point where the Indus was wrecked. It does not come within our province to ask how it came about that the captain of a mail steamer remained unsupplied with the latest information; we only have to accept as a fact that it was so; and under such conditions we may claim that the deficiency in the charts in use by the captain of the Indus, furnishes strong proof of the need we urged in our former article for an early and systematic resurvey of the dangers which surround our Indian coasts.

We, in that article, pointed out how rapidly the natural features of these coasts change under influences which are foreign to more temperate climates. Now the shoal on which the Indus has been lost has long been known. It has been repeatedly surveyed, and distinctly laid down upon the charts issued by the Indian Marine Board; and the Mullativoe shoal, extending as it does for a long distance from the shore, has been one of the most well-known dangers to be avoided in that part of the world. We may safely rely upon it, therefore, that there has in its case been some change in its configuration of recent date. We cannot otherwise conceive that one of the experienced commanders of the P. and O. fleet could have so closely approached it without taking the fullest precaution to ascertain how near he was to it. On the chart which we learn from the authority before quoted to have been issued to the ships of the East Indian Squadron, there are distinct instructions to "keep the lead going" when nearing this part of the coast. On that by which the commander of the Indus was guided such an instruction is said to be absent. Either, therefore, a most important direction was culpably omitted by the framer of the older chart, or, as we have shown, the probability of the danger of approach to this shoal has so much increased since that chart was prepared as to render it necessary that a supplementary direction should be given. It appears that a current had set the ship some thirty miles out of her course during the night; but on day breaking the land was seen and would have been recognised; yet in spite of this the vessel is run upon a danger well known, and, as far as is absolutely known, fully marked upon the chart. It is scarcely possible to realise that under such circumstances, if that chart really represented the shoal as it exists at the present day, an accident of the nature described to us could have occurred.

One of the incidents attending this unfortunate wreck possesses a peculiar interest. When the captain of the Indus found his ship aground he resorted to the common practice of attempting to drag her off by means of anchors laid out astern. In this he perfectly succeeded, and had it not been for a further mishap the Indus would probably have departed from the treacherous shoal with almost entire immunity from injury. But when the vessel slid off into deep water the bottom came into contact with one of the anchors laid out seawards. We will not prejudge this part of the case, because we are totally uninformed of the conditions under which that anchor had to be laid, but it does appear extraordinary that the possible contingency of such an accident should have been overlooked, and that no measure should have been adopted for its avoidance. Had the movement of the ship when again afloat been controlled within a certain course by warps laid to subsidiary anchors, the means adopted successfully for re-floating her would not have proved to be the cause of her ultimate destruction. But, however the neglect of such a provision may be accounted for, its result was most unfortunate; the flukes of the submerged anchor tore a large hole in the vessel's bottom, and the injured compartment became rapidly filled with water. Still the captain felt no apprehension. He had his bulkheads to rely upon for localising the effect of the injury, and we may feel sure that in vessels built with the care and skill as are those of the great eastern Mail Company that confidence could scarcely have been misplaced. It was, however, wholly discredited by the results—the bulkhead gave way under the pressure, and the entire loss of the ship followed.

Are we to be forced to conclude from this fact that the strains imposed upon the vessel while upon the ground, in addition to those probably incurred in the endeavour to drag her off it, had so weakened the bulkheads that they were no longer equal to the purpose they were designed to serve? Until fuller information reaches us it is difficult to suggest any means whereby the liability to such a result can be guarded against in future construction. It may be found wholly impossible to do so, and yet it is a problem which may well and profitably engage the attention of naval architects. To secure the highest factor of safety, it is manifest that provision should be made to secure that bulkheads should remain efficient under every possible condition of strain. Until they are so constructed it is certain they cannot be wholly relied upon.

THE BRAKE QUESTION ON THE CONTINENT.

Since the introduction of the block system, and the interlocking of point and signal, the causes which formerly gave rise to a not infrequent class of railway accidents in this country have to a large extent disappeared, although a number of other causes tending to produce equally calamitous results do still, and no doubt always will exist. It is now generally accepted that for all such emergencies a continuous brake with instantaneous action is the only means by which these results can be avoided, or at least mitigated. It is interesting to observe how these principles receive confirmation from the experience of other countries, on this occasion from the Wurtemburg State Railway. It seems that the express train from Berlin to Milan, when passing Thalhausen station at the rate of forty or forty-five miles per hour, was turned into a siding and only brought to a stand within a few yards of the edge of the embankment bounding the river Neckar. From the official report which appears in the *Wurtemburg Staats Anzeiger* of the 4th inst., the driver seeing the points were open for the siding, "lost no time in giving unnecessary signals, but with great presence of mind applied the continuous brakes with full force, and as this brake operates simultaneously on all the vehicles within a couple of seconds, the train came to a stop a short distance from the end of the siding," which it seems is about 160 yards in length. There is no need to dilate upon what would certainly have been the consequence of the loss of even a single second in applying the brakes with full power, at the time when the speed is highest, and this point is fully recognised by our contemporary, who goes on to say:—"This occurence demonstrates the wisdom of having laid special weight on rapid action in cases of emergency, in choosing a system of continuous brakes, a course which resulted in the Westinghouse brake being chosen. Other systems of continuous brakes are slower and less energetic in their action. In September, 1884, the Minister for Foreign Affairs issued an order that in future all engines and carriages used for express trains were to be fitted with the Westinghouse brake; meanwhile, proposals have been made to the various railway companies who run through carriages on our lines for a general adoption of the air-pressure brake, and there is every prospect of the fast trains between Vienna and Avricourt being uniformly equipped with it by the beginning of the summer season." An interesting feature in connection with this occurrence is also mentioned, and we are inclined to think such instances would be more honoured in the observance than in the breach in this country. The same paper states, "His Majesty has been pleased to award the engine driver Kohler the silver civil service medal in recognition of his care and bravery, and a grant of 100 marks has been allowed him by the Minister for Foreign Affairs."

SUBSIDENCE ON THE METROPOLITAN RAILWAY.

A subsidence on the Metropolitan Railway might easily become a very dangerous affair, but there seems to be no danger attending the subsidence which has recently taken place between King's Cross and Gower-street. The cause of the subsidence is variously stated, but it would seem to be due to the weight and almost superincumbent position of the great block of buildings of the Midland Railway Goods Department, St. Pancras, in conjunction with the leaking of the parish sewer, and the water from the joints of a 15in. water main. The tunnel was built more than twenty years ago, the footings of the walls being placed on the hard blue clay, and until recently it has been perfectly sound, so recent causes must be looked to. Water has undoubtedly been active, and the examinations which have been made have disclosed a large amount of water in the ground outside the tunnel, which it is evident must have saturated the clay beneath its walls; moreover, one of the lines of railroad was bulged up inside the tunnel, a circumstance indicative of the gravitation of a heavy mass upon a plastic material. The 15in. main is near the top of the tunnel, the sewer towards its base, and the front of the Midland Goods Department buildings is only some 30ft. away from its northern side, whilst their foundations are some 15ft. or 18ft. *above* the foundations of the tunnel walls. The subsidence was noticed two months ago, and immediate measures were taken for the protection of the traffic. Strong stretchers of 14in. timber were passed at short intervals across the base of the tunnel under the lines of rails and from footing to footing of the two side walls. The temporary security of the tunnel being thus effected, a concrete invert was commenced below the tunnel; and this has been actively proceeded with in sections during the night intervals in the passenger traffic. Two concrete sections of 7ft. 6in. each in length have been put in every night, and a longer section has been added on Sundays. The concrete invert has been completed nearly to its full extent, and since its commencement there has been no further subsidence.

THE GIRDER TRADE.

The information from the North of England concerning the girder trade is of a character which is eminently gratifying. Some little while ago we showed how rolled girders of native manufacture were rapidly getting into increased favour, and that the continental manufacturers were becoming alive to the fact that the monopoly which they had hitherto possessed was seriously threatened. English architects and builders will shortly have less reason than ever for purchasing continental ironwork. At the Britannia and West Marshe Ironworks, Middlesbrough, rolled girders of 20in. depth will soon be in course of production by the aid of a special new plant which the proprietors are laying down. Previously 16in. was the largest size produced. Engineers will note with special interest that these girders of native manufacture will, as a rule, stand a tensile strain of 21 to 23 tons with an elongation of 5 to 8 per cent., and a contraction of 8 to 15 per cent. The fact that there are now no fewer than ninety-eight puddling furnaces in the Middlesbrough district producing iron for use in girder making is sufficient testimony to the very considerable call which exists for the new manufacture. Middlesbrough, however, is not to have the new trade all to itself. A Bolton firm—Thomas Walmsley and Sons—have been making girders for some considerable time; and now that our ironmasters are becoming convinced that iron will be in growing use for building purposes, it may be regarded as certain that other firms will come to the front in an industry which promises to be remunerative.

WAGES IN THE IRON TRADE.

The present is an anxious time for ironmasters. Every help that is possible should be afforded them to tide over the period of low prices until the anticipated revival makes its appearance. As our Birmingham and Staffordshire correspondent reported last week, the ironmasters there are again seeking some relief in the matter of wages, and our correspondent further shows this week that selling rates are very fine, and competition from the Northern ironmasters is a reality. The main objection of the Staffordshire ironworkers is that the wages in each district ought to be regulated principally by the price of iron made in that district, and that the selling prices of all classes of iron made in Staffordshire average from 30s. to 40s. per ton more than the prices in the North. The masters, however, urge that marked bars now no longer rule the market. They decline to admit that there is a difference of 30s. or 40s. between the average prices of the North and Staffordshire, and contend that the average selling price in the Midlands to-day, excluding sheets, which are always considered to be outside the calculation, is about £5 15s. per ton. They claim, therefore, that puddlers' wages should be made uniform with the wages in the North, *i.e.*, 6s. 3d. per ton, instead of, as now, 7s. 3d. per ton. The arbitrator's award is awaited with great interest, since other leading iron-making districts besides Staffordshire will be regulated by it.

VILLAGE WATER SUPPLY.

Fun is sometimes made of the deliberations of town councils and parochial boards, but when the heavy responsibilities sometimes incurred by these authorities are considered, this hardly seems to be giving them their due. As an instance, the following may be quoted—"At a recent meeting of the Rathven Parochial Board the committee appointed to make inquiries with the view of providing a water supply for the village of Rathven gave in their report, suggesting either the digging of a well about fifteen yards from the churchyard, or in the corner of a field, the first proposal being preferred by the committee. After considerable discussion, the committee was entrusted with full powers to provide a well, the expense not to exceed £25." The headlong rushing into financial responsibility may be, perhaps, a little blameworthy, but when it is observed that considerable discussion, and, therefore much time and thought, were given to the matter, it must be assumed that all the aspects of this debt have been fully examined, and so heavy an outlay considered justifiable in the interest of sanitary welfare. Moreover, the selective judgment which places the well as near as possible to the churchyard ought not to be overlooked, and all praise ought to be given to a committee that selects a site for a well the water from which is likely to have greatest possible variety of ingredients.

PROFESSIONAL ETIQUETTE.

In the United States they do not manage things quite as they do in this country. We find the following passage in *The American Mechanical Engineer*:—"If we may judge by incessant criticism and correspondence in our English contemporaries, *Engineering* and The Engineer, compound locomotives are not performing well on English railways. This is of no especial moment, but what strikes us as peculiar is the readiness of professional readers abroad to supply hints, suggestions, and assertions, as to what is needed to make compound locomotives successful. We don't know what the custom is in England, but in this country an engineer would hardly supply hints for another engineer; he would be thought officious if he did." In this country engineers are always willing to give advice to their professional brethren, and it is not thought officious. Large questions arise every now and then of interest to the whole mechanical world, and it is generally held on this side of the Atlantic that nothing is more likely to explode fallacies than free and full discussion. We do not quite see where the officiousness comes in; but, then, we have not invented a compound locomotive.

LITERATURE.

Strains in Ironwork: a Course of Eight Elementary Lectures. By Henry Adams, M.I.C.E. London: E. and F. N. Spon. 65 pp. 1885.

This consists of a series of lectures delivered under the auspices of the Society of Engineers, by Mr. Adams, by whom they have been revised and presented in book form for the benefit of the learners or younger members of the profession. It is one of the clearest, if not the clearest, and most simple of handy books for learners, on strains in ironwork, as of roofs and girders, with which we have met, and although approximate methods are in a few cases employed, the book is exceedingly well adapted to enable students to understand with facility the more complete books and more complex problems dealt with in books which do not descend to the level of the uninstructed. No reader desirous of acquiring learning on this subject can fail to feel himself put well on the ladder by Mr. Adams' book.

A Guide to Sanitary House Inspection. By W. P. Gerhard. New York: John Wiley and Sons. London: Trübner and Co. 1885.

As in everything else, America has made great strides in sanitation within the last few years, of which the present work is sufficient proof. A concise and not too technical guide to house inspection is a useful book for the average Philistine householder to possess. It will open his eyes in many cases, and may be the means of preventing many catastrophes by teaching him to take warning in due time, before it is yet too late to call in the sanitary engineer, while yet his health is unimpaired and his dear ones alive. Mr. Gerhard is an authority in the States on the subject of sanitation and house drainage.

The Prospector's Hand-book. By J. W. Anderson, M.A. F.R.G.S. 1885.

This little work will be found, we think, to supply a much-felt want, especially among colonists, in whose way are so often thrown many mineralogical specimens, the value of which it is difficult for anyone not a specialist to determine. But it will also afford aid to many others who possess a taste for geological research. As the rule, handbooks of this description are either far too technical in their employment of terms to be useful to the uninstructed on the subjects with which they deal, or else, in the endeavour to avoid being so, they miss points of real importance. The author of the book under review appears to us to have been very successful in hitting the happy medium in this respect, and while he has placed his instructions before his readers in the plainest possible terms, he has led them on by degrees to the higher branches of the subject, gradually educating them up to the required standard for ready comprehension of them. Starting with general directions as to the leading natural conditions to which a prospector should give his attention, and then describing the principal features of a country denoting the probable presence of particular ores, Mr. Anderson proceeds to give simple rules for testing such ores when found, and for determining their constituent parts. The appearance of such ores under treatment by the blow-pipe or other reducing agents is tabulated in such a way as will enable the most unscientific to conclude as to the nature of the subject submitted to their action. The varied processes available for such treatment are fully and clearly described, and a valuable addition to the book is a short chapter on the elementary rules of surveying, sufficient to enable a fortunate prospector to mark out the ground which he may select as favourable for further research. The book is not free from faults and inaccuracies, but it is the best of its kind.

Naval Engineer Appointments.—The following appointments have been made at the Admiralty:—James Hook, chief engineer, to the Grappler, additional, for Gibraltar Yard; David E. Smith, chief engineer, to the Asia, additional, for service in Portsmouth Dockyard; Cornelius Pitt and Richard A. Shapcott, engineers, to the President, additional, for service at Woolwich; John S. Fussell, engineer, to the Pembroke, additional, for the Comus.

PRIVATE BILL LEGISLATION.

The coming events in the Parliamentary Committee-rooms next session have already cast their shadows ahead, and we can now form an idea of what the new Parliament will be asked to do to promote private legislation. For reasons not yet very apparent, there is this year a great falling off in the Bills and Provisional Orders, the plans of which have been deposited, the present total being only 174 as compared with 248 last year. These 174 are made up thus:—Railway Bills, 72; Gas and Water, 25; Tramways, 14; and Docks, 7; the miscellaneous Bills and the Provisional Orders making up the balance. And not only are there so many fewer schemes, but many of these Bills are not really projects, but are simply applications for leave to abandon works already sanctioned or to extend the period for completion. Neither are there any very big schemes advanced, such as recent sessions have produced. The Manchester Ship Canal turns up again, it is true, but the application is only for permission to pay certain dividends out of capital. Among the Bills relating to the metropolis is one for constructing a subway from South Kensington to Knightsbridge, and thence to the Marble Arch, which will revive the controversy of last session as to undermining and disfiguring Hyde Park. An illustration of the way in which some undertakings are delayed was brought before the St. George's Vestry, Southwark, the other day. The South-Eastern Railway Company, it appears, obtained an Act in 1882 enabling it, among other things, to make a connection between its terminus and some point in the East-End. Up to this time, however, it has not carried out this work, and it intends to ask Parliament for further time to do so. Such a connection would be of great value, and has long been hoped for, especially by people in the Borough. The expectation of this extension has in a sense impeded building operations, and on this ground, and also because the company is suspected of not seriously intending to construct the line, but of holding on to keep any other company out, the ratepayers, through their vestry, mean to oppose the application for an extension of time. In the discussion upon this subject it was incidentally mentioned that the Sevenoaks Railway was authorised twelve years before it was carried out, and was only completed in consequence of competition by the London, Chatham, and Dover Railway.

Among the measures which Parliament will have to consider next session is one relating to a compressed air-power system, which the Leeds Compressed Air-power Company desires, with the sanction of Parliament, to introduce into Leeds for application to various manufacturing and other operations. In due course we shall learn all particulars respecting the process, but in the meanwhile the following facts may be given:—It is proposed to erect a central station in which air will be compressed by large and powerful engines, and thence the air will be supplied by pipes and mains—in the same manner as gas and water—to all who desire it. The promoters claim that by taking this supply manufacturers will be able to dispense with boilers, stokeholes, chimneys, and other accompaniments of boilers, and obtain their power whenever they require it by simply turning on the tap, and so also save expense and avoid all the waste of getting up steam and blowing off, and get rid of the trouble and nuisance of disposing of ashes. To apply the service to existing steam engines only a change of connections will be necessary, and the air can be utilised for driving sewing and other machines for which steam power cannot be obtained, for working small electric light installations, for hoists, presses, hammers, refrigerators, and glass-blowing. There are many other operations to which the compressed air could be applied exactly as proposed for the Birmingham industries. The company proposes to start with only 3000-horse power, and eventually to go up to 20,000-horse power; and while accepting an absolute obligation to supply all who demand the service, it contemplates changes which will make this air power considerably cheaper than steam power to many users. In support of its case the company cites the experience—of course, on a narrower scale—of Birmingham, for which an Act somewhat similar to that now proposed was obtained last year. Mr. J. Sturgeon, M.I.M.E., is engineer to the company, Mr. Arthur Lupton, M.I.C.E., of Leeds, acting as joint engineer.

Volunteers, at least, will rejoice over the abandonment of a railway for which powers were obtained in 1881. In that year the London and South-Western Railway Company promoted and succeeded in passing a Bill for the construction of a new line between London and Kingston and Guildford. One portion of the line was to proceed, after leaving Putney, under Putney Heath, round the now famous shooting ground, Wimbledon Common, and thence to Kingston, where it would join the main system. When this project became known there was consternation and indignation among Volunteers, for the line if made would run close to the butts of the National Rifle Association, and the danger from such near proximity would, it was believed, eventually put an end to the annual shooting competitions. On the other hand, the residents on and round the Common warmly approved of the scheme, strongly disliking these meetings. Both sides did what they could to forward their wishes, but the Bill was passed. Now, however, it appears that the company has resolved not to proceed with this portion of its authorised line, and will ask for leave to abandon it next session. But it is intended, it is said, to go on with the line from Putney across the river to the District Railway at Fulham, as a necessary part of the Wimbledon and West Metropolitan Railway. It further appears that the company has decided to also abandon the railway authorised three years ago to give it a terminus at South Kensington.

THE LIVERPOOL WATER SUPPLY.

In view of the protracted drought, the Liverpool Water Committee decided last July to discontinue the constant service, and on the 18th July, the distribution of water in the city and in Bootle was limited to twelve hours per day. On the 28th August, the hours of supply in the city and in Bootle were further reduced to eight per day and in the suburban districts to eighteen per day. Concurrently with these restrictions, strenuous efforts were made to prevent waste and excessive consumption, and to reduce the quantity used for public purposes by employing salt water for street sprinkling, and by other means. The combined result of these measures was that the volume of water drawn for Liverpool from Rivington during the seventeen weeks ended on the 10th ult., was less by 338 million gallons than during the corresponding period of 1884. The reservoirs continued to fall until the 22nd September, when rain began to descend in sufficient volume to exceed the demand upon the reservoirs, which continued steadily to rise until a few days ago. The quantity in stock on the 18th ult. was 1630 million gallons. As the reservoirs hold, when full, 4080 million gallons, there is still a deficiency of 2450 million gallons before the overflow line is reached. Of the 16in. of rain which fell during the period of seventeen weeks above referred to, the proportion actually impounded and utilised, after allowing for the loss by evaporation, was 65¼ per cent., leaving only 2¼in. of the rain available for storage after supplying Liverpool, and giving the statutory compensation water to the rivers. During the last six weeks, when the ground has been saturated and the rain has fallen under conditions favourable to collection, the proportion impounded has been 88 per cent., showing the important influence of the circumstances under which the rainfall takes place in determining its value for waterworks purposes.

The following are the depths to the water in the several reservoirs at the present time, as given in a report by Mr. Joseph Parry, C.E. The measurements are from the overflow lines to the actual water levels; consequently they represent the depths in feet still remaining to be filled:—

	ft.	in.
Upper Roddlesworth Reservoir..	12	7
Lower Roddlesworth Reservoir..	5	5
Rakebrook Reservoir	5	5
Yarrow Reservoir	36	1
Anglezark Reservoir	13	5
Upper Rivington Reservoir..	12	10
Lower Rivington Reservoir..	19	7

The quantity now in store is 200,000,000 gallons in excess of the stock at the corresponding date of last year, but with the single exception of last year, the reservoirs are considerably lower than at the same date in any previous year since 1865. The total volume of Corporation water used for street watering is remarkable. During the period of seventeen weeks referred to it was 8,105,455 gallons—being less than half a day's total supply to the district—as against 27,180,710 gallons used during the corresponding period of last year, the saving under this head being, therefore, 19,075,255 gallons, or 160,295 gallons per day. This saving was chiefly the result of communications addressed by the Water Committee to the Health Committee, to the Mersey Docks and Harbour Board, and to the local authorities around Liverpool, requesting them to use, as far as practicable, salt water for the purpose of watering the streets, and to make every effort to diminish the consumption from the public mains. Salt water was employed to the extent of 2,968,845 gallons, and was taken from temporary pumping stations established along the line of docks and from the Cornwallis-street salt water main. The use of salt water was limited by the distance to which it had to be carted.

THE NEW HALL FOR THE JAPANESE VILLAGE.

The Japanese village, opened at Knightsbridge on 10th January of the present year, was visited by nearly 300,000 persons before it was burnt down on 1st May, with a loss of about £25,000 mainly covered by insurance. The inhabitants have since been plying their trades at Munich; but on Wednesday fortnight they reassembled at a village twice the original size, put up, under the direction of Tannaker Buhicrosan, in the new Humphreys' Hall. A miniature lake and cascade have been added, with Japanese bridge very much like that figured in the old willow pattern plates. The bridge is flanked on one side by a pair of bronze memorial vases, taken from a Japanese temple and said to be 700 years old; and near them is a bronze casting of imposing outline and most elaborate ornamentation, the work of several generations, priced at £2000. There are no less than sixty shops and houses, coated with silicate paint, and lighted at present by gas with Sugg's burners, while the interior of the building is lighted by pipes, 4ft. long, with jets, projecting from the wall; it is intended, however, to illuminate the building with arc and the shops with incandescent lamps. An agreeable temperature is maintained by Benham's system of coils with hot water; and, to ensure the immediate extinction of any fire that might break out, a 4in. main has been laid, in addition to the existing water supply, and connected with ten hydrants disposed by Merryweather about the building. The Japanese performances are now given, not in the building containing the village, but in a new shebaya, which is no other than the old Sun Music Hall, acquired by Mr. Humphreys', contractor for the iron buildings of the South Kensington official exhibitions, and thrown into his property. The new hall has been made quite fireproof, and great attention has been bestowed on means of ingress and egress, so as to avoid a crush in the event of panic. The hall has no stairs and no passage narrower than 9ft. In addition to the main entrance, there are four main exits, all 10ft. wide, while communication between the several portions of the block of buildings may be cut off by means of wrought iron doors. The ground area of the new hall is about 500,000 square feet; and works are now in progress for throwing another 22ft. into the width. The floor is constructed with rolled iron joists, the spaces between them being filled in with 12in. of concrete, directly over which are laid 2½in. of wood blocks. The height from floor to springing of roof spans is 36ft. There are two central spans of 50ft., and at present one side span of 30ft., which will eventually be repeated on the other side. The roof, which is remarkably light, is supported on elegant columns, with twisted shafts and octagonal bases, cast at the Cadogan Ironworks, Chelsea. The plans were prepared by Mr. Spencer Chadwick, F.R.I.B.A., the new restaurant being designed by Mr. Thos. Verity. The whole work has, with the assistance of Mr. Humphreys' Birmingham branch, been carried out practically in three months, under the direction of Mr. R. J. Boon, clerk of works, at a total cost of about £12,000.

The United States Navy.—The Chief of the United States Naval Bureau of Steam Engineering, engineer-in-chief Chas. H. Loring, submits his statement of expenditure and estimates, and a detailed report of the work done upon each vessel, and that at present required. He urges the building of a new boiler shop at the New York Navy-yard. The floating derrick referred to in his last report was found so defective that a contract has been made for a new one to be built entirely of steel, at a cost of 60,680 dols. It will be a most useful appendage to the New York Navy-yard for lifting heavy weights. During the year 847,900 dols. 46c. has been expended, besides 803,037 dols. 67c. on the machinery of the double-turretted monitors, and 781,075 dols. 26c. on the machinery of the new cruisers, viz., Atlanta, 241,284 dols.; Boston, 243,117 dols.; Chicago, 344,556 dols.; Dolphin, 794,715 dols. There is a balance on hand on this last account of 118,676 dols., which, it is expected, will be required to pay the cost of steam trials, "civilian experts" and other extras. New boilers have been or are being fitted to the Adams, Alliance, Fortune, Marion, Monocacy, Omaha, Vandalia, and Wyoming, and new engines and boilers complete in the Mohican. The total expenditure for engines, boilers, and machinery has been 899,225 dols., and for stores and outfits, 107,212 dols. At the Navy-yards 244,710 dols. has been expended for yard expenses, and 90,842 dols. for miscellaneous expenditures. For sea service the following vessels require new boilers:—Ajax, Canonicus, Franklin, Lackawanna, Minnesota, Powhatan, Quinnebaug, Saugus, Swatara, Tennessee, Triana, and Wabash. The Essex is being generally overhauled and repaired, and the Enterprise, Juniata, Kearsarge, Nipsic, and Palos shortly need this. New boilers will soon be required for the Galena and Hartford. The New York requires the new machinery and boilers now on hand for her.

ATKINSON'S GAS ENGINE.

THE BRITISH GAS ENGINE COMPANY, LONDON, ENGINEERS.

Fig. 4

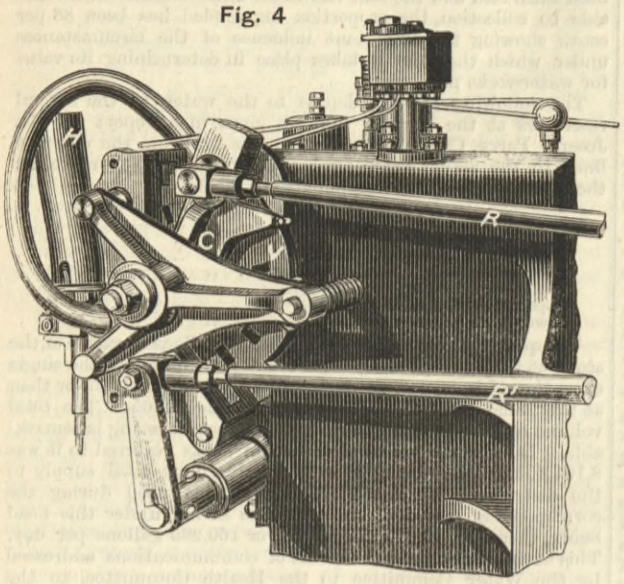


Fig. 1

PLAN

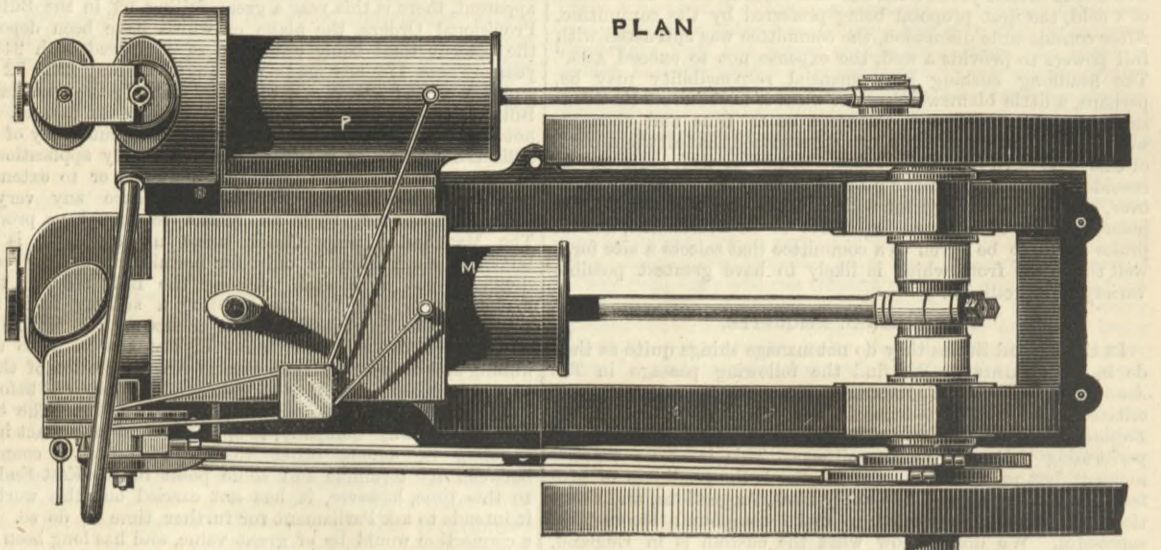
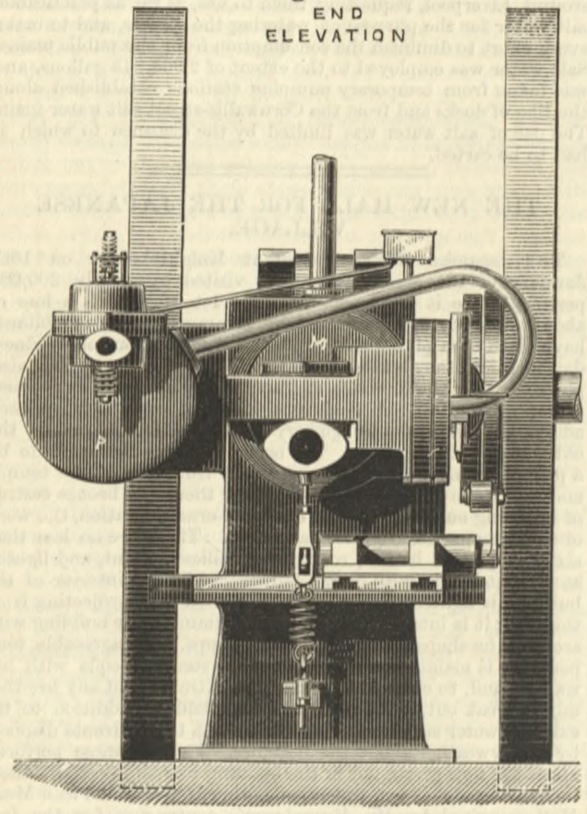


Fig. 3

END ELEVATION



SIDE ELEVATION

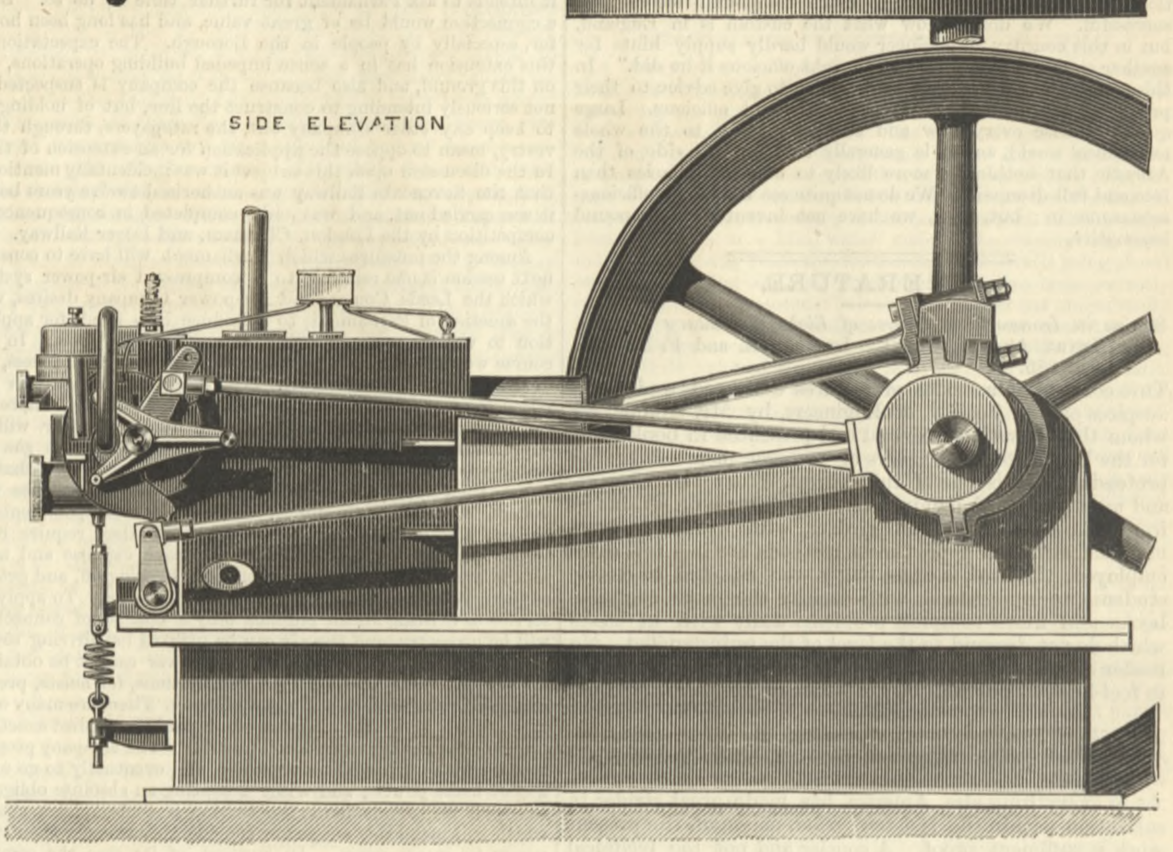


Fig. 2

GAS ENGINES AT THE INVENTIONS EXHIBITION.

No. V.

By the engravings given below we illustrate a gas engine which belongs to type 3, as classified in our impression for the 2nd October. It is, therefore, a compression engine, and is made under Atkinson's patents by the British Gas Engine Company, Mansfield-road, Gospel Oak. During the last few months it has received important modifications and improvements. This engine has a single-acting working cylinder and a separate single-acting compressing pump fixed on the side parallel to each other. The crank pin which drives the pump connecting-rod is set a little behind the main crank, so that the working piston completes its stroke a little earlier than the pump piston. The pump draws in a uniform mixture of air and gas on the outward stroke, and compresses it to about 60 lb. on the return stroke. It is compressed to this pressure in the end of the pump just previously to the working piston completing its exhausting stroke, when the exhaust valve is closed, the slide opens communication between the pump and the working cylinder, and the compressed charge is transferred to the working cylinder during the time the pump piston completes its stroke, and the working piston makes a short portion of its outward stroke. The slide then cuts off communication with the pump and ignites the charge, causing the pressure to rise so as to give the working stroke.

As will be seen, the slide, if we may call a rotary valve a slide, has an intermittent movement given to it by a ratchet and pawl, worked directly by an excentric on the main shaft. It is moved one tooth for each revolution of the engine, so that there is only one revolution of the slide for several of the engine. Two-thirds of the slide is always exposed to the air, and it keeps cool in consequence. There are ports cut through the slide—one for each ratchet tooth—but otherwise there are no ports, passages, or grooves. The pressure to keep it up to its work is a definite amount, and cannot be exceeded, so that these slides never cut, and work in a most satisfactory manner. The illustrations are of 12 nominal horse-power size. The expansion is carried so far that the final is more than the original volume. It will be understood that the crank pin is in such a position when ignition takes place that the piston is approaching its highest speed; also that the terminal pressure is about 20 lb., so that the expansion is continued to, say, 50 per cent. beyond original volume. The inventor found that the advantages gained in this manner were evident in working, and were chiefly the cause of their being followed up to their logical development in the "Differential" engine. See The Engineer for the 7th August, 1885.

The exhaust valve is operated by an excentric and rocking shaft, so that there is no gearing. The governor is automatic, and operates so as to reduce the quantity of charge delivered into the working cylinder; but with the smallest amount it will give a working stroke every revolution, as shown in the diagrams published. It keeps a regular speed, and there is no fear of the engine running away; because, if anything about the governor should break or give way, the tendency is to slow down, or stop the engine.

The makers fit a self-starting gear to their large engines. It consists of a starting valve on the end of the cylinder, a stop valve of special construction, and a reservoir to contain compressed ignited gases obtained from the ignitions of the engine itself. The engine is started by placing the crank-pin in a favourable position, opening the starting valve so as to admit pressure on to the piston which starts the engine; this is continued each time the crank comes round, till the engine runs itself, which it usually does at the second or third revolution.

Referring to the engravings, Figs. 1, 2, 3, and 4 above, we have plan, side, and end elevation of the engine, and a separate view of the valve gear.

The accompanying diagrams, Fig. 5, are from the engine loaded and not fully loaded, the admission of the combustible charge being reduced by the governor. The pump

Fig. 5

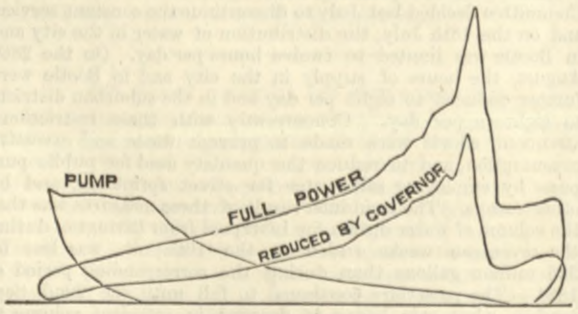
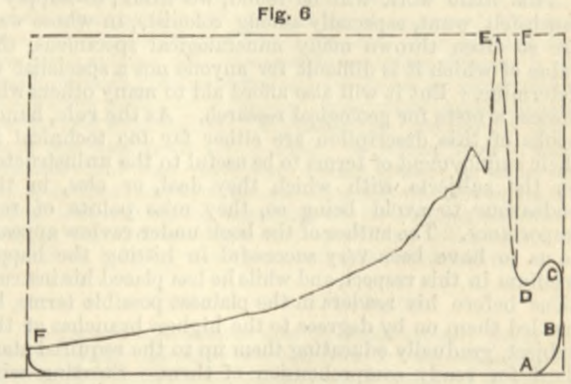


diagram gives the pressures in the pump when the engine is in full work, and the area of this diagram has to be deducted from the motor cylinder diagram in obtaining therefrom the effective pressures and indicated power. Fig. 6 is another full power diagram, given without the pump diagram for clearness. Following this diagram out and commencing at A, it will be seen that there is compression from A to B. The end of the stroke being reached at B, communication with the pump P—see Figs. 1 and 3—is established, and the pressure immediately rises from B to C—Fig. 6—and the piston stroke commences, the combustible mixture being admitted 0·116, or about one-ninth, of the stroke. C D may be thus called the admission line, the combustible mixture being at a pressure of about 60 lb. At D ignition takes place, and pressure immediately rises to E; but the combustible charge being

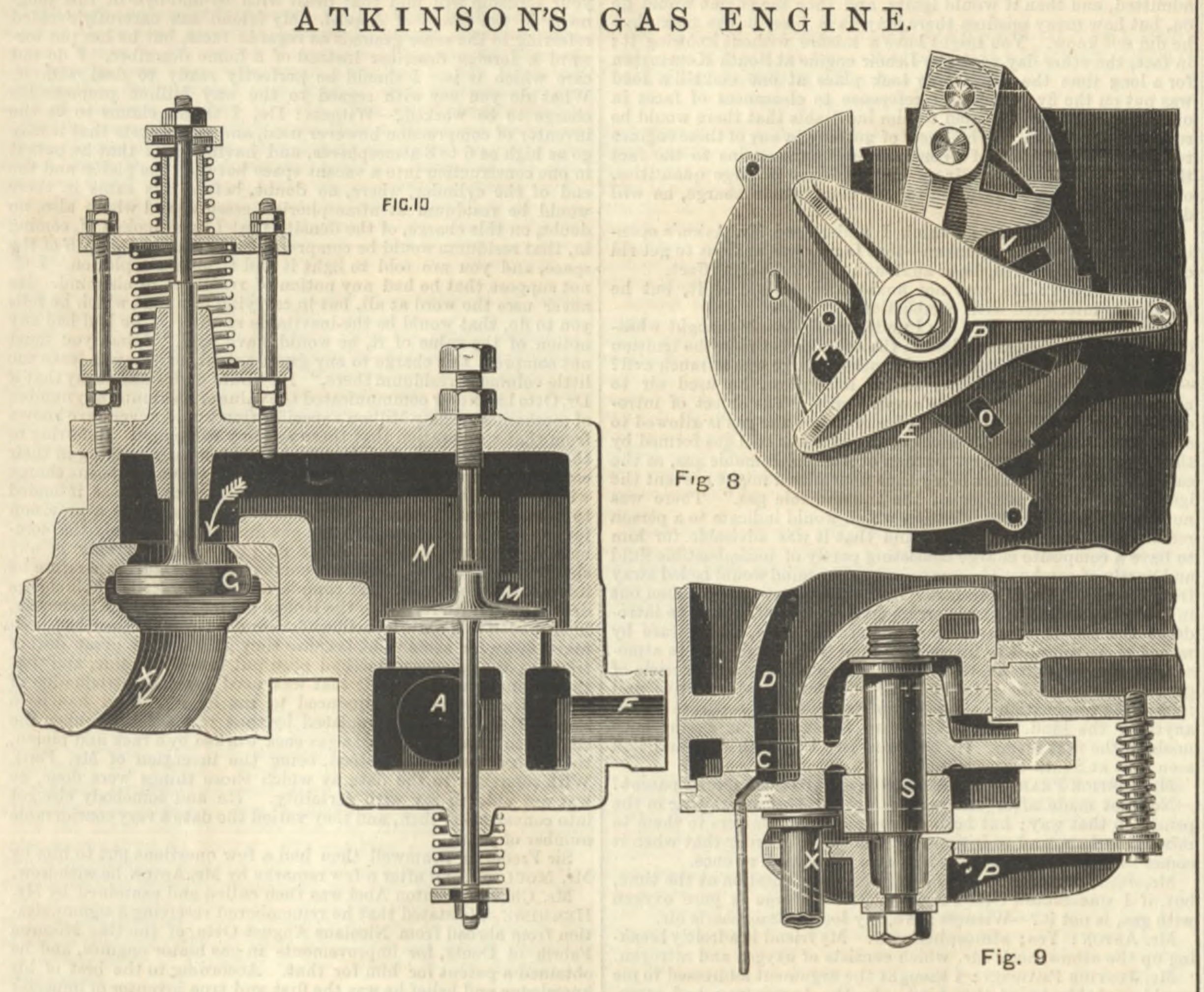
Fig. 6



a uniform mixture, the combustion of which is rapid, but hardly what would be called explosive, a very sensible period of time being occupied in realising the full pressure. This is shown by the distance between E and F. The line D F would be followed by the indicator pencil if the combustion was completed instantaneously or explosively, but as a sensible time is occupied in the combustion, the distance F E is traversed by the piston before full pressure is realised. F E is equal in the diagram, Fig. 6 to about a twenty-fifth part of the whole stroke, and the engine making 150 revolutions per minute or 300 strokes, each stroke will be made in one-fifth of a second, and the twenty-fifth part of the stroke will be performed in the $\frac{1}{125}$th part of a second; that is to say then, that complete ignition occupies one $\frac{1}{125}$th of a second. From E to H the pressure drops very rapidly, but after this it falls at a lower rate than would attend the expansion of an incombustible gas as air, showing that there is great probability in the idea that absolutely complete combustion does not take place until a considerable part of the stroke has been made.

The power and pump diagrams may be placed relatively, as shown in Fig. 7, in which the shaded portion is the pump diagram, the area D E F D being the effective

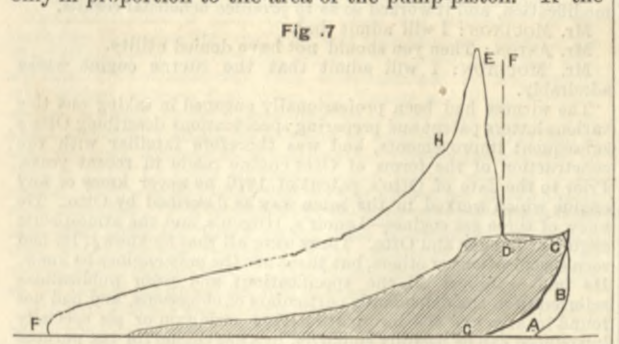
ATKINSON'S GAS ENGINE.



DETAILS OF VALVE GEAR.

motor diagram. It will be observed that the pump piston on its suction stroke starts with some pressure behind it, as shown by the curve C G, this being no doubt due to the re-expansion of the compressed gases in the pump-piston clearance and port passages. This gives an area A B, which may be credited to the power diagram, but of course only in proportion to the area of the pump-piston. If the

Fig .7



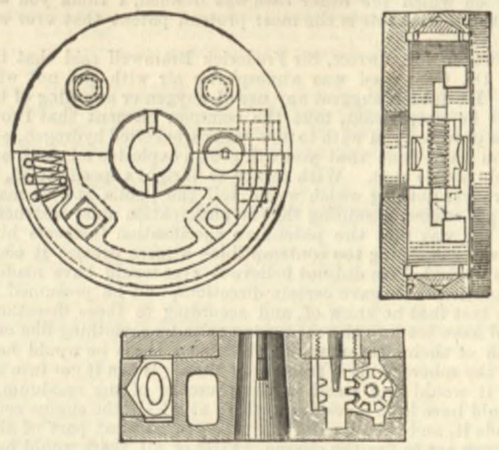
pump-piston be of the same area as the motor piston, the area A B may be credited direct. The effective stroke of the engine is of course less than the whole stroke by the length of the period of admission C D.

The perspective view in the left-hand corner above, together with Figs. 8 and 9, show more clearly the arrangement of the main valve, while Fig. 10 shows the arrangement of the gas and air admission and mixing valve, and the automatic governing valve. In Fig. 4, R is the rod working the admission and ignition valve V, held in place under the port cover C by the three-armed plate P which is adjustable as to the pressure it puts upon the valve V by the power given to the spring shown at Fig. 9. The valve V is moved one tooth per revolution of the engine by the pawl K, Fig. 8, the ports in the valve being the necessary distance apart. The exhaust valve is moved by the rod R¹. The valve V is seen in section at Fig. 9, which shows the admission port D to the cylinder, to which the combustible mixture is brought by the pipe X and ignited by being admitted inside the ignition tube, which is kept red hot by the flame at H, Fig. 4, entering at E, Fig. 9, through the valve V. Turning to Fig. 10, we have at F the entrance of the gas, at A the air inlet, the air and gas passing through ports under the valve M into the space N, where it mixes, the mixture passing on its way to the pump cylinder past the double-seated valve G and the passage X. The valve G is an automatic valve supported by differential spiral springs adjusted so that insufficient speed will cause the valve to seat itself on its lower seat more slowly than when the engine is running fast, and more combustible mixture is thus admitted. When the engine exceeds its proper speed the rush of gases causes the valve to seat itself more rapidly, and thus to shut off the supply earlier. Although the valve V is a rotary disc, its movement is so slow and the pressure upon it so small that the differential wear upon it, due to the different speeds of movement at different distances from its centre, will not make itself perceptible.

Mr. J. Cochrane, of Barrhead, near Glasgow, is about to make both the above and the differential engine, under licence, for Scotland.

GILLOTT'S ADJUSTABLE PISTON.

The annexed engravings illustrate the adjustable expanding piston, shown by John Gillott and Sons, Barnsley, at the late Mining Exhibition, Glasgow. To set up this piston, the lock-nut is slacked by a key fitting the square recess, and then, by similar means, the worm is turned, which rotates the worm-wheel forming nut to the right and left-handed screws, the ends of which butt against lugs on the segments of the internal V ring, and thus compress the spiral spring. The pressure of this spring forces the segments of the V ring against the external rings, making them tight against the inside of the cylinder and also against the cover and bottom of the piston. When the requisite tightness is obtained, the lock-nut is screwed down upon the

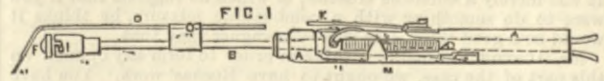


worm, thus preventing its turning. The worm and its box, worm-wheel and screws are made of phosphor bronze, so that there is no danger of their setting fast or rusting up. By this arrangement the spring may be adjusted to the utmost nicety without removing the piston cover and while under steam pressure. As the piston is set up in the direction of its periphery instead of radially, it is more likely to follow the contour of the cylinder, thus securing tightness with a minimum of friction.

AN IMPROVED LARYNGOSCOPE.

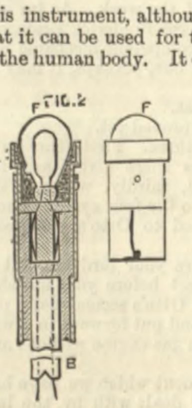
Under the above title a new and improved instrument for examining the human throat, by means of the electric light, has been designed by Mr. Arthur H. Vesey, C.E., and brought to its present state of perfection by Dr. Felix Temon, F.R.C.P., Mr. Vesey, and Mr. F. Weiss, surgical instrument maker, Strand.

FIG. 1



This instrument, although called a "Laryngoscope," is so small that it can be used for the examination of almost every cavity of the human body. It consists of an ebonite handle A about 3in. long by $\frac{1}{2}$in. diameter, and is hollow; through this the conducting wires are led, and are afterwards taken through a thin tube of German silver, B, 7in. long, attached to the handle, and from where they make connection with the small lamp F fixed at the end of the afore-mentioned tubes, and which is embedded in plaster of Paris inside a small ebonite cup. This cup together with the lamp are made detachable by means of an improved bayonet joint, so that in case a lamp breaks a fresh one can be inserted at a moment's notice. The current is stored in small pocket accumulators, and up to the present Mr. Vesey states he has not come across anything that can supersede them, as regards portability, but strongly advocates the use of the agglomerate form of the Léclanché battery, where a surgeon does not object to carry a small box containing them. By using this form of battery he gets rid of the charging of the accumulators, and always has a supply ready for use. A small resistance coil is fitted to the handle, and the surgeon can diminish the light by moving a small piece of German silver with his thumb, whilst he keeps the switch pressed down with his first finger. In order to examine the throat a small mirror is attached to the German silver tube, and by means of a sliding collar the naso-pharyngeal cavity can be examined by simply twisting this collar round whilst the instrument remains in its normal position in the hand of the operator. Several of the first London surgeons are now using it; it is also in use at some of the London hospitals. The instrument is made by Messrs. Weiss, of the Strand, and is patented by Mr. Vesey.

FIG. 2



THE WOOTTEN ENGINE.

We have received the following additional particulars of the huge Wooten engine illustrated in our impression for November 20th:—

General Dimensions of Engine, 96, Class D 44, P. and R. R. R. Company—

	ft.	in.
Diameter of cylinders	1	9
Stroke of cylinders	1	10
Centres of cylinders	6	5
Steam ports	19in. × $1\frac{1}{2}$in.	
Exhaust ports	19in. × 3in.	
Lap of valve outside	0	$1\frac{1}{8}$
Throw of excentrics	0	$5\frac{1}{2}$
Travel of valve maximum	0	7
Centres between driving wheels	7	0
Centres between truck wheels	6	2
Centre of main driving wheel to centre of truck	11	0
Total wheel base	21	1
Distance between frames	3	4
Diameter of driving wheels on tread of tire	5	[illegible]$\frac{1}{2}$
Diameter of truck wheels on tread of tire	2	9
Diameter of driving axle journals	0	$8\frac{3}{4}$
Length of driving axle journals	1	$0\frac{1}{2}$
Diameter of truck axle journals	0	$5\frac{1}{4}$
Length of truck axle journals	0	10
Dimensions of main rod bearing on crank pin—length	0	5
Dimensions of main rod bearing on crank pin—diameter	0	$5\frac{1}{2}$
Extreme length of engine over pilot	34	7
Extreme height of engine from rail to top of stack	14	4
Extreme width of engine	9	0
Length of fire-box inside	9	6
Width of fire-box inside	8	$0\frac{1}{8}$
Length of fire-box outside	10	$4\frac{1}{4}$
Width of fire-box outside	8	$8\frac{1}{4}$
Length of combustion chamber	2	$10\frac{1}{4}$
Number of water bars in grate	14	
Outside diameter of water bars	0	2
Distance from top of grate to bottom of fire-door	0	$3\frac{3}{4}$
Distance from top of grate to crown, front	2	10
Distance from top of grate to crown, back	2	$2\frac{1}{2}$
Diameter of boiler at smoke-box, outside	4	5
Diameter of boiler at dome, outside	4	$10\frac{3}{4}$
Diameter of dome, outside	2	$4\frac{1}{4}$
Height of dome	2	$4\frac{1}{4}$
Thickness of steel side, crown, bridge, and door sheets on inside of fire-box	0	$0\frac{5}{16}$
Thickness of steel side, top, and door sheets on outside of fire-box	0	$0\frac{3}{8}$
Thickness of boiler at dome, steel	0	$0\frac{5}{8}$
Thickness of boiler front course, steel	0	$0\frac{9}{16}$
Diameter of stay bolts in fire-box	0	$0\frac{3}{4}$
Diameter of stay bolts in crown sheet	0	$0\frac{7}{8}$
Distance from rail to centre of boiler	8	$1\frac{5}{8}$
336 iron tubes $1\frac{1}{2}$in. outside diameter		
Heating surface in tubes	1212 sq. ft.	
Heating surface total	1417 ,,	
Grate area	76 ,,	
Sectional area through tubes for passage of gases	446 sq. in.	
Working pressure of boiler per square inch	160 lb.	
Factor of safety	6	
Horizontal seams of boiler triple-rivetted		
Circumferential seams of boiler double-rivetted		
Weight of engine on truck in working order	31,900 lb.	
Weight of engine on drivers in working order	71,950 ,,	
Total weight of engine in working order	103,850 ,,	

The engine is provided with steam reverse and Richardson's balance slide valves.

Tender—

Capacity of tender for water	3500 gals.
Capacity of tender for coal	12,000 lb.
Number of truck wheels	8
Diameter of truck wheels	2ft. 9in.
Total wheel base	16ft. 10in.
Extreme length of tender	24ft. $1\frac{1}{2}$in.
Weight on front truck loaded	36,250 lb.
Weight on back truck loaded	33,750 ,,
Total weight of tender	70,000 ,,

Miscellaneous—

Total wheel base of engine and tender	50ft. $8\frac{1}{2}$in.
Total length of engine and tender	58ft. $8\frac{3}{8}$in.
Total weight of engine and tender	173,850 lb.

London Sanitary Protection Association. — At a Meeting of Council of this Association, held last Friday at their office, 1, Adam-street, Adelphi, Mr. E. B. Ellis Clarke, M. Inst. C.E., was appointed consulting engineer to the Association in succession to the late Professor Fleeming Jenkin.

Liquid Fuel in the Navy.—Another experiment is being made at Portsmouth with the object of determining the practicability of applying liquid fuel as a steam generator to men-of-war. Several systems have been already tried, but the difficulties which presented themselves in the shape of smoke and irregularities of combustion were found fatal objections. The present system under trial is one submitted by Colonel Sadler, of Middlesbrough, and has been previously tested with satisfactory results by private companies in Portsmouth and elsewhere. The fuel consists of creosote, which is procurable at a penny a gallon. It is contained in a tank, and is kept at a uniform temperature and consistency by steam coils inside the tank, from which it is forced into the furnace by means of steam injectors. No engine is used in the present experiment, which is confined to comparing the respective values of a pound of coal and a pound of the liquid fuel as evaporators of water. A man-of-war can only carry a limited weight of fuel, so that a comparative test of the weight of the two generators is the most practicable that could be applied. So far the system has proved superior to others previously tried, and it is believed that the difficulties in the way of the use of liquid fuel are in a fair way of being overcome.

The Duke of Bedford's Electric Launch.—The official trial of this launch took place on Wednesday 9th inst., at Westminster, in the presence of a number of spectators. The boat has been specially designed for use in connection with the steamship Northumbria, which has for some time been lit with the electric light, and when not in use will be suspended from the ship's davits. The motive power is supplied from twenty-nine of the E.P.S. accumulators, which will also supply currents to the lamps in the ship when not required for propulsion. The charging of the cells is effected by the same dynamo that lights the ship, so that no special apparatus is necessary, and when fully charged the launch will run at a speed of about six knots for four-and-a-half hours. The boat has been fitted throughout by the Electrical Power Storage Company, of 4, Great Winchester-street, and contains several improvements in the manipulation and reversing gear on those previously made by the company. The length is 28ft. by 5ft. 6in. beam, and the cells are placed in a box in the centre of the boat, the box serving as a seat. There were present at the trial Lord Sudeley, Mr. White—Director of Naval Construction—and Major-General Webber, C.B., and the Storage Company was represented by Mr. J. Irving Courtenay, Mr. Bernard Drake, and Mr. J. W. Gorham. The trial was satisfactory.

LEGAL INTELLIGENCE.

HIGH COURT OF JUSTICE, CHANCERY DIVISION.

Before Mr. Justice Pearson.

OTTO *v.* STEEL.

At the commencement of proceedings on the third day, Mr. Moulton stated with regard to the United States patent of Atwater, that he was not prepared at present to prove publication. If he proved publication afterwards, and put it to his witnesses, his learned friend would have the right to recall Sir Frederick Bramwell to ask him about it.

Mr. William D. Fletcher was then called, and examined by Mr. Moulton in reference to the publication of certain other books and documents named in the particulars of objections. These were "The Practical Mechanics' Journal," second series, and the third series "Chambers' Encyclopædia," "Der Practische Maschinen Constructeur," "Atlas des Vereins Deutscher Ingenieurs," and "Polytechnisches Centralblatt." Some of these were admitted by Mr. Aston without comment, but on others considerable discussion took place. Ultimately all were admitted except one or two of the foreign works, as to which further evidence would be given. The witness then withdrew.

Sir Frederick Bramwell was then re-called and re-examined by Mr. Aston. Alluding to the plaintiff's specification, he stated that in it three modifications were described, and in every one of those three it was a fact that the introduction of gas and air as described and shown in the drawings is an introduction of gas and air, so that what is in the cylinder before is pushed before the stream that enters. With regard to the words on page 5, "It will be evident that if a space or a separate chamber be used," and the sketch which Mr. Moulton had produced, the witness pointed out that the separate vessel should be arranged so that the entering of the combustible charge pushed before it the residue of incombustible gas which would be in the cylinder. If the separate vessel was at the side, then on the opening of the slide which is attached to that separate vessel, there would be the entrance of the combustible charge expelling the residuum which was in the separate vessel.

Mr. Justice Pearson: It seems to me the clumsiest arrangement one ever heard of, with all deference to the engineers.

Mr. Aston: Very likely.

Mr. Justice Pearson: It seems to me it would be what I may call a very perverse arrangement.

Mr. Aston: Yes, and it is a perverse arrangement people have recourse to when they want to avoid infringement. When it is reduced to practice it is not quite so impracticable an arrangement as it appears.

Mr. Justice Pearson: I do not say it is impracticable, but it is going out of your way to do something which common sense would tell you to do another way.

The Witness: Putting the slide valve beyond the vessel, instead of at the back of the cylinder, as in Mr. Moulton's sketch, would be more likely to obtain certainty of having the charge as it should be at the point of ignition than the suggestion made by Mr. Moulton, and would be more in accordance with the description of the claim that the admission is to be as and for the purpose described.

Mr. Justice Pearson: I do not think that is Mr. Moulton's objection.

Mr. Aston: If I understand Mr. Moulton's objection, it is this, that there is a certain expression in the specification directing a certain modification to be made, and that that direction, if followed out, would result in something which would be outside what the patentee tells you should obtain.

Mr. Justice Pearson: No, I do not understand it in that way. Of course I may be wrong. I am not going to ask Mr. Moulton to put his objection. The objection I understand is this. The specification is so framed that if a mechanic making this machine according to the specification adopted the side chamber he would find himself aground.

Mr. Aston: Exactly, that is my point; he would find himself aground. Now, if your lordship will bear with me, the question is directing the attention of the person who wanted to carry out the invention to the context, is it not the fact that he need not get aground unless he were minded so to do? Witness: I should like to make an observation before this is passed from. In my judgment, if an engine were constructed according to the mode sketched by Mr. Moulton, it would be an improvement upon an engine which had not got that air or residuum in that adjoining vessel. It would be an improvement upon it, but it is not the way in which a man honestly desiring to carry out the instructions given by the patentee would go to work.

Mr. Justice Pearson: You have pretty nearly answered the question I was waiting to put to you until Mr. Aston asked you. Take the one where there is simply the cylinder at the side for the residuum and the air, not having the mixture put at the further end of it, so as to act in the same way as it would do if it were at the back of the piston, and you fired a charge at the back of the piston, if I may call it so, might not the result be this, that the charge would take effect before the effect of the air and residuum in the cylinder had any practical operation?—Witness: No, my lord, I think not, and for this reason. Then you would have introduced into the engine a charge of air or of incombustible mixture in excess of the combustible charge, and, in my view, whether that charge is in the best position or not, it is a benefit to have it there for this reason, that when the pressure is created by the ignition of the combustible charge, that pressure finds a cavity filled with a yielding material, into which a portion of the pressure—if I may so phrase it—can go, thereby taking off the shock, storing up pressure at the outset, which pressure will be given out to preserve the continuous push in the piston during the remainder of the stroke.

In answer to Mr. Aston, Sir Fred. Bramwell stated, in reference to the prevention of shock, that whether Dr. Otto's theory as to the dispersion of the gases was right or wrong, the directions given in his specification produced the beneficial result pointed out by Dr. Otto. The patentee might be all wrong, but he knew as a fact that from the date of his patent the gas engine had become, and is becoming daily, a practically useful machine used on numerous occasions, and every day becoming more useful, and being made larger and larger; and that prior to his patent, with the exception of his own free piston, the gas engine was simply a thing that was condemned. Whether he was right in his explanation he did not say. He thought he was. He might be entirely wrong, but he had told the public to make an engine which fulfilled the conditions of quiet working, successful working, and great economy in the use of the gas. The difference between getting slow combustion by having a general dilute mixture and endeavouring to do it as Dr. Otto tells you to do it, by having stratification, so that you have that which is rich or dense, as he calls it, near the point of ignition, and shades off as you go towards the piston, is this, that where you have the same quantity of gas distributed throughout the whole mixture, the extreme probability is that you would not get ignition at all, and whenever you fail in ignition, the whole charge of gas for that stroke is pushed out into the air, having done nothing; whereas by doing that which the patentee tells you, you get that local richness which insures ignition, and you get the other benefits he has spoken of. The result is that these engines work with 25 cubic feet of gas per horse-power per hour, whereas, he thought, that prior to that 70ft. were used. Asked whether in his experience he had ever known any gas engines that had been worked upon the principle of having a weak diluted charge so as to obviate shock, he stated that no doubt in such of Lenoir's engines as did work, where the governor operated upon the gas valve only, then the charge under certain circumstances must have been extremely diluted. Whether it ignited or not he did not know, because the cure would be this, the engine would fall off in speed, the governor would go down, more gas would be admitted, and then it would ignite, and then the engine would go on, but how many misfires there may have been in the meantime he did not know. You might have a misfire without knowing it; in fact, the other day with the Lenoir engine at South Kensington for a long time the firing only took place at one end till a load was put on the fly-wheel. In reference to clearances of faces in other gas engines, it seemed to him inevitable that there would be residuum left in all, but he knew of nothing in any of these engines to direct the attention of a constructor of a gas engine to the fact that if he takes pains to stir up his residuum in large quantities, or to introduce air in addition to the combustible charge, he will do good.

Mr. Justice Pearson: I think I understood Mr. Aston's opening—very likely I was mistaken—that Lenoir was anxious to get rid of the residuum?—Yes, he is anxious to neutralise its effect.

Mr. Moulton: He was not anxious to get rid of it, but he thought it interfered with combustion.

Mr. Justice Pearson: As I understand, Lenoir thought whatever there was of residuum left in the cylinder between the ignition of one charge and the ignition of another charge was so much evil?—Witness: Yes. According to his letterpress, he used air to neutralise it. In the patentee's own words, "The object of introducing a supply of air into the cylinder before the gas is allowed to enter is to neutralise the effect of the carbonic acid gas formed by the combustion of the first portion of the inflammable gas, as the carbonic acid gas without being thus neutralised might prevent the ignition of the remainder of the inflammable gas." There was nothing in Lenoir's specification which would indicate to a person reading with the most willing mind that it was advisable for him to have a composite charge consisting partly of incombustible fluid and partly of combustible compound. The mind would be led away from the object that Otto has. In a subsequent patent taken out in 1861, Lenoir modifies his arrangement of 1860 so that he introduces the gas in streams through circular holes, taking care by means of an annulus to introduce round each stream of gas atmospheric air; so that he takes infinite pains that every particle of gas shall have the air close by it for the purpose of effective and immediate combustion—there is no suggestion of separate air or anything the kind. He never knew of any Lenoir having been made in the first form. He had seen the Petworth one, and had seen that at South Kensington.

Mr. Justice Pearson: Are those made after the second patent?—No; not made after the second, not in so far as drawing in the pencils in that way; but both of them have got mixers to them to mix gas and air, and to intimately mix them, in order that when it comes into the cylinder it may be able to light all at once.

Mr. Justice Pearson: I did not ask the question at the time, but, if I understand Otto's rightly, Otto's charge is pure oxygen with gas, is not it?—Witness: No, my lord; atmospheric air.

Mr. Aston: Yes; atmospheric air. My friend is adroitly breaking up the atmospheric air, which consists of oxygen and nitrogen.

Mr. Justice Pearson: I thought the argument addressed to me would probably be of this kind. In the Lenoir you had atmospheric air and gas; you constantly therefore had the nitrogen as connected necessarily and naturally with the cushion. If you in Otto's plan substitute for atmospheric air pure oxygen, and mix the oxygen with gas, then if you put in air or residuum, you only do that which Lenoir did by using air instead of oxygen.

Mr. Aston: No doubt that might be put. I am not going to controvert that. It will be a question of quantities then. All this is the argument which has been addressed before.

Mr. Justice Pearson: I am not pushing an argument upon Mr. Moulton.

Mr. Moulton: My learned friend suggested that this was the argument which was put before. When we come to examine the evidence on which the other case was decided, I think you will agree with me that this is the most protean patent that ever was started.

In answer to Mr. Aston, Sir Frederick Bramwell said that the mixture Dr. Otto used was atmospheric air with gas, not with oxygen. He did not suggest any use of oxygen or anything of the kind, but he simply said, take the common element that Providence has provided you with to mix with carburetted hydrogen, and when you have done that you will get an explosive mixture, and he says do not do that. With regard to Wright's specification, he said there was nothing which would tell the public how to make an Otto gas engine, assuming that an anticipation must instruct a man in the way that the patentee's specification instructs him. Wright was something too contemptible—a mere dream; it could not have worked. He did not believe it ever would have made a half revolution. He gave certain directions, and he presumed he gave the best that he knew of, and according to those directions, he would have got into the measuring cylinder something like only one-tenth of their contents, and then from those he would have got into the spheres only a fraction of that. When it got into the spheres, it would find itself in the presence of the residuum, if there could have been a residuum there at all—if the engine could have made it, and then he did not tell you at what part of that mixture you are to fire the charge. First of all, there would have been no appreciable quantity got in; and secondly, when in, he did not tell you how to fire it; he does not tell you where you ought to fire it. He would undertake to say that an engine made according to that never could have worked. With reference to Barnett's, he said that adopting the ingenious suggestion of Mr. Moulton, that if you sacrifice about half of your gas and let it go into the end of the cylinder where the patentee said it was not to go in, and keep it out of the end where he said it was to go in, then you may do so, but he very much doubted whether you will get motion in it. If you did work it in that way, you would work it in entire contradiction to the directions of the letterpress, and you would get an engine of such a wasteful character that no one would ever buy it or use it. It never occurred to him that anyone could think of working an engine in the way suggested by Mr. Moulton, having regard to the cost and the frightful waste of gas, as suggested by the patentee, and as the patentee tells you it is to work, it could not. The gas would go in at the wrong end. When you wanted it to go to the bottom, it would go into the top. He did not consider that Beau de Rochas described a gas engine at all. It was merely a scientific treatise, in which he suggests that if you were to do something with a combustible mixture, he thinks it would be a good thing. It was even vaguer than that.

Mr. Justice Pearson: I think in order to form any opinion on this part of the case, we ought to have Rochas' work. You have a certain number of lines here taken out of the work. As far as I have read those lines, I should agree with Sir Frederick Bramwell that it must be a description which any competent mechanic can understand. Perhaps this is theoretical, but, perhaps, it may be reduced to practice.

Mr. Aston: I have two objections to that.

Mr. Justice Pearson: The book is not proved yet.

Mr. Aston: Then I may say I have three. First, the proof of the book; next, that the directions there given are the directions of a speculative theorist; and, thirdly, which is the most important of all, there is no claim to the four cycle. There is a claim to the four cycle when applied to Otto's composite charge.

Mr. Moulton: The book shall be before your lordship, but of course I shall contend that even in the part before your lordship there is the whole of what is claimed in Otto's second claim put forward, so that there can be no novelty, and put forward in a way that a practical mechanic could turn into a gas engine without any further information.

Mr. Aston: That is repeating the argument which we have had before, and which your lordship will find dealt with by the late Master of the Rolls in his judgment.

Mr. Moulton: But Rochas was not before them any more than Million was. I only say that simply to assist the court. I do not intend to argue it now in any possible way.

Mr. Aston: But upon the evidence brought before the Court on that occasion, there was just the same proposition put forward, and your lordship will find that dealt with by-and-bye in this judgment of the Court of Appeal. My friend has carefully avoided referring to the same grounds as regards facts, but he has put forward a foreign describer instead of a home describer. I do not care which it is. I should be perfectly ready to deal with it. What do you say with regard to the way Million proposes his charge to be worked?—Witness: He, I think, claims to be the inventor of compression however used, and he suggests that it may go as high as 6 to 8 atmospheres, and having done that he puts it in one construction into a vacant space between the piston and the end of the cylinder, where, no doubt, before this came in there would be residuum at atmospheric pressure, and where also, no doubt, on this charge, of the density that I have spoken of, coming in, that residuum would be compressed into about an eighth of the space, and you are told to light it and to get an explosion. I do not suppose that he had any notion of residuum in his mind. He never uses the word at all, but in carrying out that which he tells you to do, that would be the inevitable result. If he had had any notion of the value of it, he would have said, "Mind, you must not compress this charge to any great extent, or you will leave too little volume of residuum there." He would undertake to say that if Dr. Otto had never communicated the value of residuum, any number of mechanics reading Million's specification would never have known from that specification that there was any value in it. Referring to the engines at South Kensington, he said he saw nothing in their construction that would lead him to suppose that a composite charge with combustible gases separate from residue or air was intended to be employed. Taking the Lenoir engine, there was a provision for the purpose of mixing up the gas and air to intermix the combustible mixture, but there was no provision for taking in any charge of air separate from the combustible mixture, therefore he inferred that the object was a complete mixing up of the whole charge drawn in. With regard to the Hugon engine at South Kensington, he had been told that the bellows for sending in gas and air had been taken away for some time, because they gave a very great deal of trouble; that a new piston had been put into the engine, and that the original piece of piping that was used for the introduction of gas and air which was produced to me by Mr. Ford had been removed and had been replaced by that which he saw upon the engine, to which was added a gas cock worked by a rack and pinion, the gas cock, as I understood, being the invention of Mr. Ford. With reference to the date at which those things were done, he was not able to say with certainty. He and somebody else got into conversation then, and they varied the date a very considerable number of years.

Sir Frederick Bramwell then had a few questions put to him by Mr. Moulton, and after a few remarks by Mr. Aston he withdrew.

Mr. Charles Denton Abel was then called and examined by Mr. Hemming. He stated that he remembered receiving a communication from abroad from Nicolaus August Otto, of the Gas Motoren Fabrik in Deutz, for improvements in gas motor engines, and he obtained a patent for him for that. According to the best of his knowledge and belief he was the first and true inventor or importer of that machine, and according to his judgment the specification was sufficient to enable anyone to make the machine. The invention was new and useful.

Mr. Hemming then formally put in the letters patent.

The next witness was Mr. John Imray, who was examined by Mr. Aston. He stated that he had paid attention to the construction and working of gas engines since 1876. He had seen an Otto engine constructed according to the first modification at Deutz, near Cologne, and it worked well. He had also seen many Otto engines made according to the third modification, and they worked well. A Sterne engine answered the description of Otto's second modification, and it worked so as to produce beneficial results.

Mr. Moulton: I will admit that.

Mr. Aston: Then you should not have denied utility.

Mr. Moulton: I will admit that the Sterne engine works admirably.

The witness had been professionally engaged in taking out the various letters patent and preparing specifications describing Otto's subsequent improvements, and was therefore familiar with the construction of the forms of Otto engine made in recent years. Prior to the date of Otto's patent of 1876 he never knew of any engine which worked in the same way as described by Otto. He knew of three gas engines—Lenoir's, Hugon's, and the atmospheric engine of Langen and Otto. Those were all that he knew. He had seen specifications of others, but these are the only engines he knew. He had examined all the specifications and prior publications referred to in the defendant's particulars of objections, and had not found in any one the information that residuum or air specially introduced can be usefully employed in a gas engine for the purpose of preventing shock and undue absorption of heat. Rather the contrary, as whatever information those specifications convey would lead you in another direction. He said that of all of them. He had made experiments which enabled him to state what was the result of the working of an engine when residue is retained and when residue is carefully expelled. An engine was made which had a movable piston, controlled by a spring in such a way that you could either make the piston slide in the ordinary way or allow it to move in obedience to the spring. Using this engine you could either allow the spring to operate, which swept all the products of combustion out of the cylinder, or allow the spring not to operate, in which case a substantial quantity of products was retained in the cylinder. The engine was worked in both ways. It was an Otto engine. He found the result to be broadly this, that when the products were entirely expelled, the combustion at first was much more rapid, and the pressure fell off more rapidly during the stroke, and there was a noise at each explosion which indicated a very sudden combustion amounting to an explosion, and a very rapid falling off of pressure during the stroke. When it was worked with a substantial quantity of products retained in the cylinder the combustion was very much slower. There was no shock, and the pressure was maintained to a greater extent throughout the stroke, so that practically there was considerably more power got out of a certain quantity of gas when the products were kept in than when they were pushed out. He did not know whether Otto's theory was right or wrong, but it showed a difference in practice, at all events. He was sure there was a great advantage, such as was mentioned by Dr. Otto. He had also made experiments showing the differential effect of what is called stratification, with charges stratified and unstratified. He was quite satisfied from the experiments that the stratification, if it might be called so, was far the best way of working the engine. Asked in reference to the specification, page 5, line 23, where the patentee says, "It will be evident that if the space A^1 or a separate chamber, such as an air vessel communicating therewith, be made sufficiently large to contain the whole quantity of incombustible fluid requisite for each charge, no fresh charge of air need be drawn in at the commencement of the stroke," he said he did not think Mr. Moulton's sketch fulfilled Dr. Otto's description, because wherever Dr. Otto shows a chamber at all, he shows it in connection with the inlet for the charge. With regard to the difference between the working of an engine in the Otto way and in the Lenoir way, the witness said he could speak from actual experiment, having arranged the same engine to work as desired in either way under similar conditions. By the Lenoir way he meant the way that Lenoir's engines actually do work, not the way that it is specified; that is to say, as soon as the piston began to move from the end of the cylinder gas and air mixed was admitted and then fired. In working the same engine in the Otto way, the piston first drew in a charge of air and then after that gaseous mixture. The results of those two were compared. Both engines were worked as near as possible up to the same power, and he found that, comparing the Lenoir with the Otto way, the consumption of gas was as 11 to 9 as near as possible. He then explained why, in his opinion, as a mechanical problem, if you get shock you lose heat. Heat, especially heat of a gaseous fluid, can be converted into a power or moving pressure. It always takes time in this conversion. A shock means that there is not sufficient time for the heat to be converted into power. When there is an absence of shock it shows that a certain amount of heat is converted into power. Asked by Mr. ASTON in reference to the various forms of Otto engines that have been made according to the improved patents, Mr. Imray stated that they all work substantially the same as described by Otto in 1876. The improvements chiefly consist in minor details which make them a little more perfect as pieces of machinery than they might otherwise be. For instance, there is a very ingenious governor instead of the cam governor which is described here, which answers perfectly well. The later patents do not affect the working principle at all. In all of them an incombustible charge separate from the combustible charge is admitted into the cylinder, and in all of them the combustible portion of the charge is richest at the point of ignition.

On the eighth day, December 7th, the examination of Dr. John Hopkinson was continued by Mr. MOULTON. A number of indicator diagrams were put in taken from the Lenoir engine at Petworth, the Hugon at South Kensington, and from the ordinary Otto. On these a great deal of discussion took place, chiefly in regard to the time occupied in combustion, and the effect of this in producing shock. Million's, Wright's, Bischop's, and Barnett's specifications were then dealt with. The latter in particular received special attention, the witness having prepared a number of illustrative diagrams. He considered the engine would work all right, and that it would be less explosive than that of Dr. Otto. Dr. Hopkinson was then cross-examined by the ATTORNEY-GENERAL, who produced a small model with glass working cylinder, which at one part of the stroke could be supplied with smoke from a cigarette in order to demonstrate that stratification would exist. A number of questions were put with the object of showing that certain experiments which the witness had made had been carried out in such a manner as to prevent any definite conclusions, one way or the other, being deduced from them. Mr. Imray's experiments were referred to at length, but the witness's opinion was that all his results could be explained by assuming that there was a rich combustible mixture in the port and not in the cylinder itself. The indicator diagrams were then discussed, with the object of showing that the Otto engine not only ignites more regularly than any preceding engine, but also maintains the pressure much better throughout the working stroke. At the end of the sitting, defendant's counsel requested that the model with the glass cylinder might be handed over to them for examination.

On the ninth day, December 8th, Dr. Hopkinson was further cross-examined by Mr. ASTON. He was then re-examined by Mr. MOULTON chiefly in regard to the model produced yesterday. He considered that the proportions were not such as are used in the Otto engine, certain alterations having been made which tended to produce stratification; but afterwards, in reply to Mr. ASTON, he admitted that even without these alterations you would probably get heterogeneity of character of the mixture in the cylinder to some extent.

Mr. Dugald Clerk was then called and examined by Mr. MOULTON. In the Otto engine he found that the time of the rise from the pressure of compression to maximum pressure varies from one-thirtieth of a second to one-sixtieth, and in the Petworth Lenoir it takes from one-twenty-fourth to one-sixtieth of a second. The week before he had seen a Lenoir engine working well at Truman's brewery, and had also seen a Hugon engine at the same place employed in pumping beer. The thermo-dynamic efficiency of the Lenoir engine is ·16, and of the Otto ·33. The witness was examined at great length and with great minuteness both in relation to the experiments of Mr. Imray and the alleged anticipations. He considered Barnett's an exceedingly practical specification.

The examination in chief of Mr. Clerk was continued on the tenth day, December 9th, and diagrams were produced showing the effect of exploding homogenous mixtures in a vessel not fitted with a piston. The witness was then cross-examined by Mr. ASTON, who wished to show that when the Lenoir and Hugon engines worked without shock it was only when they were running with a load abnormally small for the size of cylinder. A great deal of time was then occupied in discussing Mr. Clerk's specification of 1881, in which he relies on stratification for the working of his engine. The witness stated that he had altered his views entirely since that date. The model with the glass working cylinder was then dealt with, Mr. Clerk saying that he considered it a mere trick, not in any way representing the conditions under which an ordinary Otto engine works. The witness was also cross-examined on the alleged anticipations, and re-examined by Mr. MOULTON.

The next witness was Samuel Ford, who was called in reference to the working of the Lenoir and Hugon engines at South Kensington. He was cross-examined by the ATTORNEY-GENERAL.

Mr. John Carter, a hairdresser, was also called to prove that he had worked a Lenoir engine for about eight years, and that it worked smoothly and well so long as the cylinder was kept clean. Sometimes, however, it gave a great deal of trouble.

Mr. Carroll, of Truman, Hanbury and Co., also stated he had worked a Lenoir engine since 1866, and that it worked well, and without excessive noise.

On the eleventh day, December 14th, the chief feature was another and very vigorous effort on the part of Mr. MOULTON to get in Beau de Rochas' work. Several witnesses from the British Museum library were examined, but Mr. JUSTICE PEARSON did not consider the fact of a single copy of the book being on the shelves of the inner library of the museum sufficient evidence of accessibility, and therefore refused Mr. Moulton's request. A number of witnesses were called to prove the use of the Lenoir and Hugon engines. Mr. John Imray was recalled and examined by the ATTORNEY-GENERAL chiefly in reference to his experiments and the diagrams he had taken with engines working under various conditions as regards the charge.

Mr. Imray's examination was continued on the twelfth day, December 14th. Professor Dewar, F.R.S., was then called, and examined by the ATTORNEY-GENERAL in reference to experiments he had made as to the relative ignitability of a number of different mixtures of coal-gas, air, and residuum, his results going to show that material stratification or graduation did actually exist. He had also made analyses of samples taken from various parts of the charge of a Clerk gas engine just prior to ignition, and had found most distinct graduation. In his opinion, also, the analysis of the exhaust gases from the Otto engine proved the existence of stratification, as the percentage amount of coal-gas entering the cylinder was too small to admit of combustion, if the charge had been uniformly diluted. Professor Dewar was cross-examined by Mr. MOULTON.

On the thirteenth day, December 15th, Sir Frederick Bramwell was re-called, and spoke more particularly to the experiments shortly referred to in his first examination, and was cross-examined by Mr. MOULTON. Mr. Dugald Clerk was also re-called, he having been down to Messrs. Crossley's works at Manchester to see the experimental engine. He considered that the different results obtained with side lighting were due to difference in the sizes of igniting parts, and not to the effect of stratification. Professor Dewar and Dr. Hopkinson were also re-called.

Mr. MOULTON then commenced his summing up on behalf of the defendant. We shall give this in due course.

On the fourteenth day, December 16th, Mr. MOULTON continued his summing up, dealing in detail with the evidence.

On December 17th, the fifteenth day, Mr. MOULTON concluded his address.

SOUTH KENSINGTON MUSEUM.—Visitors during the week ending Dec. 14th, 1885:—On Monday, Tuesday, and Saturday, free, from 10 a.m. to 10 p.m., Museum, 8577; mercantile marine, Indian section, and other collections, 1725. On Wednesday, Thursday, and Friday, admission 6d., from 10 a.m. to 4 p.m., Museum, 1229; mercantile marine, Indian section, and other collections, 85. Total, 11,616. Average of corresponding week in former years, 12,081. Total from the opening of the Museum, 24,483,659.

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

(*From our own Correspondent.*)

THE year is not going out without a little excitement in some departments. The improvement in the American iron trade, which has already resulted in orders for rails and hematite pigs from this side at good prices, is affecting in a similarly satisfactory manner the purple ore business, the hematite ore trade, and the heavy steel scrap business. On 'Change in Birmingham this—Thursday—afternoon and yesterday in Wolverhampton these commodities were all firmer in price, and sellers made the most of the American buying.

Agents stated that the purchases in the Runcorn district of purple ore, and upon the West Coast of hematite ores on United States account, were going on with a good deal of spirit, and that vessels were being chartered at Liverpool and elsewhere for the conveyance of the materials in a manner which indicated some eagerness on the part of buyers. Purchasers are spoken of as being in the main the same as those who operated at the time of the short American "boom" at the close of 1879. Purple ore was quoted about 2s. per ton advance on the minimum of some weeks ago; hematite ores were stronger in price; hematite pigs were quoted up 1s., and certain heavy steel scrap was advanced 5s per ton.

Hematites of Welsh and some other makes, which had been selling at 53s., were quoted at 54s., delivered into this district, and double sawn rail ends were quoted at £2 17s. 6d. at the steel works in Wales. Staffordshire all-mine pig makers hope that the firmer tone of hematites will become more marked. They quote 55s. to 60s. per ton for hot blast sorts, and 75s. to 80s. for cold blast. A few descriptions of Midland pigs are fetching slightly more money. Apedale—North Staffordshire—pigs are quoted 40s. Native cinder pigs are 33s. to 35s.

The finished ironworks are still engaged on specifications under former orders. New buying is of a very retail sort, contracts of much size being held back until the arbitrator's award on the ironworkers' wages question has been received.

Examples of some almost remarkable prices which are being recorded in this district, but which must be regarded as exceptional, were mentioned at the meeting of the Wages Board. Instances were quoted of merchant sheets of 20 gauge being delivered at £6 3s. 6d. per ton f.o.b. Liverpool. One leading sheet maker protested that he could not get £6 for 20 gauge at the works, nor £6 12s. 6d. for 24 gauge, galvanising quality, and that he would be very glad if he could sell 27 gauge at £7 12s. 6d. One well-known Liverpool merchant had refused to give £5 7s. 6d. for hoops, and bars were being sold at £5 5s. and even £5 at works. The men urged that present sheet quotations were 20 gauge, £7 to £7 10s.; 24 gauge, £7 10s. to £8; and 27 gauge £8 to £8 10s.; while boiler plates were quoted £8 and upwards. The masters, however, contend that such quotations are merely nominal, and some of them state that in reality prices have not been so low since 1849.

As illustrating the northern competition, it is mentioned that a contract has been of late entered into for the delivery of 3000 tons of large plates from the North into Staffordshire at between £5 and £6 per ton, and that angle iron is being offered at £5 2s. 6d. in competition with Staffordshire works.

The highest rate ever paid for puddling in South Staffordshire was in 1873, when 13s. 3d. per ton long weight, or 12s. 5d. per ton short weight, was paid. Bars which were selling at £15 per ton then are, masters now state, selling at £5 5s. If in 1873 the men had pressed their claim for a full proportionate rate of wages, they would, they urge, have been receiving 16s. per ton. Present wages are 7s. 3d. per ton for puddling, and masters desire to reduce them to 6s. 3d.

There is a report current, which I give for what it is worth, that three best iron makers—the British Iron Company, John Bradley and Co., Earl Dudley, and, perhaps, W. Barrows and Sons—will not reduce their men, as they have maintained the list prices of iron.

The inquiries for marked iron are this week reported to be fewer than they were, but current prices are maintained with £7 10s. for marked bars, £6 10s. down to £6 for medium qualities, and about £5 5s. down to £5 for the common sorts, which appear to be most in request. For hoops there have been some fair inquiries, and sheets, which range in price from £6 10s. as the minimum for doubles up to £7 12s. 6d. for lattens, have likewise been bought somewhat freely. Prices of general merchant iron are being forced down by importations from other districts. Steel is as cheap as iron; the edge tool makers are able to buy soft plating quality at £5 7s. 6d. to £5 10s. as the minimum. Blooms and billets are £4 10s., plates at £6. The competition among the galvanisers is as sharp as among black sheet makers, and galvanised sheets of 24 gauge may now be easily brought at less than £11 per ton f.o.b. Liverpool.

The intended re-start, for black sheet manufacture, by the Wolverhampton Corrugated Iron Company, under the style of the Shrubbery Sheet Iron Company, of the Shrubbery Ironworks, last owned by the celebrated firm of Messrs. G. B. Thorneycroft and Co., is engaging considerable attention on 'Change. In their present condition the works are not adapted to the manufacture of sheet iron, and it is intended by the company to clear away the existing plant and put down four first-class sheet mills, at a cost of several thousand pounds—an undertaking which will occupy at least three months in completing. The enterprise is a bold one, as it is an open secret that black sheets can now be bought under cost price.

The Snedshill Iron Company, Shropshire, is reconstructing a portion of its mills so as to make them available for rolling of larger sizes of plates, bars, and angles, than has hitherto been possible.

The Director-General of Stores for India is prepared to give out further orders for transverse steel sleepers and for wagon ironwork. Some of the orders for the latter should come to Birmingham.

Pig iron makers' are looking for some little relief in the cost of manufacture at an early date. This will take the form of a reduction in wages of a percentage similar in amount to the reduction which may be awarded concerning finished ironworkers' wages.

An amicable arrangement upon the wages question between the Staffordshire colliers and their employers is likely to be arrived at. The North Staffordshire Miners' Federation, owing to other counties not being unanimous, have decided to withdraw the notice which they recently issued.

Before the South Staffordshire Institute of Iron and Steel Works Managers at Dudley, on Saturday, Mr. Wm. Jn. Hudson, A.P.S., read a second paper on "Combustion." Mr. Hudson directed special attention to the waste gas evolved from the blast furnace. The enormous economy which had attended the use of the gas in Cleveland and Scotland was demonstrated by the fact that an average furnace of the Cleveland district evolved weekly an amount of gas equivalent in its heating power to nearly 2000 tons of coal. Most of the blast furnace proprietors in the district make use of the gas for boiler and other firing purposes, thereby wholly obviating the employment of slack, but no firm has yet erected plant for the distillation of tar or ammoniacal liquors, and a great quantity of gas over and above that which is required for firing purposes is still allowed to blow off in the air.

At a meeting of the North Staffordshire Mining Institute on Monday, Mr. Hubert Gibbs, of Handsworth, on behalf of Mr. F. W. Durham, read a paper on "Durham's Oil Rings." He pointed out the importance of the packing of rods in all types of modern engines, and the practical difficulties hitherto experienced in regard to them, and described the oil rings patented by Mr. Durham.

The Wolverhampton Chamber of Commerce has, at the suggestion of Mr. William Wentworth Walker, decided to hold a special meeting, to which outside manufacturers should be invited, to consider the causes of the great progress which has been made in continental competition. Mr. Walker, who has just returned from a lengthened Australian visit, told the Chamber that he had found that large orders, which were formerly placed with English firms, were now being sent to continental manufacturers.

The Walsall Chamber of Commerce on Tuesday adopted the report of the committee which had been appointed to draw up replies to the questions put by the Royal Commission on Trade. The Walsall committee advocated a thorough inquiry into the monetary laws, which largely affected both the volume and the profitable character of our export trade, and an inquiry into the application of the law of limited liability in reference to trading concerns. The committee also expressed the opinion that the less legislative interference with the true principles of political economy, the laws of supply and demand, the better; the inquiries suggested being more with a view of removing legislative impedimenta than of enacting others.

To such an industrial district as this one of the most interesting objects in the new Corporation Art Gallery at Birmingham is the original model of the first locomotive engine ever made, put together by William Murdock in 1781, but laid aside till Watt's patent in 1784 included locomotive engines, which Watt, it will be remembered, never viewed with favour even to long afterwards, as he feared a high pressure of the steam would be unsafe with such boilers as were then possible. The model was purchased for a large sum a short time ago by Mr. Richard Tangye, and has by him been lent to the Birmingham Gallery.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

THERE seems to be an idea that the Carlists may make trouble in Spain, and this causes uneasiness to be felt in regard to Spanish ores. It is expected that difficulties may arise in obtaining supplies. This expectation, coupled with a demand from America, has encouraged the hematite iron makers to put up their prices about 3s. per ton. On December 1st hematites were quoted at 49s. to 50s. per ton, and on December 14th they were at 52s. 6d., which was the quotation in January last. Common forge iron, which was at 40s. in the opening month of the year, fell to 38s. in July, and to 36s. in the middle of December.

The directors of Messrs. Charles Cammell and Co., Cyclops Steel and Ironworks, have not yet met to decide upon what shall be done in consequence of the death of Mr. George Wilson, J.P., their chairman and managing director. Their first ordinary meeting is on the 30th inst., when the re-arrangement required will be made. The vice-chairman—Mr. Thomas Vickers, of Manchester—will, I understand, accept the chairmanship, and Mr. Alexander Wilson, brother of the deceased, will be appointed managing director, the duties of which he has practically discharged for the last two years. Mr. Alexander Wilson has been assistant managing director since the acquisition of the Dronfield Steel Works by the Cyclops Company.

Messrs. Richard Hornsby and Sons, Spittlegate Ironworks, Grantham, have paid 5 per cent. for the year, compared with 6 per cent. last year. The company has felt, like others, the depression in all branches of trade, and the condition of agriculture has particularly affected it. The most serious drawback, as the chairman pointed out, has been the reduction of the selling price, which had been forced upon them by the action of other firms. In view of this every effort has been made to reduce the cost of manufacture, though the result of these efforts would be seen more in the current than in the past year.

The sharp change in the weather last week led to a momentary increase in the demand for house coal; consumers who had delayed laying in their supplies hurried to fill their cellars, but the accession to business was confined more to the districts round Sheffield than to the country generally, the metropolitan and east counties having provided themselves with supplies at the usual time towards the end of autumn. The Sheffield Coal Company, in a notice which it has just issued, dated December 14th, quote its prices at Birley Collieries, three and a-half miles from the parish church, as follows:—Hand-picked Silkstone Branch coal, 11s. 8d.; best screened Silkstone house coal, 9s. 2d.; screened Silkstone seconds coal, 5s. 10d.; screened Silkstone nuts coal, 5s. These are exceptionally low rates for winter.

The skatemakers, who had a busy week of it during the snap of frost, are still in hopes of further sharp weather, and are preparing for it. During the ten days the frost was so severe they cleared out many thousand pairs of skates, and another fortnight of thoroughly winter weather would suffice to turn into cash the accumulation of three or four slack seasons. It is so long since there was anything like a seasonable winter that many of the artisans who at one time were engaged upon skatemaking have now changed their vocation and taken to joiners' tools and kindred industries. A revival of the skatemaking department would be very welcome to hundreds of workpeople, as well as to the manufacturers, who made it mainly a Sheffield speciality, and at one time did a great business in it.

The general elections, although they are now over have left behind them the usual evil result of dislocated business. The silver and plating trades, which were showing signs of improvement up to September, fell off considerably during October, and very little indeed was done while the turmoil and the elections were proceeding in the boroughs and counties. London being practically deserted by county and other families, the metroplitan merchants ceased ordering to any extent, and in the country districts themselves dealers were not able to command anything like the business which would otherwise have ruled. Similar remarks apply to various departments of the cutlery trade, and it is too late now in the season for the arrears of work to be made up. Many artisans are suffering considerable privation from the loss of employment in consequence of the elections following a year of marked depression.

German competition is becoming an increasingly important factor in the plating and cutlery trades of this district. A speciality in Britannia metal spoons appears to be "sweeping the market" in the cheaper classes of these goods. The Germans have discovered a method of producing a Britannia metal spoon with an iron handle. When finished the article presents the appearance of a heavy, substantial spoon, and as it can be produced at a very low price, it is preferred to the English made article. As yet our home firms have been unable to discover the secret, though it is probable they will do, as in the case of hollow ground razors, which were long a speciality of German production. These are now regularly made in the Sheffield trade, and the Germans have ceased to enjoy the benefit of their invention. In saws the German competition is also excessively severe. A Sheffield manufacturer has in his possession a 26in. hand saw which the Germans place upon the market at 7s. a dozen, six months' credit and 2½ per cent. off. This article cannot be made in Sheffield under 10s. to 12s. per dozen.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—The market generally has presented a quiet tone during the past week, and with the close of the year there is the usual contraction of buying. A steady tone is, however, generally maintained throughout the iron trade, and there is a continued vague hopeful feeling with regard to the future which evidently tends towards producing a firmness in prices. The only indication of really better trade is, however, in the continued large sales of hematites at advanced rates, but these are not for consumption in this district. In common pig iron makers are effecting very few sales, nor have they any increased weight of trade in prospect. Much the same applies to manufactured iron makers, who in very few cases are able to keep their works going full time, and are still showing an eagerness to secure orders for prompt specification at under current prices, although in their quoted list rates they maintain a firm tone. The absence of any increased requirements for actual consumption is still the weak point in the market, and until there is an increased weight of work coming into the hands of users of iron, any apparent improvement in the market must fail of the one essential element of permanency.

The Manchester iron market on Tuesday was fairly well attended, but with the exception that transactions of considerable weight were reported in hematites, with sellers able to command an advance of 2s. to 3s. per ton upon late rates—the minimum quoted figures for delivery into this district being now about 53s., less 2½ per cent., for good foundry qualities—there was only a very limited business being done. For pig iron, makers were firm at about 39s. to 39s. 6d., less 2½ per cent., for local, and 39s. 6d. to 40s., less 2½ per cent., for the better class district brands delivered equal to Manchester, with 38s. to 39s., less 2½ per cent., delivered here, representing the minimum quoted rates of the lowest sellers; for outside brands prices, if anything, have been a shade easier, but for good named brands of Middlesbrough foundry, 41s. 4d., net cash, delivered equal to Manchester, is still the average quoted price. There is, however, so little iron changing hands that any quoted rates are little more than nominal, and the only real gauge of the market is that the attitude of firmness which is assumed by the makers would seem to indicate that prices are again getting to about their lowest point.

In the manufactured iron trade there is still only a very slow demand, with no signs of any present appreciable improvement. Prices are unchanged; for prompt specification many of the makers are still open to accept £5 2s. 6d. for bars delivered into the Manchester district, whilst £5 5s. remains the average basis of makers' quoted list rates.

In the various branches of the engineering industry the condition of trade remains much the same as last reported, a tendency towards decreasing activity being still the prevailing feature.

By a combination of patents taken out by Mr. William Mather, M.P., of the Salford Ironworks, Manchester, and Mr. J. B. Thompson, of New Cross, Kent, quite a revolution in the process of bleaching has been introduced, and on Wednesday a number of the leading bleachers in Lancashire assembled at the works of Messrs. R. Ainsworth, Sons, and Co., near Bolton, to witness a trial of the first plant which has been put down for carrying out the new process. The chief features of the new process, which can only be very briefly described in the limited space of my "Notes," are the introduction of a specially arranged steamer for the initiatory stages of the bleaching, and the application of carbonic acid gas for completing the operation of bleaching. The steamer consists of a boiler-shaped oven constructed to hold a couple of specially designed trucks, each holding one ton of grey cloth. By means of the treatment to which the grey cloth is subjected in this oven, caustic soda—which hitherto, owing to the risk of burning the cloth, has been considered too dangerous an element—can be used with perfect safety. The cloth, having been saturated with a solution of this chemical, is loaded into the trucks and enclosed in the steamer, where for a period of five hours it is subjected to the action of steam under a pressure of about 4 lb. to the square inch, the cloth during this process being kept damp by sprays of water from the top of the steamer. For another hour and a-half it is subjected to a thorough washing inside the steamer, by a continual drawing of water through the mass of cloth, this water being pumped back into the steamer as it escapes from the loaded trucks through a specially arranged exit pipe. The cloth is then passed on to what is termed a continuous bleaching process, first passing through acidulated hot water, next through a chemical preparation, and afterwards through a chamber containing carbonic acid gas, which immediately bleaches the cloth; this is followed by alternately passing the cloth through a washing in cold water, a saturation in a weak solution of soda ash, and a second washing in cold water; for thick cloths the above process is repeated, but for thin cloths this is not necessary, and the bleaching is completed by a sousing in muriatic acid water, after which the ordinary washing is all that is required. The whole process is completed in less than twelve hours, in the place of forty hours occupied under the ordinary system, whilst the separate processes are reduced to three instead of the sixteen different processes under the old method. The saving of time and the lessened handling of the cloth are, however, not the only advantages of the system, the quantity of the chemicals used in the bleaching is reduced by one-half, whilst only one-fifth of the water usually expended in bleaching is required. The complete operation of bleaching by the new process was witnessed by the visitors, and the results obtained both in the economy of time and materials, and the quality of the work produced, gave general satisfaction.

Generally a fairly active demand for house fire qualities of coal is reported, but except that this helps to withdraw from the market some of the commoner qualities for steam and forge purposes, which have been more or less a drug, there is no material change to report. No better prices are to be got, and for general manufacturing and trade requirements there are still plentiful supplies in the market at low figures. For shipment a fair business continues to be done, but it is only at low figures, anything above 7s. to 7s. 3d. per ton for steam coal delivered at the high level, Liverpool, or the Garston Docks, being very difficult to obtain.

Barrow.—The firm position of the hematite pig iron trade noticed during the past fortnight is thoroughly maintained in every respect, but there is not much iron changing hands, inasmuch as on the one hand makers have only small parcels on sale, and on the other hand buyers are disposed, if possible, to secure forward deliveries at cheaper rates than those now ruling, but the impetus given to the hematite pig iron trade in the early part of November resulted in an increase in value to all qualities of iron to the extent of from 1s. to 1s. 6d. per ton, and makers firmly maintain these new prices. They are resisting any attempt to flood the market with iron by means of the increased output, which would result in the cheapening of the metal. Deliveries are being made at present to a fair extent both by home and foreign users. The orders are not largely held for forward deliveries.

Stocks are much less than they were a short time ago, and are not likely to increase. Prices still range at from 44s. 6d. for No. 1 Bessemer, and 43s. 6d. for No. 3. Steel makers have secured further orders from America for nails, and other contracts are pending. It is probable that this department of industry after the New Year will be very actively employed, so far as the rail trade is concerned, but there is no activity in any other department of steel mannfacture save that of tin bars. No new feature can be noticed in shipbuilding or engineering, which industries are quiet. Coal, coke, and iron ore are in quiet demand at late values. Shipping indifferently employed, although freights are very low.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

A QUIET feeling pervaded the iron market held at Middlesbrough on Tuesday last, and as recent shipments have not been satisfactory, and stocks are fast increasing, sellers were readily found willing to accept lower prices than prevailed last week. Cases occurred of small lots changing hands at as low a figure as 31s. 10½d. per ton for prompt delivery, but generally speaking 32s. was the price accepted both by merchants and makers. For delivery to the end of March 32s. 6d. is usually asked, and for the second quarter of the year 33s. per ton. But there are few sellers who care to commit themselves so far ahead. As regards forge iron, some sales were made on Tuesday at 30s. 9d. per ton, but the figure more commonly quoted was 31s.

Warrants are less firm than they were, there being now some holders willing to take 32s. 6d. per ton.

The total quantity of Cleveland pig iron in Messrs. Connal and Co.'s Middlesbrough store was, on Monday last, 128,689 tons, which represents an increase of 2603 tons for the week. At Glasgow, 4679 tons were during the same interval added to the stock, the quantity held on Monday being 657,489 tons.

Owing to the recent severe weather, shipments have been much impeded. Since December 1st, only 24,522 tons had been sent away on Monday last as against 35,272 tons in the corresponding portion of November.

The demand for finished iron does not improve, and there are very few inquiries in the market. Ship-plates are offered at £4 12s. 6d. to £4 15s. per ton, according to quality and specification. Angles are £4 5s. to £4 7s. 6d.; and bars, £4 15s. to £4 17s. 6d.—all free on trucks at makers' works, less 2½ per cent. discount.

Messrs. Dorman, Long, and Co., of Middlesbrough, are for the moment fully employed at their West Marsh and Britannia Ironworks, and are turning out about 1000 tons of rolled girders per week. They have just shipped 1500 tons to America, and are sending large quantities to India and Australia. They have 120 puddling furnaces at work, and are employing about 1800 men.

The Cleveland Institution of Engineers held their second meeting this session on Monday last at Middlesbrough, when Mr. Froude, of Manchester, read a paper on the "Tower Spherical Engine." The paper was illustrated by diagrams, by an excellent wooden model showing the internal arrangements of the engine, and also by one of the actual engines in working order. A hearty vote of thanks was accorded to Mr. Froude.

A terrible railway accident would certainly have occurred a few days since on the Darlington section of the North-Eastern Railway, but for the presence of mind of a signalman. The block system is almost perfect as regards the freeing of each section of a passenger line from one train before the succeeding one is allowed to enter upon it; but it is powerless to prevent collisions arising from other sources. Between Grangetown and Redcar stations a mineral line runs for a certain distance in connection with certain blast furnaces on the north or outer side of the down line, and parallel with it. The 4.11 express train from Middlesbrough to Saltburn had just passed, and the 4.22 was almost due, when a mineral train, being shunted on the outer line, ran off from some unknown cause, and two trucks were forced partly across the down passenger line. Three or four minutes more and the passenger train would have been in collision with them, with calamitous consequences, for the evening was dark and foggy, and the engineman would certainly not have seen them in time to save his train. Fortunately, however, the obstruction took place not far from a signal-box, and was observed by the signalman. He had just time to get his danger signal up and to stop the approaching train. Had the derailment occurred a hundred yards farther down, he would not have seen it. The passengers knew that the Westinghouse was suddenly put on, and that they were brought to a stand. They grumbled sorely at an hour and a-half being required for a journey of eight miles; but until next day none of them knew to what extent their lives had been, so to speak, hanging on a thread, and how much they owed to the quick-wittedness of that signalman.

Sir Lowthian Bell has taken great pains to get up evidence on behalf of the iron trade to lay before the Depression of Trade Commission, and much interest is taken in the case he has prepared. Most of the leading local ironmasters, manufacturers, and merchants have contributed some items to assist him, and to insure his information being as complete as possible. It is understood that although the leaders of the iron trade in Scotland, Staffordshire, and Wales have been separately invited to state their views, still most of them are content to allow themselves to be represented by Sir Lowthian. Few believe that any direct legislation of beneficial character will result from the inquiry, but it is generally thought that much good may indirectly result from the circulation of so much information, and from the reflection of so many minds upon it.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

THE Glasgow pig iron warrant market, which was steady last week, has within the past few days marked a considerable decline in prices. For the highest class of special brands there has been a fair inquiry, but g.m.b. has been comparatively neglected, except in the shape of purchases for delivery into store. This is a very depressing feature of the business. During a succession of weeks the quantity of iron sent into store has been much larger than usual, and it is noticeable that the extra storing has been proceeding at a time when it is persistently represented that more Scotch pigs are wanted for the United States. The general opinion in the trade is that the prices of g.m.b. are being artificially maintained at a level that cannot possibly be paid by consumers, unless a demand should suddenly arise on a much larger scale than the most sanguine anticipate. Messrs. Connal and Co.'s stores at present contain 80,000 tons more pigs than they did at this date last year, and the difference in price at the two periods is inconsiderable. Scotch consumers are using great quantities of Middlesbrough iron, which for most purposes answers as well as Scotch, and is a great deal cheaper. There are ninety-two furnaces in blast in Scotland at present, as compared with ninety-three at this date last year.

Business was done in the warrant market on Friday at 42s. 8d. cash. On Monday transactions occurred from 42s. 7½d. to 42s. 8½d. Tuesday's market was depressed, with business in the forenoon at 42s. 8d. to 42s. 6½d. cash; and in the afternoon at 42s. 6½d. to 42s. 4½d. cash. On Wednesday transactions occurred at 42s. 8d. to 42s. 4½d. cash. To-day—Thursday—the market was flat at 42s. 3½d. at the opening, bnt afterwards improved, and closed at 42s. 6½d. cash.

The current prices of makers' iron are:—Gartsherrie, f.o.b. at Glasgow, per ton, No. 1, 46s. 6d.; No. 3, 43s. 6d.; Coltness, 50s. 6d. and 46s.; Langloan, 47s. and 44s. 6d.; Summerlee, 51s. and 45s.; Calder, 51s. and 43s. 6d.; Carnbroe, 45s. 6d. and 43s.; Clyde, 46s. and 42s.; Monkland, 43s. and 40s. 6d.; Quarter, 42s. 6d. and 40s.; Govan, at Broomielaw, 43s. and 40s. 6d.; Shotts, at Leith, 47s. and 46s. 6d.; Carron, at Grangemouth, 51s. and 47s.; Kinneil, at Bo'ness, 43s. 6d. and 43s.; Glengarnock, at Ardrossan, 46s. 6d. and 42s. 6d.; Eglinton, 43s. and 39s. 6d.; Dalmellington, 44s. 6d. and 40s. 6d.

The shipments of Scotch pigs to date are 423,930 tons, as compared with 514,023 in the corresponding period of last year, while the imports of Cleveland pigs into Scotland show an increase of 92,972 tons.

The past week's shipments of iron and steel manufactures from Glasgow embraced machinery to the value of £9600; a steam launch, worth £700, for Calcutta; sewing machines, £5167; steel goods, £27,000; and general iron manufactures, £18,000. The steel goods included 1232 tons of sleepers, &c., worth £15,030, to Port Darwin, and bridge work, valued at £10,260, for Calcutta.

The shipping trade in coals exhibits some improvement this week. From Glasgow, 23,190 tons were despatched; Greenock, 2080; Port Glasgow, 200; Irvine, 1636; Troon, 6620; Ayr, 7143; Leith, 417 tons; and Grangemouth, 10,449 tons. The inquiry for steam coals is backward, a fact which is not altogether disadvantageous at present to the coalowners, seeing that the miners have been on strike in this department since the beginning of the month. Household coals are in steady request; but while the principal masters in the Hamilton district granted the miners raising house coals a rise of wages, they have not been able to obtain any advance of prices from the public, and the proposal is now made that the increase of wages should be withdrawn.

Messrs. Barclay, Curle, and Co., shipbuilders, Glasgow, have received an order from Mr. Robert Hill, shipowner, Greenock, to build a four-masted sailing vessel of 2000 tons register, to be employed in the Eastern carrying trade. Orders have also been booked by Messrs. Charles Connell and Co., of Glasgow, for a steel steamer and a sailing vessel.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

THERE is little change to be reported in the iron and steel trades. A quiet amount of business is going on, as shown by the fact that from Newport, Mon., last week, 4310 tons of iron and steel were sent away, and 2477 tons from Cardiff. The principal cargoes included Calcutta, 2750 tons; Buenos Ayres, 1000 tons; Ahus, 700 tons. A good deal of this is, of course, accumulation. Generally regarded, there is an absence of vitality in the trade, and but for colonial business, things would be disheartening. Hopes are held out that with the new year we are to see a change, but for the present it will not be surprising if the stagnation increases. As a rule there is a dearth of new orders as the year closes in.

In tin-plate, prices slightly wavered, and there was a decline generally of 3d. per box. This was owing, I hear, to a prevailing report that the masters contemplated a change of policy, but, like other *canards*, it seems to have been set on foot by would-be buyers. How it could be otherwise I am at a loss to see, as makers are pledged to continue the stop week until the middle of 1886. Last week the stop week was well maintained. In the Swansea district the shipments were small on account of steamers not having come in. The whole total was about 20,000 boxes, principaliy for Hamburg and coastwise. Over 50,000 boxes have been received for storage, and the total stock now at Swansea amounts to close upon 140,000 boxes.

Bessemer steels have fallen a trifle, and are now sold for 14s. 9d. Cokes are 14s. to 14s. 3d. Siemens, 15s. to 15s. 3d. The change, it will be seen, is inconsiderable, and in a few days there may be another in an upward direction.

Several large steamers are expected daily to load tin-plates for America. A tin-plate works of considerable extent in Swansea district has been in rather a delicate condition of late, but is understood to have weathered the storm.

A meeting of principal coalowners was held in Cardiff, on Tuesday, to take into consideration certain questions from the Commission upon the Depression of Trade. Mr. Archibald Hood presided, and Sir W. T. Lewis, Messrs. Cory, E. Jones, Martin, Colquhoun, and several other leading coalowners were present. Replies were framed to the questions propounded, and the report of the committee will be shortly published.

There was a large dispersal of plant this week in the Valley of Aberdare, Mr. Spencer, of Atherstone and Luton, having completed his contract with Nixon and Co., colliery proprietors.

Coal trade news is a little more hopeful. The Austro-Hungarian contracts are being secured, one of the principal being that invariably successful company, the Powell Duffryn.

The tone of trade is better in Cardiff and Swansea, and Newport is showing better totals, though as regards this port there is room for great improvement. At the Old Docks in particular little is doing. Alexandra shows a brisker trade.

The total coal shipped from the three ports last week to foreign destinations was 196,000 tons, a better total than we have had for some time. And yet I find that coalowners and shippers are not elated, and on every hand you hear that "things are too quiet." There is not sufficient life in the trade, and if a few large contracts are held by leading coalowners, the many do but a moderate business, with prices by no means firm. House coal quotations are the same—8s. 3d. for No. 2, 8s. 9d. for No. 3.

AMERICAN NOTES.

(*From our own Correspondent.*)

NEW YORK, December 5th.

A NUMBER of important engineering enterprises are now passing through their initial stages. An elevated railroad will be constructed next year in Brooklyn, and will be built in thirteen months. Telegraphic and telephone wires are to be placed in iron tubes on top of the columns. The Phœnix Iron Company has secured the contract for the work, and operations will begin at an early day. There are now in course of construction eighty Government buildings, ranging in cost from 25,000 dols. to 2,000,000 dols. each, throughout the country, involving a cost of about 9,000,000 dols. A large number of public buildings are to be built next season, and this, in connection with projected activity on a large scale among private dealers, and work contemplated by railway managers and manufacturing interests, points to a very heavy demand for all kinds of building material, including iron, steel, lumber, and stone. The present satisfactory condition of the iron trade, and, in fact, all other industries, is due largely to the fact that autumn business has been satisfactory, that an immense amount of material has been distributed, and that manufacturers are enlarging their plants for a greater production during the winter to meet the spring demand. Confidence exists everywhere, and unless some unexpected obstacle will arise, the spring of 1886 will draw out an immense amount of capital for a variety of reproductive purposes. Several new rolling mills are to be built, three large blast furnaces are projected, and a great deal of railroad building is to be pushed through. During the past week the New Jersey and Pennsylvania Locomotive Works have increased their orders for locomotive capacity, and the car-makers throughout the West particularly have been fortunate in securing large contracts for passenger and freight cars. Freight cars are now scarce because of the crowded condition of traffic Westward and Eastward. The railroad returns are stimulating interest among capitalists. Official reports from several railroad companies show increasing earnings. For instance, the Chicago, Milwaukee, and St. Paul shows an increase in November over same time last year of 330,000 dols.; the Chesapeake and Ohio Company show a liberal increase. All iron brokers speak this week of an improving tendency in crude and construction iron in this and Western markets, and agents of furnace companies report the close of important transactions for material to be delivered during the coming three or four months. In Western Pennsylvania forge iron has advanced at least 50c., and heavy orders have been placed. In Eastern Pennsylvania a corresponding improvement has taken place, and buyers are placing orders for supplies. Foundry irons are rather quiet. English Bessemer and Scotch pig are under inquiry. Contracts will be placed during December amounting to several thousand tons, to supply material for bridges to be built in the West. The anthracite requirements are drawing to a close. Nearly all New England buyers have been supplied, and navigation will be closed in a few days. Prices for anthracite are high. The production for this month is 2,000,000. A combination has been formed in the Clearfield bituminous region with a capital of 2,000,000 dols., to buy up a number of small mining companies, who are crowded out by the practice of discrimination maintained by the Pennsylvania Railroad Company. Three large pipe lines are projected between the oil-fields and lake ports. Discoveries indicate that the natural gas territory is greater than was believed, and manufacturing enterprise is being organised to sink wells at points varying from 100 to 1000 miles remote from the present centre.

ON the 11th inst. a trial was held on the Mersey of a small steamer, built by Messrs. Cochran and Co., of Birkenhead, for Messrs. Macvicar, Marshall and Co., of Liverpool, and intended for local towing service at Java. The vessel has been especially designed for service in shallow water, and is 45ft. long and 9½ft. beam. There is accommodation forward for a crew of four hands. The hull is of wood, coppered below the water line, and she is fitted with high-pressure engines, with two cylinders each 8in. diameter and 12in. stroke, and one of Cochran's patent vertical multitubular boilers, having 150 square feet of heating surface, and working at a pressure of 80 lb. The machinery worked very satisfactorily throughout the runs, and the vessel averaged a speed of eight knots per hour. The trial was superintended by Messrs. Flannery and Fawcus, Liverpool.

NEW COMPANIES.

The following companies have just been registered:—

Don Sheet Iron and Steel Company, Limited.

This company proposes to acquire the Hive Ironworks, Jarrow, Durham, with plant, machinery, and other property connected therewith. It was registered on the 5th inst. with a capital of £20,000, in £10 shares. The purchase consideration is £10,000, payable as to £7000 by the taking over of the existing mortgage to that amount, £1000 in fully-paid shares, and £2000 in cash. The subscribers are:—

	Shares.
*Walter Curll, Carlton House-terrace	1
J. R. Hood, Morpeth, bank clerk	1
*W. F. C. Stanley, Newcastle	1
*W. Snowball, Jesmond, Newcastle	1
*T. Snowball, Side, Newcastle, engineer	1
T. S. Salter, Jarrow, iron merchant	1
D. Hill, Newcastle, accountant	1

The number of directors is not to be less than three nor more than ten; qualification, £100 in shares or stock. The first are the subscribers denoted by an asterisk. Remuneration, £50 for the first year, and subsequently such sum as the company in general meeting may vote.

Automatic Checking Apparatus Company, Limited.

This company proposes to manufacture apparatus for preventing mistakes or fraud on the part of employés receiving money, and in particular, omnibus and tramway conductors, theatre attendants, and the like; and generally to carry on the business of mechanical and electrical engineers and machinists. It was registered on the 5th inst. with a capital of £12,000, in £1 shares, with the following as first subscribers:—

	Shares.
*G. R. Burn, 6, Bell-yard, Doctors'-commons, solicitor	100
R. W. Burn, 353, Brixton-road, articled clerk	1
*P. Everitt, 47, Cannon-street, engineer	100
A. T. Frampton, East Molesey, secretary to a company	1
T. W. Vallis, 83, Lupus-street, S.W., clerk	1
R. Bedford, South Ealing, clerk	1
E. Hore, 49, Queen Victoria-street	1

The number of directors is not to be less than two nor more than five; qualification, 100 shares. The first are the subscribers denoted by an asterisk. The company in general meeting will determine remuneration.

International Public Works Company, Limited.

This company was registered on the 5th inst., limited by guarantee to £50 each member. It proposes to carry on business as engineers, contractors, concessionaires, financiers, and of dealers in every description of plant and material used in connection with engineering works. The subscribers are:—

R. Punshon, 12, Buckingham-street, engineer.
J. Greenfield, 67, Parma-crescent, Lavender-hill, engineer.
F. G. Mitchell, Weybridge, engineer.
J. B. Boley, M.D., Clarendon House, Ealing.
C. Jackson, 6, North-terrace, Westminster Bridge-road, engineer.
W. K. Balmer, 16, Great St. Thomas Apostle, merchant.
S. F. Smart, 17, Montague-street, attorney-at-law.

The subscribers are to appoint the first three directors; remuneration, £1 1s. to each director for every attendance at board meetings.

Spratt's Patent, Limited.

This is the conversion to a company of the business of manufacturing foods of all kinds suitable for mankind, animals, &c., carried on by Messrs. Edward Wylam, C. J. Wylam, and G. B. Batchelor, at Bermondsey, trading as "Spratt's Patent." It was registered on the 9th inst. with a capital of £200,000, in £5 shares, with the following as first subscribers:—

	Shares.
W. T. Trehearn, 50, Billington-street, Hatcham, clerk	1
R. W. Humphreys, 39, Reaston-street, New-cross-road, clerk	1
F. A. Kear, 1, Derby-road, Tottenham, clerk	1
C. Towl, 53, Herbert-street, Hoxton, clerk	1
T. Turpin, 22, Amersham-road, New-cross, clerk	1
D. Bennett, 8, Nelldale-road, South Bermondsey, clerk	1
W. M. Dry, 1, Goodman's-road, Peckham, clerk	1

The number of directors is not to be less than three nor more than six; qualification, 100 shares. The first are Messrs. E. Wylam, C. J. Wylam, and G. B. Batchelor. In any year in which 10 per cent. dividend is paid, each director will be entitled to £200 for remuneration. Mr. E. Wylam is appointed managing director.

West of England Paper Mills Company, Limited.

This company was registered on the 3rd inst. with a capital of £100,000, in £5 shares, to carry on the business of a paper manufacturer in all branches. The subscribers are:—

	Shares.
J. Davis, Bristol, paper maker	1
J. J. Hall, Bristol	1
*J. B. Martin, Victoria-mansions, Westminster	1
*P. Leonard, 5, Stormont-terrace, Lavender-hill	1
*R. England, 29, Holland Park-gardens	1
Wm. Hutton, Bristol, confectioner	1
P. Munro, Bristol, architect	1

The number of directors is not to be less than three nor more than six; qualification, £500 in shares or stock; the first are the subscribers denoted by an asterisk and Mr. John Davis. The ordinary directors will be entitled to remuneration at the rate of £150 per annum for each director. Mr. John Davis is appointed managing director at an annual salary of £350, with a commission equal to 1-32nd part of the net profits of each year available for dividend. Mr. J. J. Hall is appointed secretary at a salary of £300 per annum, and a commission equal to 1-64th part of the annual net profits available for dividend.

Universal Water-Meter Company, Limited.

This company was registered on the 8th inst. with a capital of £20,000, in £10 shares, to acquire and work the letters patent No. 14,861, dated the 15th May, 1885, for improvements in meters for water and other liquids. The subscribers are:—

	Shares.
W. B. Brough, Harrow	1
J. H. Collins, 23, Lime-street, solicitor	1
F. Mansfield, 190, Gray's-inn-road, contractor	1
J. Macpherson, 61 Cambridge-road, Kilburn	1
F. W. Wright, Maidstone, miller	1
R. Field, 9, Graces-road, Camberwell, clerk	1
F. J. Henderson, 5, Kenmare-road, Hackney, sanitary engineer	1

The number of directors is not to be less than three nor more than seven; the subscribers are to appoint the first and determine their remuneration; qualification for subsequent directors, 100 shares.

Flodgvists' Patent Sulphite Pulp Company, Limited.

This company proposes to carry on the business of manufacturers of sulphite pulp or any other pulp used in the manufacture of paper, and for such purpose will purchase certain lands in Jemtland, Sweden, known as Hjerpen, and also a patent known as Flodgvists' patent. It was registered on the 4th inst. with a capital of £100,000, with the following as the first subscribers:—

	Shares.
M. Hagborg, 67, Maitland Park-road, N.W.	1
W. Bailey, Stoke-on-Trent, clerk	1
R. Tiessen, 279, Vauxhall Bridge-road	1
G. Holm, 182, King's-road, N., clerk	1
S. H. Willay, 59, Davies-street, Berkeley-square, clerk	1
E. J. Coulon, 93, Abingdon-road, Kensington	1
E. Boyle, Wimbledon	1
D. J. Flanagan, 44, Lincoln's-inn-fields, clerk	1

The number of directors is not to be less than three nor more than eight; qualification, £500 in shares or stock; the first are Messrs. Wm. Cowan, Pages Craig, James Annandale, and Lewis Evans; minimum remuneration, £500 per annum.

The Civil and Mechanical Engineers' Society.—The opening meeting of the 1885-86 session of the above Society was held on Monday, the 7th inst., at the Society's rooms, 7, Westminster-chambers, Victoria-street. The chair at the commencement of the proceedings was occupied by Mr. Thos. Cole, the retiring president, to whom a hearty vote of thanks was accorded for the ability with which he had fulfilled the office of chairman during the past year. Subsequently Mr. H. Michell Whitley, A.M.I.C.E., F.G.S., the president for this session, took the chair, and delivered his inaugural address, in which he gave some interesting details and general information concerning the chief of the great engineering works which have been conducted during the past year. Referring to the Mersey and Severn tunnels, he said it was a matter for congratulation that these two great tunnelling enterprises were both to be brought to a close in the present year. They would remain a triumph of engineering talent and perseverance under the greatest difficulties. Among bridges the Forth Bridge claims the first notice. It would be 1½ miles in length, and consist of two spans of 1700ft., two of 675ft., fifteen of 168ft., and five small spans of 25ft. each. After referring to a number of other bridges, ocean steam navigation, and a variety of other works, he dwelt exhaustively with the question of the development of railways. The total length of railways in the British Isles constructed and opened for traffic in December, 1884, was 18,864 miles. The amount of money spent in them was £801,500,000—a larger sum than the National Debt—and it was impossible to overestimate the importance of these investments. Not only had the railways added immensely to the prosperity and well-being of the people, and developed trade to a large extent, but they paid all round dividends which were fairly remunerative to the investor. Perhaps the most satisfactory feature in our railway system was the comparative immunity from serious accidents which had been attained by the adoption of approved appliances. In order to show the great improvement that had taken place in late years in railway travelling, Mr. Whitley pointed out that for some time the third-class carriage on the bulk of the English lines was an open truck with no seats, the floor being partially divided by a strong rail to prevent the passengers being thrown against each other when the train made a sudden stoppage. The sides and ends were not more than 3ft. high, and in these carriages passengers were huddled and conveyed by mixed trains. When Parliamentary trains were established a great improvement took place, and had been going on since. The universal introduction of railways into England, and the great lead that England took in ocean steam navigation, gave us the start, and with it the command of the markets of the world. The English merchant, manufacturer, engineer, and contractor, led the way everywhere, and English engineers and workmen made not only their own but great continental lines, whilst English capital was thus employed in countless useful ways. Far different was the outlook now. Foreign nations were not only supplying their own wants, but were even competing with us, not unsuccessfully, in our own home, foreign, and colonial markets. At one time America imported 50,000 tons of rails annually from Great Britain, but now these imports had almost entirely ceased, and American engines were sent not only to South America and Canada, but to New Zealand and Australia. American and continental enterprise was pressing more and more hardly on English manufacturers, and these nations were striving not only to keep pace, but to overtake us in the race for trade and commerce. He did not take the gloomy view that some persons did of the matter, but it behoved engineers, and, indeed, many other classes, to keep their eyes open and their heads at work. To the changed economic conditions both master and workman must learn to adapt themselves if Great Britain was to maintain the leading place in the commerce of the world she had hitherto held. On the motion of Mr. Brewster, seconded by Mr. Ellis Hill, a vote of thanks was passed to the president for his interesting address, and the proceedings terminated.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

Applications for Letters Patent.

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

8th December, 1885.

15,020. Printing Presses, H. J. Allison.—(*The Duplex Printing Press Company, United States.*)
15,021. Cutting the Fibres of Wood, W. A. Compton, London.
15,022. Joint-screw for Scissors, &c., S. G. Richardson and E. Kay, Birmingham.
15,023. Assisting the Driving Power of Tricycles, &c., J. Cheshire, Birmingham.
15,024. Dredgers, J. H. Bolles and . N. S. Williams, London.
15,025. Self-adjusting Brush and Broom Head and Handle Fastener, S. Hall, Leeds.
15,026. Accouchement Belt, W. Gaunt and J. M. Baines, Bradford.
15,027. Cigar Cases, H. Constantine, Bradford.
15,028. Lamps, G. Taylor and F. R. Baker, Birmingham.
15,029. Metallic Packings for Pistons, J. Haythorn, Glasgow.
15,030. Fluid-pressure Rivetting Apparatus, J., H., and R. B. Smith, Glasgow.
15,031. Jointing Cast Iron Gutters, W. B. Collis, Stourbridge.
15,032. Laths for Revolving Shutters, J. Armstrong, London.
15,033. Planing Metals, J. Barrow, Glasgow.
15,034. Self-acting Let-off Motions for Steam Power Looms, T. H. Brigg, Bradford.
15,035. Fire-places, W. S. Morton, Glasgow.
15,036. Cutting Coal, S. Broadbent, Bradford.
15,037. Washing, &c., Machines, W. Meakin, Derby.
15,038. Ventilating Water Pipes or Tubes, W. B. Collis, Stourbridge.
15,039. Ejecting Cases of Spent Cartridges from Drop-down Guns, J. Brunlees, London.
15,040. Voltaic Battery, S. W. Maquay, London.
15,041. Curling and Waving Hair, M. Moore, London.
15,042. Dyeing Straw Plaits, J. E. Figgures, London.
15,043. Neck-ties and Scarfs, F. Hochuli.—(*A. Otto, France.*)
15,044. Room Doors and Doorways, D. Gill, London.
15,045. Hoes, Trowels, &c., W. S. Skelton, Sheffield.
15,046. Caoutchouc Horseshoeing, E. De Jean, Brussels.
15,047. Compound Engines, S. Butler, London.
15,048. Condensing Engines, W. F. Martin, J. Scott, J. Albizitti, and J. J. Mahoney, London.
15,049. Anchors, J. Wright, London.
15,050. Portable Electric Thief Detector, A. Coke, London.
15,051. Puzzles, A. H. Reed.—(*I. J. Merritt, jun., United States.*)
15,052. Charging Casks, &c., with Liquids, H. Woodward, London.
15,053. Organs, E. Seches, London.
15,054. Injectors, B. C. Evers.—(*S. W. Moreland, United States.*)
15,055. Perforated Stoppers for Bottles, &c., A. R. Stocker, London.—*24th March*, 1885.
15,056. Plug Stoppers for Bottles, &c., A. R. Stocker, London.—*24th March*, 1885.
15,057. Sewing Machines, P. Waterston, Glasgow.
15,058. Vices for Straining Wire, D. Sinclair, Glasgow.
15,059. Valve Gear for Oscillating Engines, W. H. Martin, London.
15,060. Apparatus for Scoring Games, F. E. Burke and O. March, London.
15,061. Collapsible Drinking Cup, E. J. Trevitt.—(*I. M. Crum, United States.*)
15,062. Treatment of Ores, M. H. Hurrell and E. Easton, London.
15,063. Finings for Sour Beer, &c., A. W. Gillman and S. Spencer, London.
15,064. Hot Air Stoves, G. Porter, London.
15,065. Taps for Measuring Liquid, G. H. Smith, London.
15,066. Automatic Brakes, P. Everitt, London.
15,067. Electrical Arc Lamps, E. Edwards.—(*O. Lück and P. Blasche, Germany.*)
15,068. Protecting the Legs of Trousers, E. Edwards.—(*J. Schultz, Germany.*)
15,069. Window Blinds, A. Ford and J. A. Archer, London.
15,070. Drying Wool, &c., J. McNaught and W. McNaught, jun., London.
15,071. Finger Nail Cleaners, W. R. Lake.—(*T. F. Curley, United States.*)
15,072. Anti-friction Roller Bearings, E. B. Lake, London.
15,073. Reversible Motor Wheels, E. Osgood, London.
15,074. Paper Vessels, L. H. Thomas, London.
15,075. Steam Boiler Cleansers, H. B. Baker and G. B. Blazer, London.
15,076. Correcting Compasses on Board Ships, H. R. Luder, Liverpool.
15,077. Automatic Registration of Music, A. J. Boult.—(*P. Boehm and G. Juliusberger, Germany.*)
15,078. Forming Conduit-sections, W. P. Thompson.—(*J. R. Burdick and D. H. Dorsett, United States.*)
15,079. Vans for Advertising Purposes, W. Burnett, London.
15,080. Imparting the Required Tension to Signal Wires, &c., C. E. Gaunt, London.
15,081. Pudding Basin, D. H. S. Brown, South Wimbledon.
15,082. Artists' Sketch Box, W. T. Brundage, London.
15,083. Combined Scissors and Comb, D. M. Young, London.
15,084. Sash Frames, &c., A. Ayers and W. R. Wilson, London.
15,085. Wave Power or Tidal Motors, J. B. y Veciana, London.
15,086. Storing Cereals, C. V. Ham, London.
15,087. Holders for Pencil Leads, &c., L. Brennan, London.
15,088. Windows, M. S. Buckner, London.
15,089. Explosives, &c., A. M. Clark.—(*E. Turpin, France.*)
15,090. Railway Signalling Apparatus, S. Pitt.—(*G. K. Winter, India.*)
15,091. Lighting and Heating with Gas, T. C. J. Thomas, London.

9th December, 1885.

15,092. Mixing Liquid Disinfectants with Water, W. J. Bishop, London.
15,093. Furnaces for Steam Boilers, &c., S. H. Stubbs, Manchester.
15,094. Gas Cooking Ranges, T. Fletcher, Manchester.
15,095. Driving and Steering Tricycles, C. L. Back, Edinburgh.
15,096. Billiard Table Ball Conductor, A. Wilson and C. Eltringham, Sunderland.
15,097. Securing Window Fastener, C. McCarthy, Birmingham.
15,098. Fancy Yarns, J. H. Craven and J. Crabtree, Keighly.
15,099. Driving Spindles, W. T. Garnett, Bradford.
15,100. Tape Fasteners, J. Hall, Bradford.
15,101. Drying Textile Fabrics, &c., G. Spencer, Manchester.
15,102. Bolts and Nuts, G. H. Wells, London.
15,103. Bolts and Nuts for Railways, G. H. Wells, London.
15,104. Increasing the Illuminating Power of Gas, D. R. Gardner, Glasgow.
15,105. Cells for Generating Electricity, J. A. Kendall, Liverpool.
15,106. Boot Cleaning, W. Benner, Tralee.
15,107. Shuttles for Weaving, H. B. Talbot and A. Gledhill, Halifax.
15,108. Cooking Ranges and Stoves, J. E. Gibson, Glasgow.
15,109. Mechanical Clipping Apparatus, J. Cheshire, Birmingham.
15,110. Utilising the Power in Steamships, C. A. Coombe, London.
15,111. Sheep Shears, A. G. Newton, London.
15,112. Ventilating Rooms, &c., J. F. Armistead, London.
15,113. Fabric applicable for Horse Clothing, A. Stevens, London.
15,114. Velocipedes, I. W. Boothroyd and P. L. C. F. Renouf, London.
15,115. Tooth Injector, W. F. Stanley, Norwood.
15,116. Keeping Lawn-tennis Poles and Nets in an Upright Position, J. Fitzgerald, Old Charlton.
15,117. Mechanical Movements, P. M. Justice.—(*J. Thomson, United States.*)
15,118. Velocipedes, J. Keen and W. McWilliam, London.
15,119. Telegraphic Apparatus, E. J. Harling and S. J. Giffin, Hoddesdon.
15,120. Distilling Fluids, P. E. C. Stromeyer, London.
15,121. Openers for Internally Stoppered Bottles, H. W. Dover, London.
15,122. Railway Carriage Lamps, J. F. Shallis and T. C. J. Thomas, London.
15,123. Filtering and Decanting Liquids, F. Heyland, Milan.
15,124. Speed Increasing Devices for Locomotives, F. Newhouse, London.
15,125. Gig Mills, J. C. Mewburn.—(*La Société Grosselin père et fils, France.*)
15,126. Automatic Steam Trap, W. E. Gedge.—(*J. D. Granjon, France.*)
15,127. Brussels and Jacquard-velvet Carpets, E. Steidel, London.
15,128. Reservoir or Fountain Pens, W. F. B. Massey-Mainwaring, London.
15,129. Gunpowder, E. Schultze, London.
15,130. Coupling, &c., Railway Wagons, R. McAllister, Glasgow.
15,131. Axle Bearings for Tricycles, G. Singer and R. H. Lea, London.
15,132. Couches, J. H. Edwards, London.
15,133. Glass Levels, L. K. Scott, York Town.
15,134. Preparing Coloured Varnishes, A. McLean and R. Smith, London.
15,135. Pigments, A. McLean and R. Smith, London.
15,136. Boots and Shoes, H. E. Newton.—(*T. Cowburn, Austria.*)
15,137. Dust Collectors, A. C. Nagel, R. H. Kaemp, and A. W. F. G. Linnenbrügge, London.
15,138. Securing Coal-hole Plates, E. G. Banner, London.
15,139. Furniture, B. Zwicker, London.
15,140. Crimpled Yarns or Threads, A. M. Clark.—(*P. Depoully, C. Depoully, and the Société C. Garnier et Francisque Voland, France.*)
15,141. Electrical Converters, S. Z. de Ferranti, London.
15,142. Combined Watch Chain and Pen or Pencil-holder, N. Fière, London.
15,143. Waist Belts, H. H. Leigh.—(*M. Rubin, U.S.*)
15,144. Fastening for Hand Bags, &c., H. H. Leigh.—(*M. Rubin, United States.*)
15,145. Embossing Printed Cardboards, J. F. Simmons, London.
15,146. Condensers and Distillers, J. Kirkaldy, London.

10th December, 1885.

15,147. Electric Telephony, J. G. Lorrain, London.
15,148. Earthenware, H. Hill, Nottingham.
15,149. Safety Tandem Bicycle, J. Howes and G. N. Howes, Cambridge.
15,150. Motive-power Engines, C. W. Hill, Manchester.
15,151. Water Velocipedes, S. Smallwood, Manchester.
15,152. Bicycles and Tricycle Chains, S. Goodby and J. Derry, Wolverhampton.
15,153. Railway Chairs, W. Rockliffe and J. T. Green, Sunderland.
15,154. Steering Head for Bicycles, J. Lee, Portsmouth.
15,155. Steam Boiler Furnaces, J. Ferguson.—(*J. Mailer, United States.*)
15,156. Interlocking Gear, T. Smith, Bootle-cum-Linacre.
15,157. Preventing the Flow of Solid Matter from Water-closets, W. Stirling, jun., and T Swan, Manchester.
15,158. Self-trimming Reservoir Elevator, B. H. Thwaite and J. Neville, Liverpool.
15,159. Sewing Machines, J. Forbes, Belfast.
15,160. Picture Frames, &c., S. R. Williams, Birmingham.
15,161. Automatic Steering Safety Bicycle, A. T. Shellard, Bristol.
15,162. Flap Shutter for Photography, G. Mold, Banbury.
15,163. Shutter for Photography, G. Mold, Banbury.
15,164. Horse Gear, F. Mote, Finsbury.
15,165. Torpedoes, T. Smith, London.
15,166. Coffetina, W. Flatau and J. H. Trinder, London.
15,167. Controlling Rudders of Ships, G. D. Davis, London.
15,168. Preparing of Finings, F. Keeling, London.
15,169. Railway and Tramway Wheels, W. H. Kitson, London.
15,170. Rolling Steel and Iron Bars, J. D. Grey, London.
15,171. Thrashing Machines, J. Marshall, London.
15,172. Fastenings for Shirts, &c., F. Hochuli.—(*A. Lotz, France.*)
15,173. Stocking Knitting Machines, W. Harrison, London.
15,174. Steam Engines, A. J. Sedley, London.
15,175. Shrinking Cloth, &c., J. E. Valentine, London.
15,176. Permanent Way of Railways, C. D. Abel.—(*W. Pressel, Austria.*)
15,177. Duplex Writing or Figuring, T. S. Jones, London.
15,178. Tobacco Pipes, W. A. F. Blakeney, London.
15,179. Thrust Block Casings of Propeller Shafts, H. Barrett, London.
15,180. Coupling together the Ends of Pipes, H. Botten, London.
15,181. Pneumatic Hydrocarbon Illuminating Apparatus, L. Kumberg, London.
15,182. Ring Spinning Machines, &c., J. Dodd, Manchester.
15,183. Toy Cannon, G. F. Lütticke, London.
15,184. Inkstands or Inkholders, G. F. Lütticke, London.
15,185. Kilns, T. Carder, London.
15,186. Oil Lamps, W. H. Sleep, London.
15,187. Pencil Holder, B. Kölisch, London.
15,188. Combined Pen and Pencil Holder, H. J. Haddan.—(*L. Fried and B. Iscovits, Austria-Hungary.*)
15,189. Cases for Showing Articles in Shops, J. A. Lloyd, London.
15,190. Packing Cases, W. Thomson, London.
15,191. Diamond Pointed Cutting Tools, R. Arnold, London.
15,192. Fastenings for Corsets, &c., A. Combault, London.
15,193. Roller Mills, W. Bauer, London.
15,194. Producing Motive Power, N. P. Burgh and A. Gray, London.

11th December, 1885.

15,195. Burning off Old Paint, E. Coldwell, Huddersfield.
15,196. Mounting Photographs and Pictures, J. Willmott, Birmingham.
15,197. Metallic Fenders, T. Kendrick and C. Meason, Birmingham.
15,198. Lifeboats, M. H. Taylor and L. Benjamin, Birkenhead.
15,199. Pencil, &c., Appliance, T. and J. V. Harger, Settle.

15,200. Detachable Drive Chains, J. and M. H. Bradshaw, Haslingden.
15,201. Gas Lamps, A. W. Clark, Glasgow.
15,202. Couplings for Railway Vehicles, D. A. Smieton, Glasgow.
15,203. Valves or Taps, H. Aylesbury and J. Milne, Bristol.
15,204. Non-vibrating Lamp Rest, J. R. Maconochie and S. Palmer, Wolverhampton.
15,205. Substitute for Strap, &c., Buckles, W. C. Nangle, London.
15,206. Extracting Ferrules from Tubes, W. Priestley, Higher Ince.
15,207. Cutting Files, C. I. and F. Edmonson, Manchester.
15,208. Desks and Seats, J. and N. Blezard, Padiham.
15,209. Tell-tale for Cabs, &c., W. H. Edmunds, Birmingham.
15,210. Railway Chair and Fastening, F. C. Lynde, Manchester.
15,211. Bottle-washing Machine, T. Dutton and E. H. Bennett, Manchester.
15,212. Planing Short Boards, &c., F. Myers, Liverpool.
15,213. Bicycles, J. R. P. Wallace, Liverpool.
15,214. Representing Inlaid Woods, J. Hancock, Liverpool.
15,215. Horse-balls, F. Fletcher, Coventry.
15,216. Boots and Shoes, D. E. Hurst, Manchester.
15,217. Fixing Metal Tubes into Plates, S. Perkins, Manchester.
15,218. Finishing Packing Twine, J. B. Wrigley, Bury.
15,219. Fastening Metallic Stamped Wares on Metal Sheets, W. J. Kay, Sheffield.
15,220. Portable Alarm or Maroon, B. Moss, Andover.
15,221. Candlesticks, F. Bosshardt.—(*J. T. Warburton, New Zealand.*)
15,222. Travelling Rugs, J. Schlochauer and H. Rosenblatt, London.
15,223. Whips, J. E. Warner, Redditch.
15,224. Lubricating Pump, G. J. Hambruch, Liverpool.
15,225. Coupling Railway Wagons, T. Bretherton, jun., Liverpool.
15,226. Fleshing, Paring, &c., Leathers, J. Turrell, London.
15,227. Circular Combing Machines, J. J. Richardson, Bradford.
15,228. Changing Speed of Wheels, H. M. Holden, Bradford.
15,229. Propelling Boats and Canoes, C. Hoare, London.
15,230. Canisters, &c., A. J. Boult.—(*F. Reil and J. G. Metz, Germany.*)
15,231. Protecting Ships' Plates, J. Blenkinsop, London.
15,232. Saddle, P. Salvi, London.
15,233. Self-closing Ball Valve, E. Emanuel, London.
15,234. Fire-lighter, J. F. Wiles, Charlton.
15,235. Checking Time Apparatus, W. Macrone, London.
15,236. Artificial Millstones or Burrs, E. I. Heller, London.
15,237. Weighing Apparatus, T. Knowles, Manchester.
15,238. Taps, &c., E. Rutter, London.
15,239. Treating Ores, M. H. Hurrell and E. Easton, London.
15,240. Flaps of Hand Bags, F. Weintraud.—(*Weintraud and Co., Germany.*)
15,241. Velocipedes, W. Phillips, London.
15,242. Engines, T. R. Spence, Glasgow.
15,243. Self-starting Valve for Gas Engines, J. Atkinson, London.
15,244. Dividing Dough and other Plastic Material, S. Crowder, London.
15,245. Rolling Steel and Iron, T. Brown and J. G. Gordon, London.
15,246. Reversible Frames of Beehives, J. Rudge, Dursley.
15,247. Scratch Brushes, J. Masters, London.
15,248. Joints of Stoneware Pipes, O. Elphick, London.
15,249. Vices and Clamps, M. Hecht.—(*G. A. Alden and Co., United States.*)
15,250. Rotary Pumps, H. H. Lake.—(*L. Poillon, France.*)
15,251. Distributing Electric Energy, S. Z. de Ferranti, London.
15,252. Burning Limestone, &c., P. M. Justice.—(*C. Dietzsch, Germany.*)

12th December, 1885.

15,253. Tape Fasteners, T. Wright, Bradford.
15,254. Holder for Rolls of Toilet, &c., Paper, A. Christie, Manchester.
15,255. Water-closets, J. Shanks, Glasgow.
15,256. Mud-box for Bilge Pumps, G. A. Calvert, Liverpool.
15,257. Regulating the Speed of Gas Exhausters, W. Snowdon, Leeds.
15,258. Marking Ground for Lawn-tennis, T. Macdonald and R. H. Eggar, London.
15,259. Ripping and Cutting Machine, M. Moore, London.
15,260. Operating the Brakes of Perambulators, W. Snelgrove and A. Fleet, London.
15,261. Drying Tea Leaf, W. Haworth and J. Copeland, Glasgow.
15,262. Sectional Fire-grate Bars used in Locomotive, &c., Boilers, E. Morley, Grantham.
15,263. Supplying Sea-water to Towns, H. F. Wilcox, Newcastle-on-Tyne.
15,264. Slide Valves of Marine, &c., Engines, W. Wright, Newcastle-on-Tyne.
15,265. Screw-gill Boxes, G. W. Douglas and J. Shaw, Bradford.
15,266. Compass Deviation Model, G. Beall, London.
15,267. Raising and Lowering Weights, W. T. Eades, Birmingham.
15,268. Regulating the Electro-motive Force of Electric Currents, C. J. Bosanquet, W. Cameron, and W. A. Tomlinson, Lincoln.
15,269. Fittings of Doors and Gates, G. H. Couch, London.
15,270. Christmas, &c., Cards, W. H. Bacon, London.
15,271. Ringing Bells at Fire-engine Stations, J. Shaw, London.
15,272. Opening, &c., Windows, J. U. Davis, London.
15,273. Tricycles, W. Hillman, W. H. Herbert, and G. B. Cooper, London.
15,274. Flushing Sewers, A. T. Elford, London.
15,275. Securing Stoppers of Bottles, &c., J. Lewis, London.
15,276. Individual Signalling Apparatus, E. F. Frost, London.
15,277. Electric Locomotives, R. R. Hutchinson, London.
15,278. Gas and Lamp Globes, C. Dairy, London.
15,279. Frillings, J. MacCallum, London.
15,280. Return Steam Traps, J. J. Royle, London.
15,281. Boots and Shoes, T. Hewitt, London.
15,282. Measuring and Dividing Liquids, &c., H. Hammerschmidt, London.
15,283. Lawn Tennis Poles, C. Malings, London.
15,284. Bending the Edges of Metal Plates, C. E. and E. J. Layton, London.
15,285. Manganese Voltaic Batteries, B. Pell, London.
15,286. Illuminant Appliance for Gas, &c., Burners, C. A. von Welsbach, London.
15,287. Woven Fabrics, C. D. Abel.—(*F. Schmalbein, Germany.*)
15,288. Frames whereon to Make Cuffs, Muffs, &c., M. E. Scrivenor, London.
15,289. Automatic Apparatus for the Sale and Delivery of Cigarettes, &c., J. Silvester, London.
15,290. Unwinding Warp off the Warp Beam in Looms, T. H. Blamires, Leeds.
15,291. Treating Furnace Gases for Drying, &c., Purposes, J. B. Butterfield, Halifax.

15,292. Wind Instruments, A. J. Boult.—(*W. Buckley, United States.*)
15,293. Alarum or Call Bells, R. C. Scott, Liverpool.
15,294. Coating Hardware, A. J. Boult.—(*T. S. Söhne, Germany.*)
15,295. Checking Fares, A. Warner and J. P. Rock, London.
15,296. Mixed Azo Colours, P. Jensen.—(*The Actiengesellschaft für Anilinfabrikation, Germany.*)
15,297. Heating Feed-water, &c., A. Lencauchez, London.
15,298. Bolts, J. Baldwin, London.
15,299. Hollow Projectiles for Fire-arms, G. F. Simonds, London.
15,300. Steam Boilers or Generators, N. Roser, London.
15,301. Cultivating Land, G. T. Yull, London.
15,302. Safety or Locking Devices, D. L. Brain, London.
15,303. Coating for Ornamental Purposes, F. W. Parker and F. E. Webb, London.
15,304. Fire-bars, &c., D. J. Morgan and J. H. Plews, London.
15,305. Automatic Signal Apparatus, W. Taylor, London.
15,306. Combination Gas Engine, T. F. Veasey, London.

14th December, 1885.

15,307. Making Decoctions, D. Allen and G. F. Blackmore, Hammersmith.
15,308. Tubes, Rods, &c., with Taper Figure, H. Waters, Birmingham.
15,309. Window Fasteners, E. T. Horsley, Copeley Hill.
15,310. Slipping Dogs when in Pursuit of Game, J. H. Armstrong, Newcastle-on-Tyne.
15,311. Scarf Rings, &c., M. J. Abrahall and M. W. Maidment, Birmingham.
15,312. Spinning and Twisting Frames, H. Bottomley, Bradford.
15,313. Blankets, &c., C. Till, Manchester.
15,314. Removing Excrescences, &c., C. Bond, London.
15,315. Mining Signals, T. Wrigley.—(*A. C. Bagot.*)
15,316. Driving Gear, W. A. Martin, London.
15,317. Working the Valves of Water Cisterns, B. D. Scott, London.
15,318. Coupling and Uncoupling Railway Wagons, J. T. Roe, Balham.
15,319. Purifying Rain Water, J. W. Sawyer, London.
15,320. Hinged Spade, H. McC. Alexander, Ireland.
15,321. Toy Race-courses, J. T. Marean, London.
15,322. Pianofortes, J. J. Gilbert, London.
15,323. Jack Guards for Weaving Looms, J. Watson, Halifax.
15,324. Telegraphic Apparatus, W. Chadburn, Liverpool.
15,325. Connecting Threads of Carbon with Platinum Wire, C. Seel, London.
15,326. Disinfecting and Deodorising Closets, &c., B. Haigh, London.
15,327. Slotting and Planing Machines, A. A. Rickaby, London.
15,328. Horseshoes, P. Barry, Fulham.
15,329. Ceramic Ware, A. J. Boult.—(*A. Schierholz, Germany.*)
15,330. Expanding Window Blinds, D. Dormitzer, London.
15,331. Increasing the Illuminating Power of Gas, H. Kinnear and E. Fahrig, London.
15,332. Copying Letters, G. P. Armstrong, London.
15,333. Lamps for Burning Gas, A. H. Hearington, London.
15,334. Automatic Compound Fire Extinguisher, T. F. P. M. Kavanagh.
15,335. Pump without Suction Valve, J. Klein, London.
15,336. Utilising Hydrostatic and Atmospheric Forces, B. Ware and J. Hall, London.
15,337. Colouring Matters, &c., H. Hassencamp and Farbenfabriken vorm. F. Bayer and Co., London.
15,338. Preventing Waste of Water, G. S. Ullathorne, London.
15,339. Band Cutters and Feeders for Thrashing Machines, B. J. B. Mills.—(*C. Paridy and H. A. Schroeder, United States.*)
15,340. Burners for Hydrocarbon Oils, B. Cars, London.
15,341. Gas Regulators, T. Robinson, London.
15,342. Automatic Registering Apparatus for Photographic Printing Presses, A. Gache, London.
15,343. Coupling Apparatus, H. H. Lake.—(*H. Tamm and L. Buhrlen, Switzerland.*)
15,344. Electric Registers for Fares, E. A. Scales, London.
15,345. Knitting Machines, J. S. Anderson, and J. W. Watts, and T. K. Catchpool, London.
15,346. Screws, &c., A. Siewerdt, London.
15,347. Permanent Way of Railways, J. M. Wrench, London.
15,348. Dredging, &c., F. E. Duckham, London.
15,349. Folding Beds, W. H. Dell, London.
15,350. Ear Instrument, F. M. Blodgett, London.
15,351. Steam Boilers, A. Yacoubenco, London.
15,352. Microphones, R. Wreden, London.

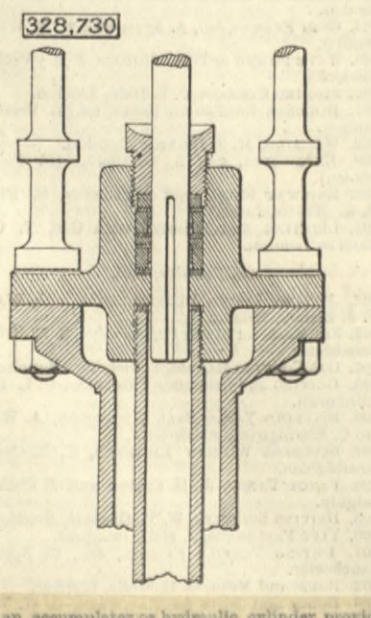
SELECTED AMERICAN PATENTS.

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

328,730. Hydraulic Pressure Regulator and Ram, *B. Thoens, New Orleans, La.—Filed May 12th*, 1885.

Claim.—The combination of a piston or ram having a groove formed in the lower part thereof, as described,

328,730

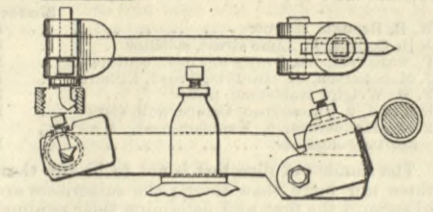


with an accumulator or hydraulic cylinder provided with a grooved stuffing-box and packing, within which the said piston or ram is adapted to operate, substantially as and for the purpose set forth.

328,707. Compound Tool Holder, *Edward F. Noyes, Hamilton, Ontario, Canada.—Filed July 20th*, 1885.

Claim.—The compound tool-holder comprising a shank having at one end a hinged box adapted to hold the tool parallel with the shank, and at the opposite end a hinged box adapted to hold a tool transversely to the length of the shank, substantially as described.

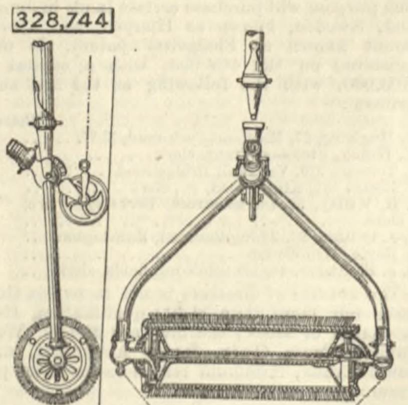
328,707



328,744. Apparatus for Cleaning the Sides and Bottoms of Ships, *Hjalmar Arentz, Copenhagen, Denmark.—Filed July 21st*, 1885.

Claim.—The combination of a bifurcated frame having hollow stub-axles projecting inward from its ends, and having one arm tubular and connected with a water supply, with a cylinder having brushes upon its surface and journalled with hollow trunnions upon the hollow stub-axles, and having a water motor for revolving it inclosed in one end and supplied from the tubular arm of the bifurcated frame, as and for the purpose shown and set forth.

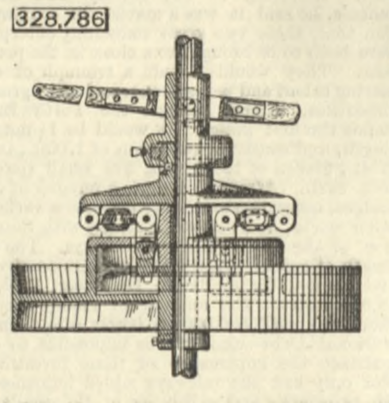
328,744



328,786. Friction Clutch, *Chas. Kaestner, Chicago, Ill.—Filed August 3rd*, 1885.

Claim.—(1) In a friction clutch, the combination with an annular clutch flange and a series of shoes sliding radially to and from the inner face of said flange of a series of rock levers connected at one end to the shoes and at the other connected by toggle links to radial arms sliding on the shaft to and from the clutch, substantially as and for the purpose set forth. (2) In a clutch, the combination with the laterally sliding and rotating clutch member of a flanged wearing ring removably attached thereto and a shipping collar sliding laterally on the shaft and formed with an interior groove to receive and hold the flange on said ring, substantially as and for the purpose set forth. (3) The combination with a shaft and a laterally sliding loose shifting collar thereon, formed with an anterior annular groove, of a sliding and rotating clutch member provided with a flange for engagement with a grooved collar, said flange being cut away slightly at its periphery and one side to leave a space within the groove to form an oil chamber, substantially as shown and described.

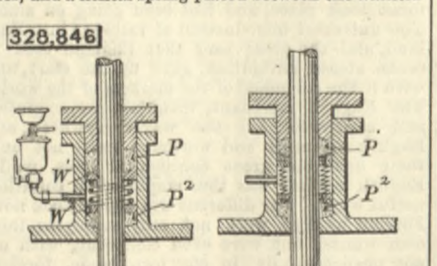
328,786



328,846. Packing for Stuffing-boxes, *Edward S. Hough, Brockley, Kent, England.—Filed July 22nd*, 1885.

Claim.—(1) In a stuffing-box, the combination, with a gland entering one end of the said box and having a concave surface, of a washer W^1 surrounding the piston-rod and having a concave surface opposite the gland, a second washer W^2, having a concave surface opposite the concave end of the stuffing-box, packing P^1 P^2, interposed between each pair of concave surfaces, and a helical spring placed between the washers for pressing the same constantly upon the packing W^1 W^2, substantially as described. (2) In a stuffing-box, the combination, with a gland entering one end of said box and having a concave surface, of a washer W^1 surrounding the piston-rod and having a concave surface opposite the gland, a second washer W^2, having a concave surface opposite the concave end of the stuffing-box, packing, P^1 P^2, interposed between each pair of concave surfaces, and a helical spring placed between the washers for pressing the same constantly upon the packing W^1 W^2, with an oil-cup supported by the stuffing-box and communicating with the interior of the box through the chamber occupied by the spring, as set forth.

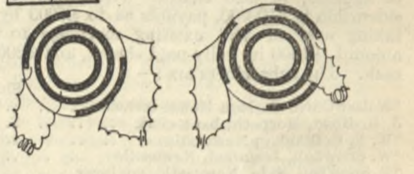
328,846



328,859. Commutator for Dynamo-electric Machines, *C. E. Piper, Moline, Ill.—Filed May 6th*, 1885.

Claim.—(1) In a commutator in the form of a cylinder, the metallic surfaces of which are insulated transversely, the combination of the metal cylinder having the enlarged portion forming one of the surfaces and provided with the insulated portions therein, the insulating sleeve mounted on the smaller end of said cylinder, and a metallic sleeve mounted on said insulating sleeve and having the sections of insulating material inserted therein, substantially as described. (2) In a commutator, the combination of the insulating core or sleeve, the metal cylinder mounted on said sleeve and having an enlarged end and the insulated strips therein, a sleeve of insulating material fitting over the smaller end of said cylinder, and having a ring or collar extending out flush with the surface of the larger end of the metal cylinder, and a smaller metallic sleeve or cylinder fitted over said insulating cylinder and provided with the insulating strips, substantially as described. (3) The combination, with the metal case having the enlarged end, of the sleeve of insulating material fitting over the smaller end of the metal cylinder and having the collar extending out flush with the larger end of the same, the smaller metal cylinder fitting over the insulating sleeve, and the pieces of insulating material inserted in the surface of the metal cylinders, substantially as described.

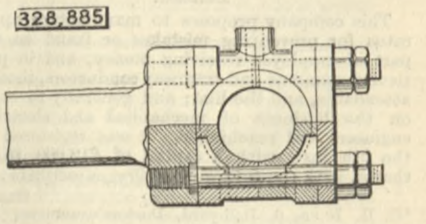
328,859



328,885. Stub End for Connecting-rods, *Lewis Griscom, Pottsville, Pa.—Filed September 14th*, 1885.

Claim.—The stub end for the crank pins of engines and other machines, said stub end having bearings and confining bolts or straps of a metal having a greater ratio of expansion than the crank pin, substantially as described.

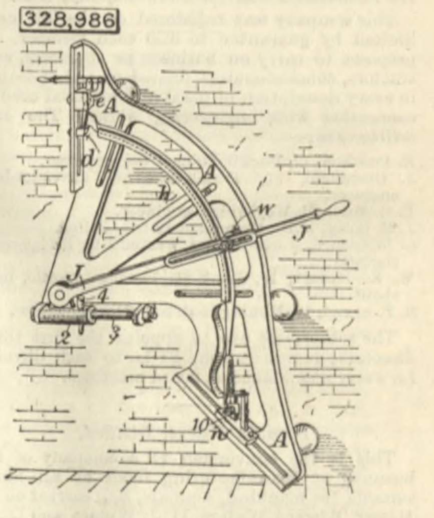
328,885



328,986. Machine for Bending and Setting the Backbones of Bicycles, *George T. Warwick, Springfield, Mass.—Filed October 31st*, 1884.

Claim.—(1) In a machine for bending and forming the backbone of a bicycle, a frame, a lever pivotted to the frame, a roller adjustably attached to said lever, a former secured to the frame, and means, substantially as described, for holding the stem and forked ends of the backbone in position, and whereby said forked end is permitted to have suitable movements, while the backbone is being shaped, combined, and operating substantially as set forth. (2) In combination, the frame A, the blocks *d* and *e*, the movable former *h*, the block *n*, having standards thereon, the block 10, lever J, having a movable pivotal connection with the frame, and the roller *w*, adjustably attached to the lever, substantially as set forth. (3) In combination, frame A, the rod 3, sleeve 2, pin 4, the lever J, wheel *w*, and the former *h*, substantially as set forth.

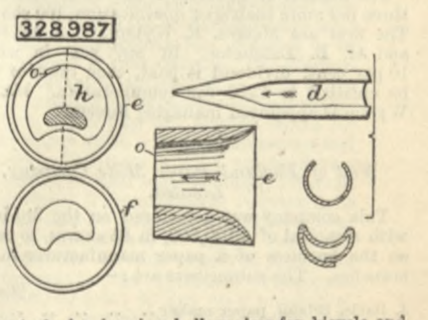
328,986



328,987. Tool for Making Hollow Rims for Bicycle Wheels, *George T. Warwick, Springfield, Mass.—Filed August 3rd*, 1885.

Claim.—(1) A die for forming rims for bicycle and other wheels having a tapering tubular-formed passage through it, and having on its inner surface the projection *v* and the guide lip *o*, extending from near one end of the die to the other in a line inclined to that of the axial line of said die, substantially as set forth.

328,987



(2) In tools for forming hollow rims for bicycle and other wheels, the die *e*, having the projection *v* and the lip *o* therein, the die *f*, having the projection f^1 on its inner surface, and the mandril *h*, said dies and mandril acting jointly to give form to the rims, substantially as set forth.