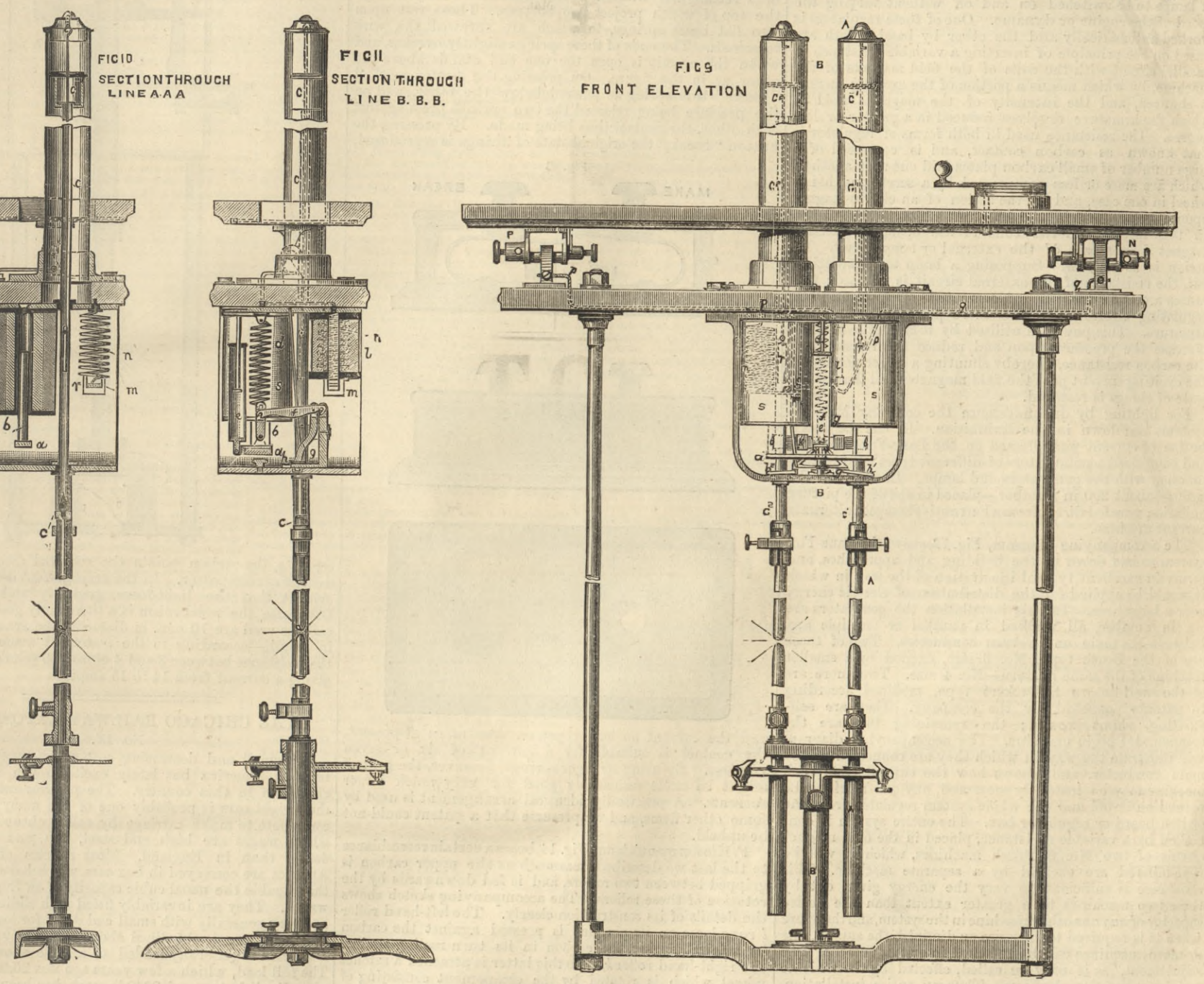
ARC LAMPS AT THE VIENNA EXHIBITION.

No. V.

THE Brush lamp is so well known that it might be supposed that we could very well omit here a description of its mechanism, and merely record the measure of success attained by it in competition with other arc lamps at the Vienna Exhibition. No accurate description of this mechanism, however, has hitherto been published in this country. Wordy volumes, gigantic alike in bulk and weight and pretensions, have appeared, in which vague generalities in the text combined with charming pictures of glass globes are made to pass muster for technical descriptions, but the writer has failed to make anything accurate. The very simple Brush device for automatically kindling a second pair of carbons when the first is burnt out is explained by an ingenious reference to a diagram in which the parts are drawn in an absurdly wrong and incomprehensible fashion. Precisely the same mistake and vagueness are copied into the pages of other books, and thus we have no doubt that there still exists in many an "electrician's" mind considerable mystery as to the mechanical construction of this lamp whose outside appearance is so well known. We are enabled by the courtesy of Mr. Thompson, the manager of the Vienna house of the International Electric Company, to give drawings which, along with our description, will, we trust, be sufficient to make the construction clearly intelligible. The illustrations show a two-pair carbon lamp. The lamp with a single pair of carbons is built on the same method, and is, of course, simpler in detail. Fig. 9 shows a front view with the mechanism exposed by the removal of the front of the box containing it; Fig. 10 is a section through one of the compound electro-magnets and one of the pairs of carbons; while Fig. 11 is a section through the centre of the box midway between the two pairs of carbons, the two section planes of Figs. 10 and 11 being parallel to each other. The same letters indicate the same parts in the different figures. The lower carbons are fixed immovably, so that as they burn away the focus of light is gradually lowered, which is of course of no disadvantage in most installations. The upper carbon holders are long tubes C_2C_1, which at their upper ends are enlarged into small cylindrical boxes. These gradually slide downwards, one at a time, through larger outside tubes which stand on the top of the case containing the mechanism, and from the upper ends of which are suspended by wires the two stop cylinders r r. The suspending wires pass downwards through small holes in the upper surfaces of the boxes C_2C_1, which are closed except for these small holes. The carbon holders c_2c_1 can, therefore, sink as the mechanism permits them until these top plates rest on the stop-blocks r r, these limiting their downward motion. The carbon holders are suspended by means of the ring clutches h_1h_2, which again rest upon the lower edges of the two opposite notches or grooves in the triangular frame-link g. These notches are considerably deeper than the thickness of the rings h lying in them, and thus allow these rings to tilt out of the horizontal position until their opposite internal edges catch on the carbon holders by jamming. The inclination to which these rings are thus tilted depends upon the difference of their internal diameter from the external diameter of the carbon holder, and upon the thickness of the ring-clutch. These being made the same for the two clutches, their inclinations when they grip the carbon holders are equal. The lower edge of the notch carrying h_1 is made higher than that carrying h_2. Suppose that both upper carbons have been allowed to slip down until they rest on the lower carbons, and that the notched frame g is then drawn up. The jam-clutch rings before this upward motion begins, lie flat on the horizontal surface of the frame. As g rises it raises h_1 earlier than h_2, and thus h_1 first reaches the tilt inclination necessary to enable it to grip its carbon holder. Thus the carbon holder c_1 is raised higher than c_2, and the carbon points c_1 are separated further apart than the other pair. The current from the binding screw P is supplied equally to both upper carbon holders, but passes the pair of points closer together, which pair is, therefore, kindled, while the other pair is left unburnt. As the carbon c_2 is burnt away the arc resistance becomes greater and the frame g is lowered by the action of a shunt circuit. The tilted clutch ring h_2 now comes in contact with the flat plate of the frame before h_1 does so. The burning carbon is released by its suspending ring and slips downwards a small distance, while h_1 has never let go the unlighted carbon. Both carbons are now drawn up once more, c_1 still remaining unlighted. This goes on until the tube c_2 has sunk so far that its top plates rest on r, when the carbon c_2 can sink no further and is, in fact, almost burnt out. The arc resistance now becomes greater than it did during the previous oscillations, and g sinks lower than before until the clutch ring h_1 touches the bottom of the frame, releases the up till now unburnt carbon c_1, and allows it to drop on its under carbon. The current now passes by this right-hand pair of carbons which are kindled, as the other pair are extinguished as soon as the frame g is again raised. The process is now continued as before, with this difference—that the burnt-out carbon holder is raised a minute distance in each rise of g, while upon each descent of g it simply falls on to its stop r, and thus makes no progress downwards, while c_1 is fed down steadily. Three pairs of carbons can be combined in the same lamp in this manner, being kindled in succession, and the lamp thus lasts without superintendence a correspondingly longer time.

The frame g is lifted by a lever f, seen best in Fig. 11, this being linked to the centre of a bridge a, connecting the lower ends of the two soft iron cores b. These cores are sucked into the two solenoids S deeper the stronger the shunt current becomes. The main current is led from P, and circulates round both these solenoids. It passes through them in parallel circuit in order to reduce as much as possible the whole lamp resistance. The shunt current also circulates round both solenoids but in series. The shunt winding lies outside the arc current winding as is indicated in Fig. 10, and winds in the opposite direction, so that the two currents counteract each other. When the arc current is strong, as when a pair of carbon points actually touch, the cores descend and the frame g and the carbon holders ascend. When the arc resistance becomes greater the shunt current is strengthened and pulls the cores b further in, thus lowering the carbon holders and reducing the arc resistance. The action of the cores upon the lever f is nicely adjusted by means of the tension of the spiral spring d. This acts in the sense of assisting the shunt current, but as the shunt current becomes stronger and pulls the cores b upwards the assistance rendered by the spring diminishes in consequence of the shortening of its length. Thus, although the primary object of the spring is to correct the balance of the attractive forces of the two opposite windings when the frame g is in its normal position, its action also makes the whole regulating mechanism more delicate. The same may be said, of course, of the action of an adjusting spring in any lamp, provided the spring pull in the direction of *assisting* the shunt current. The solenoid l belongs to the safety short-circuiting arrangement. It is also wound with the shunt wire, giving it a feeble magnetism, which in the normal working of the lamp is insufficient to draw up the iron armature attached to the end of the lever m, seen best in Fig. 9. If, however, the lamp resistance rises beyond the safe limit, the shunt current is so far strengthened that this armature is drawn up and electric contact for the short circuit is made at m. The current now passes through the resistance coil n along the lever to the contact m and then traverses the solenoid l by a thick wire winding, this greatly strengthening the magnetism of this solenoid, and thus ensuring the contact at m until the attendant comes to put the lamp right. The connecting wires for this short circuit are indicated in Fig. 10 by the letters p and q.



THE BRUSH ARC LAMP.

Fig. 12 shows a plan of the installation at the Vienna Exhibition of the International Electric Company, including both the arc and the incandescent lamp lighting. It is one of the largest in the Exhibition, and includes a considerable portion of the public lighting of the building and its approaches.

Commencing with arc lighting, the company supplies eighty lamps of the Brush type, worked by two No. 8 Brush machines, forty lamps in series being worked by each. These lamps were distributed as follows, viz.:—Forty were suspended from the balcony of the Rotunda extending round one-half of its circumference, eight were suspended in the north machine gallery, six at the intersection of

the western transept and machine gallery, seven under the arcades of the south façade of the building, ten were suspended on posts along the eastern side of the building for the lighting of the carriage stand, and nine were used for the lighting of the boiler-house. The forty lamps in the balcony of the Rotunda are of the ordinary well known workshop pattern. The remainder are of an improved ornamental type, with a neat nickel-plated casing and elliptical globe designed and manufactured at the company's Vienna works. These lamps work with a current of about 10 ampères. The carbons are copper coated 11 mm. diameter, and the average length of arc is about 2 mm. The No. 8 Brush machines, of which we will give detail drawings in a subsequent issue, run at a speed of about 700 revolutions per minute, and generate a current of about 10 ampères at an electro-motive force of about 2200 volts. The frames of these machines are a solid casting which is found a great improvement upon the original American made machine frames, which were formed of two separate castings connected together by means of a pair of steel rails which also formed the base of the machine.

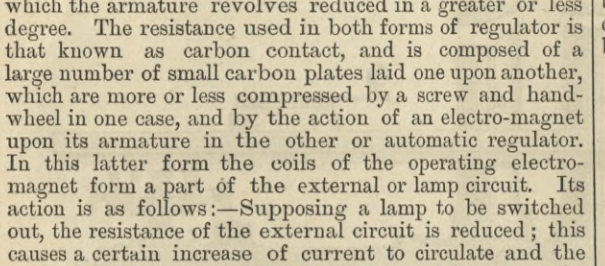
In connection with these arc lights the company exhibited two kinds of current regulators, having for their object to vary the electro-motive force proportionately to the number of lamps to be switched on and off without varying the speed of the engine or dynamo. One of these regulators is worked automatically and the other by hand. Both are based on the principle of inserting a variable resistance in parallel circuit with the coils of the field magnets of the machine, by which means a portion of the exciting current is shunted, and the intensity of the magnetic field in which the armature revolves reduced in a greater or less degree. The resistance used in both forms of regulator is that known as carbon contact, and is composed of a large number of small carbon plates laid one upon another, which are more or less compressed by a screw and hand-wheel in one case, and by the action of an electro-magnet upon its armature in the other or automatic regulator. In this latter form the coils of the operating electro-magnet form a part of the external or lamp circuit. Its action is as follows:—Supposing a lamp to be switched out, the resistance of the external circuit is reduced; this causes a certain increase of current to circulate and the regulating electro-magnet to more powerfully attract its armature. This power is utilised by means of a lever to increase the pressure upon and reduce the resistance of the carbon resistance, thereby shunting a larger portion of the exciting current past the field magnets until the normal state of things is restored.

For lighting by incandescence the company had two systems laid down in the Exhibition. In one the distribution of current was effected on the Lane-Fox principle, and comprised accumulators of different types used in conjunction with the generators and lamps. In the other the lamps—about 200 in number—placed in one of the picture galleries, were fed direct from a Ferranti-Thompson alternate current machine.

The accompanying diagram, Fig. 12, shows the Lane-Fox system as laid down in the building and approaches, and forms an excellent typical illustration of the way in which it would be applied for the distribution of electric energy over a large area. In this installation the generators are six in number, all worked in parallel or multiple arc, between the main and return conductors. Two of these are of the Brush type, No. 6 size, excited by a smaller machine of the same pattern—No. 4 size. Two more are of the well-known Schuckert type, modified according to patents possessed by the company. They are self-exciting, shunt wound; the remaining two are the compound Bürgin machine. The accompanying diagram will illustrate the way in which they are connected to the main conductor, and shows how the current from each machine may be instantly measured, any one machine be turned on or off, and the whole system regulated from one switch board or regulator box. The entire system is controlled by a variable resistance, placed in the field magnet circuit of two No. 6 Brush machines, which it will be remembered are excited by a separate machine. This resistance is sufficient to vary the energy given out by these two machines to a greater extent than the entire capacity of any one other machine in the system, and therefore when it is required to increase or diminish the supply, one or more machines can be switched in or out, and the "fine adjustment," as it may be called, effected by the variable resistance mentioned above. Thus an entire installation, comprising some hundreds of lights is placed completely under the control of one man in one place, who can, with a turn of the hand, switch in or out machines or lamps, and control the system extending, perhaps, over some miles.

The area over which the distribution is effected is mapped out into different districts, according to the average difference of potential between the two conductors in it—as may be seen by reference to the diagrammatic plan of the installation. At the poles of the machines—*i.e.*, in the

Fig. 12



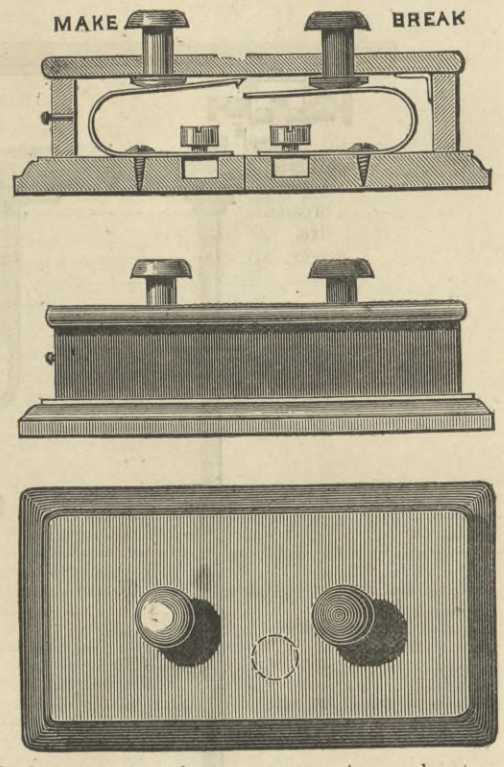
machine room, marked A on plan—this difference of potential, or electro-motive force, is 63 volts. In the B district, comprising several furnished rooms and passages leading thereto, this electro-motive force is reduced to 60 volts; in the C district, comprising the pavilion of the British Commission and the garden adjoining the Restaurant, it is further reduced to 57 volts; while in the long street or avenue there are four different districts—viz., D, E, F, and G, working respectively with electro-motive forces of 56, 54, 52, and 51 volts. It may be here mentioned that in this portion of the system the fall of electro-motive forces much was greater than would in practice be arranged in a permanent installation, the question of cost of conductors playing an important part in a temporary installation of this magnitude, laid down solely for exhibition purposes. The number of lamps used on this system is approximately 400, arranged—A district, 80; B, 150; C, 50; D, E, F, and G, 70.

An interesting feature of the D, E, F, and G districts was the use of an earth return—*i.e.*, an uninsulated conductor buried in the ground. This is believed to be the first experiment of the kind made with incandescent lighting, and so far gives promise of success. It affords ground for interesting experiments, which are being made on it by the company's staff.

The accumulators, which are shown at districts A, B, and C, are of the Planté type, according to some modifications introduced and patented by Mr. St. George Lane Fox. These were described in our issue of 7th September last. The whole of the electrical arrangements of the company's exhibit were designed and carried out by the company's chief electrician in Vienna, Mr. H. U. Wollaston.

The accompanying Fig. 13 shows in section and in outside view an extremely neat contact maker made by the International Electric Company. The whole is enclosed in a rectangular wooden box of diminutive size, through the top of which project two buttons. These rest upon two flat brass springs, to which are screwed the wire terminals. The ends of these springs slightly overlap, and when the circuit is open the one end stands above the other, as in the figure. On pressing the button marked "make" this spring is pushed below the other, and on the pressure being released the two springs press against each other, the contact thus being made. By pressing the button "break," the original state of things is reproduced,

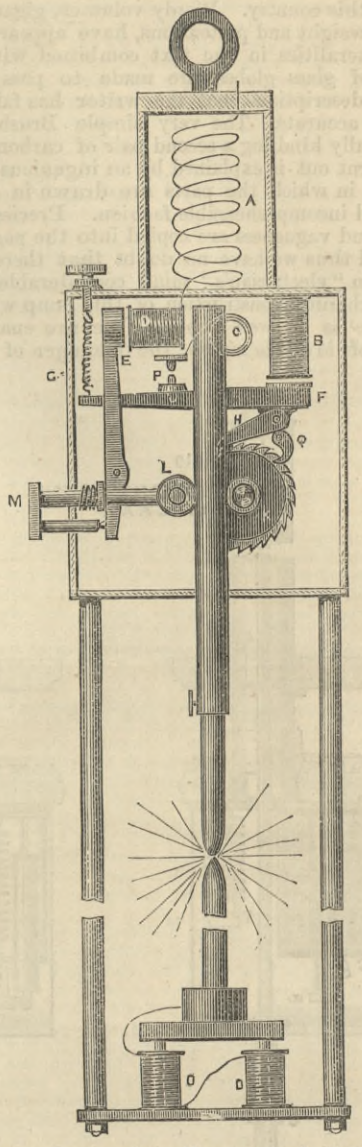
Fig. 13



and the current no longer passes. As made at present, the contact is suitable for a current of six or seven ampères. By using stronger springs, however, the contact might be made sufficiently good for very much larger currents. A practically identical arrangement is used by some other firms, and we presume that a patent could not be upheld.

F. Klostermann's lamp, Fig. 14, bears a certain resemblance to the last we described, inasmuch as the upper carbon is gripped between two rollers, and is fed downwards by the rotation of these rollers. The accompanying sketch shows the details of its construction clearly. The left-hand roller *l* runs loose on its pin, but is pressed against the carbon by a spiral spring, the carbon in its turn resting against the right-hand roller *k*. To this latter is attached a ratchet wheel, which is rotated by the escapement consisting of the pair of pawls *h* and *q*. The pawl *h* is alternately raised and lowered by the end of the lever *f*, to which is attached an armature attracted upwards intermittently by the solenoid *b*, through which the shunt current passes. This end of the lever is pulled downwards when the opposite end of the lever is raised by the tension of the small spiral spring *g*. The tension of this spring can be regulated by a thumb-screw, so that *f* is only raised when the desired limiting strength of the shunt current is attained. The shunt current may pass by two routes. One of these leads through the solenoid *b*; the other through the resistance coil *c*. The connection to the former is made or broken at *p*. Here there are two small carbon buttons, one of them mounted on the lever *f*. When the spring *g* pulls the left-hand end of the lever up, this contact is made, and the current flows through *b*, which becomes magnetised and draws up *f*. The contact is then broken, and *b* demagnetised; the armature *f* falls, and contact is once more made at *p*. Thus the lever goes on vibrating and actuating the escapement, and so feeding the upper carbon downwards so long as the arc resistance is so great as to send sufficient current through the shunt to magnetise *b* strongly enough to attract *f* against the tension of *g*. When the carbons are so wide apart that no current can pass them—as, for instance, just before lighting up—the current flows through the resistance coil *a* in the upper box, and through the solenoid *d*. This being thus magnetised draws the armature *e* towards it, and moves the lever shown standing vertically at the side of the box. The lower end of this lever then pushes *m* outwards, thus drawing the roller *l* out of contact with the carbon, and allowing it to slip downwards freely until it rests on the top of the lower carbon. As soon as it does so the current passes by the carbons through the small solenoids *o o* at the bottom of the lamp, the current ceasing at the same moment to magnetise *d*, and the roller *l* once more springing back into position to grip the upper carbon. The electro-magnets *o o* now draw downwards the armature upon which is mounted the lower carbon-holder, and thus

Fig. 14



separate the carbon points the required distance for the desired candle-power. In the arrangement described it is evident that the light-focus gradually sinks in level. Otherwise the mechanism is a thoroughly good one. The carbons used are 10 mm. in diameter, the arc about 4 mm. in length—according to the statement made to us—and the resistance between 3 and 4 ohms; 50 volts are required, giving a current from 14 to 15 ampères.

THE CHICAGO RAILWAY EXPOSITION.

No. IX.

The small and decreasing cost of transport by freight train in America has lately excited much interest and emulation in this country. The peculiar construction of the freight cars is probably one of the many factors that contribute to make carriage by rail so cheap in a country where wages are high and steel, iron, and even coal is dearer than in England. Most articles of freight in America are conveyed in box cars, which have rather more than double the usual cubic capacity of an English covered wagon. They are invariably fitted with sliding side doors, and very generally with small end doors for loading timber. The sides are double-lined about half way up, and wheat and grain is generally loaded to a little above this limit. The full load, which a few years ago was 20,000 lb., or, say, nine English tons of 2240 lb. each, has been increased to 40,000 lb., and even to 50,000 lb., or 22 tons 6 cwt.; while the average weight of the car itself has been increased only from 20,500 lb. to 22,000 lb. The average weight actually carried in a loaded car on the Pennsylvania Railway has increased from 20,260 lb. in 1877 to 24,620 lb. in 1881, though, of course, a large proportion of old and light cars were still running. The following comparative table shows clearly the relative results attained with typical vehicles for the conveyance of merchandise. The average load is in each case the average weight carried, whether loaded or empty, and not, as above, the average weight carried when loaded. The pressure on the journals, &c., therefore, represents the average results under all circumstances:—

	English. Tons.	Cwt.	American. Tons.	Cwt.
Average weight of vehicle	4	18	9	16
Average weight of lading	2	7	7	3
Total average weight	7	5	16	19
Deduct weight of wheels and axles	1	13	2	12
Load on journals	5	12	14	7
Length and diameter of ditto	8in. by 3½in.		7in. by 3⅞in.	
Area of bearings: Number by length by diameter	112 sq. in.		210 sq. in.	
Pressure on bearings per sq. in. ...	112 lb.		153 lb.	

The figures given above are deduced from careful observations on English lines and reports, &c., of various representative American roads, and may, therefore, be accepted as fairly accurate. They exhibit pretty clearly the main results of the differences in design between English goods trucks and American freight cars. It will be noticed that

though the gross weight of the American vehicle is just double that of the English, the average load is three times greater. Excluding the wheels and axles in the American vehicle, the weight of the load almost exactly equals the tare of the vehicle; but in England, the weight of body, framing, springs, &c., exceeds the load by 38 per cent. This great difference is probably due to the fact that the materials are so well disposed in an American freight car that great strength is attained with a moderate weight. The sides form a deep truss, the depth being about $\frac{3}{7}$ of the span, and the bottom is also strongly trussed, and, owing to the central buffer system, needs little or no diagonal bracing in a horizontal plane. Two English goods trucks have eight buffers and four draw-hooks, with their accompanying gear, against two central buffers and four "dead blocks" on an American freight car of greater cubic capacity. The saving in wrought iron hinges, knees, corner plates, &c., is also considerable, while the American freight car bogie, with its spiral springs and axle-boxes bolted to the bogie frame, weighs little more than the corresponding axle guards and plate springs of an English wagon. The smaller number of doors, ends, and headstocks also reduces the comparative dead weight of the longer vehicle. The comparison is still more unfavourable if the typical English vehicle be represented by a covered wagon instead of an open truck protected by a tarpaulin. The dead weight, excluding wheels, is then more than double the average paying load, instead of being equal to it, as in American practice. This great discrepancy is not due to weakness, as an examination of freight cars in traffic and in the repair shop shows that the bodies and frames of American box cars stand shunting and rough usage fully as well as our own. The medium-sided open cars, used almost exclusively for coal, are generally sagged in the middle, showing the value of the trussed sides of the covered cars. The depth of truss possible under the floor is in itself insufficient to support a timber-framed loaded vehicle, with bogie centres 24ft. apart.

Referring again to the comparative table, it will be seen that the wheels and axles of the English vehicle are far heavier in proportion to the load they carry, weighing 29 per cent. of the weight on the journals, instead of only 18 per cent. as in the case of the American vehicle. This can only be partly accounted for by some 3in. or 4in. difference in the diameter of the wheels and 6in. to 8in. difference in the length of the axles, and is chiefly due to the insufficient strength of the American wheels, as shown by their frequent breakage, to which reference will be made further on. The size of journal given is the largest in general use in America, and was adopted in 1879, after considerable discussion, as the Master Car-builders' standard. It is used under the tenders of the New York, West Shore, and Buffalo Railway, which were illustrated on page 449 of our issue of 7th December. Journals measuring only 5½in. by 2⅞in. are, however, still in frequent use. The pressure per square inch, even on the larger American journals, is much in excess of that obtained in England, and it is not therefore surprising that much trouble is experienced in America from hot boxes, and that numerous special lubricants to cool hot brasses are used, and various forms of journal bearings were exhibited at the Railway Exposition. Among the latter was Hopkins' lead-lined self-fitting bearing, exhibited by G. R. Meneely and Co., West Troy, N.Y. The soft metal adapts itself to the journal, and is said to require little or no fitting.

The Ramapo Wheel and Foundry Company exhibited the Raoul axle-box. The door of the axle-box serves as an end bearing for the axle, and is kept in place by a stirrup, which can be swung out of the way when it is desired to examine or lubricate the box. The end bearing cannot be jammed too hard against the journal, as the stirrup closes the door against the axle-box. Examination and lubrication can be effected without detaching any loose parts. The journal can be made the same size as the dust guard bearing, which is convenient, and permits a longer journal to be used without increasing the external dimensions of the axle-box.

The chilled wheel, despite the greatest care and watchfulness, is very liable to failure, and comparing 10,000 American wheels with 10,000 English wheels, it is estimated that in a year 170 American wheels will have broken completely or failed in the tread or flange, 210 will be found cracked in the disc or stiffening ribs, and 14 will have cracked in the boss. In a corresponding number of English wheels, it appears from the Board of Trade returns that 6 wheels will be found to have cracked or split tires, whilst a failure of the ordinary wagon wheel in the boss or spokes is almost unknown.

This disproportion seems enormous, but the figures given are at least approximately correct, and the *Railroad Gazette* commenting on the statistics on which the above figures are based, estimates that out of the 5,600,000 freight car wheels in America, 28,000 are dangerously broken every year. The wearing qualities of chilled wheels is a somewhat distinct question, which has been much discussed, but still remains in a state of great uncertainty, the estimates of the average life of a chilled wheel varying from 40,000 miles to 130,000 miles, many wheels giving way by being skidded through the chill. There can, however, be no doubt that our wheels wear longer and far more evenly, and that the eighteen to twenty years' life expected of a steel tire under an English goods wagon exceeds anything ever attained by a chilled wheel. This is only partly due to the American wheel being smaller and more heavily laden; for assuming that the wear is directly as the load and inversely as the diameter on tread, an American wheel should run 80 per cent. of the mileage of an English wheel for the same amount of wear.

The heavier loads and the increased use of re-melted wheels have intensified the evil, while the growing manufacture of steel tires provides a remedy, and the cheap but untrustworthy chilled wheel seems likely to be superseded by some form of elastic bodied steel tired wheels. The Allen paper wheel, which is being extensively used in America under passenger cars, engines, and tenders, is well known in this country, but the wheels which are described below are of recent introduction, and are being tried on the Chicago and North-Western, Pennsylvania, and other large lines. The inventors endeavour to attain the advantages of the Allen wheel at a smaller cost.

The Miltimore elastic steel wheel consists of a crucible steel tire, twelve Bessemer steel spokes, and two cast iron washers which are bolted together to form a boss. The spokes are made from flat bars cut to length, the inner ends being tapered. Two inches from the rim the spokes are twisted a quarter turn, placing the planes of the two sections of the spokes at right angles to one another, and forming a shoulder on both sides. The spokes being assembled, a taper mandril is forced through the centre of the wheel by an hydraulic pressure of from 60 to 100 tons, driving the spokes against the tires, and forcing circular pins or tits turned on the ends of the spokes into corresponding holes ½in. deep bored on the inner periphery of the tire. The shoulders of the spokes are then turned, so as to present perfectly circular bearing surfaces on both sides. The boss plates are now placed over the mandril and forced home against the shoulders of the spokes by hydraulic pressure. The boss plates are then rivetted together, the mandril removed, and the centre opening bored out to receive the axle. The inner periphery of the tire is not turned, but shallow grooves are cut across its width with a milling tool to receive the shoulders of the spokes. The wheel when finished is forced on the axle with the usual pressure. A 1¼in. hole, not shown in the drawing, is drilled through each spoke before being twisted, in order to give elasticity and diminish the force of concussion on the axle.

The dimensions of a wheel 2ft. 9in. in diameter—the usual size for freight cars—are as follows:—Tire, 2½in. thick on tread and 5½in. wide; spokes, 4in. wide by 1in. thick; boss plates, 1ft. 7in. diameter; weight, 7 cwt.—or about 2 cwt. more than the ordinary chilled wheel of the same size. The Miltimore wheel certainly appears to be unnecessarily heavy; probably the number of spokes and the diameter of the boss plates might be reduced with advantage. It will be noticed that the spokes do not fit against one another where they enter the boss, and therefore are only held in position by the grip of the rivets.

The wheel exhibited by the Paige Car Wheel Company has a cast iron boss, to which two ½in. plates are bolted, fitting against a broad lip or flange on the inner periphery of a rolled steel tire. A large number of bolts are used. The plates, however, are well secured, and have a long bearing on the boss. Both tire and centre are, however, extremely heavy, though the former has no extraordinary wearing powers, and the weak boss seems likely to split at the inner edge if pressed tightly on the axle.

The Boston Standard Wheel Company exhibited Cooper's Patent wheel. The wheel centre resembles an ordinary cast iron chilled wheel, but a steel tire is used fitting the centre at the edges only. Liquid india-rubber is forced into the space between the tire and centre, and thus forms an elastic cushion for the tire. A shallow rib on the tire and a corresponding groove on the wheel centre prevent any lateral movement. It is stated that 1000 of these wheels are in use on railways in New England.

It may be safely asserted that none of the wheels above described can compare in price, weight, strength, or elasticity with an ordinary English wagon wheel, and are very inferior to wheels with a wrought iron boss, such as Owen and Dyson's or Kirtley's patent. It is often stated that the Mansel wheel is unsuited to a very dry climate, and possibly the extreme changes of temperature and great variations in the amount of humidity in the atmosphere might cause the teak blocks to become loose in America, especially in a hot and dry summer, but the experiment would certainly appear well worth trying. Several wheels were exhibited by one of the few English exhibitors, the Patent Shaft and Axletree Company.

The Ohio and Mississippi Railroad exhibited a freight car fitted with a form of continuous draw-bar, which has been adopted as a standard on the Missouri-Pacific—Mr. Jay Gould's 6000 mile group of railways and other lines. The central buffer bears against a spiral spring, bedded on a cross-bar firmly secured to the under frame. A long cotter 5in. wide by 1in. thick, is fast in the centre draw-bar, and works through slots in the two middle longitudinals. Two draw-bars are used, one on the outer side of each longitudinal, the cross cotter passing through eyes at the ends of the bars. Split cross cotters prevent the draw-bars falling off. The eyes in the draw-bars are slotted, so that no strain can come upon the latter in buffing, and an angle iron stop connected with the cross-bar and bolted to the longitudinals prevents the springs being driven home. The frame of the vehicle is entirely relieved of tensile strain, as the spring furthest from the front end of the vehicle acts as a draw spring, and thus the car is pushed rather than pulled. The bogie pins prevent the use of a central continuous draw-bar, but practically the same results are achieved.

Open cars with sides 2ft. to 3ft. high are styled for some unfathomable reason "Gondola cars," and are very generally made to readily discharge their load, either by tipping sideways on their longitudinal centre, when they are known as "dump" cars, or by doors in the centre of the floor forming a hopper bottom. Cars of both varieties were exhibited. A dump car—Van Wormer's patent—was exhibited by the Gilbert Car Manufacturing Company, of Troy, New York. This car is intended for the rougher classes of freight, coal, coke, ore, ballast, ashes, or mud, which are often dropped into a car from a shute, and should, if possible, be discharged in as expeditious a manner The floor of the car is very strongly constructed, being supported by two side sills and four intermediate longitudinal stringers, the whole being trussed by four rods passing under cross bearers. The whole body and frame of the car rests on the centres of the bogies on curved rockers. The car is kept steady when running by short struts or side bearings, which can be swung out of the way when the car is tipped on its centre bearing. Chains attached to the side sills of the car pass under pulleys on the bogie frame, and thence round chain drums on a shaft running the length of the car. This shaft can be rotated from a hand wheel at the end of the car by means of a worm. As the shaft revolves the chains draw one side of the car down towards the bogie. The side doors are hinged at the top, and are held at the bottom by latches, which strike the bogie, and are released when the car is inclined, discharging the contents of the car at the side of the track. The door latches refasten themselves by means of weighted levers when the car is restored to an upright position. The arrangement is alike on both sides, and consequently the car can discharge either right or left. The drums in which the chain gears, are secured to the shaft by means of clutches. When it is desired to tip quickly the hand wheel is used until the load has passed the centre and begins to move, when both chain wheels are released from the clutch by means of a lever, and the load is rapidly delivered, entirely clearing the car. Should it be necessary to deliver part only of the load, the chain drums are retained by the clutches, and the car is held at any angle, and the load delivered at will. The worm gearing gives great control over the car, and it is stated that one man can discharge a car load—18 tons—and replace the car in a running position in from 1½ to 2 minutes. The doors being each about 16ft. long are trussed, and that the middle stanchion is braced to the floor by a raking stay.

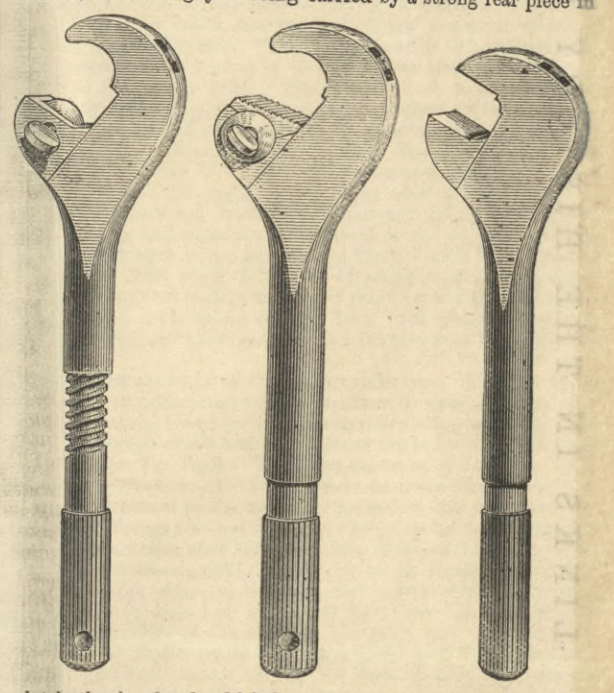
A hopper-bottom gondola car was exhibited by the United States Tube Rolling Stock Company, of New York. The framing of this car is placed in a line with the draw gear—a great improvement on the ordinary American method of attaching the central buffers below the frame. Each longitudinal stringer is formed of two wrought iron tubes 2½in. external diameter, placed one above the other at 6in. centres, and braced together at intervals by clips, bolts, and cast iron distance pieces. The body transoms or cross bearers which rest on the bogies are placed between the tubes forming the stringers. This enables the whole car to be lowered, so that the centre line of the draw gear comes within the frame. In the ordinary car frame the cross bearers must be placed below the longitudinals, in order to avoid cutting and weakening the timbers. As the height of the bogie bolster from the rail cannot well be reduced, the longitudinals are thus raised above the level of the central buffer, which stands 2ft. 9in. from the rail.

The hopper-bottom doors give a clear opening of 4ft. 4in. by 2ft. The car measures 33ft. 8in. long, 7ft. 7in. wide, and 2ft. 6in. deep, inside dimensions, giving a capacity of 647 cubic feet. The car is rated at 18 tons capacity, but this weight of coal could not be carried unless the load was heaped up in the centre. The stanchions, pitched 4ft. apart, are of white oak 3in. by 3½in. The ends, sides, and bottom are Southern yellow pine planks, 6in. wide, the two former being 2½in. and the latter 1¾in. thick. The extreme length over buffer heads is 36ft. 1in. The Pennsylvania Railroad standard hopper-bottom gondola car of very similar capacity and dimensions, but with an ordinary timber frame, weighs 10½ tons, or about 1 ton 15 cwt. more than the car above described.

A four-wheeled dump car, which discharges its load on either side, or through the bottom by doors, without tipping the body, was exhibited by the inventor, Mr. T. W. Goodwin. Its capacity is 25,000 lb., or 11 tons. The Ohio Central Railway exhibited a gondola car without drop bottom or tipping arrangement, which held 18 tons of coal, and weighed only 17,050 lb., or 7 tons 12 cwt.—a remarkably small proportion of dead weight.

BRITTAIN'S SHIFTING SPANNER, PIPE WRENCH AND CUTTER.

THE spanner, wrench, and cutter illustrated by the accompanying engravings are made by Mr. F. Brittain, St. George's Works, Sheffield. They are of similar construction as far as relates to the jaws, the moving jaw being carried by a strong rear piece in

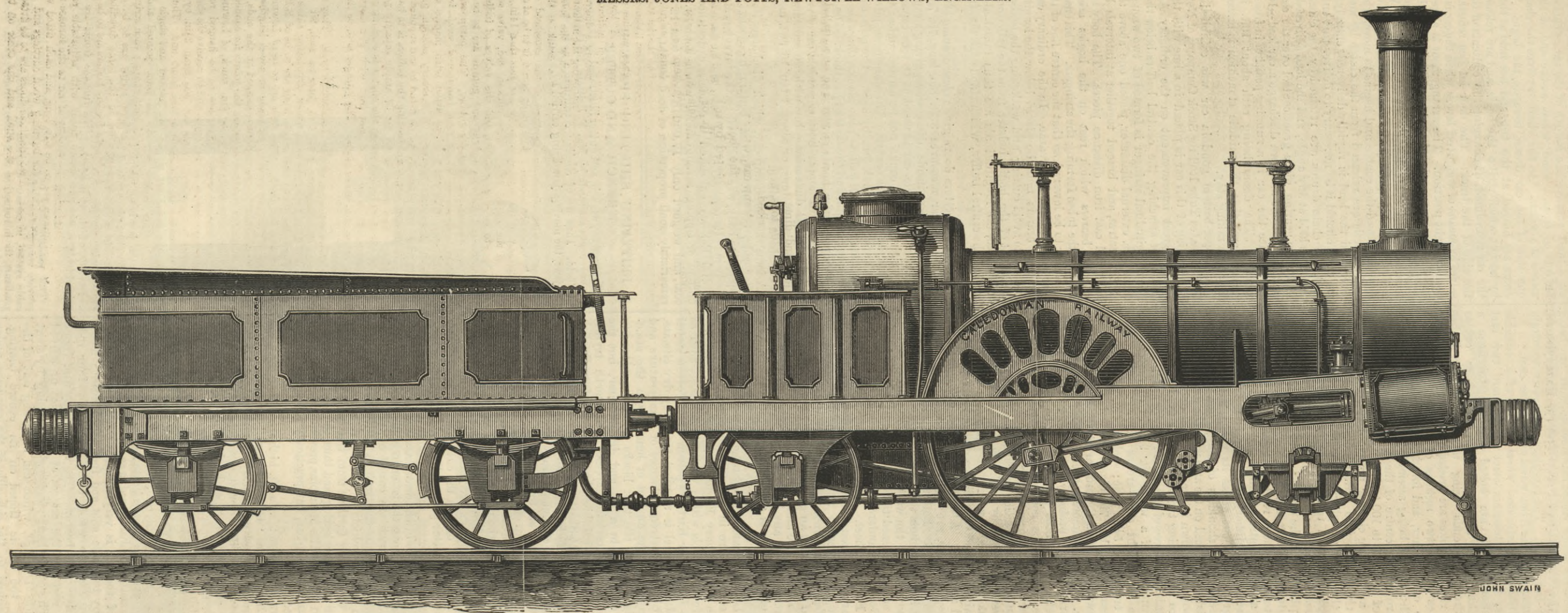


a slot in the jaw head, which is pushed nearer the fixed jaw by an interior strut piece moved by the screw handle, or allowed to recede therefrom by a spring. The modification for carrying a pipe-gripping surface or a cutter wheel are obvious from the engravings, which, it needs only to be said, show a very handy pair of tools.

THE parliamentary notices for next session include two to provide tramway connections, by means of the continuous wire cable system, in certain districts of Edinburgh, where, from the gradients, the introduction of ordinary tramways has been found impracticable.

LINKS IN THE HISTORY OF THE LOCOMOTIVE—OUTSIDE CYLINDER ENGINE, 1842.

MESSRS. JONES AND POTTS, NEWTON-LE-WILLOWS, ENGINEERS.



LINKS IN THE HISTORY OF THE LOCOMOTIVE.

No. XV.*

Among those who did much in the early history of the locomotive, may be mentioned Mr. Jones, of Liverpool, whose grandsons now carry on the St. George's Engine Works, in that city. We illustrate a locomotive constructed by Mr. Jones for the Caledonian Railway in 1842. Messrs. Jones also built engines fitted with the type of reversing gear introduced by George Stephenson, about the year 1834, and which, with various modifications, continued to be used until the introduction of the modern link motion into Messrs. Stephenson and Co.'s engines in 1843. It was designed to supersede the loose excentrics then in use, and afterwards given up on account of their liability to damage from the sudden reversing of the engines. There were several varieties of this gear. Alcard and Buddicome used a pair of excentrics keyed on to the end of the axle. The reversing shaft was placed below the level of the piston rod, and to a lever keyed upon it links were attached of unequal length, connected at their upper extremities with the ends of the excentric rods, one of which was above and one below the studs on the weigh shaft levers, so that the upper excentric rod being in gear gave the forward motion, and the lower one the backward motion. In Messrs. Sharp, Robinson, and Co.'s engine (1842) forks were situated above and below the studs on the weighshaft levers. The forward excentric rod was lifted up out of gear by a link depending from the lever on the reversing shaft, and by the same movement the backing excentric was lifted into gear by a longer link connecting it to a lever, not upon the reversing shaft, but upon a shaft below it. Stephenson and Hawthorne both used a similar arrangement, but admitting of the excentric rods being both under the studs on the weigh shaft levers, so that there was no danger in the event of a disengaged rod falling down, or of any part of the gearing being bent or twisted by both rods being in gear at the same time. We shall illustrate this arrangement in a future impression.

The following copy of a specification supplied to Messrs. Jones, Turner, and Evans, will be found interesting. The specification was accompanied by the annexed letter:—

Gentlemen, Manchester, October 24, 1838.

Annexed I beg to send you a copy of specification of a locomotive boiler such as our company are now intending to order. If you are disposed to send in a tender for a couple or three, I shall be glad to receive it on or before the 15th November next.—I am, gentlemen, Your obedient servant, Edw. Woods.

Messrs. Jones, Turner, and Evans, Viaduct Foundry.

Specification for locomotive boiler and fire-box, smoke-box, chimney, safety valves, &c., required for the Liverpool and Manchester Railway, 1838:—

The boiler to be cylindrical, 7ft. 6in. long outside, between the smoke-box and the outside casing of the fire-box below the tubes. To be 3ft. 3in. diameter inside.

To be made of four plates, of equal breadth, of the best Low Moor iron, each plate the whole length of the boiler, and five-sixteenths of an inch thick. The end next the chimney to be made of one Low Moor plate, of best quality, five-eighths of an inch thick, in which must be drilled, square through, without countersink, 130 tube holes, one inch and three-quarters diameter, and three-quarters of an inch from each other; the upper surface of the top row of tubes to be 14in. from the top of the boiler.

The boiler plates to be put together with best $\frac{5}{8}$ rivets, and to be fastened to the chimney end and outer casing of the fire-box by 3½in. angle iron, and double rows of $\frac{3}{4}$in. rivets; the whole to be well caulked nside and out. Care must be taken that the proper side of the plates be kept *upwards* in punching the rivet holes, so that when put together the *smallest diameter* of the rivet holes in each plate shall be next each other at the joint, the larger diameter in each plate forming a countersink for the rivet heads on each side; and for this object, the dies used in punching the rivet holes should be one-eighth of an inch more in diameter than the punch.

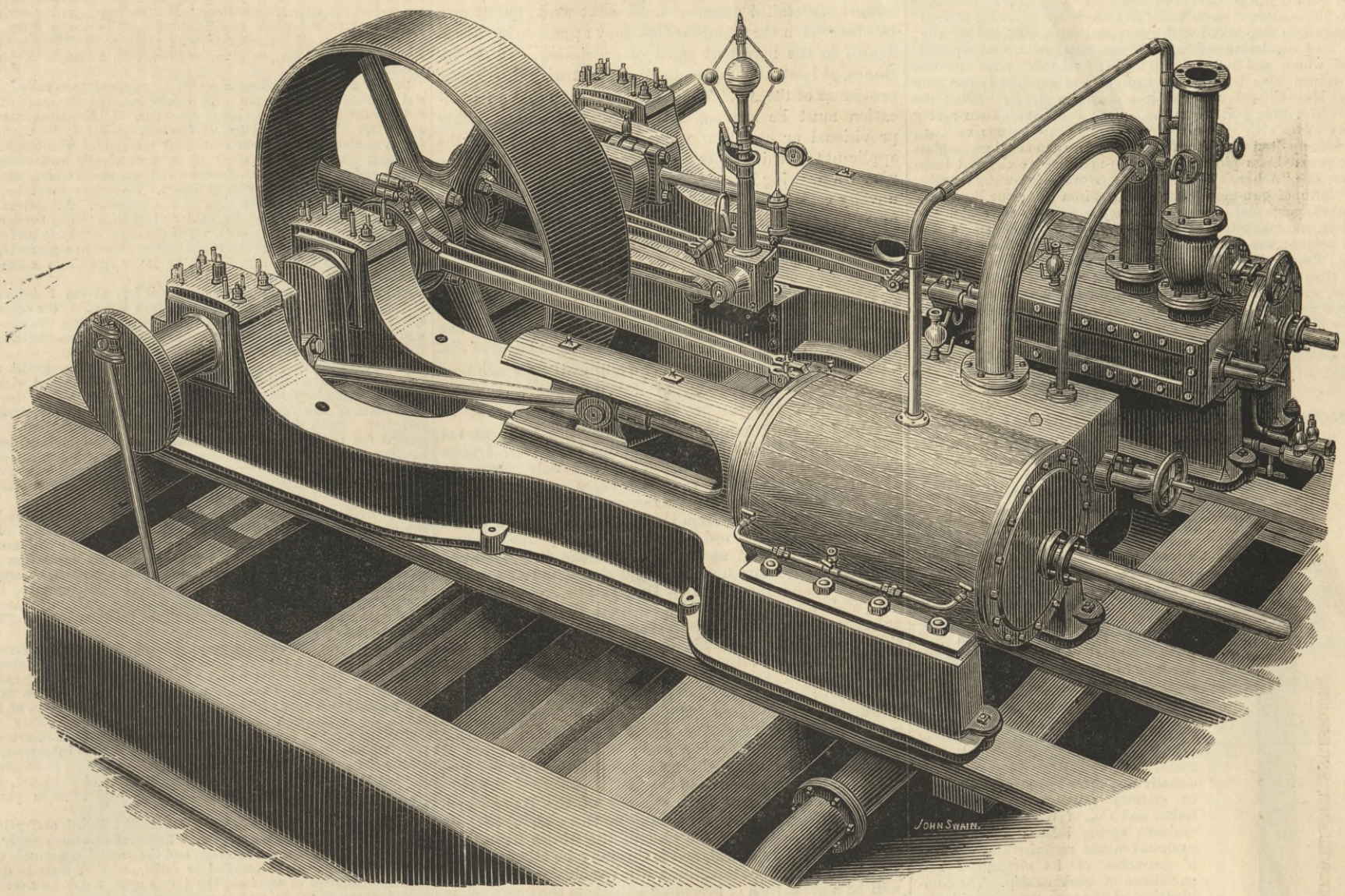
The smoke-box or chimney end to be made of the best Low Moor plates, three-sixteenths of an inch thick, chimney one-quarter thick, to be made and completed with doors and fastenings, similar to the chimney end, &c., on the Lion and Tiger engines belonging to this company, and in conformity with a drawing to be furnished. The distance between the front and back plates of the smoke-box, where the cylinders are placed, to be precisely in.; the holes for the cylinders in. diameter, and in. asunder.

The fire-box to be made of the best plate copper, seven-sixteenths of an inch thick, except the plate in which the tube holes are drilled, which must be five-eighths thick; the tube holes must be drilled square through, without countersink, 1in. five-eighths diameter, and seven-eighths asunder. The roof, which must be 1in. and half above the top row of tubes, must be firmly supported by six cross-bars, 3in. in depth, having each $\frac{7}{8}$ bolts, tapped and rivetted on the underside in the usual way. A five-eighth lead plug to be tapped into the roof, without a head upon it. The two sides, front and back, to be stiffened with $\frac{3}{4}$in. copper stays, tapped and rivetted, and holding firmly together the inner and outer casing; the stays to be 4½in. asunder, from centre to centre of each. The inside width of the fire-box to be 3ft. 4in., and length from front to back 2ft. 6in. The depth from the underside of the roof to the upper surface of the fire-bars to be 3ft. 3in. The fire-door to be circular, with a clear opening of 12in. diameter. The closing joint of the doorway to be formed of a ring of pure cast copper, 2in. broad and 3in. thick, filling up the water space between the inner and the outer casing, the same being fastened to this ring, or closing with $\frac{7}{8}$ copper bolts, firmly rivetted and countersunk on the outside. The outer casing to be united to the copper box at the bottom by means of an iron ring, of the sectional form of an inverted ∩, to the sides of which the copper box and outer casing are to be rivetted. The outer casing is to be made of the best Low Moor plates, three-eighths thick, one plate front and back; the whole neatly and firmly rivetted together, and the top must not rise above the top of the cylindrical boiler more than is necessary for the neat and substantial fastening of the one to the other, as above specified. The water space between the inner and the outer casing to be 3in., except in the fore part of the fire-box below the tubes, which must be 4½in. clear; eight 2in. iron plugs to be tapped and screwed into the outer casing

* No. XV. will be found on page 160 of our last volume. It deals with locomotives on the Scottish Central and Dublin and Kingstown Railway.

COMPOUND ENGINE, INDIAN STATE RAILWAYS.

MESSRS. VERNON, EWENS, AND CO., CHELTENHAM, ENGINEERS.



at the lower corners of the water space, the plug holes to be opposite each other, so that a rod may be passed completely through in each direction, for the purpose of cleaning out the bottom of the water space. There must be a clear water space 4in. in depth below the upper surface of the fire-bars or grate, and into this part of the fire-box eight iron studs must be tapped and screwed, two on each side, to support the grate frame. A circular hole to be cut in. diameter for the regulator above the fire-door, near the top of the outer casing.

A wrought iron dome made of best Low Moor plates, three-sixteenths of an inch thick, 14in. diameter, and 22in. high, must be placed on the outer casing of the fire-box, on which shall be placed a safety valve, 2½in. diameter at the smallest part of the mitre; the lever to be 12in. long, of the power of to one, provided with Salter's improved spring balance, graduated 1 to 60 lb., similar to those used on the Liverpool and Manchester Railway. Another similar dome in all respects must be placed on the horizontal boiler, one-third of the distance between the smoke-box and the fire-box. Both domes must be fastened on with bolts and nuts, and not rivetted, and must be neatly cased with brass.

There must also be a second safety valve similar to the one before described, and supported on a neat brass pillar near the chimney.

There must be a wrought iron manhole on the horizontal boiler, neatly and firmly fixed, and covered with a neat brass cap, similar to those now in use.

The whole to be manufactured and finished in a neat, substantial, and workmanlike manner; as complete in all respects, both as to materials and workmanship, as the boilers of the Lion and Tiger engines on the Liverpool and Manchester Railway.

HORIZONTAL COMPOUND CONDENSING ENGINE FOR THE INDIAN STATE RAILWAYS' WORKSHOPS.

THE engravings above and on page 504 illustrate a compound condensing engine for the workshops of the Indian State Railways, by Messrs. Vernon, Ewens, and Co., Cheltenham. These engines were built in accordance with a specification dated 15th May, 1882. The workshops in question are on the Rajputana-Malwa line. The high and low-pressure cylinders are 13in. and 21in. diameter respectively, and have a stroke of 2ft. 6in. They are both steam jacketted, the jacket space being formed by inserting a separate liner into each cylinder body.

Both cylinders are fitted with variable expansion valves, those on the high-pressure cylinder being controlled by a high speed Porter's governor, working on a block in a slot link. The expansion valves are grids, and are so arranged as to be in equilibrium, thus yielding readily to any variation in the governor. The expansion valves of the low-pressure cylinder are ordinary flat plates, controlled by means of a hand-wheel at the back of the valve chest in the ordinary manner.

Steam exhausts from the high-pressure cylinder into a copper pipe, forming a receiver between the two cylinders, and of a capacity equal to one and three-quarter times the high-pressure cylinder. The grade of expansion is very fine, ranging from one-eighth of the stroke in the high-pressure cylinder. The bed-plates are massive castings 1½in. thick, and have the main bearings, crosshead guides, and front cylinder covers cast on. The crank shaft is made of Lowmoor iron, the length of the bearings being one and a-half times the diameter, and the cranes are adjustable by wedges at the bottom and sides. Phosphor bronze and gun-metal are freely used throughout the engine, the slide valves, piston rings, and pump bucket rings being of the former material. The engines were erected temporarily and tried under steam at the contractors' works, one of the conditions of the contract being that an indicated horse-power of 120 should be developed and the diagrams, as results, are given below:—

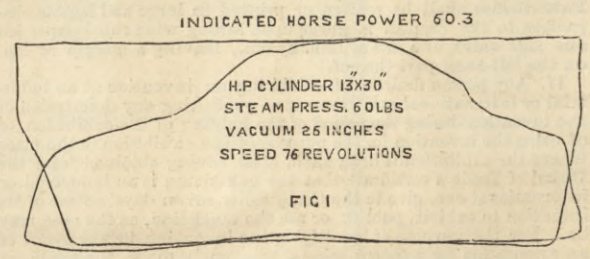


FIG 1

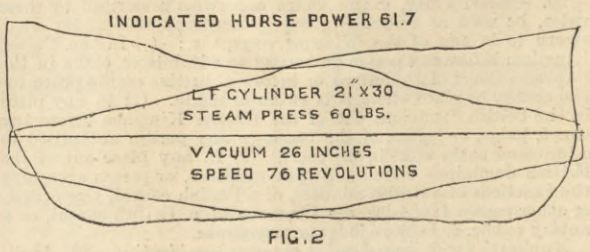


FIG. 2

Speed, seventy-six revolutions per minute; steam pressure, 60 lb. per square inch; vacuum, 26in.; indicated horse-power of high-pressure cylinder, 60·3; indicated horse-power of low-pressure cylinder, 61·7; total indicated horse-power, 122.

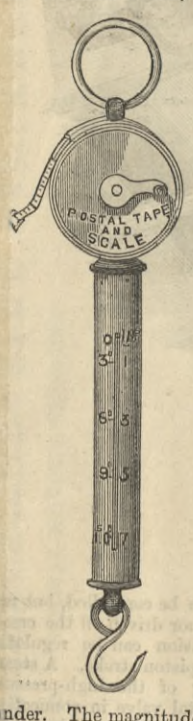
According to the terms of the contract "the engine was built to a specification of which we reproduce a portion. The engine is to be self-contained and direct acting. It is to work at a steam pressure of 60 lb. per square inch, and run at a speed of eighty revolutions per minute. The bed-plate is to be a strong hollow casting with round corners, and not less than 15in. deep, and the metal 1½in. thick in the web. It is to carry the high and low-pressure cylinders at one end and the crank shaft and fly-wheel at the other. The front ends of the cylinders, crosshead guides, and crank shaft pedestals are to be cast on the bed-plate. The high and low-pressure cylinders are to be steam jacketted, and are each to be worked off a separate crank on the shaft. The high-pressure cylinder is to be 13in., and the low-pressure 21in. diameter, each with a piston stroke of 2ft. 6in. The clearance at each end of the cylinders is not to exceed §in. The ends of the cylinders are to be bored out ½in. larger than the working barrel, so that the piston rings will overrun the barrel ¼in. at each end. The steam cylinders and valves are to be as close together as possible to shorten all the steam passages. Each cylinder is to be fitted with a slide and expansion valve of phosphor bronze. The expansion valve of the high-pressure cylinder is to be controlled, but not worked, by a Porter's high-speed governor driven off the crank shaft, and so arranged that the expansion can be regulated from one-eighth to three-fourths of the piston stroke. A steam stop valve is to be fitted to the casing of the high-pressure cylinder. A copper pipe and gun-metal valve in connection with the low-pressure cylinder, and the steam from the boiler is to be supplied for starting the engine. The crank shaft is to be of Lowmoor iron, and made by the Lowmoor Iron Company. It is to be not less than 9in. in diameter in the journals, and finished bright throughout. It is to run in strong gun-metal bearings, each adjustable for wear, and not less than one and a-half times the diameter of the journal in length. The fly-wheel is to be about 3 tons in weight, 6ft. 6in. diameter, 20in. wide on the face, and turned on the rim and face for a belt. The connecting rods are to be made of best hammered scrap iron, fitted with adjustable gun-metal bushes, marine ends, and finished bright throughout. Both high and low-pressure cylinders are to be fitted with bright gun-metal indicator cocks, pipes, and gearing suitably arranged for taking a diagram from both ends of the cylinders without removing the indicator. The air pump is to be vertical and placed below the level of the engine-house floor, it may be worked off a crank on the crank shaft, or by a bell crank, and worked off the crosshead or other specially approved means. The pump barrel is to be of cast iron, the diameter of the bucket is to be not less than 14in., and the length of the stroke 18in. The bucket, rod, valve seats, and guards are to be of gun-metal, and the valves of india-rubber. The suction and delivery valves and guards are to be of gun-metal, and the valves of india-rubber. The pump crank and connecting rod are to be of best hammered scrap iron, and finished bright. The rod is to be fitted with marine ends and adjustable gun-metal bushes. A mercury column gun-metal vacuum gauge and pipes are to be fitted to and supplied with the pump. A plunger pump for feeding the boilers is to be fitted to the engine. The pump is to be of ample capacity to supply water for the three boilers when the engine is working up to 120-horse power. It is to be of cast iron with gun-metal gland, bushes, valves, and valve seats. The plunger is to be lined with gun-metal.

The boilers are to be of the Lancashire type. They are to be 18ft. long, 6ft. diameter, with two flues in each, 2ft. 2in. diameter, and three Lowmoor iron water circulating tubes in each flue. The boiler shells and angle irons are to be of B.B.B. iron, and the plates §in. thick. The flues are to be of Lowmoor iron, §in. thick. They are each to be made in seven lengths, welded at the longitudinal joints, machine flanged at the ends, and are to have solid rings rivetted between the joints for connecting the pieces. The boiler ends are to be §in. thick, of Lowmoor iron, in one piece without weld. They are to be flanged round the edges to a large radius, at the back end to receive the shell plates, and rivetted to angle iron rings not less than 3½in. by 3½in. by ½in. on the outside of the shell at the front end. The vertical seams in the shells are to be lap jointed and single rivetted. The longitudinal seams are to be butt jointed and double rivetted, with inside and outside butt strips; each strip is to be 7½in. wide by $\frac{5}{16}$in. thick. The butt strips are to be so rolled that the fibre of the iron will be in the same direction as the plates they connect. All rivets for the boilers are to be made by the Lowmoor Iron Company. The furnace fronts are to be of wrought iron, and the doors fitted with adjustable perforated shutters for regulating the supply of air to the furnace and ash-pit. The furnaces are to be 6ft. long, and each fitted with one set of fire bars suitable for burning wood cuttings and sawdust, and one set for coal. Two manhole doors are to be fitted to each boiler—one on the top of the shell and the other on the front

end—below the flues. The mouth-pieces for these doors are to be of wrought iron or steel not less than 1¼in. thick, with double flanges; one flange is to he rivetted to the boiler shell, and the other for fixing the doors with bolts. The door and the door flanges are to be machined and accurately faced up, and fitted with 1in. bolts turned under the head and nut, and spaced not more than 5in. centres. Each boiler is to have the following fittings:—One steam stop valve with gun-metal valve, seat, and spindle; one feed regulating valve with gun-metal valve, seat, spindle, hand wheel, and index; one loaded feed relief valve and one non-return valve with valves and seats of gun-metal; one gun-metal blow-off cock, and cast iron discharge pipe for leading the water to a drain 10ft. from the boiler; two Ramsbottom spring safety valves with gun-metal valves and seats on one casting; one lock-up dead weight safety valve; two gun-metal gauge glass fittings and brass pipes; three gun-metal pet cocks and brass pipes; one "Ashcroft's"—or other approved—low-water detector and alarm, of gun-metal with wrought iron pipe; one Bourdon's pressure gauge and pipes; one damper with frame, chain, two pulleys, and brackets; 40ft. of ¼in. short link chain and a cast iron weight; two cast iron manhole doors and frames for side flues; floor plates and frame at the front of the boiler; four cast iron chairs for supporting the boiler; a set of cast iron floor plates, with openings to the blow-off cocks; and one set of firing tools, consisting of one poker, one pricker, one rake, one shovel. The boiler fittings are, as far as possible, to be arranged to fix to solid forged wrought iron mouth-pieces rivetted to the boiler shell. The pet cocks and gauge glass fittings are to be made for and packed with asbestos."

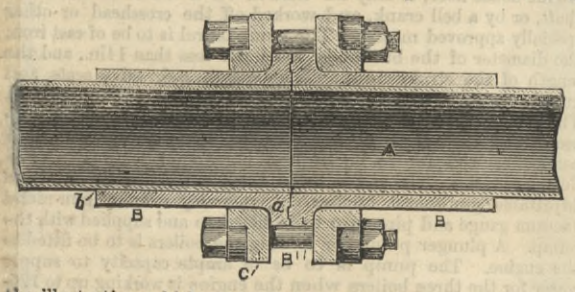
TOZER'S PARCEL POST SPRING BALANCE.

Mr. William Tozer, of 18, Abingdon-street, Westminster, has patented a very simple and ingenious little instrument—see illustration—specially adapted for the Parcel Post. It consists in the combination of a spring balance, graduated up to 7 lb.—the limit of weight allowed by the authorities—with corresponding cost of postage, together with a tape measure attached to the scale, which is also graduated in different colours to show the extreme length, or the combined maximum of length and girth. On the dial of the measuring tape full instructions are embossed, so that anyone far from a post-office may have the information and the means of ascertaining the weight and dimension of parcels and cost of postage. This invention should command an extensive sale, as it is equally uesful for the man of business or country gentleman. Messrs. G. Salter and Co., of West Bromwich, the eminent spring balance makers, have undertaken the manufacture, which is a guarantee of its correctness and excellence of workmanship. The combination of the tape measure with the spring balance was a happy thought, and the instrument will no doubt save much time and trouble. The establishment of the Parcel Post created a sudden demand for a weighing machine to deal with 7 lb. and under. The magnitude of the demand may be imagined when we state that Messrs. Salter disposed of about 50,000 Parcel Post weighing machines in a very few weeks. Something compact enough to go in the pocket was still lacking, and this has been produced by Mr. W. Tozer.



COUPLING FOR PNEUMATIC TUBING.

The accompanying illustration shows the new coupling used by the Western Union Telegraph Company, in their long lines of pneumatic tubing now being put down in Broadway, New York. Their first coupling was a swivel union of the ordinary type, but made with extra care and finish. Withal it was found they could not hold air with it in long lines, the leakage at each coupling being too great in the aggregate. Therefore the pipe first laid from the Western Union Buildings to Chambers-street, was taken up and the coupling shown adopted. As shown in



the illustration, which we take from the *Sanitary Engineer*, the pipe A is a 3in. seamless brass pipe. B B are cast brass sleeves, tightly soldered and sweated at the joints *b* to the pipe. At the ends of the sleeves at B¹ are flanges with accurately fitted faces, with an annular groove cut in one and a corresponding projection on the other. At *a* in the groove is a hard oiled paper washer, on which ultimate dependence is placed to secure a joint under the conditions of pressure likely to be carried. The binding flanges C, through which the bolts pass, are iron, and are loose to revolve on B, so as to make them universal with regard to the position of the holes. They are turned and closely fitted to B. The number of holes in a flange is six.

The Foreign Trade of India in 1882-3.—The trade statistics of India during the official year 1882-3 reveal some very encouraging facts, which are rendered still more satisfactory by the increasingly favourable returns of India's foreign trade during the last five months. Another symptom of the increasing wealth of India is manifested in the import of gold. In 1878-9 there was an export of the precious metal of £896,173; but now, and for some years, there has been a steady and growing import of gold, and during the year under review the flow of gold into the country had risen to nearly five millions sterling (£4,930,871). Of the entire trade that could have been conveyed that way, more than 86 per cent. passed through the Suez Canal, while 30 per cent. of the trade of India is with China, Australia, and other countries which cannot naturally avail themselves of the Suez Canal. During the last five months the wheat trade shows an increase in value of more than three millions sterling.

THE PATENTS ACT.

We give below a portion of the Rules relating to patents for inventions, issued by the Board of Trade under the authority of the Act of Parliament. We reserve a detailed comment until next week, but it may be observed in the meantime that they appear to have been drawn in the narrowest spirit of officialism. In one instance, at least, they are in direct conflict with the express provisions of the Act. Thus, Section 5 says that an application must be accompanied by a specification, either provisional or complete, whereas Rule 31 requires the applicant to furnish another document of a different nature, viz., "a drawing illustrative of the feature or features of novelty constituting his invention. Such drawing . . . must be accompanied by a concise explanatory statement," for the purpose of printing in the illustrated journal which it is proposed to publish. The duty of preparing such an abridgment and drawing is obviously one which belongs to the Department, and not to the applicant. An official notice from the Board of Trade, which appeared in the papers of Monday last, has given rise to a good deal of discussion. It is to the effect that no applications which bear a date prior to the 1st of January next—the day upon which the Act comes into operation—will be accepted by the Patent-office. It does not form part of the rules, and it will probably turn out to be mere *brutum fulmen*, and be withdrawn. The Act only gives the Board of Trade power to make rules and regulations in a certain prescribed manner. The idea is, we believe, an emanation from the brain of an official of the "how-not-to-do-it" order at Whitehall, the reason assigned being that until the Act comes into operation nothing can be done under it. But the actual declaration is made under the Statutory Declaration Act of William IV., and we shall be much surprised if the officer who takes upon himself to refuse a document properly executed does not get into trouble. We would remind Board of Trade officials that there is such a thing as a *mandamus*, and that even they are not exempt from its operation. On the whole the prospects of smooth working are not encouraging, and we see nothing in the rules which induces us to change the opinion so often expressed in these columns, that the day when every "horny-handed son of toil" shall be able to be his own patent agent is not yet, and is indeed further off than ever.

We only print now those sections of the Rules which are most likely to prove serviceable to those about to apply for a patent. Over 800 copies of the Rules have, it is stated, already been sold, and if this may be taken as indicating anything, it strengthens the conclusion that there will be a great rush of intending patentees the first week in January at all events. How far the Patent-office is prepared for this we cannot say.

General.—8. An application for a patent must be signed by the applicant, but all other communications between the applicant and the Comptroller, and all attendances by the applicant upon the Comptroller, may be made by or through an agent duly authorised to the satisfaction of the Comptroller, and if he so require resident in the United Kingdom.

9. The application shall be accompanied by a statement of an address, and sech statement shall thereafter be binding upon the applicant unless and until a substituted statement of address shall be furnished by him to the Comptroller.

10. All documents and copies of documents sent to or left at the Patent-office shall be written or printed in large and legible characters in the English language upon strong wide ruled paper (on one side only), of a size of 13in. by 8in., leaving a margin of 2in. on the left-hand part thereof.

17. Any person desirous of exhibiting an invention at an industrial or international exhibition, or of publishing any description of the invention during the period of the holding of the exhibition, or of using the invention for the purpose of the exhibition in the place where the exhibition is held, shall, after having obtained from the Board of Trade a certificate that the exhibition is an industrial or international one, give to the Comptroller seven days' notice of his intention to exhibit, publish, or use the invention, as the case may be. For the purpose of identifying the invention in the event of an application for a patent being subsequently made, the applicant shall furnish to the Comptroller a brief description of his invention accompanied, if necessary, by drawings, and such other information as the Comptroller may in each case require.

20. Affidavits may, except where otherwise prescribed by these rules, be used as evidence in any proceedings thereunder when sworn to in any of the following ways, viz.:—(1) In the United Kingdom before any person authorised to administer oaths in the Supreme Court of Judicature or before a justice of the peace for the county or place where it is sworn or made. (2) In any place in the British dominions out of the United Kingdom before any court, judge, or justice of the peace, or any person authorised to administer oaths there in any court. (3) In any place out of the British dominions before a British minister, or person exercising the functions of a British minister, or a British consul, vice-consul, or other person exercising the functions of a British consul, or a notary public, or before a judge or magistrate.

Application with provisional or complete specification.—22. Applications for a patent sent by prepaid letter through the post shall, as far as may be practicable, be opened and numbered in the order in which the letters containing the same have been respectively delivered in the ordinary course of post. Applications left at the Patent-office otherwise than through the post shall be in like manner numbered in the order of their receipt at the Patent-office.

23. Where a person making application for a patent includes therein by mistake, inadvertence, or otherwise, more than one invention, he may, after the refusal of the Comptroller to accept such application, amend the same so as to apply to one invention only, and may make application for separate patents for each such invention accordingly. Every such application shall bear the date of the first application, and shall, together therewith, be proceeded with in the manner prescribed by the said Act and by these rules as if every such application had been originally made on that date for one invention only.

24. An application for a patent by the legal representative of a person who has died possessed of an invention shall be accompanied by an official copy of or extract from his will or the letters of administration granted of his estate and effects in proof of the applicant's title as such legal representative.

25. On the acceptance of an application with a provisional or complete specification the Comptroller shall give notice thereof to the applicant, and shall advertise such acceptance in the official journal of the Patent-office.

26. Upon the publication of such advertisement of acceptance in the case of an application with a complete specification, the application and specification or specifications with the drawings—if any—may be inspected at the Patent-office upon payment of the prescribed fee.

Application on communication from abroad.—27. An application for a patent for an invention communicated from abroad shall be made in the form A 1 set forth in the second schedule hereto.

Sizes and methods of preparing drawings accompanying provisional or complete specifications.—28. The drawings accompanying provisional or complete specifications shall be made upon half-sheets or sheets of imperial drawing paper to be within a border line of 19in. by 12in., or 27in. by 19in., with a margin of ½in. all round.

29.—A copy of the drawings will be required upon rolled imperial drawing paper or upon thin Bristol board of the same dimensions as the original drawing or drawings. All the lines must be absolutely black, Indian ink of the best quality to be used, and the same strength or colour of the ink maintained throughout the drawing. Any shading must be in lines clearly and distinctly drawn and as open as is consistent with the required effect. Section lines should not be too closely drawn. No colour must be used for any purpose upon the copy of the drawing. All letters and figures of reference must be bold and distinct. The border line should be one fine line only. The drawings must not be folded, but must be delivered at the Patent-office either in a perfectly flat state or rolled upon a roller, so as to be free from creases or breaks.*

30. Where a complete specification is left at the Patent-office after a provisional specification has been accepted, the complete specification and drawing or drawings accompanying the same, as well as the copy thereof, must be prepared in accordance with Rules 10, 28, and 29.

Illustrated journal.—31. Every applicant for the grant of a patent shall, in addition to the drawings to be furnished with his complete specification, furnish the Comptroller with a drawing illustrative of the feature or features of novelty constituting his invention. Such drawing must be prepared in the manner prescribed for the copy of the original drawing or drawings accompanying the specification, but must not cover a space exceeding 16 square inches. The drawing must be accompanied by a concise explanatory statement on foolscap paper and legibly written or printed.

42. *Certificates of payment or renewal.*—If a patentee intends at the expiration of the fourth or eighth year from the date of his patent to make the prescribed payment for keeping the same in force, he shall seven days at least before such expiration give notice to the Comptroller of such intention, and shall, before the expiration of such fourth or eighth year, as the case may be, leave at the Patent-office a form of certificate of payment, duly stamped, subject as herein-after provided, with the prescribed fee of £50 or £100, as the case may be.

43. In the case of patents granted before the commencement of the said Act, the above rule shall be read as if the words "seventh year" were therein written instead of the words "eighth year."

44. If the patentee intends to pay annual fees in lieu of the above-mentioned fees of £50 and £100, he shall seven days at least before the expiration of the fourth and each succeeding year during the term of the patent, until and inclusive of the thirteenth year thereof, give notice to the Comptroller of such intention, and shall, before the expiration of such respective periods as aforesaid, leave at the Patent-office a form of certificate of payment, duly stamped with the fee prescribed to be paid at such periods respectively.

57. *Compulsory licenses.*—A petition to the Board of Trade for an order upon a patentee to grant a license shall show clearly the nature of the petitioner's interest, and the ground or grounds upon which he claims to be entitled to relief, and shall state in detail the circumstances of the case, the terms upon which he asks that an order may be made, and the purport of such order.

58. The petition and an examined copy thereof shall be left at the Patent-office, accompanied by the affidavits, or statutory declarations, and other documentary evidence—if any—tendered by the petitioner in proof of the alleged default of the patentee.

59. Upon perusing the petition and evidence, unless the Board of Trade shall be of opinion that the order should be at once refused, they may require the petitioner to attend before the Comptroller, or other person or persons appointed by them, to receive his or their directions as to further proceedings upon the petition.

60. If and when a *primâ facie* case for relief has been made out to the satisfaction of the Board of Trade, the petitioner shall upon their requisition, and on or before a day to be named by them, deliver to the patentee copies of the petition and of the affidavits or statutory declarations and other documentary evidence—if any—tendered in support thereof.

61. Within fourteen days after the day of such delivery the patentee shall leave at the Patent-office his affidavits or statutory declarations in opposition to the petition, and deliver copies thereof to the petitioner.

62. The petitioner within fourteen days from such delivery shall leave at the Patent-office his affidavits, or statutory declarations in reply, and deliver copies thereof to the petitioner; such last-mentioned affidavits or declarations shall be confined to matters strictly in reply.

63. Subject to any further directions which the Board of Trade may give, the parties shall then be heard at such time, before such person or persons, in such manner, and in accordance with such procedure as the Board of Trade may, in the circumstances of the case, direct; but so that full opportunity shall be given to the patentee to show cause against the petition.

64. *Register of patents.*—Upon the sealing of a patent the Comptroller shall cause to be entered in the Register of Patents the name, address, and description of the patentee as the grantee thereof, and the title of the invention.

74. An examined copy of every license granted under a patent shall be left at the Patent-office by the licensee, with a request that a notification thereof may be entered in the register. The licensee shall cause the accuracy of such copy to be certified as the Comptroller may direct, and the original license shall at the same time be produced and left at the Patent-office if required for further verification.

Cornish Boiler Explosion.—The 58th Report to the Board of Trade, under the Boiler Explosions Act of 1882, describes a Cornish boiler, the flue of which collapsed in a most remarkably complete manner. Over-pressure is the cause assigned for the explosion. The collapsing pressure of the flue-tube is calculated by the formula $\frac{806300 \times T^2}{L \times D \times 2{\cdot}15}$. The flue was 18ft. 6in. long, and 42in. diameter outside, and the thickness 0·437in., except one plate, which was 0·375in., this thin plate being at top and over the fire. To arrive at the collapsing pressure, Mr. Sampson takes the mean of these two thicknesses, or 0·406in., and so obtains 79·5 lb., which is supposed to be about the pressure at which the collapse took place. This hardly seems an allowable proceeding; for with a cylindrical flue, the thinner part would be the weakest, and the attachment to thicker plates would not affect the result. Practically, however, with imperfect form and unassignably varying stresses, the thin plate under working conditions might be able, in its place, to withstand the same pressure as the thicker. But without reference to the question of rapidity of conduction, and of the effect of the heat on thinner and thicker plates, this is more accident than otherwise, and is no reason for taking the average thickness of the plates. If this is to be done, then the relative quantities of the plates of the two thicknesses must also be taken into account. The modified formula above given is made specially to allow for effect of length in reducing collapsing resistance.

* As the drawings accompanying the provisional and complete specification respectively are copied at the Patent-office for publication by the process of photo-lithography, this rule must be strictly observed, in order that correct copies may be made.

RAILWAY MATTERS.

ADVICES from the city of Mexico, dated the 3rd inst., state that on that day the Mexican National Railroad was opened to the public. The line to San Miguel is now extended to a point 254 miles from this city.

THE question of the junction of the network of the Austro-Turkish railways now occupies the attention of the Ministry. Austria raises objections to the point of junction chosen by Turkey, while the admission into the protocol of the invidious phrase that the junction should be made "par le tracé le plus convenable" places the Porte in a dilemma out of which it is difficult to escape. The shortest, cheapest, and most direct "trace" is from Vranja to Uskup, and this is therefore "le tracé le plus convenable" adopted in principle in the protocol signed by the Turkish Minister, who is now instructed to oppose it.

THE projected railroad from Manitou to the summit of Pike's Peak is to be built as rapidly as possible, the *American Manufacturer* says. According to the survey of the route which has been finally accepted the road will be thirty miles long, and the maximum grade 300ft. to the mile. Many miles of railroad are now operated in Colorado over heavier grades than that. During the past year about 5000 persons have made the laborious ascent to Pike's Peak by the narrow trail which now affords the only access to the summit, and the projectors of the railroad consider that fact a sure guarantee of a rich return from their investment.

WE have received a copy of the "Railway Diary and Officials' Directory" for 1884. This diary is well got up, and contains besides the calendar and diary, a list of the directors and officers of the independent lines of railway in the United Kingdom; the weekly traffic returns for 1883, with blank columns for 1884; and an abstract of four half-years' accounts of some of the principal companies; as well as salaries, interest, annuity, wages, and other tables; postal, stock, stamp, city officers, and other information. The diary is arranged with a week on a page, the page being crown 8vo. It is bound in cloth, and is one of the cheapest diaries published.

THE Council of the Wolverhampton Chamber of Commerce have adopted a resolution which they propose to send for insertion on the official programme of the Associated Chambers of Commerce for the next meeting in London, by which the executive will be asked to support any measure calculated to give power to the Railway Commissioners to deal with unreasonable as well as unequal railway rates charged on goods. A joint meeting of the Council and of the executive of the South Staffordshire Ironmasters' Association was arranged for the 4th proximo, to discuss the question of heavy charges of the various railway companies for the carriage of iron and hardware goods from the district to London and other ports.

EXPERIMENTS have of late been carried out on various Prussian railways with a view of deciding the relative merits of petroleum torches and of those made from pitch or resin. The results arrived at indicate that, although the former give a clearer light, and are especially convenient in some respects, they are more dependent upon the weather, and are not well adapted for casting light for a little distance around where they are placed. While of service in repairs connected with the maintenance of the permanent way, it is considered that in accidents pitch or resin torches are preferable. With a view of these latter being always available upon an emergency, orders have been issued for a supply being kept at all stations, signal cabins, &c., and every luggage van and tender will carry several of them.

AT New Cross Station of the South-Eastern, the trains of two "foreign" companies have hitherto used the line, in addition to those employed in the company's main line, North Kent, North Kent loop, Mid-Kent, Blackheath local, and other services. The foreign trains have been those from the Great Northern, which forms a junction with the Charing Cross line near the Borough Market; and the East London trains, which have hitherto run into the South-Eastern line at New Cross. Works are in progress at New Cross which, on completion, will relieve the line of so much train pressure as may be caused by the joining of the East London trains. The passengers continuing their journey either way—by South-Eastern and East London—will now change carriages at New Cross, which will be an East London terminus, in so far as the running of trains goes. For the transfer of passengers, a light and roomy subway has been constructed across the station, at about middle distance between the ends of the four platforms.

WORK has been commenced on several of the large tunnels of the South Pennsylvania Railway, which is the Vanderbilt line to connect Harrisburg and Pittsburgh, and on which tunnels are, it appears, numerous. No. 1 is Blue mountain tunnel, 4350ft. in length, with 90,000 cubic yards of excavation. This tunnel is nine miles from Shippensburg, the nearest shipping point. No. 2, or Kittattinning mountain, will be 4635ft. long, with 95,200 cubic yards excavation. The west portal of No. 1 and the east portal of No. 2 are but 500ft. distant. These two are called the twin tunnels. No. 3, or Tuscarora mountain tunnel, will be 5400ft. long, with 112,120 cubic yards excavation. No. 4, or Sidling hill, will be the longest on the line, being 6700ft. long, and 143,240 cubic yards excavation. No. 5, or Ray's hill, will be 3620ft. in length, and 81,720 cubic yards excavation. No. 6, or Alleghany mountain, will be 5900ft. long, and 128,700 cubic yards excavation. No. 7, or Laurel hill, will be 5400ft. long, and 110,160 cubic yards excavation.

THE construction of the new branch of the North-Eastern Railway from Alnwick to Cornhill is likely to be commenced soon. The tenders for the work place the cost of construction at £320,000, the length of line being about 35 miles 37 chains. We have recently referred in THE ENGINEER to the course that the line will take from Alnwick to Cornhill; but it is worth while adding that the commencement of the line is from a point about 150 yards from the present North-Eastern station at Alnwick, and the termination is near to Kelso station, on the same company's line. The work is the only great one that the company has in course of construction, though it has other small branches advancing towards completion, such as the Spennymoor and Bishop Auckland line. In the Bill that the company projects for the next session there are one or two proposals of some magnitude; but the works that the company meditates are small in comparison with those of some of the companies of similar size. The Alnwick and Cornhill branch may be expected to be pushed on with vigour, therefore; but it is probable that about two years will elapse before the completion of the line. The traffic thereon will be largely agricultural, but the line will open out for tourist and pleasure traffic a part of the north country that has hitherto been almost inaccessible.

RESPECTING the Vienna City Railways, the *Neue freie Presse* gives the following information:—The Minister of Commerce, Baron Pino, has sent a letter to the Concessionaires of the Vienna City Railways, Messrs. Bunten and Fogerty, in which he informs them that he has had the drawings of the detail project of the first section of the railway—along the Danube Canal—examined by the officers of the General Inspection of Railways, and sanctions the designs submitted to the Department. He further informs the Concessionaires that the officers of the Imp. and Royal Statthalterei have been instructed to take the necessary steps for holding the usual Commission—over the actual ground—on the first section, which precedes the permission to commence the works. The Minister of Commerce recommends a further examination of the suggestions of the Franz Josef's Railway Company with regard to the proposed junction with their main line, as well as of the demands of the Corporation of Upper Doebling with regard to the position of the station at Heiligenstadt. In conclusion, the minister calls the attention of the Concessionaires to certain details of construction, and desires them to keep the same in view in preparing the detail drawings of the second section of the railway, which are now nearing completion.

NOTES AND MEMORANDA.

AT a recent meeting of the Edinburgh Royal Society, Professor Tait read a paper by Mr. W. F. Petrie, on the old English mile. The old mile was longer than the present, and consisted of 5000ft. of 13in. It seemed to be identical with the old French mile. The furlong had no connection originally with the mile, which was modified to suit the former.

THE New South Wales shale yields, on an average, about 150 gallons of crude oil per ton, which contains over 60 per cent. of refined kerosene oil, and the remaining products consist of gasoline, benzine, spongaline, paraffine, wood-preserving composition, and lubricating oil. Its gas-producing capabilities amount to the large yield of over 18,000 cubic feet of gas, with an illuminating power of thirty-eight to forty candles. On this account it has been found advantageous for mixing with ordinary coal in the manufacture of gas.

THE only place in America where graphite is now successfully mined is at Ticonderoga, N.Y. The output of the Ticonderoga mine in 1882 was 400,000 lb., which will be increased to 500,000 lb. this year. The mine is owned by the Joseph Dixon Crucible Company, of New Jersey, which is working a vein of graphitic schist, 15ft., and carrying only from 8 to 15 per cent. of graphite. This is crushed and concentrated by a wet process, in which the "tailings" are the useful product. The Marquette *Mining Journal* believes that the graphite veins of the upper peninsula of Michigan, particularly those of Baraga county, are as pure and free from grit as either the New York, Canadian, or Ceylon deposits.

AT a recent meeting of the Cambridge Philosophical Society, a communication was made on the measurement of electric currents, by Lord Rayleigh. The author referred to the method of measuring currents by the silver voltameter as suitable for currents from ·05 ampères to 4 ampères, and stated that the electro-chemical equivalent of silver, as determined at the Cavendish Laboratory, was $1{\cdot}119 \times 10^{-2}$. A second method was described, suitable for larger currents. It consists in balancing the difference of potential between two points in the circuit through which the current is running against the effects of a standard cell working through a large resistance, such as 10,000 ohms. The author suggested, as a third method, the use of the rotation of the plane of polarisation of light passing through a piece of heavy glass, round which the current circulates in a coil of thick wire. A current of 40 ampères will produce a rotation of 15 deg. if the coil have one hundred turns.

AT a recent meeting of the Paris Academy of Sciences, a note on "The Universal Hour Proposed by the Conference in Rome," was communicated by M. Faye. The author urged several objections against the adoption of Greenwich astronomical time and meridian, calculating the longitudes from 0 to 24 h. east, which might be convenient for navigation and astronomical purposes, but unsuitable for railways, telegraphs, Government offices, and the public generally. For the formula, universal time = local time − (L + 12h.), where L indicates the longitude calculated east from Greenwich, he proposes to substitute, universal time = local time − L. The formula would thus be simplified by the suppression of the last term, and, instead of Greenwich astronomical time, the civil hour would be adopted as the universal hour. Thus would be avoided the inconvenience of disagreement between local and universal time, which would otherwise be felt precisely in the most densely peopled regions of the globe.

IT appears from a recent return that the production of precious metals in the United States during the fiscal year just expired amounted to 32,000,000 dols.—£6,400,000—gold and nearly 49,000,000 dols.—£9,800,000—silver. The total coinage was 35,936,927 dols. gold and 28,835,470 dols. silver, of which 28,111,119 dols. was in standard silver dollars. Of the latter, less than one-third were coined at the Western mints, on account of the slight demand for silver dollars in the Pacific States, and of the large amount—upwards of 40 millions—held in the Mint and the Assistant-Treasurer's office at San Francisco. The total coin circulation of the United States was estimated on the 1st of July last at 765,000,000 dols., viz., 537,000,000 dols. gold and 228,000,000 dols. silver; and on the 1st of October last at 544,512,699 dols. gold and 235,291,323 dols. silver. The paper and specie circulation of the leading 38 countries in the world is put down as follows:—Paper, 3,832,920,903 dols.; gold, 3,333,433,000 dols.; silver 2,712,226,000 dols.

A HEAVY liquid for determining the specific gravity of minerals offers many facilities. Nearly all natural minerals are heavier than water, and therefore sink in it. But when they are placed in a heavy liquid which does not dissolve them, some sink and others float. If two minerals of unlike gravity occur in the same rock, they can be separated by pulverising the rock and putting them in a liquid intermediate in weight between both. A new liquid for this purpose has been devised and described in *Wiedermann's Annalen* by C. Rohrback, having a density of 3·57. It is an iodide of barium and mereury, and is prepared as follows:—100 parts of iodide of barium and about 130 parts of red iodide of mercury are mixed with about 20 c.c. of distilled water, shaken and heated on an oil-bath to 150 or 200 deg. C. until dissolved, and then concentrated until it will float a crystal of topaz. After standing several days, the clear liquid is decanted and filtered. The American *Engineering and Mining Journal* says it has a yellow colour, boils at 145 deg. C., and refracts light strongly. It can be used for separating axinite, epidite, heavy mica, some garnets, and nearly all hornblendes; also olivine, orthite, nearly all members of the pyroxene group, saussurite, titanite, topaz, heavy tourmaline, vesuvianite, and basaltic rocks. In diluting it to obtain any special density, it is mixed with a dilute solution of the same, so as to avoid precipitation. After the separation, the powdered minerals are washed with a few drops of iodide of potassium.

A PAPER "On the Formation of Ripple-mark in Sand," by Mr. G. H. Darwin, F.R.S., was recently read before the Royal Society. In the first series of experiments a cylindrical vessel, like a flat bath, with upright sides, was placed on a table, which was free to turn about a vertical axis. Some fine sand was strewn over the bottom to a depth of about 1in., and water was poured in until it stood 3in. deep over the sand. It was found that rotational oscillation with a jerking motion of small amplitude gave rise almost immediately to beautiful radial ripples all round the bath. If the jerks were of small amplitude the ripples were small, and if larger they were larger. The radiating ripples began first to appear at the outer margin of the bath and grew inwards; but the growth stopped after they had extended to a certain distance. If the jerking motion was violent, ripples were not formed near the circumference, and they only began at some distance inwards. An analysis of the observations was made on the hypothesis that the water remained still, when the bath oscillated with a simple harmonic motion. The problem was to find whether λ, the wave-length of ripple—in inches—was directly proportional to v, the maximum velocity of the water relatively to the bottom during the oscillatory motion; also to find the values of v_1 and v_2, the least and greatest velocities of the water compatible with the formation of ripple mark. It appears that, for the particular sand used, v_1 is ½ft. per second, and v_2 1ft. per second; and that the wave-length of ripple λ is $\cdot 00245v$ when v is measured in inches per minute. The several results were as fairly consistent with one another as could be expected. The hypothesis that the water as a whole executes a simple harmonic oscillation relatively to the bottom is not, however, exact, and does not give the maximum velocity of the water in contact with the sand relatively thereto. The quantity called v is not in reality the maximum velocity of the water in contact with the bottom relatively thereto, but it is 6·283 times the amplitude multiplied by the frequency. Thus we cannot conclude that a current of ½ft. per second is just sufficient to stir the sand. In the state of oscillation corresponding to v, it is probable that part of the water at the bottom is moving with a velocity much greater than ½ft. per second relatively to the sand.

MISCELLANEA.

THE "Two Manners of Motion of Water," shown by experiments, will be the subject of a lecture before the Royal Institution on the 28th March next.

THE Pintsch's Patent Lighting Company notifies removal from Metropolitan-chambers, New Broad-street, to 33, Clerkenwell-road, London, E.C.

ACCORDING to the census returns of 1881 the Civil Service employed 50,245 persons, and the police 32,508. Soldiers, with yeomanry and militia numbered 87,168.

A SPECIAL committee, appointed by the Ironmasters' Association, and the Railway Rates Committee of the Wolverhampton Chamber of Commerce will hold a joint meeting in Wolverhampton on Friday of next week, to discuss the best means of taking united action to bring about some reform in the present excessive and anomalous railway rates.

THE great tower of Norwich Cathedral is in a state which is causing anxiety, and, like the Peterborough Cathedral, may have to undergo important and expensive operations. The wall of the tower near the top is weakened by the introduction of a passage and open arcade, and the weight of the spire above is causing settlements in that part. It may, however, be possible to put in the saving stitch.

IT is stated that the capital invested in cotton manufacture in Canada on June 30, 1879, was 2,100,000 dols. In 1883 the quantity of cotton had increased from 12,800,000 to 38,400,000 lb. The production of cloth increased from 38,000,000 to 115,000,000 yards. The woollen trade increased during the same period from 1,614,000 dols. to 2,388,000 dols.; the cloth products from 3,212,000 to 4,079,500 yards—in value from 1,571,300 dols. to 2,042,740 dols. The large increase in the quantity of coal imported in the face of the greatly increased output from the Nova Scotia mines is also strikingly significant of increased manufactures.

"THE employment of electric light," our Birmingham correspondent writes, "is gradually spreading to some of our ironworks and large hardware manufactories. Some time ago I reported that the light was being used to carry on the erection at night of the new Staffordshire Steel Works, near Wolverhampton. I am now authoritatively informed that so satisfied is Mr. Alfred Hickman with its operation in this case, that he has now made a contract with the Wolverhampton Electric Light Company to erect at his adjoining Spring Vale blast furnaces fifty Swan incandescent lights of 100 actual candle-power each, and twelve lights of lower power. The dynamos will be driven by a pair of 16-horse power engines, which are now being constructed at the company's works; and it is anticipated that the apparatus will be in operation early in the New Year."

BEETROOT sugar is made to a large extent by what is called the diffusion process, depending on the well-known physical phenomena of *endosmosis* and *exosmosis*. The beetroot is cut up into small slices called "cossettes," and these are placed in vessels filled with water. The result is that a current of endosmosis takes place from the water towards the juice in the cells, and a current of exosmosis from the juice towards the water. These currents go on cell by cell, and continue until a state of equilibrium is attained. The richer the water and the poorer the juice, the sooner does this equilibrium take place. Consequently, the vessels are arranged in a series, forming what is called a diffusion battery; the pure water is admitted to the first vessel, in which the slices have already been nearly exhausted, and substracts from them what juice there is left. It then passes as a thin juice to the next vessel, in which the slices are richer, and the process begins again. In the last vessel the water which has already done its work in all the previous vessels comes into contact with fresh slices, and begins the operation upon them.

THE Viennese are a little concerned about their water supply. The main mountain sources under the Schneeberg yield daily under 500,000 Eimer, the minimum which they were calculated to yield; and, were it not for the 200,000 Eimer obtained from the Potshach pumping works for the last few days, the municipal authorities would have had to resort again to stringent restrictions of the use of water. Very recently the consumption, the *Times* Vienna correspondent says, was greater than the supply in the reservoirs warranted; but now again the consumption has fallen to 10,000 Eimer less than the inflow. Still, the greatest economy in the use of water is considered to be absolutely necessary. The manufacturers on the river Schwarza have protested against any extension of the pumping operations at Potshach, as the supply for their own works is thereby diminished. The Minister of Agriculture decided that they were justified in their complaint, and the permission given by the Stadtholder on January 12th, 1883, to the town of Vienna to raise at Potshach and conduct away 600,000 Eimer during every period of twenty-four hours is confirmed, on condition that the duty of the town to give compensation in case of a loss accruing to the claimants be admitted.

THE third of a course of lectures on "Meteorology," by Mr. W. Marriott, F.R.M.S., was delivered on the evening of December 20th, in the reading-room of the Society of Engineers, Victoria-street, Westminster, Mr. A. T. Walmisley, member of council, in the chair. This lecture was devoted to the consideration of atmospheric pressure. Having referred to Torricelli's experiment, proving that a column of water 32ft., or of mercury 30in., is in equilibrium with the pressure of the atmosphere, the lecturer explained the construction of the barometer, and described the Fortin, Kew siphon, aneroid, and other forms of this instrument. As the pressure decreased with altitude, it was shown how the barometer could be used for the measurement of heights. It was pointed out that there is a diurnal range of atmospheric pressure, which consists of two minima about 4 a.m. and 4 p.m., and two maxima at about 10 a.m. and 10 p.m. This phenomenon is most marked in the tropics. Having referred to the connection existing between the changes of atmospheric pressure and the flow of underground water, and also colliery explosions, the lecturer explained the construction of isobaric charts, and by the aid of such charts showed the distribution of pressure over the globe during the months of January and July.

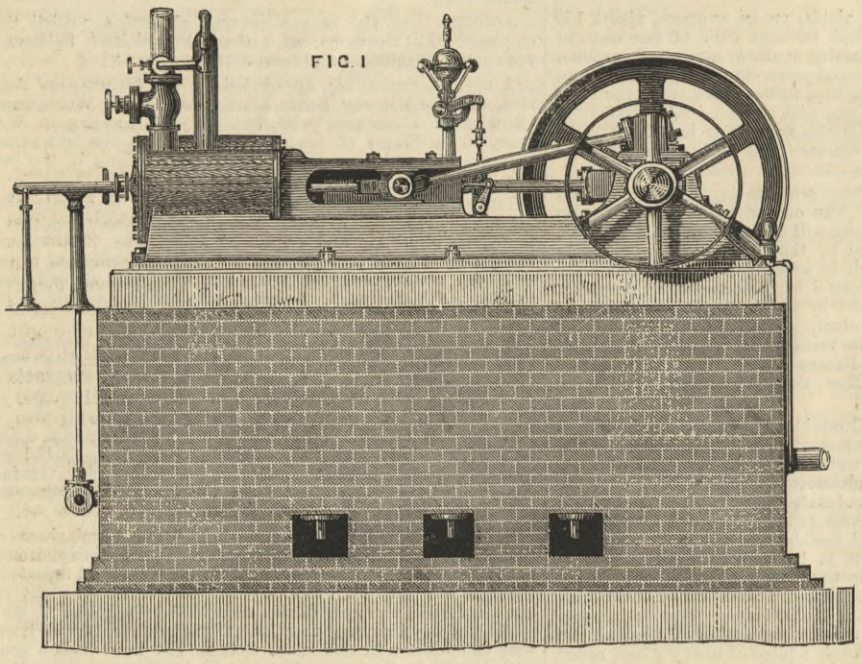
THE project of a canal across Florida connecting the Gulf of Mexico with the Atlantic Ocean is being warmly taken up in America. According to the report of the chief engineer, the total length of the canal will be 139½ English miles. It is proposed to make it wide enough to admit of two steamers passing through it abreast. The cost of the work is estimated at £9,000,000 sterling. When the canal is finished it will diminish the distance between New Orleans and Liverpool or New York by 412 miles. General Stone and his assistants have already completed the preliminary survey. The question the company has to determine is whether the traffic in prospect promises to be sufficiently remunerative to justify the large necessary outlay in realising the project. The chief engineer, in support of his view that the scheme will be a financial success, points out that the shortening of the distance between the Mexican Gulf ports and Europe and the North Atlantic seaboard of America will effect an economy of from three to seven days in time. This means in large vessels a saving of from £60 to £100 a day in food and wages, in addition to a saving of £100 a day in coal. The Straits of Florida are exceedingly dangerous, and shipwrecks there are very frequent. A further saving will accordingly be made in insurance on vessels, which is estimated at from 1 to 1½ per cent. A large increase in the foreign and ocean trade to Texas and the States bordering on the Mississippi will be almost certain to follow the completion of the canal. The most elevated spot through which the Florida Canal could be cut is considerably lower than the highest point on the route through which the Suez Canal was carried. There are, in fact, no great engineering difficulties to surmount, and the realisation of the scheme is practically only a question of time.

COMPOUND ENGINE, INDIAN STATE RAILWAYS.

MESSRS. VERNON, EWENS, AND CO., CHELTENHAM, ENGINEERS.

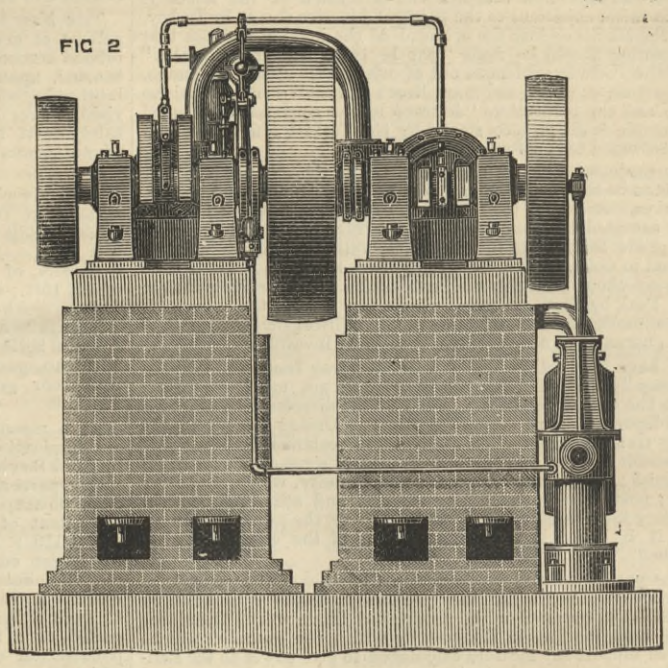
(*For description see page* 501.)

FIG. 1



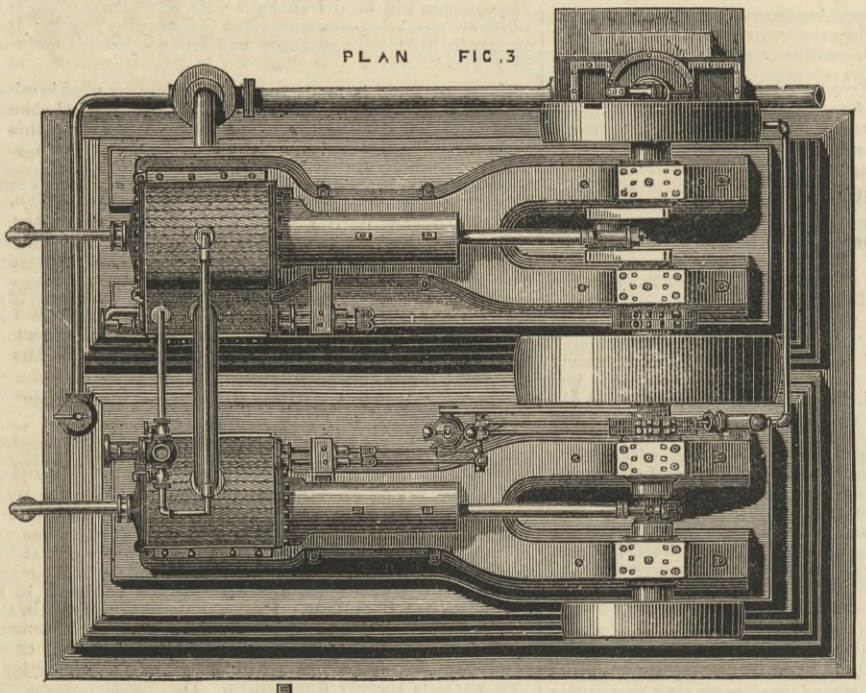
SIDE ELEVATION

FIG 2



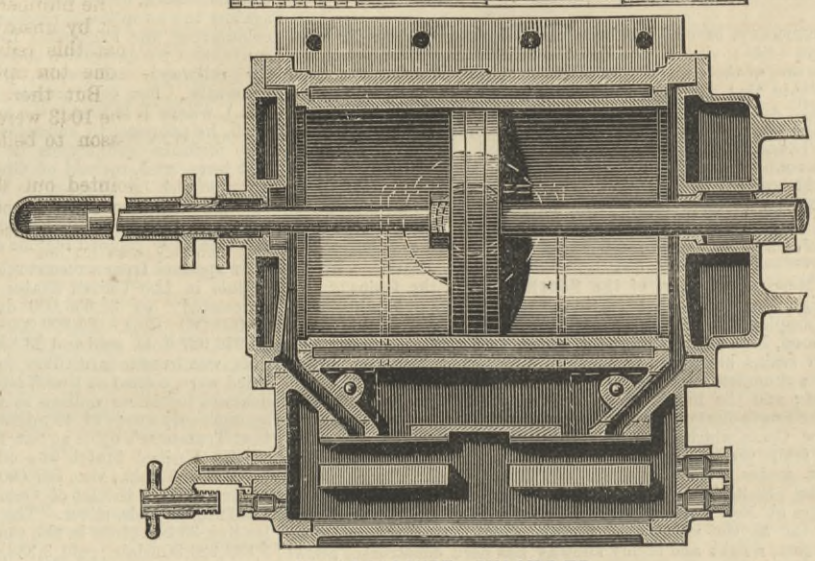
END ELEVATION

PLAN FIG. 3



SCALE OF FEET

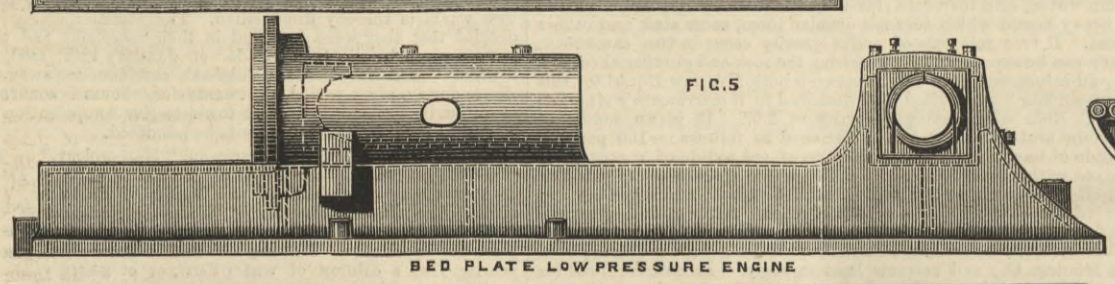
0 3 6 9 1 2 3 4



LOW PRESSURE CYLINDER

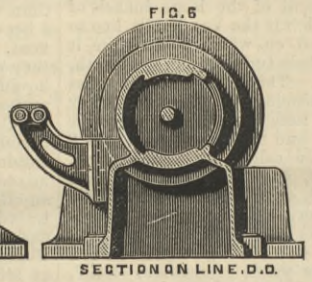
FIG. 4.

FIG. 5



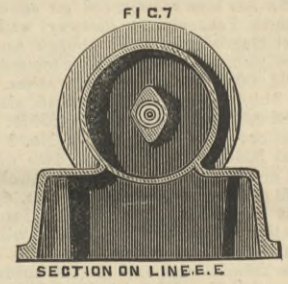
BED PLATE LOW PRESSURE ENGINE

FIG. 6



SECTION ON LINE D.D.

FIG. 7



SECTION ON LINE E.E

FIG 8

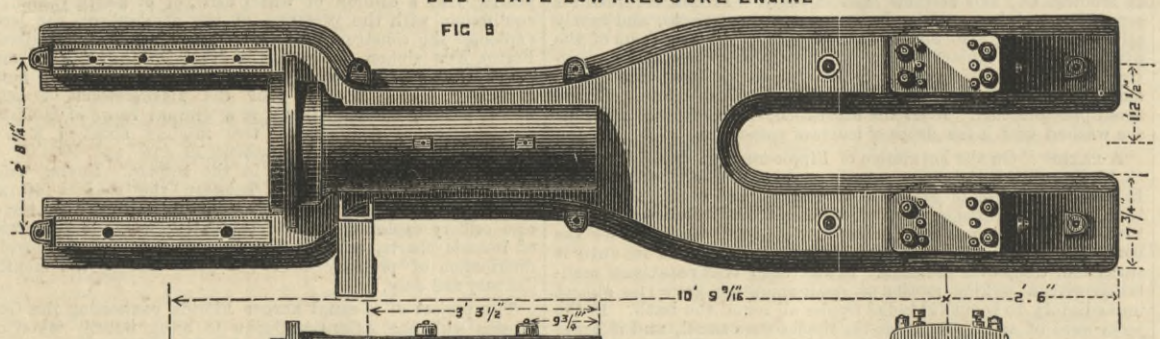
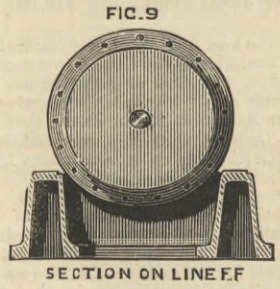
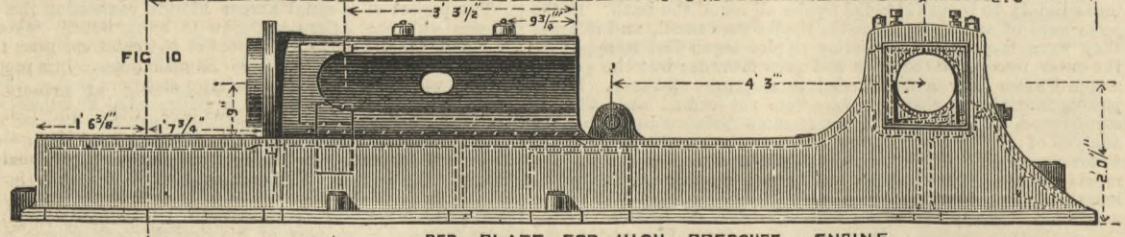


FIG. 9



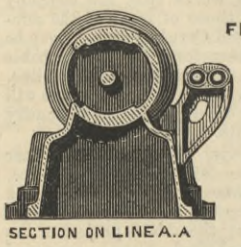
SECTION ON LINE F.F

FIG 10



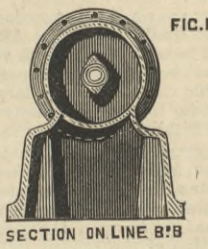
BED PLATE FOR HIGH PRESSURE ENGINE

FIG. 11



SECTION ON LINE A.A

FIG. 12



SECTION ON LINE B.B

FIG 13

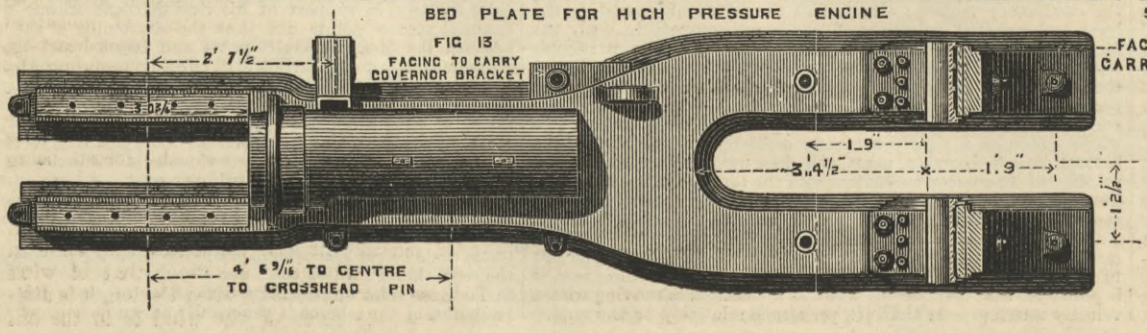
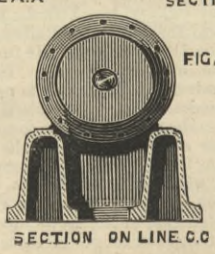


FIG. 14



SECTION ON LINE C.C

JOHN EVANS

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.*

TO CORRESPONDENTS.

*** *In order to avoid trouble and confusion, we find it necessary to inform correspondents that letters of inquiry addressed to the public, and intended for insertion in this column, must, in all cases, be accompanied by a large envelope legibly directed by the writer to himself, and 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.*

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

*** *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.*

W. R.—*Apply to the Bristol Wagon Company or Messrs. W. Crosskill and Sons, Beverley.*

E. B. D.—(1) *Write to the inventor of the windmill; no one else can tell you.* (2) *We presume you can find out by advertising whether the American machine has been made in this country or not.*

LOG CHIP.—*You are simply wasting your time by inventing boat lowering and detaching apparatus. Such inventions may be counted literally by the hundred. Neither shipowners, nor sailors, nor Lloyd's, nor the Board of Trde, nor, so far as we know, anyone else, cares for these things.*

RIVETTING MACHINES.

(*To the Editor of The Engineer.*)

SIR,—Would any of your numerous readers inform me whether there are still, or ever were, machines for heading rivets and the like of the following description working in England or elsewhere? A drum or cylinder rotated on a shaft and had a number of dies in its periphery, into which pieces of hot rod which were to receive a head were introduced. There was a vertical stamp or header fitted with the necessary dies, which had an up-and-down motion. On the piece of hot rod coming to the vertical position, the header came down and formed the head. On the header rising the cylinder made another move forward and brought a succeeding piece of rod to be headed and so on, the finished rivets falling out of the machine head first when they reached the perpendicular position.

F. Y.

Rheinland, Dec. 22nd.

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):—*

Half-yearly (including double numbers) .. .. .. £0 14s. 6d.
Yearly (including two double numbers) .. .. .. £1 9s. 0d.

If credit occur, an extra charge of two shillings and sixpence per annum will be made. THE ENGINEER *is registered for transmission abroad.*

Cloth cases for binding THE ENGINEER *Volume, price* 2s. 6d. *each.*

A complete set of THE ENGINEER *can be had on application.*

Foreign Subscriptions for Thin Paper Copies will, until further notice, be received at the rates given below:—Foreign Subscribers paying in advance at the published rates will receive THE ENGINEER *weekly and post-free. Subscriptions sent by Post-office order must be accompanied by letter of advice to the Publisher. Thick Paper Copies may be had, if preferred, at increased rates.*

Remittance by Post-office order.—Australia, Belgium, Brazil, British Columbia, British Guiana, Canada, Cape of Good Hope, Denmark, Egypt, France, Germany, Gibraltar, Italy, Malta, Natal, Netherlands, New Brunswick, Newfoundland, New South Wales, New Zealand, Portugal, Roumania, Switzerland, Tasmania, Turkey, United States, West Coast of Africa, West Indies, Cyprus, £1 16s. China, Japan, India, £2 0s. 6d.

Remittance by Bill in London.—Austria, Buenos Ayres and Algeria, Greece, Ionian Islands, Norway, Panama, Peru, Russia, Spain, Sweden, Chili, £1 16s. Borneo, Ceylon, Java, and Singapore, £2 0s. 6d. Manilla, Mauritius, Sandwich Isles, £2 5s.

ADVERTISEMENTS.

*** *The charge for Advertisements of four lines and under is three shillings; for every two lines afterwards one shilling and sixpence; odd lines are charged one shilling. The line averages seven words. When an advertisement measures an inch or more the charge is ten shillings per inch. All single advertisements from the country must be accompanied by a post-office order in payment. Alternate advertisements will be inserted with all practical regularity, but regularity cannot be guaranteed in any such case. All except weekly advertisements are taken subject to this condition.*

Advertisements cannot be Inserted unless Delivered before Six o'clock on Thursday Evening in each Week.

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.*

THE ENGINEER.

DECEMBER 28, 1883.

THE SHIPOWNERS AND THE PRESIDENT OF THE BOARD OF TRADE.

THE Liverpool Shipowners' Association has issued a Report, dated the 18th inst., upon the proposals of the Board of Trade with reference to Merchant Shipping Law and the proposed new Maritime Courts. This report is identical in tone with the articles on the same subject which have recently appeared in this journal. The report supplies a noteworthy illustration of the mistakes which an enthusiast may make. It seems to be generally admitted that the knights errant of old were now and then just a little too precipitate, and killed the wrong man; and we have all heard of "Jedwood Justice"—hang first and try afterwards. Mr. Chamberlain has been told that shipowners are in the habit of sending vessels to sea in bad condition; and that it is possible to make money by over-insuring. It is a matter of common knowledge also, that ships and lives are lost daily. Thereupon, practising the old adage, he puts two and two together, and arrives at the conclusion that the ships and the lives are lost through the fault and the greed of shipowners. His soul is stirred within him with a righteous indignation; and he gives us piles of figures to prove that the loss of life is something truly dreadful, and must be stopped. Such trifles as tornadoes, fogs, collisions, and lee-shores, he entirely ignores. Given the perfect shipowner, and there would be no more losses of life at sea. This is Mr. Chamberlain's faith and the reason for it. But the Liverpool shipowners take Mr. Chamberlain's figures and make havoc of them. They know their business professionally; Mr. Chamberlain is to them an incompetent amateur. The first point which strikes the authors of the report which we are considering, is that the words "British ships" have a very wide meaning. It in no way follows that because a British ship is lost an English shipowner is responsible. The total number of lives lost at sea in the year 1881-82 by all causes, save going ashore and collisions, is given by Mr. Chamberlain as 3118. Now, from this total must be deducted 1293 lives lost in fishing-boats and in Indian and colonial vessels. It ought to be quite clear that a fishing-boat cannot fairly be classed as a "vessel," and it is exposed to peculiar risks. The loss of life in fishing craft is, it is well known, unfortunately very heavy; but Mr. Chamberlain's strictures on shipowners have no application to such little craft and their loss. On the 8th inst. a telegram from the United States said: "It is computed that 680 persons perished through the foundering of fishing vessels in the gales on the coasts of New England, Nova Scotia, and Newfoundland, during November last." "Many of these lives," says the shipowners' report, "will be included in the total for 1883-84, but it is obvious that this lamentable loss of life could not be prevented by any action on the part of this country." Mr. Dunlop, of the Allan line, some time ago prepared an analysis of losses, from which we obtain the following figures:—The total number of foundered and missing British vessels, sailing craft and steamers, for the year which ended June 30th, 1882, was 354. Of this number 100 were fishing vessels, leaving 254 for all other kinds of British vessels, and in this number are included boats as small as one ton. This list of 254 vessels is composed as follows: Wooden sailing craft, 184; steamers, 7; composite sailing craft, 3; iron sailing craft, 20; and steamers, 40. Under the head of foundered iron vessels, the total number of sailing ships is given as 5, with a tonnage of 2524 tons. Six lives were lost. The steamers number 17, with a tonnage of 11,523 tons. The loss of life amounted to 113. As regards missing iron vessels, 15 are put down as sailing ships, of 16,050 tons. The loss of life reached 362. The steamers numbor 23, their tonnage amounting to 20,890; 562 lives were lost. Altogether the foundered and missing iron vessels number 60, of an aggregate of 50,987 tons, and 1043 lives were lost. This tonnage is stated to be about ¾ per cent. on British shipping. Commenting on these figures, the shipowners point out that, if we exclude loss of life in fishing boats, the number of lives which it is possible to think were lost by unseaworthiness is reduced from 3118 to 1043, and that this reduced number includes lives lost in vessels from one ton upwards, as well as in Indian and colonial ships. But there are no statistics to show what proportion of the 1043 were lost from unseaworthiness, and there is good reason to believe that the proportion is small.

We last week pointed out that Mr. Chamberlain will have to show that great loss of life is caused by unseaworthy vessels. Mr. Dunlop and the Liverpool shipowners have together mapped out the ground which he must cover. It is clear that we have just about one-third of the whole number of lives lost to consider. The remaining two-thirds were lost from causes with which seaworthiness has nothing to do. It rests with Mr. Chamberlain to prove that 1043 lives were sacrificed by the shipowners. But so far it does not appear that he can adduce proof that even one life was so lost. That 1043 were so lost is pure surmise. The Liverpool shipowners, however, do not assert, nor do we, that shipowners are all immaculate. But the black sheep are comparatively few in number, and the assumption that it is more profitable to lose a ship than it is to keep her afloat has but a slender foundation in facts.

There are two patent defects in Mr. Chamberlain's mode of action. The first is that it is not based wholly on fact, but partly on theory and very much on assumption. The second is that he appears to have no definite scheme for curing the disease concerning which he complains so emphatically. The Liverpool shipowners, like everyone else, not excluding, we think, the President of the Board of Trade himself, are quite at their wits' end to know what modification can be made with advantage in the present system of insurance. If a law is to be made under which a ship cannot be insured for her full value, it will either be eluded or it will not. If it is, then the law will be found worse than useless. If it is not, then the shiping trade of this country will be grievously injured, as many other trades have been, by grandmotherly legislation. The shipowners put this very fairly. They say that means ought to be taken to prevent any man making a profit out of the loss of his ship. "If, however, a shipowner is not to be permitted to protect himself against the damage suffered by the total loss of his ship, what prudent man will remain in the business, unless as a member of a company which owns so many ships that it can afford to carry on the business of underwriting as well as that of shipowning? A vast amount of capital has been attracted to the building of ships, because it is known that the property is capable of being fully insured, but it will be to a large extent withdrawn, and wisely withdrawn, if full insurance be made illegal. The shipping trade has been built up to its present position almost entirely by the small capitalists, who have invested their money in ships whose management they leave to skilled hands. In every town, almost in every village, there are owners of this description, who would be debarred from so investing if their property could not be protected by a contract with underwriters. When it is considered how the prosperity of other trades, and, indeed, of the whole community, depends on that of the shipping trade, it will be seen how widespread and disastrous would be the effect produced by any such change in the law, which should be effective in its operation." It is difficult to believe that Mr. Chamberlain understood on what basis the shipping trade stands when he wrote as he has done.

Concerning the details of the relations existing between the shipowner and the underwriter, and the proposals put forward by Mr. Chamberlain for the establishment of maritime courts, it is not our purpose to write now. A discussion of these matters in our pages would not prove either useful or interesting; we have endeavoured to deal with principles more than with details. If the principle on which the President of the Board of Trade is acting be sound, the details are certain to come right in the end; but our contention has been from the first that the principle is not sound. Mr. Chamberlain holds that the shipowners are much worse, very much worse, as a class, than they really are; and he has brought himself to believe that the ocean is after all little more than a canal or lagoon, free from all perils but those of man's making. While he is steeped in this theory he can do no good legislative work. It is not enough that he should know a little about the shipping trade, he must know all about it. The position is anomalous. Let us forget for a moment that Mr. Chamberlain is President of the Board of Trade, and what do we find? A Birmingham manufacturer, the inhabitant of an inland town, lacking all practical acquaintance with ships or the ocean, and knowing nothing save at second-hand of the maritime trade, lecturing men whose whole lives, and in many cases that of their fathers before them, have been devoted to the shipping trade; men who know all about ships, and the sea, and the sailor. Mr. Chamberlain as a Birmingham manufacturer could not obtain a moment's hearing, we will not say from the shipowners, but from the nation. They would look on him as a well-meaning ignorant enthusiast. Mr. Chamberlain as President of the Board of Trade is quite another person; but he ought to manifest a proper sense of the importance of that position, and take care to make himself master of his facts before he rushes into print in the columns of a daily paper. We have from the first said that we sympathise with him, that we believe he is actuated by noble and praiseworthy motives, but we cannot too strongly deprecate the rash and injudicious way in which he has approached a very complex question. Every unprejudiced person will assure him that in dealing with it it is very easy to do incalculable mischief; extremely difficult to do a little good. We can only hope that the President of the Board of Trade will realise this before it is too late; and will understand that the only way in which a sailor's life can be freed from special risks lies in keeping him on shore.

FORESTRY IN CEYLON.

ONE of the most valuable contributions to our knowledge of the important subject of forestry is the report, recently made public by the proprietors of the *Tropical Agriculturist* of Ceylon, by Mr. F. D'A. Vincent of the Indian Forests Department on the forests of that island. Called in by the Colonial Government to inspect the condition of the vast forests which exist in Ceylon, this officer's report makes it evident that his advice has not been sought one whit too soon to check the almost certain destruction of what yet remains of valuable forest reserve. The need for urgent measures may be estimated by the fact that in the hill country of the island all that now remains of this is not above 100,000 acres, while in the low country, which is estimated to have an uncultivated area of 9,000,000 acres, only about one-third to one-half can be said to now consist of forest. The remainder became mostly low scrubby jungle, the only growth which the now impoverished soil can produce, and fully demonstrates how this impoverishment has been brought about. For centuries it has been the custom of the natives to roughly fell a few acres of forest, burning off the logs, and on the fresh soil so obtained to cultivate one or two crops of grain, and then to abandon the land and seek fresh ground. The result has been that more than one half of the valuable forests have been destroyed; for over areas so treated by this "chena" cultivation, as it is termed, there springs up only a thorny and almost valueless jungle. This absolutely prevents the growth of really fine timber, the seedlings of which may take root in such spots, as it chokes the young saplings, denying them both the light and air necessary to that growth. Spasmodic efforts appear to have been made to check this practice; but centuries of usage, and therefore of almost prescribed right, have rendered it most difficult hitherto to do so. As for the so-called Forest Department of Ceylon, which was inaugurated about ten years back or so, there seems every reason to fear that it has been productive of little good. The few officers appointed to it were wholly untrained in forestry, and, with the best will in the world, they have been able to accomplish but little. Indeed Mr. Vincent points out that the rivalry between the officers of the several provinces to make their charges return revenue has resulted most injuriously, while their efforts to plant nurseries of valuable trees have been so ill-directed that the results up to the present have been almost *nil*.

The forests of Ceylon abound in most valuable woods. Its ebony is famed in China, and has almost the entire monopoly of that market. Satinwood furnishes the most durable of woods, while pali and halmalilla are also most useful. But years of the destructive process we have referred to have thinned off such trees to an alarming extent, until even the supply of satin sleepers for the local railways is seriously threatened. Between 30,000 and 45,000 of these are now required annually, and as railway extension in the island becomes more developed, a much larger number will certainly be used up. A satinwood sleeper Mr. Vincent states to outlast two to three of creosoted pine; but he writes, "To cut 30,000 satinwood sleepers—requiring 6000 trees annually—from the forest, would at present mean the speedy extermination of the tree, although when the forests are so large 6000 stems a year of our principal timber is no exorbitant demand." The ebony supply also is daily becoming shorter. It has been the custom for the Government officials to issue licences to fell a certain number of ebony trees, and in their search after those suitable the fellers have tapped hundreds of immature trees to ascertain if they contain the valuble black-hearting, and those so treated have rapidly decayed, denuding the forest of this tree to a far greater extent than the commercial demand for the wood would have caused. It is evident that if so wasteful a course be longer permitted, the time is not far distant when all hope of the forests being remunerative to the Government will cease.

As to the mountain zone, independently of the necessity of reserves of trees to protect the sources of mountain streams and for general climatic influences, they serve in Ceylon another most important function, that of wind screens. To those who have not visited Ceylon, it is difficult to realise what the force of the wind is in the hill

country, isolated as that portion of the island is in the centre of vast surrounding plains stretching on all sides to the seaboard. It is no uncommon thing for carts heavily laden with produce to be wind-bound for days at particular spots, or to hear of those rash enough to attempt to pass such spots being blown over the precipice, bullocks and all. Then, again, one of the chief obstacles to cultivation in the hills is this same enemy the wind, which often blasts in a single night the hopes of the planter whose lands have not been wisely chosen in a sheltered spot. To guard against such disasters Mr. Vincent deems it absolutely necessary that wooded belts should be kept in certain positions, and it will be necessary by the slow process of planting to make up for the destruction which has been permitted in many localities. That gentleman does not spare the system under which the forests have been treated in the past. He denounces it as wasteful and extravagant in the extreme, and reveals a laxity on the part of many of those charged with their management which is scarcely creditable. In several of the government Kacherris the accounts of timber sales and licences have been so ill-kept that all Mr. Vincent's attempts to obtain correct data proved unsuccessful. The selection of timber for felling has further been left to subordinate and unpaid native headmen, with the result of complicity between them and the licencees, leading to such over-supply and shipment that Messrs. Churchill and Sim reported recently the London market for satinwood "to be completely glutted with wood for the past six months, and we now hold a large stock, for which we cannot obtain £6 per ton—of 50 cubic feet—whereas twelve to fifteen months ago we were selling at £20." Mr. Vincent remarks as to this:—"Satinwood is, therefore, 25 per cent. cheaper in the London docks than in the Ceylon Government sale depôts."

The second portion of the paper under reference deals with the measures necessary to establish a better condition of affairs. Primarily, stringent legislation is insisted upon, which, while recognising well-established existing rights, shall effectually stay robbery and destruction in the future. Mr. Vincent would not have *all* Crown forest treated alike. There should be "reserves" and "particular reserves," certain privileges being accorded to the public as regards the first which should not be available in the latter, in which the systematic measures for encouraging reproduction will be carried on. For the forester holds that to attempt the fullest supervision over the whole area of forest in Ceylon would be impracticable. The attention of the officers of the department would mainly be directed to these "particular reserves," their upkeep and development; while the Government Agents would be empowered by the new legislation proposed to check waste in the ordinary Crown reserves. We have thus briefly dealt with the leading features of Mr. Vincent's valuable report. The preservation of forests in our Colonies means economy in public works, the development of which means progress. The subject treated of is, therefore—and quite independently of its importance as affecting climate—one of great interest to the large body of engineers scattered throughout our widespread Colonial Empire; and to them we should strongly recommend the careful study of Mr. Vincent's most elaborate paper, which is accompanied by a map of Ceylon showing the disposition of the forest areas treated of in it.

NICE INTERNATIONAL EXHIBITION.

The International Exhibition at Nice was opened to the public on the 24th inst., but the Commissioners have been obliged to postpone the inaugural ceremony. This was to have taken place on the opening day, and M. Jules Ferry, the Prime Minister of France, had arranged to arrive at Nice last week, accompanied by several other Cabinet Ministers, the senators and deputies of the Department, and a host of other personages distinguished in politics, science, or art. But those who have watched the progress of affairs in Paris during the last few weeks must have seen that it would be very difficult for the Premier to quit the capital for a town so many hundred miles distant just at this moment, and therefore few were surprised to hear that the inaugural ceremony had been deferred till the commencement of January, and that the exact day would have to be fixed by M. Jules Ferry himself. This must have been welcome news to the Exhibition Commissioners. Of course it was not ready—what International Exhibition has been?—on the opening day. Even in the London Exhibition of 1851 much remained to be done after the public were admitted to the building, and things seem to get worse instead of better. It is, perhaps, invidious to particularise, but many who read these lines will remember the rotunda of the Vienna Exhibition in May, 1873, the state of the Paris Exhibition in 1878, several months after the opening; the shortcomings of Amsterdam have been too recently before the readers of The Engineer to need comment; and the Madrid Exhibition, the opening of which formed part of the official festivities in connection with the visit of the King of Portugal to Spain last May, had to be closed for completion as soon as his Majesty departed, and is even now not entirely ready. At Nice things are not so bad as that; much remains to be done, but on the Riviera there is no *dolce far niente* where public works are concerned, building progresses as rapidly as the vegetation, and it is probable that on the day of inauguration little will remain unfinished. With the exception of a few decorative details, such as hangings, stained glass, &c., the main building has been terminated for some weeks, and most of the kiosks and annexes are practically completed; but as yet the exhibitors whose show cases are ready for public inspection are outnumbered by those whose goods have not yet left their packing cases. This is one more instance of the mistaken kindness in extending the limit for receiving applications, and it acts very unfairly towards those exhibitors who are ready, and yet have to bear the consequence of the dilatoriness of others. In The Engineer of March 9th it was stated that the exhibition grounds extended over twenty acres, and this was at that time considered ample; but the number of applications had been so much greater than was estimated that the grounds have been added to wherever possible, and they now probably cover more than thirty acres. Notwithstanding this addition the separate buildings are too close together to produce a good effect, and they have a somewhat cramped appearance. This will be partially removed by the completion of the gardens which surround them, but still it is to be regretted that the vacant land adjoining the Exhibition ground has not been added to them. However, it is more easy to criticise than to succeed, and it must be admitted that there is little to blame at the Nice Exhibition, and much that is deserving of the highest praise. In less than eight months a most unpromising piece of ground has been brought into shape, a light elegant building in the Italian style has been erected on the upper part, the lower portion has been laid out as a garden, with pavilions for the chief towns of the Riviera, Nice, Cannes, Monaco, &c., or for different exhibitors, and advantage has been taken of the difference of level to construct an imposing cascade. The general appearance of the Exhibition building and the cascade remind the spectator of the Trocadero in Paris, but the resemblance is not sufficient to cause any suspicion of plagiarism. The towers are of slenderer proportions, *al fresco* painting, so suited to a southern sun, has been freely employed, and the verdure round the cascade is of a more luxuriant character than the climate of Paris would allow. The *Commissaire délégué* for Great Britain, Mr. Edmund Johnson, of Castle-street, Holborn, is represented at Nice by Mr. P. Varnals, and Lord Granville has just appointed the British Vice Consul, Mr. C. Harris, to be the official representative of the British Government at this Exhibition.

LITERATURE.

Practical Electrical Units Popularly Explained. By James Swinburne. London: E. and F. N. Spon. 1883. 61 pages.

In this little book the author successfully battles with a very difficult problem, namely, the explanation of electrical conceptions and units by reference to hydrodynamic conceptions and measurements. He begins with mechanical units, so as to lead to a similarity between the ideas of the reader and those of the author as to the meaning attachable to words or terms used in this and in the next part of the book, which is electrical units. The use of the word force is very tenderly treated, and it would be difficult for any of the several schools of philosophers in abstract mechanics to quarrel with the author, who puts them all into the same category when he mentions an apparent misnomer in the term "electro-motive force," and observes that "science does not know what electricity is, but it is supposed to be a kind of motion of molecules, or of ether, very closely related to heat and light. Science knows little of molecules or ether, and does not even know if there are such things, but thinks the next best to understanding anything is naming it." Notwithstanding this foot-note ascerbity, this little book of Mr. Swinburne's is scientifically done, and anyone who will take the trouble to read its few pages carefully will find that his engineering knowledge rather helps him to gather up electrical terminology. The third part of the book is illustrative of the first and second; the fourth is on chemical work, as in primary and secondary batteries; the fifth is on potential; and the sixth is miscellaneous.

SIR CHARLES WILLIAM SIEMENS AS A METALLURGIST.

No. III.

THE OPEN HEARTH STEEL PROCESSES.

Whilst Dr. Siemens was engaged in perfecting his regenerative furnace, he did not neglect to study new directions in which its employment might be extended. About the year 1861 he proposed that the furnace should be used for the production of steel, and in the following year he started at Birmingham experimental works, which were subsequently known as the Sample Steel Works. It was here that the manufacture of Siemens steel by the ore process was first conceived and elaborated. In order to understand thoroughly what was really accomplished here, it is needful to appreciate clearly the problem that Dr. Siemens set himself to solve. This may be stated, in general terms, as consisting in the malleablising of cast iron. Cast iron consists, from a chemical point of view, of iron, together with carbon, silicon, and usually, though not invariably, other impurities, the carbon exceeding $2\frac{1}{2}$ per cent.; such iron is readily fusible, not weldable nor forgeable, and brittle. On removing the silicon and part of the carbon, the metal becomes less fusible, more forgeable, and less brittle, forming steel, until, when the carbon reaches 0·25 per cent., malleable iron is produced. The temper of the steel depends upon the amount of carbon present in it, getting softer as the proportion of that element decreases; and what is now known as mild steel or ingot steel is nothing more than fused malleable iron. In order to produce mild steel, it is therefore necessary to submit cast iron to an oxidising process, which will remove the silicon and a large proportion of the carbon, at a temperature sufficiently high to melt the comparatively refractory metal thus obtained. Now this can be done in two different ways. If pig iron be melted and exposed to a current of oxidising gas, such as air or even carbonic acid, this oxidation slowly takes place; it is so slow that for steel-making purposes it is helped by diluting, so to speak, the elements to be removed, by melting the cast iron with a large quantity of malleable iron. In the other method, the pig iron is melted at a high temperature with oxide of iron, which gives up its oxygen to the silicon and carbon of the cast iron. The latter method was the one adopted by Dr. Siemens, and it was the object of continual experiments at the Birmingham Sample Steel Works between the years 1862 and 1867, at which latter date the process was already tolerably perfect. It is only just to mention that the success of this process was greatly aided by the high ability and scientific knowledge of the late Mr. Arthur Willis, who was engaged as chemist at these steel works from the time of their starting.

In the year 1868 the directors of the Great Western Railway sent to Dr. Siemens a truck load of worn-out wrought iron rails, with the request that he would experiment upon them with a view to converting them into mild steel rails. After numerous fruitless attempts, he at last succeeded in accomplishing his object, and produced rails, which were at once laid down, and were found to be far superior [to the old wrought iron rail. The success that attended this experiment was so pronounced that the authorities of the Great Western Railway were convinced of the great part that the new process would certainly play in the future of steel-making, and some of them, in conjunction with Dr. Siemens, founded the Landore-Siemens Steel Works, at Landore, near Swansea, which works have been the school where most British open-hearth steel makers have been trained.

However, Dr. Siemens was not the only one who had been turning his attention during those five years—1862-67—to the manufacture of open hearth steel. MM. Martin, of Sireuil, in France, had been at work on the same subject, but had chosen the other and simpler process—melting down malleable iron in a bath of pig iron on the bed of a Siemens furnace, and thus originated the so-called Siemens-Martin process. The great difficulty of all experimenters appears to have been that of finding some material suitable for furnace building capable of withstanding the high temperatures required. Dr. Siemens began by trying basic linings, such as lime and magnesia; next he tried nearly pure alumina in the form of bauxite; but one after another he had to abandon these materials, and finally used, as already stated, a nearly pure siliceous sand containing about 2 per cent. of lime, similar to that used for the bottoms of copper furnaces near Swansea.

By this time the Bessemer process was rapidly gaining ground, and a material was accumulating admirably adapted to the Siemens-Martin process. In making Bessemer steel, a certain quantity of unsaleable metal is produced, *e.g.*, ladle sculls, crop ends of rails and ingots, shearings from sheets and plates, &c. This material, not being readily weldable, had to be re-melted, and was thus exactly suited to the Siemens-Martin process. It will be seen that the ore process and the scrap process thus sprung from quite different sources, and have each their own well-marked individuality; but it is found more advantageous to combine the two, and this is now done, except in special instances. Pig iron and scrap are charged together and melted, and iron ore is thrown into the liquid bath until the silicon and carbon are oxidised down to the required point. Spiegeleisen or ferro-manganese is then added, in order to give the resulting metal a certain percentage of manganese, which is found indispensable for the proper working of the steel, and the furnace is then tapped, and the steel run out into iron ingot moulds. These ingots are afterwards heated and rolled or hammered into the required shapes.

The following detailed account of the working of a typical charge at Landore will give a fair idea of the operations involved in the process. The furnace was of the usual shape and construction. The producers and regenerators being exactly similar to those already figured for the regenerative mill furnace; the following diagramatic sections—Figs. 6 and 7—show the shape of the furnace body, the lettering of the various parts being the same as in Fig. 5. $g g^1$ are the gas ports, $f f^1$ the air ports, h the furnace body. It will be seen that the roof is in the shape of an inverted arch, so as to deflect the flame well down on to the centre of the bed. The bed is deeply hollowed to contain the molten metal, the flat part of the bed a being technically known as the bank. At the front of the furnace are two or three working doors, through which the charge is introduced into the furnace and the various operations carried on; at the opposite side, the back of the furnace, are the tap-hole and spout s, through which the molten metal and slag are run out into a ladle.

Let us suppose, then, that a charge has just been tapped; the interior of the furnace is still at a bright red or white heat. The furnaceman opens the working doors, and by means of a long-handled iron ladle patches with sand all the defective parts of the bed, smoothing it well down; meanwhile his helper has rammed the tap-hole with coke-dust mixed with a little burnt clay or sand, and furnacemen and helpers then charge the furnace. The charge in the case in question consisted of—

		Tons.	cwt.
No. IV. Hematite pig iron	Solway pig ...	2	7
	Derwent pig ...	3	10
Steel—Plate shearings and scrap		2	10

The pig iron was first laid all round the bottom of the furnace and the scrap piled all round the sides of the bed and on the bank. At 3.30 a.m. the furnace was charged, and the gas and air valves were then opened and the heating-up commenced. The furnaceman and helpers then proceeded to repair and heat up the ladle and the tap-hole, and to clean everything up around the furnace. In a couple of hours the pig iron was beginning to melt, and by 7 a.m. a bath of molten pig iron had formed, in which the steel scrap was dissolving pretty rapidly. During this same time some of the iron had also been oxidised, and had combined with some of the silica of the furnace bed to form a silicate of iron; this was acting on the carbon and silicon contained in the molten metallic bath, and oxidising them with the production of carbonic oxide and silica respectively. The former was escaping through the layer of slag, and burning at the surface of the bath, so that the whole mass appeared to be boiling slowly. The furnacemen occasionally put in a long iron bar, and detached any pieces of steel scrap that might be adhering to the bank, so as to get everything completely melted. At about 9 a.m. everything was melted, and the boil was well started, but the cinder was still pretty viscid. At 10 a.m. the furnaceman threw in a couple of shovelsfull of Soumah ore, and a little limestone. At 10.30 the bath presented the appearance of vigorous ebullition, the bubbles of carbonic oxide being given off with so much violence as to spurt up small portions of the charge. At 11 a.m. the boil had reached its maximum of violence, the furnacemen still continuing to feed in ore and limestone from time to time; the slag was beginning to get a little thinner. At midday the slag was fairly thin, the furnace being now very hot, and the charge still boiling. At 12.30 p.m. it was boiling more slowly. At 12.50 p.m. the last charge of ore was put in, and the boil had almost ceased. The furnaceman now commenced to take out samples of the metal and slag in a small sample spoon—an iron spoon with a long handle. By their fracture and appearance he is enabled to tell with great exactness how the process is progressing, and whether the charge requires

more ore, or whether it already has had too much, in which case a little more pig iron may be thrown in. When the process appears to be nearly finished a sample of steel is taken, hammered out, and sent to the laboratory, where the percentage of carbon which it contains is determined by the expeditious method known as the Eggertz coloration test. When the carbon is reduced to the desired percentage, orders are sent down to get ready for tapping. In the instance now before us samples were taken and tested at 1.20, 1.30, and 1.45 p.m., at which hour the carbon was found to be sufficiently low. Meanwhile the workmen were getting ready for the cast. The ingot moulds were in their places in the pit, the tapping spout and ladle had been heated to redness, and everything was in order. The necessary amount of ferro-manganese—2 cwt. 1 qr.—was placed on the bank of the furnace to heat up, and at 2 p.m. it was pushed into the bath, where it dissolved with some effervescence, the furnaceman stirring up the bath with a long iron bar; a few minutes afterwards the furnace was tapped by cutting out the tap-hole with a steel bar; the molten steel and a little slag were allowed to run into the ladle, and the rest of the slag was run out into a small sand pit just behind the furnace. From the ladle the steel was turned into the ingot moulds; as each mould was filled it was closed by a shovelful of sand, upon which an iron plate was wedged down. The ingots were allowed to set, and were then ready for transfer to the mill for forging or rolling. The entire charge had taken ten and three-quarter hours to work off, and there had been consumed besides the pig iron and scrap steel:

	Tons.	cwt.	qr.
Ferro-manganese	0	2	1
Soumah ore	1	17	3
Limestone	0	1	3½

The yield was 8 tons of ingots.

It will be well now to examine more completely what chemical changes take place in this process of steel making.

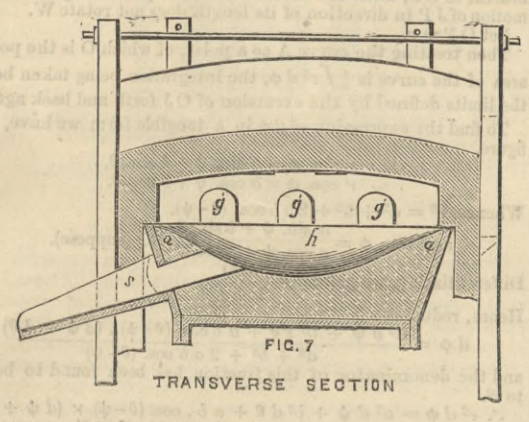


FIG. 7

TRANSVERSE SECTION

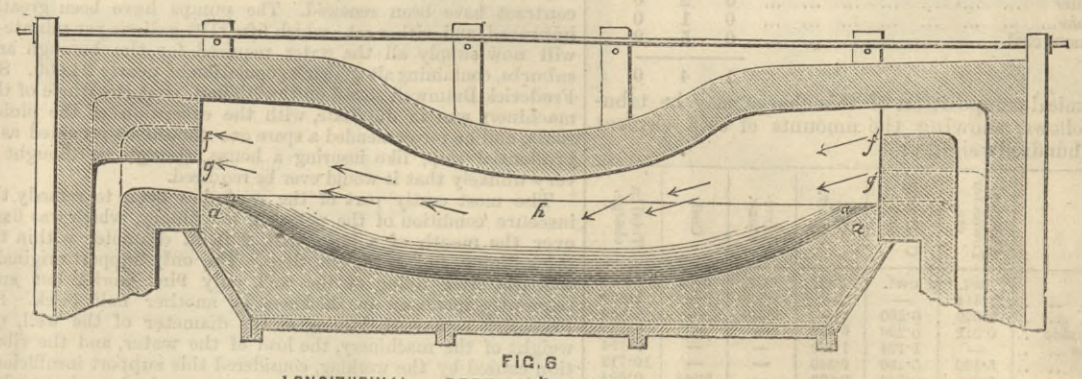


FIG. 6

LONGITUDINAL SECTION THROUGH CENTRE OF FURNACE

SIEMENS' OPEN HEARTH STEEL FURNACE.

In addition to carbon and silicon the pig iron almost always contains sulphur, phosphorus, and manganese; the two former elements are not got rid of in the steel-making process, whilst the latter is; sulphur and phosphorus are, moreover, excessively injurious to steel, the former making it brittle at a red heat, or red-short, as it is usually called, and consequently unforgeable; whilst the latter makes it cold-short or brittle at ordinary temperatures. As these injurious elements are not eliminated in the process, it is necessary to select for steel-making pig iron containing them in as small quantities as possible; hence the use of hematite pig iron, which should not contain more than 0·05 per cent. of either of these elements. An enormous amount of study has been devoted within the last twenty years all over the world to the investigation of the relations of these two elements to the quality of the steel; but in spite of all that has been done and said on the subject, it still remains involved in obscurity, and we have little except empirical rules to guide us in fixing the maxima of these deleterious elements that can be admitted with safety in a steel for any given purpose. Leaving, then, altogether the theoretical side of the question, we will confine ourselves to noting the actual chemical changes that take place during the course of one operation. A furnace in good working order was charged and a series of analyses made at different stages of the process. The charge in question consisted of—

	Tons.	cwt.	qr.	lb.
Maryport pig iron	5	0	0	0
Siemens pig iron	0	0	2	8
Steel scrap	2	5	0	0

Had this charge been simply melted without any chemical change taking place, it would have contained about—

No. 1.

Carbon	2 per cent.
Silicon	1·5 ,,
Manganese	0·5 to 1·0 ,,
Sulphur	0·05 ,,
Phosphorus	0·05 ,,

However, as already explained, oxidation takes place to some extent during the melt, and when the bath was completely fused, about seven hours after charging, its composition was found to be—

No. 2.

Carbon	1·72 per cent.
Silicon	0·588 ,,
Manganese	0·072 ,,
Phosphorus	0·053 ,,

In an hour's time, when a little ore had been fed in, but the boil had scarcely commenced, its composition was—

No. 3.

Carbon	1·38 per cent.
Silicon	0·317 ,,
Manganese	nil.
Sulphur	0·044 ,,

In another hour the metal was just beginning to boil. Its composition then was—

No. 4.

Carbon	1·37 per cent.
Silicon	0·074 ,,
Sulphur	0·032 ,,

Successive samples were then taken every hour, giving the following results—

	No. 5.	No. 6.	No. 7.	No. 8.
Carbon, per cent.	0·70	0·32	0·15	0·13
Sulphur ,,	0·036	0·072	0·120	0·112

This charge worked rather slowly, having been over twelve hours in the furnace. There were used in addition to the charge already mentioned—

	Tons.	cwts.	qrs.	lb.
Soumah ore	1	1	0	0
Limestone	0	2	2	0
Ferro-manganese	0	2	0	27

An analysis of the steel after the ferro-manganese had been added and the charge cast into ingots gave—

Carbon	0·18 per cent.
Manganese	0·504 ,,
Sulphur	0·096 ,,
Phosphorus	0·047 ,,

A study of these two analyses teaches us that the first thing that takes place is a rapid oxidation of the silicon and the manganese, which slag off together at the very outset; part of the carbon oxidises at the same time, while the rest, which was originally in the graphitic state, all passes into a state of combination, so that if a sample of the molten metal be taken out, it will give white iron, even if allowed to solidify very slowly. When all the silicon has been removed, the carbon begins to oxidise more rapidly, and, escaping in large bubbles, produces the phenomena of boiling; and now occurs a curious action, which is exceptionally well marked in the above analyses—when the carbon is reduced to a certain stage the metal begins to take up sulphur. Up to this point the percentages of the sulphur and phosphorus had remained practically stationary. The phosphorus goes unchanged to the end of the process, but the sulphur increases, rarely, indeed, to the extent here indicated, because the heat here being barely high enough, the charge was exposed for an unduly long period to the action of the producer gas. Producer gas obtained from ordinary coal contains sulphur, and if lime be heated to redness in a current of this gas it absorbs sulphur pretty readily and would doubtlessly yield it up again to a bath of metal. The amount taken up depends on many circumstances, but it may be taken as an axiom that in the ordinary open-hearth steel process the percentage of sulphur in the steel is always higher than in the pig iron used in its manufacture. On the other hand the phosphorus never increases and may even decrease a little, as the yield of steel is at times greater than the weight of the metal charged, owing to a little of the iron ore being reduced by the carbon of the pig iron.

A great deal of slag is produced by the open-hearth process; its amount and composition are, however, very variable. The following analyses will serve to show its general composition:—

	I.	II.
Silica	48·52	47·71
Alumina	12·40	7·81
Ferrous oxide	27·37	30·03
Manganous oxide	2·04	8·97
Lime	9·67	5·48
	100·00	100·00

The process as above described is the open-hearth process as generally practised now. It is comparatively rarely, and only under special circumstances, that either the Siemens-Martin or the Siemens process is practised in its original form; it will, however, approach one or the other according as the amount of scrap steel or iron or the amount of iron ore in the charge may happen to preponderate. In contrasting the two processes we may say that the Siemens-Martin process is to be preferred where ore is scarce and the supply of scrap of good quality large, as may occasionally happen in Bessemer works; but as much ordinary commercial scrap iron contains more phosphorus than can safely be permitted for most purposes, the Siemens-Martin process is unsuitable where scrap iron of commerce, collected as it is from many different sources, has to be employed, whilst it is rare that large and practically unlimited quantities of nearly phosphorus-free iron ores cannot be obtained at a cheap rate. Moreover, in the Siemens process a small portion of the ore is reduced to metallic iron, and this forms a source of profit that must not be neglected; on the other hand, the furnaces are far more rapidly destroyed by the ore process than by the scrap process, as the silicious materials composing the furnace and the regenerators are fluxed and corroded by the small particles of oxide of iron carried off from the iron ore floating on the bath of slag. The mixed process, as above described, is found to answer exceedingly well, as it combines to a great degree the advantages of both methods. In comparing the open hearth with the Bessemer process, the former has the advantage of being slower, and more easily and accurately controlled, and of working up scraps that could not well be utilised in the Bessemer converter, whilst the latter process has the great advantage of economy, in that it requires no fuel. The waste by it is, however, much greater than by the ore process, and, as a consequence, the percentages of both sulphur and phosphorus are slightly augmented in the finished product, whilst, as we have seen, the former only increases in the open hearth process, the latter remaining stationary.

Attempts have been made to apply the basic process of Messrs. Gilchrist and Thomas—so successful in working up common phosphoric iron in the Bessemer converter—to the open hearth process, but hitherto without success, in this country, at any rate. Nor is it likely that any progress will be made in this direction, as long as the difference between the values of hematite and common pig iron still remains so little; for in the present state of the market the margin is far too small to allow of any additional expense, such as must necessarily be attached to a basic process, being incurred. As to the question whether Siemens or Bessemer steel is the better metal, it is still a moot point, there being great differences of opinion among our best authorities on the subject.

THE DIRECT PROCESSES.

Before employing ore directly for the oxidation of the carbon of pig iron, Dr. Siemens had attempted to produce steel by another system, more closely resembling the Siemens-Martin process. He tried to reduce the iron ore to metallic iron, and then to melt the iron sponge so produced in a bath of pig iron. His attempts to produce malleable iron direct from the ore, without first passing through the intermediate stage of pig, may conveniently be classed together as his direct processes. Though these attempts were at first directed solely towards the production of iron sponge for steel making, they soon resulted in the production of wrought iron for rolling into bars and similar purposes. Dr. Siemens' first experiments were made on a hopper furnace, somewhat similar in principle to Chenot's. In the roof of a steel melting furnace were set a series of vertical retorts closed by a sliding door at the bottom; these retorts were filled with a mixture of ore and carbonaceous matter and heated. When the contents were reduced to a metallic sponge the iron was allowed to drop into a bath of molten pig iron on the bed of the furnace below. On attempting to carry this process into practice numerous difficulties were encountered, and it had finally to be abandoned. In the year 1869 a rotator furnace was erected at Landore for the reduction of the iron ore to iron sponge. This consisted of a long horizontal iron cylinder lined with firebrick; at one end gas and air were admitted to heat the slowly rotating chamber by their combustion, whilst the other end communicated with the stack. Ore and carbonaceous matter, ground and mixed, were introduced at the stack end, and were gradually carried forward by the rotation of the cylinder to the hot end; they thus became heated up and the ore reduced. The spongy iron thus obtained was used, as before, for the production of Siemens-Martin steel. The process was, however, soon found to be unsatisfactory, principally because the reduced iron absorbed sulphur with avidity from the producer gas. The use of spongy iron in steel making was, therefore, abandoned. It was found better to hammer the spongy iron into blooms before transferring it to the bath of molten pig iron; but even this method was not satisfactory. The use of reduced ore for steel making was, therefore, given up, and after a series of experiments with a double-bedded furnace, by means of which a stream of molten ore was allowed to run into a bath of molten pig iron, the ore process, as already detailed, was elaborated.

Meanwhile, Siemens was striving to make the direct rotator process for the production of malleable iron direct from the ore a success. In 1871 a couple of rotators on a different principle were erected at Birmingham, and in 1875 rotator works were started at Towcester with three rotators on this new system. The plant at Towcester consisted of three rotators with their producers, &c., a reheating furnace, and a steam hammer. The producers were similar to those already described. The rotator consisted of a horizontal revolving cylinder, 7ft. diameter 9ft. long, of wrought iron with contracted ends, lined with bauxite bricks. It was carried on friction rollers, and could be rotated at any desired speed by means of a small three-cylinder engine. The front end was closed simply by a movable working door; at the other end were the group of four regenerators, with their ports arranged as in the following diagram—Fig. 8—where a a^1 are the two

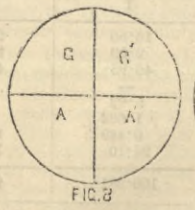


FIG. 8

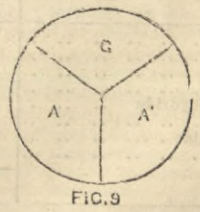


FIG. 9

air ports and g g^1 the two gas ports, each vertical pair—*i.e.*, either a and g or a^1 and g^1—working together. Two of the rotators were arranged thus; the third one, however, had only air regenerators and no gas regenerators, the gas always entering by the aperture g—Fig. 9—whilst a a^1

served alternately for the admission of air and the escape of the heated air and gases respectively.

This system has been found to work extremely well, and appears even preferable to the former one. The gas and air thus enter the rotator at the back end, where they combine, producing a flame which is carried forward by its own pressure nearly up to the working door in front, when it is reflected and drawn up to the stack; by this means the body of the rotator is kept full of flame, the flame striking downwards into that portion of the rotator that happens to be lowest. In order to understand the process as carried out at Towcester, we will, as before, examine in detail the working of a charge. Suppose then that a charge has just been drawn; most of the slag is run off, leaving a little in the bottom, the rotator is left at rest, the gas and air are cut off and the working door opened. Some highly calcined pieces of ironstone or of ilmenite are thrown in and allowed to set there. Thus, a flat side with a number of rough projections is formed which helps to turn over and mix the ore during the ensuing process. It must be mentioned that when a rotator has been newly relined with its bauxite lining, it is necessary to fettle it. This is done by throwing in some 5 tons of hammer scale and a little crushed coal, firing up, and rotating the furnace slowly till a thick uniform layer, capable of retaining the heat, is formed on the bauxite bricks. It is this fettling that forms the true working lining of the furnace. When the flat side formed by the solidified slag has set, the interior of the rotator is at a dull red heat and is ready for charging. The charge at Towcester consisted of a mixture of Northamptonshire ore, bituminous coal, and limestone, crushed under edge rollers and passed through a $\frac{3}{8}$in. riddle. In the case which we will select for illustration the charge consisted of:—

	Tons.	cwt.	qr.
Calcined Towcester ore	0	8	2
Chatterly ore	0	7	0
Tap cinder	0	2	0
Limestone...	0	1	0
Bituminous coal	0	5	2
	1	4	0

The chemical composition of this charge may be tabulated as follows, showing the amounts of each element present in hundredweights:—

	Calcined Towcester ore.	Chatterly ore.	Tap cinder.	Limestone.	Coal.	Total in charge.
	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.
Alumina	1·444	—	—	0·040	—	1·484
Lime	0·039	0·200	—	0·450	—	0·689
Manganous oxide ..	0·012	0·220	0·003	—	—	0·235
Ferrous oxide	—	1·134	1·160	—	—	2·294
Ferric oxide	5·192	5·180	0·340	—	—	10·712
Sulphur	0·005	0·040	0·003	—	0·046	0·094
Phosphoric anhydride	0·215	0·009	0·018	—	—	0·242
Silica	1·556	0·196	0·440	0·090	—	2·282
Carbonic anhydride.	—	—	—	0·360	—	0·360
Water	—	—	—	0·050	0·716	0·766
Volatile matter.. ..	—	—	—	—	1·530	1·530
Ash	—	—	—	—	0·112	0·112
Carbonaceous residue	—	—	—	—	3·086	3·086
	8·463	6·979	1·964	0·990	5·490	23·886

These and the subsequent analyses were made by Mr. H. Le Neve Foster, chemist to the Towcester Works.

This charge will contain altogether 9·282 cwt. of metallic iron. The various ingredients are brought ready crushed in wheelbarrows, and dumped out upon the iron plate in front of the furnace. There they are well mixed by a couple of workmen with shovels, and then thrown into the rotator. As soon as the charging is finished the working door is let down, and made as tight as possible with clay, &c., and the rotator is started, revolving slowly. The gas valve is then about half opened, the air valve and damper being fully open. The coal begins to decompose at once, giving off a thick yellow smoke. This ceases in about twenty minutes, and is replaced by a thin black smoke in much smaller quantity. This, too, ceases usually in about an hour from the time of starting the rotator, and more gas is then gradually admitted, the process being continually watched by the furnaceman through a sight-hole left for that purpose in the working door. The chief points to be observed are, never to have an oxidising flame, and to keep the temperature as uniform as possible. Complete reduction will usually have taken place in about two hours. The reduction is indicated by the particles of reduced iron commencing to cohere. When this takes place the furnaceman should try to ball up the iron, *i.e.*, to work it into lumps by driving the rotator fast, if the temperature is high, but at a slower rate should it be low. The heat has to be forced as much as possible. When the iron has as far as practicable been worked into two or three lumps—if it were to form one lump it would be too big to be withdrawn—the rotation is stopped, and a portion of the slag tapped off by a tap-hole contrived for that purpose. If necessary the rotator is driven a few turns more to finish balling up the iron, and the iron balls are then withdrawn by means of tongs, bars, &c. The balls are carried to the steam hammer, and forged into blooms, which are then reheated in a mill furnace and rehammered. The rest of the slag is then tapped out. The composition of these slags is the following, No. I. being the slag before, and No. II. the slag after, drawing the iron:—

	I.	II.
Alumina	16·50	20·40
Lime	2·09	trace
Ferrous oxide	46·95	49·27
Ferric oxide	—	7·05
Phosphoric anhydride	5·22	3·465
Sulphur	1·032	0·768
Manganous oxide..	0·489	trace
Silica	28·10	18·80
	100·381	99·753

It was found exceedingly difficult to keep the working of the furnace at all regular; the length of time of the operation, the yield of iron—usually about two-thirds of the iron present—and the quality of the iron were all exceedingly irregular. Some very good iron was certainly made by this process; but upon the whole it was not a success, particularly from a financial point of view, and the operations at Towcester were soon brought to a close. About the year 1875 a couple of rotators were erected in Nova Scotia at the well-known Acadian iron mines, to work the brown hematites of these mines. Here, too, they were unsuccessful, and did not do any better when they were tried for puddling. The puddlers who were set to work them found that they were of advantage in the puddling process proper, but that they could not ball up in them unless they stopped the rotators and balled up by hand in the usual way.

It must therefore be admitted that these last attempts of Sir William Siemens to produce iron direct from the ore have not been attended with the success which has crowned all his other efforts, and have, indeed, never fairly passed the experimental stage. What would have been their future had their talented originator lived to carry on his researches, it is needless, as it is useless, to speculate.

LEAMINGTON WATERWORKS.

Sir Frederick Bramwell, who was some time ago called in to advise the Leamington Corporation on certain points connected with their new artesian waterworks, recently attended the annual meeting of the Council, and announced that everything had now been completed in a satisfactory manner. The works were commenced in 1876, and have altogether cost £37,928, of which £8069 has been expended under the direction of Sir Frederick Bramwell, since the notice which appeared in our columns on the 19th September, 1879. There have been no material alterations made in the machinery beyond making the pinion shaft true, and providing new pinion blocks and improved means of adjusting the pinion shaft, so as to keep it in a line with the crank shafts of the two horizontal engines to which it has to be coupled up. A new set of cylinders had to be provided for the engines; a third boiler has been fixed, and the flues of the two included in the original contract have been renewed. The pumps have been greatly improved, and either set—which lifts 1100 gallons per minute—will now supply all the water required for the borough and suburbs, containing altogether a population of nearly 24,000. Sir Frederick Bramwell stated on the 9th inst. that the whole of the machinery was in duplicate, with the exception of the pinion shaft, ond he recommended a spare one should be provided as a prudential step, like insuring a house, though he thought it very unlikely that it would ever be required.

The most costly part of the work has been to remedy the insecure condition of the pumping machinery, which was fixed over the mouth of a large well, 20ft. in diameter within the brick lining, and 112ft. 6in. deep. The only support originally was the brick lining of the well, only 9in. work; but subsequently increased in thickness by another half brick. Sir Frederick Bramwell, looking at the diameter of the well, the weight of the machinery, the load of the water, and the vibration caused by the working, considered this support insufficient, and actually unsafe if two sets of pumps had to be worked together. Four solid piers, constructed of best bricks and Portland cement, have accordingly been built up from the solid rock, which is reached about 35ft. from the top of the well. These four piers carry the massive wrought iron girders which now support the pumping machinery.

The contract for the machinery was originally given to Messrs. Charles Powis and Co., of London, but was taken out of their hands in 1878 by the then borough engineer, Mr. Jerram, and the work was finished by Messrs. Young and Co., of London. There have already been two actions arising out of the works—one by Messrs. King and Co., of Hull, who sank the well and made the bore hole at the bottom; and one by Messrs. Young and Co., which was decided in the House of Lords in favour of the Corporation, on the legal point that Messrs. Young and Co.'s contract with Mr. Jerram to complete the works, did not bear the borough seal. Messrs. Charles Powis and Co. have now served the town clerk with a writ, claiming about £15,000 as damages for not having been allowed to finish their contract—an unpleasant fact which was announced at the same meeting that Sir Frederick Bramwell reported that the works have at last been satisfactorily completed.

LETTERS TO THE EDITOR.

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

THE DISTILLATION OF COAL.

Sir,—I notice in The Engineer of the 7th instant an abstract of a paper on "The Destructive Distillation of Coal," recently read by M. Scheurer Kestner before the Paris Academy of Sciences. In this paper the author professes to show that, commercially speaking, the question of the substitution of coke and gas for general heating purposes, in place of coal, is dependent on whether the profit arising from the recovery and sale of the ammonia produced in distillation is or is not more than counterbalanced by a depreciation due to the decrease in the calorific power of the coke and gas, as compared with that of the coal from which the products have been derived. Calculations are then given to prove that the decrease in the calorific value is greater than the profit on the ammonium salts, unless the cost of the coal is below about 8s. per ton; and figures of Professor Forster and Messrs. Jameson and Armour, relating to the yield of ammonia under various conditions, are quoted in proof.

Now, Sir, without wishing to undervalue the importance of ammonia as a bye-product in the distillation of coal, and the enormous advantages that would accrue to the community at large if some means could be discovered for utilising the whole, or even the greater part, of the nitrogen in this manner, I would submit that the arguments in M. Scheurer Kestner's paper are founded on an entirely wrong basis, while certain factors, which are always present in modern coking processes, and which very considerably modify the results, have been completely ignored. The great mistake made by the author is in the assumption that the money value of a thermal unit is the same, whether the heat is produced by the combustion of coal, coke, or gas. This we know is not the case, for by comparing the selling price of blast furnace coke with that of the coal from which it is made, we can see at once that for a given thermal effect the cost of coke is about two and a-half times as great as that of coal. Of course, this is an extreme instance, but it serves as an illustration of the fact that in adapting fuel to special uses its value cannot be estimated from one standard rate per unit—a remark which fully applies to the use of coke and gas for general heating purposes; for it is obvious that a smokeless fuel in which 80 or 90 per cent. of the total heat of combustion can be utilised should be estimated at a very different rate per thermal unit to one which cannot be practically burnt without the formation of smoke, and in which the heat utilised is only, say, 50 per cent. of the total amount capable of being produced in complete combustion. Again, no account has been taken of the valuable paraffine, lubricating, and burning oils, as well as the more volatile liquids, which are always recovered along with the ammonia, and which, though adding but very little to the calorific power of th coal, are, when applied in the arts and manufactures, in man cases fully equal in value to the ammonia.

The whole question of coal distillation has lately been very fully treated in communications to the Institution of Mechanical Engineers, and to the Iron and Steel Institute, by Mr. John Jameson, as well as in a paper I had the honour of reading before the Chemical Section of the Society of Arts last May, in which many details of costs are given; and it certainly does seem to me rather extraordinary that at this late period anyone should come forward to question the applicability of a process which, on economical grounds alone, has been advocated for years in one form or another by our highest scientific authorities. Being unwilling to occupy your space needlessly, I have merely touched on some of the principal omissions in M. Scheurer Kestner's paper; but much more might be urged in the way of refuting his conclusions, if the occasion demanded it.

T. B. Lightfoot.

35, Queen Victoria-street, E.C., December 18th.

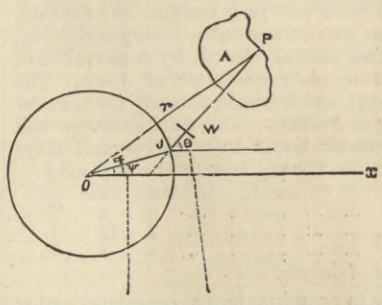
THE PLANIMETER.

Sir,—My father has sent me the following beautifully general proof of the action of the planimeter, for which I hope you can find space in your valuable columns.

Osmond P. Fisher.

Delahay-street, Westminster.

Let A be the area whose magnitude is required. Let P be the pointer, W the wheel, J the joint, and O the fixed point of the planimeter. Let O J = a. J P = b. O x a fixed direction, and let the position of the instrument be defined by the angles θ, ϕ, ψ, as in the figure. From the construction of the instrument it is evident that the wheel W measures the total change in the angle θ, whilst O J makes a complete excursion from its position nearest to O x, until it returns to the same position again. For the motion of J P in direction of its length does not rotate W.



Let O P = r.

Then treating the curve A as a polar, of which O is the pole, the area of the curve is $\frac{1}{2}\int r^2\,d\phi$, the integration being taken between the limits defined by the excursion of O J forth and back again.

To find the expression $r^2\,d\phi$ in a tangible form we have, by the figure,

$$r \sin.\ \phi = a \sin.\ \psi + b \sin.\ \theta.$$
$$r \cos.\ \phi = a \cos.\ \psi + b \cos.\ \theta.$$

Whence, $r^2 = a^2 + b^2 + 2ab \cos.\ (\theta - \psi)$.

$$\text{and tan. } \phi = \frac{a \sin.\ \psi + b \sin.\ \theta}{a \cos.\ \psi + b \cos.\ \theta} = Q \text{ (suppose)}.$$

Differentiating, we get $d\phi = \dfrac{d\,Q}{1 + Q^2}$.

Hence, reducing

$$d\phi = \frac{a^2\,d\psi + b^2\,d\theta + ab \cos.\ (\theta - \psi) \cdot (d\psi + d\theta)}{a^2 + b^2 + 2ab \cos.\ (\theta - \psi)}$$

and the denominator of this fraction has been found to be equal to r^2.

$\therefore\ r^2\,d\phi = a^2\,d\psi + b^2\,d\theta + ab \cdot \cos.\ (\theta - \psi) \times (d\psi + d\theta)$.

Now, by referring to the figure it appears that the general equation to the curve may be defined by an equation of the form

$$\theta = f(a, b, \psi,).$$

Hence, $d\theta$ is given in terms of ψ and $d\psi$; and $(\theta - \psi)$ is likewise given in terms of ψ. Hence, we may write—

$$ab \cdot \cos.\ (\theta - \psi) \times (d\psi + d\theta) = F'(a \cdot b \cdot \psi)\,d\psi.$$

$$\therefore \int r^2\,d\phi = a^2\psi + \int b^2\,d\theta + F(a \cdot b \cdot \psi) + \text{a constant}.$$

Suppose the excursion of O J to be from $\psi = \alpha$ to $\psi = \beta$ and back again,

$$\therefore 2(\text{area A}) = a^2\beta - a^2\alpha + \int b^2\,d\theta + F(a \cdot b \cdot \beta) - F(a \cdot b \cdot \alpha)$$
$$+ a^2\alpha - a^2\beta \qquad + F(a \cdot b \cdot \alpha) - F(a \cdot b \cdot \beta)$$

which $= \int b^2 \cdot d\theta$, between the limits of θ, defined by ψ being taken from α to β and from β to α. Now this latter integral is given by the reading of the wheel. Hence area A $= \frac{1}{2} b^2 \times$ total change of the angle θ, as shown by the wheel. Q E.D.

And it appears that the action of the instrument does not depend on the length of the arm which does not carry the wheel.

O. F.

RAILWAY RATES AS APPLIED TO SECOND-HAND MACHINERY.

Sir,—As the above is a very important matter affecting one of the principal industries of this country, namely, the machinery trade generally, and considering it now fully time some steps were taken with a view to securing a material reduction in the present rates charged by the various railway companies for the conveyance of second-hand machinery, &c., as compared with new, I trust you will excuse me trespassing upon your valuable space for the purpose of placing before the large number of your influential readers who are so deeply interested a few facts concerning the question for their consideration, comment, and assistance, as I think you will agree with me the space will be well occupied. The facts are: At the present time railway rates for new machinery are based upon an excessively high scale on account of the value of the traffic and all at company's risk, there being no rate at owner's risk. Now, the rates charged for second-hand machinery of any kind are precisely the same as for new, but should any breakage occur or damage have been caused to any second-hand stuff in transit, the railway companies at once deal with it as to its actual value as second-hand, although, as before explained, the greater value rate for new machinery has been charged for carriage. A fair consideration of this matter will, I feel confident, convince the respective railway companies that it is equally important to them as to freighters that the matter should receive their serious consideration, because, for instance, in my own case alone, I should send over the lines to and from different parts of the country many hundreds of tons of machinery annually more than I am enabled to do at present in consequence of the excessively high railway rates at present in existence. It would certainly be beneficial to the railway companies and to all interested in machinery generally if they would go in for a reduction of their rates upon all second-hand plant. This in the present day is positively necessary for the well-being of commerce in this particular branch, considering the many thousands of tons of plant constantly changing hands, as the present high rates really prohibit competition from a distance. It ought to be borne in mind that now-a-days the value of metal and machinery is not what it was some ten years ago, although railway rates, with regard to it, remain precisely the same for new or second-hand plant.

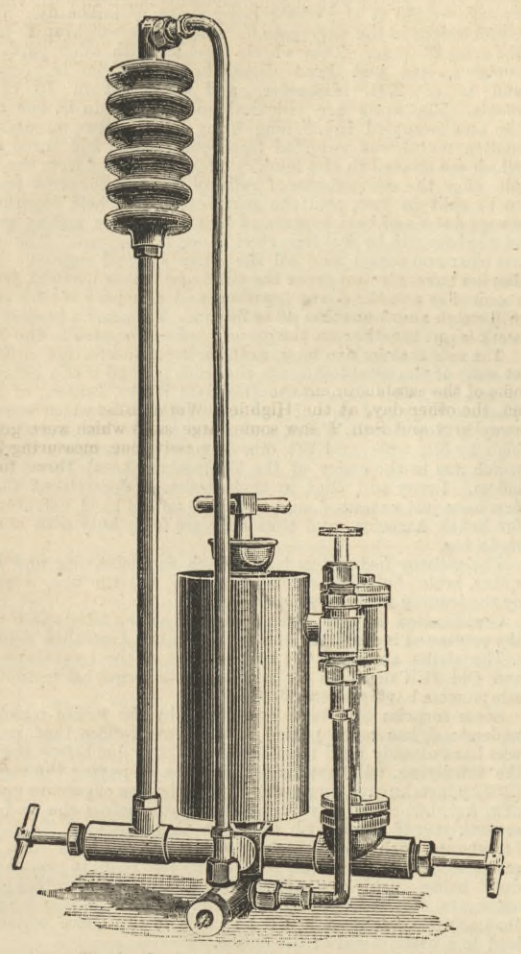
I will not proceed further in the matter at present, but trust it will receive attention and be followed up with the highly desirable result of a reduction in railway rates for the conveyance of second-hand machinery to at least one-half those at present charged in respect of new machinery.

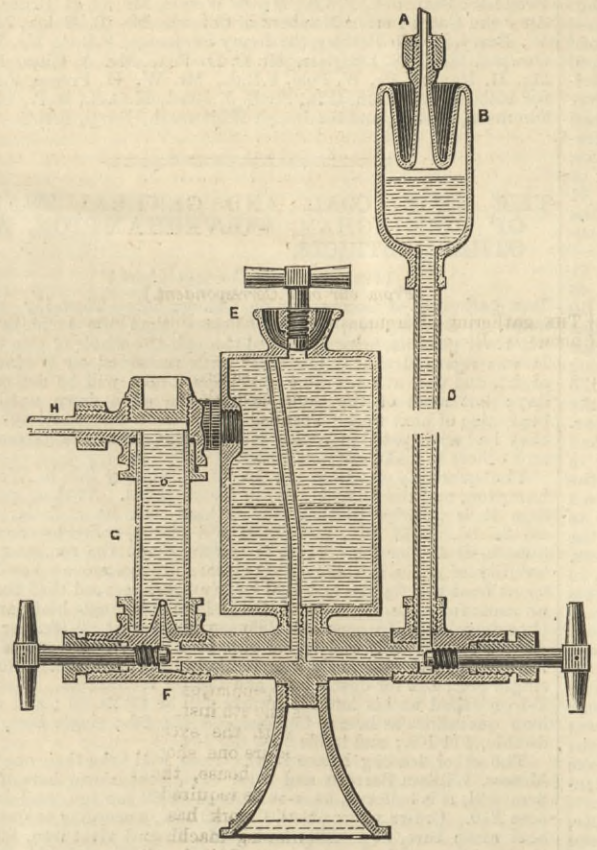
Charles D. Phillips.

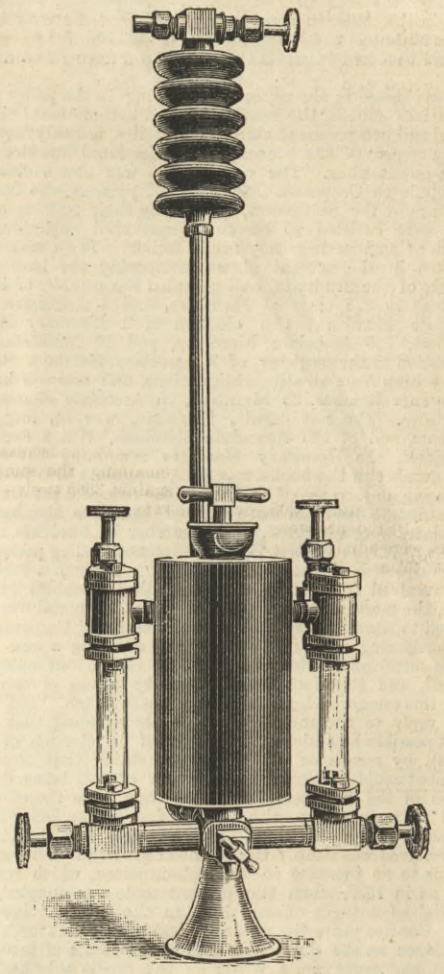
Newport, Mon., December 13th.

The Population.—What will be the population of England in 1891 is asked in the census report. If we assume that the growth preceding the census of 1891 will be the same as in the decade preceding 1881, the population will be 29,705,155.

THE EMPIRE LUBRICATOR.







THE accompanying engravings illustrate a new lubricator, "The Empire," an American invention now being introduced in this country by Mr. H. E. Morris, of 151, Cannon-street. It is fitted on the steam inlet side, and lubricates the steam with great regularity and at any desired rate. It is a lubricator of the displacement type, and its construction will be readily understood from the accompanying engravings. A is the inlet from steam pipe; B, condenser; C, water regulating valve; D, reservoir for oil; E, filling cup; F, oil regulating valve; G, glass sight feed; and H, outlet to the steam pipe. Steam is condensed in B, which can have the surface increased in various ways, as by corrugating it, as shown in the external view. The resulting water forces its way into E and expels the oil, from which rises through the water G a drop at a time, so that the attendant can see at any time how it is working. The rates recommended by the inventor are:—For 10 indicated horse-power, 1 drop per minute; 20 indicated horse-power, 2 drops per minute; 50 indicated horse-power, 4 drops per minute; 100 indicated horse-horse-power, 6 drops per minute; 200 indicated horse-power, 8 drops per minute; 300 indicated horse-power, 10 drops per minute; 400 indicated horse-power, 12 drops per minute; 500 indicated horse-power, 15 drops per minute. Of course, in many cases it may be found necessary to use more than this quantity, as much depends upon the pressure of the steam and the piston speed of engines. Mr. Morris mentions a case where an engine of 450-horse power was supplied at the rate of 25 to 30 drops per minute; and, on the other hand, we know of a marine engine indicating 1300-horse power where the feed only amounted to two drops per minute. The lubricator is, we understand, giving satisfaction. It may be seen at work on the steam engine supplying electric light at the First Avenue Hotel, Holborn.

MACLAINE'S PATENT "PERFECT" PISTON.

THE accompanying engravings illustrate a piston invented and patented by Mr. MacLaine, of Belfast, which has been fitted to several steamships, among others to the s.s. Galvanic and s.s. Teelin Head, both of Belfast, and is, we understand, giving complete satisfaction. These pistons are fitted with two packing rings, each cut through transversely in one place, and having a shallow recess between their contiguous surfaces formed by small outside and inside flanges on the rings, securely enclosing a complete circle of three to five lengths of flat wave springs of tempered steel, with the ends of each spring doubled over, forming a butt nearly the depth of the recess to maintain the springs in position. The waves of these springs are compressed by the screwing down of the junk ring, and a practically unlimited pressure can be put upon them to hold the packing rings perfectly firm and steam-tight against the junk ring and the body of the piston. The outward expansion of the packing rings is derived from a coil spring, with a loose stiffening bar through it, fixed on the ends of each packing ring where cut through, arranged to press the ends apart and expand the ring circumferentially against the inner surface of the cylinder. These rings are turned up a true fit for the cylinder, and they are made sufficiently strong to withstand without local contortion the pressure of the coil spring, so that when opened about $\frac{1}{8}$in. at the butts, in tightening up they expand gradually towards the back, and the pressure of the coil spring is distributed equally all round the circumference. In very large pistons a series of C or other springs are sometimes inserted between the packing rings and the body of the piston; but these are seldom required, as the coil springs expand the packing rings throughout their whole surface tightly against the cylinder, and the rings move up and down so expanded, any aberration of motion being absorbed and neutralised by the piston moving on the packing rings without affecting their contact with the cylinder. To prevent the risk of the packing rings being driven inwards, in the event of the boilers priming, blocks are cast in the rings at intervals all round, projecting towards the body of the piston and turned up $\frac{1}{32}$in. short, so that the outer surfaces of the rings may be driven in for that distance, but no further, past the outer surfaces of the junk ring and piston body, and these blocks are arranged to materially strengthen the packing rings without adding much to their weight.

The coil springs are inserted from the inside, and the ends of their bars are secured with brass pins between jaws formed on the ends of the packing rings, avoiding any necessity for straining the rings in putting in the coil springs, and their pressure is adjusted by the thickness of a steel washer at each end of the coil spring. The packing rings are extra strong, are fitted just floating free of each other, and with only $\frac{1}{32}$in. range of motion inwards, they are, it is claimed, as trustworthy as a solid piston. The pressure of the coil springs is adjusted by testing the rings in the cylinder, and an excess of wave spring pressure could do no harm, so the serious risk of an engineer putting an unknown and undue pressure on the cylinders is entirely avoided.

In practical working it is found that nearly all the pressure is required to hold the packing rings tightly against the junk ring and the body of the piston, while for outward pressure only so much is necessary as will secure perfect contact with the cylinder, as the piston works thoroughly steam-tight with twenty times as much pressure in the one direction as in the other. The friction and wear and tear of both the packing rings and the cylinders are, it is claimed, thus almost annihilated.

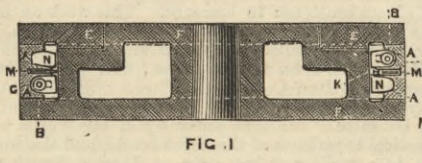


FIG. 1

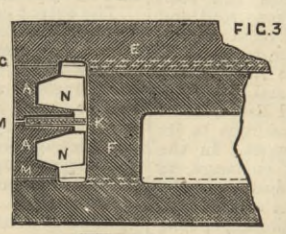


FIG. 3

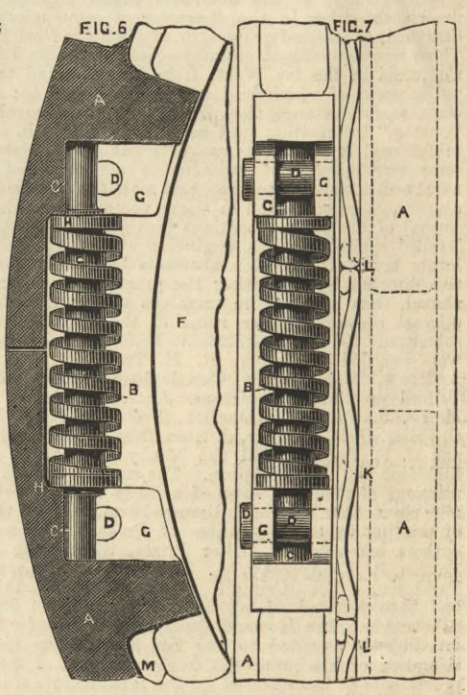
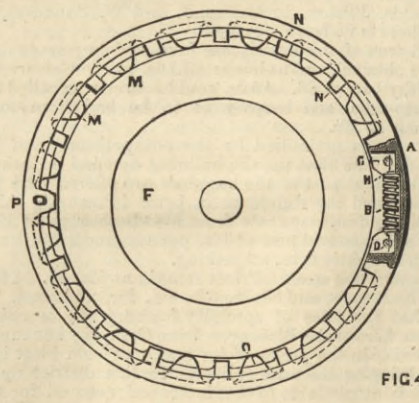


FIG. 6 FIG. 7

FIG. 2



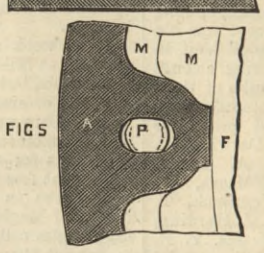


FIG 5

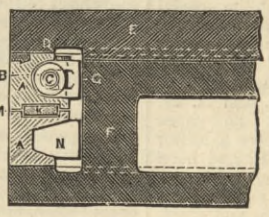


FIG 4

Fig. 1 is a sectional elevation of the piston, showing packing rings, coil springs, wave spring in its recess, packing ring blocks, &c. &c. Fig. 2 is a plan of the piston, with junk ring removed, showing a packing ring with blocks cast in it, a coil spring, a series of C springs all round between the body of piston and the inside of the packing ring, pin to prevent packing ring travelling round, &c. Fig. 3 is an enlarged detail section showing the position of the packing rings with blocks cast in them, the wave spring secured between the outside flange of packing rings and body of piston, &c. Fig. 4 is an enlarged detail section through the coil spring showing the wave spring secured between both outside and inside flanges of packing rings. Fig. 5 is an enlarged detail plan, showing the position of the pin for preventing the rings travelling round. Fig. 6 is an enlarged detail plan showing the method of securing the coil spring and bar with pins between jaws cast on packing rings. Fig. 7 is an enlarged detail sectional elevation, showing the wave springs with doubled over butts in the recess between the packing rings; and the coil spring inserted from the inside between the jaws on packing rings, and secured with pins, &c. A A are the packing rings; B B the coil springs; C C the bars through the coil springs; D D the pins to secure the bars between the packing ring jaws; E E the junk ring; F F the body of piston; G G the jaws on packing rings to receive the coil spring bar; H H the steel washers, according to the thickness of which the pressure on coil spring is regulated; K K the wave springs; L L the doubled over butts on the wave springs; M M the outside and inside flanges on the packing rings; N N the blocks cast in the springs; O O the C springs; and P the pin in ovalled hole to prevent the packing ring travelling round.

LOADING RAILWAY TRUCKS.—The American *Engineering and Mining Journal* says that the Western anthracite business is growing to such proportions that an automatic apparatus for loading trucks with the coal direct from the breakers will be very much wanted.

PATENTS, &c., ACT, 1883.—We are requested to state that no applications under the new Patents, &c., Act will be accepted if they bear a date prior to the 1st of January, 1884, the day upon which the Act comes into operation. Copies of the rules under the Act can be purchased at the Patent-office sale department, Cursitor-street, Chancery-lane. It will not be possible to place the forms for application under the Act for sale at various post-offices before the 29th December, but any persons, if they think fit, may prepare forms in manuscript in conformity with the rules.

THE FIRST PROFESSOR OF NAVAL ARCHITECTURE.—Mr. Francis Elgar, naval architect, of the city of London, has been unanimously elected to the Chair of Naval Architecture in the University of Glasgow, which was recently endowed by the widow of the late Mr. John Elder. Mr. Elgar is a Fellow of the late Royal School of Naval Architecture and Marine Engineering and a member of the Council of the Institution of Naval Architects. He has had great experience in the design and construction of warships for the British and foreign navies, and also of mercantile vessels. He investigated the causes of the disasters which befel the Daphne and Austral, and upon his evidence the rulings were based at the official inquiries in both cases. The new Professor is the first who has been appointed to a University Chair in this country on account of his attainments in the science of naval architecture.

THE INSTITUTION OF CIVIL ENGINEERS.

The annual general meeting of Corporate Members was held on Tuesday, the 18th of December, Mr. Brunlees, F.R.S.E., President, in the chair, to receive a report from the outgoing Council on the state and condition of the Institution, and on the principal matters that had engaged their attention during the now expiring year.

It was stated in the report that, owing to the policy pursued by successive Councils, the Institution had become one of the most successful and prosperous of scientific societies, not only financially, but also in respect of the amount of professional knowledge diffused by its publications. The constitution was now sufficiently broad to include as Corporate Members all persons who had acquired eminence in the profession, or who, by their training and experience, were entitled to be considered civil engineers, whatever branch of engineering they might follow. The changes that had occurred in the several classes composing the Institution, irrespective of the Students, had included the transfer of 40 Associate Members to the class of Members, and 4 Associates to that of Associate Members; the election of 1 Honorary Member, 41 Members, 223 Associate Members, and 15 Associates; and the restoration to the register of 3 Associate Members. The deductions arising from deaths, resignations, and erasures had been:—1 Honorary Member, 33 Members, 25 Associate Members, and 21 Associates. The net result, therefore, was an increase of 48 Members, and of 165 Associate Members, with a decrease of 10 Associates, the Honorary Members remaining the same. The gross number on the books was 3588, as against 3385 twelve months ago, being an increase of 203, or at the rate of 6 per cent. During the session 81 Students were elected Associate Members, and 175 candidates were admitted. The number of Students now on the books was 722, as against 707 at the corresponding period last year. With respect to the constitution of the Council, a memorial had been received from some of the leading Members practising in India, the most important point of which memorial was to ask the Council to convene a special general meeting of Corporate Members for considering and, if approved, of enacting a new bye-law to enable members resident in India to return one member to the Council, and to effect the election by a use of voting papers. Upon this memorial legal advice had been taken. The Council, in their reply to the memorialists, while agreeing that arguments might possibly be adduced in favour of an election of the whole Council by means of voting papers, stated that no satisfactory argument could be advanced in favour of this being done by one section of the members, and that they were therefore not prepared to memorialise the Crown for a supplemental charter embracing such a provision. It was stated that the large income now received was simply the result of growth in numbers, and was not due to an increase in the subscriptions, which remained the same as in 1837, when the present scale was adopted, while the material advantages offered had, in the interval, increased tenfold. For five years the accounts had been so set forth as to show at a glance on the debit side the three items of income proper, capital, and trust funds, while on the credit side had also been given under three heads, the general expenditure, investments, and trust fund disbursements. Five years ago these totals amounted to £14,230 for receipts, and £14,450 for expenditure; this year they were £17,578 and £17,431 respectively. The excess of income proper for the year 1883 over 1882 amounted to about 5⅛ per cent. Last session there were twenty-four ordinary meetings, at which sixteen papers were read and discussed, the President's inaugural address occupying one evening. A feature in the "Minutes of Proceedings" which had not, perhaps, attracted general attention, was the wide geographical range of the countries whose engineering had been dealt with, either in the character of communications read and discussed, of selected papers, or of abstracts from foreign sources. There was no civilised country—from Japan in the far East to California in the far West, from New Zealand to Norway, the public works of which had not been referred to; and in several cases, as, for instance, the paper "On the Mineral Resources of Tonking," information had been given which, in addition to its professional importance, was of great general interest. In the same way matters of moment to all classes of engineers, to naval architects, and to the great manufacturing industries of the country, were contained in these volumes. On the other hand, several of the communications proved that the reproach, so long levelled against English engineers of neglecting theory, was no longer true. The foreign abstracts had also borne good fruit in this direction by indicating the progress of engineering science abroad, thus inciting the members to record the results of their original researches. For some of the original communications submitted to the Institution Telford medals and premiums were awarded to Messrs. R. H. Tweddell, G. H. Darwin, W. Anderson, Major Allen Cunningham, R.E.; and A. Leslie. Telford premiums to Messrs. J. G. Gamble, P. O'Meara, W. Morris, J. Fernie, J. Daglish, Professor Dr. J. Weyrauch, T. C. Fidler, C. H. Moberly, J. Standfield, W. C. Unwin, J. Harding, and C. F. Tufnell; and the Manby Premium to Messrs. T. B. Lightfoot and J. Thompson. The subjects treated at the special meetings of students were of a fairly varied character. Of the nine papers then read and discussed two had been thought worthy of printing in the "Minutes of Proceedings," and five of the authors had received Miller Prizes, these being Messrs. H. J. Eunson, P. V. Appleby, A. Beckwith, T. S. Lacey, and H. H. Parkinson. The Council expressed regret that no paper had been received of sufficient importance to deserve a Miller Scholarship. The Howard Quinquennial Prize for 1882 had been unanimously awarded to the late Sir William Siemens in consideration of his important discoveries, and of the valuable improvements he had effected in the manufacture of iron and steel. The Council had had under consideration a memorial from several non-resident Members, urging that the date of the annual general meeting as fixed by the bye-laws, viz., the Tuesday previous to Christmas Eve, was inconvenient, especially when the Tuesday was closely followed by Christmas Eve, as it would be in 1884. It was suggested that if the meeting were held at the end of the session—in May or June—it would enable many more country members to attend, and might at the same time be equally desirable in other respects. The Council had on several occasions carefully discussed the whole question, with every desire to meet the views of the memorialists, but had felt compelled to arrive at the conclusion that the balance of advantages was in favour of the present practice. Reference was then made to the course of six lectures on "The Practical Application of Electricity," which had been delivered by as many lecturers, all of whom belonged to the Institution and to the Royal Society, and whose services and those of their assistants were given gratuitously. The Council felt assured that the members would fully appreciate the amount of time and labour required in the preparation of such lectures. These were highly successful and attracted crowded audiences; so much so indeed, that many persons who wished to be present were excluded for want of accommodation. The Council had arranged for a second series during the current session on another of the "Great Sources of Power in Nature," namely, "Heat in its Mechanical Application." It was intended that these discourses on electricity and heat should be printed and issued to the members. The invested funds of the Institution now amounted to £43,250, and of those under its charge as trusts to £14,642, together £57,892. Of these funds £16,893 were in Government 3 per cents., and the remainder in 4 per cent. Debenture Stocks of the leading British railway companies. In conclusion, the Council thought that whether regard be had to the primary object of the Institution—the advancement of the science of civil engineering—or whether it be had to the growth of the Institution and to that of its funds, they might be looked upon as having faithfully discharged the trust confided to their care by this corporation.

After the reading of the report, the President presented the Telford Medals, the Telford and Manby Premiums, and the Miller Prizes for 1883, and the Howard Quinquennial Prize for 1882, to the several recipients. The adoption of the report, having been moved and seconded, was, after discussion, agreed to. Cordial votes of thanks were then passed to the President, to the Vice-Presidents and other members of the Council, to the auditors, to the secretaries, and to the scrutineers for their several services.

The scrutineers reported that the following gentlemen had been duly elected to serve on the Council for the ensuing year:—President, Sir J. W. Bazalgette, C.B.; Vice-Presidents, Sir Frederick Bramwell, F.R.S., Mr. E. Woods, Mr. G. B. Bruce, and Sir John Coode; other Members of Council, Mr. B. Baker, Mr. J. W. Barry, Mr. G. Berkley, Sir Henry Bessemer, F.R.S., Mr. E. A. Cowper, Sir J. N. Douglass, Mr. C. D. Fox, Mr. A. Giles, M.P., Mr. H. Hayter, Mr. W. Pole, F.R.S., Mr. W. H. Preece, F.R.S., Sir Robert Rawlinson, C.B., Sir E. J. Reed, K.C.B., M.P., Sir W. Thomson, F.R.S., and Sir Joseph Whitworth, Bart., F.R.S.

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

(From our own Correspondent.)

The gathering of ironmasters on 'Change this—Thursday—afternoon, in Birmingham, plainly indicated that the holidays are, wherever possible, being prolonged through the whole of this week. It was reported that a few sheet mills restarted on Wednesday night, and that at some other works the forges will be set on today; but most of the works will remain shut down until the beginning of next week. Proprietors have been less successful than they had anticipated in getting specifications from the galvanisers and others to make early deliveries.

The quarterly meetings are fixed for January 9th in Wolverhampton, and the following day in Birmingham. At these gatherings it is anticipated that marked bars will be re-declared at £8 2s. 6d. to £7 10s., and sheets and plates, rolled by the same houses, at £9 per ton. There is certainly not the remotest probability of a 10s. advance—marked bars always move up or down by at least this figure—and it is pretty much agreed that there is no room for a 10s. drop. The Earl of Dudley's single best bars are therefore likely to open the January quarter at £9 10s. per ton, double best at £11, and treble best at £13. Simultaneously his lordship's rivet and angle iron is likely to remain at £10 10s. for single best, £12 for double best, and £14 for treble best. Common T-iron rolled at his lordship's works will be £9 2s. 6d.; and angle iron quotations as here:—Common, £8 12s. 6d.; single best, £10; double, £11 10s.; and treble best, £13 10s.

The other leading houses in the trade will take their cue from Messrs. William Barrows and Sons. The best crown bars of this firm will, it is believed, be re-announced as £9 per ton, and double best £10. Crown plating bars, £8 to £9 10s., according to quality; best scrap bars, £9 to £10; best angle, T, and rivet iron, £9 10s. to £10 10s.; and best swarf iron, £10 10s. "Bloomfield" hoops, of from 14 to 18 w.g., will most probably be £8, and best hoops, £9 10s. These quotations will regulate the prices of other best hoop makers.

Sheets for galvanising and merchant purposes were very variously priced this afternoon, 20 w.g. for galvanising generally fetched £7 5s. at the works, or £7 15s. delivered Liverpool; 21, 22, 23, and 24 w.g. were quoted £8 2s. 6d. by good makers, delivered Liverpool, but some second-hand makers did not refuse orders at £8; 25, 26, and 27 w.g. were priced at £9 2s. 6d. by best makers, and £9 by second-class makers.

The output of sheets continues to increase. This week an ironworks which has been standing some time at Westbromwich, but which has now been remodelled, has been set going again by Messrs. J. W., Z. W., and John Onions Bros., who will trade as the Greets Green-street Iron Company. Three mills altogether will be by and by in operation, and thin sheets of, say, 27 and 28 w.g. will mostly be rolled. The firm enter upon the works with an extensive practical experience of the sheet trade, and the senior partner was up to a while ago manager at Messrs. Smith and M'Lean's Eartosh Ironworks, near Glasgow, where sheets are the staple product. The new plant and machinery has been supplied by Messrs. J. and S. Roberts, engineers and ironfounders, Swan Village.

Next week a guide mill which has been lying idle will be restarted at Millfields, Bilston, by Messrs. J. and W. Saunders, of Deepfields, but there is no forge attached.

Prices of small iron of this description favoured buyers to-day. Hurdle bars were obtainable at as low as £5 16s. per ton at works, and common smithy bars at £6. £6 5s. could scarcely be called the minimum for strip iron, and hoops were to be had from some makers at less than £5 10s.

Business in angles is prejudiced by the competition from the North of England. Now that the shipbuilding demand is slackening, angles rolled in that part of the kingdom are offered here for merchant purposes, and the difference in price is securing sales. Although the railway freightage rate from Middlesbrough is 15s., Northern angles are to be had here at 10s. per ton under the terms which certain Staffordshire firms are asking.

Pig iron is stagnant this week. Prices remain at 62s. 6d. to 60s. for all-mine hot-blast sorts, and 85s. to 82s. 6d. for cold blast. It is noteworthy that the price of specialty foundry pigs is rising. The representative here of the Blaenavon Iron Company announces this week an advance in the prices of its make of cold blast iron of 10s. per ton, bringing the price delivered in this district up to £6 15s. The rise is attributable to the increased demand for the commodity, but the quantity selling hereabouts is very small, and is confined to the best ironfounders, who use it as a mixture for special work.

The Blaenavon Company claims for these pigs that their actual analysis shows that they are only second in quality to charcoal pigs. They are made from the company's argillaceous ores, and are smelted with a seam of charcoal coal which they mine exclusively for this purpose. The quantity made is very limited, only one out of the company's eight furnaces being employed on this iron. Prominent among the buyers of these splendid pigs are our Government, who have used them for a great number of years past.

The Blaenavon Company anticipates, I am told, doing an increased business with this district in Bessemer steel bars for edge tool purposes, when, in January, it shall have commenced the manufacture of steel with its new plant, which it has been putting down for the past seven months or so.

Scrap iron is coming into South Staffordshire in large quantities and in various forms from the Principality. For steel shearings middlemen demand 57s. 6d. per ton, but it is difficult to realise much more than 56s. The figure at which middlemen buy leaves vendors about 45s. or 46s. per ton at works in Wales—which is none too much.

The galvanised iron roofing manufacturers are moderately well supplied with orders, but the profits they are realising are becoming less by reason of growing competition.

There are some good inquiries for agricultural machinery for export, and all kinds of pulpers, crushers, &c., are in demand on home account.

Machinists do not report so good a demand as some months ago for new plant for galvanised corrugated sheet iron manufacture. Nevertheless there are here and there some fair orders of this description under execution, and additions and repairs to plants already existing are finding work for the hands. Engineers are curious just now as to who will secure the contract for the new galvanising works which, as I last week announced, is soon to be laid down at Wolverhampton. But although quotations have been submitted by some local firms, no definite selection has, it is believed, yet been made.

An important contract for heavy ironfounding and engineering work is now in course of completion at the extensive ironworks and ironfoundry in Wolverhampton of Messrs. Bayliss, Jones, and Bayliss. It is for a large portion of the machinery and millwork which is being laid down at Jarrow-on-Tyne by the new Hive Sheet Iron Company. The spur gearing is of good size, the average weight of the wheels being about 10 tons each. The flywheel weighs in the aggregate 63 tons, the rim weighing 40 tons and the arms 23 tons. This wheel, together with other parts of the contract, has just been despatched. The rim is rectangular and is of 27ft. diameter, and was cast in 10 ton segments. The arms are elliptical and were made in one casting, the time occupied in running being less than two minutes. The molten metal was supplied from one furnace and three cupolas which are erected in the foundry a few yards away from the casting pit. For the convenience of railway carriages the arms have had to be split in two, and the segments will be held together with strong dowels of best hammered iron and cotters, and on each side of the boss will be weldless steel hoops 4½in. square. The castings are clear and sound and all the edges are well defined. Messrs. Bayliss have also on order the silling and other wrought ironwork required to put the plant together, and this part of the contract will weigh about another 40 or 50 tons. To ensure a perfect fit, the work is put together on the ground before despatch to the North.

The safe makers are busy, both on home and foreign orders, and at some of the establishments the work in hand is of a heavy class. When, the other day, at the Highfield Works, Bilston, of Messrs. Thomas Perry and Son, I saw some large safes which were going away to New South Wales, and also a massive one, measuring 7ft. high by 5ft. wide and 3ft. 6in. deep, weighing nearly three tons, which was to the order of the Wednesbury Local Board for their offices. I may add that in their bedstead department the same firm have just executed, and have also now in hand, valuable orders for South America, and that they are fairly busy with the home trade too.

The railway fastenings trade, such as chairs, dog and twisted spikes, brobs, bolts, machine-made nuts, and the like, is reported by the leading makers quiet at date.

Gratification is this week expressed at the telegraphic news of the continued indications of a revival in the Australian demand.

The strike amongst the nail makers of the Lye, Hales Owen, and Old Hill districts for an advance in wages has terminated, a compromise having been effected.

Some surprise has been occasioned by the notice which, it is understood, has been posted at the Patent-office that patentees who have already paid the £50 stamp duty, due before the end of the third year, will not have the option of paying the remaining £100 by instalments, as provided for in the case of patents under the new Act, but must pay it in a lump sum before the end of the seventh year if they wish to renew their patents. To inventors hereabouts such notice appears inconsistent with the second schedule of the new Act, which seems to them to permit of this duty being paid by annual instalments, amounting in the aggregate, however, to £120 instead of £100. It is not yet clear that any representation will be made to the Office which might lead to a withdrawal of the notice.

In reply to a communication from the Derby Chamber of Commerce, the Board of Trade have written that it is not their intention under the new Act to attempt any official determination of the originality of a patent, since, as was pointed out in Parliament, such determination would not prove satisfactory to inventors or to the public.

As to the use of the Royal Arms as an ornament upon ranges and stove-grates and other articles, the department, "while not binding themselves as to their future policy," state that they have no intention, as at present advised, of attempting to enforce the provisions of the new Act in the case of these manufactures. This answer is deemed very satisfactory.

In view of a probably increased trade between this district and Spain if the negotiations for a new treaty should be brought to a successful issue, the Chamber of Commerce of Wolverhampton have forwarded a memorial to the Spanish Consul-General asking for the appointment of a vice-consul in the town.

Among the total of 295 private bills to be presented to Parliament during the ensuing session is one by the Birmingham Compressed Air Power Company. This company describes itself as proposing to supply compressed air for distributing motive power from one or more centres to manufactories, furnaces, and works, and to supply air for ventilating, refrigerating, or blowing furnaces. Messrs. Arthur J. Capel, Ernest Ibbetson, D. Geo. Sandemann, and J. C. Macdona, are named as original promoters, and the capital of the company is put down at £300,000 in 30,000 shares of £10 each.

NOTES FROM LANCASHIRE.

(From our own Correspondents.)

Manchester.—There has been very little business doing during the past week owing to the holidays. There was no meeting on either the iron or the coal exchanges on Tuesday, business in both cases being postponed until the Friday, and iron and engineering works have in many cases been closed from the Saturday until the Thursday, with collieries closed for one and two days as a rule.

Where any business has been done in the iron market prior to the holidays prices, so far as local and district brands of pig iron are concerned, have been fairly steady, makers having held for late rates in any orders that have been given out. With the close of last week moderate sales of Lancashire pig iron were made on the basis of 45s. less 2½ delivered equal to Manchester, and one or two fairly large lots of Lincolnshire forge iron were bought to renew contracts at prices equal to 44s. 10d. less 2½ delivered at Manchester. Scotch and Middlesbrough irons have been offered at low figures without, however, inducing any material accession of buying beyond what consumers have taken for special requirements. Generally, however, it would not seem to be so much a question of price as of probable requirements, and in most cases large consumers are holding back until the January quarterly meetings, when they will be better able to judge as to the prospects of next year's trade.

The hematite trade continues in a very depressed condition; there are offers in the market, and in one or two cases for fairly large quantities; but these are at prices so miserably low that makers are not inclined to accept them.

In the finished iron trade there have been very few orders given out, and these only at low prices. Good Lancashire and North Staffordshire bars can now be bought at £6 2s. 6d., with inferior brands at £6; hoops, which are being pressed in the market, are to be bought at as low as £6 5s. to £6 7s. 6d.; and sheets at £7 15s. per ton delivered into the Manchester district.

In the coal trade there has, up to the holidays, been a generally steady business doing in all classes of round coal. There has not been any actual pressure, but the orders coming in have taken away all the output of the pits, with a little filling up out of stocks in some cases. House fire consumers have, of course, been anxious to get in their supplies prior to Christmas and the New Year, and the commoner classes of round coal have been going off well for furnace and iron-making purposes; but burgy and slack have been only in moderate demand for engine purposes. With the closing of works during a portion of the present week there is, of course, only a limited demand for manufacturing classes of fuel, and in these trade will only be quiet until after the turn of the year. Prices remain without alteration, and at present there is no indication of any change with the close of the month—certainly not in an upward direction. At the pit's mouth best coal averages 10s. to 10s. 6d.; seconds, 8s. to 8s. 6d.; common, 6s. to 7s.; burgy, 4s. 6d. to 5s.; best slack, 3s. 9d. to 4s. 3d.; and ordinary qualities, about 3s. 6d. per ton.

In the hematite trade prices have shown a persistent downward tendency all through the year, and they have not, for a very long

period, touched so low a point. Makers at the commencement of the year were asking about 62s. 6d., less 2½ per cent., for good foundry brands delivered equal to Manchester; but gradually they had to give way until, about September, as low as 56s. to 56s. 6d. was taken for some considerable foundry orders, and the year closes with this branch of trade in a miserably depressed condition, with no present indication of improving values.

A downward tendency in prices has also characterised the finished iron trade during the year. The basis of prices upon which makers were quoting when the year opened was about £6 10s. for bars delivered into the Manchester district. They were, however, unable to secure orders at this figure, and as contracts which had kept them going ran out, concessions of from 2s. 6d. to 5s. per ton were necessary to secure new business. These concessions, however, were only regarded as a prelude to a further downward movement, and merchants began to undersell freely, until prices got down to about £6 2s. 6d. and £6 5s. A firmer stand was, however, made by manufacturers than buyers had evidently anticipated; the market showed a tendency to rally, and undercelling was checked, with the result that it was difficult to place orders at under £6 5s. A steady business ensued, and makers endeavoured to hold for £6 5s., but gradually sellers again came into the market at £6 2s. 6d., and business kept pretty much on this basis, until the Staffordshire strike gave another temporary stronger tone to trade. The stoppage of the Staffordshire forges transferred a considerable weight of business into this district; the local ironworks got filled up with orders. There was a general pressure for prompt delivery, and prices hardened up to £6 5s. and £6 7s. 6d. for bars, with hoops fetching £6 12s. 6d. to £6 15s., and sheets £8 5s. to £8 7s. 6d. per ton, delivered equal to Manchester or Liverpool. The chief pressure was caused by the requirements for shipment, and with the termination of the Staffordshire strike and the close of the shipping season, there was a rapid quieting down in trade, with a gradual giving way in prices, which with the close of the year do not average more than £6 to £6 2s. 6d. for bars, £6 7s. 6d. for hoops, and £7 15s. for sheets, delivered equal to Manchester.

In the coal trade business has been fairly steady during the past year, with prices certainly no worse, and in some cases a shade better than those obtained during the previous twelve months. Against this, however, colliery proprietors have been handicapped by an advance of 10 per cent. in wages conceded in November, 1882, which has not been covered by the slightly better prices which to a limited extent they have been able to realise. Practically prices of round coal have not varied much more than 1s. per ton during the year, and engine fuel not more than 6d., and the closing prices are much the same as those with which the year opened. One of the chief features during the year has been the colliers' agitation for an advance of wages, and this has had no inconsiderable influence upon the course of trade. Before the autumn set in the certainty that the colliers would with the close of the year commence an agitation for an advance of wages had its influence upon the market. Colliery proprietors were very chary about entering into contracts except at prices which would cover the risk of a strike or advanced wages, and so general was the feeling of uncertainty with regard to the future that it had a material effect upon the basis upon which contracts were taken. In the gas coal contracts, although there were a few sellers over two or even three years, the bulk of the colliery proprietors were not willing to go further than twelve months, and advances upon the previous year's prices were asked, but these were only obtained to a very limited extent. In the railway contracts an effort was made to obtain an advance of 1s. per ton upon the previous year's prices, and although this was not successful, owing to the competition for the contracts which shut out one large firm that held for the advance price, a large proportion of their annual contracts, amounting to about 100,000 tons, still an advance of something near 6d. per ton was obtained. The complete collapse of the miners' agitation is, of course, a matter of such recent occurrence that I need not further refer to it; the result has been that not only has all further upward tendency in prices disappeared, but there has since been some giving way, and very much will now depend upon the weather and the development of trade as to how far present rates can be maintained.

Barrow.—The hematite pig iron market in this district, for a long time in a very unsatisfactory and unsettled state, shows no sign of reviving. Sales are very few indeed and at such prices as to make the transaction of no value to the seller. The output of metal from the furnaces has been reduced, and in some cases considerably so; but notwithstanding this fact a very heavy tonnage is going into stock and will continue to do so, so long as the market maintains its present dull position. Steel makers are the principal users of hematite iron just now. Prices are unchanged, last week's quotations still ruling. The expectation which is indulged in in some quarters, that trade will revive with the New Year, does not give much promise of being realised. At present I cannot see the faintest indication of such a thing. Steel makers are steadily, though not busily, employed. Prices are still quoted at £4 10s. to £4 15s. per ton for ordinary heavy sections. Iron ore dull at unchanged rates. Coal and coke steady. Iron shipbuilders are likely to have an order or two shortly.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

1883 has been a most disappointing year. It opened with every expectation of trade slowly but steadily reviving, and it closes with business languid, prices lower than they were at the opening, and, except in one or two departments, no particularly bright prospects for 1884. The backbone of local industries—steel and iron—have been depressed of late to an extent which has made itself felt all round. In January, hematites suitable for Bessemer and Siemens purposes, were at 62s. per ton, a price which was maintained up to March; then the value dropped, and continued dropping till the date on which this is written—Dec. 26th—when the quotation for hematites is 55s. In January, 1882, the prices were from 72s. to 74s., and during the year they fell to 62s.; but in the previous year they opened as high as £6 10s. to £7 per ton. This was entirely owing to the great demand which set in from America—a "boom" which collapsed in a month or two, and prices have been falling ever since. Cold blast irons, which opened at £4 10s., have fallen to £4 7s. 6d. and £4 5s.; common forge irons have been lowered in value by 2s. during the year.

Steel rails were fairly called for by home companies at the beginning of the year at about £5 per ton. It is now hard to secure orders at £4 5s. There has been a steady decline all the year. The Midland Company is having rails made at Workington and delivered at Morecambe, its nearest station. Of course It will have its rails a few shillings per ton cheaper, but the lower quotation is not all gain. It loses the carriage of the raw material to Sheffield as well as the carriage of the manufactured product. In its own case the latter item may not amount to much, but it cannot afford to pull even its own rails for nothing, and in other contracts it may be doubted if it does not make a loss in encouraging the production of steel rails at the coast.

Armour-plates have been in brisk demand during the whole of the year, and both local firms engaged in their production are well off for 1884. Railway wagons are also in good request; but in tires and axles the German producers are running English makers very close, and in some instances have under-quoted them in northern markets.

The cutlery manufacturers give rather various reports of the year's trading. During the first seven months there was a good call for all markets. Then orders dropped off, and during the later months of the year the leading establishments have not been able to do more than keep their men going; to do this it has been necessary to make largely for stock. If cutlery manufacturers had felt so disposed, they might have been able to secure reductions in wages, for the workmen have been literally at their mercy. Except in two instances there has been no alteration in wages during the year. One large firm engaged in the American trade—chiefly in the Western States—has been obliged to reduce their hands, and even with the lessened staff are now very quiet. Though all markets are reported to be dull, the languor is chiefly owing to the United States, where, in addition to general depression, the political contests are fought so keenly as to seriously interfere with business. This year the "fall" orders have come so late that they cannot be executed this year, and will help to give a fillip to the beginning of 1884. Cutlery firms anticipate a brisker spring trade. Stocks in dealers' hands must have been worked down to the lowest limits, and supplies cannot be much longer delayed. Already several nice orders have emptied a few shelves.

A very heavy contract for cutlery was recently placed with two local firms. An old-established company determined to see if price would carry the work—cut their quotations down to a merely nominal profit—in fact, no profit at all. They lost the contract by 1s. per dozen. It was a big thing, being for ten New Zealand steamers; but cheapness, even with the reputation of a great house against it, carried the day by the mere feather-weight of 1s. per dozen.

Generally the cutlery and electro-plated manufacturers complain of a poor Christmas trade at home. Orders are now coming in from Australia. Messrs. Lockwood Bros.' cutlery works, Arundel-street, have received a very extensive order for ivory table knives for Australia. Messrs. John Sorby and Sons have also been favoured with a good line for the same market in sheep shears.

It is impossible now to tell accurately the course of Sheffield trade with America, as the United States consuls, by a recent order, have been forbidden to supply statistics of exports. I am in a position, however, to give some indication of what has been done in 1883. There was a heavy demand for cutlery in January, but February, March, April, and May were all "poor." A sudden bound took place in June, owing, in a considerable measure, to a great call for razors before the increased duty of 10 per cent. came into operation in July. The second quarter showed a better demand for steel than the first, but there was a decided falling off in the third quarter. The exports of cutlery to the United States during 1883 were less in value by £20,000 than in 1882, and in steel the falling off was equal to £100,000. On the whole year the trading shows a decline of £450,000. This looks an alarming amount, but the gravity of the fact is somewhat abated by the qualifying statement that in 1882 there was a rush for Bessemer steel rails, which were exported to the value of £500,000, while in 1883 the States took not much more than one-third of the amount.

Coal has been fairly called for in house, steam, and gas qualities, and prices have slightly improved; but in all other sorts there has been a heavy drop. Though the threatened strike is for the moment averted, the Derbyshire and Yorkshire colliers seem disposed to try for 10 per cent. At a conference of miners recently held at Chesterfield, it was stated that the men employed at Butterley had been granted an advance of 2d. per ton, and that at six collieries in that district, employing about 2500 hands, 10 per cent. advance had been already conceded. This will make a lever for the delegates at the Manchester conference, to move the miners to fresh action elsewhere.

This week is being held as holiday time. Boilermakers and others are busy doing repairs to machinery in the various works; and in Brightside and Attercliffe, owing to the cessation of smoke, it is possible to see the sun at noonday.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

THERE is but little to report this week with respect to the Cleveland iron trade. Business is almost at a standstill and will be so until the termination of the holidays. Buyers hold back their orders, except for small and pressing lots, and even these they are now able to place with merchants, at lower rates than those which ruled last week. No. 3 g.m.b., has been sold at 36s. 3d. per ton for prompt delivery, and grey forge at 34s. 9d. Makers ask 3d. to 6d. per ton more for No. 3, but rarely meet with success, as consumers show little disposition to buy ahead.

Nearly all the manufactured ironworks are closed this week for stocktaking and repairs. The prospects of the immediate future are far from encouraging. Fresh orders are scarce, though prices have been considerably reduced, and it is not unlikely that some of the mills will have to work short time, unless an improvement takes place soon, as old contracts are mostly nearly complete. The quotations for finished iron are as follows:—Ship plates, £5 15s. per ton; shipbuilding angles, £5 10s.; and common bars, £5 12s. 6d., all free on trucks at makers' works, cash 10th, less 2½ per cent. Puddled bars are £3 10s. to £3 12s. 6d. per ton.

The steel rail trade remains in a very depressed condition. It is said that orders for heavy sections have been placed below £4 2s. 6d., but the general quotation is £4 5s. per ton.

An action under the Employers' Liability Act was last week brought against Messrs. Andrew Leslie and Co., iron shipbuilders, of Hebburn Quay, by a rivetter named Skelly in their employ for injuries received through a defect in the plant, whereby he fell down into the hold of a vessel on which he was working. Skelly claimed £250. The jury found there was a defect in the scaffolding, and awarded him £80.

During the present year Messrs. R. Dixon and Co., of Middlesbrough, have built seventeen vessels, the total tonnage being 31,017, and the horse-power 3220. Messrs. R. Craggs and Sons have launched five vessels of 4780 tonnage, whilst Messrs. W. Haskess and Son have turned out a total tonnage of 2650. At Stockton Messrs. Richardson, Duck, and Co. have launched twelve vessels, the aggregate tonnage being 21,413, and the horse-power 1780. Messrs. R. Irvine and Co., of Hartlepool, built six steamships, with a tonnage of 8269 and 780 horse-power; and Messrs. T. Turnbull and Son, of Whitby, turned out eight steamships, of 13,662 tons and 1170 horse-power.

Dr. Spence Watson, of Newcastle, has signified his acceptance of the responsible position of referee in the approaching arbitration in the manufactured iron trade. Dr. Watson has never before so acted, and does not profess to have any special knowledge of the business. But he agrees because selected uuanimously by both parties to the dispute, and because he hopes to be the means of restoring harmony between employers and employed in a great and important industry. Both secretaries are now very busy preparing their respective cases. There is a strong feeling outside this particular trade that the employers and employed within it would be wise to unite in trying to cheapen the cost of production. Prices have fallen and are still falling in spite of the desires and efforts of both to prevent them. The alternatives are not, therefore, high prices and good wages on the one hand, and low prices and bad wages on the other hand. They are rather either low prices and low wages, or idle works and no wages at all. However, the members of the Board of Arbitration have done wisely to refer to a third person the difficulty they appear to have been unable to agree upon among themselves. It is to be hoped that Dr. Watson will maintain, as a man of sense and judgment, and as a political economist, the high reputation he has long enjoyed as a political leader.

Messrs. R. Hill and Co., of the Middlesbrough Wire Works, have just secured a large order for steel wire—600 tons—for the new Atlantic cable. The wire will be tempered so as to stand a tensile strain of 60 tons per square inch, and will be made from ingots produced by the Acid Bessemer, or Siemens process. This order will occupy the first six months of next year to execute. Messrs. Hill and Co. are thus very differently situated from their neighbours in the iron trade, for very few of the latter can see how they are to obtain employment beyond even the month of January.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

THERE has been comparatively little business in the Glasgow iron market this week, owing to the holidays. The main feature of interest has been the issue of the annual statistics of the pig iron trade. These were looked forward to with considerable difference of opinion, particularly as regards the amount of the stocks remaining in hand. The quantity in Connal's stores was, of course, well known, being reported on 'Change day by day; but it is only once a year, at Christmas, that anything like certainty is attained with reference to the quantity of pig iron held by makers in their private yards, as it is then only that official figures are issued. The makers had a meeting on Friday afternoon, and the statistics then made up were, as regards the stocks, a disappointment. Instead of showing a decrease, more or less important, they actually disclosed an increase of 24,416 tons. The decrease in Connal's stores was very little greater than that amount, so that the new year practically begins with the aggregate stocks at the same figure as at the commencement of 1882. The approximation in the outputs of 1882 and the year now closing is also remarkable, there being only the small increase of from 2000 to 3000 tons in favour of the present year. A committee of the Association of Iron Merchants and Brokers, who prepare their annual statement and obtain returns of the consumption in the malleable works and foundries and other items of importance in addition to those issued by the ironmasters, issued their report on Wednesday, and the information conveyed in both reports is embodied in the following tabular statement:—

	1883.	1882.	1883. Increase.	1883. Decrease.
	tons.	tons.		
Production	1,129,000	1,126,000	3,000	
Consumption:—				
In foundries	235,000	288,030		
In malleable and steel works	248,000	297,000		
Quantity of malleable iron and steel made — 1883, 427,000; 1882, 474,000	483,000	585,000		102,000
Exports:—				
Foreign, 419,612—less English iron transhipped (estimated), 4000	415,612	432,175		
Coastwise	204,045	184,021		
Railway to England	27,343	28,804		
	647,000	645,000	2,000	
Stocks:—				
In Connal's stores	584,138	608,604		
Quantity in makers' hand	250,862	227,396		
	835,000	836,000		1,000

	1883.	1882.
Average price M/n warrants	46/9	49/4½
Average number of furnaces in blast	110	108
Number of furnaces in blast on 25th December	103	112
Number of furnaces existing	148	148
Imports of English iron by rail & water—tons.	*432,000	345,000
Lowest price touched in 1883	43/6	
Highest price paid	49/3½	

Last year the consumption of English iron in foundries was 135,000, and in malleable iron and steel works 160,000 tons. It will be interesting to state that all classes of pigs have materially declined in value during the year. The special brands have fallen from 10s. to 12s. 6d. per ton, g.m.b. 4s. 6d., and warrants about 5s. 6d. per ton. The new year will begin with somewhat moderate prospects, but there is the hope that in its course better returns may be obtained by those engaged in the pig iron trade.

Business was done in the warrant market on Friday at 43s. 8d. per ton. The market was closed till Wednesday, when owing to the unfavourable annual statistics, warrants fell to 43s. 0½d. On Thursday—to-day—the warrant market was very depressed, and quotations fell to 42s. 10d. per ton. It is not expected that much business of importance will be done in the market during the coming week.

The malleable iron engineering departments have been fairly active during the week finishing up work preparatory to the New Year's holidays, which will extend over the greater part of next week. The past week's shipments of manufactured articles from Glasgow embraced machinery to the value of £20,000; steel goods, £14,300; sewing machines, £3588; and iron manufactures, £31,970.

The coal trade has been busy during the week, but will now display scarcely any activity for a week to come.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

THE coal trade of last week was one of almost unexampled briskness, the colliers labouring well to get up a good total to their credit for holiday enjoyments, and coalowners pressing to complete their orders. The total shipments from the principal ports amounted to 200,000 tons, exclusive of coastwise shipments, and of this Cardiff alone despatched 150,000 tons. The excessive traffic on the Taff Vale was conducted without a hitch, the trains being almost continuous.

I am glad to note another generous concession on the part of the Bute Docks management. This is the taking away of all charges for siding accommodation at the docks. The Roath sidings of the Taff Vale being complete, have relieved the Bute Dock sidings, and at once there is a generous action to shippers. This is purely apart from all Barry Dock questions. Mr. W. T. Lewis concedes the siding rate in pursuance of an open-handed policy, not with a view to disarm. He is well aware that if it can be shown the Barry promoters that they will benefit pecuniarily by abandoning their scheme, they will do so, not otherwise. The battle pending will be one of a vigorous character. The cost of a line of railway to Barry went in costs in last contest, viz., £60,000. Sir Geo. Elliott, who, like northern coalowners, has a strong dash of the sailor in his composition, invited the whole of the officers and crews of all the vessels in Alexandra Dock, Newport, to a sumptuous dinner on Christmas Day.

Prices remain firm for all descriptions of coal. Four-feet fetches 11s. easily. Rhondda No. 3 is very stiff at 10s. 6d. Small coal is getting into better demand, and house coal of best samples is at premium prices.

This week and the next will witness some degree of falling off in inquiry, after which there will be a conspicuous brightening up for New Year's trade. Prospects at present are for a continuance of prosperity in coal. As for iron, signs are not good. Rejected rails, small rails, second brand rails are sought for freely, but orders are sparingly put in for good substantial steel rails of the old "Metropolitan" character. Possibly this slackness shown by railway and other companies is from a praiseworthy desire to exhibit good balance-sheets. With their completion a change will very likely take place. A little over 2800 tons of manufactured iron left Cardiff and Newport last week. Nearly 20,000 tons of iron ore also came in—a rather venturesome transaction, as trade in that article is very quiet.

De Bergue's plant, &c., has been cleared away, and now the shell and site of the works are to be disposed of. So runs the destiny of all the old works. In the meanwhile Cyfarthfa is outvieing the fabled Phœnix. An early start is likely. The machinery is admirable, and is being rapidly placed.

There is a dispute waging at the Llanlwil and Black Vein Collieries, Caerphilly, and the men appear resolute in standing out. The dispute is in respect of the weigher.

* Of this amount 242,000 tons has been consumed in foundries and 190,000 tons in malleable iron and steel works.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

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

Applications for Letters Patent.

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

18*th December*, 1883.

5772. Fire-escapes, D. R. Clymer, Reading.
5773. Refrigerator Cars, C. C. Palmer, Oakland.
5774. Looms, H. J. Allison.—(*C. I. Kane and R. E. Lester, New York, U.S.*)
5775. Transmitters, H. J. Allison.—(*S. D. Field, U.S.*)
5776. Cabinet Cases, &c, H. J. Allison.—(*M. J. Wine, Washington, U.S.*)
5777. Circuits, H. J. Allison.—(*C. E. Allen, U.S.*)
5778. Printing Types, H. J. Allison.—(*L. B. Benton, Milwaukee, U.S.*)
5779. Automatic Holders for Knives, &c., J. H. Johnson.—(*H. Berolzheimer, New York, U.S.*)
5780. Lactic Acid, &c., A. G. Brookes.—(*S. Nowell, Boston, U.S.*)
5781. Compounds for Marking Blackboards, &c., P. M. Justice.—(*N. F. Potter, Providence, U.S.*)
5782. Making Pottery, F. A. Magowan, Trenton, and R. M. Bassett, Birmingham, U.S.
5783. Asbestos Cloths, S. Pitt.—(*H. W. Johns, U.S.*)
5784. Gas, &c., Motors, L. A. Groth.—(*G. Daimler, Germany.*)
5785. Regulating Apparatus, W. E. Wilson, Rathowen, Ireland.
5786. Metal Tips for Boots, &c., J. S. Crowley, Manchester.
5787. Equalising Pressure, E. Edwards.—(*A. Zalm, Rotterdam.*)
5788. Treating Ores, W. R. Lake.—(*C. Cherry, sen., Chicago, U.S.*)
5789. Type-writing Machines, W. R. Lake.—(*J. B. Hammond, New York, U.S.*)
5790. Electrical Conductors, &c., H. H. Lake.—(*C. H. Goebel and G. W. Bratton, Philadelphia, U.S.*)
5791. Middlings Purifiers, W. R. Lake.—(*T. Walter, Pennsylvania, U.S.*)
5792. Printing Machines, W. R. Lake.—(*T. S. Nowell, Boston, U.S.*)
5793. Safety Pins, H. H. Lake.—(*J. Jenkins and G. P. Farmer, New Jersey, U.S.*)
5794. Poles or Standards, W. T. C. Bruce and A. Still, Liverpool.
5795. Mixing Hydrocarbons, &c., with Superheated Steam, R. B. Avery, Washington, U.S.
5796. Producing Fluid Currents, A. Lorrain, Richmond.
5797. Producing Motive-power, M. P. W. Boulton, Italy, and E. Perrett, London.
5798. Aluminium, &c, S. P. Wilding.—(*L. Grabau, Hanover.*)
5799. Torpedoes, C. A. McEvoy, London.
5800. Fabrics for Covering Umbrellas, S. C. Lister, Manningham Mills.
5801. Cleaning Seed and Grain, J. Anderson.—(*Messrs. Lyall, Gray, and Co, Calcutta.*)
5802. Production of Ammonia, &c., L. Q and A. Brin, London.
5803. Printing Machinery, G. W. Osborn and Dr. W. Yates, London.

19*th December*, 1883.

5804. Rowing Machine, M. R. Cobbett.—(*F. Howcraft, New York, U.S.*)
5805. Washing, &c., Yeast, M. Bradley, Manchester.
5806. Communicating between Persons at any Distance, G. C. Gibbs, London.
5807. Telegraph Transmitters, &c., E. A. Brydges.—(*W. F. C. M. McCarty, New York, U.S.*)
5808. Printing with Metal Engravings, T. Shields, Bradford.
5809. Regenerative Gas Lamps, F. C. Glaser.—(*J. A. Essberger, Prussia.*)
5810. Lead or Crayon Holders, P. Lawrence, London.
5811. Treatment of Hops, F. C. Glaser.—(*A. Kempe, Moscow.*)
5812. Lamps, &c., J. Rogers, London.
5813. Heating Steam Generators, F. C. Glaser, Berlin.—(*H. Hempel, Leipsic.*)
5814. Apparatus Employed for Advertising Purposes, C. S. Nelson.—(*F. Fontaine, Atalanta, U.S.*)
5815. Controlling or Regulating the Supply of Gas, &c., F. A. Pocock and E. George, London, and R. Cook, Sheffield.

20*th December*, 1883.

5816. Ships' Windlasses, W. Clarke, Gateshead-on-Tyne.
5817. Metallic Wheels, J. Hodgkins, Warwick.
5818. Machinery for Making Wheels, T. N. Robinson and J. P. Fieden, Rochdale.
5819. Card-grinding Machines, G. Hoyle, Rochdale.
5820. Raising, &c., Ships' Boats, C. Fox, Birkenhead.
5821. Working Stone, G. M. Morgan, London.
5822. Winches, W. Clarke, Gateshead-on-Tyne.
5823. Fire-arms, G. V. Fosbery, Guildford.
5824. Metallic Plastering Surfaces, A. M. Clark.—(*J. Stanley, New York, U.S.*)

21*st December*, 1883.

5825. Water-closets, J. Shanks, Barrhead.
5826. Carriages, R. Croall, Edinburgh.
5827. Transfer Designs, G. E. Laideur, London.
5828. Storing Vessels, H. J. Haddan, London.—(*L. Fritz, Memphis, U.S.*)
5829. Safety Lamp, F. W. Pittuck, Hepburn-on-Tyne.
5830. Electric Conductors, J. Kahn, London.
5831. Boat Cover Raft, A. H. Bremner, Thurso.
5832. Lighting by means of Hydrocarbon Vapour, N. L. Pouschkareff, Moscow.
5833. Converting Continuous Rotary Motion into Step-by-step Rotary Motion, C. D. Abel.—(*A. Kaiser, Freiburg, Switzerland.*)
5834. Fixing Flooring, G. Howard, Cricklewood.

22*nd December*, 1883.

5835. Compounds for Insulating, &c, A. Muirhead, London.
5836. Oil Burners, J. C. Morrison and R. Smith, London.
5837. Knitting Machines, T. Coltman, Leicester.
5838. Spinning, &c., Machinery, W. Tatham, Rochdale.
5839. Longitudinal Sleepers, &c, E. G. Holtham, London.
5840. Moulded Ornamental Articles, C. D. Abel.—(*C. W. Radeke, Berlin.*)
5841. Desiccating Wood, C. D. Abel.—(*J. A. Koch, Galveston, U.S., and W. Herre, Berlin.*)
5842. Thread-winding Machines, J. Booth and J. T. Wibberley, Bolton.
5843. Storage Batteries, H. Woodward, London.
5844. Signalling by Sound, W. B. Barker, London.
5845. Materials for Insulating, J. L. Clark, London.
5846. Grinding Ores, &c., T. W. B. Mumford and R. Moody, London.
5847. Recovering Tin from Tin Surfaces, A. P. Price, London.
5848. Fire-arms, H. F. Phillips, London.
5849. Alkalies, P. M. Justice.—(*S. Thomas, Algiers.*)

24*th December*, 1883.

5850. Treating Sewage, F. Herbert, London.
5851. Electric Clock Regulators, R. H. Brandon.—(*J. F. Kettell, Massachusetts.*)
5852. Loom Shuttles, C. H. Nichols, Boston.
2853. Pile Fabrics, J. Sillavan.—(*D. Marcon, Paris.*)
5854. Shuttles, W. Brooks and T. Tweedale, Crawshawbooth.
5855. Impregnating Wood with Protective Substances, C. D. Abel.—(*J. A. Koch, Galveston, U.S., and W. Herre, Berlin.*)
5856. Electric Batteries, W. P. Thompson.—(*J. C. Himmer, New York, U.S.*)
5857. Flue Tubes for Steam Boilers, J. J. Tinker, Hyde, near Manchester.
5858. Driving Mechanism, A. J. Boult.—(*J. C. Tennent, Glyndon, U.S.*)

Inventions Protected for Six Months on Deposit of Complete Specifications.

5773. Refrigerator Cars, C. C. Palmer, Oakland.—18*th December*, 1883.
5774. Looms, H. J. Allison, London.—A communication from C. I. Kane and R. E. Lester, London.—18*th December*, 1883.
5783. Asbestos Cloths, S. Pitt, Sutton.—A communication from H. W. Johns, New York, U.S.—18*th December*, 1883.
5793. Safety Pins, &c., H. H. Lake, London.—A communication from J. Jenkins and G. P. Farmer, Mont Clair, U.S.—18*th December*, 1883.
5834. Fixing Flooring, G. Howard, London.—21*st December*, 1883.

Patents on which the Stamp Duty of £50 has been paid.

5338. Tyeing Bundles of Chips, &c., M. Glover, Leeds.—20*th December*, 1880.
5291. Shuttles for Looms, J. H. Pickles, Burnley.—17*th December*, 1880.
5293. Furnaces, E. P. Alexander, London.—17*th December*, 1880.
5305. Forming Sheet Metal into Various Shapes, H. R. Minns, London.—17*th December*, 1880.
5306. Preventing Waste of Water in Water-closets, T. H. Goodson, London.—17*th December*, 1880.
5303. Clips for Gutter Spouting, J. Wiley, Darlaston.—18*th December*, 1880.
5313. Metallic Alloys or Compounds, G. A. Dick, London.—18*th December*, 1880.
4886. Dynamo-electric Machines, J. Hopkinson and A. Muirhead, London.—24*th December*, 1880.
5350. Manufacture of Salt from Brine, &c., J. H. W. Biggs, Liverpool.—21*st December*, 1880
5372. Manufacture of Salt, J. H. W. Biggs, Liverpool.—22*nd December*, 1880.
5500. Preventing the Shifting of Cargoes on Ships, J. Goudie, East Hartlepool,—31*st December*, 1880.
51. Working Railway Brakes, J. Imray, London.—5*th January*, 1881.
5363. Guns and Vessels, H. E Newton, London.—21*st December*, 1880.
5408. Kilns, E. E. Street, Clifton.—23*rd December*, 1880.
5442. Card-grinding Appliances, J. S. Dronsfield, Oldham.—27*th December*, 1880.
5332. Preserving Meat, &c, J. Eckart, Bavaria.—20*th December*, 1880.
5361. Wood-turning Machine, W. R. Lake, London.—21*st December*, 1880.
5384. Machine Guns, W. Gardner, London.—22*nd December*, 1880.
5402. Syruping Aerated Beverages, J. McEwen and S. Spencer, Manchester.—23*rd December*, 1880.
5403. Breech-loading Mechanism, D. Fraser, Edinburgh.—23*rd December*, 1880.
5422. Piled Velvet, J. Perkins, jun., Coventry.—24*th December*, 1880.
5751. Treating Maize, E. R. Southby, London.—18*th November*, 1880.
5347. Engines, S. Robinson, Westbromwich.—21*st December*, 1880.
5367. Wood-turning Machinery, W. R. Lake, London.—22*nd December*, 1880.
5369. Combing Machinery, A. Smith, Bradford.—22*nd December*, 1880.
5376. Padlocks, A. Linley, London.—22*nd December*, 1880.
5386. Apparatus for Practical Meteorology, F. H. F. Engel, Hamburg.—22*nd December*, 1880.
5482. Telephonic Apparatus, C. J. Wollaston, London.—30*th December*, 1880.

Patents on which the Stamp Duty of £100 has been paid.

4939. Distilling Apparatus, A. L. Normandy, London.—21*st December*, 1876.
4935. Water-closets, G. Jennings, London.—21*st December*, 1876.
4937. Steel Crank Axles, J. Whitworth, Manchester.—21*st December*, 1876.
4986. Rolling Rail Ends, &c., into Billets, &c, J. C. Hill, A. C. Pilliner, and W. Williams, Llantarnam.—23*rd December*, 1876.
4921. Treating Flax, J. R. Dry and S. Anderson, London.—20*th December*, 1876.
4940. Utilising the Sun's Rays for Generating Steam, A. Cordier, London.—21*st December*, 1876.
4950. Looped Fabrics, J. McCabe, Droylsden.—22*nd December*, 1876.

Notices of Intention to Proceed with Applications.

(*Last day for filing opposition*, 11*th January*, 1883.

3825. Velocipedes, H. J. Lawson, Coventry.—4*th August*, 1883.
3956. Treating Cotton-seed Oil, J. Longmore, Liverpool.—15*th August*, 1883.
3968. Printing Machines, C. Pollak, London.—16*th August*, 1883.
3974. Utilising Galvanisers' Flux, &c., T. Kenyon, Eccles.—16*th August*, 1883.
3985. Furnaces, &c., I. S. McDougall, Manchester.—16*th August*, 1883.
3990. Brakes, J. S. Humberstone, Brentford.—17*th August*, 1883.
3994. Equipment for Soldiers, A. E. Wardroper, Chichester.—17*th August*, 1883.
3998. Boots and Shoes, T. Lilley and W. B. Skinner, London.—17*th August*, 1883.
4018. Kilns, D. Rylands and R. Potter, Stairfoot.—18*th August*, 1883.
4032. Galleys for Holding Type, J. Heywood and R. C. Ross, Manchester.—20*th August*, 1883.
4033. Heating Steam Boilers, H. Lane, London.—20*th August*, 1883.
4050. Augers, &c., H. J. Haddan, London.—A communication from H. E. Fuller and E. C. Bramhall.—21*st August*, 1883.
4067. Splitting Grain, H. Simon, Manchester.—A com. from H. Seck.—22*nd August*, 1883.
4068. Conveying Flour, W. B. Dell, London.—22*nd August*, 1883.
4088. Steam Generators, H. C. Bull, Liverpool.—23*rd August*, 1883.
4091. Horseshoes, J. J. O. Wilms and J. H. G. Schaper, Hamburg.—23*rd August*, 1883.
4100. Steam Traction Locomotive Cranes, T. Aveling, Rochester, and W. D. and S. Priestman, Kingstou-upon-Hull.—24*th August*, 1883.
4123. Crushing Coal, &c., C. Sheppard, Bridgend.—25*th August*, 1883.
4188. Gun Carriages, W. Gardner, St. Leonard's.—30*th August*, 1883.
4195. Colouring Alloys, H. H. Lake, London.—A communication from La Société A. Trélat et Cie.—30*th August*, 1883.
4201. Anæsthetics, J. Wetter, Wimbledon.—A com. from A. K. Mayo.—31*st August*, 1883.
4206. Coupling Pipes, J. Imray, London.—A communication from A. Benoit-Duportail.—31*st August*, 1883.
4218. Sad Irons, &c., S. Siddaway and A. E. W. Clayton, West Bromwich.—1*st September*, 1883.
4228. Spring Balances, G. Salter and J. Hughes, West Bromwich.—3*rd September*, 1883.
4232. Rotary Engine, H. J. Haddan, London.—Com. from V. H. F. von Swaine.—3*rd September*, 1883.
4239. Coke Ovens, H. Simon, Manchester.—A communication from F. Carves.—3*rd September*, 1883.
4273. Pumping Engines, H. Davey, Leeds.—5*th September*, 1883.
4290. Rotary Engines, H. C. Bull, Liverpool.—6*th September*, 1883.
4442. Roller Mills, F. C. Glaser, Berlin.—A communication from A. Mechwart.—17*th September*, 1883.
4839. Producing Motive Power, E. Sturge, London.—11*th October*, 1883.
4950. Treating Asbestos, J. Dewrance, Lambeth.—17*th October*, 1883.
5042. Electrical Igniting Apparatus, W. R. Lake, London.—A communication from N. de Kabath.—23*rd October*, 1883.
5094. Melting Furnaces, D. Rylands, Stairfoot.—A communication partly from R. Good.—26*th October*, 1883.
5206. Treating Peat, W. Browne, jun., Corkstown, and H. Gregg, Belfast.—2*nd November*, 1883.
5330. Anti-fouling Composition, W. F. McIntosh, and S. Croudace, Dundee.—12*th November*, 1883.
5347. Hats, J. H. Johnson, London.—A communication from C. H. Wilcox.—13*th November*, 1883.
5370. Machine for Boring Holes, R. Letherby, Barnstaple.—14*th November*, 1883.
5384. Steering, &c., Boats, T. B. Heathorn, Knightsbridge.—15*th November*, 1883.
5415. Lawn Mowers, G. W. Carr, New York, U.S.—A communication from Messrs. Carr and Hobson.—16*th November*, 1883.
5422. Dynamo-electric Machines, &c., C. T. Bright, London.—17*th November*, 1883.
5428. Sulphuretted Hydrogen, D. Urquhart, London.—17*th November*, 1883.
5433. Velocipedes, E. C. F. Otto, London.—17*th November*, 1883.
5505. Obtaining Volatile Hydro-carbons, E. Drew, London.—24*th November*, 1883.
5773 Refrigerator Cars, C. C. Palmer, Oakland, U.S.—18*th December*, 1883.
5774. Looms, H. J. Allison, London.—A com. from C. I. Kane R. E. Lester.—18*th December*, 1883.

(*Last day for filing opposition*, 14*th January*, 1884.)

3474. Safety Valves, J. H. Johnson, London.—A communication from Messrs. Lethuillier and Pinel.—13*th July*, 1883.
4019. Horseshoe Nails, S. S. Allin, London.—20*th August*, 1883.
4027. Extracting and Refining Fatty Matters, A. C. Henderson, London.—A communication from Dr. W. Schneider.—20*th August*, 1883.
4035. Boats, H. F. Coombs, Charlottetown.—21*st August*, 1883.
4039. Handgrip for Breech-loading Rifles, S. Bexfield, Stoke Newington.—21*st August*, 1883.
4056. Measuring Distances, J. T. Wish, Southsea.—21*st August*, 1883.
4062. Rotary Pumps, S. George, London.—21*st August*, 1883.
4069. Bicycles, A. C. Henderson, London.—A communication from W. Bäuerle.—22*nd August*, 1883.
4071. Galvanic Batteries, O. C. D. Ross, London.—22*nd August*, 1883.
4078. Miners' Safety Lamps, S. Pitt, Sutton.—A communication from H. Pieper.—22*nd August*, 1883.
4036. Fusible Plugs, J. W. Kenyon, Manchester.—23*rd August*, 1883.
4093. Surface Condensers, S. G. Browne, London.—24*th August*, 1883.
4094. Walls for Fences, &c., W. Thompson, Wexford.—24*th August*, 1883.
4107. Substitute for Sponges, S. Gamgee, Birmingham.—24*th August*, 1883.
4150. Window Ventilators, G. Connell, Newcastle-upon-Tyne.—28*th August*, 1883.
4161. Injectors, Lieutenant P. Zotoff and Captain B. Afonasieff, Russia.—28*th August*, 1883.
4189. Shaping or Dressing Wood, J. Wetter, Wimbledon.—A communication from A. Fischer and J. C. Schmidt.—30*th August*, 1883.
4217. Gasaliers, &c., T. Ford, Birmingham.—1*st September*, 1885.
4244. Lessening Damage to Ships from Collisions, J. H. Grell, Hamburg.—3*rd September*, 1883.
4267. Velocipedes, T. O'Brien, New York.—5*th September*, 1883.
4271. Umbrellas, T. Wrench, Waterloo.—5*th September*, 1883.
4281. Electric Lamps, J. R. P. Wallis, Cumberland, and F. Cherry, London.—6*th September*, 1883.
4283. Saloons of Steamships, J. R. Thomson, Dumbarton.—6*th September*, 1883.
4289. Lamps, A. E. Ragg, Chester.—6*th September*, 1883.
4399. Pentagraph Engraving Machines, J. Mowat, Barrhead.—14*th September*, 1883.
4407. Horseshoes, W. Smith, Kettering.—14*th September*, 1883.
4453. Measuring Electric Currents, R. E. B. Crompton, London, and G. Kapp, Chelmsford.—18*th September*, 1883.
4463. Buttons and Studs, H. E. Newton, London.—A communication from T. W. F. Smitten.—18*th September*, 1883.
4480. Construction of Ships, W. J. Clapp, Nantyglo.—19*th September*, 1883.
4714. Joints of Pipes, J. Robbins, London.—4*th October*, 1883.
4872. Ordnance, C. D. Abel, London.—A communication from W. Lorenz.—18*th October*, 1883.
4905. Treating Paper for Cheques, W. J. Clapp, Nantyglo.—15*th October*, 1883.
5067. Sheet Metal Cans, W. R. Lake, London.—A communication frem E. Norton and J. G. Hodgson.—24*th October*, 1883.
5276. Winding Machinery, J. C. Jefferson, Headingley, near Leeds.—A communication from H. C. Meinicke.—7*th November*, 1883.
5311. Making Extract from the Bark of Trees, J. Fisher, Matlock.—A communication from C. M. Allen.—9*th November*, 1883.
5338. Electric Copying, &c., Machines, J. Wetter, Wimbledon.—A communication from A. Schmid.—12*th November*, 1883.
5366. Self-regulating &c., Mechanism, H. B. Payne, Nottingham.—13*th November*, 1883.
5407. Obtaining Copper from Cupreous Solutions, A. P. Price, London.—16*th November*, 1883.
5416. Manufacture of Zinc, A. P. Price, London.—16*th November*, 1883.
5473. Manufacture of Oxide of Zinc, A. P. Price, London.—21*st November*, 1883.
5487. Rotary Engines, A. A. W. van Reede, Papendrecht, near Dordrecht, Holland.—22*nd November*, 1883.
5493. Chimney Cowls, F. Leslie, London.—23*rd November*, 1883.
5535. Telegraphic Relays and Repeaters, J. H. Johnson, London.—A communication from J. A. Maloney and G. W. Cooper.—27*th November*, 1883.
5559. Lamps, G. Wood, Warrington.—28*th November*, 1883.
5783. Asbestos Cloths, S. Pitt, Sutton.—A communication from H. W. Johns.—18*th December*, 1883.

Patents Sealed.

(*List of Letters Patent which passed the Great Seal on the* 21*st December*, 1883.)

3100. Incandescent Electric Lamps, R. Harrison, Newcastle-on-Tyne.—22*nd June*, 1883.
3103. Refining Jute, E. T. Hughes, London.—22*nd June*, 1883.
3120. Targets for Rifle Practice, R. Morris, Blackheath.—23*rd June*, 1883.
3129. Kilns for Drying Malt, E. Edwards, London.—23*rd June*, 1883.
3143. Regulating the Pressure of Gas, H. Devine, Manchester.—25*th June*, 1883.
3147. Supplying Charges for Refilling Cartridge Cases, R. Morris, Blackheath.—25*th June*, 1883.
3157. Manufacture of Tiles, &c., T. H. Rees, London.—26*th June*, 1883.
3164. Manufacture of Paper with Relief Designs on the Surface, A. O. A. and A. H. Feret and C. L. V. Ladame, Paris.—26*th June*, 1883.
3196. Lucifers, F. H. F. Engel, London.—27*th June*, 1883.
3205. Billiard Marking, R. Bateman, Birmingham.—28*th June*, 1883.
3213. Table Trucks for Weighing Bales, &c., T. McEntegart, Liverpool.—28*th June*, 1883.
3218. Mounting or Supporting Electric Lamps, W. R. Lake, London.—28*th June*, 1883.
3231. Indicators for Showing the Corresponding Time of Day at various Places, S. Goodacre, Liverpool.—29*th June*, 1883.
3232. Boxes, H. J. Haddan, London.—29*th June*, 1883.
3246. Obtaining Salts of Ammonia from Combustible Gases, J. Addie, Glasgow.—30*th June*, 1883.
3278. Electrical Conductors, H. H. Lake, London.—3*rd July*, 1883.
3296. Window Fastenings, E. M. Loe, London.—3*rd July*, 1883.
3297. Forging Railway Spikes, &c., C. D. Abel, London.—3*rd July*, 1883.
3303. Stitching or Binding Books, H. J. Haddan.—3*rd July*, 1883.
3330. Tricycles, J. Cornforth, Birmingham.—5*th July*, 1883.
3372. Segment and Star Temples and their Fixings, F. Oddy, Bradford.—7*th July*, 1883.
3377. Railway Sleepers, &c., J. Imray, London.—7*th July*, 1883.
3413. Material for Electric Insulation, W. V. Wilson, London.—11*th July*, 1883.
3437. Manufacture of Maltose, &c., J. Imray, London.—12*th July*, 1883.
3467. Grates, H. J. Haddan, London.—13*th July*, 1883.
3469. Cord Fastener for Window Blinds, H. J. Haddan, London.—13*th July*, 1883.
3853. Automatic Safety-car Signals, W. H. Rushforth, New Jersey, U.S.—8*th August*, 1883.
4059. Galvanic Batteries, G. C. V. Holmes and S. H. Emmens, London.—21*st August*, 1883.
4061. Manufacture of Commercial Products resulting from the Operation of Galvanic Batteries, G. C. V. Holmes and S. H. Emmens, London.—21*st August*, 1883.
4549. Stopping Holes in Ships, J. Richardson, North Shields.—24*th September*, 1883.
4738. Bleaching Cotton, &c., G. B. Sharples, Walmersley, near Bury.—5*th October*, 1883.
4746. Packing the Pistons of Engines, W. R. Lake, London.—6*th October*, 1883.
4799. Harvesting Machines, B. Samuelson, Banbury.—9*th October*, 1883.
4806. Pulverising Machines, W. R. Lake, London.—9*th October*, 1883.
4962. Bearing Blocks, M. Frenkel, Berlin.—17*th October*, 1883.
4964. Transmitting, &c., Sounds at a Distance, A. G. Brookes, London.—18*th October*, 1883.
5023. Shoddy Pickers, S. Pitt, Sutton.—23*rd October*, 1883.
5048. Blanks for Horseshoe Nails, R. H. Brandou, Paris.—24*th October*, 1883.
5050. Machines for Finishing Horseshoe Nail Blanks, R. H. Brandon, Paris.—24*th October*, 1883.
5090. Subjecting Materials to the Action of Dyeing Liquors, F. C. Glaser, Berlin.—26*th October*, 1883.
5136. Belt Cable Railways, H. J. Allison, London.—30*th October*, 1883.
5152. Plumbers' Traps, W. R. Lake, London.—30*th October*, 1883.
5200. Dyeing, &c., Yarn, W. R. Lake, London.—1*st November*, 1883.

(*List of Letters Patent which passed the Great Seal on the* 24*th December*, 1883.)

2851. Flour, &c., Mills, K. J. Dance, Bristol.—7*th June*, 1883.
3151. Fire-proof Buildings, &c., W. Corliss, Providence, U.S.—26*th June*, 1883.
3152. Brakes for Trains, A. G. Evans, Manchester.—26*th June*, 1883.
3182. Galvanic Batteries, J. R. and J. W. Rogers, London.—27*th June*, 1883.
3184. Exhibiting Advertisements, C. F. Pollak, London.—27*th June*, 1883.
3186. Picks for Mining, &c., G. W. Elliott, Liverpool.—27*th June*, 1883.
3187. Making Candles, W. H. Beck, London.—27*th June*, 1883.
3190. Hampers, &c., H. Brunner, Widnes.—27*th June*, 1883.
3195. Rollers for Wringing, &c., Machines, W. Lockwood, Sheffield.—27*th June*, 1883.
3198. Feeding Bottles, E. Brasier, London.—27*th June*, 1883.
3206. Ships' Berths, E. Hoskins, Birmingham.—28*th June*, 1883.
3207. Portable Fountains, W. Aubert, jun., Balham.—28*th June*, 1883.
3222. Hooks or Pegs, W. Allison, Glasgow.—29*th June*, 1883.
3225. Water-waste Preventers, E. Raitt, Brixton.—29*th June*, 1883.
3227. Fastenings for Articles of Dress, G. P. Lemprière, Balsall Heath.—29*th June*, 1883.
3230. Concentrating, &c., Sulphuric Acid, W. J. Menzies, St. Helens.—29*th June*, 1883.
3239. Rotary Engines, W. Frost, Manchester, and T. T. Bond, Luton.—29*th June*, 1883.
3244. Automatic Electric Signalling Apparatus, H. J. Haddan, London.—30*th June*, 1883.
3247. Cooking Ranges, J. Carrick, Glasgow.—30*th June*, 1883.
3250. Safety Saddle-bars, H. Rees-Phillips, Birmingham.—30*th June*, 1883.
3257. Boilers, I. S. McDougall, Manchester.—30*th June*, 1883.
3266. Clipping Skins, L. A. Groth, London.—2*nd July*, 1883.
3392. Electric Arc Lamps, F. M. Newton, Belfast.—9*th July*, 1883.
3403. Refining Sugar, C. E. Van Haesendonck, Brussels.—10*th July*, 1883.
3543. Rocking Furnace Bars, J. Hampton, Loughborough.—18*th July*, 1883.
4716. Air Compressors, F. W. Scott, London.—4*th October*, 1883.

List of Specifications published during the week ending December 22nd, 1883.

1777, 2d.; 1883, 4d.; 1886, 4d.; 1915, 6d.; 2100, 4d.; 2115, 6d.; 2122, 2d.; 2147, 4s. 6d.; 2172, 4d.; 2184, 4d.; 2190, 6d.; 2200, 6d.; 2202, 6d.; 2212, 2d.; 2217, 8d.; 2219, 6d.; 2221, 2d.; 2224, 6d.; 2226, 2d.; 2227, 6d.; 2228, 6d.; 2229, 6d.; 2231, 6d.; 2232, 6d.; 2233, 6d.; 2234, 6d.; 2235, 2d.; 2237, 4d.; 2238, 6d.; 2239, 6d.; 2240, 8d.; 2244, 2d.; 2245, 2d.; 2246, 2d.; 2247, 2d.; 2248, 4d.; 2249, 2d.; 2251, 6d.; 2252, 4d.; 2254, 6d.; 2257, 6d.; 2258, 4d.; 2260, 2d.; 2262, 6d.; 2263, 2d.; 2265, 4d.; 2266, 6d.; 2268, 6d.; 2269, 2d.; 2271, 2d.; 2272, 6d.; 2273, 6d.; 2274, 6d.; 2275, 6d.; 2277, 6d.; 2278, 6d.; 2279, 2d.; 2280, 6d.; 2281, 6d.; 2282, 6d.; 2284, 10d.; 2286, 6d; 2287, 6d; 2288, 2d.; 2289, 2d.; 2292, 2d.; 2294, 8d.; 2295, 2d.; 2296, 4d.; 2299, 2d.; 2301, 2d.; 2302, 6d.; 2305, 2d.; 2306, 2d.; 2307, 6d.; 2308, 6d.; 2309, 6d; 2310, 2d.; 2311, 6d.; 2313, 4d.; 2320, 6d.; 2321, 4d.; 2323, 2d.; 2325, 6d.; 2326, 4d; 2327, 2d; 2328, 2d.; 2329, 2d.; 2330, 2d.; 2332, 6d; 2333, 6d; 2342, 2d.; 2344, 6d.; 2345, 6d.; 2349, 8d.; 2353, 6d.; 2357, 8d.; 2569, 2d.; 2376, 4d.; 2377, 6d.; 2894, 6d.; 2398, 6d.; 2408, 6d.; 2414, 6d.; 2467, 6d.; 2471, 6d.; 2494, 6d.; 2497, 6d.; 2512, 6d.; 2952, 6d.; 3446, 2d.; 4145, 6d.; 4257, 4d.

ABSTRACTS OF SPECIFICATIONS.

Prepared by ourselves expressly for THE ENGINEER *at the office of Her Majesty's Commissioners of Patents.*

1777. Issuing Tickets in Public Conveyances *B. J. Maloney, Edinburgh.—9th April*, 1883.—(*Provisional protection not allowed.*) 2*d.*

This relates to a system of issuing tickets and reserving counterfoils, which serve to check the tickets issued.

1883. EXPLOSIVE COMPOUNDS, *F. W. Gilles, Germany.*—18th April, 1883. 4d.

This relates to the manufacture of explosives from molasses and residues therefrom, by treating them with a mixture of nitric and sulphuric acids.

1886. CONSTRUCTION OF VALVES APPLICABLE FOR WATER PUMPS, &c., *W. P. Thompson, Liverpool.*—13th April, 1883.—(*A communication from J. Flower, U.S.*)—(Complete.) 4d.

The inventor claims, First, the combination with the valve cage having openings in its side walls and head, and a dash pot at its lower end having an escape orifice, of a valve with a head arranged to play in the cage next the head thereof, and the base arranged to play in the dash pot, the head and base being connected; and, Secondly, the combination with the valve cage having a dash pot at its lower end, and provided with a liquid escape orifice, of a screw valve arranged to regulate the extent of opening of such orifice.

1915. COLLARS FOR SPINNING AND DOUBLING, *W. Jackson, Kingston-upon-Hull.*—16th April, 1883. 6d.

The collar is of cast iron or steel, and in its upper end is inserted a ferrule of brass forming the top bearing of the spindle. Through the lower portion of this ferrule holes are pierced corresponding to holes in the iron or steel part, and which are externally covered by a helical hoop of brass wire, which revolves loosely with the bobbin upon that part of the iron or steel portion immediately over or upon the upper spindle rail. The helical hoop conveys the oil necessary for lubrication.

2100. HEATERS OR BOILERS, *C. D. Yates, Brixton.*—25th April, 1883. 4d.

This relates to a burner, consisting of a tube inserted into a chamber formed so as to spread the gas at the point of ignition, and from which the gas passes down into the inner tube, then through a layer of asbestos or silicate cotton, at the same time mixing with air, and is consumed at the top of a perforated plate. The flame acts upon a heater, in which the liquid circulates, and which consists of a series of spiral coils.

2122. EXTRACTING GOLD FROM AURIFEROUS PYRITES, *T. Bowen and J. Napier, Swansea.*—26th April, 1883. (*Void.*) 2d.

This consists in calcining the ore, and, after mixing it with salt, heating it in calciners, after which it is mixed with chloride of lime and treated with an acid solution.

2172. NAVIGABLE VESSELS AND CONSTRUCTION AND ARRANGEMENT OF APPARATUS EMPLOYED THEREON AND IN CONNECTION THEREWITH TO BE USED FOR RAISING AND LOWERING AND DREDGING PURPOSES, *J. Taylor, Birkenhead.*—30th April, 1883.—(*Not proceeded with.*) 2d.

This consists of a "self monocurvable" combined steam vessel and crane, so constructed as to be adaptable either for ordinary raising and lowering and elevating purposes, or for mechanical dredging purposes, or for suction dredging purposes.

2184. COLOURING MATTER, *H. O. Miller, Moscow.*—20th April, 1883. 4d.

The new colouring matter is produced by the oxidation of hydrosulpho-cyanic acid or its salts, such oxidation being effected by means of chlorine or bromine in the presence of muriatic or other suitable acid.

2190. PORTABLE APPARATUS FOR DRILLING AND BORING, *R. H. Jones, Birkenhead.*—1st May, 1883. 6d.

For cutting small holes the apparatus is in the form of a ratchet and brace operated by a lever and secured in position by a clamp. To the drill stock a ratchet and tooth wheel are secured, and the operating lever works around the stock and has two pawls facing in opposite directions, and one taking into the ratchet and the other into a ratchet ring around the toothed wheel and provided with internal teeth, which gear with the toothed wheel through a small pinion connected to a fulcrum lever to retain it in position. For large holes cutters are used instead of drills, and the forward motion is given to the cutter stock by a worm acting on a wheel surrounding the stock.

2202. UMBRELLA AND PARASOL FRAMES, *J. Willis, Bournemouth.*—1st May, 1883. 6d.

This relates, First, to the construction of spring joints between the stretchers and ribs; Secondly, to flattening the outer ends of locks, and shaping the trough stretcher to receive them, and to admit of the flattened portion resting against the notch of the runner; Thirdly, to forming tips for ribs from a trough-like piece of metal, perforated or cut away at the sides.

2211. APPARATUS FOR MAKING INFUSIONS OF COFFEE, &c., *W. P. Thompson, Liverpool.*—1st May, 1883.—(*A communication from J. C. Grant, New York.*)—(*Not proceeded with.*) 2d.

The object is to ensure a uniform quality in every cupful of coffee or other beverage made; to prevent dissipation of the strength and aroma of the beverages in making the same; to make the beverage instantaneously at the moment it is required for use; and to economise the beverage-yielding material.

2212. HOSIERY STITCHING MACHINES, *J. Douglas and J. F. Bird, Wigston Magna, Leicester.*—1st May, 1883.—(*Not proceeded with.*) 2d.

This relates to means for cutting away the raw edges left after sewing two pieces of fabric together. A fixed blade is placed so that its back falls into a groove in the circumference of the cylinder just above the row of points from which the fabric to be sewn is suspended, so that its cutting edge is horizontal and facing outwards, and tapers to a point in the direction of the work. A movable blade works to and fro on a pivot, and is actuated from the shaft of the stitching machine.

2213. STEAM ROAD ENGINE TRACTION WHEELS, *A. J. Boult, London.*—1st May, 1883.—(*A communication from J. Enright, San Jose, U.S.*) 6d.

This consists partly in providing the wheel at the periphery and one edge thereof with an inwardly projecting flange, and applying elastic removable blocks upon the perimeter of such wheel in a shield adapted to be placed over the elastic blocks and engage with the inwardly projecting flange, and in removable clamps arranged on the edge of the perimeter of the wheel opposite to the said inwardly projecting flange, and in such manner as to engage with and hold the ends of the shields placed over the elastic blocks.

2214. APPARATUS TO BE USED IN CONNECTION WITH ELECTRICAL ACCUMULATORS FOR REGULATING THE AMOUNT OF ENERGY THEREOF, *C. A. A. Capito, London.*—1st May, 1883. 6d.

A voltameter has one of its zinc plates movable in guides and suspended by a spring balance, the pointer of which makes contact with one of two stops, according as the plate is heavily or lightly coated with zinc from the solution in which the plates are placed. The two stops are in the circuits of two electro-magnets which serve to put the accumulators into or out of the charging circuit. In a modification, electric bells give an alarm when the quantity of current stored reaches the maximum and minimum limits.

2215. APPLIANCES FOR OBTAINING MOTIVE-POWER, *G. Asher, Balsall Heath, and L. L'Hollier, Birmingham.*—1st May, 1883.—(*Not proceeded with.*) 4d.

This relates to screw gearing.

2216. MANUFACTURING HORN AND BONE STRIPS SUITABLE FOR STIFFENING DRESSES AND CORSETS, *H. A. Lyman, London.*—1st May, 1883.—(*A communication from W. A. Nettleton, Bridgeport.*) 6d.

This relates to the conversion of waste or short strips of horn or whalebone into a continuous strip, and to the machinery employed therefor.

2217. APPARATUS FOR DETERMINING THE RATE OF WATER CONSUMPTION, *H. E. Newton, London.*—1st May, 1883.—(*A communication from B. S. Church, Scarborough, U.S.*) 8d.

This relates to a method of increasing the difference between the statical and dynamical pressures of water in a pipe, by increasing the velocity of the water without changing its volume at the time of taking the dynamical pressure. This is effected by reducing the size of aperture through which the water passes at the time of taking the dynamical pressure. Special apparatus is described.

2219. PULLEYS FOR TRANSMITTING MOTION, *W. R. Lake, London.*—1st May, 1883.—(*A communication from H. H. Fulton and O. R. Olsen, Indianapolis, U.S.*) 6d.

This relates to pulleys in which the web and rim are made separately, and it consists of a web of corrugated sheet metal, one end of which is clamped between a hub made in two parts with corrugated faces, while the other end is rivetted to the rim, which is made of sheet or hoop metal.

2221. BOTTLES, AND STOPPERING DEVICES THEREFOR, *W. R. Lake, London.*—1st May, 1883.—(*A communication from H. Robertson, New York.*)—(*Not proceeded with.*) 2d.

A bottle has a neck at one end which can be closed by a cork or other device, and a neck at the other end containing a stopping device, which automatically opens when the bottle is inverted to be filled, or to permit the escape of its contents through the first neck by allowing air to enter the bottle.

2222. APPARATUS FOR EXTINGUISHING FIRE IN SHIPS, &c., *W. R. Lake, London.*—1st May, 1883.—(*A communication from W. H. Thompson, New York.*) 6d.

This relates to the arrangement of pipes through which steam alone, or steam commingled with carbonic acid gas, is blown into the part where the fire exists.

2223. OIL LAMPS TO BE USED WHERE THERE ARE CURRENTS OF AIR PRODUCED BY PUNKAHS OR OTHERWISE, *J. Fyfe, Glasgow, and T. B. Smith, Birmingham.*—2nd May, 1883. 6d.

The object is the construction of a lamp for burning paraffin oil, or other suitable oil, in an improved manner, so that the steady burning of the light may not be appreciably affected by the action outside the lamp of strong currents of air, such as are produced by punkahs.

2224. HAMMERLESS GUNS, &c., *J. Darby, Birmingham.*—2nd May, 1883. 6d.

The object is to lock all parts of the action of hammerless guns by a single motion, so as to prevent accidental discharge. A dual bolt is located at the front end of a sliding bar, and has two upwardly-turned locking parts, which can engage with slots formed in the tumblers. The sliding bar can be actuated in the usual way.

2225. WEAVING CARPETS AND OTHER PILE FABRICS, AND APPARATUS CONNECTED THEREWITH, *E. Crossley and R. Cochrane, Halifax.*—2nd May, 1883. 6d.

This relates to the method or means of cutting the pile of carpets and other pile fabrics of different lengths by the employment of deep wires having knives or cutting blades or edges at the side.

2226. CARPETS, RUGS, AND MATS, &c., *E. Crossley and R. Cochrane, Halifax.*—2nd May, 1883.—(*Not proceeded.*) 2d.

This relates to the use of threads of silk, linen, cotton, jute, wool, or worsted, combined with strips of gold, silver, or other metal for warps in the weaving of carpets, rugs, and mats. Apparatus for preparing the combined threads is described.

2227. APPARATUS EMPLOYED IN THE MANUFACTURE OF MALLEABLE IRON AND STEEL, *W. M. Murdock, Gilwern County, Brecon.*—2nd May, 1883. 6d.

This relates to furnaces or converters in which a blast of air or other gas or steam is introduced below the surface of the molten metal, and it consists, First, in means for enabling the lower part of the tuyeres employed to be removed and replaced when burnt away, whilst the furnace is hot; Secondly, in forming the interior of the lining of the furnace as a deep annular ring, suspended from the casing above so as to leave an annular space between it and the outer lining for the passage of the blast; and Thirdly, in making the upper part of the furnace so that it can be raised from the bottom.

2228. CARTRIDGE POUCHES, *T. H. Kinvig, Isle of Man.*—2nd May, 1883. 6d.

The cartridges are arranged horizontally in the pouch in two columns joined together at the bottom so as to form a U, pressers forcing the cartridges towards the delivery orifice at the bottom, which is of trough shape, and which when partly turned allows one cartridge to be discharged at a time, a spring causing the trough to return to its normal position.

2229. REFINING, DEODORISING, AND PURIFYING OILS AND FATS, &c., *A. C. Tichenor, California.*—2nd May, 1883. 6d.

This relates essentially to the application of electricity for refining, deodorising, and purifying oils and fats.

2230. APPARATUS FOR CLEANING THE BOWLS AND STEMS OF TOBACCO PIPES, *H. Emery, Burslem.*—2nd May, 1883. 2d.

A cone of charcoal and saltpetre is attached to a wire, and inserted in the pipe, and is set fire to in order to clean the pipe.

2231. MATERIAL FOR STEREOTYPE MATRICES, *L. Posselt and H. Schimansky, Berlin.*—2nd May, 1883. 6d.

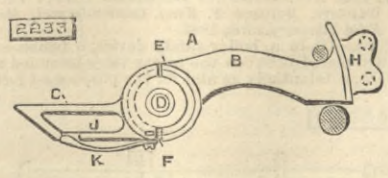
This consists, First, in the use of a composition consisting of rye flour, slime of clay, slime of chalk, borax, glycerine, and red bole, for pasting sheets of paper to form the matrix; and Secondly, to the method of drying the matrix.

2232. MACHINERY FOR SPINNING, *B. A. Dobson and W. H. Singleton, Bolton.*—2nd May, 1883. 6d.

The objects are to prevent the spindles being lifted during the operation of doffing and to release the spindles when required to remove them. Wires act on the spindle wharves and hold them during the operation of doffing, and can be turned back in order to release the spindles. The invention further relates to the bearing and lubrication of spindles having their footstep and upper bearing in one tube, several different modifications being described for effecting a constant lubrication, and combining a removable oil reservoir with an elastic yielding bearing.

2233. LOOMS FOR WEAVING, *F. Leeming and R. Wilkinson, Bradford.*—2nd May, 1883. 6d.

This consists in mechanism for securing positive motion of the healds for forming what is known as the jacquard shed. The main feature consists of a lever A composed of two parts B and C, the shaft D serving as a fulcrum and securing these parts in relative position to each other, and the joints E and F of such parts allow the necessary movement of the indicating part C when moved by the action of the peg or other indicating apparatus. On the end H of



lever B the ordinary jack for working the healds is attached, and the end J of lever C is provided with spring K, and is operated by a peg barrel or other pattern mechanism. The two parts of the lever are raised and depressed positively, and locked by means of cross bars and cross shafts caused to reciprocate within slotted guides by means of T levers, crank and connecting rod worked from the crank shaft.

2234. SAFETY APPARATUS FOR DETACHING AND ATTACHING SHIPS' BOATS, *J. Linkleter, Tynemouth.*—2nd May, 1883. 6d.

This relates to appliances for enabling a boat to be detached either automatically upon touching the water or at any point in lowering it from the davits by hand gear, and by which the boat can be safely re-attached to the tackle blocks for hoisting it out of the water. Tumbling blocks are attached to the lower blocks and connected by a cord, so that the unhooking of one, either automatically or by hand, allows the other hook to tumble and disengage.

2235. PORTABLE TRAVELLING DESK AND APPARATUS CONNECTED THEREWITH, *F. R. Baker, Birmingham.*—2nd May, 1883.—(*Not proceeded with.*) 2d.

The desk can be secured round the waist of a person, so as to enable him to write steadily when travelling.

2236. MANUFACTURE OF COACH AND CARRIAGE AXLES AND IN THE FLAPS ATTACHED THERETO, *J. Rigby, sen., and I. M. Morgan, Walsall.*—2nd May, 1883. 6d.

This relates partly to cranked axles, which cranks, instead of being formed from a straight bar, cut and welded at the required angle, are made by taking a bar of iron which has been formed with a projection or extra thickness of metal at the points where the cranks are to be formed. These projecting or thicker portions of the bar are forced by hydraulic or other pressure into a tool or die of a suitable form, to give the required angle to the cranks. Another part refers to a method of forming and attaching the flaps of spring seatings to any description of axle requiring them.

2237. RED DYE STUFFS SUITABLE FOR DYEING AND PRINTING, *S. Pitt, Sutton.*—2nd May, 1883.—(*A communication from Verein Chemischer Fabriken, Germany.*) 4d.

The dye stuffs are derived from alphanaphthol. The salts of alphanaphthol-sulphonic acids are reacted upon with the diazo derivatives of aromatic bases.

2238. DOMESTIC FIRE-ESCAPE, *G. Nobes, Paddington.*—2nd May, 1883. 6d.

A ladder of rope, asbestos, or wire has iron or other rigid treads passing through the ropes and secured by nuts, wheels being fixed to the ends of the treads to keep the ladder from the wall. The ladder can be coiled round a drum and enclosed in a hollow piece of furniture.

2239. COUPLING BUFFERS FOR RAILWAY VEHICLES, *H. H. Lake, London.*—2nd May, 1883.—(*A communication from F. F. von Ainbach and A. Hanger, Austria.*) 6d.

A hollow cylinder is fixed by a ball-and-socket joint to one carriage, and a piston fixed to the other carriage has a spring catch arranged, so that when the piston enters the cylinder the catch engages a notch in the cylinder. The mouth of the cylinder is funnel-shaped to ensure the piston entering the cylinder when two carriages are pushed together. By turning a sleeve the notch in the cylinder is filled up and the catch cannot enter it when required to uncouple the carriages. The end of the piston when inside the cylinder bears against a spring buffer arranged therein.

2240. SEWING MACHINES, *W. R. Lake, London.*—2nd May, 1883.—(*A communication from T. C. Robinson and E. B. Welch, Massachusetts, U.S.*) 8d.

The objects are to provide means for securing bindings to corsets and other articles and for trimming material simultaneously with the attachment of the binding if desired; also to improve sewing machine trimmer attachments employing a fixed blade and a reciprocating blade in rubbing contact with the fixed blade, whereby the desired degree of impinging pressure of one blade against the other may be maintained and the wear of the blades compensated for; also to provide an improved folder attachment and a blower adapted to remove scraps and cuttings; also to provide improved means for operating a pivotted trimming or shearing knife by a vertically reciprocating knife bar.

2243. MANUFACTURE OF NICKEL AND OF COBALT, AND OF ALLOYS OF EITHER OF THESE METALS WITH IRON, *A. M. Clark, London.*—2nd May, 1883.—(*A communication from La Société Anonyme dite Fonderie de Nickel et Metaux Blancs, Paris.*) 4d.

This consists in melting together in the same crucible metallic nickel or cobalt with cyanide or ferro-cyanide of potassium—with the addition of iron in the case of ferro-nickel and ferro-cobalt—in presence of an oxide of manganese.

2244. SWORD-HILT GUARDS OR BASKETS, APPLICABLE ALSO TO SWORD BAYONETS, *N. W. Wallace, Southsea.*—2nd May, 1883.—(*Not proceeded with.*) 2d.

This consists in making the guard of a skeleton frame capable of being folded up when the sword is not being used.

2245. WIRE ROPE TRAMWAYS, &c., *A. J. Boult, London.*—2nd May, 1883.—(*A communication from G. R. Elliott and M. Clark, Boston, U.S.*)—(*Not proceeded with.*) 2d.

The objects are, First, to provide a car for wire rope tramways with an upper platform or covering, and a bottom tray which are adapted to be brought in contact with each other automatically, and thus prevent any article contained therein from falling out; Secondly, to provide an adjustable stop or check block having an inclined plane or hollow rest for the wheels of the carrier, and a head or buffer to prevent shock; and, Thirdly, to provide means to deaden noise while the wheels are passing over the cable. For the latter purpose the rope is covered with vulcanised rubber.

2246. KNITTING MACHINES, *J. Gabbott and L. Holbrook, Nottingham.*—2nd May, 1883.—(*Not proceeded with.*) 2d.

The object is to produce knitted or looped fancy goods having either odd or alternate courses of coloured or different threads or plain courses, as desired, in full jack and sinker knitting frames; and it consists essentially in substituting for the cam wheel used to actuate the thread-carrier bars, a cam wheel with four cams on it, whereby the thread carrier can be caused to make both left-handed and right-handed courses. Suitable additional springs act on the carrier slides.

2247. DRAW-BARS AND COUPLING APPARATUS FOR RAILWAY WAGONS AND OTHER VEHICLES, *S. Keeton.*—3rd May, 1883.—(*Not proceeded with.*) 2d.

Two buffer-headed draw-bars are secured to each wagon, and each forms a hook at one end, the rods passing through a draw-bar head secured on the ends of the framing by two parallel rods, on which slide plates bolted to the draw-bar. On each side of the plate spiral springs encircle the draw-bar. Each draw-bar head forms a bearing for a shaft passing through a coupling link, and provided with a lever at each end to raise and lower the link

2248. CARD STANDS OR HOLDERS, *P. Ruffani, Dresden, Germany.*—3rd May, 1883. 4d.

This relates to card stands or holders for holding photographs and other cards in an almost vertical position, and it consists of a foot with two bent-up arms—the smaller stamped out of the larger arm—between which the cards are inserted and held firmly.

2249. CONSTRUCTION OF SHIPS' DECKS, *W. B. Thompson, Dundee.*—3rd May, 1883.—(*Not proceeded with.*) 2d.

The iron or steel decks are covered with corticine.

2250. DYNAMO-ELECTRIC MACHINES, *O. Williams, Liverpool.*—3rd May, 1883. 6d.

The object of the invention is to increase the diameter of the armature without decreasing the intensity of the magnetic field. Two armature rings coiled in opposite directions are placed concentrically on a rotating axis, the field magnets are arranged with their poles acting on the inner and outer armature rings. More than two concentric rings may be used on one axis, and the field magnets may be permanent or electro-magnets. Commutators and brushes of ordinary construction are used.

2252. TREATING BLAST FURNACE SLAG TO OBTAIN THEREFROM CERTAIN PRODUCTS, &c., *E. G. Colton, London.*—3rd May, 1883.—(*A communication from A. D. Elbers, Hoboken, U.S.*) 4d.

This consists in changing the blast furnace slag by the steam or air blast into slag fibres, known as slag wool, mineral wool, or silicate cotton, then heating and fritting the said slag fibres until the fibres are reduced to white friable silicates, which are then pulverised.

2251. SIZING PAPER AND TEXTILE FABRICS, &c., *C. Weygang, Childs Hill.*—3rd May, 1883. 6d.

The principal object is to size paper in the pulp with animal size or starch, or the two combined.

2253. GALVANIC BATTERIES, *J. Lea, London.*—3rd May, 1883. 6d.

This relates to connecting the positive electrode in one cell with the negative electrode in another cell through the partitions separating the cells by means of mercury placed in the bottom of the battery. To prevent oxidisation of the connecting wires, they are coated with platinum at the points where contact is made.

2254. APPARATUS FOR WEIGHING AND ASCERTAINING THE COUNTS OF YARNS OR THREADS, &c., *T. Knowles, Turton.*—3rd May, 1883. 6d.

This relates to arrangements whereby the weight of a given length of yarn or thread is caused to indicate, by means of a scale, the number or count of such yarn or thread.

2257. HARNESS, *E. Edwards, London.*—3rd May, 1883.—(*A communication from P. J. Grandy, Margaux, France.*) 6d.

This relates to the method of making the parts of horse collars capable of separation so that the collars can be easily repaired, and can be made larger or smaller, as desired.

2258. CHRONOGRAPHS, *A. H. Arnold and F. H. Huguenin, Geneva.*—3rd May, 1883. 4d.

This relates to a minute indicator for chronographs, actuated by the vertical motion of the wheel of the indicator.

2259. MANUFACTURE OF OXIDE OF STRONTIUM AND HYPOSULPHITE OF THE ALKALIES, *W. Moody, West Ham.*—3rd May, 1883. 2d.

This relates to the process for the production of oxide of strontium and hyposulphite or hyposulphide of the alkalies, whereby he utilises the sulphur and the strontium of "Celestine."

2260. HOT-WATER HEATING APPARATUS FOR WARMING BUILDINGS, *T. Wood, Bristol, and G. Milton, Stapleton.*—3rd May, 1883.—(*Not proceeded with.*) 2d.

This relates to improvements in the general construction of the furnace.

2261. MANUFACTURE OF BOXES OR BARRELS TO CONTAIN DRY GOODS AND MACHINES FOR MAKING SUCH BOXES OR BARRELS, *G. D. Terry, Bayswater.*—3rd May, 1883. 6d.

This relates to improvements in the manufacture of that description of cylindrical barrels or boxes whereof the body portion is constructed of a circumferential streak or sheet of wood bent to the cylindrical form and overlapped upon itself, such barrels being usually employed for packing dry goods.

2262. MACHINERY EMPLOYED IN THE MANUFACTURE OF LEATHER, *J. Hall, Leeds.*—3rd May, 1883. 6d.

This relates partly to the arrangement of the tool-holders.

2263. MANUFACTURE OF AMMONIA AND NITRIC ACID, &c., AND APPARATUS THEREFOR, *L. Q. and A. Brin, Paris.*—3rd May, 1883.—(*Not proceeded with.*) 2d.

The object is to utilise the nitrogen gas produced so as to form a number of manufactures or industries which have heretofore only been carried on at great expense.

2265. ORNAMENTATION OR PRODUCTION OF DESIGNS ON GLASS AND GLASS WARE, *J. T. King, Liverpool.*—4th May, 1883. —(*A communication from H. Schulze-Berge, Pittsburgh, U.S.*) 4d.

This relates to a mode of ornamenting glass and glass ware, by which an effect is produced similar to that of etching, by hydrofluoric acid, but which entirely dispenses with the use of that material.

2266. DECORATION OR PRODUCTION OF DESIGNS ON GLASS AND GLASSWARE, *J. T. King, Liverpool.*—4th May, 1883.—(*A communication from H. Schulze-Berge, Pittsburgh, U.S.*) 6d.

This relates to the decoration of glass and glassware by a process analogous to that of etching, and is designed to obviate the use of liquid hydrofluoric acid in the process of etching, and to obtain clearer and more delicately traced etching on glass than can be produced by the use of that fluid as heretofore practised

2267. MOWERS, *A. Barham, Anerley.*—4th May, 1883.—(*Not proceeded with.*) 2d.

This consists of a rotating horizontal circular cutter or saw fixed on a vertical shaft geared into a horizontal cross-shaft at right angles to the vertical shaft, said cross shaft being geared at each end by wheels with chains to wheels on the axles of the wheels carrying the machinery. Below the rotating cutter is a plate of metal having tines at its front end.

2269. APPARATUS FOR CASTING INGOTS, SPECIALLY APPLICABLE FOR CIRCULAR SAWS, &c., *S. W. Wilkinson and J. Banham, Sheffield.*—4th May, 1883.—(*Not proceeded with.*) 2d.

This relates to the construction of rotary moulds.

2271. STOPPERS FOR BOTTLES CONTAINING AERATED LIQUIDS, *J. H. Vanes, Birmingham.*—4th May, 1883.—(*A communication from A. B. Vanes, Cape Colony.*) (*Not proceeded with.*) 2d.

The neck of the bottle is constructed so as to form a valve seat for the stopper.

2272. CONSTRUCTION OF LIFE AND OTHER BOATS, BUOYS, RAFTS, OR FLOATING APPARATUS, *J. R. Hodgson, London.*—4th May, 1883. 6d.

The boats, &c., are constructed with two tubes made of cotton, jute, hemp, leather, or green hide, coated inside with waterproof paint or india-rubber solution, and filled inside with cork or any other light material.

2273. GOVERNORS FOR STEAM ENGINES, *J. Musgrave and R. Gregory, jun., Bolton.*—4th May, 1883. 6d.

The inventors claim an additional excentric groove in the governor sleeve combined with a strap, forked lever, and other mechanism for actuating fingers and ratchet wheels operating a rod or shaft with a single thread.

2274. APPARATUS FOR PROPELLING SEA-GOING VESSELS, *H. Gerner, New York.*—4th May, 1883. 6d.

This consists of a hanging keel capable of vibrating on hinges transversely to the length of the vessel, and also of a horizontal platform hinged at or near the stern of the vessel, and extending a certain distance abaft the stern.

2275. WATER WHEELS, *G. W. von Nawrocki, Berlin.*—4th May, 1883.—(*A communication from A. Baumotte, Vossnacken, and R. Nöggerath, St. Johann, Germany.*) 6d.

The floating motor consists of a number of paddles mounted on endless chains which run on chain wheels.

2276. CONSTRUCTION OF SHIPS, &c., *G. Weston, Sheffield.*—4th May, 1883.—(*Not proceeded with.*) 2d.

This relates to the construction of the floating portion of a series of iron tubes.

2277. FACILITATING MEASUREMENT FOR TAILORING, DRESS MAKING, &c., *W. R. Lake, London.*—4th May, 1883.—(*A communication from J. Monjou, Paris.*) 6d.

This consists essentially in making a jacket or bodice formed of elastic bands, so as to yield equally in all directions, and so adapt itself perfectly to the figure of the person who is being measured.

2278. COUPLINGS FOR PIPES OR TUBES, *W. R. Lake, London.*—4th May, 1883.—(*A communication from E. R. Williams, Cape May, New Jersey.*) 6d.

This consists essentially of a coupling provided with means whereby the parts thereof may be disconnected, and when the parts or objects to which the opposite pipe or lengths of hose may be attached separate or are uncoupled, as in the case of railway vehicles, the clamps of the coupling are automatically released and the coupling is thereby disconnected.

2279. CONSTRUCTION OF SADDLE BARS, *E. Ratcliffe and O. Sealey, Malmesbury.—4th May*, 1883. 2*d*.
This relates to improvements in the construction of saddle bars, whereby the stirrup leather is safely secured in a simple manner, whilst at the same time the said leather can be readily disengaged when desired.

2282. OPEN FIRE PORTABLE COOKING RANGES, *T. J. Constantine, London.—4th May*, 1883. 6*d*.
The object is partly to fit or arrange a vibrating bottom grate on centres to a portable cooking range, so that the fire can be shaken and the closely packed fuel disturbed, the dust or ashes being caused to fall and clear the bottom of the fire and the bottom grate as to permit of a free ingress of air to feed itself into and through the fire.

2283. CLEANERS FOR THE TUBES AND OTHER PORTIONS OF FEEDING BOTTLES, &c., *F. Cook, London.—4th May*, 1883. 6*d*.
The cleaners are formed of twisted wire and the like, and at one end have a plate or disc having a hole through it to allow the air to pass as the disc is drawn through the flexible tube to be cleaned, which otherwise is apt to collapse.

2284. CRANES, *C. J. Appleby, London.—4th May*, 1883. 10*d*.
This relates to several improvements in the general construction of steam cranes.

2286. SELF-ACTING POINTS AND SWITCHES ON TRAMWAYS, *R. F. Edbrooke, Liverpool.—5th May*, 1883. 6*d*.
The object is to provide means by which tramcars, &c., can be easily transferred from one line to another without the aid or assistance of anyone specially appointed for that purpose.

2287. MACHINERY FOR CUTTING METALS, *W. W. Hulse, Manchester.—5th May*, 1883. 6*d*.
The chief object of the improvements is to give greater steadiness and truth to the cutting operation, to diminish the wear-and-tear, and to provide means for counteracting the wear.

2288. CONSTRUCTION OF FRAMES OR STANDS FOR HOLDING BOTTLES, &c., *J. B. Walker, Sheffield.—5th May*. 1883.—[*Not proceeded with.*) 2*d*.
This relates to the construction of lock-up stands.

2289. TURKEY-RED DYEING FOR COTTON YARNS AND CLOTH, *J. W. Hoffmann, Manchester.—5th May*, 1883.—(*A communication from C. Seeber, Germany.*)—(*Not proceeded with.*) 2*d*.
This relates to improvements in the whole process.

2292. APPARATUS FOR MEASURING AND RECORDING THE VELOCITY OF SHIPS, CURRENTS, AND MACHINERY, *A. T. H. Scott, London.—5th May*, 1883.—(*A communication from J. M. Langdale, Paris.*)—(*Not proceeded with.*) 2*d*.
This relates to the construction of an electrical apparatus.

2293. COMPOUND FOR RENDERING TEXTILE FABRICS, WOOD, &c., FIREPROOF, *H. J. Haddan, London.—5th May*. 1883.—(*A communication from L. Gimenez and J. Yrigoyen, Pamplona, Spain*)—(*Not proceeded with.*) 2*d*.
31 grammes of the bark of iron wood and 2 grammes of sea-salt are added to 1 litre of pure water, which is allowed to macerate and then decanted. To 1 litre of water thus treated are added 140 grammes of sulphate of zinc, 125 grammes of alum, 125 grammes of sal-ammoniac, and 2 grammes of fish glue. The mixture is then heated and allowed to cool, and then passed through a sieve.

2294. TREATMENT OF HOPS AND APPARATUS THEREFOR, *A. J. Boult, London.—5th May*, 1883.—(*A communication from F. T. U. Deinhardt, Germany.*) 8*d*.
This relates to the method of boiling hops.

2295. APPARATUS FOR SEPARATING WATER FROM STEAM, &c., *E Edwards, London.—5th May*, 1883.—(*A communication from J. J. Godot, Paris.*)—(*Not proceeded with.*) 2*d*.
This relates to steam traps or apparatus used for drying steam from steam boilers, by separating from it water suspended in it.

2296 MANUFACTURE OF DYES, *G. A. Bang, Leeds.—5th May*, 1883.—(*A communication from G. A., E., and R. Dahl, Barmen.*) 4*d*.
The inventors claim, First, the production of azo dyes by the action of diazobenzol, diazotoluol, diazoxylol, diazoazobenzol, diazoazoxylol, diazoatoluol, and compound diazoazo combinations, diazoanisol, diazonaphthaline, and the corresponding sulphates or monosulphate of alphanaphthaline derived from naphthaline; Secondly, the production of an azo dye by direct conversion of monosulphate of diazoalphanaphthaline.

2299. CONVERTING ANTHRAQUINONE INTO A MONOSULPHO ACID OF ANTHRAQUINONE, &c., *I. Levinstein, Manchester.—7th May*, 1883.—(*Not proceeded with.*) 2*d*.
This relates to and consists in a mode and arrangements for converting anthraquinone.

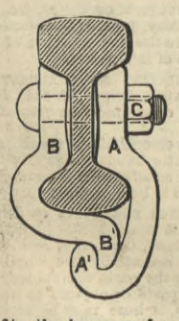
2300 MANUFACTURE OF ALPHA AND BETA NAPHTHOL, *I. Levinstein, Manchester.—7th May*, 1883. 4*d*.
The inventor fuses the sodium salts of the sulpho acids of naphthalene with caustic soda in the usual manner, and when the whole is fused he allows the mass to settle a few minutes, taking care to keep the whole fluid, when two substances will separate from each other, of which the one floating on the top consists principally of naphtholate of soda, while the other is principally composed of sulphite of soda, some caustic soda, and of some impurities of the caustic. The naphtholate of soda is treated in the usual way, viz. by dissolving it in water, and precipitating the naphthol by means of acid from its solution. The bottom layer, which is called the crude sulphite, is dissolved in water, and the solution of the same is used for converting the sulpho acids of naphthalene into their sodium salts.

2301. CONSTRUCTION OF COMBINED STEAM AND HOT AIR GENERATOR, *W. Turnbull, New Hampton.—7th May*, 1883.—(*Not proceeded with.*) 2*d*.
This relates to the combination of tubular receptacles, flues, and pumps, in which the waste heat from the furnace of a steam boiler will be utilised for heating air in a second receptacle or vessel combined and connected with the said steam generator, such second vessel or receptacle being supplied with compressed air forced therein by suitably arranged pumps.

2343 PACKING FOR PIPE AND OTHER JOINTS, *E. Marechal, Liège.—8th May*, 1883. 2*d*.
The packing is composed of minium, white lead, hair, and linseed oil.

2353. FISH JOINTS FOR RAIL AND OTHER SIMILAR JOINTS, *A. S. Hamand, Westminster.—9th May*, 1883. 6*d*.
In one form of fish joint for double-headed rails

2353



one fish-plate A fits the inner surface of the upper and lower heads, and extends downwards, terminating in a hook A^1. The second plate B also fits the upper and lower end B^1, being formed to engage the hook A^1. Bolts C secure the plates together at their upper part. Modifications are shown for a single-head rail

2372. SHIP WINDLASSES, *F. S. Manton, Rhode Island, U.S.—9th May*, 1883.—(*Complete.*) 6*d*.
The object is to construct the ship windlasses, so that they will be better able to withstand the strain in all directions to which windlasses are subjected; another object is to operate the same either by hand-power through the capstan, or by steam power through a worm and worm gear; another object is to construct the wild-cats, so that while the same can be rigidly locked, the same can be quickly unlocked; another object is to secure a firm thrust-bearing for the worm, and a further object is to lubricate the worm and worm gear automatically.

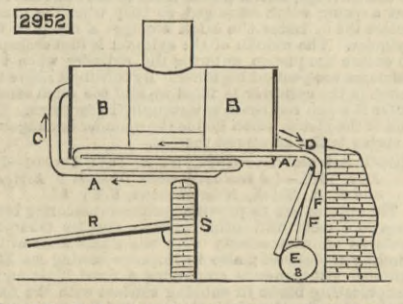
2400. LOOMS FOR WEAVING WIRE, *E. Lucas, Balsall Heath, Worcester.—11th May*, 1883. 1*s*. 2*d*.
This relates to several improvements in the general construction of the looms.

2724. APPARATUS FOR CONVERTING RECIPROCATING MOTION INTO ROTARY MOTION IN STEAM OR OTHER ENGINES, *W. R. Lake, London.—31st May*, 1883.—(*A communication from F. Zassenhaus, Cleve, Germany.*) 6*d*.
The invention consists essentially in providing the piston-rod of a steam or similar engine with a rack engine with a rack bar, and in combining with the said rack bar and the driving shaft of the engine suitable intermediate mechanism, for continuously and uniformly transmitting or converting the reciprocating motion of the said bar into the rotary motion of the said shaft.

2853. MANUFACTURE OF METAL HANDLES FOR KNIVES, FORKS, &c., *C. D. Abel, London.—7th June*, 1883.—(*A communication from W. Lorenz, Carlsruhe, Germany.*) 6*d*.
The handles are drawn and stamped out of one piece of metal.

2952. STEAM BOILERS OR GENERATORS, *W. R. Lake, London.—13th June*, 1883.—(*A communication from A. H. Crockford, Newark, New Jersey, U.S.*)—(*Complete.*) 6*d*.
Coiled pipes A are placed preferably around the bottom of a boiler B over the fire bridge S, and are connected with the front of the boiler at the top below the water line by the pipes C, and with the rear of the

2952



boiler at the bottom by pipes D. The sediment drum E and pipes F are connected at F1 with the said coiled pipes A and the said pipes D leading from the rear of the boiler, and also with the sediment drum E. The pipes in which the steam is generated may be placed directly over the fire R, and having a small heating surface compared with the boiler, great economy in fuel is thereby assured.

2995. APPARATUS FOR MANUFACTURING METALLIC ALLOYS, MORE PARTICULARLY THOSE OF ZINC, *G. Selve, Altona, Prussia.—16th June*, 1883. 6*d*.
The inventor claims, First, the method of smelting alloys, more particularly those of zinc, in closed crucibles that are situated with their lower parts in the furnace, while the upper parts project out of the same, whereby the zinc vapours generated in the lower hotter layers of metal become condensed in rising up into the cooler upper layers. Secondly, in smelting zinc alloys, the method of effecting the condensation of the zinc vapours generated in the lower part of the crucible by means of cooler upper layers of metal therein. Thirdly, the construction of furnaces for smelting metallic alloys, wherein the crucibles are only partly contained in the furnace chamber, the upper part thereof being made to project out of the furnace.

3039. FAN WHEELS, *W. Schmolz, San Francisco.—19th June*, 1883.—(*Complete.*) 4*d*.
This relates to the combination of circular tapering rims, the hub, blades or fans, radiating from the hub, and set at an angle to the plane of revolution, and plates or braces, set at an angle to the radial line drawn from the centre of the wheel.

3050. ROTARY BLOWING AND EXHAUST FANS, &c., *H. Aland, London.—20th June*, 1883.—(*Complete.*) 8*d*.
This consists of increasing the suction of the inlets of rotary fans to the size, or nearly to the size of the diameter of the revolving disc, and in which revolving disc inlets are formed from the partially exhausted case either on one or both sides of the said revolving disc, in addition to the central inlet or inlets, as in ordinary fans hitherto in use, so that as soon as the said revolving disc or propeller is set in motion a small partial vacuum is created in the case, and the revolving propeller or disc is formed so as ao receive the smaller partial vacuum in the case into a much greater vacuum in the disc or propeller, when the air or vapours submit to the laws of compressed fluids, which is equal in all surfaces in compression or partial vacuum.

3289. PERSPECTIVE DRAWING APPARATUS, *H. J. Haddan, London.—3rd July*, 1883.—(*A communication from W. S. Worden, Nebraska, U.S.*)—(*Complete.*) 4*d*.
This relates to apparatus or devices for freehand perspective drawing.

3326. DRAWERS, *G. Macaulay-Cruikshank, Glasgow.—5th July*, 1883.—(*A communication from W. Benger Sons, Stuttgart.*)—(*Complete.*) 4*d*.
This relates to the employment of a double layer of woollen or other stuff over the abdomen.

3391. CARBURETTERS, *H. J. Haddan, London.—9th July*, 1883.—(*A communication from W. M. Jackson, Providence, U.S.*)—(*Complete.*) 6*d*.
This relates to improvements in metrical carburetters for the distribution of hydrocarbon fluids to gas or air to be used for illuminating and heating purposes, and it has for its objects to provide certain improved means whereby the hydrocarbon fluid may be supplied in automatically regulated quantities to the air or gas.

3704. FEED FOR ROLLERS AND PURIFIERS, &c., *R S. Piercy, Blackburn.—28th July*, 1883.—(*Complete*) 4*d*.
The object is to automatically regulate the feed from the hoppers to the rollers, so that, however unevenly the hoppers are fed, by this arrangement the feed to the rollers is regulated and self-adjusting, and so evenly distributes the substance to the rollers along the entire length.

3705. RACKS FOR STORING AND IMPROVING OR AGEING WHISKY, &c., *B. Smith, Liverpool.—28th July*, 1883.—(*A communication from C. M. Johnson, Lexington, U.S.*)—(*Complete.*) 6*d*.
This relates to the general construction of the racks.

3713. RADIATING AXLES FOR RAILWAY CARRIAGES, &c., *L. S. Zachariasen, Christiania.—30th July*, 1883.—(*Complete.*) 4*d*.
The axles are made to radiate by the use of a separate frame for carrying the usual fittings, which frame is independent of the carriage and connected to it.

3733. TYPE MATRICE MACHINE, *M. H. Dement, London.—31st July*, 1883.—(*Complete.*) 6*d*.
The object is to provide a mechanism for making type indentations or embossment in or upon strips or sheets of paper or other suitable material, from which material, when so indented, metallic or other casts may be made to form stereotypes, from which a print may be taken, or from which lithographic copies may be made.

3734. APPARATUS FOR PUTTING STEREOTYPED LINE STRIPS IN COLUMN OR PAGE FORM AND JUSTIFYING AND SECURING THE SAME, *M. H. Dement, London.—31st July*, 1883. 8*d*.
This consists generally of an apparatus by means of which the type bars may be broken in pieces of any desired length, and put in page or column form, to be printed from or again stereotyped.

3837. ADJUSTABLE CHAIRS CHIEFLY DESIGNED FOR PHOTOGRAPHIC PURPOSES, *W. R. Lake, London.—7th August*, 1883.—(*A communication from W. S. Liscomb, Providence.*)—(*Complete.*) 6*d*.
This relates to the means for adjusting the backs of the chairs.

3931. FLUID METERS, *H. H. Lake, London.—14th August*, 1883.—(*A communication from F. G. Hesse, California, U.S.*)—(*Complete.*) 6*d*.
This relates to meters for measuring fluids, and especially water, by the velocity and force under pressure of a "head." The object is to cause such meters to fulfil as far as practicable the following conditions—that is to say, the meter is, first, to register the quantity of water flowing through with approximate accuracy, whether the quantity of such water be very large, or so small as to flow at the rate of, say, one gallon in from ten to thirty minutes; secondly, to be durable by having its wear from friction or other cause reduced to a minimum; and thirdly, to be comparatively cheap as regards cost of construction.

3966. BUTTON FASTENER, *W. R. Lake, London.—15th August*, 1883.—(*A communication from E Kempshall, New Britain, U.S.*)—(*Complete.*) 6*d*.
The button fastener belongs to that class of metallic devices by which buttons can be firmly secured to boots and shoes, without the use of a setting tool specially devised for that purpose.

3989. PROCESS AND APPARATUS FOR PRODUCING WROUGHT IRON, *E. P. Alexander, London.—17th August*, 1883.—(*A communication from L. D. Chapin, Chicago.*)—(*Complete.*) 6*d*.
This relates to an improved process and to the general construction of the apparatus for carrying such process into effect.

4036. MANUFACTURE OF FERTILISERS, *H. J. Allison, London.—21st August*, 1883.—(*A communication from The Scribner Process Company, Incorporated, New York.*)—(*Complete.*) 4*d*.
The invention consists in simultaneously exposing ferruginous and aluminous phosphates to the action of applied heat and sulphur, or, in other words, bringing into contact with the phosphates, while hot, either the vapour of sulphur or sulphurous anhydride.

4044. MANUFACTURE OF FIBROUS PACKING FOR CAR AXLE-BOXES, *S. Pitt, Sutton.—21st August*, 1883.—(*A communication from W. H. Perrine, New York.*)—(*Complete.*) 2*d*.
This relates to the use of the fibrous product of bamboo, cane, or reed, either separately or in combination with other materials, as packing for car axle-boxes.

4058. STOPPERS FOR BOTTLES, *H. H. Lake, London.—21st August*, 1883.—(*A communication from F. B. Thatcher and J. W. Johnson, New Britain.*)—(*Complete*) 6*d*.
This comprises an elastic moulded stopper of peculiar construction, and a novel combination of a neck band, a cap-plate, links, and a lever, by means of which an elastic stopper is properly confined within the neck of a bottle, and readily released.

4131. IRONING MACHINES, *C. A. Allison, London.—27th August*, 1883.—(*A communication from G. W. Cottingham, Louisville.*)—(*Complete.*) 6*d*.
This relates principally to a vertically movable iron combined with a reciprocating table and mechanism for moving the table.

4136. ELECTRIC RAILWAYS, &c., *S. Pitt, Sutton, Surrey.—28th August*, 1883.—(*A communication from L. Daft, Greenville, U.S.*) 6*d*.
A number of independent conductors laid side by side are used to supply currents where it is desired to run a number of engines on the same section of the truck. The engines are provided with a wheel for making continuous contact with one of the conductors, and it is adjustable laterally to take any of the conductors. Means are provided for magnetising the wheels, so as to cause them to act as brakes. The iron or steel wearing surfaces of the rails are provided with an internal copper conductor to lessen the resistance of the return circuit. Electro-magnets are used to increase the tractive force.

4137. ELECTRIC RAILWAYS, &c., *S. Pitt, Sutton, Surrey.—28th August*, 1883.—(*A communication from L. Daft, Greenville, New Jersey, U.S.*) 4*d*.
The invention consists in making the diameter of the armature of the motor greater than that of the driving wheel, which is keyed on to the armature shaft direct. By this means the traction is increased and the centre of gravity is kept low.

4177. DYNAMO-ELECTRIC MACHINES, *H. H. Lake, London.—29th August*, 1883.—(*A communication from G. W. Fuller, Norwich, Connecticut, U.S.*) 4*d*.
The core of the hollow cylindrical armature is composed of one or more iron spirals of like diameter and pitch. The winding of the coils traverses longitudinally the internal and external surfaces of the cylinders formed by the spirals. The spirals are centred and supported by star-shaped heads fixed on the armature shaft, the whole being longitudinally clamped together by segmental rings.

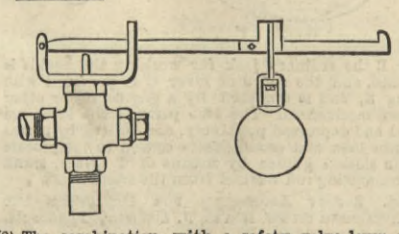
4192. DYNAMO-ELECTRIC MACHINES, *H. H. Lake, London.—30th August*, 1883.—(*A communication from G. W. Fuller, Norwich, Conn., U.S.*) 6*d*.
The cylindrical armature cone is built up of an iron plate wound spirally, and having an insulating string interplaced with its convolutions. The coils longitudinally traverse the cone upon its opposite sides.

SELECTED AMERICAN PATENTS.

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

288,710. AUTOMATICALLY RELEASING SAFETY VALVE WEIGHTS, *William T. King, Cambridgeport, Mass. Filed February 23rd*, 1883.
Claim.—(1) In a boiler safety device, a fusible connection placed between the safety valve lever and the weight, substantially as and for the purpose set forth.

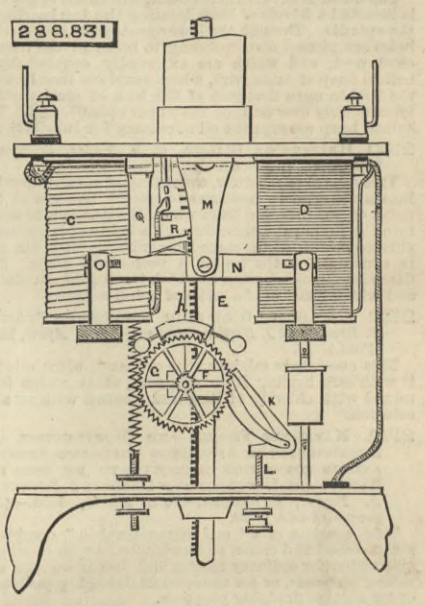
288,710



(2) The combination, with a safety valve lever of a fusible and combustible connection placed between the lever and the weight, substantially as and for the purpose set forth.

288,831. ELECTRIC ARC LAMP, *Thomas J. McTighe and Joseph T. McConnell, Pittsburg, Pa.—Filed July 30th*, 1883.
Claim.—(1) In an electric arc lamp, the combination of a helix, its armature, a carbon-feeding rod, and a lever oscillated by said armature and communicating its motion to the carbon-feeding rod through a changeable fulcrum, and adapted to mechanically equalise the variable attraction of said helix and exert a substantially uniform influence on the carbon rod, substantially as described. (2) In an electric arc lamp, the combination, with a carbon rod, connected with and adapted to operate an escapement wheel, of a lever having a detent on its longer arm adapted to engage with the escapement, and a stop which impinges on the shorter arm of said lever, substantially as described. (3) In an electric arc lamp, an oscillating lever deriving movement from the helix in the arc circuit, a carbon-feeding mechanism, and a supplemental or compounding lever interposed between said oscillating lever and carbon-feedin mechanism, and adapted to differentiate the attractive power of the helix, substantially as described-

288,831



(4) In an electric arc lamp, the combination of the lever R, pivotted to the fixed standard Q at one end, and at the other end engaging with the carbon rod feeding mechanism, bracket M, and the oscillating lever N, pivotted therein, embracing the carbon rod and engaging at its respective ends with the armatures of the main actuating helix C and the high resistance derivation helix D, substantially as described. (5) In an electric arc lamp, the combination, with the toothed carbon rod E, of the box F, carrying the feeding and releasing devices, said box having the upward extension *h*, and being connected with the electro-magnetic operative devices at its upper end, substantially as described. (6) In an electric arc lamp, the combination of box F, carrying pinion *b*, and escapement G, with lever K, pivotted to an arm on said box, having a detent on one end adapted to engage with said escapement, and impinging on a set screw L, at the other end, substantially as described.

CONTENTS.

THE ENGINEER, December 28th, 1883. PAGE