GAS ENGINES AT THE INVENTIONS EXHIBITION.

No. I.

THE display of gas engines is, as might be expected, a very fair one, and includes a considerable number of those already well known, and a few which present novel features worthy of a detailed description, which we shall give in future impressions. Our present object is to give a brief and general outline of the exhibits under this head, without entering fully into the description of any one. It has not been to the interest or credit of any person, or to the Patent-office authorities, to exhibit a Lenoir or a Hugon engine, although it is to these that the modern engines owe their existence, and both were made since 1862, the commencement of the period which the Exhibition is supposed to illustrate.

At Messrs. Crossley's stand, in the Middle Court, there is a fine display of engines, all of which leave nothing to be desired as regards finish. They show a ¾-horse power vertical engine of very neat design, and silent in its work; also horizontal engines of 5½ and 4-horse power nominal, and a twin-cylinder engine of 7-horse power nominal, which runs very steadily, the crank receiving an impulse at every revolution, for which they claim considerable economy. One of their 16-horse power engines drives some of the printing machinery in the East Gallery, and runs very regularly, notwithstanding the variation in amount of power required. Messrs. Crossley Brothers have also a number of other engines on loan to different exhibitors—in all about fifteen engines.

At Messrs. Louis Sterne and Co.'s stand is a well-finished engine, Clerk's patent, of 6-horse power nominal. This engine is now too well known to need a lengthened description; but it has recently received some important improvements, and it may serve to refresh the memory of some of our readers to restate the prominent feature. The engine comprises two cylinders—a working and a displacer cylinder. Into the latter a combustible mixture of air and gas is drawn, slightly compressed on the return stroke, and discharged into the working cylinder, driving before it almost the whole of the small quantity of residual products left after the free exhaust from the motor cylinder. The mixed air and gas is again compressed in the motor cylinder to a pressure of about 45 lb., when the charge is exploded. This series of operations takes place each revolution; the engine, in consequence, runs with great regularity and gives out a large amount of power for space occupied. This engine has attached to it one of Clerk's patent self-starters, by means of which turning by hand is avoided; they are made in sizes from 2 to 12-horse power nominal.

Messrs. Körting Brothers show two engines of the vertical type at their stand No. 1240—a ½-horse power and 2-horse power nominal. In these engines the slides are dispensed with, and are replaced by drop valves, worked by a somewhat complicated system of gearing and cams. Very small consumption of gas and oil is claimed; but we have no figures before us.

The most striking exhibit in this class will be found at the stand of the British Gas Engine and Engineering Company, stand No. 446, Middle Court, South Gallery. The company shows a 3½-horse power nominal horizontal engine—Atkinson's patent—having a separate compression cylinder, the working piston receiving an impulse at each revolution of the crank, thus giving regularity of motion. This engine has several novel features, which we shall describe more fully hereafter. The most prominent exhibit at this stand is, however, Atkinson's patent differential compression engine. Its novel appearance attracts great attention. It consists briefly of a cylinder open at both ends, and having two pistons, each of which is connected with a lever which transmits the power to the crank. There are no slide valves, the two pistons accomplishing the drawing-in of the charge, compression, and regulation of ignition. Thus great simplicity is effected without impairing the efficiency of the engine; in fact, owing to the peculiarity of the motion of the pistons, the effective power is increased, as the combined gas and air are after ignition thereby expanded to twice their original volume; so that when the exhaust is opened the gases are at a pressure equal to or very little more than that of the atmosphere. This is a very marked improvement, as in most, if not all, other gas engines the exhaust is opened at a time when the gases have considerable pressure, thus losing power, or causing a waste of gas. This engine we shall also illustrate fully in another impression.

Close by Messrs. Crossley's stand are shown two engines made by Messrs. Benyon and Cox, Torquay, and known as the Wither's patent, a horizontal and a vertical engine, the power of which is not stated. They are of simple and neat design, having few working parts, but as they are not in motion we cannot express an opinion as to their working; but from the testimonials they have received they appear to give satisfaction.

Messrs. J. E. H. Andrew and Co., of Stockport, exhibit a 2-horse power Stockport and a 2-man power Bisschop engine, both of which are exceedingly well finished, the Stockport engine especially working very steadily and as silently as could be desired. These engines have been recently described in our columns, but some improvements have been recently made in them. Messrs. Clarke and Gillespie exhibit a small horizontal engine, which we shall illustrate, as it has at least the merit of the greatest simplicity.

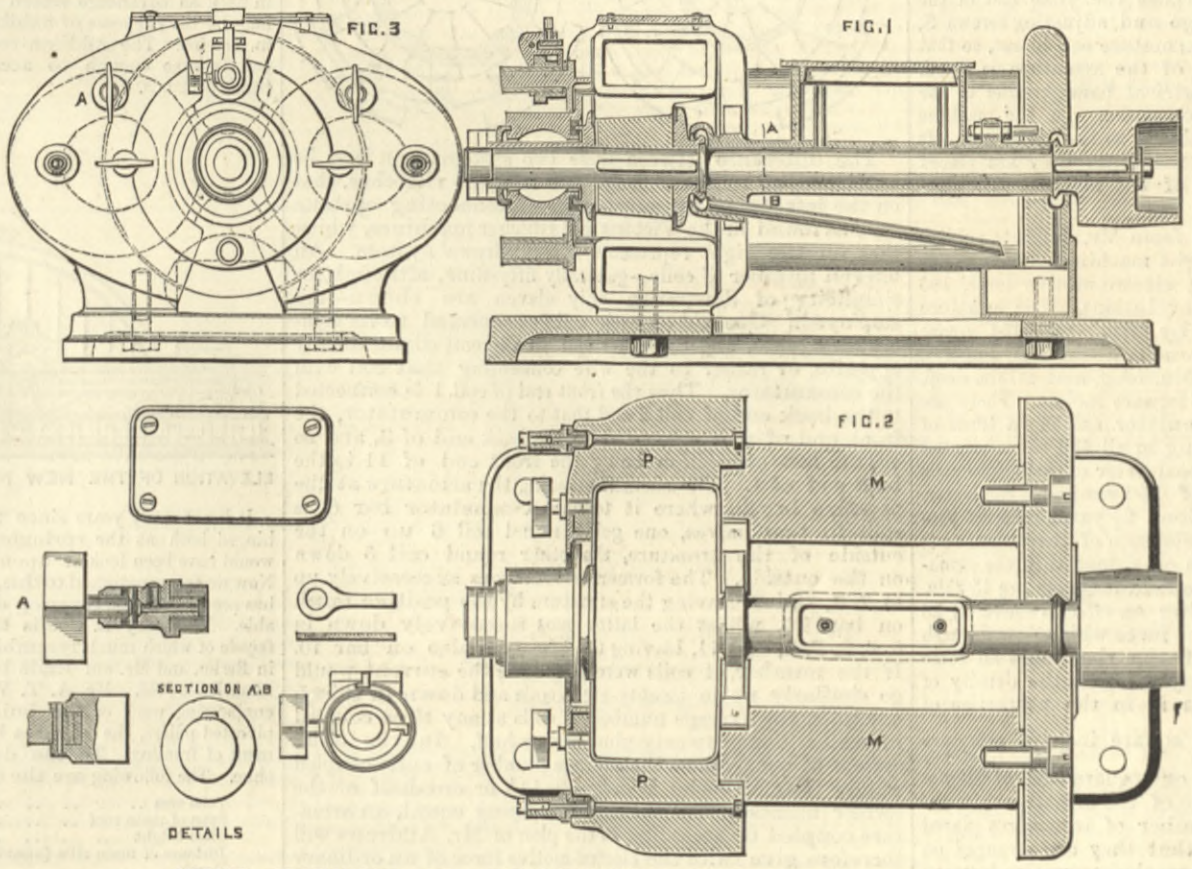
Messrs. Limb and Co. show a small diagonal engine of novel design, the distribution of the gases being effected by a valve in the piston itself. We hope to give a full description of this engine also, as its simplicity seems to call for further notice.

Messrs. Tangye exhibit at their stand a small horizontal engine, fitted with a very simple governor of new design, which has been recently described in our columns. This appears to be the only point of novelty, the general arrangement of the engine being unaltered. The workmanship fully maintains the reputation of the firm.

Mr. W. Eaton exhibits a small vertical engine patented by himself, the power of which is not stated. The design is very simple, and is worth the inspection of those interested in gas engines.

In the yard delegated to tramways is a horizontal engine of very compact design, having working cylinders, 5½ft. by 10in., which gives off 3-horse power on brake. It is called the "Griffin," and is manufactured by Messrs. Dick, Kerr, and Co. It drives a small dynamo for supplying some incandescent lamps about the yard. We may possibly have something further to say about this engine.

Notwithstanding the length of time that gas engines have been before the public, comparatively little seems to be generally known as to the relative merits of each system of construction and working, It would be of great advantage, therefore, if this collection of gas engines was made available by the Inventions Exhibition authorities for a systematic course of trials, organised and reported upon by a committee of independent experts. The relative merits of each type of engine would then be fairly stated, and the data obtained would be invaluable. This is a duty which should be looked upon as incumbent upon the Acting Committee of the Exhibition. Unless such work as this is done by it, it is difficult to see any reason for permitting Government aid to be given in numerous ways to this exhibition any more than to any other exhibition attached to pleasure grounds.

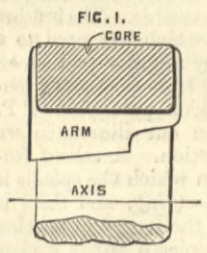


MESSRS. GREENWOOD AND BATLEYS "JONES" DYNAMO-ELECTRIC MACHINES

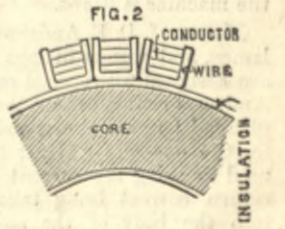
ELECTRICAL ENGINEERING AT THE INVENTIONS EXHIBITION.

No. VIII.

MESSRS. GREENWOOD AND BATLEY, of Leeds, show several "Jones" dynamos and a number of Armington-Sims engines, of which they are the sole makers in this country. These engines are well worth careful examination, as they have largely been used in America for driving Edison and other dynamos, and are said to perform this class of work very satisfactorily; but as engines do not properly belong to subjects treated of in these articles, we cannot enter here into a description of the Armington-Sims engine, and must restrict our notice to the Jones dynamo. This is a Gramme machine, the field-magnets of which are placed parallel to the spindle. At the Vienna Electrical Exhibition, in 1883, could be seen a large number of Gramme machines constructed in a similar manner by an Austrian firm, but in England the Jones dynamo and a machine made by Messrs. Andrews and Co., which we shall describe presently, seem to be the only representatives of this type. We exclude, of course, disc machines like the "Victoria," "Schuckert," or "Gülcher," in which the field-magnets are also arranged parallel to the spindle. These, on account of the shape of their armatures, are altogether a distinct type. The armature of the Jones dynamo is a cylindrical Gramme ring, and has a core composed of charcoal iron wire insulated by a single covering of cotton. The object of this insulation is to prevent internal currents which would absorb power and heat the core. It is, however, doubtful whether such insulation is necessary. In the original Gramme machine it has not been adopted, and it is probable that the insulation does more harm than good, inasmuch as the intervening layers of cotton decrease the magnetic continuity of the core—which with wire is already less than with discs—and thus a greater exciting power on the field-magnets is necessary in order that the core may be magnetised throughout its whole radial depth. From a theoretical point of view, we should certainly expect that a core consisting of naked iron wire coiled tightly into a compact cylindrical ring would offer considerable facilities for the circulation of wasteful internal currents; yet in practice this has not been proved conclusively. A great number of machines have such cores, and we do not find that they heat any more than others. It may be that although the wire is tightly coiled, the contact between neighbouring wires is, after all, only along a mathematical line, or it may be that the local currents circulating within each wire prevent the formation of a large current flowing round the surface of the core. What really happens in such a case has as yet not been satisfactorily explained, and we venture to think that on the value of insulating the wires of a Gramme core very different opinions are held by electricians themselves. To test the matter from a practical point of view, the author has made the experiment of revolving a Gramme core consisting of naked iron wire in a strongly excited field. The core was 15in. long, 10in. external and 6in. internal diameter, and presented therefore a surface of 30 square inches for the circulation of wasteful currents. Although the intensity of the field was increased far beyond the value customary in commercial dynamos, no appreciable heating took place after several hours' run, and this experiment would therefore tend to show that the insulation of the wire is not necessary. But we must return to the description of the Jones dynamo, which, by the courtesy of the inventor, we are able to illustrate in Figs. 1, 2, and 3. The core of the armature A consists, as mentioned above, of cotton-covered iron wire wound on a flanged mandril, the length being about twice the radial depth. It is supported by a number of flat U-shaped webs or arms pushed over from the inside, as shown in the annexed sketch, the inner edge of the arms being taper, and let into grooves on a central hub of fibre, as will be seen from Fig. 1. They are held in place longitudinally by being pressed tightly between two gun-metal discs insulated by fibre rings. The webs are stamped out of sheet iron, and it is claimed that they assist in reinforcing the magnetic field. As, however, most of their mass is on the inside of the core, this advantage is probably not very great. We should be rather inclined to think that they short-circuit some of the lines of force across the inner cavity of the core, and in that case webs of thin phosphor bronze would perhaps be preferable. A very good point in Mr. Jones' armature is the perfect insulation of the core from the shaft. The danger of a short circuit between the core and an armature coil—or a "nigger," as it is called with characteristic terseness by American dynamo men—is thereby greatly lessened. In fact, if the short circuit takes place only in one point, the machine might continue to work with perfect safety.



The armature conductor is a copper ribbon laid on flatwise. The winding is commenced by placing the middle of the total length of ribbon intended for one section against the inside of the core inclined at a slight angle to the axis, so that when the two halves are brought over the outside of the core they miss each other by a small distance, forming two turns side by side on the external periphery. Any requisite number of layers can thus be wound on. The advantage of this system of winding—first made use of, we believe, by M. Gramme in his larger machines many years ago—is that both ends of the conductor are on the outside of the coil, and no room is wasted in bringing the ends out. In some cases Mr. Jones inserts troughs consisting of a series of U-shaped iron wires, into which the external layers of the conductor are placed, as is shown in the annexed sketch. The object of this arrangement is to obtain the advantage of projecting teeth, by which a greater number of lines of force may be drawn into the armature He has, however, found by actual experiment that very little, if anything, is to be gained by this refinement, and some of the machines exhibited do not contain these wire troughs. When it is remembered that the wire troughs cannot be immediately in contact with the surface of the core, but that a layer of insulation at least

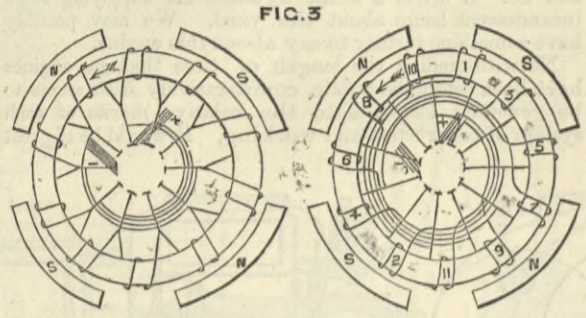


$\frac{1}{16}$in. thick intervenes, it can hardly be expected that the magnetisation of the cores should by these small wires be materially increased. The coils are connected up amongst each other and with a commutator in the usual manner. In machines for very heavy currents and low electromotive forces the conductor is of square section, and only one layer is wound on the outside of the core, the ends of neighbouring coils being soldered up without being brought out to the commutator. Connection with the latter is made by a series of L-shaped copper pieces, one end of which is soldered to the radial part of each coil, whilst the other is soldered to the corresponding plate of the commutator. The construction of the latter is clearly shown in the illustration, Fig. 1. The plates, which against each other are insulated by mica, are made of phosphor bronze, and are arched out internally to reduce their weight. They are held together by two rings of fibre, which are clamped by means of a screw between two flanged discs of gun-metal. The commutator being on the extremity of the shaft is very accessible. The brushes are mounted on insulated ferrules which are fixed to a brass ring capable of being set to any angular position on another brass ring, which at the same time serves as a connecting piece between the two cast iron pole pieces P P. As all the details are clearly shown in our illustration we need not enter into a minute description. A salient feature of the machine is the manner in which the spindle is supported. The armature is overhanging, and there is only one bearing of Mitstand metal, the length of it being about 9 diameters. Since the pole pieces partly enclose the armature on its two radial faces, it is extremely important that it should be firmly held in a longitudinal direction, and if need be, that an adjustment can be made in that direction. For this purpose the yoke end of the bearing is provided with a flange and adjusting screws S, by which the whole shaft and armature can be set, so that the clearance on either side of the armature is equal. The magnet cores are two cylindrical bars parallel to the spindle and joined by a cast iron yoke. In the machine we illustrate the magnets are placed to the right and left of the spindle, but in larger machines they are placed above and below it. The base of the machine is a plate of zinc.

We have received permission from Mr. Jones to publish the electrical data of his 100-light machines, which are as follows:—Current, 64 ampères; electro-motive force, 100 volts at terminals; speed, 950 revolutions. The armature is wound with flat tape ·22in. by ·07in., or ·0154 square inches, and the density of current is about 2100 ampères. The core is 14·5in. diameter, 6·5in. long, and 2·75in. deep, giving an effective area of 17·8 square inches. There are fifty-two sections in the commutator and eight turns of conductor to each section, making in all 416 turns counted all round the armature. The perimeter of armature coils is about 22in., giving a total of 250 yards of conductor. Thus at a speed of 950 revolutions $2\frac{1}{2}$ yards of wire produce 1 volt. The calculated resistance of the armature is ·106 ohms, consequently the loss of potential in the armature 6·85 volts. The cores of the field magnets are 15·25in. long and 5·75in. diameter, giving an effective area of 26 square inches. Since the lines of force which flow through the armature on both sides of the ring must all come through one magnet core, it follows that the density of lines in armature and magnets is in the proportion of $\frac{26}{2 \times 17{\cdot}8} = {\cdot}73$; hence, if one square inch of armature core carries seventy-three lines, one square inch of magnet core carries 100 lines. The core of the armature is, however, not solid iron, but a number of iron wires placed close together. If we assume that they are arranged on true vertical and horizontal lines, the proportion between gross area of core and area actually occupied by iron is as $4 : \pi$; and consequently the area offered for the accommodation of lines in the core is only ·78 of the gross area, that is, nearly that of the magnet cores. The magnets are compound wound, viz., one layer of ·200 square wire, and twenty-four layers of ·042 round wire. There are sixty-nine turns of main wire on each magnet and the total length of wire on both magnets is 72 yards; resistance, ·043 ohms; density of current in main coils, 1600 ampères; loss of potential, 2·8 volts. The twenty-four layers of shunt wire have a total length of 7800 yards and a total resistance of 144 ohms; current through shunt, ·7 ampère; density of current, 500 ampères. From these data we can calculate the electrical efficiency of the machine as follows:—Internal electrical energy, $64{\cdot}7 \times 109{\cdot}65 = 7100$ watts; external electrical energy, $64 \times 100 = 6400$ watts; therefore efficiency $\frac{64}{71} = 90$ per cent. The maximum exciting power of main coils is 7800 ampère-turns; that of the shunt coils is 8700; total, 16,500 ampère-turns. The calculated weight of copper on this machine is:—Armature, 43 lb.; main wire, 34 lb.; series wire, 124 lb.; total, 201 lb. At 1000 revolutions per minute the output of this machine would be about 6800 watts, or about 34 watts for every pound of copper. This figure might be somewhat increased by allowing a greater density than 500 ampères in the shunt wire. The total weight of the machine is 10 cwt.

Messrs. J. D. F. Andrews and Co. exhibit dynamos, arc lamps, and various fittings for incandescent lamps, which are designed with special reference to ship lighting. Mr. Andrews maintains that the two-wire system is too complicated for general use, and he has designed all his fittings for the one-wire system; that is to say, only one wire is used to bring the current to the incandescent lamp, the return current being taken through the fitting itself into the body of the ship or to earth, which forms the return circuit. The merits of the one and two-wire systems have of late been thoroughly thrashed out in the discussion on Professor Jamieson's paper read before the Institution of Civil Engineers, and general opinion was then found to be most in favour of the two-wire system. If the highest class of insulation is wanted anywhere, it is on board ship, and by having both the out and home circuit insulated the factor of safety is certainly double that which can be had with the one-wire system. Besides, it is not always easy to get from every lamp to the hull of the ship especially if the fittings, as is generally the case, are fixed to woodwork, and the trouble and expense of making what electricians call a "good earth" is greater than the cost of a return circuit. But we do not propose to enter in detail into Mr. Andrews' system, as we shall describe his arc lamp and incandescent fittings in a future issue. For the present we shall limit ourselves to noticing his dynamo, which might be described as a modification of a four pole Gramme machine. The connection between the coils of the armature is, however, totally different from that adopted by M. Gramme, and is very ingenious. If we take an ordinary Gramme armature and place it between four poles, we can take off the current by two pairs of brushes, or by one pair of brushes set 90 deg. apart and equivalent internal cross connections, the total current being twice as strong as that obtainable from the same armature when placed between two poles only. The multiplication of poles does not increase the electro-motive force, but merely the current. Now, in Mr. Andrews' system of winding the multiplication of poles increases the electro-motive force, but not the current, or, if an increase of electro-motive force is not wanted, the speed may be proportionately decreased.

FIG. 3

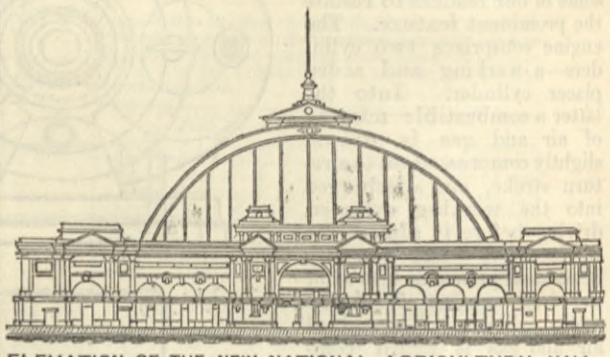


The difference between these two systems can best be explained by reference to the two annexed sketches, that on the left being the usual mode of connecting opposite coils as found in the Victoria and Gülcher machines, whilst that on the right represents Mr. Andrews' system. An uneven number of coils—generally fifty-nine, although for simplicity of illustration only eleven are shown—are employed. One end of each coil is connected to its commutator plate, and the other end to the coil diametrically opposite, or rather to the wire connecting that coil with the commutator. Thus the front end of coil 1 is connected to the back end of coil 2 and that to the commutator, the front end of 2 is connected to the back end of 3, and so on, the last connection being the front end of 11 to the back end of 1. The current entering the armature at the negative brush, where it touches commutator bar 6, is split in two halves, one going round coil 6 up on the outside of the armature, the other round coil 5 down on the outside. The former current goes successively up in 7, 8, and 9, leaving the armature by the positive brush on bar 10, whilst the latter goes successively down in 5, 4, 3, 2, 1, and 11, leaving the armature also on bar 10. If the number of coils were fifty-nine the current would go similarly up in twenty-eight coils and down in thirty-one coils, the average number of coils at any time coupled in series being twenty-nine and a-half. In the other system of connections the average number of coils coupled at any time in series is only $\frac{59}{4} = 14\frac{3}{4}$, or one-half of the former number. All other things being equal, an armature coupled up according to the plan of Mr. Andrews will therefore give twice the electro-motive force of an ordinary Gramme armature. The total output is, however, the same, because twice the current can be got out of the Gramme armature. If, on the other hand, the core of the Gramme armature be sufficiently thick, the electro-motive force might be doubled by arranging both poles at the top to be north and both poles at the bottom to be south, the brushes being set on a horizontal diameter. The current and electro-motive force will in this case be exactly the same as in the Andrews armature. It might thus seem that no advantage is to be gained by the somewhat complicated system of cross coupling; but there is this advantage, that a somewhat lighter core can be employed. In the machine we are describing the radial depth of the armature core is, indeed, only $1\frac{5}{8}$in., whilst an ordinary Gramme armature would require a core about $2\frac{1}{4}$in. thick. The armature is $17\frac{1}{2}$in. diameter and 8in. wide. It is wound with fifty-nine coils, each consisting of six turns of conductor of 14 strand ·065 wire. The total area of conductor is ·0462 square inches, and the resistance of the armature taken from brush to brush is ·034 ohms. There are two layers of this conductor on the outside periphery of the armature, filling the same completely. No ventilating spaces are provided, and air is prevented from getting to the inside by the system of supporting the armature on wedge-shaped wooden hubs drawn together by bolts. The driving force is thus transmitted by friction pure and simple from the hub to the inner wires, from there into the core, and from the core to the outer wires which do the work. It is probably owing to the want of ventilation that the current for this machine is fixed as low as 110 ampères, which, with an additional 10 ampères for the shunt coils, gives a density of only 1300 ampères per square inch of armature conductor. If we calculate the perimeter of the armature from the size of the core, we find that each turn requires about $23\frac{1}{2}$in. of wire, giving for the 354 turns a total of 230 yards. The cross connections will take about 20 yards more, making a total of 250 yards of wire on the armature. At a speed of 500 revolutions, the electro-motive force is 110 volts, hence 2·27 yards of wire are required for every volt in the external circuit.

The field magnets are arranged in an exceedingly neat and compact manner. They form a cylinder coaxial with the armature, and held at either end in circular cast iron yokes which also serve for supporting the bearings. The core of each magnet consists of six bars, 2in. wide by $1\frac{1}{2}$in. thick, and about three times the length of the armature. These bars are placed close together, forming part of the cylindrical surface. Between the four groups of bars placed at right angles to each other there are four spaces which correspond to the neutral zones in the armature. The exciting coils are placed at either end of the cores, and are so connected that alternate N and S poles are developed in the middle of each group of bars. The distance between the inner face of the bars and the outer circumference of the armature core is $\frac{7}{8}$in. The main coils on the field magnets consist of the same wire as that used for the armature, and since two coils are coupled parallel, the density of current is also about the same. The resistance of the shunt is $8\frac{1}{2}$ to 9 ohms. The exciting power in each of the eight coils is—main, 4400 ampèreturns; shunt, 5000; total, 9400. With an external current of 150 ampères the exciting power is 11,000 ampèreturns.

THE NATIONAL AGRICULTURAL HALL.

On Tuesday the Earl of Zetland laid the foundation stone of a building which will probably often be referred to in our future pages, namely, of the hall which has been designed under the above name, but which will perhaps hereafter be known as the Royal Agricultural Hall. The hall at Islington has been a grand improvement upon that in Baker-street, in which the Smithfield Club Cattle Show was for many years held. The new hall is not only to be a great improvement upon this, but it will be a building of great interest to engineers. It will be much larger than the existing hall, while its position will make it popular from its opening. It adjoins the Addison-road Station of the Metropolitan District Railway, and by an easy railway extension will be placed in complete communication with all the railways in the country. This is in itself an advantage which tells invaluably in favour of the hall for the purposes of exhibitions as compared with any other in London. The Addison-road Station has already four lines, and is large enough to accommodate very heavy passenger traffic demands.



ELEVATION OF THE NEW NATIONAL AGRICULTURAL HALL.

It is not many years since the construction of an arch bridge hinged both at the springings and at the centre of the span would have been looked upon as a bold engineering conception. Now we are accustomed to this, and the genius of Mr. Maxam Ende has produced a roof covering design which is much more remarkable. Mr. Henry E. Coe is the architect of the new hall, the façade of which much resembles that of the new Anhalt Station in Berlin, and Mr. am Ende has been called upon to design this remarkable roof. Mr. A. T. Walmisley is also engaged upon the engineering work of the building. The roof is supported on pivotted pillars, the stresses being received by a novel arrangement of framing. To the details we shall refer at a future time. The following are the chief dimensions of the main hall:

Total area	250ft. by 440ft. = 110,000 sq. ft.
Span of main roof	170ft. 0in.
Clear height	99ft. 8in.
Distance of main ribs (apart)	34ft. 0in.
Depth	7ft. 0in.
Thickness	2ft. 0in.
Length of main roof	11ft. by 34ft. = 374ft. 0in.
Side galleries (width)	40ft. 0in.
End ,, ,,	26ft. 0in. and 40ft. 0in.
Height of gallery floor	20ft. 1½in.
Height of junction between main and side roof	45ft. 6in.
Height of springing of main rib	15ft. 8in.

The main ribs are supported on double pivotted columns, avoiding all except vertical and central strains. The horizontal and bending stresses from the ribs are resisted by wrought iron frames of an effective depth from 10ft. to 13ft., the half of each being underground, the other half occupying the back part of the aisles. The iron structure is thus complete in itself without the brick walls, and is calculated to bear a wind pressure of 56 lb. per foot square, besides the load, with ample safety. The outline of the main ribs is a simple semi-circle, and is very strongly marked by the great bulk of the ribs 7ft. by 2ft., but this outline is developed into much detail, the thickness of the iron used in the roof being only ¼in. The material consists of rolled angle irons and flat bars, plates of suitable shape being used only at some of the connections. The wrought ironwork for the support of the galleries consists of angle irons and flat bars of somewhat greater thickness. Every part has the distinct function of supporting weight and pressure, and its form is that most suitable for this function. Some girders are straight, most are fish-bellied or arched, the latter are invariably continuous girders. No conspicuous ornamentation is employed, and entire reliance for architectural effect is placed in the organic grouping of the elementary bars according to the strict rules of utility. Two screens of plate glass framed in wrought iron lattice work terminate the main roof, which is also glazed on iron framework.

The offices of the company, which is very influentially supported, are at Palace-chambers, St. Stephen's, Westminster, and the proposed capital is £200,000.

TENDERS.

ASHFIELD WATERWORKS.

The following are the results of application for tenders for the construction of waterworks at Sutton-in-Ashfield, Notts, for the Local Board of Health. Contract No. 1, exclusive of ironwork. Mr. George Hodson, C.E., Loughborough, and Mr. Herbert Walker, C.E., Nottingham, joint engineers.

	£	s.	d.
Frank Dawson, Bury, Lancashire	9547	0	0
T. and W. Fisher, Mansfield	9478	0	0
Thomas Linart, Nottingham	9250	0	0
John Pickthall and Sons, Merthyr Tydvil	9086	3	7
J. Greenwood, Mansfield	8530	0	0
H. Vickers, Nottingham	7950	0	0
Foster and Barry, Nottingham—accepted	7700	0	0

RAILWAY MATTERS.

A PONTYPRIDD and Rhondda Tramway Company is being floated, with a capital of £150,000.

THE Adelaide tenderers had, at recent mail departure, complained that the Government had taken the English price-list instead of an absolute tender for the supply of ironwork for the bridges on the Hergott Railway extension, and the Employers' Association had written to the Government for information as to the data on which the comparison had been based.

THE work of reconstructing the Kent viaduct on the Furness Railway is being proceeded with. The traffic is being worked on a single line. Considerable engineering difficulties have to be contended with, but the work, when done, will make a strong and substantial job. Afterwards the Leven viaduct, on the same railway, will be reconstructed and strengthened.

THE new tramways in Barrow have been opened, and are being well patronised. There are seven of Messrs. Kitson's steam tram engines, and an equal number of tram cars, which have been built by a Loughborough firm. Another portion of the line has yet to be laid to the docks, which will complete the system, and make it, it is expected, a very remunerative undertaking.

MESSRS. M'GUIRE AND CO., the lowest tenderers for the construction of the Silverton (South Australia) Railway, had, at departure of last mail, advised the Government of a serious mistake in their tender, and had requested a return of their deposit. The Government had refused to comply with the request, and had given the contract to Messrs. C. and E. Millar, whose tender was £173,570, or £20,000 more than that of Messrs. M'Guire and Co.

THE report which will be presented at the half-yearly meeting of the Wolverhampton Railway Rolling Stock Company, to be held on the 28th inst, shows that for the past half-year the company have made a profit of £2831, which allows of a six per cent. preference, and a two per cent. ordinary dividend for the year. The number of wagons bought has been 140, and 314 have been sold during the half-year, leaving 4219 in the possession of the company.

THE *National Car Builder* says:—"The Boston and Maine road has a new parlour car called the Magnolia. It is 60ft. long, and is finished inside with mahogany. There are seventeen windows on a side. The seating consists of forty luxurious chairs upholstered in leather, each of which is numbered. It is proposed to sell them to the patrons of the road at 30 dols. per chair for the season of four months, an arrangement that proved very popular last year."

THE London, Chatham, and Dover Railway accounts for the past half year show an available balance of £70,245. Out of this the Board will recommend the payment of a dividend of £1 per cent. on the Arbitration Preference Stock for the past half year, carrying forward £14,367 as against £1333 in the corresponding period of last year. Added to the dividend of £2 5s. already paid in respect of the half year ending the 31st December, 1884, the proposed payment will make a dividend of £3 5s. for the year ending 30th June last.

THE Premier of Manitoba recently received official advice that the Manitoba and South-Western Railway will be extended to Whitewater Lake during the present year. The news has been received with considerable satisfaction by the people of Southern Manitoba, who have long looked for this important extension. A heavy crop has been sown throughout that part of the province, and the prospects for a large harvest were never better, while the extension of the railway would bring about a great improvement in the market facilities of the district.

SATISFACTORY progress had been made with the important line of railway which will connect Gravenhurst and the whole south-western parts of the province of Ontario with the main line of the Canadian Pacific Railway over the north shore of Lake Superior. The Government inspector had examined the first ten miles, from Gravenhurst to Bracebridge, and twenty further miles were expected to be ready for inspection in the beginning of July. Grading had already been carried to a point sixty miles north of Gravenhurst, and there was said to be a strong probability of the whole line being completed early in the autumn.

THE Massachusetts Railroad Commissioners wish to ascertain what effect the adoption of automatic freight-car couplers in that State has had upon accidents, and have accordingly issued the following circular to the superintendents of the roads: "In all future reports of accidents, fatal or otherwise, arising from the coupling or uncoupling of freight cars, it is desired that the nature of the couplers used should be stated. You are also requested to state to the Board as soon as may be the number and nature of such accidents that have occurred since March 1st, 1885, where either of the couplers was one of those prescribed under the law by this Board by its order of December 5th, 1884."

ON Monday last a preliminary trial was successfully made of part of the Blackpool electric tramway, which is being constructed from the designs of Mr. Holroyd-Smith. The permanent way is exactly similar to that in the Inventions Exhibition, upon which one of the fine cars for the Blackpool line is running daily. The *Blackpool Times* says:—"During one of the runs, a railway parcel van was coming down towards South Shore. It had got within 20ft. of the car, which was running at a speed of about six miles an hour, when the horse grew very restive, and backed the van right across the track. Mr. Holroyd-Smith, who was driving, turned off the current, applied the brakes, and in less than half its length the conveyance was brought to a dead stand. Had the control been less complete, or the brakes less efficacious, the parcels cart would have been made into matchwood."

THE Midland Railway Company, which has enjoyed a remarkable immunity from railway accidents, had an unpleasant experience with one of its excursions on Saturday morning. The train, composed of eighteen coaches, left Sheffield for Llandudno at 2.30 a.m. At Derby the train was divided in two, and an additional engine put on. Near Uttoxeter the connecting rod of the first engine became bent, and a goods locomotive had to take its place. After two hours' delay the two trains again proceeded on their journey, and arrived at Llandudno at 9.30 instead of 7.30. The return journey was commenced at 7 p.m. Llandudno Junction saw again the beginning of trouble, the engine attached to the first train "hitting" another engine passing over a crossing. The engine of the excursion train and the carriage next to it were thrown off the line. Fortunately the couplings did not break, and beyond some damage to rolling stock, the delay of traffic, and some slight injuries to passengers, no other consequences ensued, except that the train was an hour late in reaching Sheffield.

IN a report on a collision which occurred on the 23rd May at Boston Station, on the Great Northern Railway, Major Marindin says:—"This collision was caused by the coupling between the engine tender and the brake van becoming detached upon a falling gradient, immediately the engine began to push these vehicles back towards the passenger train. The evidence appeared to show that the shackle was not properly oiled, and that the coupling being stiff, it was pushed off the hook when the engine began to set back. I think that the best means to adopt in order to prevent the recurrence of an accident from a coupling coming loose would be to fit the draw-bar hooks of all vehicles with a spring or a weighted catch as is done upon the London and North-Western Railway and other lines, and until this is done it is clearly advisable that in the operation of putting empty carriages on to a train the couplings should be screwed up sufficiently to make it impossible for them to become detached as in this case. It would also be well to have a porter in the brake van to make use of the brake power if necessary, except, of course, in cases when the vehicles are fitted with an automatic brake coupled on to the engine and in working order."

NOTES AND MEMORANDA.

DR. C. LANG, in *Biedermann's Central-Blatt für Agrikultur-Chemie*, lays down the law that night frosts are only to be feared when the dew point lies below the freezing point of water.

A TEMPERATURE of 570 deg. will produce a dark blue colour on polished steel, and 590 deg. a pale blue. Oil or grease of any kind will answer for drawing the temper of cutlery. The temper for lancets is obtained at 430 deg. Fah., axes at 500 deg., swords and watch-springs at 530 deg., small saws at 570 deg., and large saws at 590 deg. Copper-coloured spots are not produced by tempering, but they may be obtained on the polished surface of steel by immersing the article in a solution of sulphate of copper.

FROM 1862 to 1882 the production of sulphuric acid in Germany has increased from 22,311 tons to 157,961 tons, chiefly obtained from Siegen pyrites. Lump pyrites are burnt in kilns with movable grates, and smalls in Perret or Maletra kilns. The burnt ore from certain mines is afterwards smelted for iron, but the Siegen ore retains too much sulphur to permit of its use in metallurgy. M. Hasenclever seeks to refute the views of Dr. Lunge on the inconvenience of zinc sulphide—blende—in the manufacture of sulphuric acid.

A NEW method of producing alloys of iron or manganese, or iron and manganese with tin, is described in a patent taken out by Charles Billington and John Newton, who claim the introduction of iron or manganese, or of iron and manganese not previously alloyed, into a bath of molten tin kept at a suitable temperature, the iron or manganese being connected by wires to a dynamo machine or battery. When put in circuit it is claimed that the current of electricity throws off the iron or manganese of iron and manganese into the tin bath, and produces chemical action between the metals, which causes them to alloy with each other in any desired proportion that can be regulated with great nicety.

THE coalfields of Russia are, Mr. W. Mather says, still practically undeveloped. The Donetz coalfield is too remote for the manufacturing districts, and the railroad communications are too uncertain to admit of its being largely used. The lignite found within a radius of 200 miles of Moscow does not offer fuel of a sufficiently good quality. It is a remarkable fact that during the past two years English coal has been found to be the most profitable fuel that manufacturers could use immediately around Moscow at a price laid down of about 40s. per ton. Twenty years ago the price of wood fuel was so low as to be equivalent to coal at 10s. per ton, and now coal at 40s. per ton is cheaper fuel. This is apparently a consequence of the reckless destruction of forests in Russia without systematic planting under Government supervision.

IN the *Bulletin de la Société d'Encouragement pour l'Industrie Nationale*, M. Carnot, in a report presented by him on behalf of the Committee of Chemical Arts, showed that the cause of the corrosion of sheet copper employed for the sheathing of ships is the presence of cuprous oxide, which, in contact with salt water, occasioned the formation of soluble salts, even when the air is excluded. In order to reduce more completely the oxygen compounds present in the copper, he introduces a small quantity of metallic manganese, which completely reduces the cuprous oxide remaining in the metal, and becomes converted into a manganese silicate, in contact with the sides and the sole of the furnace. If a few thousandths of manganese remain alloyed with the copper, they affect neither its malleability nor its resistance to the action of sea water. The manganese is introduced in the form of cupro-manganese, an alloy containing 75 per cent. of copper and 25 of manganese.

M. DE TROMELIN has attacked the hypothesis that clouds are composed of vesicles or hollow spheres of condensed vapour. He supposes that every solid body, whatever may be its diameter, retains around it by adhesion a special atmosphere of the gas in which it is plunged; that the thickness of this atmosphere is nearly independent of the volume of the solid body; that the attraction which retains it is within the domain of the molecular forces, and is manifested only within very short distances. In this way he accounts for the difficulty of completely removing the air from a tube which is to be filled with liquid. In the case of a vesicle surrounded by its atmosphere, the thermal absorption of the water is much greater than that of the surrounding diathermanous air. The atmosphere of the vesicle is consequently expanded, and the particle with its atmosphere floats by displacing an equal volume of the circumambient air. The dust particles which are observed in the sun's rays are supposed to be sustained in the same way.

IN the following figures are given, first, the sea-going merchant fleets of all nations, and, second, the steamships of all nations:—Great Britain, 22,500 vessels, 11,200,000 tons; United States, 6600 vessels, 2,700,000 tons; Norway, 4200 vessels, 1,500,000 tons; Germany, 3000 vessels, 1,400,000 tons; France, 2900 vessels, 1,100,000 tons; Italy, 3200 vessels, 1,000,000 tons; Russia, 2300 vessels, 600,000 tons; all nations, 46,000 vessels, 23,000,000 tons. Thus it will be seen at a glance how tremendously England outrivals every other marine Power. Her preponderance is even greater in steam vessels, as appears by this second statement:—All nations, 7764 steam vessels, 9,232,000 tons; Great Britain, 4649 steam vessels, 5,919,000 tons; France, 458 steam vessels, 667,000 tons; United States, 422 steam vessels, 601,000 tons; Germany, 420 steam vessels, 476,000 tons; Spain, 282 steam vessels, 305,000 tons; Italy, 135 steam vessels, 166,000 tons; Holland, 127 steam vessels, 155,000 tons; Russia, 194 steam vessels, 149,000 tons.

MARTIN KILIANI, of Munich, has recently described a new method of zinc extraction. The material to be worked—precipitated zinc oxide, calamine, calcined blende, zinc ashes, &c.—is placed in lead-lined wooden vats, and digested with a liquor consisting of ammonium and ammonium carbonate, until the liquor is saturated with zinc. After filtration, the solution then passes to a reservoir, from which it is fed continuously to the precipitation tanks. The cathodes in these are of zinc or brass, the anodes of sheet iron. A portion of the zinc in solution is precipitated in a compact metallic form on the cathodes, with a corresponding liberation of oxygen at the anodes. The liquor passes through the precipitation tanks at a speed regulated according to the amount of zinc contained and the strength of the current at the electrodes, and then flows into the reservoir at a lower level, from which it is pumped up again into the first tanks, to extract a fresh amount of zinc, and pass again to the precipitation tanks. All the vats and reservoirs are well covered over, to prevent loss of ammonia.

A PAPER on "Zinc in Drinking Water" is given in the "Journal of the American Chemical Society," by Dr. F. P. Venable. It has long been known that zinc dissolves in water, and that soft water, such as rain water, dissolves it more easily than hard water. Water containing carbonic acid is specially able to dissolve it. The use of galvanised iron for pipes and tanks being so much on the increase, the subject becomes more and more important, and it is desirable to ascertain, as far as possible, to what extent solution of the zinc coating takes place, and how far water contaminated by zinc is injurious to health. The author quotes several investigators as to the latter point, the evidence being to some extent conflicting, but giving a very decided balance on the side of the view that such water is considerably injurious. Investigations made on behalf of the French Government resulted in the prohibition by the Ministry of Marine of the use of galvanised iron tanks on board men-of-war. Professor Heaton has given an analysis of a spring water, with a further analysis of the same water after it had travelled through half a mile of galvanised iron pipe. It had taken up 6·41 grains of zinc carbonate per gallon. Dr. Venable gives the results of an observation of his own, where spring water passed through 200 yards of galvanised iron pipes to a house, and took up 4·29 grains of zinc carbonate per gallon. It seems pretty clear that drinking water should not be allowed to come in contact with zinc.

MISCELLANEA.

WITH the view of improving the harbour, the Ayr Harbour trustees have resolved to pile the north wall for a distance of 300ft. at a cost of £2000.

THE principal industry of the town of Liége being the manufacture of arms, a complete and instructive museum of arms, ancient and modern, has been formed in the large building known as the Prefecture.

A VERY useful book, giving statistical tables from the history and statistics of American waterworks, compiled by Mr. J. J. R. Croes, M.I.C.E., has been published at the office of the *American Engineering News*, New York. The particulars given relate to the position and size of the towns, date of construction of works, kind of works and machinery, cost, officers, &c. &c.

THE construction of a new suspension foot-bridge over the river Thames at Teddington is shortly to be commenced, plans having been approved by the Thames Conservancy Board, subject to certain conditions which the Teddington Local Board will comply with. At a meeting of the above local authority, held last week, it was stated that £2000 would cover the cost of the bridge, and this sum it is proposed to borrow.

IT is said that there is a fair prospect that the works for the improvement of the Danube waterway will at last be undertaken. The commission of experts appointed to examine the means of removing the obstructions at the Iron Gates is nearly ready with its report, and meanwhile the Hungarian Government has granted 1,500,000fl. for dredging operations on the Hungarian part of the Danube. This money is to be recouped by tolls on shipping.

IN answer to a question by Mr. Healy in the House, on piers and Harbours, Ireland, Sir W. Hart-Dyke said: "The Government have decided to have an inspection of these piers made by an independent engineer of undoubted eminence, who will inquire and report not only as to the suitability of the sites selected for these works, but also as to their design and the manner in which they have been executed. I do not understand the hon. member to allege any 'misapplication' or 'improper expenditure' which is not covered by these points of reference. I have no objection to produce the correspondence, but I think it would be better to await the engineer's report before doing so."

IN the latter part of last week, Messrs. Yarrow and Co. launched from their yard at Poplar one of the new large sea-going torpedo boats, of which forty were ordered by the Government at the time strained relations existed between this country and Russia. Twenty of these boats are being built by Messrs. Thorneycroft and Co., and twenty by Messrs. Yarrow and Co. The one just launched by the Poplar firm is the first of the forty which has been put in the water, and the remainder, we believe, will follow in rapid succession, the two firms working under heavy penalties. These boats are 125ft. in length by 13ft. beam, and consequently much larger than any which took part in the late Bantry Bay manœuvres.

IT has been arranged that the King and Queen of the Belgians, accompanied by the Crown Prince and Princess of Austria, will visit Antwerp on Sunday next, to be present at the opening of the new quays, which have been several years under construction at a cost of upwards of four millions sterling. After the opening ceremony a historic procession of nations is announced to take place on the Scheldt, with illuminations. The Great Eastern Railway Company will run their new steel paddle steamer Adelaide from Harwich—Parkeston Quay—to Antwerp, in connection with a special express train, leaving Liverpool-street station at 9 a.m. to-morrow, to accommodate travellers intending to be present at these *fêtes*.

WITH reference to the paragraph in our issue of the 10th inst. referring to the boilers for Glengarnock Steel Works, Kilbirnie, we are informed that of the twenty steel boilers for Messrs. Merry and Cunninghame's new steelworks, only four were made by Messrs. William Wilson and Co., of Lilybank Boilerworks, Glasgow, the other sixteen having been made by Messrs. Alexander Nicholson and Co., Crownpoint Boilerworks, Glasgow. It is due to Messrs. Merry and Cunninghame that we should state that these boilers, which were of an improved type, were made in accordance with specifications and drawings supplied by themselves. We also understand that several of the boilers made by Messrs. Alexander Nicholson and Co. were constructed of basic steel plates and rivets, made from Glengarnock pig iron, and that the working of that material was most satisfactory to all concerned.

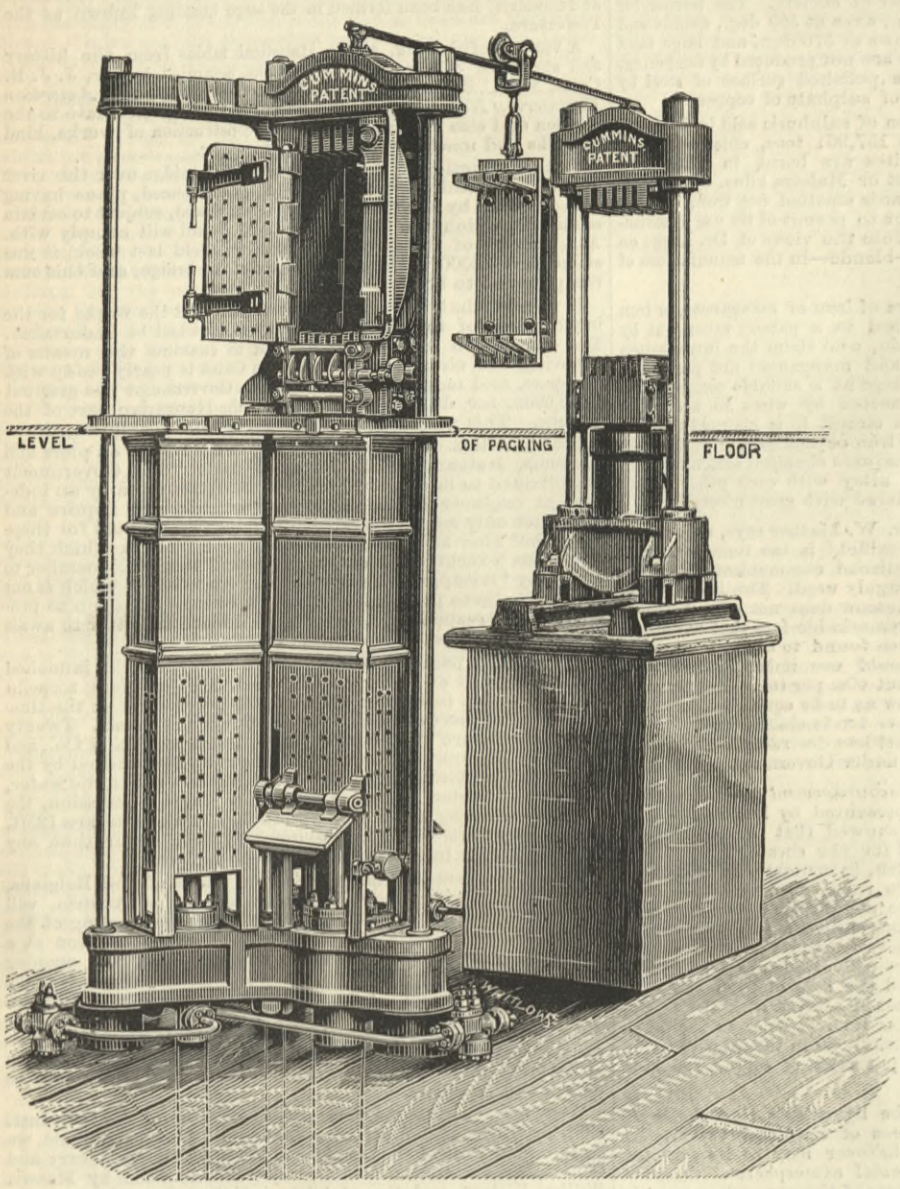
THE employment of natural gas as a fuel by manufacturing concerns may, remarks the American *Railway Review*, mean more to our industrial interests than has been generally anticipated. "Great sums of money have been invested in changed plant by many heavy houses who figure upon material profits through the use of the novel fuel. Despite the dangers which the timid ascribe to its use, and the lack of absolute certainty as to permanence of supply, the heavy capitalists of Pittsburgh have enough faith to warrant these large expenditures. Some of the anticipated results in the way of savings have already made themselves felt. For instance, it is estimated by good judges that there are already 3000 tons less of coal burned in Pittsburgh per day than there were before natural gas was used. This takes away a coal business of 2,500,000 dols. or more a year. One concern saves 100 dols. a day in wages formerly paid to men who wheeled out ashes. The decrease of smoke in the atmosphere is already noticeable."

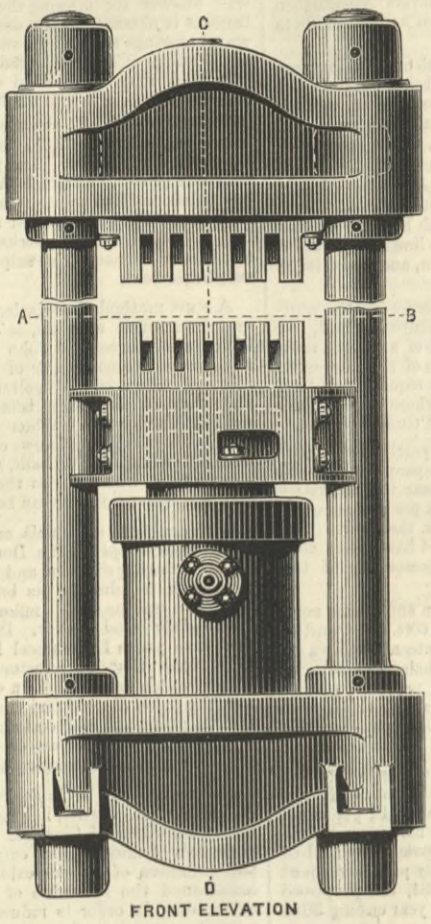
THE *American Manufacturer* says:—"The Mississippi Glass Company, St. Louis, are making nearly 5000ft. of glass a day, about two-fifths of which are coloured. Their product is largely supplanting the foreign glass with which it comes in competition." The *Age of Steel*, however, tells something that shows that glass-workers are as troublesome a lot in the States as elsewhere. It says the men of the St. Louis Glassworks, St. Louis, offered recently to allow the proprietor, Mr. Cummings, six apprentices in case he chose to restart his works. This is the number Mr. Cummings had always claimed as his quota under union rules, but to no purpose. Owing to dulness in the glass trade, and to the further fact that his men had broken faith with him last summer, after agreeing to work straight through till autumn, Mr. Cummings declined the proposition. At the Great Western Glassworks the delay in re-starting was due to the refusal of the men to allow the proprietors their quota of six apprentices. They first agreed to allow it, then after the fires were lit refused, and finally compromised on four apprentices.

AN experiment is shortly to be made in the conveyance of laden railway trucks between the mainland and the Isle of Wight. The Carrier, a paddle steamer, possessing facilities for receiving cargoes, has been acquired, and it is intended to run this vessel from Langstone Harbour to Brading. A wharf is to be erected at Langstone, and a line of railway constructed to the water's edge. On the upper deck of the Carrier a double line of rails has been laid from stem to stern, affording accommodation for fourteen ordinary railway trucks. The vessel will come alongside the wharf, where there are steam appliances for running the trucks on the deck direct, and at Brading similar facilities will be provided for unshipping them, and again placing them on the railway. It is also anticipated that in the course of time passenger trains may be carried across the water by similar means. At present considerable difficulty is experienced in conveying merchandise to and from the Isle of Wight, the arrangements necessitating the unloading of goods, which occasions considerable delay. This will be entirely obviated should the experiment prove successful. One of the principal objects of the new system is to facilitate the transit of vegetables, &c., for the Isle of Wight, and it is calculated that at least two hours will be saved by this means. It is stated that trucks could be filled with coal at the pits and conveyed to any station in the Isle of Wight without being unloaded, and the same advantage would apply to furniture vans. After the arrival of the carrier at Portsmouth from Newhaven a trial was made of her seagoing capabilities between Langstone and Brading with satisfactory results.

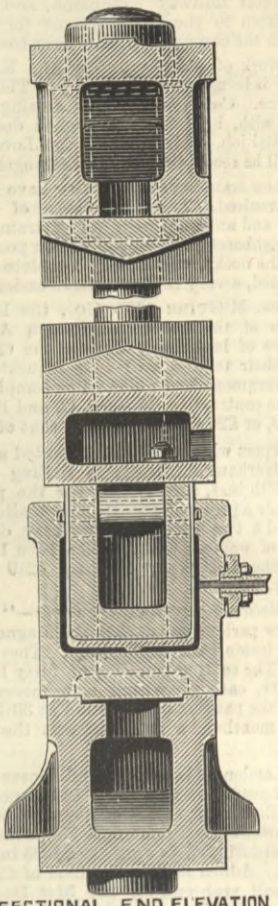
CUMMINS' COTTON BALING PRESS.

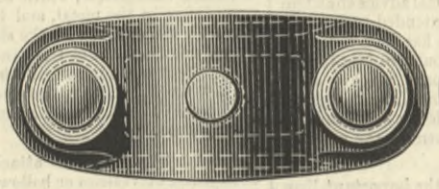
MESSRS. ORMEROD, GRIERSON, AND CO., MANCHESTER, ENGINEERS.

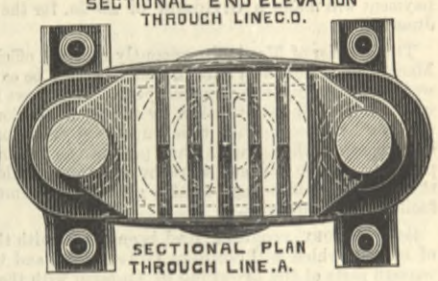




FRONT ELEVATION


SECTIONAL END ELEVATION THROUGH LINE C.D.


PLAN OF TOP

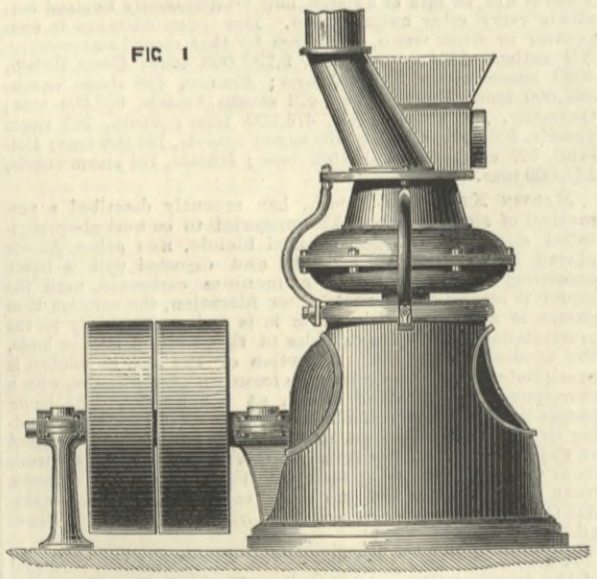

SECTIONAL PLAN THROUGH LINE A.

THE press which we illustrate above and on opposite page is exhibited in model at the Inventions Exhibition by Messrs. Ormerod, Grierson, and Co., Manchester. It has been designed with a view of reducing the great expansion which takes place in a bale of cotton after it has been pressed, which not only lessens loss of power in pressing, but reduces the liability to injury which the cotton fibre is subjected by an unnecessarily high pressure. It has been found that this great expansion is influenced by the shape of the bale, and that if the section is small as compared with the length, much less pressure has to be employed, and much less expansion takes place. As long pressing-boxes would be very inconvenient in practice, and would entail the use of large and costly presses, the box is divided into three parts. These boxes are fixed over rams of varying diameters, and a movable bale chamber which revolves upon the centre pillar is brought over the first box, which has a ram 3in. diameter. The cotton is forced into the bale chamber, after which a grid, which works automatically, is inserted to support the cotton whilst the bale chamber is moved over the second box, which has a ram 5in. diameter. The operation is then repeated, and again with the third box, which has a ram 9½in. diameter. Immediately one box has delivered its cotton the operators go on filling, and so the work is continuous. In forming cotton into bales, it is essential that the cotton fibres should be pressed only in one direction, otherwise the fibre will become what is called cross packed, and its quality will thereby be much deteriorated. Therefore in most cotton presses now used the requisite quantity of cotton for forming a bale is first laid into a deep box, and the bale must necessarily be of comparatively small depth in the direction in which it is pressed, as in order to obtain a bale of sufficient density the cotton has to be compressed into about one-tenth or even a less portion of the depth it occupied in the box. No bale deep in the direction into which it is pressed could therefore be pressed to the same density from the contents of one box without making the box of very extensive length. A bale of cotton after it has been released from the press always tends to expand in the direction in which it has been pressed. This expansion cannot be entirely prevented by the hoops or lashings by which the bale is bound, as it is impossible to pull the lashing hoops perfectly tight, therefore when the bale is set free from the press, it expands somewhat both upwards and downwards. Any expansion taking place over large areas largely increases the ultimate bulk of the bale. It will therefore be readily seen that to obtain finished bales of sufficient density, it is necessary under the former method to press the bales into much smaller dimensions than they will occupy after being hooped and finished. To remedy this evil without employing filling boxes of an impracticable length, and yet to obtain a bale of the requisite weight, the above-described three-cylinder press, in connection with a finishing press, has been designed. The finishing press is an ordinary single-cylinder press, with a ram 16in. diameter. Presses of the above description are working very satisfactorily. A bale of cotton weighing 400 lb., and measuring 8 cubic feet, is finished with a total pressure of 350 tons; whereas the total pressure required when the bale is made by other presses is from 1600 to 1800 tons. The saving in hoops is very considerable; 45ft. of ⅛in. by 20 b.w.g. is required, against 70ft. with other presses. With this new press it is stated that 200 bales can be made per day of ten hours, with a consumption of 4 lb. of coal per bale, whilst the cost of the plant is, we are told, less than that of presses on other systems equal to the same work.

GRIFFIN'S PULVERISER.

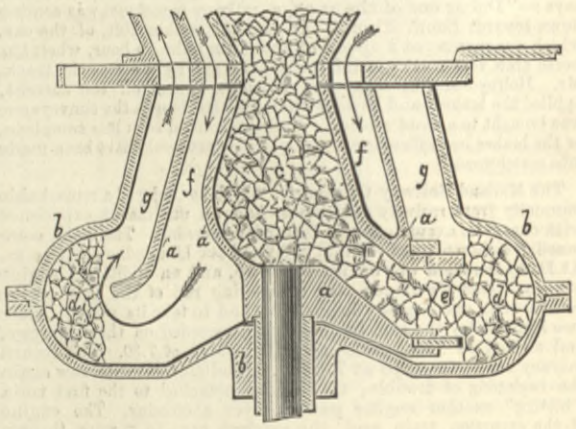
THE past few years have been very prolific in improvements in mining and milling machinery, crushers and pulverisers receiving their full share of the attention of inventors. It was natural that efforts should be made to find a more rapid and economical pulveriser than the old-fashioned stamps, and one that would grind finer than the rolls; hence a variety of centrifugal machines in which the ore is crushed by rollers and balls revolving vertically or horizontally, and discs or arms with paddles revolving vertically at a very high velocity, and pulverising by impact on the paddles and by attrition of the particles among themselves; Blake multiple crushers; and vibrating drums of the Griffith type, recently described in the *Engineering and Mining Journal*. Many of these machines possess features of great merit, and do satisfactory work each under conditions to which it is adapted.

FIG 1



Thus, rolls are not suitable for fine crushing, but on the other hand they are no doubt the best for coarse crushing for concentrating. Most of the centrifugal pulverisers are best adapted for very fine crushing.

One of the most ingenious of these new pulverisers that has come to our notice is illustrated herewith. "This machine presents some novel and valuable features. It consists, as is shown in the elevator, Fig 1, and in the sectional drawing, Fig 2, of a central conveyor *a a*, within an annular shell *b b*, both of which rotate horizontally, but at different speeds and in opposite directions, by means of gearing or belting as may be preferred. The central conveyor is divided into four compartments or spouts, through two of which *e e* the ore enters from a central hopper, and through the other two *f f* the air enters behind each of the ore-spouts, and after sweeping the face *d d* of the ore held in the annular shell *b b*, is drawn out by means of a fan through the flues *g g*. In operation, the material to be reduced is taken from an ordinary crusher and automatically fed to the conveyor through the passage *e* into the outer shell, where it immediately forms a solid annular wall *d d*, to make one of the grinding surfaces. The other surface is the unground material compactly held against this wall in the two sections of the conveyor *e e*, provided for that purpose. The section is shown through one of the ore-spouts and one air-flue, at right angles to the ore-spout. The central conveyor is attached to the head of a vertical steel shaft and makes about 120 revolutions per minute; the outer annular shell *b b* is attached to a sleeve on this shaft, so that it can be driven at a speed of about 200 revolutions in the opposite direction from the feeding spouts or conveyors. With these very moderate speeds, even if they were much higher than they are, the wear and tear of the running parts of the machine is slight, an advantage that can be fully appreciated only by those who have run the 1000 to 2000 revolution machines. The relative as well as the absolute speeds of the revolving parts appear from experiment to have a considerable influence on the fineness as well as on the amount of the material crushed. The work done has usually called for a fineness of from No. 50 to impalpable powder—as in the case of grinding wheat, &c.; but the inventor believes that

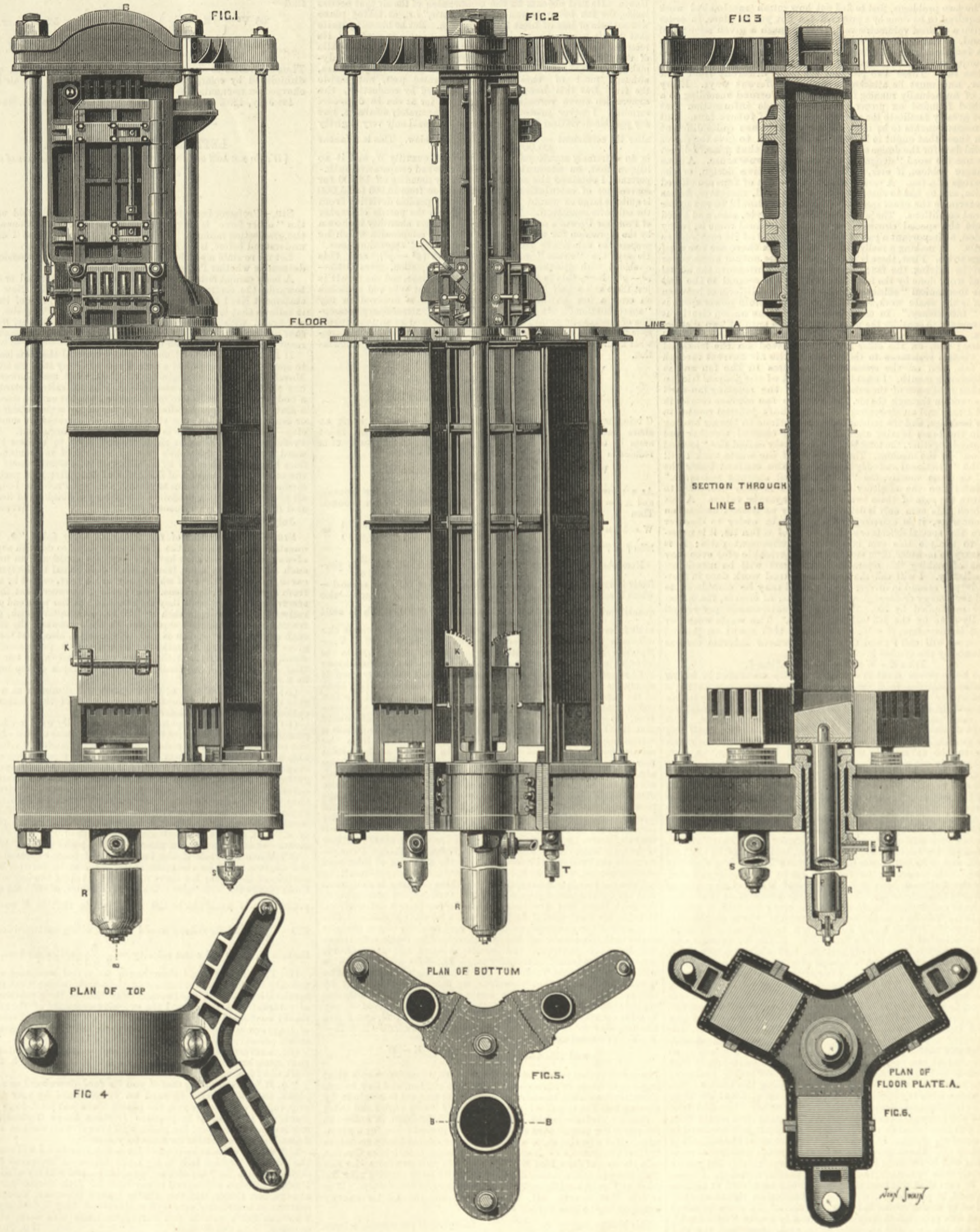


it will crush to almost any degree of coarseness, the amount of draught and speed of revolution regulating the coarseness of the particles. The slower it runs the coarser will be the grains. The suction of the air and the inclination given the division between the bottoms of the revolving parts prevent the accumulation of dust between them or its entrance into the bearings. When desired water can take the place of air, and the centrifugal force of the revolving shell can be utilised to draw the water, and with it the pulverised ore, out of the machine. The only parts of the pulveriser that wear, and those but slowly, are the adjustable plates at the outlets of the ore-spouts; indeed, the small amount of wear in machines of this class is quite remarkable, as is also the moderate amount of power required to run them—from 15 to 20-horse power, as measured by the dynamometer—for a machine able to finely pulverise from 1 to 3 tons of ore per hour. The weight of such a machine complete is stated at about 3000 lb., and its cost, including counter-shaft, pulleys, and blower, is quoted at 1000 dols. This pulveriser appears to offer some exceptional advantages; it is extremely simple, easily transported, and inexpensive to erect; has a large capacity, equal to say ten stamps, and can crush to any degree of fineness desired."

CUMMINS' COTTON BALING PRESS.

MESSRS. ORMEROD, GRIERSON, AND CO., MANCHESTER, ENGINEER

(*For description see page* 64.)



CLEETHORPES.

IT is not, perhaps, everyone who is acquainted with the geographical position or of the character of the place known by the name Cleethorpes. It is not every traveller who has been to Fingal, and so some may not have found out this modern seaside place on the Lincolnshire coast, and, as the guide-book says, "pleasantly situated, where the broad waters of the Humber meet the salt waves of the North Sea." The "cheery" township has, it is said, "long been a favourite summer resort, natural advantages having made it an enviable seaside residence when artificial attractions were altogether lacking." What it is now that these attractions are not lacking must be learned from the guide published by Nicholson and Son, in London, or, perhaps, by going there. On the 2nd inst. Prince Albert Victor adopted the latter course, and formally opened the newly completed sea defence works, promenade, and pleasure gardens. These have converted Cleethorpes into a good example of the modern seaside haunt of the people of what Ruskin calls "this machine and devil-driven England," who inland grow weary of chimneys and mills, and seek relaxation in artificially improved natural advantages of the seaside.

The works which have been carried out consist, first, of a sea-wall nearly a mile in length, commencing opposite the railway station—or on the Grimsby side of the station—and finishing opposite Brighton-street. This structure is of concrete, with a foundation 8ft. in width, and measuring from summit to base 21ft., which is 6ft. above high tides. The slightly sloping wall is faced with concrete blocks, counterfortes being placed at every 11ft., making the wall at that particular spot a thickness of 10ft. 6in. at the base. By this wall visitors are placed 30 or 40 yards nearer the tide than formerly. At the rear of the wall is an asphalt walk 25ft. in width, and a carriage drive running the whole extent of the wall, and of a uniform width of 40ft. The pier which was erected some years ago has been raised, and other works completed.

INTERNATIONAL INVENTIONS EXHIBITION. — The number of visitors to this exhibition for the week ending July 18th, was 150,053. Total since opening, 1,572,618.

UNIVERSITY EVENING SCHOOLS IN SYDNEY.—In connection with Sydney University, evening classes for graduation in arts, by means of a five years' course, have been organised for those whose occupations prevent their attendance on the day lectures. They have been in operation about one year, and this year there will be two sections of the students who are in for the two years' course, which is to qualify for a first year examination at the University; and, as time goes on, the classes will increase until they embrace two sections each for the two year courses, and one for the fifth year course qualifying for graduation.

THE TESTING OF FANS.*

By Professor ROBERT H. SMITH, of Mason College.

AT the monthly meeting held at Mason Science College, Birmingham, Thursday, July 2nd, 1885, Mr. W. B. Scott, vice-president, in the chair, the following paper was read by Professor Robert H. Smith :—

The two problems, first to find out how much mechanical work is required to be done by a proposed fan not yet in place, in order to give a desired volumetric ventilation through a given mine ; and second, to test how much mechanical work is being actually done by a fan already in place, and working under given conditions, and in conjunction with this test to calculate the mechanical efficiency of the fan. These two problems are very different from each other, and must be attacked in entirely different ways. Every test of an actually running fan carefully performed according to a method founded on proper principles affords information that must greatly facilitate the accurate designing of future fans. But the measurements to be made for such a test are quite different from those that ought to be made for each mine to give the direct special data for the design of the fan to ventilate that mine. I do not here use the word "design" in the ordinary narrow sense. A mine manager seldom, if ever, makes the constructive design, or the drawings of a fan. A variety of styles and sizes of fans are offered to him, and he has to choose between them; and, moreover, he has to determine the exact speed at which the fan should be run under normal conditions. The judicious selection of style, size, and speed to suit the special circumstances of the individual mine is, in my opinion, as important a part of the design as that of its constructive details. In making a really useful test of a fan there are two chief things to do. First, there is to be measured the actual horse-power spent in driving the fan; secondly, one must measure the actual useful work done by the fan. The ratio of the second to the first is the mechanical "efficiency" of the fan. The difference between them is the waste work, and its ratio to the whole power spent is the "inefficiency." In order to understand the action clearly, it is necessary to consider the waste work as the sum of two distinct parts. These are, on the one hand, that wasted in journal friction; and, on the other hand, that wasted on the frictional and viscous resistance to the passage of the air current through the fan, and on the creation of air eddies in the fan and in its discharge mouth. I must include as part of the journal friction the skin resistance of the outside surface of the rotating fan-shell to its motion through the air. This outside fan surface rotates in what I may call an air-bearing just as the shaft journal rotates in brass bearings, and the resistances to the motions in the air bearing and in the brass bearing are quite properly classed together and measured together, the total being conveniently called the "journal friction" of the machine. The other part of the waste work I will call the "frictional and eddy resistance of the current inside the fan," or more shortly, the "waste internal current resistance." To determine the efficiency of the fan it is only necessary to measure the sum of these two, not their separate values. A test in which this sum only is determined is by no means useless; on the contrary, it is extremely useful. But in order to discover where the special defects or special merits of a fan lie, it is necessary to analyse this sum into its two component parts; it is necessary to measure them separately. Practicable and even easy means of making this separate measurement will be mentioned immediately. I will call the actual measured work done in foot-pounds per second in driving the fan E—E may be considered to stand for energy or for engine. This equals, of course, the horse-power multiplied by 550. The work in foot-pounds per second usefully done by the fall will be called W. The waste work per second is, therefore, E − W. The part of this spent on journal friction we will call F; and that done on waste internal current resistance by the symbol R.

Thus E − W = F × R.—Equation I.

E, the horse-power spent in driving is usually measured by taking indicator diagrams from the engine, the fan commonly having a special engine to itself. The transmitting gear from engine to fan being usually short, simple, and direct, this method of measurement does not ordinarily involve any very large error. The amount of the error is the waste of power in the engine itself and in the gearing between engine and fan. All the work done by the steam in the cylinder is not transmitted to the fan. A part, unfortunately often a large part, amounting to sometimes over 20 per cent., is wasted in journal friction and in vibration in the engine and gearing. Even when the engine works direct on the fan shaft, this loss may be no inconsiderable percentage. It should also be borne in mind that we have lately discovered that indicator cards as ordinarily taken, especially with fast running engines, are extraordinarily deceptive. I recommend the use of small sized indicators with stiff springs, short pencil stroke, short barrel stroke, best fine steel wire—with the stretch taken well out of it—instead of cord, and a reducing gear in which there is not the slightest "shake." By measuring the driving power in the engine cylinder, the mechanical inefficiency of the engine and transmitting gear is included in that of the fan. This makes the test unfair to the fan, and I have endeavoured to show that the error may be a serious one. It is, therefore, much more satisfactory, where practicable, to measure the driving power directly by a transmission dynamometer applied directly to the fan shaft. I am at present constructing a very compact, easily portable, and cheap rotary transmission dynamometer which is capable of attachment to the shaft to be tested in a few minutes. After trials have been made with this instrument, if they are successful, I shall be happy to lay details before this Society. When the engine, however, works direct on to the fan shaft it would be difficult, although not impossible, to arrange for the insertion of a dynamometer at any point of the mechanism. F, the journal friction of the fan, can be measured separately by taking the driving power required with the inlet and outlet mouths of the rotating fan both stopped up so that no current can pass through the fan. Note particularly that the mouths to be closed are not those in the fixed casing enclosing the fan, but those in the rotating portion carrying the blades. The result given with the openings in the casing only closed would be an entirely false and deceptive one, giving a higher than the true value of the journal friction, because the rotating fan would then be still left free to act as a fan in churning the air left enclosed in the stopped-up casing. In some forms of fan it would be difficult to completely close the rotating mouths, but a far more nearly true measurement will be obtained by stopping these imperfectly but nearly completely than by stopping the openings of the fixed casing. It need hardly be said that this journal friction should be tested at various speeds, and, if practicable, with the transmission dynamometer, instead of by steam engine indicator diagrams. It must be noted also that this experiment gives the friction only under "light load," because the fan is doing no useful work, and, therefore, the end thrust on the collar bearings is reduced to a minimum. In a Schiele fan I should expect the journal friction to increase considerably as the useful load is raised, but in such large and heavy machines as the Guibal or Waddell fans, I venture to risk the statement that this loss of power increases at a hardly appreciable rate with increase of useful work done. W. In general terms this "useful work" is that done in creating the required circulation of air. It may be defined as the work the fan would need to do even if it were constructed with absolute theoretical perfection—*i.e.*, that part of the whole work done which is not diminished by further improvements in the design of the fan in the direction of theoretical perfection. The measurements that need to be made to enable this quantity to be calculated with accuracy are—the inlet and outlet areas of the fan, called below A and A^2 square feet ; the inlet air velocity—average—called below v ft. per second ; the height of outlet above inlet, called below h ft.; the excess of pressure at outlet over that at inlet, called below G in. on water-gauge. From these five measurements, as data, the value of W can be found. The volumetric flow at the inlet area can be directly calculated from the inlet area and average velocity. Calling it V, we have V cubic feet per second = v A. The calculation of W from these data is given fully in a letter published in the issue of 19th December, 1884, of THE ENGINEER. The calculation given there is strictly correct.* It was criticised by Professor W. C. Unwin. He first objects to the compression of the air that occurs inside, the fan being taken as "adiabatic," *i.e.*, as taking place without gain or loss of heat by conduction. But he himself admits that the air passes through the fan too quickly to admit of its receiving or losing heat by conduction from the blades or walls of the fan. He says heat is generated by viscous and eddy-making resistance in the air itself. This undoubtedly occurs, although most of this heat is generated past, not inside the fan. But this heat not being received by conduction, the compression curve remains adiabatic, so far as can be *à priori* surmised. I never pretended that it is accurately adiabatic, but any possible deviation from this condition would only very slightly alter the coefficient $\frac{1}{20,000}$ in the formula below. This is a factor in an extremely small part of the whole quantity W, and it so happens that, on account of its smallness and comparative unimportance, I obtained the number 20,000 by rounding off 18,900 for convenience of calculation. The alteration from 18,900 to 20,000 is quite as large as would be caused by any possible deviation from the adiabatic condition. This shows clearly the puerile character of Professor Unwin's criticism, but its careless absurdity is shown by the expression for work done on adiabatic compression which he proposes to substitute for what he calls my "approximations." He says the "exact" expression is $2{\cdot}45\ (p^3 - p^2)$, and this combined with another quantity in the equation, gives $3{\cdot}45 - p^3 - p^2$. Now, this is a pure and simple mistake, and the result is just three and a-half times as much as it ought to be and contains an error a few hundred times as great as is involved in my "approximation!" It is deduced from the extraordinary conception of "adiabatic compression of air considered as an incompressible fluid!" My formula for W I will here write down in a somewhat modified form as being rather more convenient for calculation.

$$W = 5{\cdot}2\ G\ V \left\{ 1 - \frac{1}{20,000}\ \frac{v^2}{2g}\ \frac{A^2}{A_2^2} \right\} + {\cdot}08\ V \left\{ h - \frac{v^2}{2g}\left(1 - \frac{A^2}{A_2^2}\right) \right\} \quad \text{Equation II.}$$

G being in inches water gauge and the other quantities being as above stated—($g = 32{\cdot}2$ft. per sec.). If the outlet and inlet areas be equal—($A = A_2$) and if h be neglected as small, this reduces to

$$W = 5{\cdot}2\ G\ V \left\{ 1 - \frac{1}{20,000}\ \frac{v^2}{2g} \right\} \quad \text{Equation III.}$$

As a numerical example, take G = 1½, and v = 10ft. per second, and A 2 = A = 50 sq. ft.; so that V = 500 cubic feet per second. Then

$$W = 5{\cdot}2 \times 1\tfrac{1}{2} \times 500 \left\{ 1 - \frac{100}{20,000 \times 2g} \right\} = 3900 \left\{ 1 - \frac{1}{12,880} \right\} = 3899{\cdot}7$$

or 7·1-horse power.

Here observe that the subtraction on account of the $\frac{v^2}{2g}$ is perfectly insignificant. If the inlet velocity were 50ft. per second—which is seldom, if ever, reached in mines, so far as I know—the quantity within brackets would be $1 - \frac{1}{515} = {\cdot}99806$, which is still so little less than unity that evidently for all practical purposes the difference may be neglected, and the formula W = 5·2 G V.—Equation IV., used as sufficiently accurate. This formula is identical in shape with that ordinarily used in mine calculations; but I regret to say that I understand that the G commonly used is simply the water-gauge vacuum shown at the inlet to the fan, that is, the excess of atmospheric pressure over the pressure at the fan end of the drift. This involves what may be sometimes a serious error. It cannot be too distinctly impressed upon mine engineers that the G that must be used in order to make this calculation a correct one is the excess of the pressure at the outlet from the rotating fan over that at the inlet. The pressure at the outlet may be, and I suspect usually is, considerably different from atmospheric pressure. There should be two gauge pipes mounted, one of them as close as convenient to the inlet opening and the other equally close to the outlet from the fan. These two gauge pipes should lead both close to the engine-house as usual, and should terminate in open-topped gauge glasses mounted side by side on the same inch scale-board. The scale may be conveniently placed between the two glasses, these being placed just far enough apart to allow of the scale being easily read between them. With this arrangement one can read off at once, not only the difference of inlet and outlet pressures, which is the G to be used in the above calculation, but also the absolute amounts of both these pressures as compared with the simultaneous pressure in the outside quiet atmosphere. Although these last are not needed for our present calculation, still they are most useful and instructive for other purposes. The open ends of the gauge pipes must be very carefully placed at right angles to the direction of the air current. No doubt sometimes the difference between the outlet pressure and atmospheric pressure will be found extremely small, but these will be cases in which the outlet area from the fan is very much larger than the inlet area, and in which, therefore, we must not approximate by considering A = A_2. R. The waste internal current resistance ought to be worked out in each test of a fan. It is obtained simply by using equation I, in which the three quantities E, W, and F are now supposed to have been measured. Thus we have—R = E − W − F. The total efficiency is, of course,

$$\frac{W}{E} \text{ and the inefficiency } \frac{R \times F}{E} = \frac{E - W}{E}$$

I have now stated what in my opinion are the measurements that ought to be made in an experimental test of a fan, and how to use these measurements in calculation. I am tempted to conclude by showing how the required G—difference between outlet and inlet—pressure at fan—could be calculated beforehand in order to determine the proper size and speed of a proposed fan for a given mine. If A e be the exit area where the current finally re-enters the free atmosphere on leaving the discharge tunnel from the fan—in the case of fans like the Waddell, the exit area from the fan itself must be taken—the final average discharge velocity may be taken as V − A e with sufficient approximation to accuracy. It is certain that nearly all, if not quite all, the kinetic energy corresponding to this velocity is lost.

This kinetic energy is $\frac{{\cdot}08}{2g}\ \frac{V^3}{A_e^2}$ foot-pounds per second, where ·08 is the weight of air in pounds per cubic foot. The work done per second on the "drag" of the mine is $08 f V^3 \Sigma \left(\frac{L}{A^2 8}\right)$ where L is the length of one part of the passage of the current through the mine; A is the cross sectional area of that part; 8 is the "mean hydraulic depth" of that section; where the summation represented by the symbol Σ of the quantities $\frac{L}{A^2 8}$ has to be performed throughout the whole length of all the intricate passages through which the ventilating current circulates from top of downcast shaft to the discharge from the fan; and where f is a sort of coefficient of friction. This coefficient has not been yet determined with any accuracy, the different values given in Fairlie's book on the authorities of Atkinson, Devilley and Clark being one thrice as large as the other. To determine it with accuracy by direct experiment requires an instrument showing variations of pressure to the $\frac{1}{10}$in. water gauge. I have not yet succeeded in inducing any instrument maker to undertake the construction of any pressure gauge of this extreme delicacy, but I fail to see why such an instrument should be looked on as impossible. The sum of the above two quantities is the whole work necessarily performed by the fan, that is, it equals W. Equating it to the approximate value of W already found, viz., 5·2 G V, we find—

$$\cdot 08\ V^3 \left\{ f \Sigma \left(\frac{L}{A^2 8} \right) + \frac{1}{2g\ A_e^2} \right\} = 5{\cdot}2\ G\ V, \text{ or}$$

$$G = \frac{V^2}{65} \left\{ f \Sigma \left(\frac{L}{A^2 8} \right) \div \frac{1}{2g\ A_e^2} \right\} \quad \text{Equation V.}$$

Thus G varies as the square of the volume required, and is diminished by enlarging the area A e from which the air is discharged on re-entering the free atmosphere.

1st July, 1885. ROBERT H. SMITH.

* Read before the South Staffordshire and East Worcestershire Institute of Mining Engineers, July 2nd, 1885.

* Two easily detected misprints occur in THE ENGINEER, viz., V_2 for V_3 and A_2 for A_3.

LETTERS TO THE EDITOR.

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

THE LAWS OF MOTION.

SIR,—Professor Lodge forgets that he has already told us that the "other force" is the reaction or push-back of the stone against the gravitation medium. The mere repetition of what I did not understand before, is not likely to make me much wiser.

Let me re-state my difficulty and put it to your correspondents to determine whether Professor Lodge has solved it.

A body cannot resist its own motion. It is attracted or driven towards the centre of gravity. But it pulls back. Now as by statement No. 1 it cannot pull back through any force of its own, it follows that it is kept back by the force of something else, and I ask again, with the earnest hope of getting an answer, *What is that other force?* By virtue of what power is the stone enabled to react against the gravitation medium ?

If Professor Lodge now denies that he ever said that it is incorrect to speak of the drawback of a cart, I can only say that his letter of March 21st seems meaningless. Be that as it may, however, he has abundantly admitted, and indeed emphatically asserted, that a body cannot resist its own motion—*i.e.*, that it cannot start from a state of rest unless impelled or attracted by some outside force, or cease moving when once started, unless arrested by something else—and this is all that is needed for my argument. But if Professor Lodge, as seems clear, means only to express by the word "reaction" the stone's rate of change of momentum, why does he confuse our minds by speaking of it as a push *back?* (See the concluding paragraph of his letter of May 21st.) A push back means resistance if it means anything, and yet Professor Lodge has all along been warning us against the fallacy of thinking of Reaction and Resistance as synonymous terms! A STUDENT.

July 19th.

SIR,—In continuation of my letter of July 6th. "Φ. Π.'s" question in your issue of the 17th has nothing to do with any tug-of-war, and I do not know how the engines could get an impulse such as he demands, *i.e.*, from a source external to the system—earth, railway, engines—of which they are a part, except by a blow from a passing meteoric stone. Supposing, however, that they do receive such a blow while they are standing at the west end of the railway, with steam in each at 120 lb. per square inch, giving tension on draw-bar and compression on rails between the engines each equal, so that motion is *nil*. Supposing, also, that the blow gives them a speed of five miles per hour (=7·3ft. per second) eastward. Remembering that the mass of the railway is ten times that of the engines, and finally denoting the force of the impulse by 6 x, then—

(A) The speed eastward of the engines will diminish at a time rate determined by the comparative capacities of their boilers and cylinders—both unknown—for :—

(B) The force of the impulse will be gradually used up half in pumping the exhaust steam of E ‡—> into the boiler of O <—‡ W by the reversed action of its pistons, and half in imparting velocity—also eastward—to the railway itself because of the reaction of the reversed pistons of <—‡ W upon it. While <—‡ W was thus gathering a thrust tending to drive both engines westward and actually driving the railway eastward, the compression strain on that part of the rails which at any instant might lie between the engines would remain constant, but the tension on the draw bar would rise *pari passu* with the increasing thrust of the pistons of <—‡ W due to the accumulation by them of E ‡—>'s exhaust steam—or of air, which you please—in the boiler of <—‡ W.

(C) When the whole of the impulse had been expended thus, the engines would for a moment stand at rest in relation to the surface of the earth; but there would be a thrust tending to drive them westward with force = 3 x in the boiler of W—the steam pressure in W would now be $120 + \frac{3x}{2}$, while that in E would be $120 - \frac{3x}{2}$—and the railway would be travelling eastward beneath them with force = 3 x and velocity = $\frac{5}{2 \times 10}$ miles per hour.

(D) The engines would then begin to travel westward with a velocity in relation to the surface of the earth, whose mean rate of acceleration would be nine-twentieths of that of their previous rate of retardation westward, and the velocity eastward of the railway would continue to accelerate at a mean rate of eleven-twentieths of its previous rate. This would continue till the 3 x difference of steam pressure in the engines had vanished, then—

(E) A reverse process would commence, which consideration for your space and my own time induces me to leave for "Φ. Π." to work out for himself.

"Φ. Π." errs in stating that if you lie face downward on a loose plank, and pull yourself forward on it eastward by your hands, gripping its edges before you, the plank does not tend to go westward. It is true that in practice friction keeps it steady, but remove the friction, and the plank will travel westward at a rate dependent on the ratio of its mass to yours.

If "Φ. Π." will now keep quiet for a week or two I will examine the draw-bar problem fully in my next letter—I hope that we are done now with the "tug-of-war" problem—and will try a fall with Professor Lodge, as promised in my note of 24th March—provided always, Mr. Editor, that you kindly grant me space, though the matters in controversy were well understood long before any one who has taken part in this correspondence was born, except, perhaps, "An Old Student." WM. MUIR.

Edmonton, July 20th.

SIR,—Dr Lodge has my sympathies. Steeped as he is in a certain mode of thought, he finds, I know, overwhelming difficulties in accepting the propositions which I put forward. To regard the laws of motion from my point of view is to him all but impossible; and yet I do not even now give up all hope. I still think that a man who can admit that all energy is most probably kinetic, will yet admit that there can be no cause of motion save one—motion.

The most noteworthy fact about this whole controversy is that Dr. Lodge has never vouchsafed the smallest scrap of proof that force is the cause of motion. He has never even by a hint attempted to disprove the proposition that force can only be caused by motion. If, then, for the sake of argument I conceded that force was a cause of motion in one sense, he would have to admit, on the other hand, that motion was the cause of force, and therefore itself the cause of motion. As to Newton's laws, Dr. Lodge interprets reaction at one moment as passive resistance, while the next he invests inert matter with the attributes of *vis viva*, momentum, effort, push. A ladder is an inert mass, but it pushes

up against a man standing on it just as much as the man pushes it down by his weight. To Dr. Lodge these things are quite possible; they involve no contradiction. It is, indeed, hard to make a convert of a man in this frame of mind.

In my last letter referring to the tug of war I put a question to Dr. Lodge. Taking four efforts, A, B, C, D, two opposing each other by pull through a rope, and two opposing each other by thrust through the ground, I asked Dr. Lodge to tell me how any one of these thrusts or pulls could be increased without the rest, the men pulling deriving all their thrusting power from the pull? Dr. Lodge replies that the extra thrust is got because momentum is imparted to the mass moved. But before the mass could be moved at all—that is to say, before momentum could have existence—the thrust must be greater than the pull on the rope. Dr. Lodge has stated this in a former letter, which, no doubt, he has forgotten. His answer (?) to my question refers to an entirely different set of conditions. I do not want to know what are the strains and thrusts after one party in the tug of war begins to haul the other party up to the scratch line. I do want to know how it is that we have at one instant an unbalanced effort somewhere in a system which was the instant before balanced. I repeat, in Dr. Lodge's own words, that before motion could take place, the thrust of one set of men on the ground must be greater than the thrust of the other set of men against the ground, and I want to know how (1) this extra thrust is got at all; and (2) I want to know how it can be got without the motion of an external agent? No system in which the forces are all balanced can originate motion of itself. This is a fundamental proposition which Dr. Lodge will not dispute. I repeat that he has not answered my question.

In conclusion, I would say that it is matter for regret to me that so able and good-tempered an opponent should go out of his way to attribute notions to me which I have not written a line to put forward. Of course, I know that he does not really think that, because I hold that all forces are balanced, I also hold that the pull on the last draw-bar of a train is equal to that on the front. This is Dr. Lodge's little joke; but it is not in good taste. Dr. Lodge knows that all the forces on a crane chain hanging from the point of the jib are balanced; but he does not hold that the forces at the lower links are the same as those at the upper links.

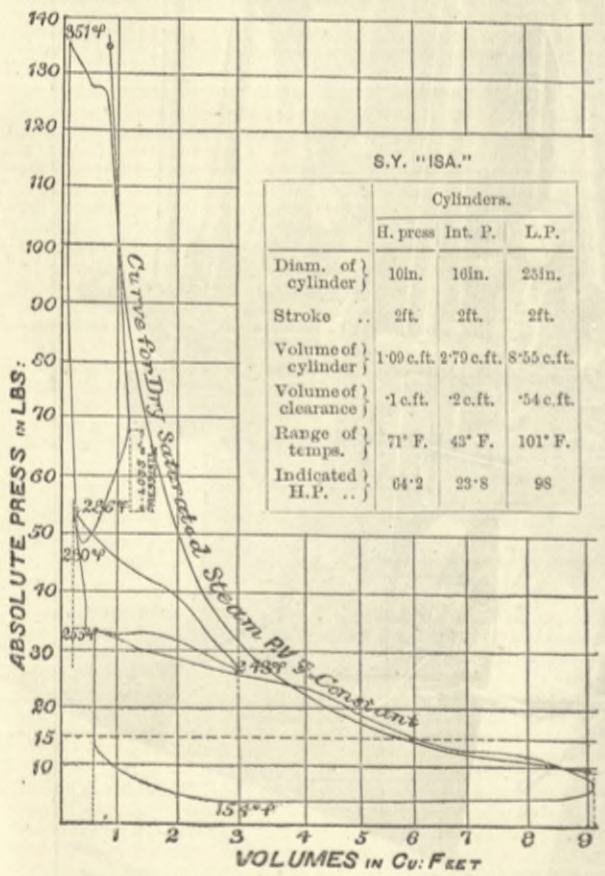
If I said more, I should, perhaps, direct Dr. Lodge's attention away from the question to which I want a reply. Let me put it in numerical form. There are two boys, A and B, pulling against each other by means of a rope; A pulls with a force of 50 lb., and B, of course, pulls with the same; A thrusts against the ground with a force of 50 lb., and B thrusts in the opposite direction with the same force. I now ask Dr. Lodge to tell me how it is possible for A to exert a thrust of 60 lb. on the ground without putting a pull of 60 lb. on the rope. I will concede to Dr. Lodge, if he likes, that if the motion of the boy who is defeated, say B, is accelerated, then his thrust on the ground may be less than A's thrust. But this, as I have said before, has nothing to do with the matter; because the augmented thrust must be got before motion takes place.

London, July 20th. Φ. Π.

TRIPLE EXPANSION ENGINES.

SIR,—I herewith enclose the original indicator cards of the steam yacht Isa, noticed in your issue of June 26th last, along with a diagram drawn by Mr. James Welsh, one of our engineering students, showing them reduced to one scale, and the theoretical expansion curve of dry saturated steam $PV^{\frac{19}{9}}$ = a constant.

Had all the diagrams been taken simultaneously, instead of under varying boiler pressures and speeds, we would have been able at a glance to determine the efficiency of each cylinder and the fall of pressure between each.



S.Y. "ISA."

	Cylinders.		
	H. press	Int. P.	L.P.
Diam. of cylinder	16in.	16in.	26in.
Stroke ..	2ft.	2ft.	2ft.
Volume of cylinder	1·09 c.ft.	2·79 c.ft.	8·55 c.ft.
Volume of clearance	·1 c.ft.	·2 c.ft.	·54 c.ft.
Range of temps.	71° F.	43° F.	101° F.
Indicated H.P. ..	64·2	23·8	98

The clearance has been assumed at $\frac{1}{15}$, $\frac{1}{14}$, $\frac{1}{18}$ of the capacity or volume of the high, intermediate, and low-pressure cylinders respectively. ANDREW JAMIESON, Principal.

College of Science and Arts, Glasgow, July 8th.

ENGINE BED-PLATES AND AMERICAN INDICATORS.

SIR,—Your readers are, doubtless, all familiar with the modern forms of engine beds designed by American engineers, and many of them are probably conversant with the very excellent form of bed lately brought out by the Buckeye Engine Company. For the last three or four months, however, this engine has, for some reason utterly unintelligible to me, been largely advertised in America as the Tangye engine. In Europe it is, I believe, universally acknowledged that this type of bed originated certainly with Mr. Porter, of America, who showed an engine on this system at the Paris Exhibition of 1867, Tangye commencing to put his on the market in 1871. I think no mechanic can look at the two designs without being struck at the vast superiority of the original one. That the Americans still have talent amongst them capable of the most perverted ingenuity in the design of engine framing I much regret to observe. Saving weight in a torpedo boat, marine, portable, or even a locomotive engine is often desirable, but surely this saving is entirely out of place in the bed of a stationary engine. In the Reynolds Corliss engine, advertised by Messrs. Westinghouse, Church, Kerr, and Co., the main bearing is carried on a casting connected to the cylinder merely by two round rods; and this severely simple connection between the cylinder and the main bearing certainly partakes more of the nature of a skeleton's ghost than of the rigid union engineers generally prefer in this important position.

Westminster, July 20th. AUDI ALTERAM PARTEM.

BERTHON BOATS.

SIR,—Will you allow me to correct what seems to me a slight error in your otherwise excellent notice of the manœuvres carried on here with my collapsing boats and pontoons on the 11th ult.?

Remarking upon the experiment of putting a pair of wheels representing the limber of a gun loaded to one ton upon two little boats only 12ft. long, you say that it was "a rash experiment that proved buoyancy, and nothing more." Perhaps you are not aware that this is done by the Royal Engineers at Chatham with my boats of smaller dimensions, and that guns weighing 1 ton 6 cwt. are thus transported across the water. Were this done with only one boat, I grant that the want of stability would be a dangerous element, but when two are used, and placed at a considerable distance apart, as on the day mentioned, the case is very different. To make this clear, let us suppose a weight to be carried by a single boat, the centre of gravity being high—thus:

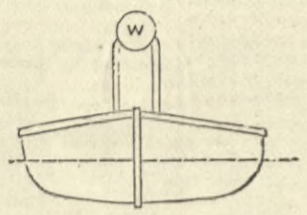


FIG. 1

In this case the stability is very small. But supposing the same weight to be carried at the same height on two smaller boats placed at a considerable distance apart, and connected by a platform, thus, the stability is very great:

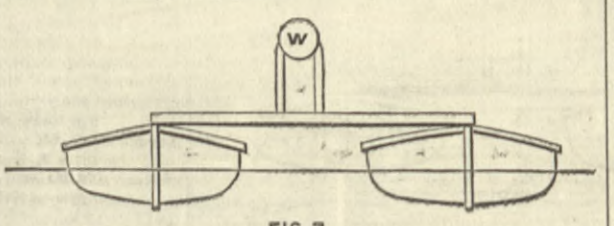


FIG. 2

As in the experiment alluded to the boats were not more than half immersed, it would have required half as much more weight in either boat to bring its gunwale down to the water-line.

Romsey, July 17th. E. S. BERTHON.

PATENT-OFFICE SPECIFICATIONS.

SIR,—The highly amusing illustration given in your last number of what is acceptable by the United States Patent-office induces me to send you the enclosed specification, as an example of what has actually been filed in ours. The patent refers to the preparation and use of charcoal as a filter. It is No. 1861, dated 1860.

The artless ingenuousness and confiding simplicity of the concluding paragraphs containing the claims deserve a wider publication, and I have no doubt they would, if inserted in your columns, delight your readers as much as they have charmed NEMO.

London, July 14th.

"Having unreservedly fully, and as accurately and as clearly, as I possibly could, (and indeed, can, for time will not allow a revision, this being the twenty-ninth day of January and my provisional protection expires on the thirty-first,) therefore I trust that my apparent inaccuracies of description or technical defects will be construed as liberally as each respective case will admit. I will now state as briefly as I can what I know as to the novelty of my invention as herein-before specified. I first became aware of the purifying qualities of charcoal some twenty years ago in the course of my readings and practice as an operative chemist but it never occurred to me to apply it to the purification of water until the early part of last summer when I at once gave my whole soul to the subject and have continued incessantly to pursue it with all my energy during eight months strengthened by the hearty and efficient co-operation of my dear wife the support of our brother Sampson, the enthusiastic admiration of our dear friend Mr. Robert Noyes, and our brother-in-law Mr. William Neeld, the cheerful assistance of our several women, particularly Martha Heath and Betsy Jebbs, and the warm smile of an enchanted public; particularly the dear little ones who clasp the cold sparkling chrystal with both their tiny hands and lifted it to their sweet little quivering lips. To some this may seem irrevelant but I feel it a tribute of justice which gives me inexpressible pleasure to render, for without such aids it would have been a physical impossibility for me to have brought my invention to a successful issue. Although I did not suppose when I commenced to apply carbon to the purification of water that there was any novelty in the thing but I felt that whatever efforts there may have been made they had not resulted in the production of an efficient water and air purifier, I know now what I did not know then, that impure charcoal have been and still is used as a water filter, but beyond that fact I am not aware of any other virging upon my invention. I have experimented upon every substance and material likely to answer my purpose and have combined and arranged them in every imaginable mode, until I am so far satisfied with my researches that I have no desire for any addition or change. Whatever the invention in regard to novelty may be to others. It is all new to me with the sole exception herein-before stated. That impure charcoal has been and still is used as a filter."

PATENT-OFFICE REPORT.

SIR,—The second report to Parliament has recently been published, but it may be regarded as practically the first report, because it is the first for a year of office work, from which any inferences can be drawn as to the probable operation of the new law. It is certainly satisfactory to find that, notwithstanding the reduction of fees, the surplus income for the year 1884 should have amounted to £39,704 4s., especially as it is reasonable to expect a considerable increase in the receipts from renewal fees in the course of a few years. It is also satisfactory that after all the hard things that have been said about patent agents, and the great facilities offered for direct correspondence with the Patent-office—"out of the total number of applications about 73 per cent. were made through agents and 27 per cent. were made direct by applicants." There is one feature in the new practice to which I attach the greatest importance. In the report it is announced as follows:—"Forty-six reports of patent cases tried in Courts of Law in the United Kingdom during the year 1884 were published as supplements to the 'Official Journal' of the Patent-office." From the beginning of the present year these reports have been published separately, and are furnished to subscribers independently of the "Official Journal." This I think an improvement, especially as affording a prospect of permanency and completeness in the work. And I know of nothing more calculated to improve the practice than to give to lawyers and patent agents an opportunity of reading the decisions regularly soon after their delivery in Court. Without some provision of this kind only a few cases would ever get reported at all, and then probably only in a meagre form. Besides, the ground of the choice of cases for report might be their costliness, rather than their containing points of law of importance to future cases.

Among other reasons for desiring the continuance of a regular publication of authorised reports is the protection it may incidentally afford against the undue growth of officialism in the Patent-office. This is by no means only an imaginary danger, now that we have established a system of examination under the control of the Board of Trade. I believe from my own observation that there is a great natural tendency to narrowness of view in the official mind; a great want of freshness and receptiveness, owing to the contracted range of departmental thought, unrelieved by the varied experience of general practice. As a counteraction for this natural tendency, the practice in the Courts of going behind everything and dealing with every point that can be fairly raised, and the admission of extrinsic evidence—leading, it may be, to an interpretation of documents different from that to be gathered from them alone—all this tends to widen the view, and keep the judicial mind in a comparative state of freshness to deal with new points in a spirit of justice and impartiality. This comparative breadth of treatment, with an adaptation to the special circumstances of each particular case, governed by a due regard for well-established principles of construction, is essential to a good administration of patent law, which from its very nature has continually to deal with new things, and therefore requires elasticity, while preserving continuity as to principle.

It must be obvious to anyone who has given due attention to the subject that although trade marks and patents are to be administered under the same Act, yet they are essentially different as to the legal principles involved in them; and that an official system that might work very well for artificial creations like trade marks, might be altogether inadequate for the due legal recognition of novelty of invention. Bearing this in mind, I see great need for the action of the Courts to restrain the tendency of the practice in the Patent-office to undue narrowness and officialism.

8, Quality-court, Chancery-lane, W.C., WILLIAM SPENCE.
July 9th.

HEDGE'S SPEED GAUGE.

SIR,—Will you permit me to make a few remarks on the engraving of "Hedge's Speed Gauge," which appeared in THE ENGINEER of June 26th, for the benefit of anyone who may have been puzzled by it, as I confess I was until I saw the gauge itself? The dotted lines showing the different parabolas, formed by the section through the axis of the paraboloids due to the different rates of velocity, are all drawn to meet at the top edge of the tube. This could only be the case if the tube were open at the top, so that the water could run over as the speed increased. In this case, the equation to the parabolas being

$$y^2 = \frac{2g}{w^2} x$$

—where y is constant, being the radius of the tube—x, the depression of the water, would vary as the square of the angular velocity, not directly with it.

It is not till the water reaches the closed top of the tube, and the diameter of the paraboloid at the top begins to decrease with any further increase of speed, that the depression of the water begins to vary directly as the angular velocity, this being due to the volume of the air, which is

$$\tfrac{1}{2}\pi y^2 x$$

—where y is the radius of the paraboloid at the top of the tube—*i.e.*—

$$\pi \frac{g}{w^2} x^2$$

being constant; so that x varies directly as w.

J. SHIFFNER,
Captain, Royal Artillery.

Coombe-place, Lewes, Sussex, July 11th.

SOLID BEAMS.

SIR,—I beg of your reviewer not to feel any regret on my account for his not being able to understand the lesson taught by the agreement of the actual experimental breaking weights with those calculated from my formulæ. I can assure him that his review has given me great gratification, because it has afforded me the opportunity, long sought, of publicly stating what objects have been attained by my little work. A milk-and-watery review of the usual type would not have done this. If there is any desire amongst engineers to ascertain the truth, this publicity cannot fail to cause the speedy issue and speedy sale of a second edition.

Three qualities are essential in a reviewer: thorough knowledge of the subject, impartiality, and candour. Would the contents of his review and letter justify even a partial friend in attributing any one of these qualities to the reviewer of my work on "Solid Beams?" Working out the formula which he states gives the shearing stress accurately may be a very long process; but surely he can have no excuse for declining to say whether it is based on experimental data or imaginary assumptions. The reviewer, whilst professing the greatest respect for Rankine's "Applied Mechanics," affirms that he has not studied the work. On what basis, then, does his respect rest?

It is quite out of my power to form the least idea of what is meant by the moment of inertia of a section or a surface. I see the famous I figures largely in Mr. Graham's criticism of the Danubian Bridge scheme. Doubtless to this marvellous conception is due the birth of the statical-dynamical hybrid monster, the "ellipsoid of stress." WILLIAM DONALDSON.

4, Westminster-chambers, July 22nd.

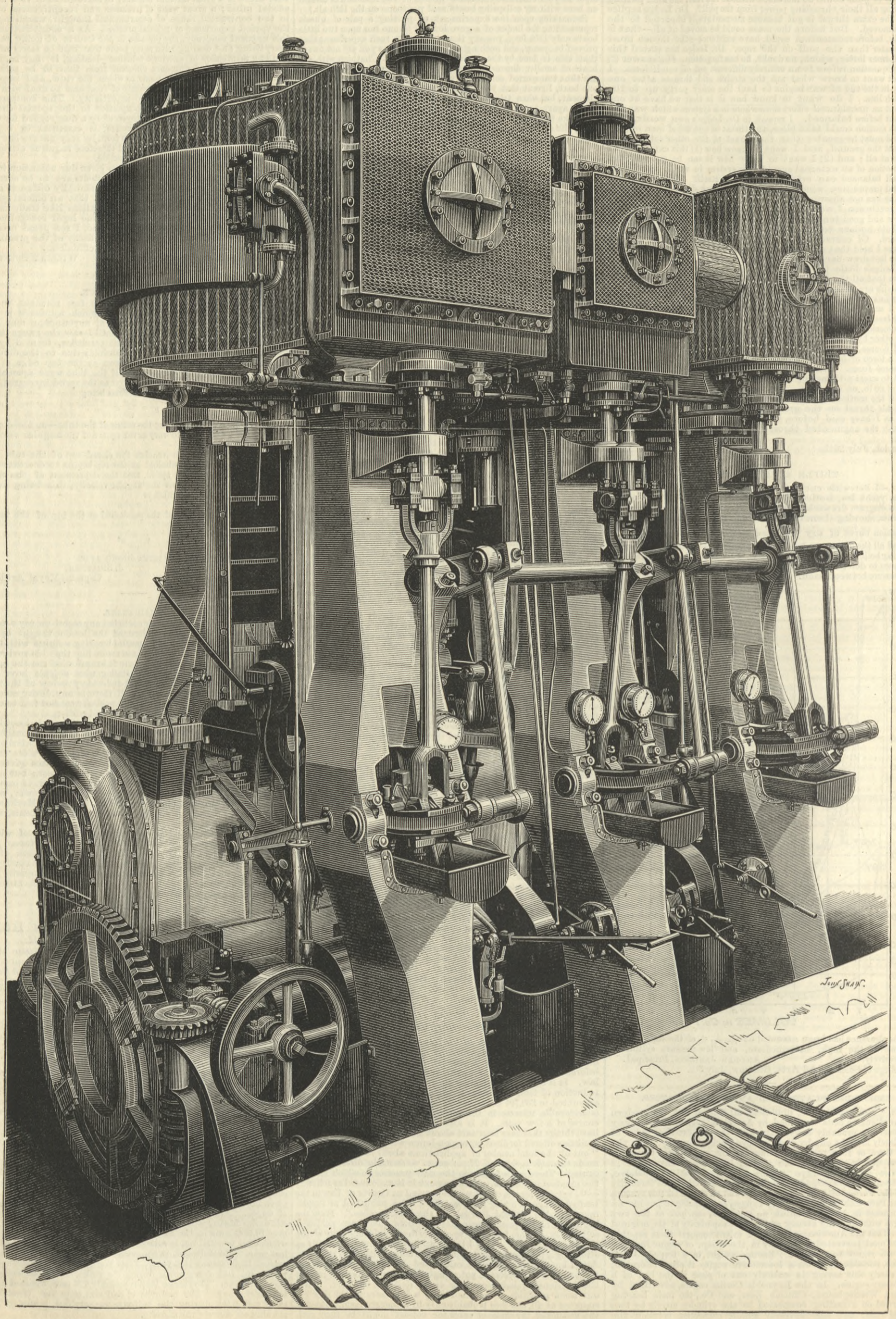
THE YORKSHIRE COAL TRADE WITH HULL DURING THE PAST HALF YEAR.

CONSIDERABLE interest is being attached to the issue of the official return relating to the tonnage of coal, by rail and water, to Hull. As might have been expected, there is a marked falling off in the quantity sent during the past six months, as compared with what was forwarded in the corresponding periods of 1883 and 1884. The falling off is to a great extent due to the disastrous strike, which for seven or eight weeks completely paralysed the mining districts of South and West Yorkshire. The quantity sent during the last six months was 532,256, as compared with 611,920 tons in the corresponding period of 1884. The tonnage sent from the leading South Yorkshire collieries during last month and in the six months was of a most varied character. The Denaby Main Colliery last month sent no coal to Hull, whereas in the corresponding month of last year 11,848 tons were sent, and 76,136 tons in the six months, against 14,992 tons in the past half-year. From Corton Wood only 4616 tons have been sent in the half-year, as compared with 11,416 tons last year. Manvers Main, which is next to the ill-fated Denaby Colliery, sent the largest tonnage of any colliery in South Yorkshire, forwarding 39,440 tons in the half-year, against 35,096 tons in the first six months of 1884. South Kirby, the newly-developed colliery on the new Hull and Barnsley line, sunk in a part of a rich virgin coalfield, only sent 3168 tons in the last six months, against 5336 tons last year. Although the colliery which belonged to the Roseberry Iron Company was purchased at a startling reduction on the outlay, the owners have given notice to the men to leave work, it is believed, for a reduction of wages. Amongst the collieries in the Rotherham district, the Aldwarke Main, which worked throughout the recent strike, sent over 10,000 tons in the half-year, against 8112 in 1884. Kilnhurst, which also worked on, is accredited with 11,336 tons, against 4260 last year. Roundwood, in the same locality, supplied 14,576 tons, against 13,768 tons last year. From Wath Main, another colliery which did not cease work during the strike, 6608 tons were sent last half-year. Thryberge Hall supplied 19,024 tons, against 16,872 tons last year. The quantity of coal sent from the West Yorkshire collieries during the half-year was very fair, many of them working on during the dispute.

TRIPLE EXPANSION ENGINES WITH JOY VALVE GEAR.

THE WALLSEND SLIPWAY COMPANY, ENGINEERS.

(*For description see page* 73.)



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

J. H. (Dublin).—*Cullen "On Turbines," published by Spon, Charing-cross.*

POWER-TESTING BRAKES.—*Brakes and dynamometers are described in a paper by Mr. W. E. Rich, read before the Institution of Mechanical Engineers, from the Secretary of which you can probably obtain a copy at a small cost.*

CRANES (F. E., Hull).—*We do not know of any work "On Cranes" except that in Weale's Series. You must consult the "Proceedings" of the Institution of Civil Engineers, the Institution of Mechanical Engineers, and our columns.*

APPRENTICE.—(1) *One object is to approach to the advantage of the right angle position, and to allow the exhaust from the high-pressure to the low to take place at the time when the pist n in the latter is on the point of commencing its stroke. When a receiver is employed they may be placed at right angles.* (2) *The high-pressure.*

DRAUGHTSMAN.—*The ends of the girders at present are least subject to stress. Under the alteration, with the ends joined and forming the centre of the girders, the top and bottom members would be here subject to maximum compressive and tensile stresses respectively. The two diagonals inclined from top outwards should be supplemented by two from bottom upwards, and top and bottom flanges materially strengthened. Even if you use a truss-tie as shown, the top and bottom flange plates should have each a good cover plate put on. The simple truss would do, and the rod may be attached either to top or bottom of ends. But can you not sufficiently strengthen the two joined girders to do without any truss?*

OXIDE OF IRON.

(*To the Editor of The Engineer.*)

SIR,—Will any of your readers favour me with the name and address of the makers of oxide of iron? S. S.
London, July 20th.

FOLDING MACHINES.

(*To the Editor of The Engineer.*)

SIR,—May I ask through your columns the name of the makers of a machine for folding circulars, letter paper, and note size two-leaf? It is to save labour and for expedition I need it. R. B.
Liverpool, July 20th.

ASPHALTE FOR BRIDGE FLOORS.

(*To the Editor of The Engineer.*)

SIR,—Can any of your readers give me a good specification for asphalte or other substance suitable for covering the wood decking of a suspension bridge? It should be as light as possible and thin, not slippery or soft. The chief object is to preserve the timber from the weather, and to prevent the horses' hoofs from cutting up the surface of the planks.
Newcastle, July 21st. PONTIFEX.

THE DANUBE BRIDGE PROJECTS.

(*To the Editor of The Engineer.*)

SIR,—In my article on Culmann's treatment of elastic arches, appearing in your current number, where a rule is given to determine the dangerous load on any division of the arch, the word "inner" should appear before the first occurrence of the term "apex," and "this" should be replaced by "the," where it occurs a second time. R. H. GRAHAM.
July 20th.

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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.*

DEATH.

On the 4th inst., at 35, Rochester-square, N.W., HENRY BROCK BILLOWS, aged 72, Gas Engineer, for many years connected with the Chartered Gas Company.

THE ENGINEER.

JULY 24, 1885.

THE METROPOLITAN BOARD AND THE FIRE OFFICES.

OF all the functions imposed on the Metropolitan Board, that of maintaining the Fire Brigade is the only one concerning which there is a want of pecuniary means. For every other purpose within the sphere of the Board's operations there are ample funds at command, and no statutory limit is assigned to the expenditure. But the Board may not levy more than a halfpenny rate to meet the current expenses of the Fire Brigade; and although this proved sufficient for some years subsequent to 1869, when the present system was established, the halfpenny limit has lately been found seriously embarrassing. In all its financial arrangements the Board is very much at the mercy of her Majesty's Treasury, and it so happens that there is a question related to this affair which places the Board in an awkward position towards the Government Department. Part of the revenue of the Board for Fire Brigade purposes is derived from the fire insurance offices. The amount of the contribution thus furnished is fixed by an Act passed in 1865, which specifies that every insurance company shall contribute to the Board at the rate of £35 for every million pounds on the gross amounts insured by it in respect of property in the metropolis. Previous to this provision being settled, the fire offices had shown themselves desirous of contributing a proportion not exceeding 30 per cent. of the amount to be raised by a metropolitan rate. This preference was set on one side, but the reason for it was apparent from the fact that the contributions from the fire offices amounted for the first few years to much more than 30 per cent. of the amount paid by the ratepayers. In 1869 the offices contributed a proportion exceeding 42 per cent. of that raised from the rates. From that period there was a change, and the ratio dropped, so that ultimately it fell below 30 per cent. The disproportion is increased by the circumstance that all the outlay on the capital account, together with the interest and the sinking fund, falls on the rates; and to the burden thus borne there is no limitation, the charge being thrown on the consolidated rate, as part of the ordinary expenditure of the Board. So badly does the present system work, that the Board is now subject to a yearly and increasing deficit on the Fire Brigade account. Thus in 1883 the deficit ranged between £7000 and £8000; in 1884 it was between £10,000 and £11,000, and the deficiency this year will be still greater. That which we have called a deficit is really an excess of expenditure over receipts. The Board spends the money, and in reality takes it out of the rates. The Government auditor disallows the excess of expenditure, but he has no power to make a surcharge. The money is spent, and as it cannot be helped, the Board afterwards gets an indemnity from Parliament. In this lame way matters are going on, and obviously there must be a change, such as will prevent so undignified a proceeding.

The Metropolitan Board is dependent on the Treasury for the passing of its annual Money Bill, and this brings into play a very curious feature in the local government of the metropolis. It would seem that the Treasury are willing to have a clause in the Money Bill abolishing the halfpenny limit in respect to the Fire Brigade rate. But there is an opinion prevailing at the Board that if the ratepayers are to contribute on a higher scale than heretofore, the fire offices should be similarly treated. As the insurance companies stoutly oppose this proposal, the Treasury refused to have that part of the question dealt with in the Money Bill. On the other hand, the Metropolitan Board refused to let the Money Bill repeal the halfpenny rate, unless it also included a clause which should increase the contributions of the fire offices. In pursuance of this determination, the Board last year introduced a Bill into Parliament, the effect of which would have been to make the fire offices contribute in a higher ratio than in recent years. But the Bill was "persistently blocked," and never got through. This year nothing has been done, except to expend more money. Next year something is to be attempted, and on this point a step of considerable importance has just been decided upon. The resolution of the Board is practically to renew an attempt to enforce on the insurance companies a scale of contribution which shall bear some definite proportion to the amount which falls upon the rates. A Bill for this purpose, as also for raising the halfpenny limit to a penny in respect of the rates, is to be introduced in the session of 1886. It will be seen that by this scheme the Fire Brigade rate would still be limited, only the maximum would be raised from a halfpenny to a penny. What the companies are to contribute is not yet announced, but, of course, it will be in advance of the present amount. How they will meet this proposal is already clearly declared. If the companies are asked to contribute on a higher scale than they now do, they will consider themselves morally released from their old bargain, and will seek to pay nothing. It is not very likely that Parliament will let them off to that extent; but if Parliament is lenient with the fire offices, there is danger that the Metropolitan Board will again prove restive, and refuse to increase the burdens of the ratepayers. But the war must end, and Parliament ought to be allowed to end it. It were better for the ratepayers to bear the extra burden than for London to be desolated by wasteful fires. The Metropolitan Board is probably right in demanding a revision of the bargain with the fire offices. The latter are, perhaps, taking a narrow and mistaken view of the question. But London must not burn because these two high contracting powers cannot agree. What the Board will ask for we cannot yet tell, except that Mr. Richardson, one of its members, has proposed that the contributions of the companies should be raised from £35 to £40 per million of the gross amounts insured by them in respect of property in the metropolis. The extra sum involved is under £4000 per annum. If the companies cannot bear this small addition to their burdens, they must be miserably poor or very parsimonious; or else they must be contending for some principle irrespective of the actual amount at stake. If they urge that they have nothing to do with the extinction of fires, the plain answer is that they felt it to be to their interest to undertake that duty when the Metropolitan Board had no existence. It would not be to the interest of the companies that London should have no Fire Brigade, and hence they cannot properly plead that they have no special and peculiar interest in the maintenance of that establishment.

Some time ago we dwelt on the fact that the fire offices had been raising their rates of insurance, and we pointed out the reasons for it. Fires in London had become increasingly disastrous in a pecuniary sense. We showed that the modern style of building, and the very mode of extinguishing fires, tended to aggravate the risks of the insurance companies. In dealing with the statistics of metropolitan fires, as furnished by the annual reports of Captain Shaw, we have deduced certain considerations which prove how arduous is the task of suppressing conflagrations in the enormous aggregation of buildings now to be found in the metropolitan area. Mr. Richardson's proposal as to the scale on which the companies shall contribute has not been adopted by the Metropolitan Board. On the contrary, the plan has suffered a species of rejection. Yet it may represent substantially the terms that will find place in the Bill, and, if so, there is nothing which the fire offices need resent. They may try to escape the additional burden, light as it would be; but to seek to escape altogether would be an attempt rather calculated to prejudice their cause. Paying £40 per million, the companies would have contributed last year rather less than £28,000 towards a total expenditure of £120,000. If the Metropolitan Fire Brigade were swept away, a very large proportion of this expenditure must fall on the fire insurance companies, as we cannot suppose they would be satisfied with a mere revival of the old parish engines. But let the case as it affects the fire offices be what it may, the Brigade must be maintained in efficiency, and if possible extended. There is no doubt that the Brigade, as it exists, is a very splendid institution; but large fires warn us from time to time that London is not so well protected as it should be. The Brigade is heavily worked on some occasions, and it may at some unfortunate juncture find itself with more to do than it can well manage. The central part of London is becoming more and more a congeries of huge warehouses, each a slumbering volcano. The materials of a great conflagration are spread all round St. Paul's, and whether the insurance companies contribute £4000 a year extra or not, the Metropolitan Board must clearly recognise its own imperative duty to give London adequate protection against the ever-existing danger of a far-spreading and destructive fire. The Chamber of Commerce of the City of London has pointed out the need of extending the Fire Brigade, and yet we see that the funds provided for that establishment in its present form are insufficient. The City Chamber of Commerce considers that the fire offices should contribute rather more than hitherto. This may be admitted, but Parliament must be asked to settle the question, and the Board must seek the solution in the most direct and practicable way it can discover. The subject has been long postponed, and does not admit of further delay.

THE FORTH BRIDGE.

THIS stupendous work has reached an interesting stage, and although we do not want by our remarks to stimulate and increase the stream of visitors whose numbers are already somewhat embarrassing to the contractors, a short description of what has been done and is now doing may not be out of place. Our readers will remember from various references in THE ENGINEER that this bridge crosses the Firth of Forth at Queensferry, about eight miles above Leith and about one mile below the present railway ferry. The Firth is here about 1¼ miles wide, and for three-fourths of this width is so deep that piers are practically impossible. But the rock or islet, Inch Garvie, which rises abruptly out of the deep water in mid-channel, obviously affords an intermediate support, and it has accordingly for many years past determined this as the site for a much-needed bridge. At present railway traffic to Perth, Aberdeen, and the North passes round by Stirling and a glance at the map shows the saving in time and distance which may be gained by a crossing at the new bridge. The present ferry, it is true, affords access to Dunfermline and Fife, but is not sufficient to justify a corresponding railway for the main traffic northward. The railway companies most interested, and who have contributed to the bridge scheme, are the North British, the North-Eastern, the Great Northern, and the Midland. Sir T. Bouch, who had obtained some fame by his Tay Bridge, prepared the design for the Forth Bridge also, and a contract was even made for its execution, but the disastrous failure of the Tay Bridge caused a further investigation, and it was found that the design proposed—a wire rope suspension bridge—presented so many difficulties and risks, both during construction and in after stability, that it was abandoned. The bridge now in course of construction was designed by Mr. John Fowler and Mr. Benjamin Baker, under whose superintendence the works are being carried out.

The best approach to the site is by water, but the opportunities for this are not frequent for those who have no yacht or steam launch at their disposal, although excursion steamers run occasionally. A railway ride of half an hour from Waverley Station, Edinburgh, brings one to Dalmenie, the station preceding that of the railway terminus at the ferry, and here skirting the park of Lord Roseberry, and in the middle of rural scenery, a walk of about a mile brings one to the Forth Bridge works and to the barracks or huts which have been built for some of the workmen. Even with these and with the houses in the neighbouring village the accommodation is quite inadequate, and a special train to and from Edinburgh morning and evening is run for those who cannot find lodging near their work.

One of the most interesting features in this, the largest of bridge structures, is that the whole process of manufacture is to be seen, as well as the foundations, the piers, and the operations of erection. The workshops occupy a considerable tract of land between the railway and the Firth, these shops and the building yard being on a level about 100ft. above the water. An inclined railway worked by a stationary engine and wire rope runs down to the wooden jetty which has been erected alongside the bridge site, and from which the material is embarked. The first of the workshops were built for making the original structure

of Sir T. Bouch; but they have been considerably extended, and are full of special machinery designed by Mr. Arrol, one of the contractors, some of which has been already described in THE ENGINEER of 16th January and 13th February this year. It will be remembered that the bridge, which is on the cantilever principle, is mainly composed of tubular members, and the construction of these and the various junctions and intersections of the parts, involve details and arrangements of manufacture for which there are no precedents. To begin with, the material is entirely of steel, the various plates and bars ranging from ¾in. to 1¼in. in thickness. The plates, the tee, angle, channel, and other forms of steel are of a size and weight which a few years ago would have been unprocurable in iron except at a prohibitory cost; but now they are made without difficulty, most of the supply in the present case coming from the Steel Company of Scotland, whose works are at Glasgow, and therefore within moderate distance. All the rivet holes are drilled, and besides the multiple drilling machines used now in most bridge factories, special machines have been made to suit the peculiar shape of the various connected pieces, so as to drill through numerous thicknesses attached together. There are also special planing and bending machines, hydraulic pressing dies and hydraulic cranes, all adapted to the massive work they have to deal with.

The present rate of manufacture of this drilled and planed steel work is about 1000 tons per month, and it is reckoned that about two years will see the manufacture of the bridge completed, so far as the factory is concerned. With every modern appliance, including the electric light, there is no reason to doubt the fulfilment of this promise.

Visiting now the site of the bridge itself, one endeavours first to realise the height at which it is to cross the Firth. We must refer for an outline elevation of the bridge to the engraving, which appeared in THE ENGINEER of 16th January; but this, while assisting our description, hardly conveys any idea of the real dimensions. Standing in the factory building yard at the top of the railway incline, one looks down to the water, whose level is 100ft. below. There, about 20ft. above the water level, are seen resting in their masonry piers the shore spans, each of about 170ft. These spans will be lifted as the piers are built upwards. Still looking downwards, one seeks for some mark or sign of the ultimate level of these girders, which will give that of the roadway of the big spans. But one is directed to look round and upwards, instead of downwards, to a pole fixed in the upper level where one is standing, and there on the pole 50ft. above us is a mark "rail level." When the eye endeavours to extend in imagination this level across the wide waters below, and to further picture how the pier towers of the central spans will soar a further two hundred above the rail level, giving a total height of about 400ft. above the water, one is able to realise, though very imperfectly, the gigantic structure audacious man is attempting to build.

Descending to the lower level on the shore, one reaches the old stone pier or causeway sloping down into the water, which before the days of railways was the landing place for the old ferry. This has historic interest to readers of the Waverley Novels, for it was here in the Hawes Inn—whose present landlord profits greatly by the pilgrims to the Forth Bridge—that the antiquary, as is narrated in the first chapter of the romance of that name, had to wait till the tide served for the ferry boat to take him to the opposite or Fife shore.

The piers for the shore spans have been built in shallow water by means of ordinary timber coffer-dams, but the foundations of the large towers have been built in iron caissons, the sinking and excavation being done by the compressed air system. These caissons were illustrated and described in THE ENGINEER of 6th and 27th February last. There are three towers, one on the south or Queensferry side in the shallow water; another, the central tower, on Inch Garvie; and the third on the northern or Fife shore, on the edge of the deep water. The depth of the two deep water channels is about 200ft. Each tower rests on four circular masonry piers built on concrete-filled caissons, and these four piers are strongly united, affording a sufficient area and solidity of base to carry the huge structure above. The caissons are about 70ft. diameter, and 7ft. from the bottom or cutting edge is a diaphragm or floor forming the top of the air chamber, within which the operations of excavating are carried on. The ingenious air-lock through which communication is obtained was described in THE ENGINEER of 13th February last, and is now in daily use. The men who work under pressure in the air chamber are mostly Italians who have had a previous experience in somewhat similar circumstances at the Antwerp Harbour Works. Some of the concrete with which the caissons are to be ultimately filled is placed within them, above the working chamber, to give them steadiness in floating them to their exact position, and more is added to sink them. The excavating is performed in the rock by ordinary percussion drills and dynamite, the earlier use of the revolving diamond drill for the shot holes being apparently abandoned. For excavating the hard clay that is met with, and which would, if hand labour were used, require hard work with the pick, an ingenious hydraulic spade is employed. Fashioned somewhat like a hydraulic lifting jack, the hilt or closed end rests against the roof plates of the air chambers, and when the pressure water is admitted above the piston the latter descends, and the steel spade with which it is armed cuts down into the hard and sometimes almost rock-like clay, and detaches a good sized chunk or slice, which is lifted out by the workmen and placed in the skip. In the passage to or from the air chamber there are separate tubes for the workmen and the spoil, and there are besides, for the softer mud which is met with, also ejection tubes, through which the mud is forced upwards by the air pressure, in the manner found successful at St. Louis and Brooklyn Bridges and elsewhere. The labour of the workmen is obviously lightened and expedited by these appliances, and the comfort and health of the men is also promoted by the use of incandescent electric lights, instead of the oil lamps, which are so unpleasant in a confined space. When the caisson has reached a firm and level foundation the air chamber is filled with concrete, the workmen retreating as the empty space diminishes. Is is, of course, necessary to pack the air chamber tightly up to the roof, so that the solid mass shall be continuous with that in the upper part of the caisson. It would almost appear as if this could be more effectually done by making a final stratum of hard brickwork in cement, so as more certainly to underpin the roof; but in any case the load above will soon take a solid and continuous bearing on the mass below.

The concrete is made with Medway Portland cement, sand, and broken stone. Ballast cannot conveniently be obtained, but the whinstone from the adjacent quarries on the Fife shore, from which paving and kerb stones are supplied for the Edinburgh streets, affords good material. Stone breakers are continually at work, and the quantity required may be estimated when it is considered that some 30,000 tons of cement will be used, and that this forms only a sixth part of the concrete. Above the concrete, and starting from just below the water level, the circular granite piers are built. Four of these piers, of about 60ft. diameter, form the base of each of the large towers. On each pier is fixed a bed-plate of steel, composed of massive slabs, almost like armour-plates, and bolted down by bolts descending deep into the masonry, as shown in THE ENGINEER of 27th February. The vertical and raking tubes forming the commencement of the superstructure, are strongly framed together, and the erection of these in place will shortly commence, as they are nearly completed in the building yard, their dimensions and the area they cover in the yard giving the first actual evidence of the magnitude of an undertaking seen hitherto only on paper. With this erection the novel and unprecedented part of the work will commence. The exact methods and appliances to be used are only known to those concerned, but as the form, weight, strength, and strain of every part have been fully considered, and primarily with a view to the erection, no doubt need be felt concerning its achievement. The rivetting in the workshop has been done by hydraulic machines, now so universal in bridge factories, and in the present case almost essential to the closing and holding of the massive plates and bars; but it is intended also to use hydraulic rivetting machines on the superstructure *in situ*, with accumulators on the towers, and this will indeed be unprecedented. Certainly every aid that modern science can afford is here brought into use, while the highest engineering skill and the special experience of those who are accustomed to move heavy weights are also enlisted in the work. One cannot but be struck by the combination of novel appliances here at work, showing clearly that only a few years ago such a bridge would have been impossible. Homogeneous steel, in size and form and weight appropriate for the purpose, produced at a much less cost than would be possible in rolled iron; the elaboration of the old diving-bell in the air chambers and air locks of the caissons; hydraulic pressure simply and effectively applied to lifting and excavating by means of the accumulators; concrete which has alone revolutionised the methods and extended the limits of submarine structures; the electric arc lights in the building yards and on the site of erection; incandescent lights in the workshops and down in the caissons; telegraph and telephone communication from shore to shore; daily photographic records of progress—all make up together a well-devised and well-executed system unprecedented in the history of engineering, and place this titanic structure on an equality with the Pyramids and other achievements of a prehistoric age. We hope to give further particulars from time to time of the progress of the work.

THE PRESTON SHOW.

EXPERIENCE has hitherto shown that the financial success of the Royal Agricultural Society's shows has been greater in manufacturing districts than in purely agricultural districts, such as that in which the show is to be held next year. The results of the Preston Show have, it appears, not supported this experience—a fact which is perhaps to some extent due to the somewhat unfavourable weather, but more to the fact that these shows are becoming yearly less attractive to the public. There are now so many exhibitions catering for public support, and made in various ways popularly attractive, that it is scarcely remarkable that the Royal Agricultural Society's market—for that is what it has become—has ceased to draw the numerous patronage that at one time gave it financial success. Almost every other body dependent upon popular support offers attractions of a popular kind to supplement the business attractions. The Royal Agricultural Society has not done this, and cannot with dignity do this, although the Kensington shows under Government support do this to such an extent that it is often remarked that the Inventions Exhibition is simply a side show tacked on to very well organised pleasure grounds. The whole affair is, however, very completely managed, and thousands of people who would not go to the exhibition alone do go in consequence of the combined attractions. These are not of the order which could be adopted by the Royal Agricultural Society; but that Society has ceased to offer attractions which were irresistible to many thousands who now remain at home. It is contended that the trials which used to be carried out under the auspices of the Society did not pay. It may be admitted that they did not pay directly, but it cannot be admitted that they did not pay indirectly and add enormously to the popularity of the shows, though they ceased to be popular a few years ago with a section of the Society's council. It is not necessary that the prizes offered should have much intrinsic value, nor that the trials should be very costly to the Society. The offer of awards for various classes of agricultural machinery and implements is, however, undoubtedly as necessary as the awards for cattle, pigs, poultry, and sheep. The need of a stimulus to improvement and novelty is becoming more generally admitted, just as the fact is each year more certain that the show is not as valuable to exhibitors. It has sometimes been said that attending the shows paid no one directly; but history shows plainly enough that those firms that were most energetic in bringing out new and successful implements did most business. The shows paid indirectly, and those who won prizes as the result of trials needed only business and manufacturing capacity to reap substantial reward. The Society performs only part of its mission unless it fosters, as it used to do, the improvement of farm machinery, and that section of the council which is afraid of trials must retire if the usefulness and success of the Society are to be considered. It remains to be seen what the Society will do at its Norwich meeting. Something more than a mere horse, cattle, and implement market will be necessary to attract paying members to Norfolk. Finality may have been reached in cattle breeding, but certainly has not in good economical implement and machine construction. Even in this year of poverty in new inventions the Society has awarded a silver medal to Messrs. Hornsby for a draining plough, and to Mr. R. Maynard for a large self-feeding chaff-cutter with sifting and bagging apparatus. If suitable inducements were offered there is great room in engines, thrashing machines, and some field implements for novelty in that most desirable direction—namely, simplicity.

CENTRIFUGAL PUMP PATENTS.

IN our last impression we referred to the case of Gwynne Drysdale and Co. On the 16th inst. Lord McLaren, with Professor Tait sitting as assessor, gave judgment. The pursuer, the sole partner of the firm of John and Henry Gwynne, hydraulic and mechanical engineers, Hammersmith, Middlesex, asked the Court to interdict the defenders, Drysdale and Co., Bon Accord Engine Works, London-road, Glasgow, from infringing letters patent dated 23rd July, 1878, said to have been granted to the pursuer for an invention of "improvements in pumping engines," and, in particular, to have them interdicted from "making, selling, or using without the pursuer's consent any mechanism relating to pumping engines in which the pumps are driven by steam power, and having for its object to enable their suction and discharge pipes to be swivelled and set on any angle without interfering with the driving engine, and constructed in the manner described in the letters patent." The pursuer averred that the defenders had, from 1st January, 1884, until the raising of the action, manufactured and sold, or caused to be manufactured and sold, pumping engines which were so constructed as to form a direct infringement of the letters patent. The defenders pleaded that the letters patent founded on were null and void, in respect (1) that the alleged invention was publicly known and used prior to the date of the letters patent; and (2) that the invention was of no practical utility. After the hearing of the counsel, Lord M'Laren gave judgment. His lordship said he expressed the assessor's opinion when he said that the merits of the improvement consisted in this—that it had the power of free rotation round any angle, the power of moving or rotating the pump by merely slackening the screws without displacing them, and the power of clamping the pump at any angle that might be required. There might be other mechanical means of accomplishing these objects, but they were certainly accomplished by the means described in the specification, and, in the opinion of the assessor, accomplished in a very efficient and practical manner. Therefore, there could be no doubt that the patent was a good patent if it had not been anticipated. They had not had any evidence that deserved consideration on the subject of anticipation, because the patents referred to in evidence were not anticipations of that improvement for the purpose of swivelling. His lordship and the assessor were both of opinion that Drysdale and Co. had not infringed the patent, and consequently they were entitled to be absolved from the conclusions of the action, and to have the action dismissed with expenses. This is a very remarkable judgment, and if it is upheld it cannot fail to have an important influence on patent law. In substance it is this:—Gwynne's patent specification provides a circular T-shaped channel formed in the face of the pump case fixture flange, suited for reception of the heads of bolts, which secure this flange to the corresponding flange on the engine frame. Drysdale's pumps, which form the ground of action, in place of having a similar T-channel for the bolt-heads, have ordinary holes and ordinary bolts through both flanges, and these bolts have to be wholly withdrawn in Drysdale's machines and only slackened in Gwynne's. The judge finds that no infringement has taken place. A discussion arose during the trial between the learned judge and one of the witnesses, when the former stated that a patented machine was not infringed if even a bolt had to be withdrawn in place of something in a competing machine being slackened. In order to perform the operation covered by the patent, it must be borne in mind that Messrs. Gwynne claim the swivelling action as a whole, and not merely the means by which it is carried out.

ACCIDENTS IN COAL MINES.

As there has been of late more atttention given to the question of the relative safety of life in coal mines at different periods, and as some highly-coloured statistics have recently been given in one of the monthly magazines, a table in the recently issued Blue-book on Mines and Minerals is opportune. And it will be none the less welcome to the mining engineer and to the public at large because it proves conclusively that there is increased and increasing safety in the coal mines—or, rather, in the mines which are registered under the Coal Mines Act. One of the truest evidences of that safety is to be found in the table which shows the number of persons employed in the coal mines in proportion to each death from accident therein. In the first year after the passing of the ruling Act—1851—the ratio of persons employed was 219 for every death in the mines from accident; and for the first ten years the proportion advanced to 245 on the average of those years. In the next ten years it advanced to 300 persons employed for every death; in the next decade—1871 to 1880 inclusive—it was 425. Finally, in the last five years the average has been one showing still greater proportionate safety. In the year 1881 it was 519; in the year 1882 it was exceptional—447—in 1883 it was 488; and finally, last year it was 552. Last year, therefore, the ratio of persons employed to each death in the mines in question was greater than in any preceding decade; and we believe that the comparative safety was greater than in any preceding year. As far as this decade is reported on, it is the safest of the whole period over which there have been authentic particulars of the accidents. The actual loss of life has varied in the thirty-four years—the lowest number of lives lost being in 1864, and the highest number in 1866, the average being, roughly, 1000 yearly—but the number of workmen employed in and about the mines in that time has been much more than doubled, so that the comparative safety is greater; and as the output of coal has grown greatly in the years, the safety in relation to the output of the mines is also greater. This brief summary of the teaching of the elaborate tables of the inspectors of mines should be not only of interest to mining engineers, it should be made known to the miners and to the public, so that we may be spared in future the story which has been recently given to the public so highly coloured and so incorrect. Mining inspection is not a "sham;" it is carried out, and with very beneficial results.

BALLOONING FOR PURPOSES OF WAR.

A SERIES of experiments, intended to show the practicability of flashing war signals at night by means of an electrically

illuminated balloon, the invention of Mr. Eric S. Bruce, M.A., commenced on Monday evening at the Albert Palace, under the personal superintendence of the inventor, who, after giving a short lecture, accompanied by explanatory experiments in the concert room of the building, showed by the aid of a captive balloon of some four thousand feet capacity the utility of his invention in the grounds. The balloon was given rope enough to allow it to ascend to an altitude of 500ft., so as to be visible fifteen or twenty miles away, but the wind carried the balloon so that the rope was always at a considerable angle, and the balloon at a correspondingly lower elevation. Mr. Bruce's invention has excited much interest among the military authorities, and the experiments, which are to be continued some time, illustrate the feasibility of the system as far as making signals is concerned. The balloon is made of cambric, and is sufficiently translucent to permit the light of six 16-candle incandescent lamps to make it appear bright on a dark night, and to give distinctness to the flashes for the signalling system, Morse or other. The lamps are provided with current from a number of E.P.S. secondary batteries ; they are unprotected by any wire-work or other guard, and are suspended in the centre of the balloon; the current is communicated by leads separate from the rope by which the balloon is held captive. Words and sentences were signalled on Monday which were intelligible to those acquainted with dot and dash telegraphy, and the objection that the reading might be equally easy to the enemy does not seem to have much weight with military people. Special codes might of course be used. On a still night the signals might be read with the balloon at a considerable height, Mr. Bruce thinks 1000ft. There does not seem to be any reason why this should not be the case, although a difference in the brilliancy of the light and sharp distinction of the signal flashes was observable on Monday night when the balloon was low and when at from about 350ft. to 450ft. in height. The six lamps used only gave nominally about 100 candles, but the number and power of the lamps could of course be increased.

A DIAMOND AND BLUE STONE SEPARATOR.

A RICH reward is said to await the ingenious man who can invent a practicable machine much wanted on the Kimberley diamond fields. The precious stones are, as is known, embedded in what is called "blue ground." This is a kind of clay which is very difficult to manipulate. As it is excavated from the mine it is laid out on the ground, exposed to the action of the sun, wind, and rain until it is thoroughly pulverised. Then it goes to be washed, and the diamonds drop out. But while the "blue ground" is lying on the land, the keen-eyed Kaffirs have ample opportunities for stealing the diamonds. This traffic is carried on so successfully that no less than half-a-million pounds value is known to be stolen every year. What is needed is a machine which will deal with the blue ground as it comes from the mine, so as to remove the opportunity which makes the thief. Taking the substance as it is excavated direct to the machine would not only prevent the huge felony which goes on, but it would save in the case of one company alone at least £10,000 a year in working expenses, while this company calculate that the machine would increase their diamond production by one-third. At the premises of the Savile-street Engineering Company a machine has just been constructed to the working drawings of Mr. Raphael, an inventor from London. It was privately tested in the presence of two representatives of a large diamond company of Kimberley and one member of the press last week, as a preliminary to a public trial. The power of the machine to crush such refractory material as forms the home of the South African diamond was abundantly shown; but the difficulty of dealing with moist clay—which was the accepted substitute of blue ground—was not satisfactorily overcome. It was admitted, however, that the machine in actual working would never have to undergo so severe an ordeal as that to which it was subjected at Sheffield, and as the inventor declares he has pulverised the real blue ground with his model on a small scale, he is confident that the other half of the programme will yet be as satisfactorily demonstrated as the other.

RAILWAY RATES FOR COAL.

AT last ! Yet not till the eleventh hour ! The North-Eastern and the Manchester, Sheffield, and Lincolnshire Railway Companies, on the very day the Hull and Barnsley line was opened for traffic, decided to reduce their rates for coal to the principal Humber port. The reduction is not much, but it is better than nothing at all. The former rate was 3s. 1d. per ton ; it has now been reduced to 2s. 10d. It is expected that a proportionate reduction will also be made in the carriage rates of South Yorkshire coal to London. The new Hull and Barnsley Railway Company is expected to carry a large tonnage to the metropolitan market, the coal being taken direct from the district coalfields to the magnificent Alexandra Dock at Hull, and from thence shipped to London. With this prospect before them, the existing companies must now be prepared to concede what they have hitherto stubbornly resisted—a concession in the tariff for the long distance. Time after time have deputations of colliery owners waited on the railway magnates and urged the necessity of having relief so as to admit of their competing with the seaborne fuel from the Tyne and the Wear. Every appeal was piteously refused, and the northern coal steadily shouldered the South and West Yorkshire out of the greatest of all markets. The present rate for the South and West Yorkshire coal to London is 9s. per ton, inclusive of truck hire and City dues. The colliery proprietors of the Tyne and the Wear do not pay more than one-half that sum to place their coal on the metropolitan market. A reduction of even 1s. per ton would be an immense relief to the South Yorkshire coalfield, as it would decide many consumers to prefer the Barnsley Silkstone to the qualities which are now forwarded from the ports of the Tyne and Wear. Any change which would cheapen coal in the capital, without affecting miners' wages or adding to the employers' loss, would be a distinct gain, and those who make rates of carriage a special study, are as one in the assertion that 8s. a ton would leave ample profit.

LITERATURE.

The Engineer, Millwrights', and Machinists' Practical Assistant. By W. TEMPLETON. Seventh edition. London: Crosby Lockwood and Co. 1885.

IT appears that this little book is yet sufficiently frequently called for to necessitate the issue of this new edition. No doubt many engineers of the older school and many in the Colonies know this little collection of rules and tables so well as still to find it more handy for many purposes than books which are much more complete, but with which they are less familiar. We can, however, hardly commend the re-publication of the book, for it is, in spite of its being "carefully revised with additions," very much out of date, and contains many inaccuracies, more especially in matters relating to the steam engine. Steam is said to be "pure fresh water in an aeriform state through the absorption of caloric or the matter of heat." Nominal horse-power is given as the power of any engine working with 7 lb. steam, while "the other is the mean effective pressure taken by an indicator and called actual horses power." Tables are given of dimensions of cylinders for "condensing engines of nominal horses power, the strokes of proportionate lengths, and the dense steam 7 lb. per square inch," and for the same diameters for non-condensing engines "the dense steam 30 lb. per square inch." A note to the second table, explanatory or otherwise, says : "The dense steam at 30 lb. per square inch and continued to three-quarters of the stroke in a non-condensing engine is considered a fair average effective power per horse in a commercial point of view." Amongst the "useful notes" is the following :—"The proper length for the connecting rod of a beam engine is the perpendicular distance between centre of beam axis and centre of fly-wheel shaft." Another rule equally original and valuable, is "the proper length for connecting rods of direct-acting engines is the distance between the crank axle and centre of piston-rod crosshead at half-stroke." The price of this book is about five times its value.

Exterior Ballistics. By Captain JAMES M. INGALLS, Captain First Artillery, Instructor Fort Monroe, Virginia. Printed at the United States Artillery School.

THIS is a high-class of text-book. The calculations are in better shape, and the work mastered and worked out more carefully than usual. The most noticeable original work is in the investigation of resistances to projectiles with heads of different shapes, although, of course, data will be found supplied by Mayevski and Bashforth. The writer appears to have studied most of the best works on the subject. Dichon, Krupp, Siacci, Greenhill, Niven, and MacKinlay are quoted. The work is put in a good shape by the author, and is a valuable contribution to the literature of gunnery. The author points out how far English and foreign results are in accordance with each other, and discusses them fairly. It is important in a book of so technical a character to have the opinions of authorities on the subject such as are quoted in the work itself. Three of these we know to be favourable.

PRIVATE BILL LEGISLATION.

IN connection with private schemes in Parliament, Mr. Craig Sellar recently obtained the order of the House of Commons for the production of three useful returns. One is to give the following particulars respecting the Manchester Ship Canal Bill in its progress through both Houses of Parliament during the sessions of 1883, 1884, and 1885—number of days Committees sat in House of Commons and House of Lords respectively ; expenses incurred by promoters ; expenses incurred by opponents; total expenses of promoters and opponents; number of witnesses called, distinguishing those who appeared one session from those who appeared two sessions, and those who appeared three sessions; decisions of House of Commons and decisions of House of Lords. These details, when published, will not only be of interest to all persons concerned with this particular Bill, but will furnish a valuable illustration of the extent to which private enterprise may be carried under the existing system of legislation. This information would have been particularly useful, from this point of view, if it could have been introduced into Mr. Pembroke Stevens' "History of Private Bill Legislation;" but as one of the numerous counsel engaged in the case, Mr. Stevens has, to some extent, dealt with this instance of costly and protracted contest. The other two statements, moved for by Mr. Sellar, are: A return of expenses incurred by each Railway, Gas, and Water Company; by each Canal, Tramway, and Dock Company ; by each Town Council, Local Board, or body of Improvement Commissioners in England and Wales, including the Corporation of London and the Metropolitan Board of Works; by each Town Council, body of Police Commissioners, and Commissioners of Supply in Scotland ; and by each Town Council, body of Town Commissioners, or Township Commissioners in Ireland, in promoting and opposing Private Bills before Parliament in each year from the year 1883 to 1885, both inclusive, specifying in different columns the expenses incurred in promoting and in opposing Bills, with the totals in each case summed up. And a like return from such harbour, navigation, pier and port authorities as gave affirmative answers to the return ordered by the Honourable the House of Commons, on the 9th day of July, 1883—in continuation of Parliamentary Papers, No. 441, of session 1862, and Nos. 299, 351, and 303, of session 1883. In the same way Baron Henry De Worms, the new Parliamentary Secretary to the Board of Trade, has obtained a Return of Street and Road Tramways authorised by Parliament, showing the amount of capital authorised, paid up, and expended, the length of tramway authorised, and the length open for the public conveyance of passengers down to the 30th day of June, 1885 ; the gross receipts, working expenditure, and net receipts, the number of passengers conveyed, and the number of miles run by cars, during the year ending the 30th day of June, 1885 ; together with the number of horses, engines, and cars at that date.

The Regent's Canal City and Docks Railway Bill was again the subject of discussion in the House of Lords. The week before last, as we mentioned in our previous issue Lord Ravensworth tried to induce the House to suspend, in regard to this measure, a Standing Order which forbids the payment of interest out of capital during the construction of works, but his proposal was negatived, and the Bill was read a second time. On the same occasion Lord Bramwell moved the suspension of a Standing Order, so that the Metropolitan Board of Works might be heard by counsel against the Waterworks Clauses Act Amendment Bill, but his motion was also defeated.

A few days later Lord Balfour of Burleigh made a similar motion on behalf of the Metropolitan Board in respect to the Regent's Canal City and Docks Bill. He observed that this motion arose out of the decision of the House on the previous Tuesday. He explained that he did not desire to go behind that decision, but only that the inquiry before the Select Committee should be a full and fair one. The House on Tuesday allowed the Bill to pass a second reading, containing clauses which were against one of the Standing Orders of the House. In 1882 the company procured an Act authorising the raising of a capital of 10½ millions. Since that time nothing had been done, and the object of the present Bill was to authorise £660,000 to be raised in order to pay interest on the 10½ millions of capital. If his motion were not agreed to the promoters of the Bill and their witnesses would not even be cross-examined on their financial proposals. There was no doubt that the Metropolitan Railway Company, which was a rival undertaking had a *locus standi* in the matter, and they had not petitioned because they relied on their lordships not reversing the decision of 1882, when they refused to allow the payment of interest out of capital. If the Metropolitan Company were not allowed to be heard against the Bill a dangerous precedent would be created, as companies would promote two Bills—one directed to the execution of the work, and the other to the financial proposals—and this separation might exclude those who would otherwise have a right to oppose one or other of the Bills. The Duke of Richmond and Gordon was understood to assent to the motion on the understanding that the opposition of the Metropolitan Railway was to be confined to the financial question, and the motion was agreed to.

The Corporation Tower Bridge Bill having passed the House of Commons is now going through the several stages in the Upper House. The wharfingers and traders on the banks of the Thames, who fought so stoutly against the Bill before the Commons Committee, are again the chief opponents. Besides these opponents are the following:—Tower Subway Company, the Steamship Owners' Association, the Ferrymen of Horseleydown Old Stairs, the Ferrymen of Irongate Stairs, and the General Steam Navigation Company. The Bill was read a second time on the 9th inst., and is still occupying committee.

At a recent sitting of the Ship Canal Committee a strange attitude was taken up by Mr. Lysten, engineer to the Mersey Docks and Harbour Board, in opposition to the Bill. It may be remembered that last year Mr. Lysten intimated that while he objected to the scheme as it stood, he would not resist it if certain alterations which he suggested were made. In coming to Parliament again this year the promoters contended that they had modified their plans in the manner suggested by Mr. Lysten, and they therefore claimed, if not his support, at least his abstention from opposition. To this, however, Mr. Lysten demurred, alleging that they had in their new proposal mutilated his design. Being examined the other day, he said he had two grave objections to the promoters' plans. The first was that the works involved direct abstraction from that part of the estuary where the maintenance of the entire estuarial capacity was of the utmost importance, and his second objection was that a permanent channel would be formed along the Cheshire shore. Silting up would be caused in the other parts of the estuary. This would prove detrimental to the normal condition of the river, and would materially interfere with the channels that were now so important to the ports of Liverpool and Garston. Of his two objections, the formation of a permanent channel was the more important. The elongation of the deep opposite Eastham would draw waters from other parts of the estuary, and thus stereotype a channel to the exclusion of the channels now existing. In designing a plan as an alternative to that of last year, he endeavoured as much as possible to follow the natural configuration of the foreshore, and to minimise any intrusion upon it. The promoters had been guilty of serious plagiarism as regarded his plan. They had simply mutilated his plan. Replying to various further questions, Mr. Lysten said he had put his plan before the Committee because it could be carefully followed, but the promoters had so mutilated and materially altered what he considered its salient features that he could not be responsible for it in any way. The present plan was superficially like his, but it was really unlike in many respects. He maintained that his plan could be safely carried out without injury to the estuary of the Mersey, provided that compensation must be provided for the inevitable abstraction of water. This compensation, he urged, should be equal to the abstraction, but he admitted that his plan did not show how he would provide that compensation. He only "incidentally referred" to where compensation might be obtained, viz., from the river Weaver. Even so, he did not say that the seven or eight million cubic yards of compensation could be got from that source, and being asked where else he would go for the quantity, he replied that he should leave the promoters' engineers to define a further source; and he added that he had not thought that question out, nor would he consider how compensation was to be obtained. Some other questions clearly indicated the surprise of the Committee at this curious tone ; but Mr. Lysten maintained the position he had taken up. At Hull great difficulty is experienced in meeting the increasing traffic across the river, and the Corporation have resolved to build a bridge over the river as a first step to facilitate matters. They have accordingly brought forward a Bill for this purpose. Their scheme has the general sanction of the ratepayers, and the projected outlay is £41,000. The Old Dock Company, of Hull, oppose, and desired to suggest an alternative scheme, but the Committee decided against their proposal.

The Committee of the House of Lords have decided to pass that portion of the Metropolitan Board of Works (Various Powers) Bill, which authorises that body to construct and maintain two free ferries across the river Thames, one at Woolwich, the other between Greenwich Pier and Barque-street, Poplar. As regards the Greenwich Pier, the chairman stated that the Committee would require the insertion of a clause compelling the Board to buy up the ferry rights which already exist near this spot, and not simply compensate the owner, as was proposed in the Bill. On behalf of the Metropolitan Board, Mr. O'Hara stated that with such a condition he must ask their lordships to strike out all powers relating to the Greenwich ferry. To this course the chairman objected, and after some discussion it was arranged to postpone the further consideration of the Bill.

THE RIVER WITHAM.—The extensive improvement works above the grand sluice on the Witham are now completed. They were designed and carried out by Mr. J. Evelyn Williams, M.I.C.E., the engineer-in-chief of the Witham Outfall Works and new sea channel into the Wash. The new channel has been in use about a year ; it is three miles long, and of greater sectional capacity than the Suez Canal or the proposed Manchester Ship Canal.

CARDIFF COAL SHIPMENTS.—The *Western Mail* publishes the following table, which gives the shipments of coal coastwise and foreign for the six chief British coal ports, according to the status of each port for coal export :—

Port.	Jan. 1 to June 30, 1884.	Jan. 1 to June 30, 1885.	Increase.	Decrease.
	tons.	tons.	tons.	tons.
1. Cardiff	4,137,851	4,238,447	100,596	—
2. The Tyne ports, including Newcastle and North and South Shields	4,046,504	4,029,120	—	17,384
3. Sunderland	1,665,341	1,827,413	162,092	—
4. Newport	1,337,500	1,440,143	102,643	—
5. Swansea	832,788	788,590	—	44,198
6. Liverpool	626,238	660,383	34,145	—

The above quantities do not include bunker coal shipments, which at Cardiff last half-year amounted to 878,880 tons, bringing up the shipments from that port for the six months ended June 30th to the enormous total of 4,908,000 tons, being a daily average of over 31,000 tons.

STATIONS ON THE HULL, BARNSLEY, AND WEST RIDING RAILWAY.

LITTLE WEIGHTON STATION

HOWDEN STATION.

HULL, BARNSLEY, AND WEST RIDING JUNCTION RAILWAY.

The opening of this railway, the largest which has for some years been constructed in the United Kingdom, took place on the 16th inst. for goods, and will be opened on Monday for passengers. Some account of the line will now be of interest.

In laying out the line the leading idea was to connect the Alexandra Dock with the main lines of the Barnsley and West Riding districts, independently of the North-Eastern Railway Company. This has been accomplished by the company's main line and branches, and the lines in connection with them, which grasp the whole of those districts and connect them direct with the port of Hull, and especially with the Alexandra Dock. The lines which have been constructed are practically those which were authorised in 1880, after the great parliamentary contest of that year. Although some of them have been omitted, others have been added by subsequent Acts, and thus the mileage remains about the same, viz., 66 miles 2 furlongs 14·60 chains.

The line is double throughout, and commences at Hull at the Alexandra Dock, where there are many sidings and goods lines, and a small passenger station for emigrants, which will, no doubt, develope into an important station as the dock business expands. From this station the line is measured, and the mile posts along the line indicate the distances from it, so that the main line may be considered as running from the Alexandra Dock to Cudworth, where it joins the Midland Railway on the one hand, and to Stairfoot—where it joins the Manchester, Sheffield, and Lincolnshire Railway—on the other, the distances being 54 miles and 56 miles respectively.

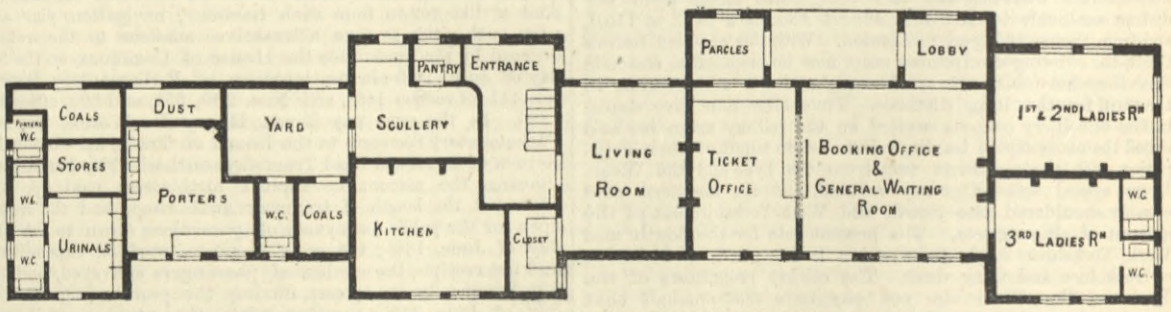
To revert to Hull, there are several branches besides the main line which require to be noted. First, the junction with the North-Eastern Railway at Sculcoates, which is completed in all respects except the points and crossings at the junction. Next, the junction with the Sculcoates goods yard and British Gas-works, the former being laid out for a considerable goods traffic from the warehouses and manufactories on the banks of the river Hull; the latter being designed to supply coals for gas making and to take away the residual products, on terms already arranged with the gas company. At Beverley-road the passenger line from Cannon-street joins the main line, and passenger trains will start from Cannon-street, calling at Beverley-road for Cudworth and beyond, on and after the 29th inst.

The next junction is at Springbank, where a line branches off to the old docks, and terminates in a large goods station abutting upon Neptune-street and Jackson-street. This line is exclusively for goods, and it has been fitted with numerous sidings, where all the traffic from Hull will be marshalled before despatch.

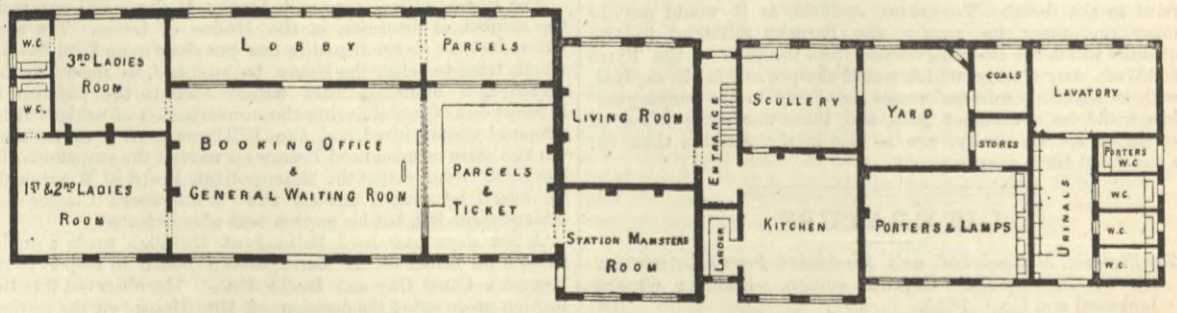
From the previously mentioned junction at Springbank to what is called the locomotive junction at Springhead, there is a goods line running parallel to the main line at some distance from it, and between the two there are extensive sidings for storing coal and for receiving the goods traffic to Hull. The whole of these sidings are arranged upon an incline so as to be worked by gravitation; that is, the trucks will run by their own weight into their proper positions, and so save the cost of shunting by locomotives. At the locomotive junction there is a branch into the large engine-shed of the company, which will hold thirty-two of their finest engines.

After passing this point there is no junction, although the North-Eastern Railway—Hull and Selby line—is crossed at Eastrington, until the Lancashire and Yorkshire—Knottingley and Goole—Railway is reached at Hensall. Here are extensive exchange sidings, and all works necessary for the interchange of a large traffic, all of which have been constructed by agreement with the Lancashire and Yorkshire Railway Company.

The next junction is with the Swinton and Knottingley Railway, which is complete excepting points and crossings, and forms the shortest route from Hull to Sheffield. About a mile west of this point there is a junction with the West Riding and Grimsby Railway at Hemsworth. This is also fitted complete with exchange sidings and works, by agreement with the Great Northern Railway Company. Five miles further west brings us to the large goods depôt of the company at Cudworth. Here there are extensive sidings for the reception of goods traffic, which will be marshalled in trains, being brought together from various points in the neighbourhood before being despatched to the port of Hull. The goods lines here have been separated from the passenger lines in order to facilitate despatch and to



GROUND PLAN OF LITTLE WEIGHTON STATION.



GROUND PLAN OF HOWDEN STATION.

secure safety, and connections have been formed with the Monkton Main Colliery, Carlton Main Colliery, New Oaks Colliery, with exchange sidings alongside the Midland Railway, and with exchange sidings at Stairfoot, close to the Manchester, Sheffield, and Lincolnshire Railway, by means of which a large quantity of traffic can be collected and stored for Hull, and on the return journey traffic from Hull can be distributed through all the places supplied by the above-named systems of railway. Passenger lines from this point have been extended to the Cudworth Station on the main line of the Midland Railway, which has been made a joint station by agreement with that company. The result of these connections is that, on the one hand, a hold has been obtained of the best sources of traffic in and about the port of Hull; and, on the other hand, connections have been secured with the West Riding and manufacturing district and the Barnsley coalfield, which will enable the company to receive and distribute traffic independently of the North-Eastern Railway Company.

The stations are in most cases permanent, but in others they are temporary only, pending the development of the traffic. The temporary stations are the Emigrant Station at the Alexandra Docks, the passenger terminus at Cannon-street, which is the carriage shed of the company converted into a passenger station; and the joint station with the Midland at Cudworth, where, in the event of the company's line being extended to Huddersfield, a very large accession of traffic may be expected which will have to be provided for when the time arrives. All the other stations are permanent and very commodious, being in almost every case provided with two ladies' waiting rooms, an exceptional accommodation.

The architectural style of the buildings is that known as Queen Anne, the ornamentation is substantial and moderate, having regard to the cost of maintenance and to the purpose. They are universally admired. We illustrate two of them. From the shareholders' point of view a provision has been made which is very important, but which will not strike the casual observer, viz., one or two long sidings have been constructed at each station in order that slow trains may be laid by whilst fast trains are passing, thus entirely preventing delay to goods and passenger traffic requiring great despatch and punctual delivery at the port of Hull. The railways in the Hull district are entirely carried on embankments. These are over ten miles in length, and have been pierced by about sixty bridges for carrying the line over railways, streets, and watercourses. Of these bridges, which are somewhat more pleasing than usual, the following are exceptional and worth noting, viz.:—The bowstring girder bridge over the North-Eastern Railway between Sculcoates and Stepney stations on the Victoria Dock Branch; a similar structure over the North-Eastern Railway at Dairycoates; the large bowstring swing bridge over the river Hull, and already illustrated in our pages; and the highly ornamental structure over the Beverley-road.

The whole of the Hull district is practically level, and, with the exception of these works, the construction may appear easy; but, in fact, it has been otherwise, for immediately under the surface the ground consists of soft silt, which is quite inadequate to carry the railway, and which has necessitated the greatest care in the formation of the banks, and has involved enormous additional cost in the construction of the foundations of the bridges, many of which are carried to a depth of 50ft. From Willerby to North Cave, a distance of ten miles, the line passes through the Yorkshire Wolds. This was a formidable undertaking, and was described by the engineer of the North-Eastern Railway, when opposing the Bill in 1880, as the heaviest piece of work in his experience. For about five miles the works consist entirely of tunnel and cutting. The greatest depth of cutting is 83ft., and the longest of the three tunnels is 2116 yards. The chalk through the Wolds turned out much harder than was expected, and as the whole of it required to be blasted, the additional expense was considerable. Moreover, on the west side of the Wolds the strata were found to be greatly disturbed, and the chalk, which had been broken by distortion of the strata in pre-historic times, rested upon a slippery clay, which threatened to bring down the country side upon the line. A catastrophe like this would have endangered the safety of the railway for years, besides adding greatly to its first cost; but it was foreseen and provided against by a massive retaining wall, a small part of which is visible, the remainder being underground. In order to give an idea of the pressure to be overcome, it is worth mentioning that this wall is in some places more than 30ft. thick, and that its base is supported by a strong invert carried under the railway to the opposite side of the cutting.

From South Cave to Heck, a distance of twenty miles, the railway is carried entirely on embankments, which have been made for the most part from earth excavated from additional land purchased by the company for the purpose. These banks are generally very low, but of sufficient height to raise the line above the flood level of the district in case of the rivers bursting their banks; but in many places the embankments are raised to a considerable height in order to cross railways and rivers. The Market Weighton Canal at Newport, the North-Eastern Railway—Hull and Selby line—at Eastrington, and the rivers Ouse and Aire are the principal points. The first is crossed by a wrought iron girder bridge of three spans, the North-Eastern Railway by a large open girder bridge of one span, and the river Aire by a fine bowstring girder bridge of two spans. The bridge over the river Ouse is the *chef d'œuvre* of the railway, and is well worth a visit. It is one of the largest swing bridges in England, having two clear openings for navigation of 100ft. each, and two side spans of 77ft. The whole of the girders are lattice or bowstring, and those which cover the opening spans are 250ft. in length. The weight of the movable portion is 700 tons, and it has been opened in three-quarters of a minute. The speed is now, by the order of the engineer, reduced to a little under two minutes. The structure is supported upon massive brick and stone abutments at the shore ends, and on cast iron cylinders sunk in the bed of the river at the intermediate points. The swinging portion is turned by hydraulic machinery, which is worked from a signal cabin in the centre of the bridge, the power for which is created for the purpose by steam engines in an adjoining engine-house. This bridge and its machinery have been fully illustrated in our columns. It was estimated in Parliament to cost £70,000, but owing to the difficulties which were encountered in the foundations, that amount was somewhat exceeded.

From Heck to Cudworth the line traverses a hilly district through the magnesian limestone and coal measures, the works in which consist of alternate cutting and embankment in hard rock, and of two tunnels, one being 1226 yards, and the other 685 yards. The longer tunnel passes through a singular formation. The top of the tunnel is entirely in magnesian limestone, and the bottom in the shales of the coal measures, which added greatly to its cost. It is some consolation, however, to know that the truth of the geologist's theory, that the coal measures underlie the magnesian limestone, was thus proved, and on this point at least there is no longer any doubt that the unworked coal of the Barnsley seam extends much beyond what appears from the rocks on the surface. It has already been shown that arrangements have been made for the quick despatch of traffic coming upon the line, and it should be added that to secure its safety the signal stations are fitted throughout with electric interlocking apparatus as used upon the metropolitan lines.

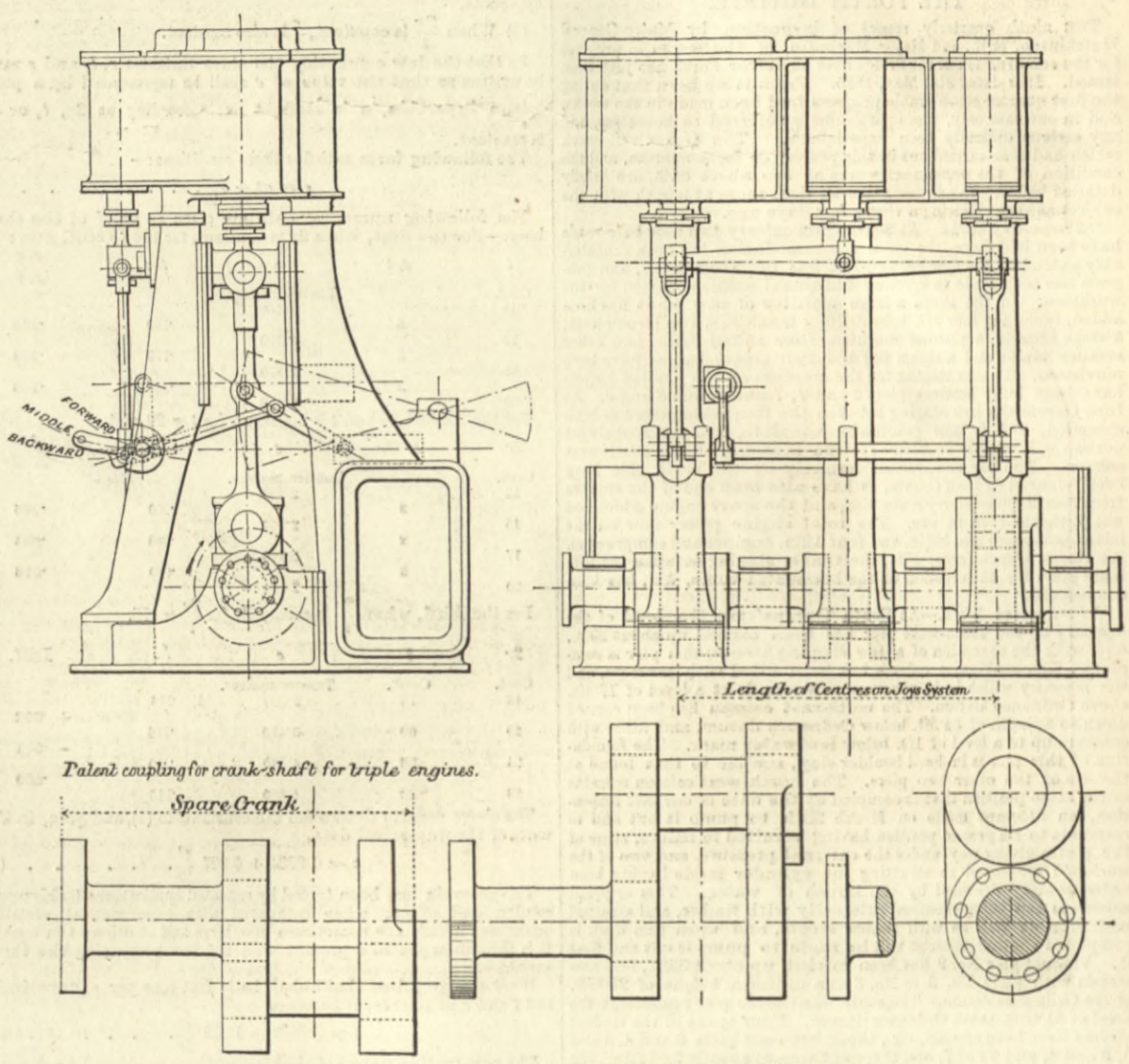
The works have been designed and carried out by Mr. W. Shelford, of Westminster, and Mr. George Bohn, of Hull, who are joint engineers for the railway part of the undertaking, Mr. Shelford being chief professional adviser to the company, in which capacity he located the line originally, fought it through Parliament in 1880, and is responsible for the character and design of all the work that has been done.

MISCELLANEOUS MACHINERY AT THE INVENTIONS EXHIBITION.

No. II.

Messrs. Thwaites Brothers, Bradford, exhibit a sectional model of Stewart's patent rapid cupola, an illustrated description of which has already appeared in these pages. It will be sufficient, therefore, if we briefly allude to several points in relation to its working. The cupola is used for melting iron pig, and we understand that a series of carefully carried out trials have shown that a ton of pig iron can be melted in it with from 1 to 1¼ cwt. of coke, a result which we need hardly point out is much superior to what is ordinarily obtained. This is partly accounted for by the high pressure of blast—from ¾ lb. to 1 lb. per square inch—which enables a strong coke to be used, thus ensuring good combustion, and consequently a high temperature. The metal as fast as melted in the furnace portion of the cupola runs direct into the receiver, and is there thoroughly mixed by the constant flow produced by the blast. The hot air in the receiver is conducted by a pipe from the top, back again into the cupola above the air belt, the heat thus obtained being utilised by the metal below the charging door. The air belt is fitted with valves in such a manner that the blast can be shut off from one-half the tuyeres without stopping the other half. This arrangement is found very effective in preventing accumulations of slag, and does away with the troublesome operation of pricking out the tuyeres one by one with a bar. Another feature to be noticed is that the top is completely covered in, or bricked over by a flat dome. At the side of the cupola near the top is fitted, on one side or both, a neat cast iron hood, which covers the opening for the escape of the waste gases. The hood inside is lined with ganister, and is provided with a damper door, that can be deflected at any angle to throw down the sparks when the blowing is finishing. The whole arrangement seems extremely simple and efficient, and embodies to a large extent the principal features of the best American practice. Other forms of cupola are specially arranged with water jackets, and are used for smelting silver, lead, and copper ores. The well-known Root's blower is also shown for a medium pressure of from ¾ lb. to 1 lb. per square inch. All parts of the blowers are constructed on the interchangeable system. They are made in a great number of sizes, the smallest producing 20 cubic feet of air per minute, while the largest, for mine ventilation, will deliver 200,000 cubic feet.

The various applications of the valve gear now so well known as the Joy gear are shown by drawings and photographs. From among these we select for illustration—see page 68—a photograph of a set of triple expansion engines fitted with the Joy valve gear in its ordinary form, and built by the Wallsend Slipway Company, of Newcastle-on-Tyne. We hope shortly to be enabled by this Company to give detailed drawings and particulars of this class of engine. Those illustrated gave on trial trip an indicated horse-power of 1600, and to them we shall return on another occasion. We also illustrate Mr. Joy's most recent advance in improvements of valve gearing specially arranged for this type of engine. This he illustrates by a moving picture model of a triple engine similar to the engraving, but in which, instead of employing three distinct sets of valve gears, one for each cylinder, he employs a valve gear for each outer cylinder, and then uniting these two by a floating lever, takes motion for the valve of the third cylinder from about the middle of this lever, this motion being found to be correct in its character for the purpose, and is under the same control for reversing and for expansion as the other two valve motions. Being, moreover, the resultant of the other two motions, it is a mean between them, so that the high-pressure cylinder may be set with a cut-off of, say, ·65, and the low-pressure at ·55; the resultant motion for the medium-pressure cylinder will be ·60. These proportions may be varied to suit circumstances, or all the valves may be set to cut-off alike, and within considerable limits also the cut-offs of the high and low pressures may be varied independently of each other to equalise the strains on the cranks, without affecting appreciably the cut-off of the intermediate cylinder. Thus a considerable saving in complication and cost of the triple cylinder engine is effected, a complete set of valve gear being replaced by a single lever. Mr. Joy also illustrates the application of his invention by a number of photographs, representing altogether over 400 locomotives and 65,000 indicated horse-power in marine engines, and by numerous engravings showing sections and working drawings of both marine and locomotive engines so fitted. He also exhibits the quadrant blocks from the first locomotive fitted with his gear, and built by the London and North-Western Railway Company to test it. These blocks have run 145,000 miles, and are still good for some considerable amount of service.



JOY'S VALVE GEAR AND CRANK FOR TRIPLE EXPANSION ENGINES.

We must also notice a model of a method of coupling up the crank shafts for marine engines, especially of the triple cylinder type, which has been designed—see above—to meet the conditions of the shortened space in the bed-plate when the room has been saved by bringing the cylinders close together. This crank shaft consists of three independent cranks, each duplicates, interchangeable and reversible, and any crank may be removed without disturbing either of the others and lifting only one main bearing. Each crank is bolted direct to the next forward cheese-head, into which it interlocks, the interlocking arrangement receiving all the stress due to compression and lead, as well as a considerable part of that of torsion. It has received the sanction of the Board of Trade and of Lloyd's.

Colonel Wethered's fire-escape has been described by us many years ago. It possesses the following recommendations:—It is extremely simple and portable; it can be attached to any window frame in a minute; it can be used with a little dexterity from the nearest window in the next house. Stress is to be laid on these two last features, the former because it often happens that any

particular window provided with an escape is not available owing to the locality of the fire, and the latter because a policeman provided with an escape might be able to effect a rescue from an adjoining house. In most cases in towns this is possible, and the operator would be a trained man with his wits about him instead of an incidental individual in a burning house. A gentleman living in the Albert-mansions occasionally startles the neighbourhood by descending about 100ft. in this escape. We have seen school girls use it with great speed and facility the first time they saw it. This we think speaks well as to its simplicity.

Colonel Wethered has a springless railway lock which appears to act very well indeed. It shuts with a very gentle push, and it shuts with a strong firm catch. As fitted in the Exhibition it does not open from inside, but it is quite as suitable for this as for opening for outside if so fitted. There is also a simple good spring lock, but we call attention especially to the springless one.

In our impression for the 3rd inst. we described the new patent tumbler bearings of Messrs. Appleby Brothers. The engraving illustrating these bearings was, we regret, inverted, that which was printed at the top should have been at the bottom.

THE FORTH BRIDGE.

THE ninth quarterly report of inspection by Major-General Hutchinson, R.E., and Major Marindin, of the works in progress for the construction of the bridge over the river Forth has just been issued. It is dated 31st May, 1885. From it we learn that during the first quarter considerable progress had been made in the works, and in one case only, more particularly referred to hereafter, had any serious difficulty been experienced. The amount of work which had been carried out in this period of three months, and the condition of the permanent works at the above date, are briefly detailed below. In another place we deal more at length with the subject as viewed during a visit a few days ago.

"*Temporary works.*—At South Queensferry two new tube-roads have been laid down, the office accommodation has been considerably extended, the new pattern-loft has been completed, and progress has been made in erecting additional accommodation for the workmen. In the shops a large quantity of new plant has been added, including four 8ft. tube drilling machines, two locomotives, a stone breaker, a planing machine, four radial drills, and other smaller tools; and a steam tug and two steam barges have been purchased. Timber staging for the erection of the viaduct girders have been built between piers 6 and 7, 7 and 8, and 8 and 9. At Inch Garvie the iron staging between the four main piers has been extended, and is now practically complete, and the south-west portion will shortly be ready for the berthing of the south-west caisson. The air compressors formerly at the north side have been removed to Inch Garvie, as have also been one of the engines from South Queensferry main pier, and the spare engine which has not hitherto been in use. The total engine power now on the island comprises two 16½in. and four 12in. engines and compressors. At North Queensferry, Fife, the timber staging between the Fife main piers for the erection of the horizontal tubes, &c., has been commenced.

"*Permanent Work.*—At South Queensferry the level of the masonry of the south-west pier has been carried up about 20ft., and, with the exception of a few capping stones, this pier is complete. The south-east caisson has been filled with concrete, and the masonry which is in progress now stands at a level of 17·4ft. above Ordnance datum. The north-east caisson has been carried down to a depth of 84·5ft. below Ordnance datum, and filled with concrete up to a level of 1ft. below low-water mark. The foundation of this pier is in hard boulder clay, similar to that found at the site of the other two piers. The north-west caisson remains in the same position that it occupied at the date of our last inspection, an attempt made on March 25th to pump it out and to restore it to its proper position having resulted in failure, some of the plates giving way under the external pressure, and two of the workmen employed in strutting the cylinder inside having been unfortunately drowned by the inrush of water. This crippled caisson is now being sheathed externally with timber, and strutted with iron as well as with timber struts, and when this work is completed another attempt will be made to pump it out and float it. Viaduct pier No. 9 has been carried up about 33ft., and now stands with piers No. 3 to No. 8 at a uniform height of 27·85ft. above Ordnance datum. The south cantilever pier remains at the level of 31·88ft. above Ordnance datum. Four spans of the viaduct girders have been erected, viz., those between piers 3 and 4, 4 and 5, 5 and 6, and 6 and 7, and three of these are ready for lifting, the remaining span being well advanced. At Inch Garvie the north-east and north-west piers have been carried up to the full height, the former being quite and the latter very nearly ready to receive the lower bed-plates. The south-east caisson has been launched, floated into position, and sunk on to a level bed, made up of a bank of sand bags, mostly placed in position by divers, with two concrete piers built up to support the outer edge of the caisson in case of any slipping of the sand bags. At the deepest point this bank of sand bags is about 18ft. high, and at this point it is about 8ft. wide at the top and 25ft. wide at the bottom. A chase about 1ft. deep was cut out of the highest part of the rock for a length of about 20ft. to receive the cutting edge of the caisson, which was then let down. Blasting has now commenced, and the caisson has begun to descend, the cutting edge being now at a level of 43ft. below Ordnance datum, or about 16ft. above the level which it will have to reach. Concrete has been deposited in the caisson to a depth of about 13ft., and the brick lining has been built. The south-west caisson has been completed, and was successfully launched on May 29th. At North Queensferry, Fife, the north-west, north-east, and south-west piers are completed, and the lower bed-plates are fixed. The south-east pier has been successfully founded, the leak in the cofferdam having been stopped, and the foundation put in dry, and the masonry has been carried up to a level of 8ft. above Ordnance datum. The north cantilever pier remains at the level of 92·69ft. above Ordnance datum. The five spans of the viaduct girders are ready for lifting; the extreme north and south bays, which cannot be added until lifting has commenced, and the parapets, being the only unfinished parts.

"*General remarks.*—Up to this date about 242,300 cubic feet of granite have been delivered, of which 200,300 cubic feet are set; about 64,900 cubic yards of concrete and rubble masonry are in position, and about 12,200 tons of cement have been used. The upper bed plates of Fife, north-west, north-east, and south-west main piers, are ready for erection, the lower bed plates being already in position. The Fife south-east and the four South Queensferry bed plates, both upper and lower, and the Inch Garvie lower bed plates are finished and ready for erection, and the Inch Garvie upper bed plates are being drilled. The Fife skewbacks are nearly finished, and those for South Queensferry are in hand. The Fife and South Queensferry horizontal tubes between the piers are ready for erection. One of the top members for the Fife groups of piers is finished, and the other is planed and drilled. About 575ft. of 12ft. vertical tube, about 450ft. of diagonal struts between piers, 100ft. of strut No. 1 for the Fife north cantilever, about 320ft. of the bottom member of the Fife north cantilever, and 80ft. of the same member of the Fife south cantilever are now drilled. Up to this date 9900 tons of steel have been delivered at South Queensferry, exclusive of 2145 tons for the girders of the viaduct spans. In conclusion, we can again report that the work which has been completed up to the present time is, so far as we are able to judge, of very good quality; and that the progress, which has been considerable, has apparently been checked only at South Queensferry north-west main pier by the accident to the caisson, which, we should point out, is not a necessary part of the permanent work of the pier, but only a portion of the appliances for building the foundation. Whether or not this caisson will be fit to use for the purpose for which it was constructed can only be ascertained for certain after it has been floated; but at the present time, although many of the upper plates have been broken and removed, there is, we understand, no reason to believe that the air chamber at the foot has been damaged."

ON THE LAWS OF PENETRATION OF WROUGHT IRON PLATES.

THE following is a translation of a mémoire by M. Martin de Brettes, published in the *Comptes Rendus* of the Paris Academy of Sciences, tome 99, No. 17, October 27th, 1884:—

An examination of Krupp's experiments upon the penetration of armour-plates shows, calling $2r$ the diameter of the projectile, t the thickness of the plate, and e the energy of the shot per unit cross section, that—

(1) When $2r$ is constant, the quantity $\frac{e}{t}$ increases with t, so that the curve representing the relation between e and t may be considered a parabola.

(2) When t is constant, the quantity $\frac{e}{r}$ decreases when r increases, so that the curve between e and r may be considered a hyperbola.

(3) When $\frac{2r}{t}$ is constant, $\frac{e}{t}$ is also constant.

So that the law connecting the three variables r, t, and e must be written so that the value of e shall be represented by a parabola, a hyperbola, or a straight line, according as $2r$, t, or $\frac{2r}{t}$ is constant.

The following form satisfies these conditions:—

$$e = at + b\frac{t^2}{2r}. \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

The following numerical data are given as proof of the three laws:—For the first, when $2r$ is constant, for the 15 cent. gun:

t	Δt	e	Δe	$\frac{\Delta e}{\Delta t}$
Cent.		Tonnes-metres.		
15		1·500		
	5		·700	·140
20		2·200		
	5		·770	·154
25		2·970		
	5		·830	·166
30		3·800		

For the second, when t is constant, for $t = 20$ cent.:

$2r$	$\Delta\,2r$	e	Δe	$\frac{\Delta e}{\Delta\,2r}$
Cent.		Tonnes-metres.		
12		2·400		
	3		·200	·066
15		2·200		
	2		·080	·044
17		2·120		
	3		·050	·016
20		2·070		

For the third, when $\frac{2r}{t}$ is constant, for $\frac{2r}{t} = ·75$.

$2r$	t	e	$\frac{e}{t}$	Diff.
Cent.	Cent.	Tonnes-metres.		
12	18	2·060	·114	
				+ ·002
20	30	3·470	·116	
				− ·001
24	36	4·149	·115	
				·000
28	42	4·830	·115	

The above results determine the constants in (1), and give, in the units of the numerical data,

$$e = 0·073t + 0·027\,\frac{t^2}{2r}. \quad . \quad . \quad . \quad . \quad . \quad (2)$$

This formula has been tested by repeated applications to Krupp's results, and gives, when compared with experimental results, quantities which are sometimes too large and at others too small. It is thus thought to represent well the law connecting the three variables.

If we change (2) so that e shall be in foot-tons per square inch, and t and r in inches, it becomes

$$e = 3·863t + 1·429\,\frac{t^2}{2r}. \quad . \quad . \quad . \quad . \quad . \quad (3)$$

The penetrating power of shot is sometimes considered to depend upon their energy in foot-tons per inch of circumference, and (3) may be easily transformed to suit this. If e_1 be the energy so stated, we have evidently

$$\frac{e_1}{e} = \frac{r}{2},$$

whatever value t may have. Inserting this relation in (3), we have

$$e_1 = 1·932tr + 0·357t^2. \quad . \quad . \quad . \quad . \quad . \quad . \quad (4)$$

The particular curves represented by (4) when $2r$, t, and $\frac{2r}{t}$ are constant, will not, however, be the same as before.

The differences between the values given by (4) and by experiment are greater than in the case of (3), and they increase as the diameter of the projectile increases, since they have been multiplied by $\frac{r}{2}$.

THE ENGINEERING TRADES.

MESSRS. MATHESON AND GRANT'S half-yearly engineering trades' report is always of interest as containing original information and statistics in a well digested form. The following is their report, dated 15th July:—The depression which characterised most branches of trade in January has been prolonged and deepened by the apprehensions of an Anglo-Russian war, and by the uncertainties of a political crisis. Engineers and the numerous industries dependent on public works feel perhaps more than general traders the effect of international disputes in impeding or postponing new enterprises, and until the present political tension is at an end an improvement can hardly be expected. A large number of manufacturers are now working at prices which leave no margin of profit beyond the mere interest on the capital invested, and in many cases factories are being worked without any profit at all, or if the wear and tear of machinery be reckoned, even at a loss. In the United States the depression has been even greater than here, because being almost entirely dependent on a home trade, there is not the same wide area of markets which to English manufacturers averages and softens the fluctuations of trade. The New Orleans Exhibition has drawn attention to the Southern States, where a rapid development of the coal and iron mines is taking place. Alabama, Tennessee, Georgia, and Virginia, which have been hitherto associated with cotton and other agricultural pursuits, are likely to take an important place in the coal and iron industries of the world, not only altering the relative position of the Pennsylvania iron trade, but affecting also the exports from this country.

Coal.—The various circumstances affecting the coal trade during the last six months have tended, on the whole, to a reduction in price.

Iron.—Although the understanding between makers of pig iron not to increase production has been maintained, the reduction in exports and the general slackness at home have together caused a fall in price, both in Middlesbrough and Scotland. The prices of rolled iron have been brought to a point so low that they are only accepted by makers because their plant exists, and may be utilised at less loss than would be caused by an abandonment. This must be taken into account in comparing the current prices of iron and steel, as the real cost of making iron, if interest on capital be taken into account, is not so much less than that of steel as the prices indicate.

Steel.—The prices of steel rails have not varied much during the last six months, heavy sections in large quantities selling at £4 15s. to £5 5s. per ton, according to conditions of delivery, and light sections at £6 to £7 per ton; these rates being increased about 5s. if the fastenings be included in the price. Ship plates, which had fallen to £7 per ton in December last owing to the collapse of the shipbuilding trade, recovered in the spring when that trade seemed to be reviving, and in May had reached £7 7s. 6d. per ton, but have since fallen 5s.

Scrap iron and steel.—Scrap iron and steel have declined in value, and the trade in old metals appears altogether stagnant, for not only is the home demand dull, but there is no revival of the purchases from America, which generally assist in maintaining values. Heavy wrought scrap iron can be purchased, free on board London, at 42s. 6d. per ton, but even this low price does not allow of shipment to the United States, and the small quantity shipped thither has been purchased from weak holders on the Continent at a price of 50s. delivered in New York. About 3000 tons have recently been brought for shipment to San Francisco. The demand from Italy, which has of late years had considerable effect on the prices here, and which was brisk at the beginning of the year, has since fallen off. Small quantities of old fish-plates have been purchased for China at about £3 per ton, f.o.b. Old iron double head rails cost now about 53s., f.o.b., and if of steel about 55s. 6d. Old spring steel is quoted at 47s. 6d. in London, but can occasionally be purchased at provincial ports at rather lower prices. The following table summarises the fluctuations in value during the last five years:—

	Per ton.						
	July, 1880.	July, 1881.	July, 1882.	July, 1883.	July, 1884.	Jan., 1885.	July, 1885.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Steam coal, f.o.b. at Cardiff ..	0 9 3	0 10 6	0 10 9	0 12 0	0 11 6	0 10 9	0 10 3
West Hartley coal, f.o.b. at Newcastle ..	0 9 3	0 9 0	0 9 0	0 10 0	0 9 6	0 9 0	0 9 0
Pig iron at Glasgow, No. 3 ..	2 14 0	2 7 0	2 9 6	2 7 6	2 1 6	2 2 6	2 1 0
Pig iron at Middlesbrough No. 3	2 2 6	1 17 6	2 3 6	1 19 6	1 17 0	1 15 6	1 12 0
Iron ship plates at Middlesbrough	6 15 0	6 5 0	6 15 0	6 0 0	5 0 0	4 17 6	4 15 0
Iron bridge plates in South Yorkshire ..	8 0 0	7 5 0	7 15 0	7 10 0	6 15 0	6 10 0	6 0 0
Steel ship and bridge plates	13 0 0	10 10 0	10 10 0	9 10 0	7 15 0	7 0 0	7 2 6
Iron rails, f.o.b.	5 10 0	5 15 0	5 5 0	5 0 0	—	—	—
Steel rails, f.o.b.	6 10 0	6 10 0	5 10 0	4 15 0	5 0 0	5 0 0	5 0 0

Iron and steel shipbuilding.—There has been a slight recovery from the extreme depression of last year, although the vacant spaces in the shipyards and the prevailing low prices are in marked contrast to the activity and high prices of 1882-3. Swift cruisers and torpedo boats have been in special demand, and the few builders who make a speciality of the latter have had more orders thrust upon them than they can well execute. Steamers for trading and passenger service can now be contracted for at very low rates.

Bridge builders and makers of structural ironwork have been fairly well employed during the last six months, but at prices unprecedentedly low. The cheapness of iron and steel, and the development of labour-saving machinery have, together, brought down the cost of production, the advantage going entirely to the purchaser, who has benefitted also by the keen competition among manufacturers. In India the extension of strategic lines in the north-west causes a regular demand for bridges, which may be expected to continue for some time, and there have been considerable purchases on some of the private Indian lines for spans up to 200ft. There is an increasing demand for bridges and other structures from the Australian colonies, where the growing expenditure on railways and other public works not only gives present employment to manufacturers at home, but creates a future need for renewals and extensions. Competitive tenders for an important bridge 3000ft. long for an estuary near Sydney have just been sent in from English and American manufacturers. It has long been known to English engineers, and the opinion is now being rapidly adopted in the United States, that the light and cheap American bridges, with pin connections, are neither staple nor permanent enough to justify their use, but at present there are political influences in New South Wales which favour greatly the importation of railway material from the United States. In England most of the work done during the past twelve months has been to meet requirements of increased traffic on the existing railways. Large new stations have been built at Birmingham and Rugby, and the Midland Railway Company are building in London the largest goods station in the world, some 20,000 tons of ironwork being required in its construction. It is becoming evident that there will be much work to be done in the immediate future in the repairing, strengthening, and even replacing existing iron structures. The increasing weight and speed of railway trains have hastened the inevitable deterioration of bridges designed twenty and more years ago, the decay being mainly due to the narrow margin of strength for the repeated strainings, and to the insufficient allowance for loss by rust in structures inaccessible to the painter's brush, or in which painting is neglected. The substitution of steel for iron makes slow but certain progress.

Railway material.—Most makers of railway plant and appliances share in the present depression. Factories are not well employed, and there is a keen competition for all new contracts. Steel sleepers, of trough shape, rolled or pressed in dies, which in Germany, America, and elsewhere are rapidly superseding wooden sleepers, are receiving more attention from English manufacturers. The trade, if once established, is likely to be on a large scale, but at present the demand would probably be only for export, as railway engineers here are slow to abandon the familiar wooden sleepers in favour of a new system. The London and North-Western Company have, however, found steel sleepers serve well, and are continuing to make them at their Crewe Works.

Locomotives and rolling stock.—Locomotive builders continue to be fairly well employed, but the uncertainty about the future, and the approaching opening of the new factories, tend to hinder any improvement in price. Besides the three-cylinder compound locomotives of the London and North-Western Railway, which have been working some time, the Great Eastern Railway is trying a compound engine with two cylinders, and in neither case have the results been wholly favourable. The early application of the compound system to marine engines involved many costly failures before success was assured, and an expensive experience would probably be needed for locomotives without the same compensating results. In the United States locomotive factories are so numerous, owing to the stimulus of railway extension a few years ago, and the present demand for current renewals is now so slack, that trade is worse than here. It is mainly from this cause that American makers are competing so strongly in Brazil, Australia, and elsewhere. But the nominal cheapness of their engines is chiefly due to the use of cast iron instead of wrought iron, iron tubes instead of brass, and steel fire-boxes instead of copper. Not only do English engines last longer, but when broken up the value

of the scrap material is a considerable proportion of the original value, while that of the American engines is almost *nil*.

Railway wagon and carriage building is at present in an unsatisfactory condition. A year ago, although prices were kept low by the number of competing factories, work was abundant. Now, however, the volume of trade has also diminished, and there is no prospect of immediate improvement. Iron and steel underframes continue to be made in large quantities for Indian railways, and in some cases complete vehicles are made in steel and iron. The manufacture of tramway cars is becoming an important industry in this country, and the demand for renewals as well as for new lines is growing every year. American car builders are competing with England abroad from the same causes as given above for locomotives.

Agricultural engineers are in a worse condition than six months ago. There is but slight change in the home trade, and the lack of means among English farmers still prevents that expenditure on machinery which would be advantageous to buyers and sellers alike. Unfortunately also the foreign trade, which has for the last few years done much to balance the depression at home, has fallen off considerably. The leading makers of portable engines, thrashing machines, and implements have reduced their list prices; but the considerable stocks in hand at many of the foreign and colonial depôts do much to restrain further export. Harvest prospects appear favourable in the principal corn-producing districts of Europe, and an increased demand for machinery may be looked for; but the competition among manufacturers here is so keen that no rise in prices is to be expected. The compound system of portable engines seems likely to be more widely adopted; and generally the standard of excellence in this department of engineering is becoming higher.

Mechanical engineers.—Mechanical engineers who are dependent on special industries are busy or otherwise according to the condition of these industries. Thus the numerous trades engaged in sugar-making apparatus have suffered greatly from the prolonged depression in the West Indies; machine toolmakers have been busy, especially in the heavier classes of tools, but as neither shipbuilders nor locomotive makers are ordering much, the prospects of new work when orders now in hand are completed are not encouraging; wood-working machines are not in great demand owing to the slackness in the building and railway carriage trades. There is much quiet activity among leading firms who have a widespread reputation, but there is a general feeling that business does not promise well for the coming winter unless there is a general revival of enterprise abroad. Manufacturers of war material and of apparatus for making it are well employed, and are likely to continue so.

Public works abroad are for some time to come likely to afford more opportunities for employment to professional as well as to manufacturing engineers than works at home. The present session of Parliament has been more barren of new enterprises than for many years past, and engineers, lawyers, and others have suffered accordingly. The project for the Manchester Ship Canal and the Tower Bridge have been sanctioned by the House of Commons, and are now before the Lords, but both as presented are of doubtful utility, and may need modification. The Hull Railway and Docks are both to be opened this month. The Mersey Tunnel is finished, and contracts for the approaching railway lines are being let. The Forth Bridge foundations approach completion, and the erection of the superstructure is commenced.

Railway rates and charges will before long be brought before Parliament with a view to their amendment. In the Midland Districts, where there is no competitive water carriage, manufacturers, especially those in the iron and engineering trades, deem themselves unduly burdened with the freight and terminal charges of the railways as compared with those imposed on foreign manufacturers with whom they compete. Not only are rates to the ports higher per mile than in Germany and Belgium, but through rates to English inland towns are granted to the foreigner on easier terms than for much shorter distances to the same places from neighbouring English towns.

Germany has of late years obtained a stronger position as a rival to this country in engineering manufactures. With longer hours of labour, lower wages, and low rates of carriage, she has many advantages which take effect in our colonial and foreign markets where competition is keen. When fairly judged, however, there are compensations. English vigour and enterprise still assert themselves, the quality and fitness of English goods still rank highest, and the cost of labour in the two countries if measured by results tends to equalise. On the ground where Germany has been strongest, the scientific education of the people, a great change is taking place in the position of this country. Technical schools are established in all the large towns, and managers, draughtsmen, and leading workmen in the manufacturing trades are already showing the good effect of the higher training; while the old superiority of English over German workmen in regard to practical experience and individual assertion still remains.

In conclusion, as the depression in trade of the last two years has been largely due to the postponement of much-needed works, so it appears certain that these cannot be held back much longer, and the reaction will be great when it comes. Railways with reduced traffic earnings have neglected as far as they dare renewals of their fixed and rolling stock, this being specially the case in America, where the accumulation will have very soon to be wiped off. If only peace be assured, railways, mining ventures, and other works in all parts of the world, will absorb the capital now lying idle, and afford full scope for the energies of the engineering trades. The colonies alone, backed by the English capital which their credit allows them to borrow cheaply, are increasing greatly their purchases, which, if measured by population, exceed those of any other people in the world.

TORPEDO BOATS.—In the article which we published on this subject in our last impression some numerical mistakes crept in which should be noticed, although their correction improves the premises upon which the proposals made in the article were to some extent founded. The piston speed was taken as 600ft. per minute instead of 1200. Correcting this would correspondingly reduce the average gross effective pressure and the necessary area of the pistons. The horse-power per ton of displacement would be $2000 \div 250$, instead of $1000 \div 250$ as taken, or 8-horse power per ton of displacement.

DISINTEGRATION OF BUILDING STONE.—The sandstone commercially known as freestone, which is extensively used for building purposes in American cities, is subject to disintegration from the action of the sulphurous acid produced by the consumption of coal and from frost. There is much difference in the ability of various quarries to withstand these destructive influences. The outer surfaces of some buildings in New York and Philadelphia have been by the advice of an eminent chemist treated with a mixture of paraffin and carbolic acid, with apparently good results. The flat surfaces are warmed by means of a stove like a plumber's stove but with a flat side, and the paraffin when applied in a melted condition penetrates the stone readily—it is said in some instances to the depth of 1½in. Mouldings and carved work are heated by means of a blast flame from india-rubber bags of illuminating gas. Another process has been suggested, but the preliminary results do not appear to be of a satisfactory nature on account of its tendency to crack. In this process the mixture used is an artificial stone, and consists of three parts glass sand, three parts broken marble, two parts anhydrous clay, and two parts freshly-slaked lime still warm. After a coat of the above has been applied, wash it with water on the following day. The central portion and wings of the Capitol building at Washington were originally built of freestone, which disintegrated so rapidly as to threaten the permanence of the structure, and the whole was protected by several coats of white paint. The wings afterwards added to the above, and now used for their House of Representatives and Senate Chamber, are built of white marble, which conforms in colour to the central portion of the building, so that the whole building appears to be made of marble.

LAUNCHES AND TRIAL TRIPS.

ON Saturday, the 18th inst., Messrs. Earle's Shipbuilding and Engineering Company launched from their yard a large steel screw steamer, built for Mr. Edward Leetham, of Hull. The dimensions of the vessel are as follows: Length, 300ft.; breadth, 42ft.; depth to floors, 20ft. She is built to Lloyd's 100 A1 class for steel steamships, has a raised quarter-deck aft, long bridge amidships over engines and boilers, and topgallant forecastle forward, with turtleback sides, and will be rigged as a barquentine. It will be seen that she is adapted for carrying a large cargo on a moderate draught of water. Water ballast is provided under engines and boilers, and there is also a deep tank in the main hold which can be used either as a ballast tank or for cargo. The saloon and state-rooms are fitted in a large iron house on the bridge. The officers are berthed in houses on the bridge at the sides of the engine casing. The four steam winches are made by Earle's Company, three of them being of their special long-stroke, compound type. These winches will be supplied with steam from a large donkey boiler, as well as from each of the main boilers. The vessel will be fitted with steam steering gear by Messrs. Amos and Smith, and with a steam windlass by Messrs. Harfield and Co. The engines are on the three-crank triple compound system, of 250 nominal horse-power, and with two large steel double-ended boilers, to work at 150 lb. pressure. The machinery, which has also been made by the builders, is the fifteenth set on this system turned out by them.

The screw yacht Salamander, which has just been built by Messrs. Schlesinger, Davis, and Co., of Wallsend-on-Tyne, proceeded on Tuesday to sea for a preliminary trial trip. The dimensions of this yacht are as follows: Length, 120ft.; breadth, 20ft.; depth, 10ft. 6in.; tonnage, 211, yacht measurement. We have already given general particulars of this yacht. The engines are of the Perkins' triple expansion type, working at a pressure of 500 lb. per square inch. The cylinders are 7⅜in., 15½in., and 22⅝in. diameter, 15in. stroke, and will work at about 140 revolutions per minute. At no time on Tuesday, however, was the full pressure worked, the gauge rarely showing more than 300 lb., pressing the engines to their full power not being considered desirable; in spite of which fact, after several trials on the mile, the average speed obtained was nearly nine knots per hour. Considering the small nominal power of these engines, and the very small amount of fuel they will require, to drive a vessel of this size at such a speed is considered a remarkably good result. On the deck-house is placed a steam steering engine, by Messrs. Davis and Co., which during the trial worked smoothly and well. Harfield's direct-acting steam windlass is also placed forward. These auxiliary engines are supplied with steam from a generator in the engine-room. This generator is one of Mr. Perkins' patents, being a wrought iron vessel containing a coil through which a current of high-pressed steam passes, generating steam from the water outside the coil to 60 lb. or 80 lb. pressure. The yacht has been built for Mr. Frederick Power, of London, and after the trial proceeded at once to the Thames for the East India Docks, where she will be received by the owner, who intends to furnish her saloons in the most luxurious manner.

The steamship Ormerod, built for Colonel Thursby and the executors of Burnley Colliery, by Messrs. Oswald, Mordaunt, and Co., of Southampton, ran a successful trial on the measured mile in Stokes Bay on Saturday, the 18th inst. On the measured mile the speed attained with 80 lb. of steam and 70 revolutions was, we are informed, nine knots. Owing to a lumpy sea and a strong wind —the vessel being light—she could not be driven at her full power, which, with full pressure, would be about 90 to 95 revolutions. The ship's frames were started on April 16th last, and the ship was launched on the 27th of June. She is built on the cellular principle, and classed 100 A1 at Lloyd's, but is in excess of their requirements for a vessel of her class, and is of great additional strength in her bottom to make her safe for grounding in tidal harbours. The engines and boiler are built by the same firm; the engines are inverted surface-condensing compound, with cylinders 21in. and 42in. diameter and 30in. stroke. She has one large steel boiler of 100 lb. pressure.

AMERICAN NOTES.

(From our own Correspondent.)

NEW YORK, July 11th.

ENGLISH bondholders are devoting much more than ordinary attention to their railway interests in the States. The attention is needed. Important changes and reorganisations are near at hand; a large amount of mileage is lingering on the outskirts of receivership; the railway managers are as yet unable to harmonise conflicting interests; the Lackawanna, under the control of Gould, has cut rates; the Pennsylvania will not follow for the present; Sir Henry Tyler has been endeavouring to bring order out of confusion, in order that the Grand Trunk Railway might be liberated from embarrassments created by the rate-cutting among other lines; Mr. Bald, representing the English bondholders of the general mortgage bonds of the Wabash Company, has recommended the reorganisation of that system of over six thousand miles. Numerous railway enterprises, some of them of considerable magnitude, are awaiting the return of favourable conditions. Railway material is extremely cheap, and half the producing capacity is idle. Less than one thousand miles of road have been constructed. All the trunk lines have much projected work in the way of feeders which will increase local traffic. Competition on long hauls cuts off margins, and drives companies to develope contributory territory.

Sales of 20,000 tons steel rails were effected a few days ago at 26·50 to 27 dols. Contracts on hand are in the neighbourhood of 150,000 tons. Old rails are selling at 16·50 to 17·50 dols.

The manufacturing and building interests are not prepared for an advance in prices, as raw material of all kinds is in very light supply.

The iron mills are making less iron, because of repairing. Steel mills are making full time. A heavy demand for pipe for natural gas and ordinary gas pipe and pipe for water continues. The western nail strike is nearing its end.

Several new gas wells of enormous producing capacity have been struck in the natural gas regions, and boring of wells is reported in new localities.

The railroad wreckage for the first six months includes fifteen roads, of 1121 miles track, representing 75,000,000 dols. capital, was sold under foreclosure. Thirty-six roads, owning 6439 miles of track, passed into the hands of receivers.

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

(From our own Correspondent.)

THE tone of the market yesterday in Wolverhampton, and this afternoon—Thursday—in Birmingham, was again more satisfactory than a week or a fortnight ago. The improvement was not traceable so much to an increase in the demand as to a more settled aspect which is appearing in local trade circles. Additional orders to those placed last week were given out for sheets, bars, angles, tees, and hoops; and although they were not generally of large account, ironmasters have yet sufficient contracts to keep them fairly going for some weeks.

One of the most encouraging features is the step which is being taken by one of the leading sheet iron firms to secure a second works, with a view to a considerable extension of their already large output. Several idle works in the Wolverhampton district have been inspected, and preliminary negotiations are now going on with respect to one of them.

At the Round Oak Works of the Earl of Dudley a slowly, but steadily, increasing business is being done in best quality horseshoe, tire, and rivet iron with Australia. The augmentation has been noticeable since the late colonial exhibitions, at the close of which his lordship's managers made a present of their handsome case to the colonists. From London and other home centres his lordship is also experiencing a steady demand for horseshoe and rivet iron. His lordship's bars remain at £8 2s. 6d. for lowest qualities, £9 10s. single best, £11 double best, and £13 treble best. Rivet and T iron, £10 10s. for single best, £12 for double best, and £14 for treble best. Angles, and also strips and hoops, from 14 to 19 w.g., £8 12s. 6d. lowest quality, £10 single best, £11 10s. double best, and £13 10s. treble best.

Second and third-class bars are selling much better than marked iron, at, for the former, an average of £6 10s., and for the latter £6 down to £5 5s. Hoops continue plentiful at £5 7s. 6d. to £5 10s. upwards, and gas strip at £5 2s. 6d. and upwards.

Boiler plates are quiet. Messrs. E. T. Wright and Son quote their "Wright" qualities of iron as:—Boiler plates, £8 and upwards; sheets, singles, £7; doubles, £7 10s.; lattens, £8 10s.; hoops, £6 5s. per ton. Their "Monmoor" boiler plates are £8 10s.; Monmoor singles, £8; and Monmoor hoops, £7 5s. per ton. Basic steel boiler plates are offered at £7 10s.

Makers of ordinary, galvanising, and merchant sheets are unable to secure any advance upon the former low rates. Galvanising doubles are selling at £7 10s. and upwards, delivered Liverpool, and lattens £8 5s. upwards, delivered Liverpool.

A reduction in price appears in Morewood and Co.'s list as regards their Woodford Crown annealed and cold rolled galvanised flat sheets in cases; 18 and 20 gauge, 24 gauge, and 28 gauge are all reduced 10s. per ton, while 26 gauge is reduced 30s. per ton. The price for 18 and 20 gauge now becomes £14 10s.; 24 gauge, £15; 26 gauge, £16; and 28 gauge, £18, all f.o.b. Other sheets made by the same firm are without alteration.

John Knight and Co., Cookley Ironworks, quote working-up thin sheets, singles, £10 10s.; steel sheets, £12 10s. for singles; working-up doubles, £11 10s.; working-up steel sheets, doubles, £13 10s.; charcoal sheets, £19 10s.; and charcoal doubles, £21. Tin-plates the same firm quote at 20s. for I.C. cokes, 24s. for I.C. Cookley K. charcoal, and 6s. per box for X's. Messrs. Knight, who, as I have previously stated, have resolved to remove their works from the present site to Brierley Hill, hope to be in full swing at their new premises by the end of the year. The chief advantage which the firm will secure is that their new works will be in the centre of the Staffordshire thick-coal district. They will also have increased railway accommodation.

The demand for pig iron is more considerable for second and third-class qualities than for all-mine pigs or hematites, and descriptions imported from Midland counties are selling more freely than native irons. Prices of Northampton and Derbyshire pigs vary from 38s. to 40s., and native pigs made from Northampton ores are also quoted 38s. All-mine pigs are quoted 60s. for hot blast sorts, but realise about 55s. Part-mine pigs are 37s. 6d. to 44s., and common pigs, 33s. to 36s.

Welsh sheet shearings are advanced in price consequent upon the short supply. Sellers demand 48s. delivered.

An improved demand appears for rolls and for wheels and pinions for use by iron and steel masters, and by the producers of other sheet metals. The European continent is a considerable market to this district for machinery of the descriptions specified. Orders arrive from Belgium, France, Austria, Germany, and Russia, and one or two engineering firms are under standing contract to supply certain ironworks companies in those countries with all the machinery in the shape of rolls and wheels which they from time to time require.

A fine chilled roll of unusual size has just been successfully cast by Messrs. Thomas Perry and Sons, of the Highfield Engineering Works, Bilston. It is 29in. in diameter, 13ft. 1in. long on the working barrel, and has 3ft. necks. Its total weight when removed from the casting pit was over 15 tons, and its turning and finishing will occupy some three weeks. It is believed that this roll is to be used in imparting a surface to linoleum floor cloths manufactured in one of our home factories.

In the wrought iron tube trade an attempt is being made to revive the makers' association which some time ago existed for the object of regulating prices.

NOTES FROM LANCASHIRE.

(From our own Correspondent.)

Manchester.—As an evidence of the prevalent extreme depression, I may mention that leading representatives of the iron trade, whose experience in at least one instance extends over pretty nearly the last half century, and in others over upwards of thirty years, have declared to me that they have not known trade to be worse than it is at present. There has been only one occasion during the above-named period when prices were lower, and it is questionable whether even then makers were not in a better position, owing to the lessened cost of labour and production. The most discouraging feature of the present depression is not only the protracted period over which it has extended, but the utter absence of any immediate prospect of relief, and the continued persistent downward tendency of prices. The market never seems to touch the bottom; however low the current rates, there is constantly some seller prepared to grasp at orders at figures below anything that has been taken before; and although this may represent for the time being only an isolated transaction, the fact that iron has actually been bought at such a figure tends to establish a lower market price.

The Manchester market on Tuesday was moderately well attended, but inquiries were few, and the actual business done very small. In the pig iron trade the difficulty of effecting sales seems, if anything, to increase. There is so little iron really wanted, and some of the district brands are offered at such low figures, that makers who hold to their quoted rates are practically out of the market except for occasional small lots that are wanted for special requirements by regular customers. Lancashire makers still hold to 39s., less 2½, as their minimum for forge and foundry qualities delivered equal to Manchester; they are, however, at this figure doing only a very limited trade in small odd parcels, and where they have to compete for orders of any weight they are undersold by low-priced district brands. For Lincolnshire iron, which is practically the only other iron really competing in this market with the local brands, 39s. 6d., less 2½, delivered here, is quoted by the leading makers, but it is exceptional where more than 39s. is being got, or held out for, and there are one or two brands which are offered freely at quite 1s. per ton under this figure. For outside brands, such as Scotch and Middlesbrough, prices continue extremely low.

Hematites still meet with a very poor sale, and with heavy stocks accumulating makers in most cases are prepared to come down to extremely low figures to secure orders. During the past week good foundry brands have been sold for delivery into this district on the basis of 51s., less 2½, delivered equal to Manchester.

The manufactured iron trade continues extremely dull, both for home requirements and shipment. I do not hear of any actual underselling below the minimum prices quoted of late; but the general ruling price for Lancashire and North Staffordshire bars delivered into this district has now settled down to £5 5s. per ton, and it is only in very exceptional cases that more than this is being got. Hoops average £5 15s. to £5 17s. 6d.; sheets, £6 15s. to £7; and North-country plates are to be got at £5 6s. 3d. per ton delivered into this district.

The reports I receive with regard to the engineering trades continue very unsatisfactory. In nearly all branches orders are being worked off much faster than they are being replaced, and although here and there large firms are still busy, and in special lines there is some activity, the general condition of trade is one of slackness. The leading cotton machinists in the Oldham, Accrington, and Manchester district are kept fairly well employed, but the weight of new work giving out is only very limited, and smaller firms generally are but very indifferently supplied with orders.

With regard to the condition of the tool-making trades and the apparent anomaly to which I referred last week, that whilst from most of the makers I received reports of slackness or decreasing activity, tool draughtsmen were so fully employed that in a number of cases tool makers were unable to fill up vacancies in their drawing offices, I may add that from further inquiries I find that although work is very unevenly distributed, some of the leading firms are very busy. Messrs. Hulse are fully employed on heavy tools, and Sir Joseph Whitworth and Co. have more tool orders in hand at present than they have had for years past. These include a number of tools for the Brazils, Buenos Ayres, and for the fitting up of new works that are being erected in connection with some of the South American railways. There are also a number of other foreign orders, whilst for home customers there is a good deal of work in hand. The orders embrace machine tools of all descriptions, and do not run upon any special class of work.

The recent change of Government has put a stop to the giving out of any further work in connection with armaments and war material, but the orders in hand for ordnance material, which includes steel tubes for several of the 100-ton guns, and cranks and shafting for the new war ships that are being built, are still keeping the steel works of Sir Joseph Whitworth and Co.'s fully employed, and will keep them going for some time to come. The firm have also in hand large orders from other Governments for the rapid firing guns of the Hodgkiss and Nordenfeldt type.

Messrs. Goodfellow and Matthews, of Hyde, have in hand for the Woolwich Arsenal a pair of specially designed inverted vertical engines of 600 indicated horse-power, which are to drive direct from the crank shaft without any intervening ropes or pulleys. This firm are also very busy in their triplex engines, which they are building for some of the new gunboats and also for electric driving purposes.

The result of the coroner's inquiry into the recent disastrous explosion at the Clifton Hall Colliery, and some of the facts brought out during the inquiry, still provoke considerable criticism. The representatives of the Miners' Trade Unions have been using their utmost efforts to secure a further inquiry; and Mr. Ellis Lever, in a letter this week, endorses the opinion expressed by the Miners' Conference last week that the verdict was not in accordance with the evidence. He urges that colliery explosions should, as in the case of shipping and railway disasters, be subjected to a Board of Trade inquiry.

In the coal trade business continues in an extremely depressed condition, all descriptions of fuel being bad to sell, and even with a large proportion of the Lancashire collieries not working more than three to four days a week, there is a good deal of the output going into stock. The current quoted rates are without material change; but as stocks accumulate under load in wagons, colliery proprietors have frequently to seek relief by forcing sales for shipment at extremely low figures, or by accepting offers at considerably under current rates from buyers prepared to take quantities promptly. The consequence is that there is a good deal of irregularity in the actual selling prices, and the tendency all through is in the favour of buyers. At the pit mouth the average quoted prices are about as under:—Best coal, 8s. to 8s. 6d.; seconds, 6s. 6d. to 7s.; common, 5s. to 5s. 6d.; burgy, 4s. 3d. to 4s. 9d.; best slack, 3s. 6d. to 4s.; and common, 2s. 6d. to 3s.

For shipment there has been a larger weight of orders coming forward; but no higher prices have been got, the better qualities of steam coal delivered at the high level, Liverpool, or the Garston Docks, not averaging more than 7s. to 7s. 3d., with common sorts to be got at 6s. 9d. per ton.

Barrow.—There has been no large accession of orders during the past few days for hematite pig iron, but although the trade remains very quiet it is steady, and at many works there has been a regularity of output for several months past. Of course deliveries have not been very regular, but makers have been able to keep their stock down, and only in a few instances has any marked increase in stocks taken place. The inquiry from foreign, colonial, and continental quarters is very much restricted, and on home account there is not much change to note. Prices remain at 42s. 6d. for mixed parcels of Bessemer iron net at makers' works. Steel makers are better employed than they were, as amongst a few orders lately booked have been 5000 from the Canadian market, which have been placed amongst the makers in this district. But no succession of large orders is expected, and it seems more than probable that the quiet summer's trade will be followed by an even quieter business during the winter months. Shipbuilders have not secured any new contracts, although some new orders are expected during the ensuing few weeks. Engineers and ironfounders are doing a very quiet business, and the only department amongst minor industries which is at all likely to be busy is that of boilermaking. Iron, ore, coal, and coke are all in quiet request, and the low prices which have in all cases been ruling are ikely to be maintained.

THE SHEFFIELD DISTRICT.

(From our own Correspondent.)

TWO great events fall to be chronicled this week—the opening of the Hull and Barnsley Railway and Dock, and the closing of the prolonged and bitter strike at Denaby Main Colliery. After an experience probably without parallel in the history of English railway enterprise, the Hull and Barnsley Railway, opening up a magnificent country, is an accomplished fact. Whether the original shareholders will see in their lifetime any dividends on their stock is a point about which there is reasonable doubt; but there is no question that the new line opens up a fertile district, and will immensely benefit the port of Hull. It has already had important result, in the lowering of the two leading railway companies carrying the commerce of the locality of their rates for coal to the chief port of the Humber. And still further benefit is anticipated when the companies holding the London coal trade in their hands are generous and sensible enough to follow suit. Newcastle is already a little jealous of Hull in its acquisition of the new railway and dock. The latter is a noble work, extending over 46½ acres, and is believed to be the finest dock in the kingdom. I "assisted" at its formal opening on the 16th inst, when there was no mistaking the enthusiasm of the Hull people over the undertaking. Newcastle expects to be able to hold its own, on account of the north-country coal being generally only a mile or two from the port, while the Hull company must carry its coal some fifty miles before it reaches the new dock. No doubt this is a great matter; but it is not everything, and the disadvantage under which Hull labours in this respect may be more than counterbalanced, in the event of a war of ports, by full facilities of shipment, and low dues for land carriage as well as port charges. At all events, the South and West Yorkshire coalowners regard the new railway and dock as of immense consequence to them, and look forward to a largely increased export trade.

Of the Denaby Main strike the least said the soonest mended. It has now lasted about forty weeks, during which the men and their families have suffered severely. Few people cast the blame on the miners. They were led away by several prominent persons who ought to have known better. The fault of the men was that they never even gave the new system proposed by the employers a trial. Had they tried it for, say, a month, and then found that it really realised starvation wages, their position would have strongly commanded public sympathy; but instead of doing this, they resolutely refused to alter their method of getting coal, and as the employers could not work the colliery to a profit unless they altered their system, the difficulty became a deadlock, during which several regrettable scenes took place. Nor does the matter end now as it could be wished. The coal getters return to work at 5s. a day—4s. a day for fillers—which is less than they were offered at first; and they find amongst them some 400 strangers from Staffordshire who will share the labour they might have had to themselves. And while the colliery has been standing all these weeks the trade has drifted northward, where the heavy contracts which formerly came into Yorkshire are now being executed. All this means loss both to masters and men.

The Industrial Exhibition of the Cutlers' Company at Sheffield has been successful on the whole. It was intended to demonstrate the excellence to which Sheffield artisans had attained, and to stimulate to still greater skill in the future. In the staple trades of the town, with the exception of a very few sections, the exhibits were satisfactory, but there was a regrettable absence of novelty and originality, and in several instances where the artisan had left the beaten track he had also left out of sight the chief object to be aimed at—the combining of beauty with utility. It was abundantly demonstrated, however, that the skill of Sheffield workmen in every leading branch of the multifarious industries was equal to anything ever previously done, and where progress was possible the improvement was most marked. The judges were all thoroughly experienced men, who had passed through the workshops themselves, and their decisions are therefore trustworthy and valuable. It is probable that the Industrial Exhibition will be repeated again after the lapse of five years, if not earlier.

THE NORTH OF ENGLAND.

(From our own Correspondent.)

THE Cleveland pig iron trade is as quiet as ever, there being no improvement in the demand either at home or abroad. The attendance on 'Change at Middlesbrough on Tuesday last was meagre, and the tone despondent. Prices of No. 3 g.m.b. are unchanged. Merchants continue to ask 32s. per ton, and are willing to accept that price for delivery over the remainder of the year. Some makers are running short of orders, and are willing to accept the same price as merchants; but the leading firms are still fairly well supplied with contracts, and do not take less than 32s. 6d. to 33s. per ton. The stock of forge iron is increasing at most of the furnaces, and consequently prices are weaker than they were. The usual quotation is now 31s. 3d. per ton, but some small lots have been sold as low as 31s.

Holders of warrants evince considerable firmness. They continue to increase their purchases, and maintain the price at 32s. 9d. per ton.

The stock of pig iron in Messrs. Connal's store on Monday last was 57,682 tons, being an increase of 1850 tons during the week. About 7500 tons have been added since the beginning of June.

Shipments of pig iron from the Tees have been much below the average this month. Up to Monday last only 45,607 tons had been sent away, or 12,000 tons less than during June. The demand from Scotland has fallen off considerably during the last few days.

Prices of finished iron remain the same as quoted last week. The demand does not improve, and most of the mills are in great need of specifications. Some will have to stand shortly, unless things take a turn for the better.

The Scarborough and Whitby Coast Railway which was opened for public traffic on the 16th inst., is being worked by the North-Eastern Railway Company, which is to receive for their services one-half of the gross earnings. The line is about twenty miles in length. Most of the work has been executed by Messrs. J. Waddell and Son, of Edinburgh, during the last three years. Messrs. Charles Fox and Son, of Westminster, are the engineers.

The accountants to the Cumberland Coalowners' and Miners' Associations issued, on Saturday last, their report for the second quarter of 1885. It shows that the average net selling price of coal during the time named was 4s. 7·89d. per ton. Under the sliding scale arrangement wages will be reduced 2½ per cent.

The operative chain-makers in the north are on strike for an advance of wages. The chain-making industry is located mainly on the banks of the Tyne, at Gateshead, Shields, and Sunderland, and the men are paid for their labour by tonnage rates varying according to the size and weight of the chain they make. One of the employing firms, Messrs. Lumsden and Co., appear to have already given in to the demands of the men. Another, Messrs. John Abbot and Co., have succeeded in persuading those whom they employ to continue at work at the old rates. At all other places the strike continues. The strike hands have been holding meetings to ventilate their views, and secure uniformity of resistance if possible. They have passed a resolution to the effect that the extra obtained by Messrs. Lumsden's men shall, in the meantime, be handed over as a contribution to their own support; and another, which amounts to a vote of censure on Messrs. Abbot's men. Indeed, their denunciation of the conduct of the latter was very severe, as they do not believe in Free Trade principles at all if applied to the labour market. Considering the utter stagnation in the shipping and shipbuilding trades, and that the demand for chains depends almost entirely upon them, it is scarcely likely the men will succeed. Indeed, the world can do very well without any new chains for several months to come.

The pitmen at Denaby Main Collieries, who, it will be remembered, have been on strike for nearly thirty weeks, have at last accepted the terms offered throughout by their employers, and by this time will have resumed work.

The freight market continues dull and unremunerative in almost every direction. Mr. Harrowing, of Whitby, who is well known as the manager of a large fleet of steamers, has issued a circular to his shareholders. He tells them that after mature deliberation and careful calculation he is satisfied that nothing but loss can be the result of continuing to compete for cargoes. He has therefore decided to lay up the vessels as fast as they return, and await better times.

A meeting of the Board of Arbitration has been called for Monday next. It will be held at Darlington, and Mr. Dale will attend to give the result of his deliberation on a new sliding scale. He will advise both employers and employed as to the course which he thinks they ought to pursue.

NOTES FROM SCOTLAND.

(From our own Correspondent.)

BUSINESS has been very quiet in the past week in the principal manufacturing districts of Glasgow and the neighbourhood, in consequence of the annual fair holidays. All the factories and workshops have been closed, and will remain so till the end of the week. Indeed, in numerous instances one or two days of next week will pass before work will be fully started.

The iron trade continues without much animation. There are ninety furnaces in blast, against ninety-one in the preceding week, one having been damped out at Gartsherrie. At the same date last year there were ninety-six blowing. The week's shipments were again comparatively small. Several merchants report inquiries from abroad for Scotch pigs, but they are not of such importance as will tend to improve the extent of the export trade. The deliveries of pigs in Messrs. Connal and Co.'s Glasgow warrant stores are larger than usual. The consumption of hematite pigs is fair, but the stocks of Cumberland are large, and the current prices are at the very lowest point.

The warrant market was closed from Thursday of last week till Tuesday, when business was comparatively quiet at about 40s. 11d. to 41s. 1d. cash. Yesterday the market was firm, with transactions from 41s. 1d. to 41s. 2d. cash, and 41s. 3d. one month. To-day—Thursday—business was done from 41s. 4d. to 41s. 4½d. cash, and 41s. 6d. one month; sellers halfpenny per ton more.

For makers' iron the inquiry is slow, and the quotations tending downward, although there has not been much alteration in the course of the week. Gartsherrie, f.o.b. at Glasgow, per ton, No. 1, is quoted at 46s. 9d.; No. 3, 44s.; Coltness, 48s. 6d. and 46s.; Langloan, 48s. and 46s. 9d.; Summerlee, 46s. 9d. and 43s. 9d.; Calder, 52s. 3d. and 44s.; Carnbroe, 46s. and 44s.; Clyde, 46s. and 41s. 9d.; Monkland, 41s. and 39s.; Quarter, 40s. 6d. and 38s. 6d.; Govan, at Broomielaw, 41s. and 39s.; Shotts, at Leith, 48s. and 47s. 6d.; Carron, at Grangemouth, 50s. 6d. and 47s.; Kinneil, at Bo'ness, 43s. 9d. and 42s. 9d.; Glengarnock, at Ardrossan, 46s. 6d. and 41s.; Eglinton, 41s. and 38s. 3d.; Dalmellington, 43s. and 39s. 6d.

The malleable ironworks are in a number of cases well occupied with bars, sheets, rods, &c., largely on account of foreign orders. Founders are busy with miscellaneous work. The large pipe founders have some heavy contracts in course of execution, and there are others in prospect.

In the past week there was despatched from Glasgow for Calcutta four locomotive engines and tenders, valued at £10,800, and four smaller ones for Japan, worth £9150; machinery to the value of £5950, of which £1850 went to Dunkirk, £1234 to Calcutta, and smaller quantities elsewhere; £2864 sewing machines, £4400 steel goods, and £26,500 iron manufactures, including £5520 pipes, galvanised iron, bars, &c., for Sydney; £4530 bars, nailrods, scraps, &c., for China; and £4050 sleepers and railway materials for Calcutta.

Steel is in good request for shipbuilding and marine engineering purposes.

The coal trade has been quister than usual during the week, but this has been largely due to the interruption of business by the holidays. The export inquiry is satisfactory as to amount, but the prices continue low. Up till the close of the past week the total shipments, both coastwise and abroad, amount to about 2,000,000 tons, being 170,000 tons more than in the corresponding period of last year.

An important meeting of the shareholders of the Oakbank Oil Company will be held in a few days to consider the position of the company's affairs in view of the resignation of two of the directors, and to receive and consider a report of a committee of shareholders appointed in May last. The directors have resolved to call up the remaining 10s. a share due on the 30,000 new shares created upwards of twelve months ago.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

THE staple industries of Wales are entering upon the quiet period which is invariably expected about this time of the year. In iron and steel very little movement has to be recorded, and the consignments to seaboard have been very small in comparison with those of former weeks.

The only novelty worthy of notice is the experiment which is being essayed at Trimsarn, near Kidwelly, which to those unacquainted with the district, I may say is within easy run of Swansea. Here new works have been erected for the purpose of bringing out Bull's patent process of steel manufacture by water gas. The works were begun by the patentee, and completed by Messrs. Healey and Thwaite, and the object may be briefly stated as converting ore into steel without the intermediary process of making pig iron.

This week a numerous and influential party, including gentlemen from Liverpool, London, and Swansea, attended to witness the preliminary process; but as the huge blast furnace is not quite complete, the full development of the process must be awaited. The claim of the inventor—which our ironmasters are regarding with a good deal of interest—is that, by means of water-gas, the use of large quantities of fuel is not required, the steel is produced direct from the ore, and the manufacture greatly accelerated.

The gas producers are similar to the Strong and Lowe producers, or of the *quasi* recuperative type. During the interval the coal is forced by a hot blast of air into partial combustion, the resultant heat of which is collected into separate recuperators. An interval follows, during which the air is turned off, steam forced in a reverse direction through the recuperators, and becoming highly superheated, is decomposed or transformed into a powerful reducing gas. This is led through conduits to the tuyeres of the blast furnace. At the tuyeres combustion is effected by the new principle of Healey and Thwaite. It is expected from the careful arrangement of the crucible of the blast furnace, which is of the cupola form, that a bath of pure iron can be maintained in a fluid condition. When the metal is tapped it will be carried by ladle and run into a Siemens open-hearth steel furnace. Great things are expected, and hopeful speeches were made at the gathering after the working of the blast engine and the making of gas had been witnessed.

Wales is evidently keeping to the fore in the scientific manufacture of iron, and no more startling changes can be witnessed now-a-days, especially by those who, like myself, can remember the early make before gas was utilised at all, and when puddlers refused to have any but the very best and largest coal. This was the time when William Crawshay refused to sell any coal at all. "He wanted his coal for the ironworks." Now coal is king, and iron and steel play secondary parts. Dowlais is taking another lead in acceleration of make, and rolls are to be erected which will turn out rails of unusually great length.

I had the pleasure this week of seeing a superb album which, with a costly service of plate, has been presented to Mr. David Evans, of Barrow, by his Welsh friends after a long and arduous career amongst the iron industries of the principality.

Coal is in a rather dull state, especially in the anthracite district of Swansea, where I hear that 300 men are out of work in the Garnant Cwmamman Valley, a strike pending at the Raven, and only half time in Cawdon and neighbouring collieries. The house-coal districts of eastern Glamorgan and Monmouthshire present a depressed, though not quite so gloomy a condition, and even in the usually active districts of the Merthyr, Aberdare, and Rhondda, slackness prevails, which has told especially on Cardiff shipments. A little while ago I chronicled some of the largest shipments on record, now it is my misfortune to name one of the lowest since the prosperous coal days began. The total coal to foreign destinations from Cardiff last week amounted only to 114,000 tons. Here we have a falling off of nearly 50,000 tons, and no holiday or strike to have the discredit. Fortunately this may be regarded as only exceptional. Prospects ahead are not bad. The Admiralty are again in the field for fresh contracts, and the Central Argentine Railway Company have already placed one. Newport, too, has been busier of late, and some heavy clearances have been effected. In one day last week there was a clearance of 13,480 tons, and the total of the week was 41,000 tons.

In Swansea the great complaint is not so much want of trade, but want of steamers. Last week more came to hand and the clearances were accordingly heavier. Large cargoes of fuel are being sent from this port to Russia and Spain, and the trade is satisfactory. Small steam very firm at 5s. Market has a tendency to rise on account of deficient supply.

The Ferndale coal scale follows that of the Coalowners' Association, I see, and a reduction of 2½ is to take place.

By the way, as the Northern Iron Association has memorialised that Mr. Dale be placed upon the Commission for inquiring into the depressed state of trade in the country, why not the Associated Coalowners of South Wales and Monmouthshire memorialise that Mr. W. T. Lewis represent Wales on that Commission? I hear it discussed, but action should follow.

Tin-plate is in a better state, and there is a good deal of hope exprcssed that the problem has been solved. Prices are firm, with a decidedly upward tendency. Large clearances are going on to America from Swansea.

I note that a Preston contemporary refers in a flattering manner to the Lower Resolven coal, Neath, which did wonders at the Royal Show in driving the various agricultural machinery.

The success of the Taff Vale Railway in getting their Bill is expected to tell upon the Rhymney dividends. It is another step to the desired amalgamation.

The subject of the protection of ports is being discussed at Cardiff and Swansea very seriously, but public movement lags.

Pitwood is coming in freely; prices, 18s.

NEW COMPANIES.

THE following companies have just been registered:—

Bradford District Steam Tramways Company, Limited.

This company proposes to acquire Parliamentary and other powers, for the construction of railways or tramways in the United Kingdom, and also to adopt an unregistered agreement of the 8th inst. between Maurice Jones and William Potts relating to the sale of certain tramways therein specified. The company was registered on the 10th inst., with a capital of £90,000, divided into 5500 ordinary shares of £10 each, and 3500 preference shares of £10 each. The subscribers are:—

	Shares.
Maurice Jones, Shipley, tramway proprietor	1
T. Wilkinson, 60, Victoria-street, Liverpool, solicitor	1
J. Pass, 180, Southgate-road, clerk	1
W. Potts, 33, Duncourt-road, Hornsey-rise, accountant	1
E. A. L. Elvins, 89, Appach-road, Brixton, clerk	1
A. A. Cubitt, 59, Mercers-road, Holloway, clerk	1
H. M. Welford, Weybridge, Surrey, solicitor	1

The number of directors is not to be less than three, nor more than seven; qualification, shares or stock of the nominal value of £100; the subscribers are to appoint the first; remuneration, £200 per annum, and an additional £100 for every 1 per cent. dividend beyond 6 per cent. per annum.

Gorsedd and Sinclair United Mines, Limited.

This company was registered on the 14th inst., with a capital of £20,000, in £1 shares, to carry on mining operations in the township or parish of Whitford, County of Flint. The subscribers are:—

	Shares.
J. Lake Blaxland, 7, Queen Victoria-street, solicitor	1
J. Sadler Wood, 13, King-street, E.C., accountant	1
J. Toms, 30, Great St. Helens, secretary to a company	1
E. Wickham, 5, Arthur-street East, E.C., secretary to a company	1
T. F. Gamble, East Acton	1
T. H. Baxter, 23, Waldon-street, Commercial-road, clerk	1
G. W. Mecham, 3, Leopold-street, Walthamstow, clerk	1

The number of directors is not to be less than two, nor more than five; qualification, 25 shares; remuneration, £50 per annum to the chairman, and £25 per annum for each director.

Marchant Engine Syndicate, Limited.

This company was registered on the 11th inst., with a capital of £100,000, in £5 shares, to acquire and work the letters patent of Mr. Robert Mudge Marchant for "A method and process for the retention and circulation of steam in its application to engine power." The subscribers are:

	Shares.
*R. M. Marchant, C.E., 69, Fenchurch-street	1
*Alex. Brogden, M.P., 9, Victoria-chambers, S.W.	1
Douglas A. Onslow, J.P., 28, Carlton-hill, N.W.	1
F. R. Mealy Gossett, J.P., Portslade, near Brighton	1
Enoch Horton, 110, Cannon-street, ironmaster	1
*W. Downie, 35, Lorne-road, Upper Tollington Park, managing director	1
Henry Brogden, Altrincham	1

The number of directors is not to be less than three, nor more than seven; the subscribers denoted by an asterisk are the first, and Messrs. R. M. Marchant and A. Brogden may each appoint two others; the subscribers acting as directors *ad interim*. Mr. Wm. Downie is appointed managing director for three years at a salary of £800 per annum. The remuneration of the ordinary directors is to be one-tenth of the divided profits, provided such profits do not exceed £50,000 in any one year, in which case the fixed sum of £5000 per annum will be divided. Qualification for directors (other than the first), 20 fully paid shares.

Minera Mountain Lead Mining Company, Limited.

This company proposes to acquire and work the properties known as the Minera Mountain Lead Mines, comprising the mines, "The Park," "South Minera," "Pool Park," "Lower Pool Park," and "Mid Park," situate at Minera, Denbigh. It was registered on the 9th inst., with a capital of £10,000, in £1 shares, with the following as first subscribers:—

	Shares.
*T. J. Rolland, Didsbury, near Manchester, merchant	1
*G. C. Comer, Waverton, Liverpool	1
*Robert Gee, M.D., 5, Abercromby-square, Liverpool	1
J. D. Pugh, Wrexham, Denbigh, solicitor	1
S. Michell, Minera, Denbigh, mining agent	1
R. Hamilton, 1, Princes-road, Liverpool, surgeon	1
John Webster, Heaton Chapel, near Stockport, clerk	1

The number of directors is not to be less than three nor more than seven; qualification, 200 shares; the first are the subscribers denoted by an asterisk; the company in general meeting will determine remuneration.

National Construction Company, Limited.

This company proposes to construct and work roads, railways, tramways, docks, harbours, canals, sewage, draining, water, gas, electric, and all other works or conveniences of public utility. It was registered on the 14th inst., with a capital of £50,000, in £1 shares. Power is also taken to carry on the business of miners, builders, contractors, engineers, merchants, importers, and exporters, negotiators of loans, money lenders, and bill discounters. The subscribers are:—

	Shares.
H. F. Monro, 4, Wyndham-place, Bayswater	250
W. V. Brown, Davis Wharf, Southwark, merchant	250
Wm. Agnew Pope, Merrington House, Bolton-gardens, newspaper proprietor	250
W. Bacon, 20, Arundel-street, Coventry-street	250
T. M. Joseph, 4, Paper-buildings, Temple, barrister	250
Major-General W. Agnew, 6, Belsize-park-gardens	250
E. A. Bayliss, Church-court, Old Jewry, solicitor	250

Registered without special articles.

Thompson's Smoke Consuming Stove and Grate Company, Limited.

Upon terms of an agreement of the 10th ult., this company proposes to purchase several letters patent granted to Mr. Henry Thompson, for improvements in the construction of domestic stoves and grates, and for boiler furnaces, &c. It was registered on the 14th inst., with a capital of £5000, in £5 shares. The purchase consideration is 700 fully paid shares. The subscribers are:—

	Shares.
*Henry Thompson, 33, Alwyne-road, Canonbury, builder	1
N. A. Cababe, Walton-on-Thames	1
W. G. K. Kenrick, Victoria-road, Upper Norwood	1
G. M. Scott O'Callaghan, 13, South-square, Gray's-inn, solicitor	1
W. H. Brigg, Bankside, Teddington	1
*W. Brigg, 23, St. James-street, Piccadilly	1
J. Duncan Miller, Little Marlow, Bucks	1

The number of directors is not to be less than two, nor more than five; qualification, shares of the nominal value of £300; the first are the subscribers denoted by an asterisk; each ordinary director will be entitled to £25 per annum remuneration.

Pontypridd and Rhondda Valley Tramway Company, Limited.

This company was registered on the 15th inst., with a capital of £150,000, in £10 shares, to construct and lay down tramways or railways in the county of Glamorgan. The subscribers are:—

	Shares.
*H. T. McNeale, 8, Elm-park-gardens, S.W., contractor	25
T. Winder, Wood-green, N., accountant	1
*F. R. Crawshay, J.P., Bridgend, Glamorgan	25
*Charles Harding, 10, St. Swithin's-lane, manager of the Accident Insurance Company	25
*P. A. Vyvyan Robinson, 10, Bute-crescent, merchant	25
J. McKenzie, C.E., 191, Camberwell New-road	1
F. Goodrich, 4, Bishopsgate-street Within, secretary to a company	1

The number of directors is not to be less than three, nor more than 7; qualification, 25 ordinary shares; the first are the subscribers denoted by an asterisk; remuneration £350 per annum, and also one-tenth of the residue of the net profits, beyond the amount required for payment of £6 per cent. per annum dividend.

THE BRITISH ASSOCIATION.

THE 55th annual meeting of this Association is to be held at Aberdeen from September 9th to the 17th, under the presidency of Sir Lyon Playfair, K.C.B., F.R.S. A circular just issued by the local executive committee states that it is now twenty-six years since the Association met in Aberdeen, under the distinguished presidency of the Prince Consort, and during the intervening period considerable progress has been made in everything which can render the meeting interesting and attractive to members of the Association and others. Aberdeen is easily accessible from all parts of the kingdom. From London it can be reached by rail by any of the leading routes in about fifteen hours; and after July 1st an improved railway service is to be introduced. There are through carriages from London, sleeping cars are attached to all night trains, and during the visit of the Association these will be continued to Aberdeen. All the railway companies issue cheap tourist tickets, available until December 31st. A line of excellent steamers runs twice a week between London and Aberdeen; passage, a little over thirty hours. The railway companies have agreed to make special local arrangements for members of the Association who may wish to reside a little distance from town. The Senatus of the University have placed at the disposal of the executive committee their halls and lecture rooms in Marischal College, to be used as reception rooms, and for the meetings of several of the sections, while the city and county authorities have similarly granted their halls, and sectional meetings will be held there, as well as in several other buildings situated in convenient proximity. For the general meeting, the Music-hall, capable of containing an audience of about 3000, has been engaged, along with the adjoining rooms. It has been arranged to hold two *conversaziones* in the new Art Gallery and Gray's Art School adjoining, in which a loan collection of paintings, got together by the Aberdeen Artists' Society, will be on exhibition during the time of the meeting, as also collections illustrative of the natural history of the North of Scotland. Besides objects of interest in or near the city, such as the Cathedral, University, Market buildings, and harbour, there are in the neighbourhood numerous objects and places interesting to the antiquarian, the geologist, and others. The industries and manufactures of the city, such as granite-polishing, shipbuilding, paper-making, comb-making, cotton, wool, and linen manufactures, will, it is believed, in many cases be opened to visitors; and for places and objects at a distance excursions are being organised. These will include Upper Deeside; antiquities of the North of Scotland and places of geological interest, as Portsoy, Elgin and its cathedral, Peterhead, the Eird Houses at Kildrummy and Glenkindie, the Vitrified Forts at Noth and Dunnydeer, the Kieselguhr of Loch Kinord, &c., and special excursions will be arranged for some of these.

RONKAR'S THEOREM.—According to the principle of conservation of energy, every vibratory movement offers an example of the periodical transformation of actual into potential energy, and *vice versâ*. The total energy alternately becomes wholly actual or wholly potential. In elliptical movement produced by the attraction of a fixed centre, in the inverse ratio of the square of the distance, the total energy is always composed of two parts, one actual, the other potential; the first attains its maximum at the point of the trajectory which is nearest to the centre of attraction, the second at the point which is most distant. E. Ronkar gives the following theorem:—In a system of which the movement is periodic and which satisfies the principle of conservation of energy, if the initial conditions of the movement undergo an infinitesimal variation, the increase of the mean potential energy surpasses that of the mean actual energy by a fraction of the latter, which is double the relative increase of the period.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

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

Applications for Letters Patent.

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

14th July, 1885.

8477. PLUCKING BEAVER, &c., PELTS, E. G. Colton.—(*J. W. Sutton, United States.*)
8478. METALLURGICAL FURNACES, J. T. King.—(*S. T. Owens, United States.*)
8479. SAFETY VALVES, G. Wilson, Anerley.
8480. OIL CAN, J. Starley, Birmingham.
8481. CALCULATING INSTRUMENTS, J. W. C. Atkinson, Bradford.
8482. SEA, &c., SALTS, F. W. Holloway, Haywards Heath.
8483. STAIRCASES, D. Hall, Eastbourne.
8484. WROUGHT METAL PLATES, A. H. Emery, London.
8485. EYE-LINKS OR BARS, A. H. Emery, London.
8486. THREADED BOLTS, RODS, and PIPES, A. H. Emery, London.
8487. WROUGHT METAL COLUMNS, &c., A. H. Emery, London.
8488. SCREWED KEY, I. Jackson, Glossop.
8489. LUBRICATING and CLEANING SPINDLES, T. H. and H. Blamires, Manchester.
8490. VENTILATING WATER-CLOSETS, F. W. Holloway, Haywards Heath.
8491. SIGNALLING and SWITCHING APPARATUS, A. Coleman and F. Brown, London.
8492. OSCILLATING SHUTTLE SEWING MACHINES, J. and W. U. Morton, Glasgow.
8493. FEATHERING APPARATUS for SCREW PROPELLERS, R. T. Bells, Liverpool.
8494. STEERING GEAR, R. Morrin, Liverpool.
8495. ENVELOPES, C. Carruthers, Putney.
8496. FINISHING the PILED SURFACE of WEFT PILED FABRICS, S. and T. Crabtree, Manchester.
8497. STEAM ENGINES, J. Thom, Barrow-in-Furness.
8498. SUPPORTING the BACK, &c., of the HUMAN BODY, R. Jellico, Liverpool.
8499. ACID TAPS, &c., for CHEMICAL WORKS, W. Allen, London.
8500. CURTAIN STRETCHERS, T. Watson, London.
8501. METALLIC BEDSTEADS, W. N. Bryett, London.
8502. ACTUATING the DABBING BRUSHES of COMBING MACHINES, E. Bray and J. Heald, Leeds.
8503. CRICKET BAT HANDLES, F. E. Fenson, London.
8504. ICE SAFE, A. G. Anderson, Edinburgh.
8505. PLUMBERS' TRAPS of LEAD, F. N. Du Bois, New York, U.S.
8506. CRANK SHAFTS and BEARINGS, H. See, London.
8507. CONVERTIBLE DRESS STANDS, &c., A. Gems, Sidcup.
8508. PRESSING and MOULDING BRICKS, &c., R. Stanley, London.
8509. FORMING SCREW THREADS in BOTTLES, W. B. Fitch, London.
8510. STOPPERING BOTTLES, JARS, &c., W. B. Fitch, London.
8511. SIGNALLING on BOARD SHIP, J. Lea and R. Matthews, London.
8512. ARTICLE of FURNITURE, W. H. Beck.—(*J. G. Wolff, France.*)
8513. WEATHER BAR for DOORS and WINDOWS, S. R. Rossiter, London.
8514. PHOTOGRAPHIC SHUTTERS, C. D. Durnford, London.
8515. INDIA-RUBBER RING for HORSES, W. D. Hutchinson, London.
8516. FUEL, T. Chappell and C. H. Adames, London.
8517. LOCKS, LATCHES, and KEYS, E. E. Deacon, London.
8518. BADGE for CLUBS, &c., R. E. Phillips and E. R. Shipton, London.
8519. VELOCIPEDES, J. Ford, London.
8520. GENERATING and UTILISING ELECTRICITY, A. F. St. George, London.
8521. CORSETS, C. Bayer.—(*La Société Stiegler Jne. et Cargemel, France.*)
8522. SLEEVE BUTTON or STUD, A. M. Clark.—(*R. Benedict and H. M. Scott, United States.*)
8523. CHLOROFORM, ACETIC ACID, &c., H. E. Newton.—(*G. Michaelis and W. T. Mayer, United States.*)
8524. SECURING RAILS, J. M. Stuart and F. H. Gill, London.
8525. TELEGRAPHIC SIGNALLING, L. de M. G. Ferreira, London.
8526. CURTAIN FIXTURES, L. Weber, London.
8527. FILTERING APPARATUS, W. R. Lake.—(*J. W. Hyatt, U.S.*)
8528. DYNAMO-ELECTRIC MACHINES, W. R. Lake.—(*E. R. Whitney, U.S.*)
8529. RIVETTING MACHINES, T. Morton, London.
8530. SAND MOULDING MACHINES, A. Rice, London.
8531. GAS STOVES, W. Moffatt, London.
8532. STEERING MECHANISM for TRICYCLES, J. M. Starley, London.
8533. ATTACHING DOOR KNOBS, R. R. Harrison, London.
8534. LIQUID MEASURER, H. Fleming, P. Jones, and M. Convie, Glasgow.
8535. TOY BRICKS, H. W. Hart, London.
8536. MANUFACTURING FOOD from CEREALS, H. W. Hart, London.
8537. STRAPS for BOXES, &c., A. P. Rockwell, London.
8538. ELECTRIC CLOCK, D. Vanderplancke, London.
8539. PRINTING, &c., TICKETS, W. W. Colley and M. Hart, London.
8540. VOLTAIC BATTERIES, F. H. W. Higgins, London.
8541. DECARBONATING CARBONATES of STRONTIA, &c., H. Leplay, London.
8542. MIDDLINGS PURIFIER, O. Imray.—(*H. Simon, Germany.*)
8543. LIQUID METER, W. A. G Schönheyder, London.
8544. SUPPORTS for FIRE-ARMS, G. Shepheard and H. F. Holman, London.

15th July, 1885.

8545. CONNECTING CARDS in JACQUARDS, S. Tebbutt, London.
8546. MEASURING INDICATORS, S. Tebbutt, London.
8547. SPINNING and DOUBLING FIBRES, J. Hall, Halifax.
8548. CHECKING CASH TAKINGS, R. C. Sayer, Newport, Mon.
8549. WEIGH CART for COAL, &c., M. E. Court and S. Tomlinson, Birmingham.
8550. METALLIC SPRING HOOK BRIDLE BIT, J. Ford, Levenshulme.
8551. RULING MUSIC and LINES, W. Carter, jun., Glasgow.
8552. WOODWORKING MACHINERY, S. Ingham, W. Illingworth, and J. W. Haywood, Leeds.
8553. REVOLVING CUTTER HOLDER, T. M. Hobson and E. Harrison, London.
8554. FINELY DIVIDING and TEMPERING CLAY, W. P. Thompson.—(*C. and A. Potts, United States.*)
8555. WATER or SANITARY CLOSETS, S. R. Henshaw, Liverpool.
8556. SHIRTS, J. M. Murphy, Liverpool.
8557. FUNNEL for FILLING LIQUIDS, W. W. Barraclough, Skipton.
8558. CHECKING WORKMEN'S TIME, W. Macrone, Glasgow.
8559. VENTILATORS, F. W. Willcox, Sunderland.
8560. RAILWAY WAGON COUPLINGS, E. J. Ainsworth, Blackburn.
8561. MIDDLINGS PURIFIERS, R. Howarth, London.
8562. SPRINGS for PISTONS, A. T. Allen and H. Cavill, London.
8563. BREWERS' and DISTILLERS' MASH TUNS, S. Rhoden, London.
8564. LEATHERS or INNER BANDS for HATS, A. Davies, Manchester.
8565. SOCKETS for SUPPORTING BRACKETS, &c., J. E. Sheldon, London.
8566. DYNAMO-ELECTRIC MACHINES, T. J. Handford.—(*R. H. Mather, United States.*)
8567. ASCERTAINING NUMBER of BLADES for PROPELLERS of NAVIGABLE BALLOONS, W. N. Hutchinson, Bideford.
8568. DYNAMO-ELECTRIC MACHINES, T. J. Handford.—(*R. H. Mather, United States.*)
8569. RAILWAY and other TICKETS, R. W. Winder, Leeds.
8570. METAL FENCING, W. Orr, Glasgow.
8571. WHIPPLETREES, W. Brenton, London.
8572. ALBUMS, W. Spear.—(*J. W. Spear and Sons, Germany.*)
8573. COPYING PRESSES, D. Smith, jun., London.
8574. TREATING METALS, &c., H. R. Cassel, London.
8575. FIXING LAWN-TENNIS NET POSTS, J. L. Birley, London.
8576. COMPRESSED AIR ENGINES, G. H. Nicholls, London.
8577. KITCHEN FENDERS, &c., A. W. Woodhead, London.
8578. DOOR CHECKS, J. S. Banks, London.
8579. COFFEE MACHINES, F. Mohrhoff, London.
8580. ACCORDEON, H. J. Haddan.—(*G. Richter, Saxony.*)
8581. KNEADING MACHINE, H. J. Haddan.—(*F. Tretrop and P. Luther, Germany.*)
8582. IRONS HEATED by GAS, G. Bryant, London.
8583. GAS MOTOR ENGINES, O. T. Newton, London.
8584. GAS ENGINES, A. Treeton, London.
8585. DECORATING GLASS with STRIPES, W. W. Boulton, Kingswinford.
8586. SHIPS' PROPELLERS, W. P. Branson, London.
8587. UNIVERSAL WRENCH, J. Turner.—(*R. Cochrane, Victoria.*)
8588. ELECTRODES, E. N. Reynier and A. Simmen, London.
8589. ETCHING PICTURES on GLASS, A. A. and W. Dalglish, Glasgow.
8590. ANGLE CLAMPS, P. Jensen.—(*J. Scherbel and T. Remus, Saxony.*)
8591. MUSICAL BOXES, C. E. Juillerat, London.

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8592. HUMAN PARTURITION MACHINE, J. Bland, London.
8593. AUTOMATIC LUBRICATOR, W. Hill, Longport.
8594. WELDLESS METALLIC TUBES, H. Cheesman, Hartlepool.
8595. APPARATUS for REGISTERING FARES, J. Bamber, Liverpool.
8596. MILK CHURNS, &c., T. Eaton, Derby.
8597. IODINE COLLOID, E. Kent, London.
8598. PRODUCING DENTAL APPLIANCES, R. Marston, Leicester.
8599. FILLING, &c., AERATED BEVERAGES, J. McEwen, London.
8600. LAMPS, W. T. Webber, Birmingham.
8601. SPRING MATTRESSES, J. Wohl, Liverpool.
8602. TREATING COPPER LIQUORS, N. Glendinning, Liverpool.
8603. PISTONS, &c., G. Temple and W. Rowntree, Liverpool.
8604. SAFETY LOCKING ATTACHING HOOKS, J. Roberts, Liverpool.
8605. FRAMES, P. Campbell, Glasgow.
8606. MOURNING STATIONERY, A. Mullord, London.
8607. FURNACE BARS, T. Thompson, Seghill.
8608. PEN GUIDE, W. G. R. Penley, Wandsworth.
8609. SAFETY LAMP, R. Purdy, London.
8610. DETERMINING the QUANTITY of FAT in MILK, C. G. P. de Laval, London.
8611. TRACE BUCKLES, A. J. Boult.—(*E. Kraft, Canada.*)
8612. SECURING CONTINUOUS PRESSURE for SILOS, E. Heard, London.
8613. ELECTRO-GILDING METALLIC ARTICLES, J. M. Davis, London.
8614. VALVES of STEAM ENGINES, H. Kuhne.—(*R. Proell, Saxony.*)
8615. ROYLE'S CONDENSATION APPARATUS, R. Kullig, London.
8616. PULP-SCREENING MACHINERY, F. X. Black, London.
8617. RAISING EGG HOLDERS, &c., T. Dykes and J. L. Corbett, Glasgow.
8618. PORTABLE or TABLE FOUNTAINS, W. Tucker and H. Tye, London.
8619. COUPLING JOINT for PIPES, W. E. Gedge.—(*G. Guillemin, France.*)
8620. CYLINDER FLUTE, H. Carter and H. Potter and Co., London.
8621. ELECTRICAL SIGNALLING, W. R. Lake.—(*M. W. and M. F. Parrish, United States.*)
8622. ELECTRICAL COMMUNICATION BETWEEN DOOR KNOCKERS, &c., R. A. Lee, London.
8623. PREPARING MILK of LIME, S. H. Johnson and C. C. Hutchinson, London.
8624. GAUGING the DEPTH of WATER, &c., J. Hooker, London.
8625. BOTTLE STOPPERS, C. M. Taylor and A. P. Turner, London.
8626. SUBSTITUTE for LEATHER, G. F. Redfern.—(*A. Buckingham, London.*)
8627. GALVANIC BATTERIES, W. H. Tasker and T. J. Jones, London.
8628. WRITING INSTRUMENTS, W. F. B. Massey-Mainwaring, London.
8629. WRITING INSTRUMENTS, W. F. B. Massey-Mainwaring, London.
8630. EFFECTING the ABSORPTION of GASES by LIQUIDS, E. Edwards.—(*L. Rohrmann and M. Hiller, Germany.*)
8631. INDICATING the PRESENCE of FIRE-DAMP in MINES, W. R. Lake.—(*I. Kitsee, United States.*)

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8632. BRACE BUCKLES, PRONGS, BACKS, and PLATES, G. Walker, Birmingham.
8633. FARMING LAND by CO-OPERATION, G. C. Phillips, Chelmsford.
8634. MACHINERY BELTING, C. G. Grossett, Glasgow.
8635. TRIPPING MECHANISM for SHEAF BINDING MACHINERY, J. Hornsby and J. Innocent, Grantham.
8636. REGENERATIVE GAS LAMPS, W. P. and G. B. A. Gibbons, Birmingham.
8637. VESSELS for REARING and KEEPING FISH, J Westaway, Coryton.
8638. WATERPROOF GARMENTS, R. S. Moss, London.
8639. FASTENING for SECURING WINDOW BLINDS, J. Lewtas, Manchester.
8640. REGISTER STOVES, J. C. Richmond, Hammersmith.
8641. RAILWAY and TRAMWAY LINES, H. Emery and S. White, Limehouse.
8642. NEEDLES, W. B. Clarke, Birmingham.
8643. DIAMOND EMBOSSING, R. F. Dorendorff.—(*M. Krause, France.*)
8644. DECORATING CARDS with NATURAL FLOWERS, &c., R. F. Dorendorff.—(*M. Krause, Germany.*)
8645. VALVE APPARATUS of STEAM ENGINES, J. S. G. W. Stroud, London.
8646. TICKET PRINTING PRESSES, W. Heckert, London.
8647. MOTIVE POWER ENGINES, I. Engelson, London.
8648. MACHINE for CUTTING WHEAT, &c., F. Lange, London.
8649. ORNAMENTING METALLIC COAL VASES, G. H. and S. Pears, London.
8650. CYCLES, J. I. Warman, London.
8651. PENCIL HOLDERS, H. J. Haddan.—(*Helmreich and Dinkelmeier, Bavaria.*)
8652. MALTING HOUSES, G. F. Redfern.—(*C. Völckner, Austria.*)

8653. SHIPS' BINNACLES, C. F. Swan, London.
8654. UTILISING WROUGHT IRON and STEEL SCRAP, &c., D., W. N., and A. T. F. Rose, London.
8655. SASH WINDOWS, V. Klán and R. Seitz, London.
8656. ART NEEDLEWORK, G. A. Thierry, London.
8657. ADVERTISING upon TRAM-CAR TICKETS, G. H. Busch, London.
8658. SUPPORTS for HOLDING BOOTS, D. Pope, London.
8659. TAP and LEVEL INDICATOR, A. J. Boult.—(*J. Audouy, France.*)
8660. HAND REST APPARATUS for WRITING, E. Nunan, London.
8661. REFINING COPPER, W. Wood and M. H. Hurrell, London.
8662. CLOSET PANS and SEATS, T. B. Weller, London.
8663. HOLDING DEVICES for NECK WEAR, W. H. Rose, London.
8664. ROTARY SCREENS, T. and W. Nalder, London.
8665. FASTENING for DRIVING BELTS, E. Edwards.—(*P. Loison-Prost, France.*)
8666. SPANNERS, J. H. Barry, London.
8667. SCREW STOPPERS for BOTTLES, J. H. Weston, London.
8668. RIFLE ACTION, H. Schlund, London.
8669. GAS PRODUCERS, F. Siemens, London.
8670. CHENILLE THREAD MACHINERY C. A. Day.—(*C. B. Auer, United States.*)
8671. FRONT UNDERFRAMES of PERCHLESS FOUR WHEELED CARRIAGES, T. and J. T. Brainsby, and C. W. Woollard, London.

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8672. SCISSORS, W. H. Furniss and W. B. Hatfield, London.
8673. HORSESHOES, Baron Bellier de Villiers, France.
8674. BICYCLE LAMP, T. S. Tongue, Handsworth.
8675. TELEPHONIC APPARATUS, W. Blenheim, New Egham.
8676. OVER-EDGE SEWING MACHINES, T. Robertson, Glasgow.
8677. STEEL, J. Riley, Glasgow.
8678. LAMP BURNERS, R. McLachlan, Glasgow.
8679. EVER-POINTED PENCIL CASES, A. H. Woodward, Birmingham.
8680. MEANS for DELIVERING SAND on to the RAILS in FRONT of the DRIVING WHEELS of an ENGINE, F. Holt, Manchester.
8681. CONSTRUCTION of BOBBINS and SPOOLS, J. S. Crowley, Manchester.
8682. LOOM SHUTTLES, E. Booth, Manchester.
8683. WASHING CLOTHS, S. Davey, Birmingham.
8684. CIRCULAR MAGNETIC LOOMS, E. Winckler and J. J. Heilmann, Liverpool.
8685. HYDRAULIC PULP EDGE TRIMMER, J. P. Cornett, Durham.
8686. VELOCIPEDES, A. Malpas, Birmingham.
8687. HANDLES for TABLE CUTLERY, &c., C. Ibbotson, Sheffield.
8688. WEIGHBRIDGES, J. Hines, Liverpool.
8689. CONVEYING COAL from the MINE, A. Leigh, Surbiton.
8690. FURNACES, C. Jones, London.
8691. VENETIAN BLINDS, G. Otway, London.
8692. GENERATING CARBONIC ACID GAS AUTOMATICALLY, F. Foster, London.
8693. ORDNANCE, J. A. Longridge, London.
8694. MOVABLE CORE MOULDS, J. Patterson, Glasgow.
8695. BANDS for TRANSMITTING POWER, J. A. Black and T. C. Loe, Glasgow.
8696. SHARPENING PENCILS, J. L. Clarke, London.
8697. SHARPENING PENCILS, J. L. Clarke, London.
8698. APPLIANCES to AXLE-BOXES, D. Halpin, London.
8699. UTILISING EXHAUST STEAM, C. A. Morcing and P. Tarbutt, London.
8700. ROTARY ENGINE, J. Brockie and M. W. W. Mackie, London.
8701. IRON-CLAD VESSELS, H. de Burgh Lawson, London.
8702. DOUBLE-ACTING AIR PUMPS, C. Barker, London.
8703. FASTENING GUY ROPES, D. Sinclair, Glasgow.
8704. WIRE COILS for ELECTRO-MAGNETS, H. Aron, Glasgow.
8705. CHAPLETS, T. Wilson, London.
8706. COVERING WIRES, J. C. Sellars, Liverpool.
8707. METAL TUBES, F. Elmore, London.
8708. HEATING ROOMS by GAS, C. Launay, London.
8709. MOULDING MACHINES, J. A. McFerran, London.
8710. TREES for BOOTS and SHOES, T. S. Howie, London.
8711. TYPE WRITERS, C. C. Underwood, London.
8712. FACILITATING the TRANSFER of MONEY, H. H. Lake.—(*D. H. Rice, U.S.*)
8713. FASTENINGS for RAILWAY CHAIRS, &c., F. J. Talbot, London.
8714. HEELS of BOOTS and SHOES, H. H. Lake.—(*P. J. F. de Meeûs, France.*)

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8715. PENCIL-CASES, C. D. Durnford, Edinburgh.
8716. CARTRIDGE CLIPS, P. A. Martin, Birmingham.
8717. BRACES, P. A. Martin, Birmingham.
8718. FISHING REELS, S. Allcock, Redditch.
8719. INSTRUMENT for MEASURING SHOT, W. P. Jones, Birmingham.
8720. STRAP or BELTING GUIDES, F. Reddaway, Manchester.
8721. GAS MOTOR ENGINES, C. W. King, Southport.
8722. EXPOSING SENSITIVE PAPER, S. D. McKellen, Manchester.
8723. FILTERS, W. P. Thompson.—(*Solvay et Cie., Belgium.*)
8724. MANUFACTURE of CHLORINE, W. P. Thompson.—(*Solvay et Cie., Belgium.*)
8725. SKATES, T. H. Heard, Sheffield.
8726. STUDS and SOLITAIRES, L. P. Conard, Birmingham.
8727. ELECTRIC INCANDESCENT LAMPS, P. M. Justice.—(*I. W. Heysinger and J. Pusey, United States.*)
8728. COMPRESSED LEATHER, W. J. Goulborne and E. Morse, London.
8729. CONTRIVANCE for HOLDING ROPES, S. H. and C. E. Manners, and J. T. Ledan, London.
8730. BRICKS, D. Crossley, Halifax.
8731. STORING ELECTRICITY, J. Noad, London.
8732. COCK for CASKS, &c., E. de Pass.—(*H. Ruttin and L. and H. Kellerman, Austria.*)
8733. GALVANIC BATTERIES, W. H. Quarterman, London.
8734. CHAINS for CURTAINS, A. A. Wales, London.
8735. LOCKS, C. Bauer, Brockley.
8736. PLASTIC COMPOUNDS, H. W. Merritt, United States.
8737. PAINT or PIGMENT, W. R. Lake.—(*J. P. Perkins, United States.*)
8738. DUST COLLECTORS, W. R. Lake.—(*E. Kriess, Germany.*)
8739. CLOSING TIN BOXES, &c., F. W. and J. Feaver, London.
8740. SMOKE-CONSUMING FIRE-PLACES, &c., G. Raven, London.
8741. FEEDING POULTRY, W. R. Lake.—(*C. Labbe, France.*)
8742. TRAM-CARS, A. E. Adlard, London.
8743. COMBINATION of TELEPHONES and ELECTRIC BELLS, J. H. Johnson.—(*La Société P. Barbier et Cie., France.*)
8744. CONTROLLING the PASSAGE of ELECTRIC CURRENTS, J. H. Johnson.—(*La Société P. Barbier et Cie., France.*)
8745. UTILISING TAR, &c., OILS as FUEL, S. A. Sadler, London.
8746. MAGAZINE FIRE-ARMS, W. R. Lake.—(*G. V. Fosbery, Belgium.*)
8747. GENERATING ELECTRO-MOTIVE POWER, A. I. Gravier, London.
8748. ROCK DRILLS, A. W. L. Reddie.—(*H. C. Sergeant, United States.*)
8749. PRESSING METAL into TUBULAR FORMS, W. D. Allen, London.
8750. VAPORISERS, T. Brown.—(*E. H. Gouge, United States.*)
8751. ELECTRIC LAMPS, O. C. D. Ross, London.
8752. PACKING CASES, G. J. F. Tate, London.
8753. COOKING RANGES, A. S. Cooper and T. Harbord, London.
8754. HANDLES for BAGS, P. Hayman and J. Knight, London.
8755. GAS REGULATOR, F. Clouth, London.
8756. MAKING STEEL, &c., H. White, London.

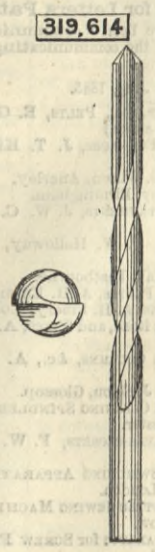
SELECTED AMERICAN PATENTS.

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

319,614. DRILL, *John H. Pendleton, Brooklyn, N.Y.—Filed September 4th*, 1883.

Claim.—The drill having grooves at opposite sides, the bottoms of the grooves being planes 1 2 and 3 2,

319,614

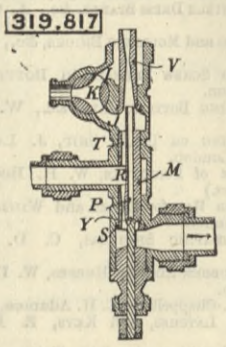


uniting at 2 near to but at each side of the axis of the drill, the portions 3 4 of the grooves having curved or partially curved surfaces, substantially as set forth.

319,817. INSPIRATOR, *Parker P. Hogue, Sandy Lake, Pa.—Filed March 18th*, 1885.

Claim.—(1) In an inspirator, the combination, with a casing having steam entrance, water entrance, overflow, and connection with the water space of a boiler, substantially as described, and provided with passages I and J, the barrel M, having recess R, and passage P, S, and T, the tube V, three-way cock K, valve Y, and a pivotted rod connecting the stem of the said valve with the handle of the three-way cock, all constructed, arranged, and operating substantially as and for the purpose herein set forth.

319,817

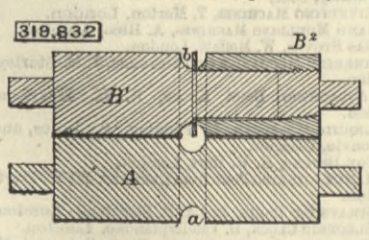


and for the purpose herein set forth. (2) In an inspirator, the combination of a casing having a steam entrance, water entrance, overflow, and connection with the water space of a boiler, substantially as described, and provided with passages I and J, the barrel M, having recess R, and passage P, S, and T, the tube V, three-way cock K, valve Y, and a pivotted rod connecting the stem of the said valve with the handle of the three-way cock, all constructed, arranged, and operating substantially as and for the purpose herein set forth.

319,832. ROLL FOR METAL RODS, *William A. McCool, Perryville.—Filed May 12th*, 1884.

Claim.—(1) The combination, with a roll formed with an annular depression of a companion roll, having a corresponding depression, and formed of two sections, and provided with a removable former, substantially as set forth. (2) The combination, with the roll A, formed with an annular depression *a*, of a two-

319,832

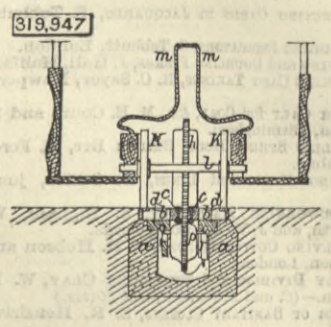


part roll consisting of the shouldered portion B^1, formed with a threaded core, a shoulder, and an annular depression, and the threaded sleeve B^2, formed at its inner end with an annular groove to complete the depression *b*, substantially as set forth.

319,947. ELECTRIC TRAMWAYS, *C. Bastos, Rio de Janeiro, Brazil.—Filed December 11th*, 1883.

Claim.—(1) In an electric tramway system, the underground open channels having conducting linings G, insulated as described, combined with the elastic friction pieces L, having extensions M, supported in

319,947

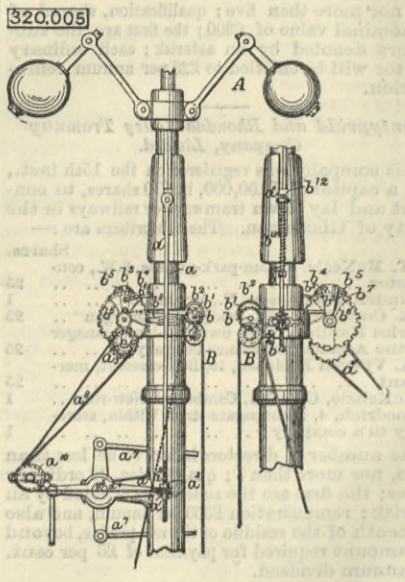


piece N, the expanding springs R, and electric connections with the car and motor as set forth. (2) In combination with the underground channels, as described, and with the spring friction piece L, the wheels *h p*, frame *n*, means, as *q*, for adjusting the friction, and connections with the car, as and for the purposes set forth. (3) The combination, with the wheels *h p*, meshed as shown, of the adjustable frame *n*, the springs *o*, for supporting the said frame *n*, the cams *q*, for adjusting the friction of wheel *p* upon the lower surface of the rail *c c*, the underground channel, and means, substantially as described, for making electrical connections therewith, as herein specified.

320 005. GOVERNOR, *John Scott, Willimantic, Conn.—Filed November 14th*, 1884.

Claim.—(1) In a governor for steam engines, the combination of the governor A, rod *a*, nut a^1, lever a^4, and valve connections a^7, with the pulleys a^2 a^{10} a^9, and the belt a^8, when the belt a^8 is caused to turn the nut a^1 by power or mechanism that is put in action and controlled by the change of elevation of the governor A, substantially as herein shown and set forth. (2) In a governor for steam engines, the nut a^1, pulleys a^2 a^9, and belt a^8, in combination with and actuated by the ratchet wheel b^6, arm b^3, pawls b^4 b^5, connection b^2, excentric b^1, pulley *b*, and belt B, when the action of the pawls b^4 b^5 is limited and controlled by mechanism directly connected with and operated by the governor A, rod connection b^8, lever b^9, swivel nut b^{10}, rod b^{11}, and guard plate b^7, as herein shown

320,005

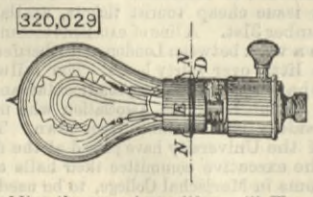


and described. (3) In a governor for steam engines, the connection b^{11}, having a head b^{12}, spring b^{13}, and adjustable stop b^{16}, in combination with the governor A, and guard b^{14} and adjustable stop b^{15}, when constructed and operated substantially as herein shown and set forth. (4) In a governor for steam engines, the nut a^1, turned and controlled by mechanism regulated by the governor, in combination with the rod *a*, operated by the governor, lever a^4, rock shaft lever, and valve connections a^7, substantially as and for the purposes herein shown and set forth.

320,029. INCANDESCENT LAMP HOLDER, *Edward Weston, Newark, N.J.—Filed July 18th*, 1884.

Claim.—(1) The combination, with an incandescent electric lamp globe having a cylindrical neck, a sheet metal cylinder in which a circular groove or depression is formed, secured to the neck, a plug of insulating material closing the end of said cylinder, and contact terminals secured thereto, of a socket into which the said cylinder fits, spring catches secured to the exterior of the socket and extending through the sides of the same for entering the circular groove or depression

320,029

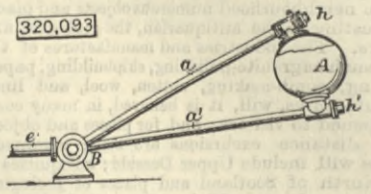


and holding the same in position. (2) The combination, with the lamp having a cylindrical neck, the sheet metal cylinder E, around which is formed a groove or depression D, secured to the neck, a plug of insulating material closing the end of the cylinder, and contact terminals secured thereto, of a socket for receiving the cylinder, contact terminals secured thereto, and spring latches N, fixed to and projecting into the socket and adapted to enter the groove D and hold the lamp in position, as set forth.

320,093. FEED-WATER REGULATOR, *W. Ritter, Altona, Prussia, Germany.—Filed April 3rd*, 1885.

Claim.—The combination, with a steam boiler and tubes $e\,e^1$, entering the boiler at different levels, of the hollow sockets B B^1, with which the tubes $e\,e^1$ are in constant communication, the tubes $c\,c^1$, entering and free to turn in the sockets B B^1, the vessel A, and tubes $a\,a^1$, extending from the top and bottom thereof,

320,093

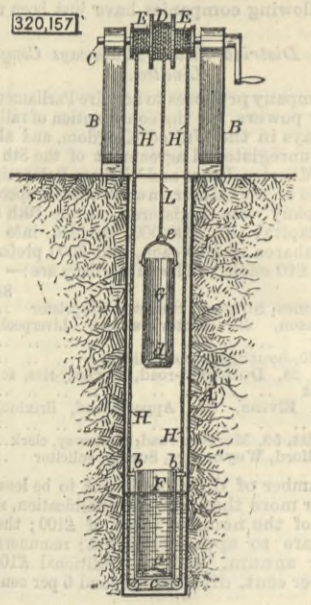


and the coupling piece *b*, connecting the tubes $a\,a^1$ and $c\,c^1$, and serving to maintain the top of the vessel A in constant communication with the boiler through the tubes $a\,c\,e$, and the bottom of said vessel in constant communication with the boiler through the tubes $a^1\,c^1\,e^1$, substantially as herein described.

320,157. WATER ELEVATOR, *John H. Morris and Thomas D. Morris, Seward, Nebr.—Filed November 1st*, 1884.

Claim.—(1) In a water elevator, the bucket F, with its valve *a*, rollers *c*, and guides *b*, in combination with a bucket G of smaller diameter, and a drum and ropes connected to the buckets, whereby the said buckets approach each other, the upper one displacing and receiving the contents of the lower one, substantially as herein described. (2) In a water elevator, the bucket F, with a valve in its bottom, and suitable pulleys or rollers *c*, in combination with the bucket G, the cord or chain H, drums upon each side of a central drum, and a crank or handle for raising and lowering said buckets, substantially as described. (3) In a water elevator, the bucket G, with its valve *d* and ball *e*, in combination with the bucket F, whose diameter is greater than that of the bucket G, a rope or chain L, a central drum, and a mechanism for winding the ropes L and H, to cause the buckets F and G to approach each other, substantially as herein described. (4) A water elevator comprising the following elements:—A lower bucket with a valve to receive water from the source of supply, an upper bucket of smaller diameter with a valve in its bottom, suitable guides and rollers on the lower bucket, cords or chains attached to both buckets and wound around drums in opposite directions, so that the buckets approach each other, the upper one receiving water from the lower one by the continued descent of the

320,157

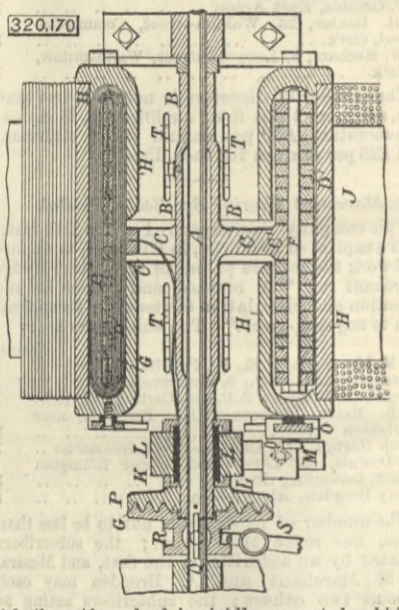


former, and a shaft for imparting motion to both buckets, substantially as described.

320,170. DYNAMO-ELECTRIC MACHINE, *Jose M. Rivera, Buga, United States of Columbia.—Filed April 16th*, 1883.

Claim.—(1) In a dynamo-electric machine, the combination, with an armature, of the spider wheel to which the centre of the armature is fastened, a tubular shaft on which the spider wheel is rigidly mounted, a driving shaft passing loosely through the tubular shaft, and a clutch for locking the tubular shaft on the driving shaft, substantially as herein shown and described, and for the purpose set forth. (2) In a dynamo-electric machine, the combination, with an armature, of a spider wheel, to which the middle of the armature is attached, a tubular shaft on

320,170



which the spider wheel is rigidly mounted, which tubular shaft is provided with an enlargement forming an oil chamber, a driving shaft passing loosely through the tubular shaft, and devices for locking the tubular shaft on the driving shaft, substantially as herein shown and described, and for the purpose set forth. (3) In a dynamo-electric machine, the combination, with the armature of the spider wheel C, attached to the middle of the armature, the tubular shaft B, the driving shaft A, the clutch disc P, mounted on the shaft B, the sliding clutch disc Q, mounted to turn with and slide on the shaft A, and of devices pressing the disc Q against the disc P, substantially as herein shown and described, and for the purpose set forth. (4) In a dynamo-electric machine, the combination, with the armature, of a field magnet J, provided with wings H^1, forming a tubular space in which the armature can revolve, which wings H^1 are provided with slots or openings T, for admitting air to the armature for preventing overheating of the same, substantially as herein shown and described, and for the purpose set forth. (5) An armature for a dynamo-electric machine, constructed of a series of quadrant pieces D having overlapping wedge-shaped pieces D^1 at the ends, the rivets E, uniting the several quadrant sections D, and the bolts F, passed through the apertures *d* in the said overlapping wedges D^1, substantially as herein shown and described, and for the purpose set forth.

320,316. HOISTING MECHANISM, *Thomas A. Weston Stamford.—Filed January 5th*, 1884.

Claim.—(1) In combination with a hoisting machine, a shaft which automatically oscillates to apply or remove a brake, substantially as described. (2) In combination with a hoisting machine, a shaft which forms the bearing for the main chain wheel or drum, and which by the revolution of said wheel or drum oscillates to apply or remove a brake, substantially as described. (3) In a hoisting machine, the combination of a driving and a chain sheave or drum formed in one piece, an oscillating shaft on which the sheaves turn, a helical incline, and a stationary brake, substantially as described. (4) In a hoisting machine, the combination of one side of the frame having a plain friction

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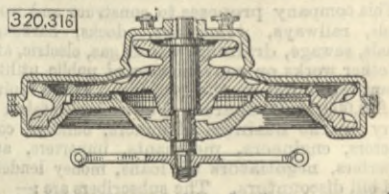

surface, a driving sheave or drum having a corresponding adjacent friction surface, and friction discs between the two, whereby the brake mechanism is brought within the lateral thickness of the driving sheave, substantially as set forth. (5) In a hoisting machine provided with frictional incline braking mechanism, an adjustable weighted operating lever, whereby the said brake mechanism is operated or made inoperative, substantially as described. (6) In a hoisting machine having an automatically applied brake, an elastic releasing device interposed between the place of the operator and the brake, substantially as described.