SIR CHARLES WILLIAM SIEMENS AS A METALLURGIST.

No. II.

THE REGENERATIVE FURNACE.

IN order to explain fully the construction and mode of operation of the modern regenerative furnace, we will select for illustration a mill furnace such as is actually being used at the Landore-Siemens Steel Works for the reheating of steel ingots for the forge or rolling mill. Such a furnace may be said to consist of three separate portions—(1) the gas producers, (2) the regenerators, (3) the furnace body. The gas producers are usually located at some distance from the furnace, and often, as at Landore, quite outside and away from the mill itself. They may be built of different types to suit the different kinds of fuel available at the spot. It is one of the great advantages of the Siemens furnace that the most inferior fuel, which would be utterly useless in an ordinary furnace, can be utilised without any difficulty in the gas producer. Sawdust, peat, lignite, soft coal, and anthracite slack can all be made available with equal facility by simply altering the proportions of the producer to suit the fuel to be employed, so that quantities of coal slack, which were formerly regarded as a waste product, have now their definite commercial value. The engraving, Fig. 3, shows a producer adapted for the consumption of the slack of non-caking bituminous coal. These producers are usually built in a double row, back to back, a separate gas uptake and flue taking off the gas from each group of four, and opening into the main gas flue; each consists essentially of a chamber *a*, lined with fire-brick, rectangular in plan and front section and tapering downwards in longitudinal section as shown. *b* is a cast iron hopper holding about ½ cwt. of coal, and covered by a tightly fitting lid, communicating with the interior of the chamber *a*, the bottom being formed by an iron plate, working on a horizontal pivot, and maintained in its place by the counterpoise of the weighted lever *c*. The hopper should always be kept quite full of fuel and closed by means of the lid. When it becomes necessary to charge fuel into the producer, the workman in charge of the producer, called usually the producer-man, lifts the lever *c* and allows the fuel in the hopper to fall into the chamber *a*; when the lever is allowed to drop back into its usual place the communication between the producer and the hopper is once more cut off, and the hopper can now be replenished with fuel without allowing any gas to escape. The fuel falls from the hopper on to the inclined plane *d*, which is made of fire-brick laid on iron plates. It is worthy of note that the angle of this plane to the horizontal has an important influence on the working of the producer, and must be altered to suit the kind of fuel that has to be used. *e* is a step grate, there being room between its bars for the insertion of pokers or hooks, and for the breaking up and removal of any masses of clinker, &c., that may form during the working. *f* is an ordinary grate, the bars resting on iron bearings, and being usually pretty close together. These grate-bars are kept as low down as they conveniently can be. It will be noticed that the floor of the producer-house slopes from the front to the back, the hollow thus formed being kept always full of water by means of a constant supply pipe. *g* is a small sight-hole, through which the interior of the furnace may be inspected, and the quality of the escaping gases examined. It also serves, in case of necessity, to introduce a long pricker bar, in order to break up any agglomeration of clinker or fuel that cannot well be got at from below. As shown in the engraving, the fuel in the producer may be broadly divided into three zones—an upper zone A, consisting of still unacted-on or but slightly heated coal; a middle zone B, in which the coal is decomposed as in a gas retort, giving off hydrocarbons of varying compositions (some of which are permanent gases and some condensable), ammonia, water, &c., and leaving behind the ash and the solid carbonaceous residue. This, descending, gradually becomes heated to redness—zone C —until it is brought in contact with the current of air entering at the fire-bars, where it undergoes a slow combustion. The carbonic acid, the immediate product of the combustion, passes up through the mass of glowing carbon, and taking up thence another atom of that element, becomes reduced to carbonic oxide. As air contains 80 per cent. of nitrogen, it follows that, even supposing no carbonic acid to be formed, every volume of carbonic oxide produced is accompanied by two volumes of inert nitrogen. As this will have to be subsequently heated in the furnace by the combustion of the carbonic oxide, there is here a great source of loss of heat. However, there is an additional source of combustible gas, which furnishes a far more valuable fuel. The heat radiating through the fire-bars *f* vaporises the water below them, so that there is a constant current of steam ascending through the glowing fuel of the producer. In its passage it is of course decomposed, with the production of carbonic oxide and hydrogen. Thus the gases issuing from a producer in active operation consist of:—

	Per cent.
Hydrocarbons of varying quantity and composition ..	3
Hydrogen	4 to 11
Carbonic oxide	15 to 19
Carbonic acid	6 to 7
Nitrogen	—

It is evident that of the two reactions referred to above, the latter one, namely, the decomposition of steam by the red-hot carbon, is by far the more efficient for the production of gas of high calorific power—firstly, because of the great heat developed by the combustion of hydrogen; and secondly, because it is not diluted by the presence of an incombustible gas like nitrogen. It is hence advisable to work the producers so as to favour as much as possible the occurrence of this reaction, which can be done principally by having the fire-bars as near as possible to the floor of the producer house, by keeping up a sufficient but not over-abundant water supply beneath the bars, and by keeping them as free from clinker and ash as possible. The extent to which this reaction can be made available is, however, limited, as it is directly dependent for its occurrence upon the former and less valuable one, for it does not take place except at a red heat, which heat can only be kept up in the producer by the combustion of carbon in air; for whereas the combination of carbon with oxygen is attended by the evolution of heat, the decomposition of steam by carbon is attended by the abstraction of heat from the surrounding heated bodies. The quantity of steam decomposed can thus never exceed a certain definite proportion to the amount of carbon burnt to carbonic oxide even under the most favourable circumstances. It must, however, be added that this proportion is never even approached in the most successful producer practice.

From the producer the gas passes out through the arch. Fig. 3, into the uptake K, a short vertical brick stack, thence into the cooling tube, a horizontal tube of sheet iron, and thence into the downtake which leads to the regenerators. The cooling tube is made as long as possible in order to cool thoroughly the producer gas. The object of this arrangement is to drive the gas onwards to the furnace with a positive pressure. The gases leave the producer at a temperature of about 300 deg. to 400 deg. C., whilst by the time they reach the downtake their temperature has fallen to less than 100 deg. C.; the up and down-takes and cooling tube thus form a syphon, the weight of the cooled column of gas in the down-take dragging along the lighter column of heated gas in the up-take. At first sight it seems that heat is being wasted in the cooling tube, but this is not the case. There is a certain amount of mechanical work that has to be done—namely, the propelling of the gas from the producer to the furnace—and this work can only be done by the absorption of a corresponding amount of heat. Whether this heat be employed in raising steam to drive blowing machinery, in heating up the stack of the furnace, or, as is actually done, radiated into space

THE SIEMENS GAS PRODUCER AND REGENERATIVE FURNACE

Fig. 4. Vertical Section. Through reversing gas valve

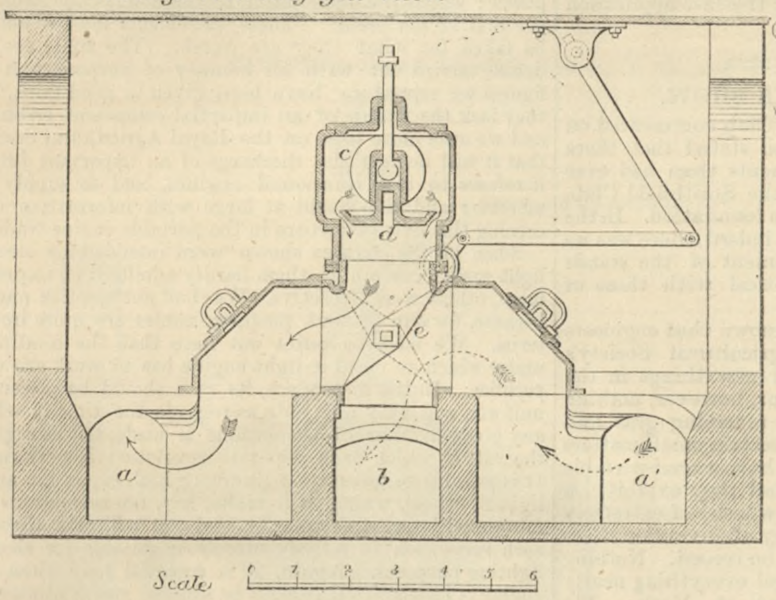


Fig. 3. Vertical Section. Through gas producer

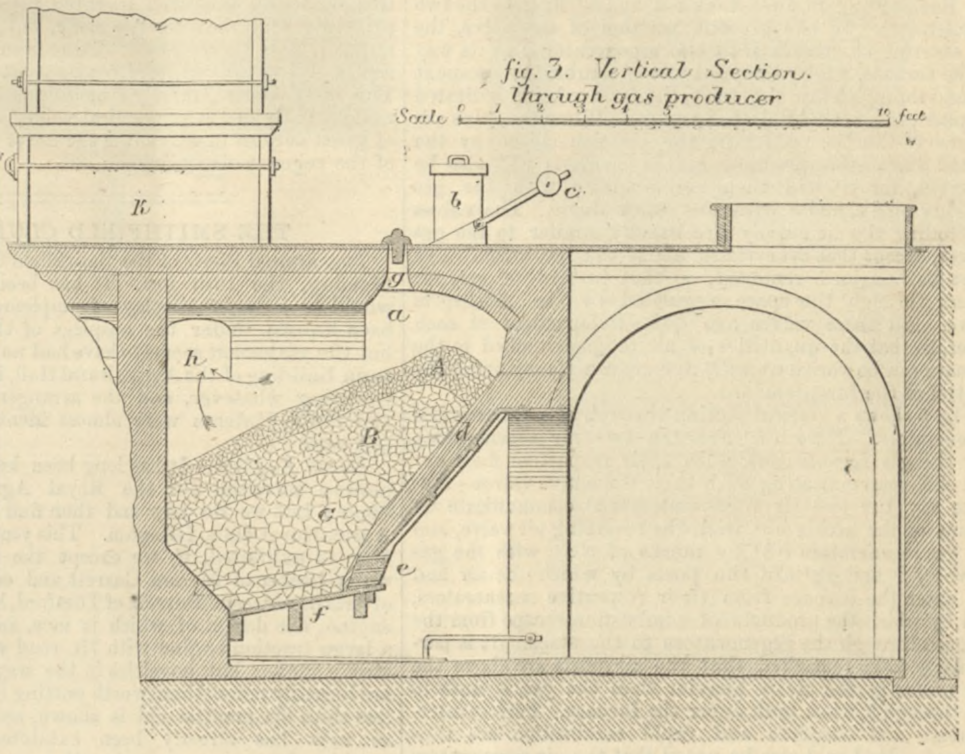
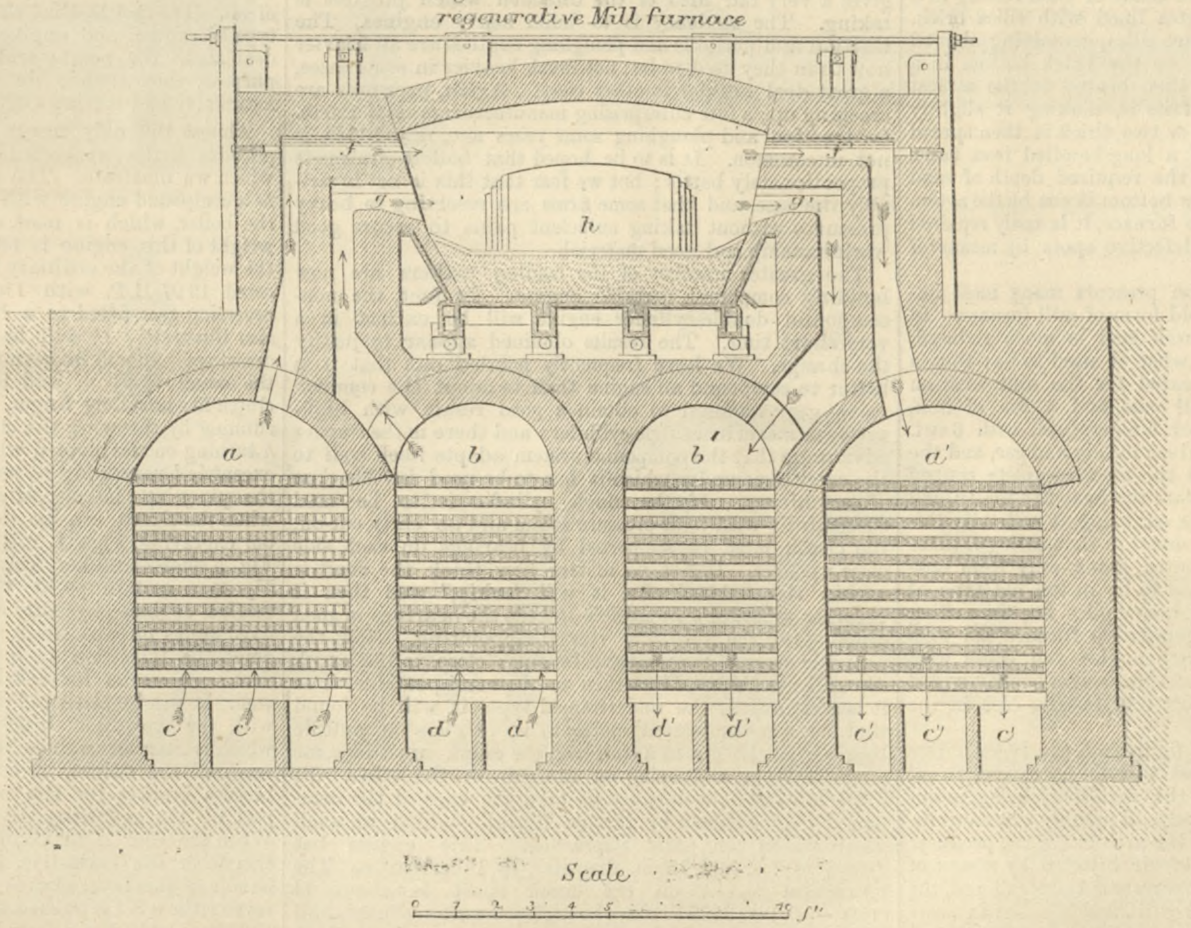


Fig. 5. Vertical Section. regenerative Mill Furnace



to cool the producer gas, is quite immaterial; the work cannot be done except at the expense of a certain amount of heat. The inconvenience attending the cooling of the producer gas is the condensation of the tarry matter it carries, and which would, if it were to pass through the heated regenerators, form gaseous fuel of great heating power. As it is, however, it has to be collected in specially provided tar wells, and removed from time to time. Together with the tar, a certain quantity of water also condenses. This is a decided advantage, as the gas thus passes to the furnace in a drier state. The gas down-take terminates in the reversing valve shown in section in Fig. 4. The gas enters the valve at *c*; *d* is the so-called "mushroom" valve, which can, if necessary, completely cut off the supply of gas, and controls the quantity supplied to each individual furnace on being raised or lowered; *e* is the reversing valve; *b* is the flue leading to the stack; *a* and *a*' flues to the two regenerators. In the present position of the valve, the gas entering at *c* passes into the regenerator *a* on its way to the furnace, whilst the products of combustion escape at *a*', and through *b* into the stack, the former being indicated by plain, the latter by dotted arrows. When the valve *e* is reversed—that is, occupying the position shown by the dotted lines—the direction of the currents will also be reversed, for *a*' will then communicate with the gas delivery pipe *c*, and *a* with the stack flue *b*. The valves controlling the air supply are exactly similar to the gas valves, except that everything above the mushroom valve must be imagined removed, so that instead of gas, air enters through the space regulated by the mushroom valve. All these valves are quite independent of each other, so that the quantities of air or gas supplied to the furnace can be varied at will, and are completely under the control of the furnaceman.

Fig. 5 shows a vertical section through the furnace and regenerators. Here *a a*' are the two air regenerators, *b b*' the gas regenerators, with their respective flues *c c*' and *d d*' communicating with their respective valves—that is to say, the two air regenerators *a a*' communicate by means of the arches *c c*' with the reversing air valve, and the gas regenerators *b b*' by means of *d d*' with the gas valve; *f f*' and *g g*' are the ports by which the air and gas enter the furnace from their respective regenerators, and by which the products of combustion escape from the furnace through the regenerators to the stack. It is particularly to be remarked that the air ports are above the gas ports; as the air is heavier than the gas, it tends to fall through it when both enter the furnace. Perfect intermixture and complete and rapid combustion are thus secured. It should also be noted that the air regenerators are much larger than the gas regenerators. As already observed, this has been found necessary in order to obtain the best results, contrary to the earlier anticipations of Siemens himself. The body of the heating furnace *h* differs but little from those of ordinary heating furnaces. It is built of silica brick firmly braced with iron plates held up by tie-bars of 1½in. round iron and struts formed of old rails.

The bottom of the furnace is made of sand resting in a sort of box made of iron plates lined with silica brick. The sand consists of nearly pure silica, containing about 2 per cent. of lime; this is laid on the brick bottom in a layer a few inches thick, and then heated to the utmost heat of the furnace, which frits it, making it slightly pasty; another layer an inch or two thick is then spread over the first one by means of a long-handled iron ladle, fired in its turn, and so on till the required depth of sand bottom is produced; when the bottom is cut by the action of the mill cinder formed in the furnace, it is easily repaired by placing more sand on the defective spots by means of the ladle.

A furnace of this description presents many most important advantages over the old form of mill furnace. In the first place the consumption of fuel is much reduced, being only about one-half of what it used to be; thus a ton of steel ingots can be heated for the mill with an expenditure of 3 cwt. of small coal, and a ton of iron, which requires a much higher temperature, with 6 cwt. By means of the mushroom valves for air and gas, and the stack damper, the heater has the most complete control over his furnace; he can regulate the heat to a nicety, and can make the flame reducing or oxidising at will. By this means oxidation and waste of metal in the heating furnace may be in great measure prevented, being only from one-half to one-third of what it used to be in the old type of furnace; no one who has seen heavy piles for the rolling of iron rails reheated in a regenerative furnace can help noticing and admiring the sharp angles and edges with which such piles leave the furnace, instead of being rounded and wasted away as used too often to be the case in the old heating furnace.

The above description and figures of the regenerative mill furnace will apply almost without alteration to all furnaces of this type in use, the variations being unimportant. For some kinds of fuel, and notably when anthracite slack has to be consumed, the arch below the producer grate is closed and a current of air injected by means of a steam blast. As a positive pressure is thus produced, the cooling tube may be dispensed with, and this has in some cases been done. The dimensions of the regenerators and ports have at times been varied; they should always be kept as large as possible consistently with the size of the furnace. When the furnace is used, not for reheating, but for open-hearth steel making, the shape of the body is a little different. The bed is deeply dished and the roof is depressed in the centre, forming an inverted arch, so as to deflect the flame down upon the centre of the bed. In all other respects the furnace has remained without modification.

An important application of the regenerative principle yet remains to be mentioned—its employment for heating the blast of blast furnaces. In the year 1857, Mr. Cowper patented a hot-blast stove, now known as the Siemens-Cowper stove. It consists essentially of a large closed cylinder of boiler plate lined with firebrick and filled with a brick chequerwork; the waste gas of the blast furnace is admitted at one side and there burnt by means of a current of air, the hot products of combustion heating up the chequerwork, and then escaping to a stack. When it is sufficiently heated the gas, stack, and air valves are closed, and the cold blast sent through the chequerwork in the reverse direction, by which means it becomes intensely heated; whilst meanwhile a second, and usually a third, stove are being heated up as the first had been. By this system it was soon found that far higher temperatures were attainable than had been possible in the old pipe stove, in which 1000 deg. Fah. to 1100 deg. Fah. was considered a dangerously high temperature; whilst with the brick stove 1400 deg. to 1500 deg. could be obtained without trouble. The main objection to this stove lay in the fact that the chequerwork was apt to be rapidly clogged up by the dust carried by the furnace gas, and always required at least two days for cleaning out. To overcome this difficulty Whitwell invented his stove, in which the principle still remains the same, but is more effectively applied, the chequerwork being done away with and replaced by easily cleaned passages between vertical walls. This is, of course, merely a modification of detail which is undoubtedly of great practical value, and which has been of great service in extending the use of this last application of the regenerative principle.

THE SMITHFIELD CLUB SHOW.

The annual Show of the Smithfield Club commenced on Monday, the 10th inst. It has been stated that there would be a larger display of implements than had ever been known under the auspices of the Smithfield Club, but the statement seems to have had no foundation. In the main building of the Agricultural Hall, indeed, there was no crowding whatever, and the arrangement of the stands and their contents were almost identical with those of last year.

Steam Engines.—It has long been known that engineers reserve novelties for the Royal Agricultural Society's Show; but we do now and then find new things in the Agricultural Hall, Islington. This year, however, nothing new is exhibited, if we except the reversing gear and water-heater of Messrs. Garrett and certain small matters of detail. Messrs. Burrell, of Thetford, have a semi-portable engine, the design of which is new, and they exhibit also a large traction engine with 7ft. road wheels, of extremely strong make; but novelties in the way of invention there are literally none others worth putting on record. Nothing less than six months old is shown, and everything nearly as new has already been exhibited at York. We would only weary our readers if we gave in detail statements that one firm had augmented the diameter of its crankshafts by an eighth of an inch, or that another firm uses cast iron excentric rings. Unless, however, we went into such particulars it would be impossible to speak at any length of the various exhibitors.

It will be perhaps not without profit if we say here something concerning the steam machinery exhibited as a whole. Such an exhibition as that of the Smithfield Club gives a very fair idea of the direction which progress is taking. The tendency is to build heavy engines. The traction and portable and ploughing engines are all heavier now than they used to be; not much heavier in some cases, a great deal heavier in other cases. Again, pressures are creeping up; a few enterprising manufacturers used 120 lb. for traction and ploughing some years ago, now 160 lb. is not uncommon. It is to be hoped that boilers are made proportionately better; but we fear that this is not invariably the case, and that some firms are resorting to heavy pressures without taking sufficient pains to secure good workmanship and good material.

The greater number of the leading makers are now building compound portable engines. In fact, the non-compound double-cylinder engine will be extinct in a very short time. The results obtained appear to justify the change. We have frequently pointed out that it is better to compound an engine than to adopt the complex valve gear required to obtain a good result with high-pressure steam in a single cylinder; and there is the further advantage that the compound system adapts itself well to the conditions under which it has to be used in this class of machinery. If the single cylinder is to be used successfully with high-pressure steam and an early cut-off, the crank must be supported by bearings on each side close up to it. If not, no matter how thick the shaft is within reasonable limits, it will "whip," and then it becomes practically impossible to keep the bearings in good order, and the result is very disappointing. Now the portable engine cannot have bearings close to the crank dip on both sides. If we turn to the semi-portable, or as it is now called, the underframed type, it will be found that the same statement applies to it. Unless an outside bearing can be got in a wall-box, the crank must be some distance from a bearing on one side or the other. To illustrate our meaning, let us take the case of the compound engine shown by Messrs. Burrell—which we shall illustrate in an early impression. This engine has cylinders 7in. and 12½in. diameter, by 14in. stroke. The maximum strain on the crank shaft is about 44 $(120 - 40) = 3520$ lb. for the high-pressure cylinder, and $122 \times 40 = 4880$ lb. for the low-pressure cylinder. Now, it is well known that a single-cylinder engine to be of the same power when working under the same conditions of expansion as a compound engine, must have a cylinder of the same size as the largest cylinder in the compound engine. If the small cylinder in Messrs. Burrell's engine were suppressed and the large cylinder worked non-compound, the maximum strain on the crank shaft would become $122 \times 120 = 14{,}640$ lb., or nearly three times as great as the actual strain. Under these circumstances, it is not matter for wonder that the compound engine is growing in favour, especially if such results are obtained as that stated by Messrs. Hornsby. We learn from a circular issued by the firm that during trials made in last November they obtained the following results:—

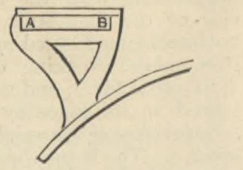
Duration of trials	6 hrs. 20 min.
Average number of revolutions	134·06
,, piston speed in feet per minute ...	357·50
Indicated H.P. of the high-pressure cylinder	33·82
,, ,, ,, low ,,	31·16
,, ,, ,, both cylinders	64·98
,, ,, × by the hours run	411·54
Quality of coal used	Welsh
Coal consumed	967·6 lb.
Water evaporated	9260·0 lb.
Steam used in the cylinders	8661·0 lb.
,, ,, jackets	599 lb.
Temperature of the feed-water, Fah.	50 deg.

The above trials were made as in ordinary every-day work, except that the coal was broken into regular-sized lumps. From the above it will be seen that a little over 2¼ lb. of coal and 22 lb. of water only were used for each indicated horse-power given off, the engine indicating more than three times its nominal horse-power.

Messrs. Ruston and Proctor also exhibit a compound portable engine, concerning which they state that in one of the trials a 12-horse power engine, with a load of 30·26-horse power on the brake, ran for 3 hours 45½ minutes with only 300 lb. of Welsh coal, equivalent to the satisfactorily low consumption of 2·63 lb. per effective horse-power per hour, or about 2·4 lb. per indicated horse-power; whilst the feed-water required was only 20·46 lb. per E.H.P. per hour. These statements must of course be taken for what they are worth. The trials are, no doubt, carried out with all honesty of purpose, and the figures we reproduce have been given in good faith, but they lack the stamp of an impartial competent tribunal, and we once more urge on the Royal Agricultural Society that it will neglect the discharge of an important duty if it refuses to test compound engines, and so supply its members and the world at large with information concerning this new departure in the portable engine trade.

Some of the engines shown were intended for electric light work; certain of them hardly admitted of improvement, others were defective. We shall not mention names, because, for our present purpose, names are quite immaterial. We wish to point out here that the conditions under which an electric-light engine has to work are very peculiar. In the first place, its rate should be extremely uniform, and this not only as regards the time in which any given number of revolutions is made, but as regards the rate at which each separate revolution is performed. It is possible to have an engine with high expansion and a light fly-wheel, which will make, say, 100 revolutions per minute with great regularity, and yet will jerk through each revolution in a way utterly unsuitable for electric lighting purposes. Again, it is essential that when the engine is once started it shall be able to run continuously without stopping for even a moment for several hours. To get this, perfection in the arrangements for lubrication is essential. In the Agricultural Hall we did not find a single engine adequately fitted up in this respect. Lastly, it is necessary that the engine should be exceedingly strong, not so much for the sake of durability as because, if this condition is lacking, it will be next to impossible to keep the bearings in really good order or to secure regular turning. There is no reason to complain of some of the engines exhibited in this respect, but this cannot be said of all. The fact is, that electric lighting requires a special type of engine, and engineers have yet to learn a good deal about the points which are essential; and for this purpose, they cannot do better, we think, than study locomotive and marine engine practice.

Almost the only novelty in the Hall is the "Alpha" portable engine, exhibited by Messrs. Garrett, of Leiston, which we illustrate. The drawing explains itself. This is a compound engine with a feed-water heater on top of the boiler, which is neat, cheap, and easily made. The weight of this engine is 66 cwt. 3 qr. against 67 cwt. 2 qr., the weight of the ordinary 8-H.P. portable. It has indicated 19·97-H.P. with 110 lb. in the boiler. Boutard's reversing gear fitted to a No. 6 semi-portable engine we also illustrate. It will be readily understood from the drawings. It will be seen that the excentric *c* is loose on the crank shaft *a*, and is faced by a clutch *k*. This clutch has one long finger. The engine is reversed while running by throwing the clutch *g* to one side, by the lever *h* turning on the pivot *i*, when the engine will revolve the excentric *b* remaining at rest until the long finger *k* takes the pin *g* at the opposite side and begins to drive it, when the clutch can be thrown into its place again. In our engraving, Figs. 1, 2, 3, and 4 show one arrangement, Fig. 5 shows another, the like letters refer to like parts. Up to a certain point the arrangement for reversing marine engines by the aid of a loose excentric and fixed snugs on the shaft is the same, but beyond that point the invention is quite new, and works remarkably well. It will be observed that with the governor bracket, which is situated well within reach of the driver, is combined a bracket for the support of the reversing lever. When the disc is in connection with the excentric, the handle of this lever stands at A. When it is desired to reverse, the lever is pushed to B. It is then necessary to wait a moment until the driver hears the plate on the disc come into contact with the taper pin of the excentric, which has ceased to move, when the lever must be returned as sharply as convenient to A, and the engine is reversed. This operation may be repeated as often and as quickly as is desired. The engine has often been reversed 100 times within five minutes.

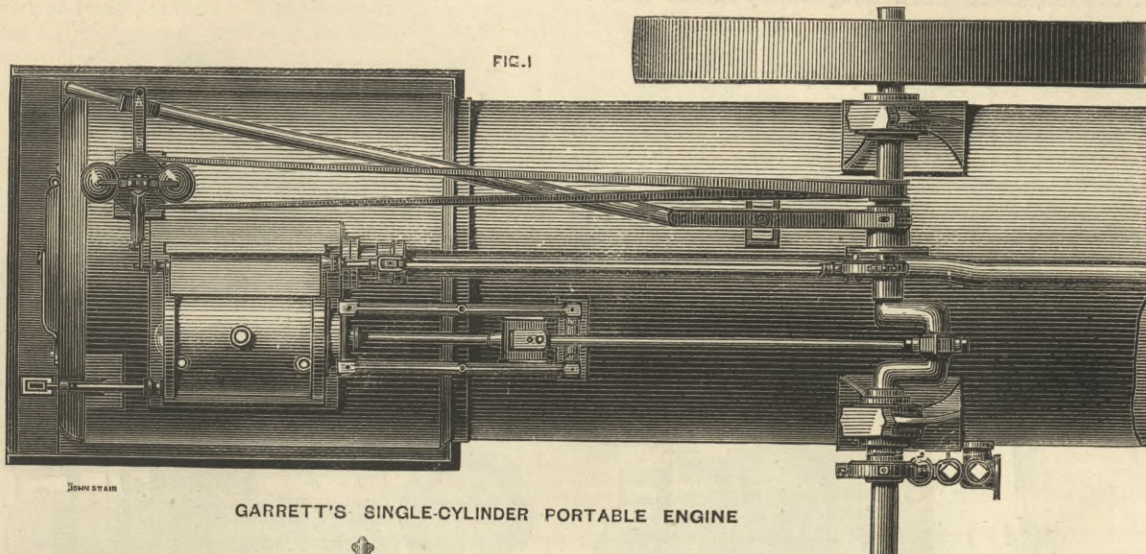


Mr. Savage, of King's Lynn, shows an engine which deserves notice, because it is of a type which deserves to be more adopted than it is, namely, the self-propelling portable. This engine is driven by a long pitch chain, and it may be interesting to state that Mr. Savage finds that these chains do much better if made of Bowling or Low Moor iron case-hardened than of steel. The engine is fitted with an extremely slow motion for moving it a few inches when being set to thrashing machines. The accompanying engraving represents the gearing as arranged for the quick speed. When

ENGINES AT THE SMITHFIELD CLUB SHOW.

(*For description see page 458.*)

FIG. 1



GARRETT'S SINGLE-CYLINDER PORTABLE ENGINE

END ELEVATION

FIG. 2

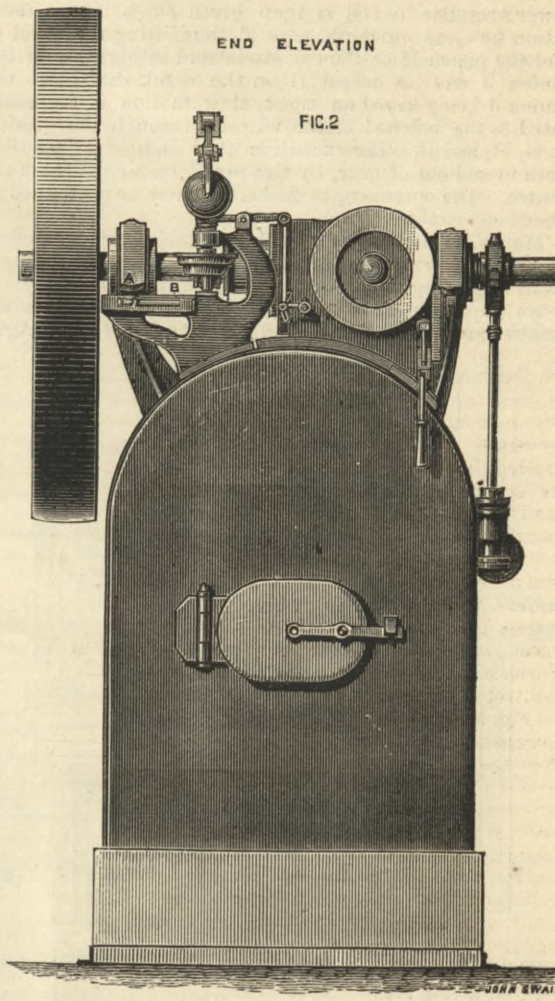
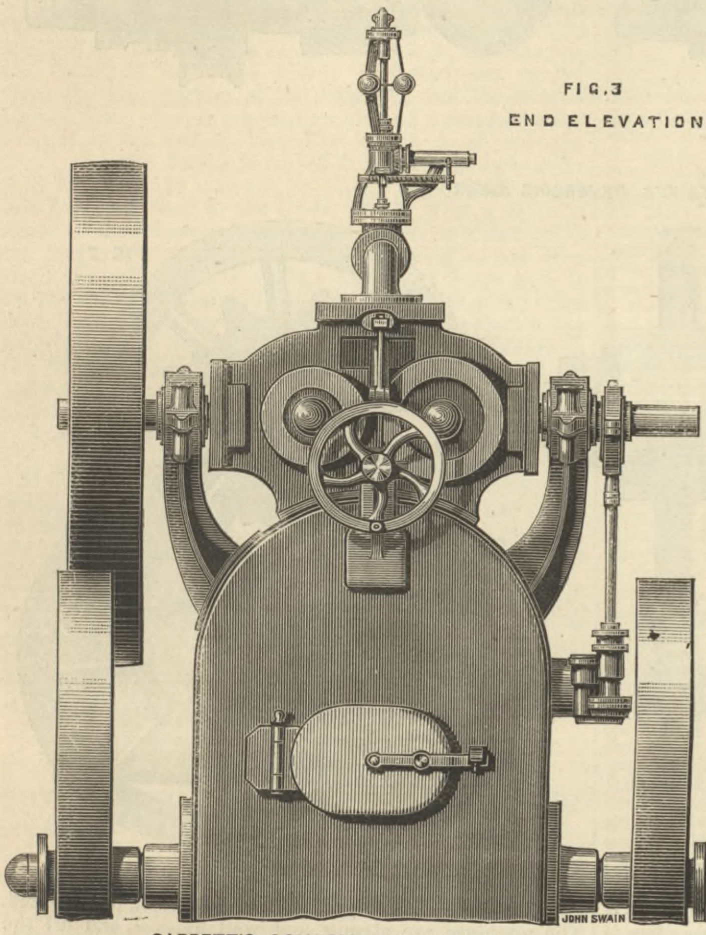


FIG. 3

END ELEVATION



GARRETT'S COMPOUND PORTABLE ENGINE

CRANK SHAFT AND BEARINGS

FIG. 5

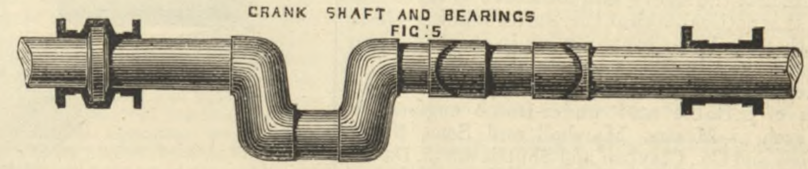
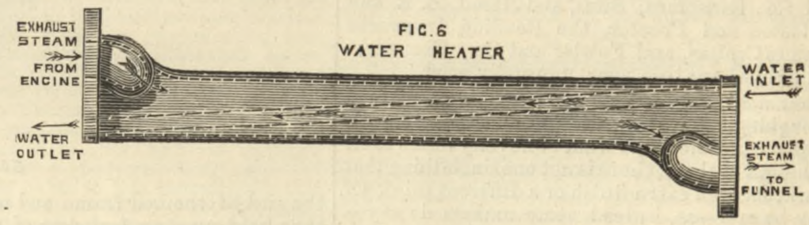


FIG. 6

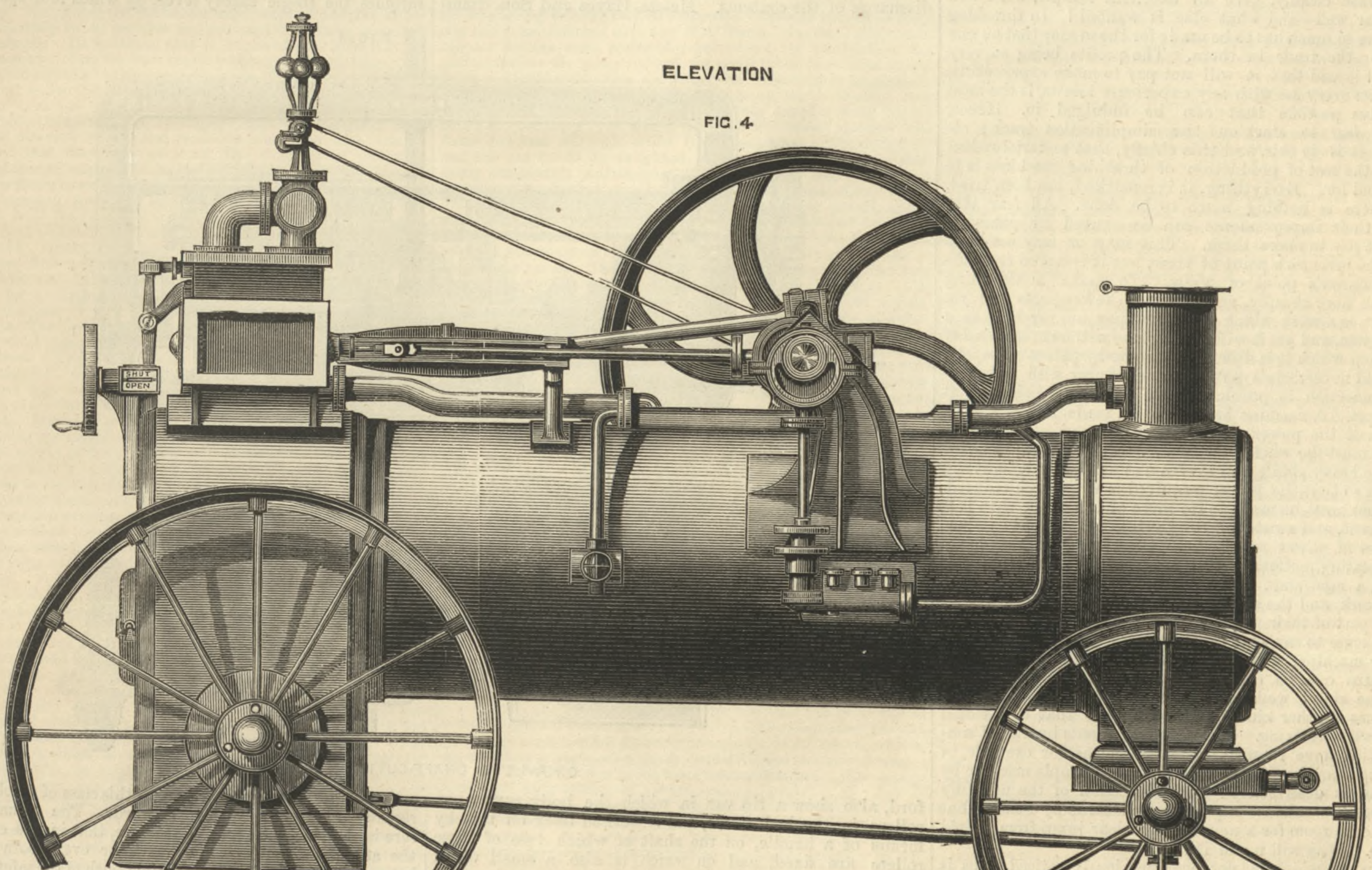
WATER HEATER



GARRETT'S CRANK SHAFT AND FEED WATER HEATER

ELEVATION

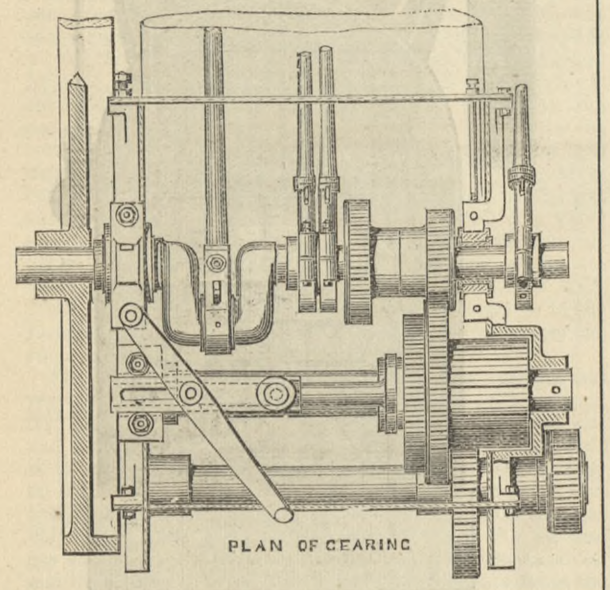
FIG. 4



GARRETT'S COMPOUND PORTABLE ENGINE

it is required to alter it to the slow motion, the clutch A on the end of the crank shaft is withdrawn from the gear wheel B, thus leaving the gear wheel B and the notched chain wheel C free to revolve on the brass bush L. The lower excentric stud E is then given one-half of a revolution by means of the handle F, thus lifting the wheel G and the pinion H on the excentric stud into gear with the pinion J and the wheel B on the crank shaft, and the pinion J being keyed on tight, slow motion is communicated to the notched chain wheel C through the gearing J, G, H, and B. The excentric stud is held in position, both in and out of gear, by the pin K passing through the centre. The operation, as described, may be performed in about one minute.

Messrs. Aveling and Porter exhibit, amongst other engines, an agricultural locomotive fitted with the arrangement of gearing shown in the accompanying engraving. It is an improvement in their gearing arranged between the brackets, as illustrated in our account of the Royal Agri-



AVELING AND PORTER'S AGRICULTURAL LOCOMOTIVE GEAR

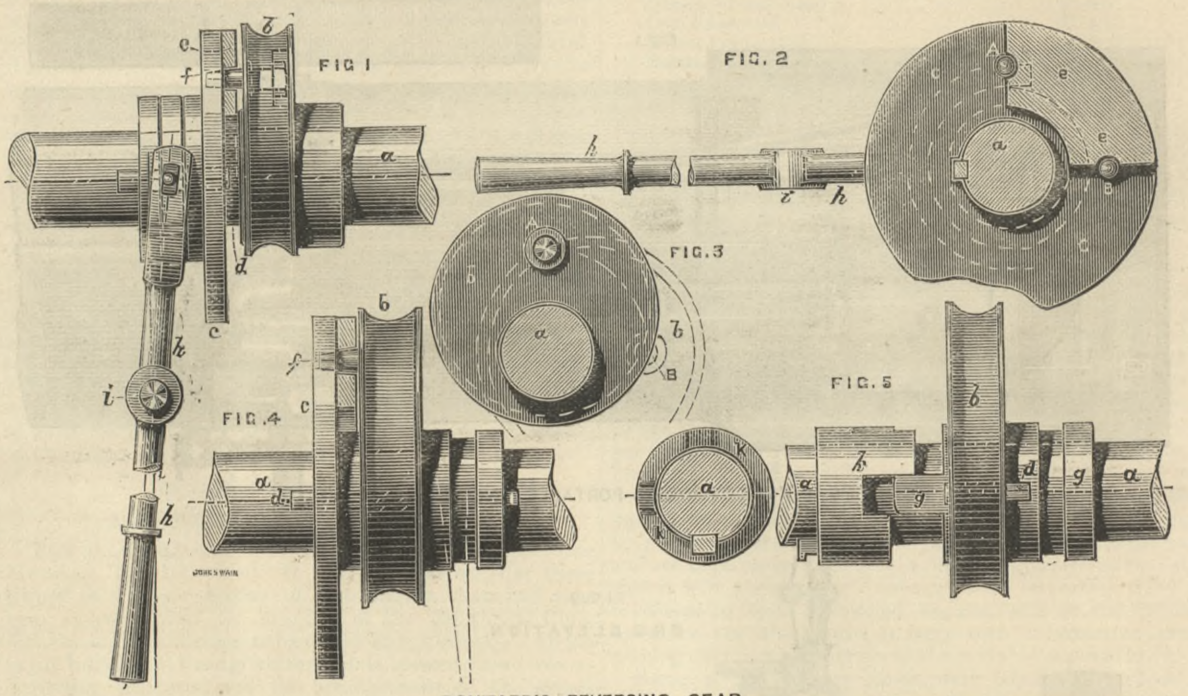
cultural Society's Show at York. This improvement makes the gear more compact and avoids the use of the sleeve used in the engine exhibited in July. It prevents the necessity of bolting the pinion to the sleeve and the sleeve to the double spur-wheel. It is noticeable that there are no sliding wheels or keys or feathers, and that for throwing in and out of gear it has, moreover, the advantage of being lighter.

We have really nothing to add, save that all the principal makers of portable and under-frame engines are represented, such as Messrs. Marshall and Sons, Brown and May, Robey and Co., Clayton and Shuttleworth, Davey, Paxman, and Co., Ransomes, Sims, and Head, E. R. and F. Turner, Ruston and Proctor, the Reading Ironworks Company, James Coultas, and Fowler and Co. The workmanship and designs are this year unusually good.

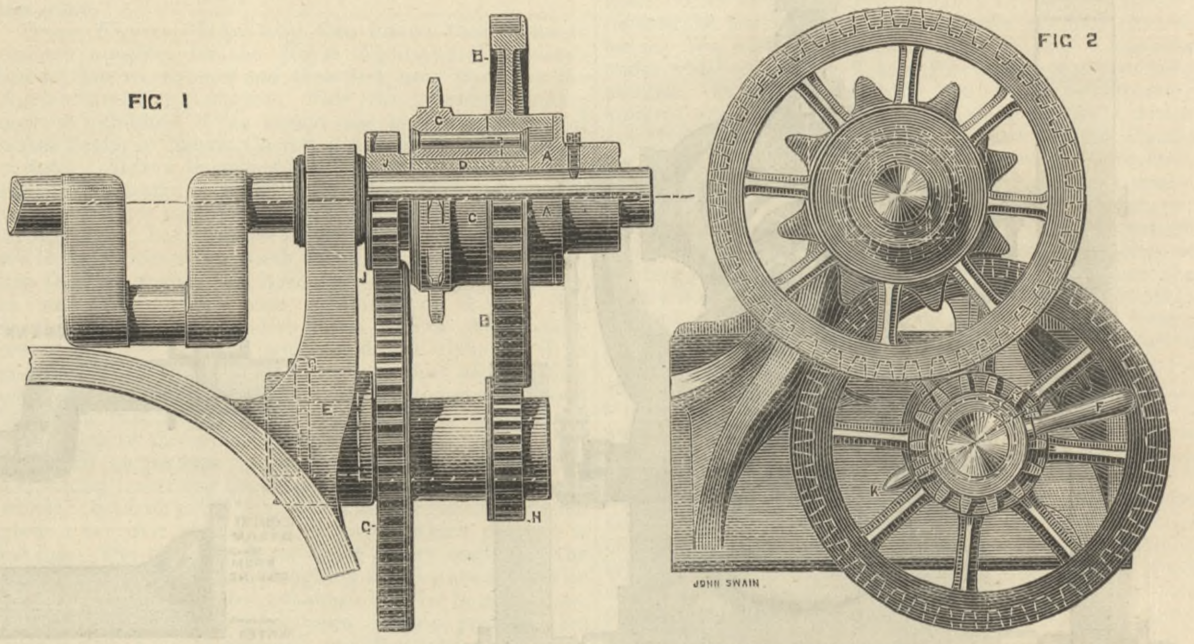
Miscellaneous machinery.—Amongst thrashing and food preparing, ploughing, cultivating, drilling, and harrowing machines and implements, the same want of novelty forces itself upon us. In the first of these, there is not one single thing that calls for remark, not even extra finish or a different paint. Of course, it may be said—as, indeed, some makers do say—that thrashing machines are now so far perfect that they will thrash cleanly, give an excellent sample, work well and wear well—and what else is wanted? In thrashing machines so much has to be made for the money that no one cares for the trade in them. The profits being so very small, it is said that it will not pay to make experiments, which, as everyone with any experience knows, is the most expensive pastime that can be indulged in. Hence, makers fear to start on the simplification track; although it is in this, and this chiefly, that material reduction in the cost of production of thrashing machines is to be looked for. Everything, it is remarked, has been tried, and there is nothing more to be done. All fear that unless their improvements can be secured by patent it will not pay to make them. This may or may not be so from the inventor's point of view, but it is not so from the manufacturer's point of view. To make a thrashing machine more cheaply, yet well, with fewer parts and yet efficient, is a work which may not pay an inventor as a speculation, and yet it will not be done without that kind of invention which it is difficult to secure by patent monopoly. It would nevertheless pay a manufacturer with an extensive connection to purchase such inventive assistance at some cost. A machine has yet to be made that will work with half the power at present consumed. The clumsy shaker must be wholly discarded. The heavy jog board and the heavy riddle and its frame must be made light and worked so that the power required is very much reduced. Air blast must be made to do more of the work than it is at present, and must be brought into operation to reduce the loss of power required to effect some of the costly reciprocating motions. The machine must be altered all round, a new start made so that the frames may stand their work and the climates of every country, and yet be only a part of their present unwieldy weight and size. It is no excuse to say that the heavy machine stands well; a lighter machine, well made, would also stand well, and apparatus can be easily devised to make the lightest machine stand well. No one would think of making machines of other kinds heavy simply so that they would stand without fixing. Some improvements by way of simplification have recently been made—as, for example, in the single crank machine of Nalder, the simple machine by Mantle, as described in our impression of the 6th July last, and the exhaust separating machine by Foden—but these leave room for a new start, a clear jump from the old groove. Who will make it?

A tip van which has not been previously noticed by us is exhibited by Mr. C. Hill, of Peckham Park-road, Old Kent-road. The main feature of the van is the arrangement of levers and connecting rods, by which the body of the cart is released from fixture with the bed frame, and which at the same time liberates the tail-board from the end of the van, the tail-board being held by standards at the end of the bed frame, and not by the van body. It is thus held up some feet clear of the end of the van when it is tipped, and does not in any way interfere with the free discharge of the contents. Messrs. Hayes and Son, Stamford, also show a tip van in which the body rests upon rollers in the bed frame, and is worked back off this by means of a handle, on the shaft of which two of these rollers are fixed, and on which is also a small wheel with teeth gearing into a short wrought iron rack. The body is by this gear very easily and quickly run back, and it automatically fixes itself and the tail-board when brought back.

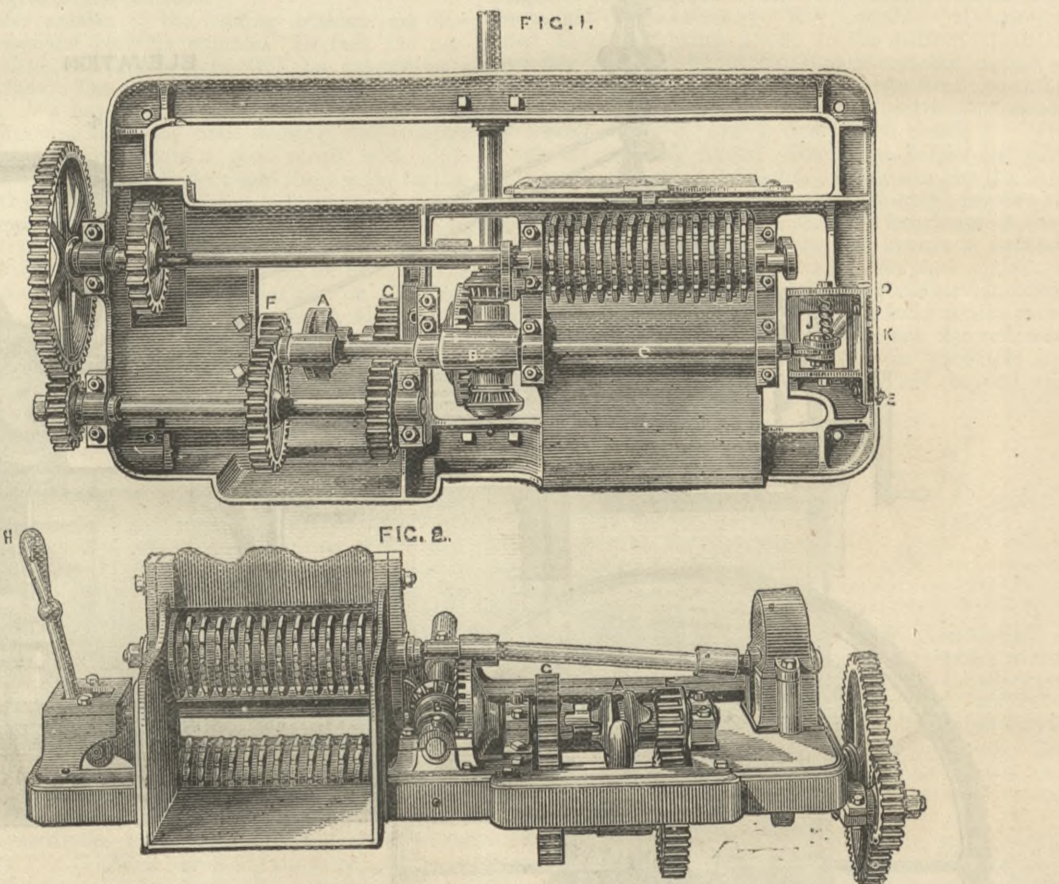
In the collections of food-preparing machinery, one of the finest shows of really well-made chaff-cutting machines is that of Messrs. J. Crowley and Co., of Sheffield. The machines are strong and well finished, and all the larger sizes are made under Mr. S. Edwards' patent, which includes the single safety lever, by which four operations are effected. An improvement in this class of machine has recently been made by Mr. Edwards. The valuable feature in the machine is, as heretofore, that in the event of the attendant getting his hand, or even both hands, between the feed rollers, by a simple push of the safety lever,



BOUTARD'S REVERSING GEAR



SAVAGE'S GEAR FOR SELF-PROPELLING PORTABLE ENGINE



CROWLEY'S CHAFF-CUTTER GEAR

which, in case of such an accident, the attendant could hardly help making with his body, the rollers are stopped instantaneously. We have not hitherto illustrated this arrangement, and may do so now. In the accompanying engravings, Fig. 1 gives a view of the underside of the top frame which carries all the gear, the fly-wheel being removed. Fig. 2 is a perspective elevation of the frame and gearing. A is the clutch fork for changing the length of the cut, B is the clutch fork for stopping and reversing the feed rollers, C is the lever shaft upon which the two clutch forks work, and which is actuated by the handle seen at H, Fig. 2, and at J, Fig. 1, which has four motions imparted to it. The motion is shown with the handle in the position to give a reverse or back motion, and to cut short; when the handle J is moved from D to E, the feed will go forward to the knives; when it is brought half way between the letters D and E, and opposite the letter K, the whole of the motion is stopped. When the handle is moved from H to I—Fig. 2—the cut is changed from short to long, at which length it has also the same facilities for stopping and reversing the feed as in the short cut. B—Fig. 2—shows the two bevel pinions on the fly-wheel shaft for forward and reverse motion. It will be seen that the lever C passes through the clutch fork B, at which part there is a key sunk into a shaft which slides through the clutch B, and causes it to move the same way as the handle J, when moved from D to E for reversing, stopping, and sending forward the feed. At the end of the lever C is the clutch fork A, for changing the length of cut; the clutch is bored out smaller than the main portion of the lever C, and the lever is turned down where it passes through, and a pin and washer are put at the end, to keep the clutch A on endways. Thus, when the handle is moved from H to I it moves the feed from short to long cut, by simply drawing the clutch box from one wheel to the other, which gives a different speed to the rollers, and, as a consequence, a difference in the length of cut. The two clutches being on one lever shaft, the action of one against the other keeps each in its respective position without the use of pins or any other contrivance, and consequently gives perfect freedom to the handle. Hence the slightest pressure applied sideways to the handle with the arm, elbow, or any other part of the body of the operator, will throw the feed rollers out of gear.

Amongst the field implements we did not observe any object calling for special remark. In model Messrs. Fowler and Co. show their new system of ploughing for very large fields, such as some of the American and Russian, by means of two ploughs strung on one rope between two powerful engines, each plough traversing half the distance between the engines.

The show is a good one from the buyer's point of view, but engineers will perhaps be disappointed. In concluding this short notice of the show, we cannot help remarking that the disgraceful condition of some parts of the ground floor of the hall seems to suggest a state of poverty, from which few people would have thought the Hall Company to be suffering.

THE GENERATION OF STEAM AND THE THERMODYNAMIC PROBLEMS INVOLVED.*

By W. ANDERSON, C.E.

THE second of the six lectures on "Heat in its Mechanical Applications," was delivered on Thursday evening, the 6th of December, by Mr. William Anderson, M. Inst. C.E., the subject being "The Generation of Steam and the Thermodynamic Problems Involved." The lecturer commenced by remarking that the source of our fuel supply was derived from the rays of the sun acting upon the earth ages ago. He pointed out that those rays were of complex structure, intimately bound together and yet capable of being separated and analysed. He remarked that it required over 1000-H.P. to separate one ton of carbon from the atmosphere in twelve hours; but that, in consequence of the enormous area of leaf surface in which the decomposition took place, the action was silent and imperceptible. As soon as a law of definite chemical combination had been established, chemists began to suspect that the changes of temperature observed in chemical reactions were also of a definite kind, and that they were as much the property of matter as chemical atomic weights. In the last century Lavoisier and Laplace, and after them, down to the present time, Dulong, Despretz, Favre, and Silbermann, Andrews, Berthelot, Thomsen, and others, had devoted much time and labour to the experimental determination of the heat of combustion and the laws which governed its development. Messrs. Favre and Silbermann in particular, between the years 1845 and 1852, had carried out a splendid series of experiments, by means of a calorimeter, which was illustrated by a diagram. The apparatus consisted of a gilt copper receiver, in which the substances tested were burnt by a jet of gas. This receiver was immersed in another vessel containing water, which again was protected by another vessel lined with swansdown. Thermometers of great delicacy were employed to determine the temperatures, and the whole of the apparatus used for generating the gases and for collecting the products of combustion, was constructed with the utmost ingenuity and skill. Messrs. Favre and Silbermann adopted the plan of ascertaining the weight of the substances consumed, by calculations from the weight of the products of combustion. By this means they were enabled to deal with larger quantities, and several errors incidental to the opposite process were eliminated. A table was given showing the calorific value and the chemical composition of such substances as commonly formed the constituents of fuel. The thermo-chemical laws relating to combustion and decomposition were then stated, and the general formula for calculating the thermic value of any kind of fuel whose analysis was known, was explained. It was pointed out that energy existed on the earth in a form which was often unsuitable for the wants of man. For example, the water flowing down the Alps was competent to furnish the power necessary for boring through those mountains; but it was not in a form which could be used directly. The kinetic energy of the water had first to be transformed into the potential energy of compressed air, and in that form it became available for the miners. In the same way the energy of combustion could not be applied directly to the wants of man. It had first to be converted into the form of steam or air at high pressure and temperature, and then, by means of suitable heat engines, it could be used in the manner with which all are familiar. It was probably to this circumstance that the tardy development of the steam engine was due, for its history dated back only some two hundred years—a very small proportion of the time during which the human race had existed. A steam boiler was in reality a species of heat engine, and its action should be investigated upon the same principles, and consequently the doctrines of Carnot were applied. According to these, the efficiency of a boiler depended entirely upon the range of temperature through which the heated gases acted, and, by means of an illustration derived from an application of water power, it was demonstrated that the proper way to increase the efficiency of a boiler was to raise the temperature of the furnace to the utmost degree possible, and to lower the temperature of the smoke to the lowest point practicable. Particular instances were then taken in which it was shown that 1 lb. of carbon would be capable of evaporating 14·87 lb. of water from and at 212 deg. The case of the prize engine of the Cardiff show of the Royal Agricultural Society in 1872 was described in detail, and it was demonstrated that the maximum amount of work which could be expected from its boiler was equivalent to the evaporation of 13·27 lb. of water, the actual evaporation having been 11·83 lb., showing a duty of 89 per cent. In pursuance of the idea of treating a boiler as a heat engine, an indicator diagram was exhibited and explained, and the laws of Carnot were stated in detail and discussed. The terms of Carnot's formula were then examined separately—first, in relation to the temperature of the furnace, the process of combustion was explained, and it was shown that the temperature of the furnace depended upon the supply of air. A minimum supply would give the highest temperature, but it was found necessary to add an excess in order to make combustion perfect. It was pointed out that the limit to high temperature in a furnace was the imperfection of the material out of which boilers were constructed. It was shown from the fact that steel was capable of being melted in boiler furnaces, that temperatures so high as that were not injurious; but that, when the melting point of steel was greatly exceeded, the boiler plates began to suffer severely. Next, the temperature of the chimney end of the boiler was examined. It was stated that by the adoption of feed-water heaters and by the use of forced draught, not for the purpose of augmenting the steam-production, irrespective of economy, but with a view to promoting economy, that the temperature of the smoke could be lowered to about 100 deg. above that of the feed-water. The loss of 11 per cent. in the Cardiff boiler was then looked into, from which it appeared that it arose partly from radiation and convection from the body of the boiler, partly from imperfect combustion, which always prevailed more or less, and partly from losses incidental to the transfer of heat from substances less dense to others more dense, and *vice versa*. It was stated that this loss was common to all energy propagated by undulatory motion, such as light, heat, or sound. The law of conduction through plates was then explained, and it was pointed out that even joints in a bar of uniform material interposed a certain amount of resistance, and the fact was illustrated by an experiment. The loss was much greater when there was a joint between dissimilar materials, such as between the gases of the furnace and the boiler plate, and between the boiler plate and the water. At first sight it would appear a matter of common sense that a boiler which contained its own furnace must be a better generator than one with an external furnace formed of brickwork; but brickwork was an extremely bad conductor of heat, while it was a very good radiator, absorbing heat from the gases and returning them by radiation to the boiler surfaces. This action was strongly pronounced in the case of the reverberatory furnace, and in the brick arches now commonly introduced into the fire-boxes of locomotives. The gases forming the products of combustion were very bad absorbers and very bad radiators of heat. Pure dry air and nitrogen were absolutely incapable of absorbing or radiating heat. They were not in the least affected by the passage through them of the most intense heat rays. Carbonic acid was a somewhat better radiator, while the vapour of water was a good absorber, and therefore a good radiator. It was then demonstrated that the products of combustion consisted mainly of air and nitrogen, and consequently, taken as a whole, the products of combustion were bad radiators. Little or no economical advantage was derived from making the combustion in a boiler perfect, because the colder luminous flame was a good radiator, on account of the white-hot particles of carbon it contained, while the hotter and non-luminous flame was a bad radiator, and carried a great deal of heat into the chimney. This circumstance was illustrated by an experiment, by which it was proved that an intensely hot non-luminous Bunsen flame had very little more effect upon an air thermometer than a smoky-luminous flame burning the same quantity of gas, but that the moment a spiral wire was hung in the Bunsen flame, it commenced to glow, and the radiation from the wire immediately had a powerful effect upon the thermometer. It was probably owing to this circumstance that the backwardness of the owners of steam boilers to prevent smoke was to be attributed. Had considerable advantage been obtained by the suppression of smoke, Acts of Parliament would not have been necessary for the purpose. A different class of boiler was required for consuming flaming fuel, as contrasted with such fuel as anthracite and coke, burning with very little flame. In the latter case, tubular boilers were preferable; but unless the combustion was perfect before the gases reached the small tubes, the gases cooled down so considerably that the flame was frequently extinguished. This fact was illustrated by an experiment, which showed that when pieces of ½in. gas pipe of various lengths were placed over an ordinary gas flame, the shorter tubes allowed the flame to pass through, while the longer ones extinguished it, and the gas could be re-lighted at their upper ends. Water, being completely adiathermanous, and a very bad conductor, could not be heated by direct radiation or conduction. The process of heating by convection was explained in detail, and a comparison was instituted between the heat transmitted from the hot gases in the furnace of a boiler to the water, with the reverse effect of warming by the transfer of heat from hot water pipes to the air of a room. The two being reverse operations, agreed very closely together in accordance with the theory of exchanges. The proper heating surface to be allowed in a boiler to effect a given amount of evaporation was then dwelt upon. The mode of calculating the sectional area of tubes and flues was given, the heat of the chimneys and their area was considered, and finally the thermodynamic theories relating to the formation of steam were investigated. It was stated that, of necessity, the molecules of steam which became emancipated from the water through the energy of heat, carried with them particles of water, and that these particles constituted priming, the amount of which depended upon the velocity with which the steam escaped from the water. A table was exhibited of a large variety of boilers ranged in order of the velocity and disengagement of steam from the water surface; and from this it appeared that those in which the velocity was highest were also those most subject to priming. The doctrine of the viscosity of liquids and gases was next dealt with, and applied to account for the manner in which particles of water and of very minute solid impurities were carried over from the water of the boiler into the steam. The same theory was adduced to show that from the slowness with which smoke fell in the atmosphere, it must be composed of exceedingly small particles, and that they were not very numerous compared with the volume of the gases with which they were associated. It further went to show how it was that complete combustion did not produce any marked economy, because the absence of the white-hot particles of carbon from the gases caused a loss of radiating power. It was thought that no great improvement was to be expected in the economy of boilers, for the limit had been already almost reached. The honour of having first pointed out the true principles on which the duty of boilers should be estimated, namely, by comparing the work actually done with the potential energy of the fuel used, was due to the late Professor Rankine. The lecturer concluded by a tribute of respect and admiration to the late Sir William Siemens, whose name was closely associated with the subject of his lecture. At the time of his death, Sir William Siemens was engaged in perfecting a pyrometer, intended to indicate accurately temperatures above those of melting steel. In addition, therefore, to the many causes of regret at his lamented decease, was to be added this, that the production of a trustworthy pyrometer would be indefinitely postponed. The impulse which Sir William Siemens had given to the study and elucidation of thermodynamics would not cease with his life, but this and succeeding generations would long profit by his example and his labours.

* Abstract of lecture delivered before the Institution of Civil Engineers.

COMPUTING THE HEATING SURFACE OF HOT-BLAST STOVES.

FURNACE men in France and Germany have been for some time quite eagerly discussing hot blast stoves, their advantages, their drawbacks, and the best method of overcoming the latter. The leading journals of the Continent, *Stahl und Eisen*, *Le Génie Civil*, *Zeitschrift des Vereins Deutscher Ingenieure*, and others, have printed exhaustive articles in rapid succession, and a good many suggestions of value have been brought out. Among the most interesting contributions is an attempt by Herr Steffen to compute the heating surface required. We (the *Engineering and Mining Journal* says) may briefly run over his figures, as reviewed by Herr Fritz W. Luermann, a metallurgist whose name is thoroughly known in this country. Assuming that it is desired to ascertain the heating surface of two blast furnaces, using each 75 tons of coke, or 150 tons together, deducting 15 per cent. for ash and moisture, it will be necessary to consume 92·39 kilogs. of carbon during every minute of the twenty-three hours actual blowing time. Steffen assumes that it will require only 4·3 cubic metres of gas per kilog. of carbon, a quantity which Luermann considers too low, as it would only convert the carbon into carbonic oxide. It should not, however, be confounded with the estimate made in computing the blowing engine capacity, usually placed by German engineers at from 5·2 to 6·33 cubic metres. Taking the charge to be 1000 kilogs. of coke, containing 850 kilogs. of carbon, 2000 kilogs. of ore, and 250 kilogs. of fluxes, yielding 1097·46 kilogs. of pig, Steffen estimates that 4266·15 kilogs. of blast would yield 6054·12 kilogs. of gas per 1000 kilogs. of coke, or 3890 and 5516 kilogs. respectively per 1000 kilogs. of pig. If this quantity of blast were heated to 800 deg. Celsius, it would carry into the furnace 744 calories per kilogram of pig iron. In this theoretical case, Steffen calculates the heat required per kilogram of iron at 3953 calories, of which 3209 must be furnished by the combustion of carbon. In reality, the 850 kilogs. of carbon consumed per 1097·45 kilogs. of pig iron produce 6254 calories per kilogram of pig, so that only 51 per cent. of the heat produced in the blast furnace is actually used in the manufacture of pig; and deducting losses, 5·097 kilogs. of gas per kilogram of pig iron produced are available for other purposes, or, at the rate of production assumed, 607·56 kilogs. of gas, containing by calculation 22·5 per cent. of carbonic oxide and 0·5 per cent. of hydrogen, capable of yielding per kilogram 715 calories, or 434,405 calories per minute. Luermann assumes that the 360-horse power blowing engine would require 1·5 kilogs. of coal per hour per horse-power, or 12,420 kilogs. per run of twenty-three hours; and that the hoists, pumps, &c., would want 2376 kilogs. more—a total of 14,796 kilogs., or 10·65 kilogs. per minute. Taking the value of 1 kilog. of boiler coal at 7500 calories, 1 kilog. would be equal to 10·49 kilogs. of gas, so that the quantity of gas necessary for the boilers would be per minute 111·72 kilogs., leaving 495·84 kilogs. of gas for the hot-blast stoves, or 354,525 calories per minute. Steffen estimates the loss of heat in the stoves by radiation and by the temperature of the escaping gas at 40 per cent., so that 212,714 calories would be available per minute. He states that practical experience has shown that it is not advisable to go in cooling beyond 1 deg. Celsius per minute. Assuming the quantity W of blast delivered into the furnace at a temperature of 12 deg. Celsius, the temperature to which it is to be heated T, the surface to be heated by the gas at 1·26 square metres per cubic metre of blast, the specific heat at 0·239, we have the formula:

$$1{\cdot}26 \times 0{\cdot}239 \times W \times (T - 12) = X \text{ cal.}$$

The product X calories must be equivalent to the cooling of the mass of firebrick in the stove, and we have therefore the formula:

$$G \times 0{\cdot}25 \times t = X,$$

in which G is the weight of the masonry, 0·25 its specific heat, and t the rate of cooling per minute in degrees, in this case 1 deg. From this the weight G can be calculated, and by calling the weight of a cubic metre of brickwork 1900 kilogs., its cubical contents may be ascertained. If the stoves work on gas twice as long as on the blast, the thickness of brick which will cool may be assumed at 0.10 metre, so that the surface will be twenty times approximately of the cubical contents. Thus the needed heating surface, given consumption of fuel and production of pig per diem, may be roughly ascertained.

NAVAL ENGINEER APPOINTMENTS.—The following appointments have been made at the Admiralty:—Robert Harding, engineer, to the Vernon, additional, for service in the Vesuvius, vice Smith; John J. K. Medlon, engineer, to the Minotaur, vice Griffin; David E. Smith, engineer, to the President, additional.

LIVERPOOL ENGINEERING SOCIETY.—The annual meeting was held on Wednesday evening, December 5th, at the Royal Institution, the president, Mr. Bramwell, M. Inst. C.E., in the chair. The report of the council having been read, the president congratulated the members upon the flourishing state of the society therein disclosed, and moved its adoption, which was carried. The following gentlemen were then elected officers for next year:—President: Mr. R. R. Bevis, jun. Vice-presidents: Messrs. J. S. Brodie and W. E. Mills. Council: Messrs. C. S. Pain, J. Morgan, C. J. Maginnis, F. Hudleston, and J. Price. The present Hon. Sec., Mr. C. S. Pilkington; Hon. Lib., Mr. W. H. Beswick; and Hon. Sec., Mr. R. S. Tapscott, were unanimously re-elected. The president, Mr. Bramwell, then delivered an address on "Modern Progress in Mine Engineering," and said the Americans had so improved the Chinese method of boring deep holes by aid of a rope that they had attained a speed of 13 yards per day in Pennsylvania oil wells, while with the diamond drill perfect cores of the strata had been obtained from a depth of nearly 4000ft. A great improvement is the flushing of the hole by a continuous stream of water, and this power in the Aarlberg system has enabled 100ft. to be bored in loose ground in a day. The adoption of power drills, varieties of which were noticed with the powerful modern explosive dynamite, &c., together with electric firing of the charges, has enabled tunnels to be driven at a speed hitherto unknown. The danger attending the use of gunpowder in fiery coal mines has led to the invention of many kinds of wedges and coal cutting machines, as also the lime system. Difficulties of water-bearing strata had been overcome. Kind Chaudron method, by which pits up to 15ft. diameter were bored from the surface, and by the Pretsch system, the wet ground was frozen into a solid mass, in the centre of which the pit was dug out. Iron has been largely introduced for the support of roads underground and pits. The size of pits has been increased till we have some in England from 700 to 950 yards deep and up to 20ft. diameter, fitted with coupled engines having two cylinders up to 54in. diameter, capable of raising a gross load of 15 tons at a rate of nearly thirty miles per hour. The numerous improvements in engines and winding appliances for attaining safety and economy, electric signalling and the telephone, transmission of power to the interior of mines by electricity, and compressed air, the adoption of direct-acting pumping engines underground, such as fired boilers and the various mechanical ventilating machines, by which underground furnaces have been superseded, were noted. A perfect safety lamp we unfortunately do not yet possess, and the inventions of Davy, Cluny, and Muesler are in general use where the risk of the former has been diminished by the use of the "tin can" shield. The efforts to render the electric light useful to the miner have not yet succeeded. Some improvements in mechanical preparation of ores and utilisation of small coal were briefly alluded to.

AYR HARBOUR SLIPWAY HAULING MACHINERY.

MESSRS. J. AND A. TAYLOR, AYR, ENGINEERS.

For description see page 450.

FIG. 18 ELEVATION

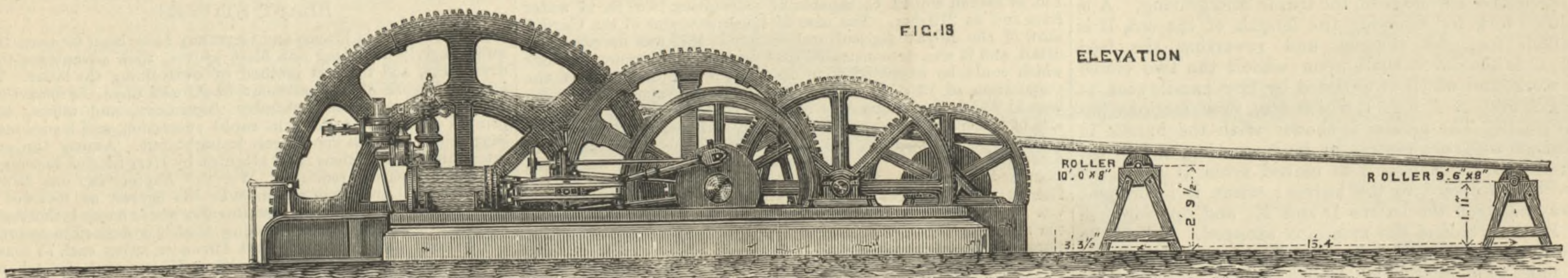
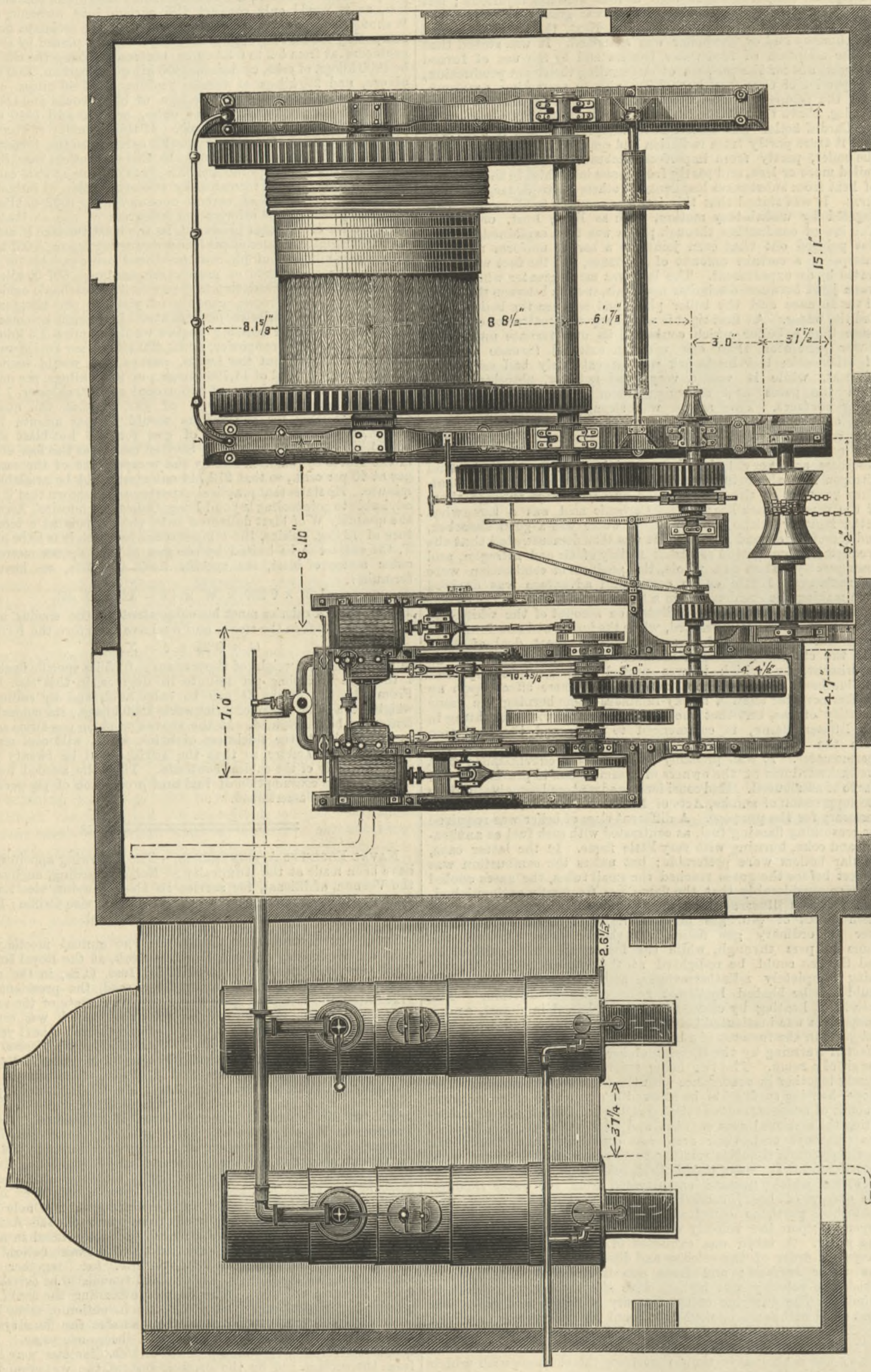


FIG. 17 GENERAL PLAN



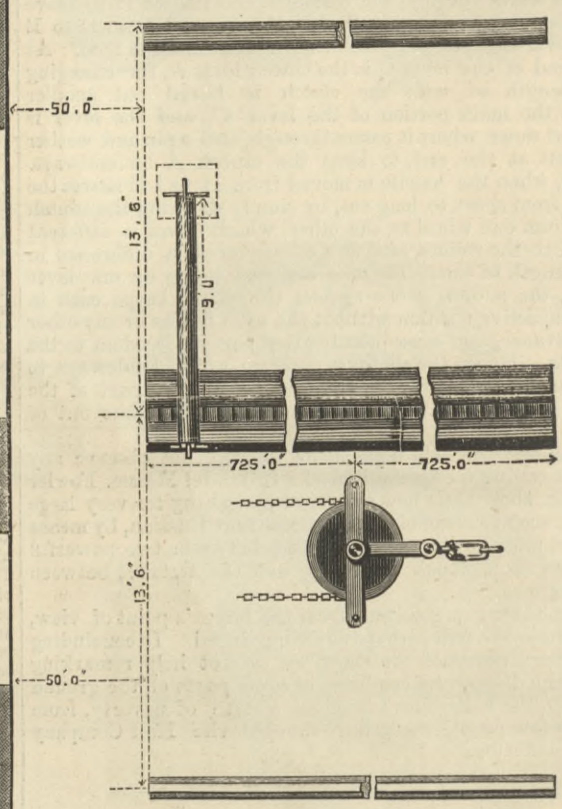


FIG 22

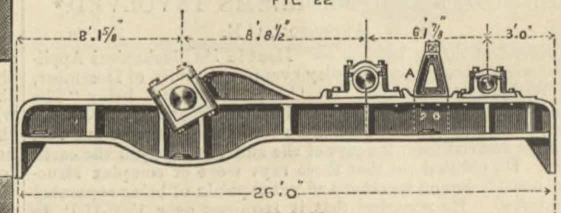


FIG 23

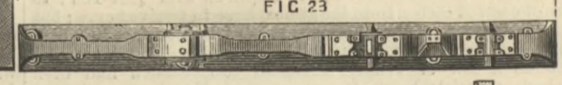
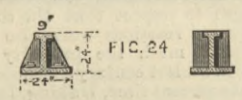


FIG. 24



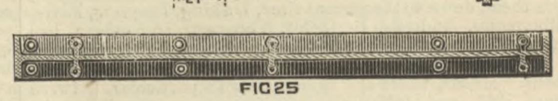


FIG 25

FIG. 26

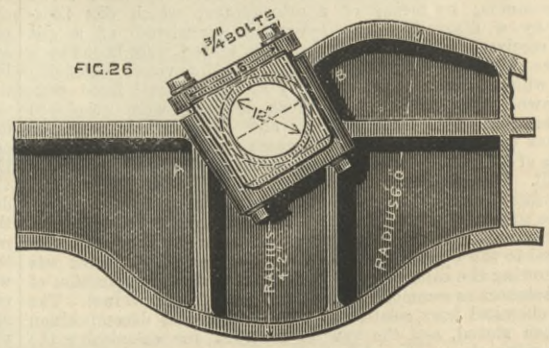
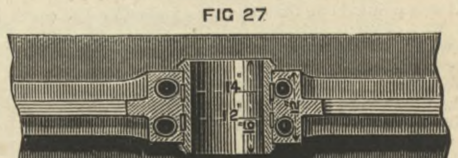


FIG 27



SECTION ON LINE AB

FIG 28

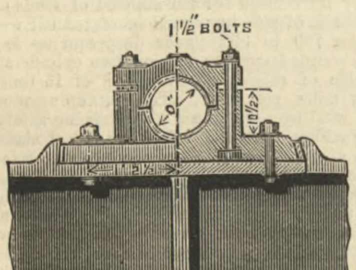


FIG 29

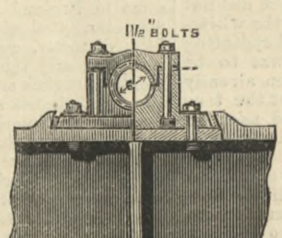
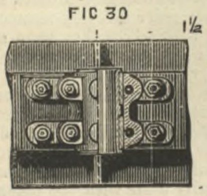


FIG 30 1¼ BOLTS FIG. 31



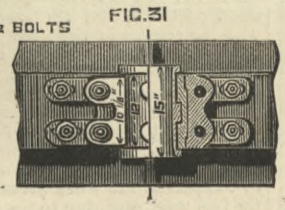
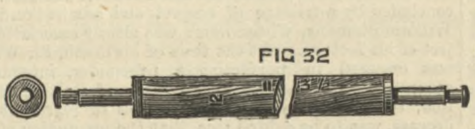


FIG 32



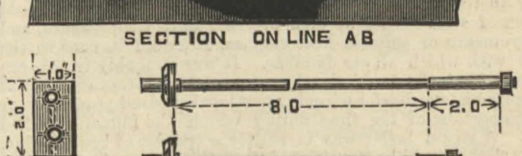
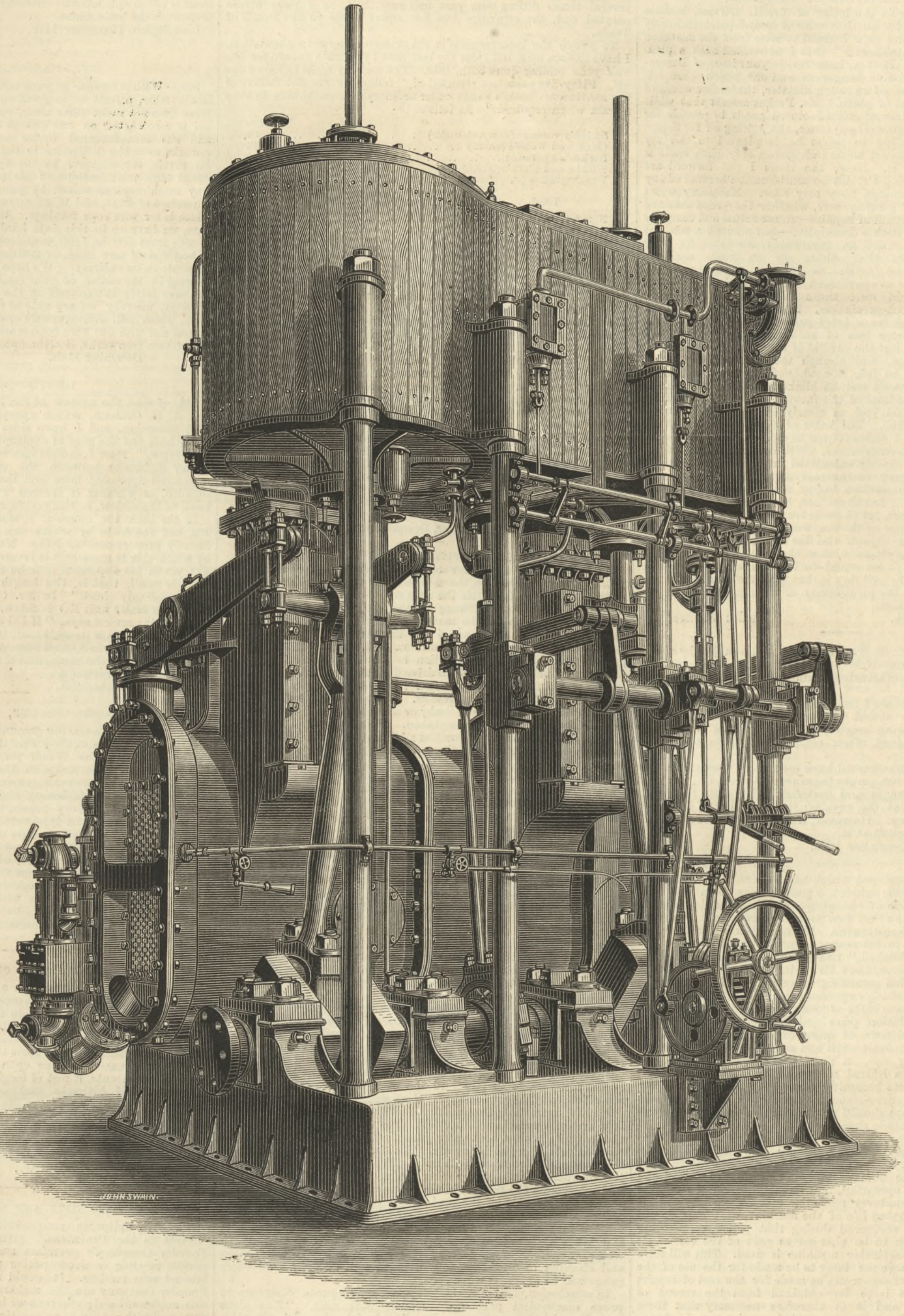


FIG 33

JOHN. SWAIN

COMPOUND ENGINES OF THE S.S. DEVON.

MESSRS. J. G. STEVENSON & CO., PRESTON, ENGINEERS.



WE illustrate a pair of compound marine screw engines constructed by Messrs. J. G. Stevenson and Co., of Preston, for the steamer Devon. The engines are of the usual compound type, having cylinders inverted, and side by side, with cranks at right angles. The cylinders are 26in. and 50in. diameter, with a stroke of 36in. The low-pressure cylinder is fitted with a starting valve, by which high-pressure steam can be admitted direct into its ports. This valve is worked by a hand lever beside the starting wheel. The piston-rods of both cylinders are carried through the covers, and both top and bottom stuffing-boxes are made of extra length. On the starting—starboard—side the cylinders are carried by four wrought iron columns cottared into the bed-plates, on the port side they rest on two frames carried up from the surface condenser. The latter has horizontal brass tubes packed with wooden ferrules. The total cooling surface is 1050 square feet. The bed-plate is in one casting, with four plummer blocks in it. The crank shaft has journals 9in. diameter, and is made in two parts connected by flanged couplings between the middle bearings. The air pump is 18in. diameter single-acting; the circulating pump is 12in. diameter double-acting; there are two feed and two bilge pumps, each 4½in. diameter. The stroke of all the pumps is 18in., and they are worked by levers off the low-pressure crosshead. The propeller is 12ft. diameter and 15ft. pitch, and has a surface of 43 square feet. Steam is supplied by one boiler 14ft. diameter and 10ft. 6in. long, with three furnaces 3ft. 3in. internal diameter. The total heating surface is 1950 square feet, and the working pressure 80 lb. The Devon is a steamer 220ft. by 21ft. 6in. by 14ft. 6in. depth. The speed when the vessel is loaded is expected to be 9 knots per hour upon a consumption of 9 tons per day. This is the first pair of marine engines that have been constructed by Messrs. J. G. Stevenson; they were built under the superintendence of Messrs. Flannery and Fawcus, engineers, Liverpool, and are working very satisfactorily.

SOCIETY OF ENGINEERS LECTURES.—The first of a course of lectures on "Meteorology," by Mr. W. Marriott, F.R.M.S., was delivered on December 6th, in the Reading Room of the Society of Engineers, Victoria-street, Westminster. Mr. Marriott began by showing how everyone was interested in and affected by changes of the weather, and how important a knowledge of meteorology was to the engineer. After describing the constitution of the atmosphere, he explained the methods adopted for measuring the temperature of the air, and exhibited and described the various forms of thermometers which have been used for this purpose. Instruments for registering the maximum and minimum temperature, as well as those for giving a continuous record, both by photography and electricity, were also explained. The proper exposure of the thermometers in a screen, to protect them from radiation, and also the necessity of having the instrument verified at the Kew Observatory, having been dwelt upon, the lecturer referred to the diurnal and annual range of the temperature of the air. The highest temperature in the day occurs between one and two o'clock p.m., while the lowest during the night takes place just before sunrise. In this country January is usually the coldest and July the hottest month in the year. Temperature was also shown to decrease with altitude, the rate of decrease being about 1 deg. for every 300ft. After having described the boiling point thermometer for measuring heights, the lecturer concluded by giving an account of observations made in some remarkable balloon ascents. The annual dinner of the society was held on Wednesday evening at the Guildhall Tavern, Mr. Jabez Church, C.E., in the chair. About 120 sat down to dinner. In the course of the speeches, it was mentioned that the society was founded in 1854 as the junior of the Institute of Civil Engineers; it now numbers some 400 members. Reference was made to the society's meetings and to the valuable results attending their summer visits to various engineering works. As is well known by our readers, lectures are delivered for the instruction of the junior members of the profession. After the usual loyal and patriotic toasts, the chairman, in proposing the toast of the evening, "Success to the Society of Engineers," remarked that the association might take to itself a certain meed of praise for what it had accomplished during the thirty years of its existence. In every part of the world both land and water bore marks of the hand of the engineer, who had done much for the advancement of civilisation by using the vast powers of nature to satisfy the wants as well as to furnish the luxuries of mankind. Engineers, whether civil, military, or mechanical, had reason to be proud of their profession, which had done so much for the common good and for the advantage of the world at large. He was glad to be able to say that the society was now in a better position than it ever had been in point of numbers and in point of financial matters. During the period of its existence it had done a great deal for the education of the junior members of the profession, and he trusted that it had a useful career before it in the future. Mr. Fung Yee spoke at some length, and the toasts were proposed or replied to by Mr. A. Williams and others, the speeches being relieved by music, under the direction of Mr. Montem Smith.

LETTERS TO THE EDITOR.

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

THE DEPRECIATION OF FACTORIES.

SIR,—I did not reply to the letter of Mr. H. S. Price, because his objection to making the auction value of second-hand machinery the basis of a depreciation rate seemed to arise from the mistaken statement of "Long-Established" that I advocated such a plan. The letter of Mr. C. R. Parkes, however, in your issue of December 7th, sets up a doctrine so dangerous, and one which when followed has been the cause of so much disaster, that a few words of comment may not be out of place. Mr. Parkes asserts that while it is necessary in the prices of manufactured goods to provide for management and other general expenses, the writing off for depreciation of plant, according to what he is pleased to call my scientific method, is a luxury to be indulged in only when trade is good and profits allow it. Now, the views I put forward are either right or wrong, and I claim no consideration because of any merely theoretical advantage they may offer. Machinery wears out by the operations of manufacture, whether the prices obtained are good or bad; no amount of repairs—unless actual and complete renewals are merged in such a description—can prevent a machine deteriorating; and to make an insufficient allowance for wear and tear on the plea that there are no funds available for the purpose is as futile as if one were to refuse for the same reason to pay rent for one's dwelling-house. I acknowledge that in dull times prices may afford little or no margin for such depreciation. I will go further, and say that it may be expedient for a brief period to sell at an obvious loss, to avoid the greater loss of an idle factory with current expenses still going on; but the capital of the proprietors is in such cases being drawn upon, and though the partners, to use Mr. Parkes' phrase, "must be fed, housed, and clothed according to their degree," the fact must not be blinked that such expenditure is unearned by the operations of the factory, and that the partners are living on their capital just as clearly as if they had pawned their plant for the purpose. The rates of depreciation which are appropriate depend, as I endeavoured to explain in my article, on an infinite number of circumstances, which not only differ in every factory, but cannot be exactly calculated in advance, and periodical revisions are necessary to increase or reduce them. Manufacturers may deem themselves happy who have capital to live upon when trade is bad. Let them not, however, ignore the facts, but, when they take stock, let them bravely depreciate the value of their plant in accordance with the work they have done. The principle is a simple one, though the due application of it may be difficult and at times unpleasant, that the actual capital value of the plant should always be equal to that shown in the books. When this is shirked, the evil day is but postponed, and the loss must ultimately fall on the proprietors or their successors, or perchance upon their creditors.

London, December 9th. EWING MATHESON.

SIR,—Although Mr. C. R. Parkes comes at his subject by a side wind—in your last issue—it is a subject well worth ventilation, and one that many manufacturing engineers would do well to read, mark, learn, &c.

For the last twenty years I have made out estimates, not from theory alone, but from actual and correct prime costs; but the fact of my manufacturing neighbours working from theory and "rule-of-thumb" combined often compels me to do a little in suicidal competition.

Mr. Parkes' contribution would have been more interesting if he had stated what the given percentages are levied on, *i.e.*, are they on wages only or on wages and materials? If on the former, I, for one, am surprised at the results; if on the latter, I do not subscribe to that theory. However, if the ball be set rolling, I shall be glad to have a push at it. P. C.

Barrow-in-Furness, December 10th.

SIR,—In the correspondence which has appeared recently in your columns bearing upon this subject, a good deal has been said with reference to the question of charging a high rate of depreciation for machinery within the first few years after its erection, in order to reduce it to second-hand value. This I think is manifestly incorrect, and Mr. Price in his response to the appeal of your correspondent, "Long Established," has put the matter very clearly. It appears to me, however, that Mr. Price has not dealt with the real point of the question regarding depreciation. It is no doubt quite true that the working expenses are a difficult matter to deal with in obtaining accurate costs of work done, but the question of the charge for depreciation pure and simple, that is, the loss arising from wear and tear, is quite distinct from this item of cost, and requires to be dealt with and ascertained independently. As Mr. Matheson truly says, an exact provision is impossible, and he therefore advocates a liberal allowance to provide for contingencies, such as machines becoming obsolete or insufficient. Now I think these contingencies should be provided for in a special manner, and the attempt should not be made to fix a rate of depreciation to cover and include these risks.

In order to fix the charge to be made for depreciation of machinery, it will be necessary to estimate the length of time a machine is likely to be fit for use, then an estimate can be made from experience of the number of hours per week in which the machine is actually in operation, and deducting from the original cost of the machine whatever realisable value there may be in it at the end of the estimated life of the machine, the difference will be the amount to be recovered during that period, or, in other words, the depreciation to be charged as part of the cost of all work for which this particular machine is used. This will form one portion of the charge per hour to be made for the use of the machine. A further charge must be made for the cost of repairs and upholding. This is to be obtained from the record of "working expenses," and it is therefore necessary that these charges should be so kept that every information may be forthcoming as to the exact nature of the various outgoings. Mr. Price has, perhaps, somewhat exaggerated the difficulties involved in dealing with these charges. At all events, my experience in dealing with cost accounts is that the required amount of detail can be obtained, and in such a form that the work done can be charged with its proper proportion of these indirect charges, either as part of a "machine rate" or as a percentage upon the net cost, according to the nature of the expenditure. By this means as small an amount as possible is left to be charged as a general percentage upon the out-turn of the works. In fact, it reduces this amount, so that it consists principally of establishment charges, which are not directly affected by the amount of work turned out; so that, as Mr. Parkes puts it in his letter in your issue of last week, in estimating for any contract, after ascertaining the estimated net cost, it will depend upon the position of the firm as regards the supply of orders whether they increase the net cost by the full ascertained percentage as worked out for previous periods or not. J. ARNOTT SISSON.

Newcastle-on-Tyne, December 12th.

THE CONTINUOUS BRAKE RETURNS.

SIR,—A long and perfectly misleading statement relating to the brake failures has recently been published and very widely circulated, the object evidently being to make the public believe that non-automatic vacuum brakes are the best. The Board of Trade requires the cases to be placed under one of three heads: (1) Failure to act in case of accident; (2) Failure under ordinary circumstances; (3) Delay to a train. A failure of a brake to act when wanted is a very serious matter, but a delay of a few minutes is of little importance; yet the "statement" to which I refer simply gives a total number of cases reported, and draws up a proportion of failures to miles run. This is, indeed, absurd, as some trains with one brake run a hundred miles without stopping, and others having another brake perhaps stop a hundred times in running the same distance. The chain brake on the North-Western is carried over a number of miles, but is only used in emergencies. The two-minute vacuum on the Midland has failed several times during the past half-year, but, as I have before pointed out, the company does not report these to the Board of Trade.

To prove the incorrectness of the statement now in circulation, I have drawn up a list from the last Board of Trade return for the half year ending June 30th, 1883. The returns under Class 1 are *nil*. Fifty-five cases are reported of "failure or partial failure of the continuous brakes to act under ordinary circumstances to stop a train when required." As follows:—

	No. of cases.
Smith's vacuum (non-automatic)	30
Clark and Webb's (chain)	13
Barker's hydraulic	3
Wilkin and Clark's (chain)	1
Westinghouse (automatic)	8
Total	55
Non-automatic systems	47
Automatic systems	8

The figures show that out of a total of 55 failures no less than forty-seven occurred to non-automatic brakes. I shall now proceed to consider the eight cases reported against the Westinghouse automatic brake. In five instances the cocks at the ends of vehicles were shut when they should have been open; in one instance the pipes between vehicles were not even connected. These six cases are clearly due to neglect of couplers and of guards in not testing the brake as required by the railway companies' regulations. On the North British Railway a "pump did not keep up air pressure, as the air chamber of suction valve was filled with dirt, through want of attention and driver's mismanagement." The last case is on the Midland, where a rod broke on a tender; the brake was only out of order on this tender, and the train did not overrun the station.

Now, when we look at the above what do they amount to? Simply seven cases of neglect by companies' servants and one broken rod. In two of the instances recorded the brake was only affected on one vehicle, and the trains did not overrun stations, so that in point of fact the brakes did not "fail to stop a train when required." I think your readers will agree with me that the above facts disprove the statements which have been circulated against automatic air-pressure brakes. CLEMENT E. STRETTON.

Saxe-Coburg-street, Leicester, December 8th.

THE EFFICIENCY OF FANS.

SIR,—I gladly accept your suggestion that a competent engineer should test and report on the new fan, and will lend every assistance in my power to enable the tests to be carried out to the satisfaction of all critics. A wrong notion appears to prevail as to what position I take up in the matter. The trials of November 1st, 3rd, 5th, 6th, 7th, were carried over the long period to investigate and follow up the point I at once noticed, on the first day, viz., power in air was out of proportion to power in engine. Then, on the third, I noticed "power to drive did not rise as cube of water-gauges or cube of volumes." This led to other experiments, all giving practically the same results. I was as puzzled as the rest who saw the trials as to the "why or wherefore," and could find no flaw in the way the tests were taken. They were as I have taken hundreds of tests with my own and all the best known types of fans; the only new element was the indicated engine. I turned to the engineers and sought for some "bread" of advice or suggestion, but got only a "stone," being fairly "pelted," for daring to divulge what Thompson's indicator, Cassella's anemometer, and the water-gauge told me. I treated the matter as a scientific problem worthy of investigation, and was treated as propounding from my inner consciousness "revolutionary dogma" in the mechanical world. I now ask all your correspondents to await further trials before pronouncing for or against a machine they only know by hearsay. The solution of the problem, I believe, will be found in this "point." If the outer fan is disconnected from the inner fan and port holes, the blast from the inner fan drives the outer fan at great speed. Thus, as the air velocity increases, the speed of the outer fan increases. If I suddenly, with a spring stop, connect the two fans, then, like your apt illustration of the train and the wheat, the energy put into the outer fan is imparted to the whole machine. Thus the inner fan is the prime motor; the outer fan picks up energy which would otherwise be lost in the air thrown off. This is my theory. Experiments will show how far I am right or wrong.

In reply to your correspondent who simply denies everything, I must demur at his dogma, "An open fan can never, by any possibility, equal for duty a perfect, covered, Guibal fan." I ask, Why so? If I can show an open fan giving 12in. to 14in. of water-gauge with closed inlet, why cannot it pass the air at corresponding velocity? If the same fan has an inlet five-ninths the diameter of the fan instead of one-third the diameter, as in the ordinary mine fan, why should it not pass more air?

He also seems to ignore the fact that the work of an exhaust fan is to create a vacuum within itself. The fan that can empty itself the fastest gives the best water gauge. The friction in the mine only affects the fan indirectly. The fan displaces air, and this causes a partial vacuum in its body. The atmospheric pressure on the downcast shaft of the mine fills up that vacuum in the fan, and overcomes the friction in the air-ways of the mine. In other words, the fan cuts off the head of the upcast air column. Nature abhors a vacuum, and forces down air to supply the loss of balance created by the fan. If a fan is a good one, the greatest power it can put forth is to keep itself running empty, and to create high water gauge. Enclosing a fan is waste of power, in case friction and choking of discharge, and should not be done if good water gauge can be obtained when open.

In conclusion, I do not think it necessary to quote Scripture to prove mechanical problems. Horace well said, "Nec deus intersit, nisi dignus vindice nodus;" and with regard to the allusion to "heaven-born genius," I think a trite old proverb, slightly altered, would have suited better: "*Exspirator* nascitur non fit," where the first part of the sentence would apply to the exhaust fan which has come into existence; the "*fit*" to the engineer who would work it out. J. M. CAPELL.

Passenham Rectory, December 11th.

LEAD PIPES.

SIR,—Some time since I noticed a question upon the merits of the elliptic pipe *v.* the round, as to proof against burst lead pipe, which I did not agree with, and I have noticed with interest the letters in THE ENGINEER on the cause of burst lead pipe. My opinion for a long time has been that bursts are caused by hydraulic pressure, not ice or air, and have argued the point with several practical persons. It is not generally known that pipes do not burst where the ice is first formed, but where it is last in freezing; it is the hydraulic pressure of the water that bursts the pipe, by being forced both ways and gradually swelling the pipe till it bursts. If a pipe gets frozen up at two points, and between these points runs into a warmer place long enough to allow the pressure to extend along the whole length of pipe, it will not burst, and the frozen part will not swell, but let a pipe freeze up from two exposed places, say 6ft. apart, and then form ice to meet each other, then the burst will be in the warmest part, or the last place to freeze.

Many plumbers will have noticed that bursts, as a rule, always are where that part of the pipe is most protected from the frost, and often where it has not frozen at all, and in the most awkward place to get at. Many examples of this could be mentioned; for instance, if a pipe runs through, say, from one closet through a floor into another closet, the burst often takes place between the floor and ceiling. I contend that if a lead pipe could be frozen all at once it would not burst, and would only swell the pipe slightly all along it; but freeze it up from both ends to the centre, and the swelling will take place at one point and burst—see sketch in yours of November 24th—and again, freeze up a pipe gradually from one end and the other open, it will not burst. The law that water expands in freezing is well known, but the fact of what causes the pipe to burst is not so well known—freezing is the first cause, but hydraulic pressure is the main cause. WM. DAWKES.

Leamington, December 11th.

AYR HARBOUR SLIPWAY.

SIR,—With reference to your notice of the Ayr Slipway in your last number, permit us to point out that we think the description given does not make quite clear, viz., that the machinery there in use is constructed on our patent non-fleeting wire rope system, and was manufactured under our license. As regards your remarks as to the difference in the gearing used north and south, Mr. Strain, the engineer to the Ayr Harbour Trustees, has introduced some modifications of his own in the gearing of the slipway machinery, as stated by you, but we very much doubt the advantage of same, and it, of course, in no way affects our patent, which is for wire rope haulage. With our own machinery in use here, we have up to this date hauled up over 100 vessels varying in size from 500 to 1150 tons dead weight without a single hitch or accident of any kind, a sufficient guarantee, we think, of our principle in its entirety. We hope shortly, with your permission, to bring to the notice of your readers an important improvement we have lately introduced in the construction of the cradle for slipways, whereby we are able to reduce the friction some 60 per cent., which will consequently enable us to haul up vessels of the largest size with our wire rope machinery.

Northam Ironworks, Southampton, December 11th. DAY, SUMMERS, AND CO.

GRAPHIC STATICS.

SIR,—I read the review of the book on "Graphic Statics," by Mr. R. H. Graham, which appeared in THE ENGINEER of the 23rd November, and I have since read the letter by the author of the book and the note of explanation appended by the "writer of the review." Now I should like to know whether it is that there is any difference between the statement made in the above-mentioned appended note and that in the book upon which it is founded, or whether it is that I do not understand either the book, or the review, or the reviewer's explanation.

In the book the moment is taken as proportional to the line $x\,y$, and the scale by which this is measured is either EO or is directly proportional to EO. Now the reviewer says the scale by which this is measured is inversely proportional to this length EO, yet in his appended note he says, "If the line be short the scale is small, that is, the length representing 1 inch-pound, is correspondingly short." In Mr. Graham's letter he says, "The larger the scalar unit EO is taken, the smaller will be $x\,y$." The writer of the review says, "If EO be taken great, the line—and I suppose he means $x\,y$—obtained, for the moment is short and the scale therefore small, and *vice versâ*." Now these two things seem to me to be the same, and if so the book is right. However, I must subscribe myself a PUZZLED STUDENT.

Staines, December 9th.

MESSRS. ESCHER, WYSS, AND CO.

SIR,—In your interesting account of the works of Escher, Wyss, and Co., you state that they were the first on the Continent to make steam engines on the Woolf principle. This is not correct, as many such had been made in Alsace when Mr. Loyd—who came from there to take the management of the Zurich works—made at Escher's their first stationary engine on that principle. On the other hand I have every reason to believe that the first pair of engines of the compound type were made by Escher, Wyss, and Co. early in 1863, for a small steamer called the Biene. These engines consisted of a single high and low pressure cylinder, placed diagonally one beside the other, with their cranks at right angles. The pressure in the boiler was 60 lb. per square inch, and the results obtained led to the exclusive adoption by the firm of this system. Prior to that time many marine engines on Woolf's principle were made at Zurich, but always, as in the case of those exhibited at the London Exhibition of 1862, with two high and two low-pressure cylinders. MURRAY JACKSON.

Budapest, December 5th.

THE MARQUIS OF WORCESTER.

SIR,—There has always been a mystery about the claims to invention of the Marquis of Worcester which his biographers have not succeeded in clearing up. In the *Academy* of December 8th is an essay by Mr. J. H. Round, which places the character of the author of the "Century of Inventions" in a most unfavourable light. This examination of some of the most remarkable incidents of his political career fathers upon him the charge of uttering two forged royal patents, if not of forging them. These extraordinary documents had hitherto met with acceptance among many historians. It looks as if the life of the marquis will have to be written in a more sceptical spirit, and particularly with reference to any statement made by himself and uncorroborated. It is for this purpose I call attention to the researches of Mr. Round, which may escape the notice of engineering readers.

32, St. George's-square, S.W., December 8th. HYDE CLARKE.

CAUSTIC POTS AND DECOMPOSING PANS.

SIR,—We notice in your edition of the 23rd ult. an article, "Visits to the Provinces," giving particulars of the Widnes Foundry Company's premises and manufacture, and think the portion relating to decomposing pans and caustic pots likely to mislead your readers. It would seem to infer that the Widnes Foundry Company are the makers of the largest and best pots in this neighbourhood; whereas we have a reputation equal to their own, and with reference to caustic pots only lasting eight months, there are some of our make working now which have been in use over twelve months. With regard to the size of the caustic pots, we are now making them to finish 25 tons, the pots themselves weighing 12½ tons, these being the largest pots of the kind made in the kingdom. Perhaps you will kindly give this publicity, and oblige JOHN VARLEY AND CO.

St. Helens, Lancashire, December 8th.

TENDERS.

TWO DOUBLE TWIN SCREW BOATS,

LIST of tenders for two double twin screw boats for the Wallasey Local Board. Messrs. Flannery and Fawcus, Liverpool, engineers.

Name.	Iron (2 boats) £	Steel (2 boats) £
Edwards and Simes	36,000	37,000
Earle's Shipbuilding Company	17,500	18,000
S. and H. Morton	16,239	16,721
McIntyre and Co.	16,000	16,500
James Jack and Co.	16,000	16,200
Simons and Co.	15,500	15,995
Dunsmuir and Jackson	15,350	15,510
J. Watkins	14,970	15,300
Stevens and Co.	14,977	14,977
Barrow Shipbuilding Company	—	14,000
Seath and Co.	12,900	13,200
Wm. Allsup and Co.—accepted	12,450	12,950
Abercorn Shipbuilding Company	12,300	12,900
Edward Finch and Co.	12,750	12,500
Toward and Co.	—	12,500

Engineer's estimate, £12,500.

RAILWAY MATTERS.

NEWS from Brighouse states that during the gale on Tuesday night about fifty yards of the platform at the Bailiffe Bridge Railway Station was blown on to the line, and an engine in consequence ran off the line, causing much traffic delay.

THE Pesth-Semlin Railway was opened on the 10th inst. throughout its length for traffic. Passenger trains started from the two terminal stations and performed the journey quite satisfactorily, the line being everywhere in good order.

THE Newport, Pontypridd, and Caerphilly line is on the eve of being opened. This will relieve the Taff Vale traffic. The Rhondda Bay Railway is to be opened in nine months; this will make Swansea better acquainted with the remarkable No. 3 coal of Rhondda, and relieve the Bute Docks.

AT the half-yearly general meeting of the East Indian Railway Company, to be held in January next, the board of directors will recommend the payment of a dividend of £1 12s. 6d. per cent. on the deferred annuity capital of the company, in addition to the guaranteed interest of £2 per cent. for the half-year.

THE Haidarabad-Manda Railway project is still being considered. The only hitch lies in the alignment, as it would be in continuation of the line in British territory to the Singarene coal-fields, which the Madras Railway Company is very desirous of utilising for the coal supply for locomotives on the railways in that Presidency.

DURING the past ten years the expenditure per train mile of English railways has remained at about the same level. Between 1872 and 1882 there have been some fluctuations, but in 1872 their expenditures per train mile, including maintenance of way, motive power, repairs, &c., were 32·27 pence, and in 1882 they were 32·47 pence.

A PASSENGER coach at the rear of a train running near Worcester, Massachusetts, a few days since, left the line and rolled twice over down a steep embankment. Nearly all of the fifty passengers in the car were injured, but none fatally. This must have been an experience which none of those passengers will wish repeated.

A SHORT electric railway between the sawmill of M. Steinbass and the station at Rosenheim—a distance of about 1 kilometre—has recently commenced working. The gauge is normal, and goods can thus be transported direct from the station to the mill without reloading. The motor used is a Schuckert machine. The railway is not used after dark, the current being then used to supply the Edison incandescent lamps by which the mill is lighted.

THE Railway Rates Committee of the Wolverhampton Chamber of Commerce are arranging for a joint meeting between themselves and the Railway Rates Committee of the Ironmasters' Association, and they have requested a number of manufacturers to furnish information of the rates of carriage of goods of their respective manufacture. It will thus be seen that the iron trade and the hardware manufacturers of South Staffordshire are in this matter of railway rates acting in unison.

THE half-yearly report of the directors of the Bombay, Baroda, and Central India Railway Company shows a gross revenue of £656,115, against £562,830, there being an increase of no less than £84,000 in the goods traffic. The expenses, which absorbed 37·76 per cent. of the whole of the income, as against 38·67 per cent., amounted to £247,748, or an increase of £30,084, the net earnings being £408,367, against £345,166. The directors recommend a dividend of £1 3s. 6d. per cent. for the half-year, in addition to the guarantee of 2½ per cent., a balance of £2005 being carried to the credit of the surplus account.

THE *Roller Mill* says:—"A Buffalo locomotive entered the flour business in a hurry the other day. A train was leaving the city at full speed, when, on a cross-road beyond the city line, the engineer discovered a man with a wagon load of barrels attempting to cross the track. In spite of the air-brake the train slid on to the crossing, and caught the rash teamster before he got across the rails. The engine struck the wagon plump in the centre. The farmer went flying 30ft. away, and the horses, liberated from their load, sped away down the road. Strange to relate, the man was uninjured. He picked himself up swearing mad, and made things blue around there for a little while. But oh, the poor engine? The barrels were flour barrels, and the machine was a sight to behold! Floured? We should say it was! And didn't the wipers quote when they saw the machine come into the round-house at the end of the trip!"

THE official returns of the New Zealand revenue and expenditure of railways for the first twenty weeks of the current financial year are not very satisfactory. Last year the net profit for the twenty weeks was £136,084; this year they are only £118,946, showing a falling off of £17,138, or at the rate of £44,000 per annum. Practically the whole loss of £17,000 is made on the Huruni-Bluff line, which, the *Colonies and India* says, shows a decrease of £18 per mile in receipts, and an increase of £40 per mile in working expenses. The returns also show a large increase in the quantity of work done on that line, both in passenger and goods traffic. The working expenses have increased in proportion, but the receipts, on the contrary, have seriously diminished, owing to the fact that so much less is earned for a given quantity of work done. There is a fair improvement in the Wellington, Auckland, and Napier sections; while the Manganui, Taranaki, Picton, and mineral lines show a slight falling off. Nelson is almost exactly the same as last year.

A HORRIBLE rear collision on the Burlington, near Streator, Illinois, November 16th, serves, "the American *Railway Review* says, to again impress us with the necessity for unceasing vigilance in railway operation. A wild freight train ran into a passenger train which had been stopped by a broken-down train ahead, and from the accident seven deaths resulted. The coroner's jury censure the engineer and conductor of the wild freight train for running at an excessive speed so closely in the rear of the passenger train, and also censure the yardmaster, train dispatcher, and superintendent for sending out the wild train with brakes so defective that the train was not readily controlled. The staff of the wrecked passenger train are exonerated, for they flagged the wild train as soon as they stopped. Whatever the merits of the jury's verdict, railroad operation should not be such as to allow of one train's running into another in broad daylight. But management is hardly censurable for such disasters, and we have nothing to blame but the human weakness of the forgetful individual whose heedlessness precipitates them. The lesson of this disaster is for train men, and tells them what their superiors' instructions always do—in case of uncertainty take the safe course and take no risks."

WHILE the railways hitherto made in Russia serve principally for the conveyance of export goods, those now projected are, says the *Hamburgische Boersen-Halle*, chiefly intended to facilitate the commercial relations of the interior. The following are the projected lines, forming a total length of 2315 versts—1535 miles:—Extension of the Riga and Tuckum line to Windau on the Baltic, 127 versts (a verst = 0·663 mile); the Siedlec and Malkin line, 70 versts, connecting the Terespol with the Warsaw and St. Petersburg Railway; the Schmerinka and Novofelz line, 230 versts, for uniting the South-West Railway with the Austrian system; the Perekop line, 100 versts, starting from Perekop and terminating at the Taganasch station of the Losovo and Sebastopol Railway; the Losovo-Pensa line, 450 versts, passing through Balaschov and Serdobsk; the Millerovo line, 88 versts, being an extension of the Lugan Railway to the Millerovo station on the Koslov and Woronesch Railway; extension of the Eastern Railway to the Volga, about 400 versts; the Navorossijsk line, about 300 versts, from a station on the Rostov and Vladikavka Railway, terminating at Navorossijsk, on the Black Sea, where a harbour is to be made; the Ufa line to Tekaterinenburg, 500 versts; and the line starting from Stavropol, and terminating at a station on the Rostov and Vladikavka Railway, about 50 versts.

NOTES AND MEMORANDA.

IN New South Wales in 1882 the number of births was 29,702, and the number of deaths 12,816.

ACCORDING to the last census Algeria has a population of 2,800,000 Mahomedans, as compared with 460,000 Christians and Jews. The Spanish colony numbers 112,000.

IN 1873 there were 29 coal mines in New South Wales, of which 5 were not worked, the output being 1,192,862 tons, valued at £665,747. In 1882 the number of mines had become increased to 44, all in active operation, the output being 2,109,282 tons, valued at £948,965 12s. 8d.

FOR grinding circular saws, M. Dugoujon, of Paris, replaces grindstones by discs cast with a V groove on the periphery filled in with lead. Pulverised flint or quartzose sand and water are allowed to drop during the operation of grinding, which is thus accomplished more economically than with stones.

THE estimated amount of gold raised in New South Wales from 1851 to the close of 1882 was 9,310,501 ounces, valued at £34,518,708. The largest quantity of gold raised in any one year was 616,909 ounces, valued at £2,360,383. This was in 1863. The smallest quantity was in 1879, being only 107,640 ounces, valued at £399,187.

DURING the year 1881-82 there were 3660 shipping disasters immediately around and on the coasts of the United Kingdom, exceeding the total of the previous year by 85, and resulting in the loss of 1097 lives, the corresponding number for the year 1880-81 being 984. This total of 3660 wrecks includes all sorts and classes of maritime accidents, viz., wrecks involving total loss, partial loss, collisions, &c., and it is a matter for satisfaction to know that the cases of total loss declined from 705 to 606, and those resulting in loss of life from 238 to 235, so that the remaining 3054 casualties may be looked upon as less serious.

DURING the week ending November 10th, in 31 cities of the United States having an aggregate population of 6,946,800, there died 2562 persons, which, according to the official returns published by the American *Sanitary Engineer*, is equivalent to an annual death rate of 19·2 per 1000, a diminution of the average rate for the preceding six weeks. For the North Atlantic cities the rate was 18·0; for the Eastern cities, 19·5; for the Lake cities, 16·4; for the River cities, 17·3; and in the Southern cities, for the whites, 23·2, and for the coloured 32·9 per 1000. Of all the deaths 33 per cent. were of children under five years of age, the highest proportion in this class being in the lake cities, where it was 41·4 per cent.

A VARNISH has been patented in Germany for foundry patterns and machinery, which it is claimed dries as soon as put on, gives the patterns a smooth surface, and is a good filler. This varnish is prepared in the following manner:—"30 lb. of shellac, 10 lb. of Manila copal, and 10 lb. of Zanzibar copal are placed in a vessel, which is heated externally by steam, and stirred during from four to six hours, after which 150 parts of the finest potato spirit are added, and the whole heated during four hours, to 87 degrees Cent. This liquid is dyed by the addition of orange colour, and can then be used for painting the patterns. When used for painting and glazing machinery, it consists of 35 lb. of shellac, 5 lb. of Manila copal, 10 lb. of Zanzibar copal, and 150 lb. of spirit."

IN an article in the San Francisco *Chronicle*, W. W. Goodrich says:—"Having occasion to examine a brick that was taken from an old ruined and forsaken building, which was being torn down, I was somewhat startled, upon adjusting a microscope upon a fragment, to see each pore of the brick inhabited by a peculiar rod-like animalcule of the genus *bacilli*. These insects cannot be seen except by aid of the microscope, even when they live in the human system and prey upon our vitality; neither are they visible in the soil or substances in which they may live and hive, except through a powerful glass. Their motions when they were agitated by blows were as the links of a chain, reminding one of a system of joints to be extended and contracted. They were semi-transparent, with a light, scintillating column nearly two-thirds their length, extending from near their head to their pointed tails, probably their spinal column."

DURING the week ending November 17th, in 31 cities of the United States having an aggregate population of 6,797,300, there died 2518 persons, which is equivalent to an annual death rate of 19·2 per 1000, or precisely the same rate as that of the preceding week. For the North Atlantic cities the rate was 17·5; for the Eastern cities, 19·6; for the Lake cities, 16·0; for the River cities, 17·4; and in the Southern cities, for the whites 27·1, and for the coloured 37·8 per 1000. Of all the deaths 34·4 per cent. were of children under five years of age. According to the statistics officially published by the American *Sanitary Engineer*, accidents caused, 4·4 per cent.; consumption, 13·1; croup, 2·6; diarrhœal diseases, 4·3; diphtheria, 5·1; typhoid fever, 2·7; malarial fevers, 1·5; scarlet fever, 2·3; pneumonia, 8·8; bronchitis, 3·3; measles, 0·3; and whooping cough, 0·4 per cent. of all deaths. The increase in the mortality from pneumonia was chiefly in the Eastern and Lake cities. Diphtheria was most prevalent in the River cities.

AT a recent meeting of the Physical Society, Professor R. B. Clifton, president, read a paper on "The Measurement of the Curvature of Lenses." With very small lenses the spherometer cannot be used, and the author's method is based on the Newton's rings formed between the lens and a plain surface, or a curved surface of known radius. From the wave length of the light employed in observing, and the diameter of a ring, the radius of curvature can be determined. He places the lens on a plane or curved surface under a microscope, and lights it by the sodium flame—wave length 5892×10^{-7}—he measures the approximate diameters of two rings a distance apart—in practice the tenth and twentieth rings are found convenient—takes the difference of their squares, and divides it by the wave length, and the number of rings in the gap between to find the radius of the lens. The formula is—

$$\rho^1 m \lambda = \left(x^2_{m+n} - x^2_n\right)$$

where x_{m+n} and x_n are the diameters of the nth and $(m+n)$th rings; λ is the wave length of the light, and ρ^1 the radius of curvature of the lens. The method with proper care gives accurate results. Professor Clifton has also used it to determine the refractive index of liquids in small quantities; Mr. Richardson having found it for water = 1·3335 by this method, which is usually correct to two places of decimals. It can also be used to determine if the lens is uniformly curved and spherical.

THE 3660 shipping disasters which occurred off the coasts of the United Kingdom during the year 1881-82, comprised 4367 vessels. Unfortunately, the number of ships is larger than the total of the previous year by 70; it exceeds the casualties reported, because in cases of collisions two or more ships are necessarily involved in one casualty. Thus, 686 were collisions, and 2974 were wrecks and casualties other than collisions; 526 of these latter disasters were wrecks, &c., resulting in total loss; 719 were casualties resulting in serious damage, and 1729 were minor accidents. In the previous year, 1880-81, the wrecks and casualties other than collisions on and near our coasts numbered 2862, or 112 less than the number reported during the year 1881-82. We observe that out of the 2974 casualties, other than collisions, 2623 occurred to vessels belonging to this country and its dependencies, and 351 happened to foreign ships. Of these 2623 British vessels, 1663 were employed in our own coasting trade, 720 in the—oversea—foreign and home trade, and 240 as fishing vessels. There were 8 casualties to ships belonging to foreign countries and States employed in the British coasting trade, and 275 to foreign vessels which, although not engaged in our coasting trade, were bound to or from British ports; while there were 68 casualties to foreign ships which were not trading to or from the United Kingdom. Excluding collisions, the localities of the wrecks are thus given:—East Coast of England, 809; South Coast, 586; West Coasts of England and Scotland, and East Coast of Ireland, 1046; North Coast of Scotland, 99; East Coast of Scotland, 161; other parts of the coast, 273; total, 2974.

MISCELLANEA.

THE value of goods exported from the Tees last month, exclusive of coal, was £247,901, being an increase of £67,200 as compared with November, 1882, and exceeding the value of the Newcastle exports by £25,439.

THE Verviers Industrial Society offers two prizes of £240 and £68 for the best and second-best discovery, invention, or application contributing to the progress or prosperity of the woollen trade during the last five years.

THE Swedish frigate Vanadis, fourteen guns, Commodore Lagerhung, from Carlscrona, has arrived at Sheerness on a voyage round the world, undertaken on behalf of the Meteorological Society of Sweden and Norway.

SOME good contracts have been booked in the Clyde shipbuilding trade, but they are not of sufficient importance to induce the employers to withdraw from their resolution to reduce the wages of all classes of workmen from the beginning of the year.

NOTICES have been posted in all the shipyards on the Tyne and Wear stating that on and after the 4th of March, 1884, the piece-work rates and time wages in all departments will be reduced to those current immediately previous to the advance in 1880. This corresponds with a reduction of 10 to 15 per cent.

A PROPOSAL, in itself very good, has been made to construct a subway from South Kensington to the Albert Hall. This would be of great convenience to large numbers of people, as it would make it possible to go to the Hall or the Museum from any part of London or its suburbs without leaving cover. But why on earth, or rather under it, should such a thing, less than 1000 yards long even if provided with a tramway, cost £100,000? Sir E. Watkin can perhaps explain.

ON the 8th inst. the paddle tug Buffalo, built by Messrs. Heppel and Co., of Shields, for Messrs. J. T. Rennie, Son, and Co., of London, made her first trial trip off the Tyne. She is fitted with a pair of condensing engines with 24in. cylinders, and works at 35 lb. steam pressure, making about 42 revolutions per minute, and averaging about 10 knots per hour. The vessel has been surveyed during construction by Mr. J. F. Flannery, of London, and immediately proceeds to her station at Algoa Bay, South Africa.

THE Commissioners of Northern Lights have given instructions for the erection of mineral oil gasworks on Ailsa Craig, Firth of Clyde. This gaswork is for the purpose of supplying gas to the gas engines to be used for driving the fog-signal apparatus and for lighting the lighthouse which is being erected on the "Craig" rock by the Commissioners for the safer navigation of the mouth of the Clyde. The gasworks will be capable of manufacturing continuously, in case of a lengthened fog, 2000 cubic feet of oil gas per hour, of 50-candle illuminating standard.

VENEZUELA threatens to become one of the more formidable of the competitors of the American Western copper mines in the markets of the world, to judge, the *Engineering* and *Mining Journal* says, from the reports of the leading concern, the Quebrada Railroad Land and Copper Company, a fusion of the Boliva Railroad Company and the New Quebrada Copper Company, in which together £1,000,000 have been invested. In the first six months of the present year the company shipped to the coast 15,300 tons of ore, 2150 tons of regulus, and 470 tons of "kernels." With a considerably smaller output, the mines had dividends last year amounting to £13,000.

AT the official trial of the little twin steamships Jeanne and Louise, on the Mersey, a speed of 8 knots was obtained with a load of 18 tons on a draught of 2ft. 6in. The vessel, which is built of steel, is 60ft. long, 12ft. beam, and 4ft. 3in. deep, with raised forecastle, and deck-house amidships. She is fitted with two single-crank tandem compound engines, having cylinders 5in. and 10in. diameter by 8in. stroke, fitted with a wrought iron surface condenser, and a separate engine for air and circulating pumps. The boiler is of Cochran's patent multitubular type, 4ft. diameter by 8ft. 6in. high, and is made of mild steel throughout. The vessel and machinery were built for service on the Gaboon river, on the West Coast of Africa.

DESPITE the fact that the steel trade has not of late been advancing with as rapid strides as could be desired, the promotion of extension of works and the establishment of new works continue. The Glasgow Iron Company has acquired 15 acres of ground at Wishaw, near its ironworks, for the purpose of erecting a steelworks. The contracts have been placed for the machinery and buildings, part of the machinery to be supplied by an English house, part by the Vulcan Foundry, Glasgow, and the roofing of the buildings by Messrs. P. and W. M'Lellan, of Glasgow. It may be stated here that the last-named firm have secured the contract to supply the ironwork to be used in the erection of the Glasgow Municipal Buildings.

THERE now remain only 194 yards to be driven through before the two approaching ends of the Mersey tunnel will meet under the river Mersey. The total distance penetrated last week was 41½ yards, being 33 by Beaumont's boring machine, and 8½ by hand labour. In order to facilitate operations, and for the convenience and health of the workmen employed below, arrangements have been made with the local corporation whereby temporary ventilating shafts are being sunk in Lord-street, Liverpool, and Hamilton-street, Birkenhead. The works continue day and night, with the exception of Sundays. Between the two extremities of the main river tunnel operations are being carried on at eight different faces. The junction with the Birkenhead Joint Railway at Tranmere is being pushed forward.

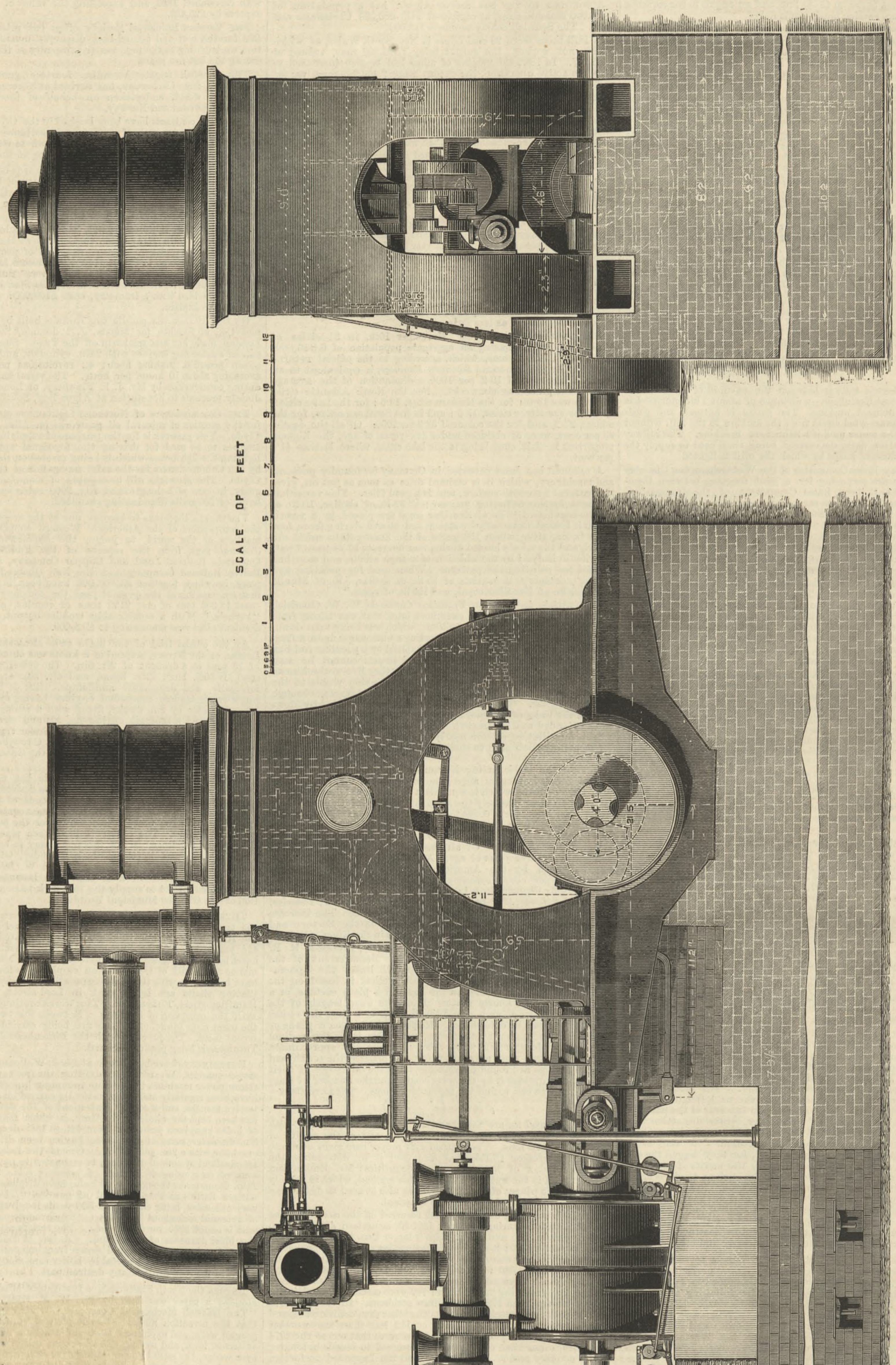
EXPERIMENTS have been made at Sir J. W. Pease and Co.'s limestone quarries, Weardale, in drilling the rock with Cranston's steam power machines in the blue mountain limestone. The trials have been regularly and systematically carried on during the past twelve months, and a correct statement of the work accomplished has been kept the whole of the time, in which many hundred feet of holes have been put down from 4ft. to 18ft. deep each by 2in. to 3in. diameter, some of the holes having been drilled 5ft. deep in one hour with a 2in. gauge drill. One of the holes, 18ft. deep, by an excellent system of blasting, is estimated to have removed 3000 tons of rock, using 4½ barrels of powder; some 9ft. holes, being 2¼in. diameter at the bottom of hole, have displaced over 400 tons with a little less than ¼-barrel of powder. These quarries are very extensive, being close upon 500 yards long, with a fore breast of splendid rock about 50ft. deep. The average output at the present is about 2000 tons per week. The rock is principally used in the blast furnaces of Cleveland. A line of railway, 4ft. 8½in. gauge, has been specially laid down from one end to the other on the quarry top, so that a portable boiler runs along it and supplies steam to the rock drills at any desired part.

BEFORE the North Staffordshire Institute of Mining Engineers on Monday a paper was read by Mr. W. F. Hall, of Durham, on "The Haswell Mechanical Coal-getter." He expressed the hope that the invention might take the place of gunpowder in underground work, and explained that the machine was a combination of screw, lever, and wedge. The bursting action was accomplished by a wedge, the initial power which drove the wedge being manual force, the man's power being multiplied by a special combination of mechanical powers. The President of the Institute—Mr. J. Lucas—said that if the machine were not too heavy and cumbersome it would in some seams be useful. The great thing to be considered in a machine for cutting coal was to have something that could be easily moved about from place to place. A paper on "Sinking through the Quicksands at Minnie Pit, at the Codmore Hall Colliery," was also read before the Institute by Mr. Ritson Wilson. By means of cast iron tubbing, in segments 7ft. long, 3ft. deep, and 1in. thick, a shaft 18ft. in diameter had been sunk through 38ft. of quicksand, yielding 170 gallons of water per minute. The water was pumped out by a Pulsometer.

ROLLING MILL ENGINES, RHYMNEY IRONWORKS.

MESSRS. TANNETT, WALKER, AND CO., HUNSLET, LEEDS, ENGINEERS.

(*For description see page* 471.)



TO CORRESPONDENTS.

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

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

C J. R.—*We never heard of such books.*

OLD SUBSCRIBER.—*The proportion of cement used in the mortar was not stated, but a comparatively small quantity will probably give the best results.*

MARSEILLES.—*The principal makers of copper for locomotive fire-boxes are Messrs. Vivian, Pasco Grenfel and Co , W. Foster and Co., Bebbys, and the Broughton Copper Company.*

A READER FOR TWENTY-FIVE YEARS.—*D. W. capacity is the displacement between the light and deep load lines. In cargo vessels it is about 1¼ times gross registered tonnage. There are no fewer than eighteen recognised formulæ for calculating the nominal horse-power of compound marine engines.*

SOAP-CUTTING MACHINERY.

(*To the Editor of The Engineer.*)

SIR,—Will any of your numerous readers kindly furnish me with description or sketches of some simple apparatus for cutting blocks of soap into bars; also for making and stamping oval or square toilet soap tablets?

DARKNESS.

Ulverston, December 10th.

CLEANING FOUNDRY WINDOWS.

(*To the Editor of The Engineer.*)

SIR,—Can any of your correspondents inform me of a good way to clean foundry windows? Some travelling window cleaners successfully cleanse them from an accumulation of smoke and sulphur in a rapid way. What do they use?

FOUNDER.

Derby, December 19th.

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MEETINGS NEXT WEEK.

THE INSTITUTION OF CIVIL ENGINEERS.—Tuesday, Dec. 18th, at 8 p.m.: Annual general meeting to receive the report of the outgoing Council, and to elect the Council for the ensuing year.

CHEMICAL SOCIETY.—Thursday, Dec. 20th, at 8 p.m.: "Researches on the Constitution of the Gums of the Arabin class," by Mr. C. O'Sullivan. "On the Decomposition of Ammonia by Heat," by Dr. W. Ramsay and Mr. Sydney Young. "On the Dissociation of the Halogen Compounds of Selenium," by Dr. W. Ramsey and Mr. Franklin P. Evans.

ROYAL METEOROLOGICAL SOCIETY.—Wednesday, Dec. 19th, at 7 p.m., the following papers will be read:—"On the Explanation of certain Weather Prognostics," by the Hon. Ralph Abercromby, F.R. Met. Soc. "Preliminary Inquiry into the Causes of the Variations in the Reading of Black-bulb Thermometers in Vacuo." by Mr. G. M. Whipple, B.Sc., F.R. Met. Soc, F.R.A.S. "Report on the Phenological Observations for 1883," by the Rev. T. A. Preston, M.A., F.R. Met. Soc. The meeting will be adjourned at 8 p.m. in order that a special general meeting may be held to consider certain alterations in the bye-laws.

SOCIETY OF ARTS.—Monday, Dec. 17th, at 8 p.m.: Cantor Lectures. "The Scientific Basis of Cookery," by Mr. W. Mattieu Williams, F.C.S. Lecture III.—The nutritive constituents of vegetables. The changes effected by cookery on vegetable substances. Ensilage of human food. May the use of flesh food be superseded by the scientific preparation of selected vegetables? Wednesday, Dec. 19th, at 8 p.m.: Fifth ordinary meeting. "Canada and its Products," by the Most Hon. the Marquis of Lorne, K.T., late Governor-General of Canada. Sir Alexander Galt, G.C.M.G., will preside.

DEATH.

On the 25th Oct., at Dharmsalah, Punjab, India, killed, by a fall down a precipice, caused by an attack from a bear, THOMAS WILLIAM KNOWLES, late Executive Engineer in the Public Works Department, India, aged 50 years.

THE ENGINEER.

DECEMBER 14, 1883.

THE QUALITY OF LONDON GAS.

WE hear with satisfaction that arrangements are about to be made which will ensure a more satisfactory testing of the metropolitan gas supply than has been the case for some time past. In carrying out these arrangements, no hardship can be inflicted on the gas companies, unless they claim it as their privilege to supply a certain quantity of gas below the statutory lighting power. But this will be indignantly repudiated, as it ought to be. The companies will assert that, except in case of accident, their gas is in complete accordance with the requirements of the Act of Parliament. Consequently nothing more is proposed than to give practical assurance to the public that the gas is a perfectly correct article. There is no dispute that the gas fulfils the law so far as the existing testing stations deal with it. But it is equally undeniable that the testing stations as at present established do not test the whole of the gas supplied to the metropolis. We should like to know that this untested portion is equal in quality to the rest, and we fancy there can be nothing very unreasonable in making a demand for that purpose. At all events, such is the view taken of the subject by the Metropolitan Board, and we are glad to hear that the Gas Referees consider it a proper thing to increase the number of the testing stations, as also, in some cases, we believe, to revise the internal arrangements of those already in operation. Reasonable and business-like as all this appears—at least so far as our judgment will carry us—the remarks which we recently offered in advocacy of what is going to be done have brought down upon us a violent attack from the organ of the gas companies. Whether such an onslaught was judicious in the interest of those companies may be doubted. If there is nothing amiss, there is nothing to quarrel about. Perhaps it is considered in some quarters wrong to question the quality of the gas, be it ever so untested. Since we addressed our readers on this subject, there has come into our hands the full text of the report which was presented to the Special Purposes Committee of the Metropolitan Board by Mr. Dibdin on the existing arrangements for testing the gas supply. Mr. Dibdin is the chemical assistant to the Board, and superintends the gas-testing arrangements established under its authority. In this matter Mr. Dibdin practically takes the position occupied by the late Mr. Keates. His statements, therefore, carry peculiar weight, and must have been made with due consideration. In his report we find Mr. Dibdin saying that whether the quality of the gas in all parts of London is always equal to the standard, although found to be so at the official testing-places, "has been a matter of not infrequent question." To this he adds: "The results of some tests which I have lately made in the Board's Laboratory tend to confirm this doubt, as the results of careful experiments have shown the illuminating power of the gas to be frequently under 16 candles, and on several occasions even below 14 candles."

Assuredly here there is something more than suspicion. In furtherance of our former remarks, we venture to say there is something ludicrous in the fact that the Metropolitan Board, which is the authority for testing gas all over London, minus the City, has been receiving upon its own premises gas of a lighting power seriously below the legal standard. How could the Board be expected to protect London if it could not protect itself? This state of things is now to be altered, and very properly so. The Board's laboratory is to be certified as a testing station, and we have no doubt there will be an entire disappearance of 14 candle gas. We are not going to say that the company have practised any deliberate fraud upon the public. We have no doubt that the directors are perfectly innocent. We also know that the Chartered gas which passes through the testing stations is of excellent quality, and has a lighting power considerably above the standard. But it stands to reason that where the gas is sure to be tested special care will be taken to maintain the quality; whereas the same incentive will not exist in those cases where it is known that the gas will pass unobserved. That all the mains which proceed from a gasworks contain the same quality of gas is a point on which we are by no means assured. But no force of argument, or flight of fancy, can do away with the fact that Chartered gas in the Board's laboratory has been found one and two candles below the proper lighting power, whereas at the testing stations it has been generally found one candle above what the law demands. We give the company credit for the excess, but it would be more satisfactory to have a uniformly good quality throughout. How much of the gas is above the standard, and how much falls below it, we cannot pretend to determine. Possibly some estimate may be made as to the proportion which goes untested; but even this is difficult. There is an ominous paragraph in Mr. Dibdin's report which says:—"The Beckton gas, although averaging 21,000,000 cubic feet per day, is untested, except in the City, presumably at Cloth-fair and Salisbury-square; yet, as I have shown, this gas is stored for distribution at Bromley, Bow Common, Westminster, and Fulham, and supplies about one-third of the company's consumers." It is no great marvel to find Mr. Dibdin saying immediately afterwards:—"Obviously an extension of the existing arrangements for testing the quality of the gas supplied by this system of mains and countermains is extremely desirable."

We attach considerable importance to the fact that a species of perambulatory photometer is about to be established, for the purpose of testing the gas in various parts of the metropolis. The testings thus applied will have no statutory authority, but they will be of great value as showing where fresh testing stations are required. Possibly the law will be amended, so as to make the portable photometer an official instrument. This would save the expense of those testing stations otherwise necessary, and would legalise a mode of examination which offers peculiar advantages to the consumer. Statutory authority already exists for taking the pressure of the gas wherever the officers of the Metropolitan Board may think proper, and this authority is frequently exercised. Before quitting the subject, we should like to say a word for the Gas Referees, on a point concerning which we may have somewhat misapprehended the extent of their powers. We have complained of the length of time—occasionally two years—expended in the establishment of testing stations, during which period the gas may be said to take care of itself. The law empowers the Referees to demand that a testing station shall be erected, but leaves it to the gas company to provide the station in its own good time. Neither the company, nor those who are paid by the company to prepare the station, are in any particular hurry, and the Referees can exercise nothing more than moral suasion. The law requires amendment, so as to confer on the Metropolitan Board the power to construct and fit up the station, charging the company with the expense—a charge which the latter have now to bear. Finally, we are glad to find the Referees entering heartily into the question of removing the defects which attach to the present organisation of the testing stations. This readiness to serve the public is what we might expect from so highly-qualified a trio as Mr. A. Vernon Harcourt, Dr. Pole, and Professor Tyndall.

THE INTERNATIONAL HEALTH EXHIBITION.

THE very remarkable success of the International Fisheries Exhibition has led to the projection of a series of such attractions, the first of which is to be held next year in the buildings erected in the grounds formerly held by the Horticultural Society. The International Health Exhibition is to be devoted to the endless variety of things which may be brought under the two general heads health and education. The first will include everything that can be brought under the sub-heads food, dress, the dwelling, the school, and the workshop; while the second will include all that has any claim to be designated apparatus used in primary, technical and art schools.

The organisation of exhibitions has become a fine art, and although success cannot be commanded in this any more than in any other business, it may be best assured by that attention to a few subjects at a time, that specialism which is necessary in business, in order that these subjects may be exhaustively treated. No general exhibition is ever complete in its illustration of all that might pertain to any one subject. Experience in exhibition organisation has therefore led to specialism. This alone, however, has not always secured success, for the series held at South Kensington about ten years ago died for want of popular support, and therefore without popular regret. But special exhibitions must not be arranged for the edification of specialists only. These are comparatively few in number, and even when there is added the number of those who are so far self-denying as to go more than once to an exhibition, not for pleasure pure and simple, but because of its educational character, the numbers are not sufficiently great to warrant any large expenditure, or hopes of profit. A new phase in exhibition organisation was inaugurated in the Fisheries Exhibition. Briefly, this was embodied in the attention which was paid to the development of the thing as a pleasant resort. There is no doubt that even more attention will have to be devoted to this point in the coming exhibitions. Visiting exhibitions is usually tiring work. Staring at objects of arts and manufactures, listening to descriptions and consulting catalogues, is work a little of which goes a long way with most people. Music, lounges, promenade gardens, refreshments, and ample facilities for partaking of them are essential if such work is to be popular and paying. The exhibition must be a text, and the promoters must be satisfied if a very little of the sermons hung thereon is retained by the majority. This has been fully learned, as was shown by the remarks of Sir Philip Cunliffe Owen after the dinner given at the last of the closing ceremonies at the Fisheries. In effect, he said the exhibition must be complete of its kind, but that every facility must be given to enable the visitors to enjoy visiting it, and especially must it be remembered that the charm of the exhibition is the extent to which people may exhibit themselves. All this is, no doubt, perfectly true; but, of course, the exhibition, the text, remains as the central object, and it must be a good one; for people like to persuade themselves that they have primarily an intellectual object in visiting an exhibition, however often and however little of the things exhibited is seen at each time. The subject, then, of the exhibition which is to be opened on the 1st of May next has everything to recommend it. It is comprehensive beyond the conception of the proposers. Unprepared animal and vegetable foods, and what might have been prepared, but by mistake got stuffed for ornament instead, and models and drawings of these, form the first class. This, perhaps, does not include much more than hunting, fishing, butchering, gardening, taxidermy, drawing, carving, and water-colour painting; but the second class—there are fifty-nine classes—will make up for it. It includes prepared vegetable substances used as food, including tinned and compressed preserved fruits and vegetables, and the whole of the applications of the products of the millers all over the world, including the thousand-and-one sorts of bread. This, however, does not include much. It is true there are gardening, farming, tin-plate and tin can and box manufacture, mills and milling, baking, and cooking involved in it; but this is, after all, not so much as appears at first sight. Class 3 may therefore be thrown in. It includes prepared animal substances used as food in a preserved form. Class 4 is tolerably wide. It includes beverages of all kinds—that is, alcoholic, unalcoholic, and infusions. This dces not appear to stand for much. It will, of course, include grain growing, for some farmers are of opinion that there is a good deal of wheat grown for whisky distilling, beside that which is "wasted in making bread," and it will include brewing, distilling, the manufacture of aerated waters, jars and bottles, tea and coffee growing, drying, roasting, and all the things which when mixed make up what is called cocoa and chocolate, and the machines will of course be there to do this. This class is not so very meagre after all, and may be a little popular. There are more classes in this group. The 11th includes apparatus and processes for conserving, storing, conveying, and distributing fresh foods of all kinds. Now this class will have something under it. All the apparatus and plant yet mentioned, and much more than ever was mentioned in one decade, will be supplemented, of course, by such little things as an Orient liner, with freezing rooms, fishing smacks, a railway train or two, some with ice chamber trucks, butchers' carts, and—well, the rest will come in Class 12, which includes machinery and appliances for the preparation of all the articles we have already recited. This will, as a sort of appendix, represent an engineering exhibition which would about fill some small outlying structure like the Crystal Palace. Group No. 2 now commences, but it will never do to particularise again. This is dress, and it is a relief to find that the collections under this group will be placed in the Albert Hall galleries. There is plenty of room there, and the music can go on just the same. Class 19, under this head, includes all the machinery and appliances in any way connected with dressmaking—such as sewing machines, cutting machines, gutta-percha and india-rubber cloth-covering machines—and about everything that did not come under Class 12. Group 3 relates to the dwelling house. The architect, carpenter, builder, sanitarian, cooking range maker, plumber, painter, decorator, and machinist are all in this group. Buildings and houses are to be erected in the grounds as specimens, and the sanitarian is to see that the filters, cisterns, water-closets, drains, ventilators are properly designed, and the plumber is to see that the plumbing wants attention every day during the Exhibition; the range maker is to see that the cooking can be done, however small the quantity of smoke made or large the quantity of coal burned. Electricians and electrical engineers, gas engineers, and oil lamp makers are to contend in friendly competition to show that each kind of light is the best, and portable fire engines are to be there, perhaps partly in consequence. Even in this group there is the one thing that is above all interesting in æsthetic eyes—namely, all that machinery which relates to group 3. This machinery is just a little too miscellaneous, so it had better not be spoken about at length here.

The school, the workshop, and educational works and appliances constituting groups 4, 5, and 6, are not concerned with engineering or machinery in any way that has not been already mentioned, so in these groups no special reference is made to them. This is just to prevent any appearance of omniscience in engineering pursuits; but as space is to be provided free of cost, perhaps a little machinery will find its way under the school desks. The Exhibition promises to be interesting in itself, and no doubt the arrangements will be at least as good as they were at the Fisheries Exhibition to make it attractive.

THE INSTITUTION OF CIVIL ENGINEERS.

THE meeting of the Institution next Tuesday will, as usual just before Christmas, be devoted to the business of the Institution, the reading of the annual report, and the election of the president, vice-president, and other members of council. This election reminds everyone of the irreparable loss which the Institution sustained by the death of Sir William Siemens, one of its most able and most energetic councillors. In the council there are this year four vacancies, so that three new names have to be added to the list beside those which under ordinary circumstances would have been placed there with a view to selection by the members. Sir Joseph Bazalgette is the only name presented for election as president, and no one would wish to see it replaced by any other. Twenty-four well-known names are placed on the list from which fifteen members of council are to be elected. Members may, of course, erase any of these names and insert any others, but everyone will, no doubt, find that selection from twenty-four gives quite enough scope for choice. Of the names on the list but not yet on the council are those of Mr. William Anderson, who last week gave the excellent practical lecture on the "Thermodynamic Problems involved in the Generation of Steam," and of which we publish an abstract in another page, and Mr. W. H. Preece, whose name is so well known in connection with what is now fast becoming one of the most important branches of engineering, namely, the applications of electricity. While speaking of the balloting list, we cannot refrain from referring to the regret which has been expressed by many that Sir W. Siemens had not been elected president. It is known that generally speaking few members ever add to or alter the balloting list as regards the selected president and vice-presidents. It is now, however, very well understood that members may do as they please as to the names they vote for, and a good deal of individual expression of opinion has been evident from the recent election papers. This, however, is not so with the Council itself, and it is little less than a disgrace to the Institution that its members of Council should be so far afraid of giving effect to their own opinions that, instead of electing a president from among themselves every year, they never elect one. However far above the mean level one of their members may be, respectable, safe mediocrity takes the lead for the presidency if its owner's birthday is the more remote. Members of Council do not vote for the man whose abilities and accomplishments make him an ornament to the Institution, they vote for the oldest birthday. Very often it happens that the right man is in this way put into the presidential chair; but although the greatest care is exercised in electing members of council, it not unfrequently happens that a man very useful as a member of council, may be far less fit for the position of president than another who is younger than himself. Notwithstanding this, however, once elected, and especially if moved to the position of vice-president, a man is sure to go by seniority to the presidential chair. In this way Sir W. Siemens never passed the chair. This was no loss to him, his name and fame shone the world over, and would not have been one ray brighter for his being president of the Institution of Civil Engineers, but it would have been better for the Institution. Why could not councillors vote for a president and not for a date? Seniority should not be the test.

THE BOARD OF TRADE ON BOILER EXPLOSIONS.

MR. THOMAS GRAY has issued a report to the President of the Board of Trade on the working of the Boiler Explosions Act of 1882. Concerning this report we shall have more to say. Meanwhile we wish to call attention to one paragraph: "Inspection by insurers of boilers does not insure safety, for we find that one-fifth of the explosions which happened during the year happened from boilers not only inspected by, but insured in boiler insurance companies." The construction of this passage will hardly commend itself to the strict grammarian, but its meaning is sufficiently clear. Boiler insurance companies do not secure absolute immunity from accident. This, after all, is only to say that man is fallible; but there is another point from which this matter may be viewed. What is a boiler explosion? To Mr. Gray it would appear that all boiler failures are alike. A table is appended to the report, setting forth the conditions under which the boiler worked. Now the first boiler referred to as inspected was in Liverpool at a dye works. It was insured by the National Boiler Insurance Company, and the explosion (?) consisted in the blowing out of a fusible plug. "Either melted or blown out, thread of plug was probably stiffened when the plug was first inserted." This can hardly be said to be the fault of the insurers. The next case was one where the internal tube collapsed. This boiler was inspected, but not insured. Probably the insurance company would not insure, and had warned the owner. The next case calling for comment is one of a Lancashire boiler. The crown of the right-hand furnace collapsed, because of "the sudden contraction of the top of the furnaces because the door was left open for a period of five or ten minutes." This is a curious statement; but, at all events, the National Boiler Insurance Company can hardly be held responsible. Then we have a Lancashire boiler insured by the Boiler Insurance and Steam Power Company, of Manchester. The right-hand flue collapsed because the boiler was allowed to get short of water. The next case was that of a boiler insured with the Mutual Company. This was a collapse due to overheating the furnace crowns. The next case was of the same character. There are only three cases where boilers were insured in which any blame could be attributed to boiler insurance companies, so that Mr. Gray's percentage becomes very much smaller indeed than one-fifth. No boiler company pretends to provide against collapses due to scale and shortness of water. Mr. Gray's report contains an obvious censure. If it only contained an obvious warning we should have no fault to find. Boiler insurance cannot do everything, but it can do a great deal, and ought to be encouraged by Government rather than discouraged.

THE WORD "PATENT."

SOMETHING like a panic has been caused amongst the hardware manufacturers in the Black Country by the discovery of a clause in the Patents Act making it an offence to sell articles marked "Patent," when "no patent has been granted for the same." It appears from the proceedings of the Wolverhampton Chamber of Commerce on Friday last, that the holders of large stocks of goods so marked—which will become virtually contraband after the 1st of January next—are puzzled to know what to do. In the extremity of their distress they proposed to join the town of Walsall in a deputation to the President of the Board of Trade, but it is not easy to see how Mr. Chamberlain can suspend the operation of a statute, even though he was the originator of it. For the comfort of persons whose case may be similar to that of the Wolverhampton manufacturers, we beg to suggest that as the clause in question is of a penal character it must be construed strictly, and it would probably be sufficient for a defendant to show that even one part of the "patent" article had at one time or the other been included in a patent. To put the matter in another way, assume that every patent which has ever been granted for the particular article to be still in force, and then consider whether any of the proprietors of those patents could successfully maintain an action for infringement. If so, then the lock, or whatever it may be, comes within the statute and the proceedings must fail, as it cannot be said that "no patent has been granted for the same." Further, these words are quite general, and it might suffice to prove that an American, French, or German patent had been granted for some detail. Perhaps, however, it might be said that the simplest plan of all, if the stocks are large and valuable, would be to apply on the 1st of January for a patent for the condemned goods. The patent would not be good of course, but if granted it might be a shield against the common informer.

THE UNDERGROUND RAILWAY EXPLOSION.

A VERY exhaustive report on the explosions in the Metropolitan Railway tunnel, on the 30th October, as submitted to the Home Secretary by Colonel Majendie and Captain Cundill, has been published. The report is to the effect that the explosive used was of the nitro compound order, less explosive than the ordinary dynamite, and that it was deposited from trains at about the same time. The first explosion, it will be remembered, occurred at about 7.52 p.m. near Praed-street Station, and the second soon after 8 p.m. between Charing-cross and Westminster, only the first taking place during the passage of a train, the two rear carriages of which were shattered and about sixty-two passengers injured, although the Pintsch gas apparatus with which the carriages were fitted was uninjured. The evidence as to the character of the explosive used is weighed in the report at great length, but it is unnecessary to reproduce it here. It is estimated that at Praed-street about 2 lb. of the dynamite were used, exploded by means of a detonator and held in a zinc case. At Praed-street a piece of unfired ordinary blasting fuse was found. A table is given in the report showing that during the week from 2nd to the 8th November inclusive, the number of up trains passing through Charing-cross Station between 7.30 and 8.30 p.m. having empty compartments was 108, the number of empty compartments during that time being 352 first-class, 267 second-class, and 168 third-class, the average per train being 3·26, 2·47, and 1·56 respectively. The opportunities are therefore not a few for depositing such an explosive from a train. The report is accompanied by lithograph plans, which show the locality of the explosion and indicate the character of the craters produced, the crater at Praed-street being in the masonry of the tunnel, its centre being at about the rail surface level, while that near Charing-cross was in the ballast between the end of the sleepers and the tunnel wall. In both cases the damage extended over a very small area.

THE PRODUCTION OF NORTHERN IRON.

IT is now possible to state with something that will approach accuracy the extent of the production of iron in the North of England in the present year. It may be said that in round numbers the total production of the year will be about 2,750,000 tons. This was the largest production ever reached in the North of England; but it was only reached by a very large use of ores which are imported. The production of iron for use in the steel manufacture—mainly from ores which are imported—is so large now that it may be said to form roughly a third of the total make of the Cleveland and Durham district. The continued growth of the production of crude iron in the North is one of the most remarkable of the signs of the determination of the iron trade to the districts where iron can be most cheaply produced. For though much of the iron made is obtained from imported ores, yet the cheapness of the transit by sea, and the fact that they are smelted on the seaboard, are proofs that that production must now be cheap to be large; and it is worthy of notice that, so far as we have the opportunity of judging, the whole of the iron that has been made has been sold. It is true that a very large part of it has been sold to other countries to manufacture; but so far as the crude iron trade of the North is concerned, that is not a loss. The loss is to the manufacturers, and it is well worthy of the consideration of our producers whether they could not make more of the crude iron into manufactured iron or steel in this country instead of sending it out to Germany, France, and other districts to be made there.

LITERATURE.

Die Gasmaschine. By R. SCHOTTLER. Goeritz, Brunswick.

THE author of this volume, who holds, in the Technical School, Hanover, the peculiarly German position known as that of a "Privat-docent," observes that the literature of the gas engine is at present comprised in numerous technical papers and articles, very ill-adapted for reference; while at the same time the large and growing demand for small motors renders it increasingly desirable that such reference should be easy and convenient. On the other hand, the theory of the gas engine is not sufficiently developed to make a complete and formal treatise possible, while something beyond a mere abridgment of existing materials seems practicable. Accordingly he has written what he wishes to be taken as an introduction to this little known branch of engineering. It consists of two parts; the first describing the chief types of gas engine which have come into practical operation, and the differences between them; the second dealing with the cycle of operations which constitutes the work of a gas engine, as of all other heat engines, and so developing the theory of the subject, and its bearing on practical conditions.

The condition of things described by the author undoubtedly exists in England as much as Germany. It is true the theoretical part of the subject was very fully treated in the able paper of Mr. D. K. Clark, read before the Institution of Civil Engineers in 1882; but anyone who reads that paper, with the discussion which followed it, in the simple hope of obtaining full and clear information on the subject treated of, is not likely to find himself altogether satisfied. The need of a work dealing with such engines as are specially adapted for acting as small motors is also felt in England; and if such a work comes to be written, its author will find much assistance ready to his hand in the present volume. We will summarise its contents. It opens with a short introduction, explaining clearly the nature of the explosion produced by kindling a mixture of coal gas and air, and the mode in which this mixture must be regulated if used to give motive power. Then follows a historical sketch, which the author summarises by saying that the history divides itself into three periods, as follows: Before the Paris Exhibition, 1867—direct-acting engines, without compression; between the Exhibitions of 1867 and 1878—atmospheric engines; since the Exhibition of 1878—direct-acting engines with compression. The chief types of engine are then described and illustrated in their historical order, beginning with the Lenoir and ending with that of Simon (the more recent English engines, such as that of Clark, are, unfortunately, omitted). The largest space is, of course, devoted to the Otto engine, the marked superiority of which over its earlier competitors is traced to three improvements; (1) compression of the mixture before kindling, (2) higher piston speed, (3) slower combustion. In addition to a full description, the results of several experiments, chiefly made by the author, are given; and also a comparison of its cost of working with that of a steam engine, hot-air engine, and water engine. Although the comparison is based on engines of only 2-horse power, it comes out in favour of the steam engine—a somewhat difficult fact for those promoters of the gas engine who insist on its economy under all circumstances.

The second or a theoretical part, begins with a sketch of the leading facts of thermo-dynamics, which might, perhaps, have been dispensed with; and then specifies the various constants whose values are required in applying the facts to the subject under discussion. It is then again pointed out that the experiments as yet available do not offer the means of constructing a complete theoretical diagram of the process going on in any given gas engine; but the general nature of this process is investigated for the following types:—(1) Direct-acting engine without compression; (2) direct-acting engine with compression and with complete explosion; (3) direct-acting engine with incomplete explosion followed by combustion; (4) direct-acting engine with combustion simply; (5) the atmospheric engine. Numerical examples are given in each case, and special points, such as the influence of cooling and of waste spaces, are examined. Finally the actual process in the case of the Otto engine is more fully investigated. The question of dissociation, raised by Mr. Clark, and so hotly debated before the Institution of Civil Engineers, is not touched upon, and the need of further experiment is strongly emphasised. It will be seen from this description that the work by no means contains the last word to be said on the gas engine; but any engineer competent and anxious to study this new and interesting branch of engineering, may by its perusal attain, as it were, a well-laid and solid foundation on which to erect his own structure of research.

THE LATE SIR W. SIEMENS.—We have received from Messrs. Adams and Scanlan, High-street, Southampton, four admirable cabinet *cartes de visite* of the late Sir W. Siemens. The likeness is perfect, and the execution of these photographs leaves nothing to be desired. They were taken at 8.30 a.m., during the meeting of the British Association last year. The pictures have been taken from two points of view—one nearly full, and the other nearly side, face. The latter was Sir William's favourite.

WATER FOR LOCOMOTIVE BOILERS IN AMERICA.—The water supplied to locomotives on the line of the New York Central Railway between Syracuse and Buffalo causes much trouble from incrustation. The *National Car Builder* says:—"Mr. Amos Gould, the master mechanic of the locomotive repair shops at East Buffalo, showed us a few days ago some specimens of scale taken from the crown-sheets of engines that had been running about a year on this division. It was $\frac{7}{16}$ in. in thickness and apparently as hard as granite. The accumulations on the flues were nearly half as thick after running six months." Coal need be cheap under these conditions.

THE DOCKISING OF RIVERS.

No. II.

In 1879, after the opening of the two docks, matters had become so serious that a special committee of the Corporation was appointed to consider the subject of dockising the river. They called for a report from Mr. Howard, who recommended that before any further steps were taken special calculations should be made with regard to the question of the discharge of floods. He was accordingly requested to make these calculations, which proved to be a very long and elaborate proceeding. The problem was as follows:—It was assumed that the maximum flood discharge, taking into account the great increase in floods during the recent years, might be taken at 40,000,000 cubic feet per hour for the Avon, and 8,000,000 cubic feet per hour for the Frome. The former of these would pass over the dam at Netham, the latter would enter the floating harbour. But the level of this harbour is about 6ft. below that of equinoctial spring tides, which in consequence flow over the Netham dam and for some distance up the Avon. The result is that at the time of such tides the Avon and Frome are both pressed back for a certain period at high water. When, however, the tide begins to ebb, the Avon is free to flow over the Netham dam, and the sluices of the floating harbour to discharge the flood waters of the Frome. But if the floating harbour were extended down to the mouth of the river, as now proposed, it becomes an important question to consider what would be the condition of things, especially as regards the old or inner floating harbour, supposing that a flood such as has been mentioned should occur at the time of one of the highest spring tides.

To determine this question, it was first assumed that the new float would be about the same level as the existing harbour. But to enable the flood water to run off through the ten miles between Netham and Avonmouth, a surface slope of several feet would be necessary, and this slope must be steepest at the upper and narrower parts of the river. To find out what these slopes and the consequent velocities would be, it was necessary first to determine the sectional area of the river at every change of width, and, secondly, its cubical capacity as a reservoir for every inch in depth; then, taking the assumed maximum discharge per hour, it was possible to determine the velocity it must acquire in order to pass through these varying sections, the slope attendant on these velocities, and the effective capacity of the reservoir as dependent on the relative levels of the water inside and outside.

The method proposed for meeting the floods was, of course, to draw down the great float before the flood tide to such a level as would leave a storage capacity sufficient to make a reservoir for the storm waters during the period of high water. As there was no possibility of predicting what would be the best level to which the float should be drawn down, some such level had to be assumed, and then a series of calculations worked out in order to see what the level would be at each successive half hour. By a repeated series of such trial and error calculations, a result was finally obtained showing what would be the condition of the great float at any time during the tide, and the extreme level to which it would have to be lowered beforehand. The practical results were as follows:—Supposing the river to be dockised by a dam at Avonmouth, and that a flood of 40 million cubic feet per hour should coincide with an equinoctial spring tide, this flood could be passed off by lowering the great float to the extent of 8ft. at the lower end and between 6ft. and 7ft. at Rownham. The maximum height to which it would subsequently rise at the top of the tide would be 20in. above float level at the lower end, 27in. at Rownham, and 5ft. 9in. at Netham. During this period communication would be maintained between the outer and inner float by locking. Large sluices would be provided for carrying off the waters of the Frome at Rownham; and it was recommended that pumps should be laid down to assist in the discharge of the Frome if necessary. The velocity in the harbour when discharging this flood would at the utmost amount to three miles per hour, and would therefore not be dangerous for the working of vessels. The difficulties of dealing with the flood become less as the range of tide decreases; and at mid tides no lowering whatever of the great float would be needed.

Mr. Howard's report, which was presented in January, 1881, went on to describe a new Admiralty survey made of the anchorage at Kingroad, which showed that whilst several changes had occurred in the deep water since 1867, it still continued ample in depth and extent. A curious discrepancy as to the datum line of the two surveys to which Mr. Howard called attention prevented any very accurate comparison being made. So far Mr. Howard's official report; but in an informal letter to Mr. Townsend, the chairman of the Dockising Committee, he stated his own general views upon the question at issue. He was convinced that, although not without its difficulties, the dockising scheme was a practicable one, and should it ever be properly carried out no injury would be caused by it to the roadstead of Kingroad, nor would it prove a source of danger, or in any degree disadvantageous, to the city or its neighbourhood. Moreover, he still retained the opinion that no other scheme of dock accommodation would so well preserve to the city her ancient position and advantages as a port. But as regards the possibility of getting the scheme carried out, he saw grave difficulties in the way. There were obvious sources of opposition, to which he merely alluded; but they may be generally stated as including the Admiralty, the proprietors of the Avonmouth and Portishead docks, and that numerous class of individuals whose business in life is obstruction. Among less obvious opponents he pointed to the city of Bath, which is much troubled by floods in the Avon, and might probably think that these would be increased by the formation of the new float; although, in Mr. Howard's opinion, the result would really be a benefit to them, because the tide would be completely excluded from the upper waters of the Avon. Again, he observed that the general feeling now existing as to the damage done by floods would create a prejudice against any scheme which might ever seem to interfere with their discharge. Lastly, he observed that whilst he would not himself touch upon the financial aspect of the question, it was certainly desirable that some definite scheme on this head should be put forward.

The result of this report was that the committee determined to take further action on the question of floods; and they called in the assistance of Mr.—now Sir—Robert Rawlinson, chief inspector for the Local Government Board. Unfortunately, Mr. Rawlinson's health prevented his going far into the question himself; but he engaged the assistance of Mr. H. J. Marten, engineer to the Severn Commissioners, &c., and of Mr. G. J. Symons, F.R.S., past president of the Meteorological Society. Early in this year both these gentlemen presented reports upon this subject. That of Mr. Marten deals first with the general features of the rivers Avon and Frome. It appears that the area of the catchment basin of the Avon above Rownham is 798 square miles, and that of the Frome 68 square miles. It is a remarkable fact that every geological formation from the upper greensand and chalk to the old red sandstone is developed within the former of these basins. At the same time, about two-thirds of the whole area consists of the various strata of the oolitic system, so well developed in the neighbourhood of Bath. The total length of the Avon and its tributaries above Bristol is 675 miles, or about four-fifths of a mile per square mile of drainage area. On these streams there are no less than 114 mills. About two-thirds of the basin faces the south-west and has a heavy rainfall, especially on the high crests of the Mendip Hills. Here the annual rainfall is about 47in., whilst at Bristol it is about 32½in. But as the large fall is only on a small area, the main rainfall over the whole district is estimated by Mr. Symons at 33in., while that of the Frome basins is taken at 35in. With regard to the channels themselves, both rivers are held up at various levels by dams or weirs, and their sections at different points are very irregular. This especially applies to the Frome, which enters the floating harbour through two long culverts built at different times and in a very irregular manner. The result has been that, in late years especially, disastrous floods have several times occurred in some flat lands near Stapleton, on the outskirts of Bristol, which have been recently covered with cheap houses, and the abatement of these floods has become a very serious question.

Next Mr. Marten states that he has carefully checked the elaborate figures prepared by Mr. Howard as to the discharge of flood waters, and he expresses the opinion that a flood of 48 million cubic feet per hour could be satisfactorily dealt with as there suggested, on the assumption that the cross sections of the river as supplied to him are correct, that the sluices, &c., will at all times be in good working order, that they will be able to be opened and closed rapidly, and that proper flap valves will be fixed outside them, so that the moment the level of the water in the new float is higher than that outside, discharge may commence automatically without delay. Mr. Marten then goes into the question whether Mr. Howard is on the safe side in assuming 48 million cubic feet as the maximum discharge to be dealt with. For this purpose he gives particulars of all the leading floods in the Avon and Frome, with respect to which any reliable observations are extant. From these he deduces the conclusion that Mr. Howard's estimate is a safe one; and he further points out that the period of maximum discharge in the Frome is fortunately not synchronous with that from the Avon, but would occur something like twelve hours earlier, and would therefore be passed off on a previous tide. Assuming, however, that a quantity of 8 million cubic feet per hour should enter the existing floating harbour at a time when no discharge into the great float is possible, Mr. Marten considers how this should be dealt with, and instead of the pumps proposed by Mr. Howard he suggests the driving of a culvert from a point on the Frome at Stapleton Lower Mill to the bend in the Avon at the foot of Durdham Down, about a mile and a-half below Rownham. The distance would be a little over three and a-quarter miles, with an available fall of 15ft. to 16ft. Mr. Marten does not give an estimate of the cost of this culvert, but he points out that it would have an excellent effect in saving the lowlands above Bristol from floods. At present these lands act as a reservoir additional to the floating harbour, but in the future this cannot be expected to continue, and further provision therefore seems necessary, especially as a great part of the Frome's basin lies in the coal measures, and the owners of collieries are likely to take full advantage of such powers as Parliament may hereafter give them for freeing their lands from surface floods. With this further provision, Mr. Marten does not expect that any difficulty will arise from the anticipated legislation as to the prevention of floods. "It is evident," he observes, "that no very immediate or sweeping change can be safely effected in the general *régime* of a river; for the flood waters cannot be held back to any material extent, nor can their discharge be greatly accelerated from the uplands without intolerably burdening the lowlands. It is a moot point whether extended cultivation and under-drainage have the effect of causing flood waters to be discharged more rapidly into the main stream than formerly, or whether, by the superior absorbing power they give to the land so dealt with, they do not, whilst eventually discharging the flood waters with more efficiency and completeness than formerly, have for the moment a somewhat equalising effect in tending, by absorption, to retain and retard the first discharge. . . . The improvement of the river channel, the removal of obstructions, and the execution of other river conservancy works, will accelerate the period at which the preliminary swelling of a river like the Avon will take place; but the rise from that period will not be more than, if so rapid as, at present, and hence the rate of maximum discharge will not be materially affected, while the general effect will be to pass the floods off land and other places where they are not wanted to remain, in a much more effectual and complete manner than is now the case."

Mr. Symons report deals of course with the meteorological question only, and gives in an appendix the particulars of some twenty-three floods in the district and, where possible, of the rainfall preceding them. He observes that the heaviest of these floods do not represent the maximum which might occur under a very peculiar and unfavourable combination of circumstances. But even so, it would appear that Mr. Howard's estimate leaves an ample margin.

These reports were presented by Mr. Rawlinson, together with a final report by himself, which, however, contains very little that is new or important. We may, perhaps, quote the last paragraph:—"Having had some experience in docks, river, and canal work generally, I see no practical difficulty in converting the river Avon from a difficult tidal navigation into a safe and practicable floating harbour, through which sea-going steamers may navigate to and from Bristol with much more regularity and safety than they can do at present; and I do not need to remind Bristol merchants that the shipping trade of the world is now for the most part carried on by very large sea-going steamers, which must have a ready and safe port to facilitate quick passages, and that the use of steamers of large dimensions will inevitably extend to the exclusion of every other class of vessel. Some improvement in the port of Bristol seems therefore to be imperative." B.

LEGAL INTELLIGENCE.

HIGH COURT OF JUSTICE—QUEEN'S BENCH DIVISION.

Before Mr. JUSTICE DENMAN *and a Special Jury.*

WESTINGHOUSE *v.* THE LANCASHIRE AND YORKSHIRE RAILWAY COMPANY.

THE hearing of this important case has been continued during the week, and is expected to be concluded to-day or to-morrow. The counsel engaged are for the plaintiff the SOLICITOR-GENERAL, Mr. ASTON, Q.C., Mr. DAVEY, Q.C., and Mr. CHADWYCK HEALEY; for the defendants Mr. WEBSTER, Q.C., and Mr. MOULTON.

The first witness examined was Mr. Imray. In reply to Mr. CHADWYCK HEALEY, he described and explained the plaintiff's apparatus as specified in patent No. 1540. He said the loaded valve closed when there was a sudden change of pressure, and the brakes were then put on. It was most important to provide for leakage in the plaintiff's apparatus. The brakes once on, could not leak off, because the heavy valve was closed. A small passage—as, for example, a hole in the piston—would let the reservoir be charged, but the brakes would leak off. This apparatus might be used either with vacuum or compressed air. In the defendants' apparatus there is a passage from the train pipe to the reservoir with a heavy valve in the way. The witness described the action of the apparatus. Asked if he found in the defendant's apparatus the equalising arrangement that exists in Westinghouse's, he replied, "Yes; the valve." A model was then put in showing the effect of breaking the train in two in any place. A vacuum was made by witness and the model put in action. A different model was then put in, working with compressed air, and that was also shown in action on a pair of inclined rails.

The witness was then taken on the question of brake rigging under patent 3840 of 1873. He described the plaintiff's rigging as made in accordance with this specification. A model was put in, and also one of the arrangements used by the defendants. Witness saw no difference between the plaintiff's and defendants', save that one used a roller running on a bar—see page 437—and the other used two side links. There was no substantial difference between the two.

Mr. Imray was cross-examined at great length by Mr. Webster. The first questions referred to the non-appearance of Mr. Westinghouse in the case, and to the way in which the specifications had been sent over to Mr. Imray—plaintiff's patent agent—from America. Specification 1540 referred to ten previous specifications of Mr. Westinghouse. Asked if 1540 did not contain parts referred to in these, witness said it did some of them. The valve, piston, leakage valve, cup leather, cylinder, and V-shaped rib. Most of them appeared in some of the specifications. The small hole for the passage of fluid did. The model—see Fig. 3, page 437—was made at Mr. Westinghouse's works in England. He believed nothing exactly like it had been used on an English railway. Substantially the same thing had been used with vacuum on the Midland Railway. A big piston and a small piston, as in Fig. 3, had not been used. Asked as to the antiquity of the parts, witness said a cylinder for actuating brakes was old, an auxiliary reservoir was old, a leakage valve was old, a leakage valve which permitted the passage of a gentle current, and came on its seat when the current was strong, was old. The reservoir could be charged past the cup leather in plaintiff's apparatus. In reply to Mr. Justice DENMAN, witness said that the basins and diaphragm—see page 437—used by defendants were the equivalents of a cylinder and piston. They were a well-known device. There was no V-shaped rib as in plaintiff's apparatus.

On Tuesday, December 4th, the second day of the trial, Mr. WEBSTER further cross-examined Mr. Imray. Witness said that a heavy valve was necessary to work the defendant's apparatus; would not undertake to say that a pith valve would not do; nobody would speak of a pith valve as a heavy valve. But plaintiff used a light valve with a large area past it. Thought it was very likely that a small india-rubber valve, about the size of a marble, was working on the Taff Vale Railway. No engineer would speak of that valve as a loaded valve. Line 23 in specification 1540 indicated that the valve was to be vertical. A good deal of questioning then took place concerning the precise meaning of the words in plaintiff's specification: "A valve in a case, with a seating above and below the valve," counsel contending that with a double seating charging could not take place past the valve, and witness contending that it could. In practice the valves were not made to seat tightly at both ends; but witness admitted that there was not a word in the specification to show that they should be less tight at one end than the other. It made no difference whether the valve was put horizontally or vertically; it might be put in any attitude. Witness was cross-examined as to whether prior patents of Mr. Westinghouse anticipated No. 1540. Nothing important was elicited. Witness was then asked if a flap valve would or would not infringe plaintiff's claim. He stated that if it was fitted so as to hang away from its seat it would. If it did not hang away from its seat it would not. Theoretically the valve might be an infringement when the train was running uphill and not an infringement when it was running down hill, for in one case the valve would be off its seat, and would act as an equalising valve, and in the other it would be on its seat and would not act as an equalising or leakage valve. We do not give the witness' exact words, but their sense. The defendants' apparatus could not work as a practical working instrument unless there was a leakage valve between the train pipe and the auxiliary reservoir.

Witness was then taken on Steel and McInnes' brake—see page 470—and described its action. We reproduce the patentees' description.

Fig. 1 is a vertical section of a compressed air cylinder and receiver, with attachments, constructed in accordance with our invention. The cylinder A and air vessel B are shown fixed in one casting. The cylinder A is cast with the upper end close, the lower end being fitted with a cover C. The cover C is provided with a stuffing-box and gland D, secured by studs E to the cover C, the space F being filled with any suitable packing. On the inner side of the cover C a hollow cylindrical projection G is fixed, on which the piston H rests when it is in its lowest position—that is to say, when the brakes are off. The projection is provided at the top with an india-rubber ring, which acts as a cushion to prevent any shock which might arise from the fall of the piston H. The space between the piston-rod and the interior of the cylindrical projection G may be filled with packing, to further prevent the escape of air from the cylinder A. The piston H is packed by a cup leather, secured to the upper side by a washer and nut, which nut at the same time secures the piston H to the piston-rod, as shown in the drawings. An india-rubber ring is placed on the washer, to cushion the shock in the event of the piston striking the top of the cylinder. On the inlet-pipe N is a branch O, in which is formed a valve chest and seat. The branch O is connected to the air vessel B by a pipe P. A ball valve or clack, Q, accurately fitting the seat in branch O, prevents the air from returning by the valve Q. The herein-before described connecting pipe P and ball valve or clack Q may, however, be dispensed with, and the piston H made sufficiently slack in the air cylinder A to allow the air admitted by the pipe N to pass the piston H to the lower part of the cylinder A, and thence to the air vessel B. When the compressed air in the vessel B and lower part of the cylinder A is allowed to expand, so as to lift the piston H and brake the train, the cup leather secured to the piston H is inflated thereby, and pressed against the interior of the cylinder A, so that no air is allowed to pass the piston H on its upward stroke. The piston-rod is coupled to the brake apparatus by the connecting links R.

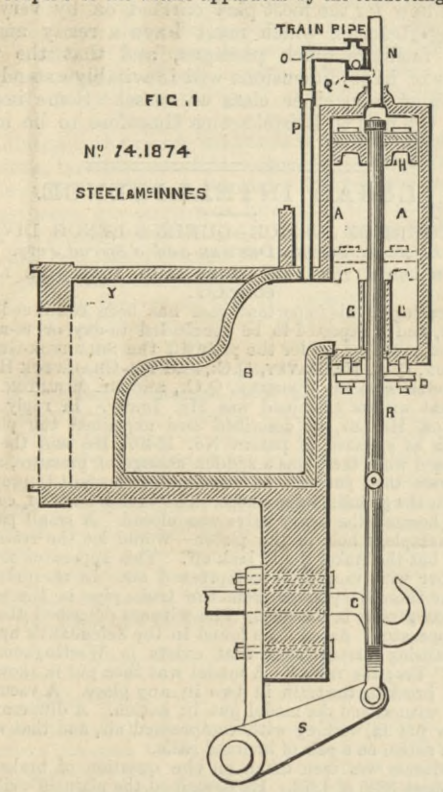
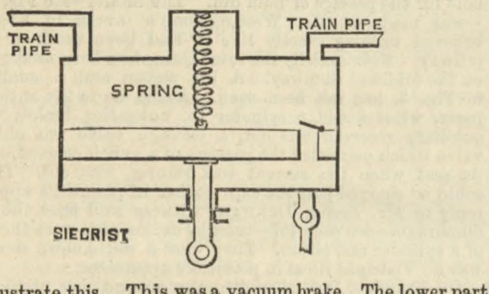


FIG. 1
Nº 74.1874
STEEL & McINNES

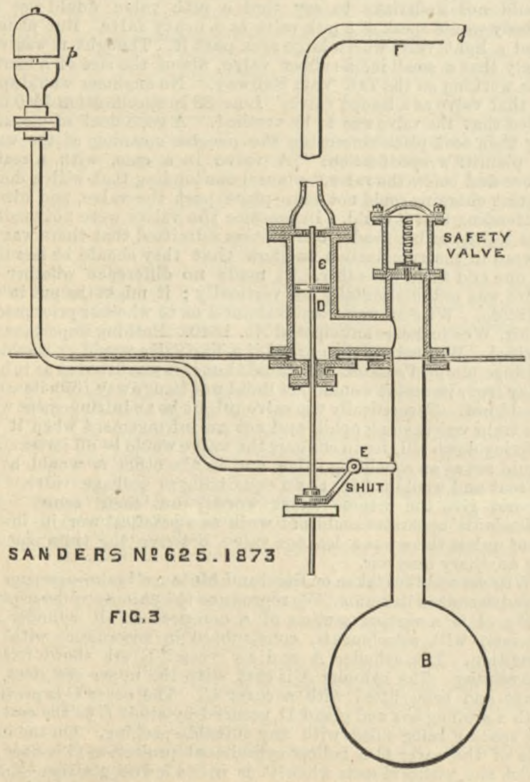
Asked if the operation of the ball valve in this was not identical with that of the ball valve in defendants' brake, witness replied that it was not, because in the Steel-McInnes brake the valve was always on its seat, and in the defendants' it always rested away from the seat, unless pushed on. If Steel and McInnes' brake were put down on its side, the ball valve would be that which the defendants have got. The sole difference between Steel and McInnes' apparatus and that of the plaintiff was that the ball valve was made by the latter to act as a leakage valve. The V-shaped rib in Steel and McInnes' would act in precisely the same way as the V-shaped rib in plaintiff's. Had heard that Mr. Westinghouse had bought Steel and McInnes' patent.

Plaintiff was next taken to Siegrist's specification of 1863. A drawing was put in made from the specification. The diagram



SIEGRIST

serves to illustrate this. This was a vacuum brake. The lower part of the cylinder is exhausted through the flap valve in the piston.



SANDERS Nº 625.1873

FIG. 3

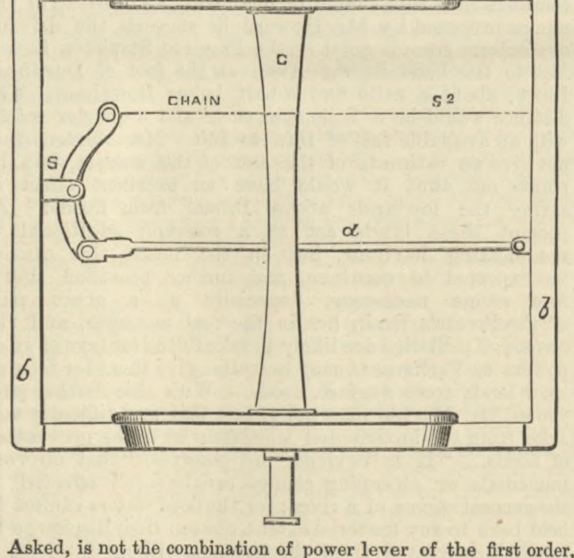
The spring keeps the brake off. When the train pipe is broken or opened, air rushes in, closes the flap valve, and forces down the piston putting on the brake. The point discussed was whether the flap valve was the equivalent of the ball valve used by defendant. Our readers will see that it was claimed that it was. The plaintiff could not substantiate his claim, according to the defendant, because if Siegrist anticipated defendants', and defendant's was the same as Westinghouse, then Siegrist anticipated Westinghouse as well as defendant, and so Westinghouse could have no ground for complaint. An immense number of questions was asked, mainly intended to show that Siegrist's, although only a provisional specification, described a brake that would work well, and could be made from the specification by any competent workman. After some questions concerning the triple valve, Mr. Webster directed Mr. Imray's attention to Sanders' patent, No. 625, 1873, Sheet 2, Fig. 3, which we reproduce below. We also reproduce as much of the specification as refers to it.

"So long as the pipes F on and between the carriages are complete and the cocks or valves are closed, a current of air passing to the said pipes from the receiver B is very feeble, and passes by the disc valve in the cylinder C without raising it; but should any rupture take place in consequence of the train becoming accidentally divided, or should any of the cocks or valves on or in the carriages or brake vans be opened, the pressure on the top of the disc valve D is immediately diminished, and the pressure of the air in the receiver B, acting on the under side of the valve D, forces it up to its seat at the top of the cylinder C, thereby shutting off communication between the air receiver B and the carriages, and by opening the cock E turns the condensed air in the receiver direct to the whistle *p*. A like effect is produced by the pressure of the atmosphere when the apparatus is worked by exhaustion. The valve D is weighted so that it always falls to the lowest position when the pressure of air is equal on both sides of it."

Mr. Webster read over the specification, and asked the witness —"Excepting it being applied to brakes as distinguished from signals, is there any difference whatever in the operation of Sanders's and the operation of the plaintiff's combination." Mr. Imray said there was this difference—that Sanders used his leakage valve as his operating piston to open a cock of a whistle. The plaintiff does not use his valve at all as an operating piston. This was the only difference. The witness had nothing to add. Asked if in Bolitho's patent, No. 592, of 1872, there was not a piston regulator which was, in fact, a leakage valve for allowing fluid to pass at slight pressure in order to prevent the brakes going on, witness said there was, but not for the same purpose; it was only a valve for charging the pipe. Asked if Mr. Westinghouse had bought Bolitho's and Sanders's patents, he said he had no reason to doubt it. Mr. Webster then took the witness on the cam-shaped segments for applying the brakes—see page 437. He took Claim 4 in patent 1540, and Claim 5 in patent 3840. Both refer to the use of vertical cylinders and excentric segments. Witness said there was a difference, namely, that in one case the segments were close together, and the segments were pivotted on the brake blocks; but in the other case the wheels were far apart, and a connection had to be made between the segments and the brake blocks. In one the piston-rod worked through the top of the cylinder, and in the other through the bottom. The first meant that push rods had to be interposed between the brakes and segments. Thought it required invention to make the difference. As regarded Claim 5 of patent No. 1540, the witness said that the parts were old, but that the invention consisted in applying the truss and the lever which were previously used, to one pair of blocks instead of two pairs. Witness subsequently qualified this, and said it was not perfectly well known or described how to apply four brakes by means of a rod and lever of the first order to two trusses. Chapin's patent was then put in, No. 2973, 1872. We reproduce Fig. 5, which is the most important. The specification runs concerning it

"When it is desirable to apply the brakes to the wheels on both sides of the axle, I modify the apparatus as illustrated in Fig. 5. To each of the cross bars *b* which are placed on the outer side of the carriage axle *c* I joint a lever *s*, that is to say, the fulcrum s^1 of the said lever is fixed upon the cross bars *b*; another cross bar also carrying brake shoes is placed on the inner side of the axle. One end of the connecting rod is *d* attached to an arm of the lever *s*, and connects the same with the central horizontal lever *e*. The other arm of the lever *s* is connected by a rod or chain to the inner cross bar when the said horizontal lever is turned in one direction on its axis, the two cross bars will be drawn together and the two sets of brake shoes forced in contact with the wheels. By turning the lever in the other direction, the two sets of brake shoes will be drawn back or away from each other and the wheels released."

FIG. 5



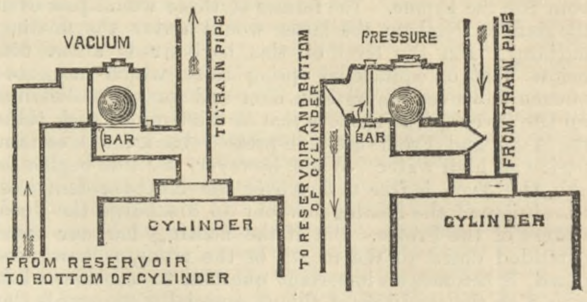
Asked, is not the combination of power lever of the first order, rod, truss, and brake blocks, identical in that sketch, Fig. 1, and the model of the plaintiff's claim identical, witness said they were very much the same, but not quite identical. The difference was that Chapin used a horizontal lever and the plaintiff one which was vertical. In Chapin's this rod extended a considerable way from the lever. In the plaintiff's it was close to the truss. These modifications required invention. The invention lay in supporting the fulcrum of the lever by a truss under the carriage frame. Webb's arrangement was different, because there was a rocking shaft shown in it.

The witness was then taken back again to the loaded valve. The witness said that although the valve was old and the seat old, he thought the use of a valve which did not normally lie on its seat was new. The arrangement shown in plaintiff's specification was new, but it was not new if used vertically. Putting the valve vertically upside down, with the valve away from its face, witness said the arrangement was new, but he admitted that one modification of Montgolfier's hydraulic ram was exactly the same in form.

A return was then made to Chapin's rigging, and Fig. 5, which we reproduce, was referred to. "This was," the witness said, a 'floating fulcrum' in the Westinghouse patent." With Chapin's specification in his hand, he still thought it required invention to produce the floating fulcrum.

The next point of interest raised was the use of screw eye bolts to hold down the lid of a triple valve box. We need not reproduce the drawing, for such eye bolts are well known to all engineers. They are used for fastening side lights on ships, and the lids on the valve boxes of pumps, in order that ready access may be had to the valves for cleaning them. Mr. Webster put in one of Newton's specifications, showing the device applied to an air chamber for a pump. The witness admitted that the two were identical. This terminated the cross-examination. The witness was briefly re-examined by the Solicitor-General, but nothing of importance was elicited.

If our readers will carefully peruse our abstract of Mr. Imray's evidence, they will be in a position to understand the merits of this case. A great many witnesses were called, but the evidence given went very much over and over the same ground; and we shall only reproduce those portions of it which seemed to cast fresh light on the case. The accompanying diagrams are reproductions on a small scale of two much used in the Court to illustrate in Steel and McInnes the action of the ball valve, according as vacuum or pressure is employed.



The Solicitor-General continued Mr. Imray's re-examination on Wednesday, the third day of the trial. His examination was principally directed to showing that there was a substantial difference in the result produced by Chapin's and Westinghouse's brake gears. As regarded Chapin's, Mr. Imray said that springs would be necessary to cant the brake blocks off the wheels; but they would not be needed in Westinghouse's. The pressure on the brake blocks would not be equally distributed by Chapin's gear. He considered Westinghouse's rigging a distinct improvement on Chapin's. Witness was then taken to the valve shown in Fig. 3, No. 1540—see page 437—and stated that it did not seat at both ends as had been alleged. The arrangement would permit of charging the auxiliary reservoir; the valve served for both equalising and charging. The valve shown in specification 3840, of 1873, would not serve that double purpose. The only object in the Steel and McInnes valve was to prevent air from returning. If the apparatus was turned on its side it would perform the function of the plaintiff's valve; this would depend to some extent on the size of the pipe. Siegrist's arrangement differed from the plaintiff's in there being no auxiliary reservoir and no equalising arrangement. In the specification Siegrist said that the "vacuum vessel" on the engine should have a capacity at least twenty times greater than the aggregate of the cylinders on the train. This would be so large as to be practically inconvenient. He did not think Sander's arrangement for blowing whistles could be applied to brakes. The working of brakes was named in the same specification, but the brakes were to be worked in a different way. The remaining questions put to witness went over and over old ground and elicited nothing important.

Dr. John Hopkinson was next called, when Mr. Justice Denman said:—"I hope there will be something like mercy towards everyone in not calling half a dozen witnesses on each side to the same things. There is no reason why there should be a difference between patent actions and any other actions; but I very often find people act on the theory that there is. The rule of *nisi prius*, I think, which is common sense, and really essential to the trial of actions such as this before juries, is that the parties should do something like selecting witnesses in whom they have confidence, and when they have proved a thing once, to rest content with it. I would not submit to sit here and hear the same thing proved over and over again by half a dozen witnesses on either side; otherwise, I should immediately refer to some scientific person. It is intolerable the time the jurors are kept over one case, and they do not come a bit better to decide, than they could if they attended closely to the evidence of two or three witnesses, which would be quite enough." All sensible men will agree with Mr. Justice Denman's remarks; and as our purpose is not to weary our readers, but to give them a fair conception of what this trial is about, we shall make no attempt to report at any length what the remaining witnesses had to say. Indeed, with the statements of the leading counsel on both sides before them, and the evidence of Mr. Imray as we have reported it, they can know as much about the case as is possible for any one not in Court, and with the models and drawings and witnesses before him, to learn.

Dr. Hopkinson is a Fellow of the Royal Society, a Senior Wrangler, and a consulting engineer. Little new matter was elicited from this witness. He principally went over the ground covered by Mr. Imray, expressing himself somewhat differently. Thus, he held that Steel and McInnes expressly stated that they used the valve—on which so much turns—to prevent air from returning, while Westinghouse says his valve shall permit the air to return. Siegrist's specification could not produce a practicable brake for use on a railway, because it had no adequate auxiliary reservoir. As to Chapin's rigging, he agreed with Mr. Imray. Cross-examined by Mr. Moulton, witness said that ball valves were used in all sorts of positions, as, for example, in glass water gauges. He was then taken over the clap valve question, and admitted that it might infringe going up hill and not down hill. It may be safely said that the examination and cross-examination of this witness did not advance the case at all. Asked as to the rolling cams for putting on the brakes—see page 436—witness did not think them the same as a toggle joint. Did not think Stephenson's patent of 1833, with a vertical cylinder and crosshead and side rods lifting a toggle joint, an equivalent of Westinghouse's. With cams a variable pressure could be got. Concerning the rest of the rigging, on which he was examined and cross-examined at great length, he maintained generally that Westinghouse's arrangements differed from Chapin's enough to require invention. As to the difference in pressure referred to by Mr. Imray on the different brake blocks, witness admitted that this was merely a question of the length of the lever arm, and that there was no essential distinction there at all. His examination occupied most of the fourth day as well.

The next witness examined was Mr. Abel, Mr. Imray's partner, but only a few formal questions about the preparation of patents were put to him. This closed the plaintiff's case.

On Friday, the fifth day of this remarkable trial, Mr. Webster, Q.C., commenced his reply for the defendants. He spoke for two hours, and stated his case with extreme clearness. The points on which he relied were, he said, that in the patent No. 1540 Clause 2 must be confined to the precise combination claimed, and he submitted that there was no evidence that the defendants infringed that combination. The second point was that the valve used by the defendants being old, the cylinder and piston for the purpose of actuating the brake gear being old, if the plaintiff's claims were construed so as to include the application of the old valve and the old cylinder and piston, it was bad, but unless so construed the defendants did not infringe. The third point was that the patent is bad, because it does not distinguish the new from the old, or tell the public what it might or might not use. He alleged that the 4th claim of the same patent, 1540, was bad, as being the same combination as Claim 5 of 3840 without further invention, and claim 5 is bad as not being the subject matter of a patent having regard to the existing state of knowledge, by reason of its being the same as previous combinations requiring no invention. Claim 1 in 3840 was bad, because the method of securing the valve box cover was separately claimed, and was on the evidence old. This was also anticipated by claim 5, the knee joint of 3840. He then went on to comment severely on the fact that neither Mr. Westinghouse himself nor any competent railway engineer was put into the witness-box in support of the plaintiff's contention, only two witnesses being examined, namely, Mr. Imray and Dr. Hopkinson, neither of whom had any special railway experience whatever. If our readers will turn to our last impression they will find on page 437 Fig. 3 of patent No. 1540, which it is alleged the defendants are infringing. Mr. WEBSTER contended that this invention is of no utility, and it is a well-known fact in patent law that an invention to be a good subject for a patent must be useful. It was suggested to the jury that Mr. Westinghouse brought this action to prevent the Vacuum Company infringing some useful invention of the plaintiff's, but this was not a useful invention, and he would prove by competent witnesses that the particular arrangement shown in Fig. 3 never had been used, and that it could not be used with any chance of success. Mr. Westinghouse had done nothing with it. If the plaintiff could have called a single witness to prove that it was useful no doubt he would have done so. But he did nothing of the kind, and Mr. Westinghouse had had very great opportunities for trying it if he had thought proper, because Mr. Allport, late general manager of the Midland Railway, was a great friend of the plaintiff's and gave him every facility for trying his inventions. Furthermore, he would show that the system of keeping brake pistons under pressure other than that of the atmosphere was not liked by the defendant; and thus the very system which rendered the use of a leakage valve desirable was not used now by the defendants at all. The learned counsel then proceeded to explain a model—full size—of a brake cylinder, &c., made from the drawing Fig. 3, in accordance with the patent specification, and he explained that the system could not be worked in practice, because of the dirt and grit which would be drawn into the open small cylinder. Again, useful or not, the thing was not a good subject for a patent, because the parts were old, and the law says that where a man patents a combination of a number of old things and puts them together, then, unless a defendant takes the same combination in its integrity, he does not infringe. The law has been distinctly laid down so in the House of Lords. Now, Mr. Westinghouse himself had taken out nine patents before that of 1873, and ten before that of 1874, and these patents, containing dozens of claims, anticipated each other, the same thing being patented twice over. He then went on at considerable length to deal with the question of the leakage valve. We shall not attempt to reproduce the learned counsel's words; it will suffice to give the substance of his argument. Mr. Westinghouse uses the so-called "heavy" valve as a leakage or equalising valve. A valve which is kept off its seat, unless forced on by a sudden rush of fluid, is not new, such valves being used in water gauges and hydraulic rams, therefore the plaintiff could not claim the valve; all he could do was to claim the use of such a valve for a specific purpose, that is to say, as an equalising or leakage valve, as already explained in our last impression. Now, as a matter of fact, the defendants did not use a normally unseated valve for this purpose at all. They dealt with leakage in an entirely different way. They provided for it by putting a small ejector on the engine, which ejector was kept continually at work to remove leakage. The valve was used by the plaintiff to prevent his brakes from going on, but it was used by the defendants for the very opposite purpose, namely, to put the brakes on. Thus, then, the valve itself was old and could not be patented, though its application could. But if the plaintiff patented it to do one thing, the fact that the defendants used it to do another thing would not infringe the plaintiff's patent. It was explained by Mr. Webster, and will be readily understood by an inspection of the Aspinall brake, as used by the Lancashire and Yorkshire Railway Company, page 437, that when the train pipe is opened the ball valve goes on to its seat in order to prevent the pressure being equalised on both sides of the diaphragm. The valve was used to charge the brake reservoir, using the word charge for either vacuum or compression. But the plaintiff never contemplated charging through his loaded valve at all, but by letting the air pass the cup leathers of his piston. The leakage valve was, indeed, fitted with a seating at both ends, so that if there was any considerable difference of pressure, as there would be in charging, it would be closed tight. Having considered the plaintiff's specifications step by step, the learned counsel said:—"I put it to you, is not that the description of a combination special in its parts, special in its uses, special in its application to railway brakes? Not one of its parts for the purpose of use does the defendants take, not one of its uses does the defendants take, and not one of its modes of application do they adopt." Mr. Webster next proceeded to show that Siegrist had anticipated Mr. Westinghouse. He produced two drawings made by independent draughtsmen from Siegrist's provisional specification, which is not illustrated; and it was admitted that this was an automatic brake, and would work.

It is well that our readers should bear in mind that these alleged anticipations do not refer to the Westinghouse brake as used, for example, on the London and Brighton Railway, which brake is worked by entirely different patents, and it is not alleged that the defendants are infringing these; the whole question being tried turns on two patents only of the plaintiff, namely, 1540 of 1874 and 3840 of 1873. It is these, and these only, that the Vacuum Brake Company is said to infringe.

If our readers will turn to the drawing of the defendants' brake, page 437, they will see that the ball valve is kept away from its seat by its gravity, the way up to the seat being inclined or coned. It is alleged by the plaintiff that this constitutes it a heavy valve. It will be readily understood that a flap valve could be used for the same purpose, and that if the valve was suitably suspended it would hang a little away from its seat just as the ball valve lies away. The plaintiff's witnesses were asked if a flap valve so used would be an infringement, and they said it would. Mr. Webster next proceeded to say that, even as regards the equalising or leakage valve, it was not new. In Westinghouse's patent No. 1735, 1873, there is a triple valve patented. At that time the plaintiff's idea was to keep equal atmospheric pressure at both sides of the piston, and accordingly he put in a pipe which leads from the brake cylinder and triple valve box, and a leakage valve; and it makes no difference whether its construction is this, or the same as in patent No. 3840. It will work in the same way, and as Dr. Hopkinson had told them, for this purpose there was no difference whatever in the operation of the leakage valve, although the particular arrangement might be different. He would summarise his position by saying that equalisation of pressure, equalisation of vacuum, equalisation of relative pressure of air on both sides of the piston were as old as the hills; securing this by a leakage valve in a pipe communicating between the auxiliary reservoir and the brake cylinder was as old as the hills; and the result was, that in order to make a good claim, the plaintiff can only claim something that was distinct from, and a separate combination from that which he had previously told the public, and had claimed against the public in his earlier patents; and this quite apart from adducing any argument based upon either Steel and McInnes' or Siegrist's. The application of a common well-known leakage valve or a ball valve was not the subject of invention, and could not be claimed by Mr. Westinghouse.

The learned counsel then went on to explain what had taken place between the plaintiff and defendants before this action was brought, and said that the defendants, in order to avoid litigation, had consented to withdraw every form of vacuum brake that the plaintiff desired, save the one in question, and that, they said, was not an infringement, and they would not withdraw, but would fight. One of the brakes withdrawn had a leakage hole in the piston. "This brake," said Mr. Webster, "we told Mr. Westinghouse eighteen months ago we did not want to use any longer; if you like, for the purpose of peace, we will submit to an injunction in respect to this, and will pay you damages if you have sustained any, and the plaintiff took no steps whatever, but he comes here to prejudice this case, and produced this brake, and says it is an infringement. Now, this is simply Siegrist's, with the valve taken out, and the hole left. This mode of equalising pressure was as old as the hills."

The learned counsel next went on to deal with the second portion of the case, that concerning brake rigging. If our readers will turn to page 437 they will find Figs. 9 and 11 of No. 1540. It is contended by the defendants that the claim for Fig. 9 is bad, because the only difference between it and previous arrangements shown by the plaintiffs is the introduction of the extension bars M M, which required no exercise of invention. Mr. Imray, when pressed on claim 5, could only say that the plaintiff had taken what was an old apparatus, as applied to four wheels, and applied it to two. It would be for his lordship to say whether that was good in point of law or not. He then dealt with the arrangement shown in Fig. 1, No. 3840, 1873, and held that the use of a "floating fulcrum," as shown, was not new. Mr. Imray had stated that the novelty lay in having a fulcrum, capable of suspension, not free to move. "I then put it to him, 'Mr. Imray, don't you think fulcra capable of suspension and free to move are old,' and I put to him that which I submit to you." The learned counsel then put in a model of Chapin's brake rigging, Fig. 5, which we illustrate on page 470. Here were the brake blocks, and the pull rod, and a lever of the first order suspended from the floor of the carriage and free to move, so that the fulcrum is floating and free to move, and not suspended. Mr. Webster then put in a model of the defendant's rigging, and asked them to say which it was most like, the plaintiff's or Chapin's. The learned counsel concluded by pointing out that the system of brakes which the Solicitor-General had said was so perfect, had never been used at all by the plaintiff.

Mr. Dean was the first witness examined. We must reserve a further report for our next impression.

HIGH COURT OF JUSTICE.—QUEEN'S BENCH DIVISION.

(*Sittings in Banc, before* LORD COLERIDGE, MR. JUSTICE STEPHEN, and MR. JUSTICE MATHEW.)

BAKER *v.* HANDYSIDE.

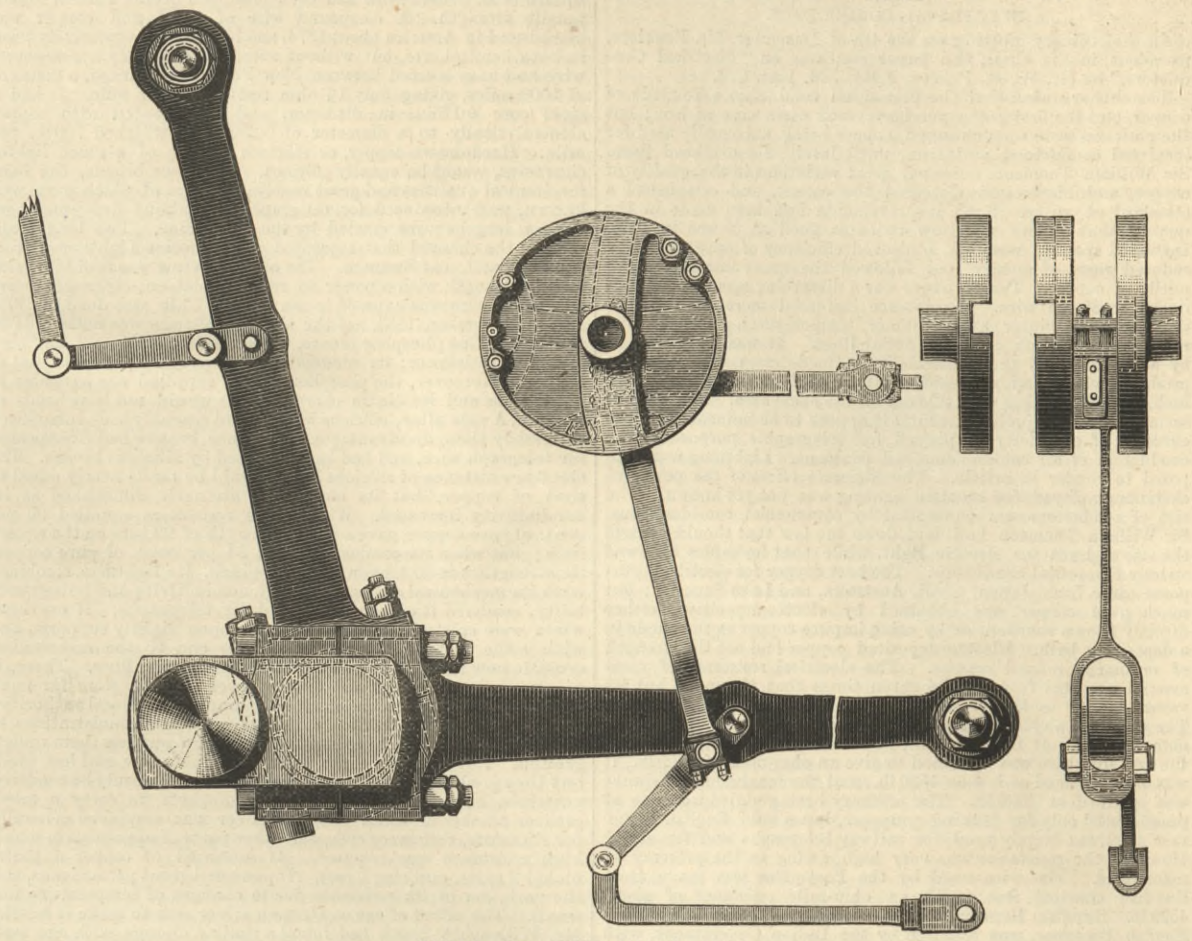
This case raised a question under the Employers' Liability Act as to the liability of employers to their workmen for injuries arising through defects in their machinery or plant. The defendants were railway contractors engaged in making a bridge over the Ouse, and the plaintiff was in their employment and engaged in the work. Cylinders had to be driven into the bed of the river by means of weights upon platforms over the cylinders. The platforms projected over the cylinders all round. The weights were raised by means of a steam engine, which could not be stopped at once. The plaintiff was engaged on the platform, his duty being to take hold of the tackle and guide the weight being raised so as not to catch the projecting edge of the platform. A weight caught the projecting edge, and as the engine could not be stopped at once, the consequence—which it was admitted was quite inevitable—viz, that something must give way—took place, and in this instance the beam above, not able to bear the strain, gave way and fell on the plaintiff beneath it, and broke several of his ribs. Since then a regulator had been applied to the engine. The County Court judge, who heard the case without a jury, said that the accident was the result of a defect in the machinery and not through the negligence of the workman, and that it was a defect which might have been avoided by ordinary care—as to which, it should be observed, that since the accident a regulator had been attached to the engine to enable it to be stopped at once—and so he gave judgment for the plaintiff for £170. The question was whether the Judge was right in his conclusion. It was admitted that it was likely that a weight might catch at the edge of the platform as it was being raised, and that both the workman and the employer knew this—the man being posted for the purpose of so guiding the tackle as to prevent it—but the case for the plaintiff was that through the defect in the engine it could not be stopped so soon as the weight caught, and this was the effect of the finding of the Judge.

Mr. ROBSON, on behalf of the employer, the defendant, argued that the Judge had wrongly decided the case.

Mr. F. MELLOR, on the other side, was not called on.

The Court on Saturday held that the finding of the County Court judge was justified by the evidence, and supported a judgment in favour of the plaintiff. The Act cleared away the former doctrine as to the non-liability of the employer for injuries to his workman, and put the workman in the same position as if he were not in the employment of the defendant. The case decided in a Court of Error long ago showed that mere knowledge of the danger was not sufficient to deprive the party injured of his remedy. The judgment of the County Court judge, therefore, was right, and must be affirmed.

ROLLING MILL ENGINES, RHYMNEY IRONWORKS.

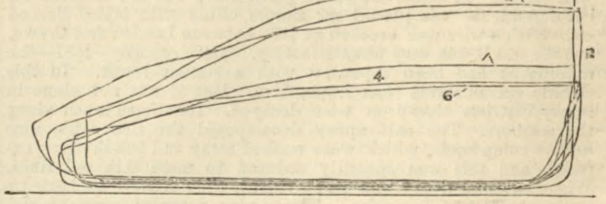


DETAIL OF JOY'S VALVE GEAR.

ROLLING MILL ENGINES, RHYMNEY IRONWORKS.

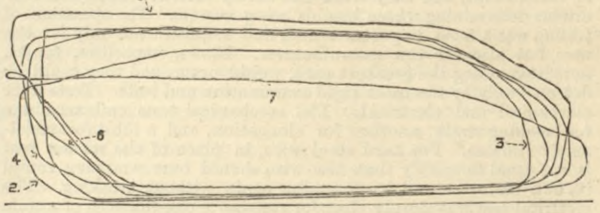
THE engraving above and on page 466 illustrates an arrangement of vertical and horizontal engines lately constructed for the Rhymney Iron Company by Messrs. Tannett, Walker and Co., of Leeds. The cylinders are 60in. diameter, and the stroke 4ft. These engines are used for driving the roughing rolls of the Rhymney rail mills, and they work with a pressure of 40 lb. of steam, and are found to be very economical and thoroughly under

SOUTH END



control. This arrangement of engine is one that eminently suits Mr. Joy's valve gear, and in our opinion a very much nicer arrangement can be made with Joy's gear than with any other valve gear with which we are acquainted. We give an enlarged detail engraving of the valve gear, which is now too well known to need explanation, and also a series of diagrams. The numbers on the lines refer to the notches in reversing quadrant. The average speed of the engine is 90 revolutions per minute. The work

NORTH END



usually done is that of driving the roughing train with rolls with 26in. centres, commencing with a bloom 8in. square. It sometimes drives both a 26in. train and a 24in. train coupled together. This engine is used both for cogging, roughing, and finishing; and although its usual speed is about 90 revolutions per minute, it will run at 100 and 120. Messrs. Tannett, Walker and Co. have recently made a large number of rail and cogging mill engines.

THE LATE MR. JAMES PALMER BUDD.—We have to announce the death of Mr. James Palmer Budd, of Ystalyfera and Ynis-y-daren, near Swansea, who for many years took a very active part in the Welsh iron trade. His father, Edward Budd, was a Wesleyan preacher and schoolmaster at Truro and Liskeard, at which latter place James Palmer Budd was born, on the 31st of August, 1803. He was educated at St. Jeroan's College, near St. Malo. His name is associated with social improvements in the metallurgy of iron, and notably with the utilisation of blast furnace gases, which he was the first to carry out practically. A patent for that object was granted to him in 1845, and a full account of the system as worked at the Ystalyfera Ironworks may be found in the "Report" of the British Association for 1843. He was a strong opponent of Neilson's hot blast patent, and was a prominent witness in the great trial of 1843. On that occasion he gave evidence to the effect that, in his opinion, cold-blast was more economical than hot-blast, and that it yielded more iron at less cost both for work and materials. Notwithstanding this, he adopted the process almost immediately afterwards at Ystalyfera. His name appears in the patent lists as the inventor of improvements in refining tin and in the manufacture of tin and terne plates. Mr. Budd was a justice of the peace and deputy-lieutenant for the county of Glamorgan. He died on the 9th inst. at 44, Argyll-road, Campden-hill, London.

THE INSTITUTION OF CIVIL ENGINEERS.

ELECTRICAL CONDUCTORS.

At the ordinary meeting on the 4th of December, Mr. Brunlees, president, in the chair, the paper read was on "Electrical Conductors," by Mr. W. H. Preece, F.R.S., M. Inst. C.E.

The author stated that the first aërial conductors were made of copper, and the first gutta-percha-covered wires were of iron; but the positions were soon changed, copper being universally used for insulated conductors, and iron, until lately, for overhead lines. Sir William Thomson detected great variations in the quality of copper, and Mathiessen detected the causes, and established a standard of purity. Such improvements had been made in the quality that copper was now twice as good as it was in 1856. Increased speed of working, improved efficiency of apparatus, and reduced waste of energy had followed the great increase in the purity of copper. Temperature was a disturbing agent in the conductivity of the wire. Resistance increased more than 20 per cent. between winter and summer temperatures. Copper had recently been much used for aërial lines. It was less attacked by acids, and had great durability. Hard-drawn wire was now produced which had a breaking strain of 28 tons on the square inch, iron wire giving only 22 tons on the same area. Age did not seem to affect its quality, nor did it appear to be influenced by the currents of electricity employed for telegraphic purposes. The conductors of all cables remained constant. Lightning was supposed to render it brittle. The ultimate effect of the powerful currents employed for electric lighting was not yet known. The size of conductors was controlled by commercial considerations. Sir William Thomson had laid down the law that should control the size of leads for electric light, while that for cables followed strictly theoretical conditions. The best copper for electrical purposes came from Japan, Chili, Australia, and Lake Superior; but much pure copper was obtained by electro-deposition, either directly from a solution, or by using impure copper as the anode in a depositing bath. Electro-deposited copper had not the strength of ordinarily refined copper. The electrical resistance of commercial iron was from six to seven times that of copper, but its variation, due to the presence of impurities, was even greater. The weight of a cylindrical wire one mile in length, and giving one ohm resistance at 60 deg. Fah., was called an ohm-mile. While the first iron wire was specified to give an ohm-mile of 5500 lb., it was now obtained as low as 4520 lb., and the maximum resistance was specified at 4800 lb. The ordinary best puddled iron was at present used only for fencing purposes, but a mild English Bessemer steel was largely used for railway telegraphs and for stays. However, the resistance was very high, owing to the presence of manganese. The wire used by the Post-office was made from Swedish charcoal iron, with an ohm-mile resistance of about 4520 lb. Swedish Bessemer, or a specially prepared low-carbon English Bessemer, was adopted by the Indian Government, with an ohm-mile resistance of about 5000 lb. Cast steel wire, with a breaking weight of about 80 tons to the square inch, had been adopted on the Continent for telephone currents, with an ohm-mile resistance of 8000 lb., while in England, where speed of working was the prime consideration, and length of span was negligible, electricians were satisfied with a breaking strain of 22 tons on the square inch. In the colonies, where long spans were essential, and speed of working was not so important, the specification was 30 tons on the square inch. The electrical conductivity of iron wire increased with the percentage of pure iron, except where the percentage of manganese was high. An increase in the percentage of manganese augmented the electrical resistance considerably more than an increase in the percentage of sulphur or phosphorus. The durability of iron wire was maintained by galvanising. When the galvanised wire was to be suspended in smoky districts it was additionally protected by a braided covering, well tarred. In some countries galvanising was not resorted to, but dependence was placed on simple oiling with boiled linseed oil. Such a wire was erected in 1856 between London and Crewe, but the result was very unsatisfactory. More recently—1881—the experiment had been repeated with a similar result. In this climate galvanisation was imperative. But it was not alone in smoky districts that iron wire decayed. It suffered much along the seashore. The salt spray decomposed the zinc oxide into soluble compounds, which were washed away and left the iron exposed, and this was speedily reduced to mere thin red lines. Where external decay was not evident, time seemed to have no apparent effect on iron wire. Thirty-nine years of incessant service in conveying currents for telegraphy had not apparently altered the molecular structure of the iron wires in the open country on the London and South-Western Railway. Swedish charcoal iron was imported either in bloom or in rods, principally in rods. Each rod was rolled down to about 0·26in. diameter, and weighed on the average about 1 cwt. Iron wire could be rolled and drawn into coils 0·171in. in diameter, weighing 400 lb. and measuring one mile; but 110 lb. was about the best practical limit for transport and use. The Swedish iron owed its value, not only to its comparative purity, but to the fact that it was smelted and puddled entirely with charcoal. The best qualities were a mixture of various ores, and they were known by various brands, the conditions determining those brands being secrets. The operation of testing was a most important one, and requisite not only for the user, but also for the manufacturer. Flaws, impurities, faults, notwithstanding the greatest care, would occur, and they could be detected only by the most rigid examination and tests. Tests were mechanical and electrical. The mechanical tests embraced one for breaking strain, another for elongation, and a third for resistance to torsion. For hard steel wire, in place of the torsion test it was usual to specify that the wire should bear wrapping round its own diameter and unwrapping again without breaking. The electrical test was simply that for resistance one-thirtieth of a mile of the wire to be examined was wound round a dry wooden drum, and its electrical resistance was taken in ohms by means of a Wheatstone's bridge. Galvanisation was tested by dipping in sulphate of copper, and by bending or rolling round a bar of varying diameter, according to the size of the wire. Special machines were constructed for the mechanical tests, the condition to be fulfilled being that for the breaking strain the increasing load or stress should be applied uniformly, without jerks or jumps, and the elongation machine should correctly register the actual stretch without the wire slipping. The resistance to torsion of the wire was determined by an ink mark which formed a spiral on the wire during torsion, the number of spires indicating the number of twists taken before breaking. The perfection to which the manufacture of iron wire had been brought was very much due to the care bestowed upon the specifications by the authorities of the Post-office. The standard had been gradually raised until it had attained a very high one. Many administrations objected to the expense of thorough inspection, with the result that they were the recipients of the rejected material of those who did rigidly inspect. One break in the wire cost far more than its inspection, and one extra ohm per mile affected the earning capacity of the wire in inverse proportion. It was, however, necessary to remark that the mechanical quality of charcoal iron wire sometimes changed with time—its electrical quality remaining unaffected. Tests repeated at some subsequent period might therefore be deceptive unless allowance were made for the effect of time. Bessemer or homogeneous iron wire as a rule improved in its mechanical properties by being kept in stock. The Post-office authorities had decided to abandon a gauge altogether as applied to conductors, and to define size by diameter and weight. In future, all copper wires would be known by their diameters in "mils," or thousandths of an inch, and all iron wires by their weight in pounds per mile. Steel wire was used for long spans, or for places where great tensile strength was needed; but it was for the external strengthening of deep-sea cables that steel wire was principally adopted. It was first employed in the Atlantic cable of 1865 for this purpose. It had since been generally used for deep-sea cables. The usual diameter was 0·099 m., and it was specified to bear a breaking strain of 1400 lb., which was equivalent to 81 tons on the square inch. Steel wire had been produced giving a much higher tensile strength. A compound wire of steel and copper was introduced in America about 1874, and it had been extensively tried in both hemispheres, but without success. Recently a compound wire had been erected between New York and Chicago, a distance of 1000 miles, giving only 1·7 ohm resistance per mile. It had a steel core 0·125in. in diameter, and was coated with copper electrolytically to a diameter of 0·25in. It weighed 700 lb. per mile. Hard-drawn copper, or silicious bronze of a much lighter character, would be equally efficient. Phosphor bronze, the hard mechanical qualities and great resisting powers of which were well known, was introduced for telegraph wire about five years ago. Several lengths were erected by the Post-office. Two long spans crossed the channel that separated the Mumbles Lighthouse from the headland near Swansea. The object in view was to obtain great tensile strength with a power to resist oxidation, especially active where the wire was exposed to sea spray. This was done in 1879, and in November, 1883, not the slightest change was noticeable in the wire. But phosphor bronze, though extensively used, had high electrical resistance; its conductivity was only 20 per cent. that of copper. Moreover, the phosphor bronze supplied was irregular in dimensions and brittle in character. It would not bear bends or kinks. A new alloy, silicious bronze, had recently been introduced to remedy these disadvantages. Phosphor bronze had disappeared for telegraph wire, and had been replaced by silicious bronze. The electric resistance of silicious bronze could be made nearly equal to that of copper, but its mechanical strength diminished as its conductivity increased. Wire, whose resistance equalled 90 per cent. of pure copper, gave a tensile strength of 28 tons on the square inch; but when its conductivity was 34 per cent. of pure copper, its strength was 50 tons on the square inch. Its lightness, combined with its mechanical strength, its high conductivity and indestructibility, rendered it eminently adapted for telegraphs. If overhead wires were erected of such a material, upon sightly supports, and with some method, there would be an end to the meaningless crusade now made in some quarters against aerial lines. These, if constructed judiciously, and under proper control, were far more efficient than underground lines. Corporations and local authorities should control the erection rather than force administrations to needless expense and to reduced efficiency by putting them underground. Not only did light wires hold less snow and less wind, but they produced less electrical disturbance, they could be rendered noiseless, and they allowed existing supports to carry a much greater number of wires. German silver was employed generally for rheostats, resistance coils, and other parts of apparatus in which high resistance was required. It consisted of copper 4 parts, nickel 2 parts, and zinc 1 part. It possessed great permanence, and the variation in its resistance due to changes of temperature was small. The effect of age on German silver was to make it brittle. Mr. Willoughby-Smith had found a similar change with age even with wire drawn from an alloy of gold and silver. The form and character of electrical conductors must vary with the purposes for which they were intended. For submarine cables and for electric light mains, where mechanical strength was not required, and where dimensions were of the utmost consequence, the conductors must be constructed of the purest copper producible, for copper was the best practical material at command. For aerial lines they must not only have great tensile strength, but in these days of high-speed apparatus they must have high conductivity, low electrostatic capacity, expose to wind and snow the least possible surface, and must be practically indestructible. Iron had hitherto occupied the field, but copper and alloys of copper seemed destined in many instances to supplant that metal, and to fulfil all the conditions required in a more efficient way, and at no greater cost per mile.

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

(*From our own Correspondent.*)

"Hand-to-mouth" is the phrase that perhaps best describes the class of work upon which the mills and forges are this week chiefly engaged. Proprietors are completing deliveries under contracts booked some while back, and which they desire to pretty much clear off before the holidays. The new orders arriving are not conspicuous. Yet orders are coming to hand, as to some of which immediate delivery is a necessity. Sheets and hoops are mostly called for. The galvanisers are chiefly buying the former, and the export merchants the latter. Prices keep steady. Best—thin—sheets for working-up purposes remain on the basis of £11 for singles; sheets of the description rolled by the "list" iron houses are £8 10s. and £9 nominal; and galvanising sheets are, singles, £7 17s. 6d. to £8; doubles, £8 5s.; and lattens, £9 5s.

Corrugated sheets are in more request than plain sheets for export. Stocks in this line are increasing, and to keep them down the leading houses will take stock after next week. Makers quote about £13 for 22 to 24 w.g. delivered at outports. It is impossible to get more money except for special brands.

Marked bars are £8 2s. 6d. to £7 10s.; other best bars, £7; second sorts, £6 15s. to £6 10s.; common, £6 5s. to £6 for hurdle qualities. Hoops are £6 7s. 6d. to £6 12s. 6d. for exports, and £6 15s. to £7 for superior sorts for home consumption; £8 remains the quotation for best branded descriptions.

Gas strip and nail strip are abundant. Makers ask £6 5s. to £6 7s. 6d., and they get it. Wire rods rolled on the Shropshire side of the district vary a very great deal in price. They are anything from £5 to £7 per ton.

The consumption of mild steel in the shape of ingots, blooms, and billets, is rapidly increasing in this district. Messrs. Jno. Knight and Co., of the Cookley Ironworks, near Kidderminster, have recently commenced the manufacture of bars, sheets, and light plates in all classes of steel. They are now producing considerable quantities. The steel rolling they will carry on in addition to their old-established business of iron, tin-plate, and tinned sheet makers.

Upon 'Change in Birmingham this—Thursday—afternoon there was a good deal of discussion, especially among the sheet makers, upon the gauge question. The meeting in Birmingham last week has not done much to settle matters, and it is feared that the present great variety of gauges will still be worked from. By no means all the ironmasters are prepared to adopt the Birmingham wire gauge so-called in accordance with the resolution of last Thursday, even if it could be distinctly defined, and upon this point even experienced members of the trade are at wider variance.

At present most ironmasters are working upon gauges which are known as the "Gospel Oak" and the "Partridge" gauge, both of which are from a half gauge to a whole gauge thicker than what is generally known as the Birmingham wire gauge. The gauges named are on the basis of about 1 lb. on the square foot. Unless something further can be determined, these and other gauges will still continue and there will be no uniformity.

The ironworkers have given notice for a reconsideration of the wages' question, when at the close of this month the arrangement expires under which, by the award of Mr. Thos. Avery, of Birmingham, they are receiving 7s. 6d. per ton for puddling. The recent sliding scale has been abolished. There is no probability of their receiving any advance. Indeed, should wages in Cleveland come down, as seems not unlikely, the Staffordshire masters may seek a reduction.

Pig iron is unchanged as to the state of the demand. Northampton qualities can scarcely be sold at 45s., delivered here, nor can Derbyshire at 46s. Native part-mines are 50s. to 47s. 6d., and common pigs, 40s. Northampton ironstone is abundant at from 5s. 9d. to 6s. 6d. per ton, delivered here, according to quality.

By the mail from Melbourne delivered this week it is learned that galvanised iron has received moderate attention out there. Gospel Oak has been quitted at £21 10s. for 26 w.g., and 150 cases of Orb have been cleared off at late rates. General quotations when the mail left ranged from £20 to £21 10s. Bars and rods have moved off quietly at from £8 10s. to £9 10s. Black sheets have changed hands at from £10 10s. for Nos. 8 and 18. Good sales were recorded in pigs at £4 5s. In fencing wire Ryland's No. 8 had been disposed of at £13 10s.

Ironmasters hereabouts are resolved to continue to press the desirability of the legislation of 112 lb. weight for the iron trade upon the Associated Chambers and upon the Board of Trade.

A fine specimen of chilled roll turning has just been completed at the Highfields Works, at Bilston, by Messrs. Thomas Perry and Son. Its extreme length from end to end is 18ft., the length of the working part or body is 12ft. 10in., and the diameter of the body is 28in. Through the entire length of the 18ft. a hole 4in. diameter has been bored in the centre of the roll. The cast weight of the roll was about 14 tons. It was run out from two furnaces containing a united charge of from 16 to 17 tons. The mixtures were, with one exception, English cold-blast irons; the exception was an American charcoal iron, which, laid down in the works, cost £10 per ton. Though the depth of the chill was about $\frac{3}{4}$in., yet the boring of the centre was effected without more resistance than might be looked for from a roll incapable of bearing any chill. There is therefore every prospect of the roll proving long-lived as well as effective. The whole work has been accurately denominated "a triumph of roll engineering." Upon the whole surface there is not a speck of blemish, and it has the sheen of burnished steel. To complete it the firm went to an outlay in new machinery of £1000, and they accepted the order upon a second appeal, after it had been rejected by other roll-making firms in England to whom it had been offered, after a similar issue had attended appeals to continental firms, and when no better success had resulted from efforts to place the work in the United States. Messrs. Perry's preparations enabled all the processes, from casting to polishing, to be completed without a hitch. The roll has been made to the order of Messrs. Nairn and Co., of Kirkcaldy, by whom it will be used in the rolling of linoleum. This specimen of the work of a firm, which has been in the business half a century, has this week been a source of much attraction to ironmasters and others. In the same double pit, of 23ft. deep, in which this roll was cast in its chills, we noticed on Saturday another chilled roll in process of casting, whose weight was $9\frac{1}{2}$ tons; and there were several such in various stages of completion in different parts of the works. Most of these latter are intended for metal rolling in near and remote home counties and abroad.

Concerning the Antipodean demand for hardwares, vigour in buying is seen in scarcely any department, stocks being generally in excess of current requirements, and the tendency continuing to open stores in Sydney and Melbourne by manufacturers at home, who have hitherto sent out only upon order. India is steady, with a considerable aggregate business doing, and the larger exportations from the empire of wheat increases the confidence with which the future of that vast market is anticipated.

Orders continue to arrive from the United States for certain forged iron goods required in the shipyard and in the smithy, and buyers encourage the expectation that as the tendency to reduced import duties makes its impression upon legislation a larger trade will be practicable.

The Brazil nail makers of Dudley continue on strike for an advance of 4d. upon every 1000, and they complain that, although the nails which they make cannot be produced by machinery, yet their branch is the worst paid of the nail makers.

Much interest is felt in the Patent Act in its bearing upon the lighter industries in this district. The Willenhall manufacturers especially are hopeful of the desired amelioration in their favour of the clauses to which, as I last week pointed out, the attention of the Wolverhampton Chamber of Commerce has just been directed. This body on Friday determined to co-operate with the Walsall Chamber with a view to a joint deputation to Mr. Chamberlain to elicit what may be the intentions of the Board of Trade as to the accumulated stocks of goods which are known to be now in the hands of manufacturers marked with the words "Patent" or "Registered," or with the Royal Arms.

Hardwares from Birmingham have now to pay 23s. 4d. per ton for conveyance to Liverpool, besides dock and town dues, and steamer freight to destination; and by Birmingham merchants this anomaly is contrasted with the circumstance that Manchester goods can be sent at a through rate of 25s. per ton—measurement—from Manchester to Calcutta, *vid* Liverpool, by rail and steamship.

The committee who are formulating the proposed Industrial and Fine Arts Exhibition for Wolverhampton have determined to invite a member of the Royal Family to open the Exhibition in June next year, and Lord Wrottesley has consented to become the president. It is proposed to erect an additional building for machinery in motion and other purposes on a second large space of land which has been granted by the Town Council.

The Associated Chambers of Commerce have been invited to hold their autumn meeting next year in Wolverhampton.

NOTES FROM LANCASHIRE.

(*From our own Correspondents.*)

Manchester.—In the iron trade business continues quiet, and it is not likely that it will be more than of a hand-to-mouth character until after the turn of the year. Pending the usual stock-taking there is of course not much disposition to buy beyond actual requirements, and in addition to this buyers are further influenced in holding back orders by the absence of any indication that an upward movement in values is at all probable for the present.

The iron market at Manchester on Tuesday was tolerably well attended, but there was very little enquiry for either pig or manufactured iron reported. So far as prices were at all tested the tendency of the market was in the direction of weakness. Quoted rates for pig iron were without alteration, Lancashire makers adhering to 45s. and 45s. 6d. less $2\frac{1}{2}$ as their minimum, whilst for district brands 44s. 10d. to 45s. 10d. less $2\frac{1}{2}$ were the average quotations for Lincolnshire forge and foundry, with Derbyshire foundry offering at about 46s. 6d. less $2\frac{1}{2}$ delivered equal to Manchester. At these figures only a few occasional sales are made, but fairly good offers for forge Lincolnshire at about 6d. less, which would appear to be about the margin, generally, between buyers and sellers, are reported on the market. Scotch iron has been offered in this market during the week at under the prices quoted by makers.

In the finished iron trade new business is coming forward very slowly, and if anything there is an easier tone in prices. In a few cases makers are still holding for £6 5s. for bars, but local brands are to be bought at as low as £6 and North Staffordshire makes at £6 2s. 6d. per ton delivered into the Manchester district. Other descriptions of manufactured iron are also proportionately low, and North-country plates have been offered here during the week at a reduction of 5s. per ton upon late quotations.

Although the general branches of the engineering trade in this district would appear to be drifting into a somewhat depressed condition, activity is being fully maintained at many of the leading establishments. During the past week I was over the works of Sir Joseph Whitworth and Co., the largest of their kind in the district, and here they have not only been able to keep fully supplied with orders, but further extensions of the works have been necessary. These extensions, which have just been completed, include an addition to the steel works—the second that has been made within twelve months—of a new building 100ft. long by 50ft. wide, and this section now extends over a covered area of about four acres. Recently the firm have turned out steel castings for gun blocks weighing as much as 43 tons, but the additional plant that has now been put down will enable them to produce castings up to 60 tons in weight. Another addition to the works has been the erection of a large shop for the joiners and pattern makers who have hitherto been located in the main building, but the space they have occupied is now required for a number of special tools. This new building is 150ft. long by 50ft. wide, and well lighted from the top. The whole of the works have now a covered area of between eight and nine acres, and with outbuildings and yard space occupy about seventeen acres of land. Amongst a number of new special tools that are being put down are several powerful lathes with 42in. up to 48in. centres, and power varying from 350 to 365 to 1, whilst the average belt speed throughout is 2200ft. per minute. These are constructed to take in work 30ft. in length, and the total weight of each lathe is about 100 tons. Two of these lathes are so arranged that when required they can be made into one, so that work up to 60ft. in length could be taken in. The most powerful of the lathes are for turning large gun hoops, which are carried on the face plates without any other support, and are turned externally and internally at the same time, four tools being at work simultaneously. Another special tool is being laid down for boring crank shafts at both ends simultaneously as well as the bolt holes in the couplings, the machine being also adaptable for general work. A couple of wheel presses are also being erected in which a new feature is introduced, the bars being arranged perpendicularly to each other instead of horizontally, so that the wheels can be rolled into the press without the necessity of lifting. The new arrangement may in fact be described as the old style of press placed on edge. Another important feature, which applies to all Messrs. Whitworth's heavy machine tools, and to which it may be of interest to draw attention, is that they have adopted the principle of steel gearing throughout, the large wheels being cast, the pinions cut, and in all cases where it is possible the pinion is made solid with the shaft, thus securing greatly increased strength.

As to the work which Messrs. Whitworth have at present in hand, I found every department full of orders, not only in their special steel forgings for propeller and crank shafts and in various descriptions of gun material, but also in machine tools for home and abroad. Amongst their marine work they had just completed for France a couple of steel propeller shafts 45ft. in length, forged hollow, with a 10in. hole, and an outside diameter of 15in. For foreign Governments, including France, Spain, Italy, Brazil, and the United States, they have guns in hand ranging from 6in., 8in., 10in., to 12in. bore, and weighing up to 43 tons, whilst for the English Government they had just completed several gun tubes, each weighing 30 tons, which are to form part of the 63-ton guns, and they have in hand the manufacture of material for guns of the largest calibre that have yet been produced. In the tool department there were in hand a number of tire-boring machines for the Midland Railway Company, wheel-planing and cylinder boring machines for Russia, and a number of special quartering machines have just been completed for the Indian State Railways, which have been constructed for turning the crank pin, boring the hole for the crank pin, and turning the end of the crank pin so that it can be screwed rigidly in position.

Messrs. William Collier and Co., of Salford, have in hand, for Messrs. Mather and Platt, of Salford, a special tool for boring out in duplicate the blocks for electro-magnets. The special arrangement is that the machine will bore simultaneously from each side of the head-stock, and the tool consists of a boring machine with a long bed, carrying the head-stock in the centre, which is driven by a steel worm wheel connected on to the spindle. A boring bar is fixed at each end of the spindle, and by this means work can be taken in on each side of the head-stock. Two carriages are provided, with slots in the tables, for fixing the blocks to be bored, and there are self-acting motions and separate screws to each table for forcing the work up against the boring cutters, which are stationary. The machine is constructed for taking very heavy cuts, and is exceptionally massive in all its parts.

The annual general meeting of the members of the Manchester Association of Employers, Foremen, and Draughtsmen was held on Saturday, and Mr. Thos. Ashbury, C.E., was unanimously re-elected the president for the ensuing year. Eight new members were admitted at the meeting, and during the past year 43 new members have been enrolled—a rate of increase which has hitherto been without precedent in the history of the society.

There has been a pretty general quieting down in the coal trade of this district during the past week, so far as the weight of new orders coming forward is concerned. In the Manchester district the leading collieries are kept fully going, and the advance on the wharf and delivered rates is being maintained without difficulty; but in the West Lancashire districts, where the pit prices were put up, it is mainly on orders in hand that the pits are kept going, and to effect further sales it has been necessary to give way on the top prices quoted last week. Round coals are moving off fairly well, but slack is again becoming difficult to sell. Generally it may be said that not more than 6d. per ton upon last month's prices is being realised, and at the pit mouth the average selling prices are about as under:—Best coal, 10s. 6d.; seconds, 8s. 6d.; common house-fire coals, 7s.; steam and forge coals, 6s. to 6s. 6d.; burgy, 5s. to 5s. 3d.; best slack, 4s. to 4s. 6d.; and common sorts, 3s. 6d. per ton.

Shipping has been only moderate, with Lancashire steam coal averaging 8s. 3d. to 8s. 6d. per ton delivered at the high level, Liverpool, or the Garston docks.

The miners in the West Lancashire districts do not appear to have thoroughly settled down as yet, and generally they are reported to be working only very indifferently, with the result that the output is being considerably restricted.

Barrow.—The pig iron market of this district is still in a very dull state, and from present appearances will continue so. The bad state of trade seems almost to have become permanent. I can hear of but few orders having been received by the various makers. It is just possible, and it is generally expected, that with the New Year a revival will take place, and that some extensive orders for forward delivery will come to hand. At present, however, makers are simply purchasing to supply immediate wants, and there is no appearance of speculation in the present sales. The stocks now held have considerably decreased, now that the output has been reduced. Prices still continue very low and unremunerative. No. 1 Bessemer is quoted this week at 47s. 6d. per ton net at works; No. 2, 47s.; and No. 3, 46s. 6d. per ton. Steel makers are not so well employed as they might be, and it is noticeable that few orders are coming to hand. The output in all departments is, however, steadily maintained. Bars are selling at from £4 10s. to £4 15s. per ton net at works. Shipbuilders are very quiet, and few inquiries are being made. Iron ore is in limited consumption, and heavy stocks are still to be found at the mines. Prices this week are from 9s. to 11s. per ton net. Coal and coke firmer.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

THE Yorkshire Miners' Association, after the Sheffield Conference, adjourned to Barnsley, where a further meeting was held on Saturday. Mr. Benjamin Pickard, Mr. John Frith, and Mr. W. Parrott, the secretaries, were present. A series of twelve resolutions were passed, the gist of which was that the wages agitation should not cease, "as we are more convinced every day that we, as miners, are entitled to an advance." Confidence was expressed in the officials, and very strong feeling evinced against the newspapers and the shopkeeping public who opposed the strike. One of the resolutions ran thus:—"That we recommend, seeing the one-sided way the Sheffield and Rotherham papers have dealt with the wage question, and also having done all in their power to poison the public mind against our leaders and miners generally, that we have a weekly paper of our own." There is a balance of £3000 at the credit of the Yorkshire Miners' Association. It would be hard to find an easier or readier way of spending that balance than by starting a weekly paper.

Mr. William Chappell, who represents the Sheffield and Rotherham district, has fallen into disfavour among the extreme section. Mr. Chappell, who has shown a good deal of capacity as a union agent, is a man of moderate views. He supported an advance, but limited his demand to 5 per cent. until he was overruled by the majority at the general conference. Mr. Chappell sent a telegram to the Kiveton Park Lodge of the Rotherham Association, stating, "Shall take no more part in any conference which has force in lieu of better means for its object. This I shall carry out at all risks and at any cost." Thereupon the Kiveton Park Lodge resolved, "That Mr. Chappell be not allowed to take any part in any future work connected with the wages question." This resolution has been endorsed by the Barnsley Conference, so that Mr. Chappell is practically "boycotted" on the wages question.

Another conference is to be held at Barnsley on the 17th inst., and a general conference at Manchester on the 27th. The Thorncliffe miners have already taken action which will probably be followed by others. They have intimated to the officials of the Miners' Association that it is not their intention to send a delegate to the adjourned conference of miners on the 27th inst.

As anticipated a few days ago, the strike of the colliery lads for an advance of 1s. a week has not lasted long. Though in some quarters it is not quite settled, there is a surrender of the juveniles every day. The boy drivers at Shireoak and Steetly returned to their work, having succeeded in causing considerable loss to the miners, some of whom were obliged to discontinue working for several days.

Iron keeps very dull. Present quotations in this district run as follows:—Bessemer hematite, 1, 2, and 3, 56s. per ton; ordinary hematite, No. 3, 55s. 6d.; Lincolnshire, No. 3 foundry, 44s. 6d. to 45s.; Lincolnshire, forge qualities, 42s. 6d. to 43s.; Derbyshire, No. 3 foundry, 45s. to 46s.; Derbyshire, forge qualities, 42s. 6d. to 43s.—all at Sheffield. In 1880 the quotations were double, and in some instances more than double, these figures. In the edge-tool trade, though one large firm is busily employed on German and Australian orders, I hear considerable complaints. Joiners' tools are a good deal affected by the introduction of cheap "lines" in German goods, and there are increasing symptoms of the severity of continental competition in this and other departments.

The puddlers, who were under notice during the threatened strike agitation, have now had their notices withdrawn, and are working as before. Several collieries will not be reopened till after Christmas; at others three days a week are being worked. This will enable the railway lines to get cleared by the loaded wagons which had accumulated prior to the day on which the colliers were expected to go out.

Steel manufacturers are complaining on every side. An ominous feature of present trading in the steel department is the readiness of firms to accept orders at low rates for future deliveries. This is strong proof that no early improvement in values is looked for by the producer. It is pretty clear now-a-days that the line of demarcation between cast and Bessemer steel is getting "fine by degrees and beautifully less." It is not satisfactory to hear that the reputation of Sheffield for reliable cast steel is being endangered by the present race for cheapness in production. The best evidence that the sacrifice of quality for price does not pay in the long run is found in the fact that at this moment the busiest manufacturers in many important industries are those who rigidly adhere to the sound principles which have given their firms a solid foundation, and to Sheffield a fair name all over the world.

An important movement is at present in progress for the establishment of a technical school in connection with Frith College. The Right. Hon. A. J. Mundella, M.P., and Mr. C. S. Wortley, M.P., were both present at a meeting on Thursday in support of this scheme, which is being liberally aided by Sheffield manufacturers and companies. The chief object will be to make the school useful in its application to Sheffield industries, which afford ample scope for art instruction.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

A QUIET tone pervaded the Cleveland iron market held at Middlesbrough on Tuesday last. But few inquiries were made, and where business resulted lower prices than those ruling last week were accepted. Merchants disposed of small lots of No. 3 g.m.b., for immediate delivery, at 36s. 9d. per ton, but asked 37s. for January or February delivery. Some makers were willing to book orders for delivery over the first quarter of next year at 37s.; but the majority asked 3d. to 6d. per ton more. All were willing to accept 37s. for prompt delivery. Grey forge was freely offered at 35s. per ton for prompt and 35s. 6d. for forward delivery.

Warrants are scarcely ever mentioned now. The price is nominally 37s. per ton.

The stock of Cleveland iron in Messrs. Connal's store at Middlesbrough was reduced 197 tons last week, the quantity held on Monday being 63,396 tons.

The shipments are not nearly so heavy as they were last month; but that could scarcely have been expected. Up to Monday night only 18,655 tons of pig iron had been sent away, as against 40,862 tons in the corresponding period of November.

Finished iron manufacturers are anxious to book orders for delivery during the first quarter of next year; but consumers are keeping back their inquiries, and little business is being done. Plates are still quoted at £6 per ton, ship's angles at £5 12s. 6d., and common bars at £5 15s., all free on trucks at makers' works, less $2\frac{1}{2}$ per cent.; but good orders can be placed at 2s. 6d. to 5s. per ton below these prices.

The Cleveland Institution of Engineers held their second meeting for the session on Monday last. An interesting discussion took place on the paper read at the previous meeting by Mr. Wm. Ripper, of Sheffield, on "The Education of Mechanical Engineers." Mr. G. J. Clarkson, of Stockton, subsequently read a paper on "The New Patent Laws."

Messrs. Bolckow, Vaughan, and Co. have not yet arrived at a settlement with the workmen at the Eston Steel Works as to the proposed reduction of wages. The company asks for a reduction of 10 per cent. in the manufacturing department, and 5 per cent. in the engineering department. Mr. E. Windsor Richards met representatives of the men to receive their answer on Monday last. The men in the manufacturing department ask for the matter to be referred to arbitration. Some of the men in the engineering department are willing to accept the whole reduction proposed, but others are only willing to submit to an abatement of $2\frac{1}{2}$ per cent. Mr. Richards will meet them again shortly to receive their final decision.

A meeting of the Board of Arbitration for the North of England iron trade was held at Darlington on Monday last, to further discuss the wages question. There being little prospect of a mutual agreement, it was decided to place the matter before an arbitrator, and this will be done unless some definite arrangement is come to when the Board meets again on Monday next. Meantime the Standing Committee has been summoned to Durham on Thursday, the men at the works having been asked to decide in the meantime whether they will accept Dr. Robert Spence Watson, of Newcastle, as arbitrator.

Steel rails continue to fall in value, like all other departments of the iron trade. The present price for desirable specifications is about £4 2s. 6d. per ton at makers' works, less $2\frac{1}{2}$ per cent. discount. Manufacturers say that relief in the shape of cheaper material and labour is urgently needed by them.

A terrible gale passed over the Cleveland district on the night of the 11th inst., doing extensive damage to roofs, chimneys, and fences. Several of the ironworks were laid off in consequence, as the men refused to work while slates were being blown about in all directions. The damage to shipping will no doubt be found to be heavy, when sufficient time has elapsed for reports to be received from abroad.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

THE Glasgow iron market has been quiet this week, and the fluctuations in warrants were upon an unusually limited scale. Brokers are arranging their accounts for the close of the year, and the only speculative business likely to take place at present consists of purchases by those who are of opinion that a slight advance in prices will likely occur about Christmas. Such a thing has happened frequently, and there are operators who think that the reduction in stocks to be disclosed in the official reports of the iron trade ought to produce some increase on the present occasion. The values of makers' special brands have varied very little since last report. There are now 103 furnaces in blast, as against 114 at the same time last year.

Business was done in the warrant market on Friday at 44s. 6d. per ton cash; Monday, 44s. $4\frac{1}{2}$d., 44s. 5d., and 44s. 4d.; Tuesday, 44s. $4\frac{1}{2}$d. to 44s. 4d. Business took place on Wednesday at 44s. 4d. to 44s. 1d. cash, and 44s. 6d. to 44s. $3\frac{1}{2}$d. one month. To-day—Thursday—the market was quiet with business at 44s. 2d. cash, and 44s. 4d. one month.

The market quotations of makers' iron are:—Gartsherrie, f.o.b. at Glasgow, per ton, No. 1, 52s.; No. 3, 49s. 6d.; Coltness, 55s. 6d. and 51s.; Langloan, 54s. and 50s. 6d.; Summerlee, 52s. 6d. and 48s. 6d.; Calder, 55s. and 48s.; Carnbroe, 52s. 6d. and 48s.; Clyde, 48s. and 46s.; Monkland, 45s. 9d. and 43s. 6d.; Quarter, 45s. and 43s.; Govan, at Broomielaw, 45s. 9d. and 43s. 6d.; Shotts, at Leith, 55s. and 52s. 6d.; Carron, at Grangemouth, 49s. (specially selected, 56s. 6d.) and 47s. 6d.; Kinneil, at Bo'ness, 47s. and 46s.; Glengarnock, at Ardrossan, 52s. 6d. and 45s. 6d.; Eglinton, 46s. 6d. and 43s. 9d.; Dalmellington, 48s. and 46s. 6d.

The import trade in iron ore shows a larger arrival, the quantity received in the Clyde in the course of the past week having been 8360 tons.

The malleable trade is still fairly active, and the operatives at the puddling furnaces and rolling mills are giving some trouble on the question of wages. At a meeting of the Representative Council of the Iron and Steel Workers' Association of Scotland it was stated that no reply had been received from the masters with regard to the objection of the men to the reduction recently made in their wages. It was then resolved to hold an idle day, and this was done on Monday last, when the executive committee were empowered to issue a circular giving fourteen days' notice to the employers that the men wish to withdraw from the arrangement by which wages are regulated in accordance with those paid in the North of England.

In the Lanarkshire district of Scotland the coal trade is active, the demand for both household and shipping coals being good. The f.o.b. quotations at Glasgow are:—Main coal, 7s. 3d. to 8s. 3d.; special, 7s. 9d. to 8s. 3d.; ell, 8s. to 9s. 6d.; and steam, 8s. 6d. to 9s. 6d. At Troon 5222 tons of coal were shipped in the past week, and 7937 tons at Ayr. On the east coast business is also good, and the quantities despatched included 4000 tons at Leith and 5213 tons at Grangemouth. The shipments of coals at Burntisland for November are returned at 63,500 tons, as compared with 64,750 tons in the corresponding month of last year. In Fife steam coal ranges from 7s. 6d. to 8s. 3d. per ton, f.o.b. The miners are working steadily in all districts in view of the Christmas and New Year holidays.

The Executive Board of the Fife and Clackmannan Miners' Association have resolved to intimate to the coalowners' secretary that the men are unwilling to proceed further with the matter of a sliding scale. At the meeting where the above resolution was passed a movement was originated having for its object the erection of a national memorial at Glasgow to the late Mr. A. Macdonald, M.P.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

DOWLAIS has had a serious aggregation of troubles lately. The Bedlinog Colliery has been a drawback. The iron trade has been dull, and collieries that supplied ironworks coal slack. The Rhymney and Great Western Railway has gained an action against the company for the traffic over 730 yards of line. The hauliers have been on strike on account of "time," and now that everything had been peacefully arranged the colliers refused to work a day or two ago, and came out because the concession to the hauliers affected them. All these must have been perplexing, but has been well arranged, and the leviathan establishment is progressing as vigorously as ever.

Another of the old companies, that of Aberdare and Plymouth, is in tribulation, two petitions for liquidation having been presented, the first by Messrs. Simons and Pleuss, W. Simpson, and others, and the second by the Marquis of Bute and others. The ironworks of the company may be regarded as obsolete. The coal, however, is yet in considerable area as regards the lower coals, and the expenditure of money in sinking to the deep, and the addition of a new field of four-feet would prolong a brisk coal trade for many years yet.

The coal trade is buoyant, and the output in all quarters at its highest. At no period has the traffic been so enormous, yet we have only the minimum of complaints at the railway and the docks. The great prosperity in both quarters is provocative of some degree of discontent in the labour market, as may be reasonably expected, and some are murmuring for shorter hours and others for more wages. It is creditable to the sagacity and liberality of both railway and dock management that so far trade has not been interrupted, and the concessions offered are likely to be taken.

At the Bute Docks the coal tippers have put in a claim for payment at the rate of 5s. 2d. per 100 tons. This has been refused, and an offer made of 12s. per week fixed wages and one farthing for every ton shipped. In practical circles this is regarded as very fair, especially as the alterations going on are such as will increase the facilities for tipping. The strain on the docks is excessive, but will soon be relieved; and what with the new dock and the Penarth improvements the coal stream will be grappled successfully with. Statistics are being got up for the Barry promotion, and ringing the changes is promised. A skilful attempt, for instance, is being made to dissever the connection between the Taff Vale and the Bute Dock interest, and break up that formidable coalition.

Just now South Wales must be envied. The statistics of the principal ports show an increase of 245,874 tons for the month of November over the corresponding month of 1882. Cardiff, for instance, shows an increase of 190,251 tons; Newport, 38,601 tons; and Swansea, 19,022.

In iron trade is passive, but not so gloomy as some would have us believe. During the month of November 9524 tons of iron and steel were sent from Cardiff, and 13,323 from Newport. Meanwhile Swansea only sent 496 tons. Taking the year up to the present Cardiff has sent over 90,000 tons, Newport 190,000 tons, and Swansea 6000 tons, in round numbers. There is a fair prospect of prices lifting early in the new year, and of important colonial orders coming to hand.

Heavy shipments of rails have this week been made to the Cape, New York, and Buenos Ayres. Prices are low.

In house and steam coal prices are firm, and best qualities very stiff.

Tin-plate is moderately busy, prices of ordinary coke plate vibrating between 14s. and 15s.

Iron ore is quoted very low. Sales are small. At all ports the quantity now received is not so much by two-thirds as six months ago. The object evidently is to cause a scarcity. Prices now are not remunerative.

Pitwood is coming in freely. t Plymouth collieries the scarcity of pitwood lately almost led to toppage, but all now is in steady work again.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

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

Applications for Letters Patent.

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

4th December, 1883.

5623. DETECTING BURGLARS, G. L. Pearson, London.
5624. EXPLOSIVE COMPOUNDS, S. R. Divine, U.S.
5625. EXPLOSIVE COMPOUNDS, &c., S. R. Divine U S.
5626. ELECTRO-TELEGRAPHIC SYSTEM, S Roos, Turin.
5627. MULTIPLE PUMPS, A. W. L. Reddie.—(*D. S. Hines, W. A. Perry, and C. C. Worthington, U.S.*)
5628. SALICYCLIC ACID, J. H. Johnson.—(*O. Leupold, Germany.*)
5629. OPENING, &c., RAGS, G. and J. E. Tolson, Earlsheaton.
5630. WRITING PENS, W. H. Thomson, London.
5631. BALL VALVES, &c., H. F. Hill, Nottingham.
5632. GAS ENGINES, L. H. Nash, Brooklyn, U.S.
5633. GAS ENGINES, L. H. Nash, Brooklyn, U.S.
5634. SPRING MATTRESSES, I. Chorlton, Manchester.
5635. PIANOFORTES, E. W. Brinsmead, London.
5636. HOT-AIR ENGINES, S. Wilcox, Brooklyn, U.S.
5637. IMPROVED WOVEN FABRIC, A. M. Clark.—(*A. Urbahn and A. G. Jennings, U.S.*)
5638. AMMETERS, &c., F. V. Andersen, Greenwich.
5639. STUD BUTTON, W. G. Delf, London.
5640. STOVES, H. Darby, London.
5641. DECORTICATING WHEAT, &c., J. H. C. Martin, Walthamstow.
5642. MINING COAL, W. R. Lake.—(*B. F. Asper, U.S.*)
5643. ROLLING MILLS, C. D. Abel.—(*W. Garrett, U.S.*)
5644. SOLID NON-DELIQUESCENT PHOSPHATE of LIME, C. D. Abel.—(*F. Barbe, Paris.*)
5645. STEERING APPARATUS, J. K. Kilbourn, Brixton, and G. Fossick, Stockton-on-Tees.

5th December, 1883.

5646. ILLUMINATING by MEANS of the INCANDESCENCE of REFRACTORY SUBSTANCES, W. H. Spence. — (*O. Fahnehjelm, Stockholm.*)
5647. SEWING MACHINES, H. Leeming, Manchester.
5648. VELOCIPEDES, J. White and J. Asbury, Coventry.
5649. BOOTS and SHOES, W. H. Stevens.—(*W. James, Chicago, U.S.*)
5650. WOOD PAVING, R. Hall and C. C. Woodcock, Leicester.
5651. SHOVELS or SPADES, W. R. Lake.—(*E. L Fenerty, Halifax.*)
5652. ROLLER MILLS for GRINDING, W. P. Thompson.—(*D. E. Dowling, New York, U.S.*)
5653. UMBRELLAS, &c., T. Wrench, Liverpool.
5654. SELF-REGULATING TORPEDO, A. J. Boult.—(*E. de Taund and W. de Szigyártó, Vienna.*)
5655. ABDOMINAL BELT, E. Edwards.—(*H. L. Marquis, Lille.*)

6th December, 1883.

5656. BROUGHAMS, H. C. Lowther, Brigstock.
5657. OPERATING BICYCLES, &c., E. Nunan, London.
5658. SHEET PILING, &c., W. P. Thompson.—(*F. Paponot, Paris.*)
5659. SEAL TRAPS for WASH-BASINS, &c , W. P. Thompson.—(*A. Edwards, Ashbury Park, U.S.*)
5660. BOOTS and SHOES, C. Sutton and W. Kirkland, Leicester.
5661. GENERATING PRESSURE for WORKING ENGINES, A. M. Clark.—(*J. A. Costa, Paris.*)
5662. PRODUCING MOTIVE POWER, S. J. Williamson, Liverpool.

7th December, 1883.

5663. ANCHORS, J. Barton, Glasgow.
5664. GOVERNING STEAM ENGINES, W. Knowles, Bolton.
5665. ADDRESS LABELS, T. Humphreys and J. P. Milbourne, Manchester.
5666. ROWLOCKS for BOATS, E. Edwards.—(*L. M. Gautier, jun., St. Malo, France.*)
5667. MOTIVE-POWER ENGINES, H. G. Hosmer, London.
5668. OPERATING FOG-SIGNALS on RAILWAYS, G. W. von Nawrocki.—(*Dreyse and Collenbusch, Germany.*)
5669. MARINE ENGINES, R. Wyllie, West Hartlepool.
5670. DYEING VEGETABLE, &c., SUBSTANCES, W. R. Lake.—(*E. Crèbassu and P. C. Rogniat, Paris.*)
5671. SAFETY SUSPENDER for STIRRUP LEATHERS, W. J. Bacon, Poole.

8th December, 1883.

5672. BOILERS, &c., R. Hannan, Glasgow.
5673. DOUBLE POST CARDS, H. A. Bonneville.—(*D. Cornilliac, Paris.*)
5674. PAINT BRUSHES, G. H. Nash, Birmingham.
5675. NAVIGATIONAL SOUNDING APPARATUS, Sir W. Thomson, Glasgow.
5676. MARINER'S COMPASS, Sir W. Thomson, Glasgow.
5677. GAS FURNACES, F. Siemens, London.
5678. WEIGHING APPARATUS, T. H. Ward, Tipton.
5679. CRUSHING MINERALS, T. R. Jordan, London.
5680. ACCUMULATORS, J. Greenwood, Bacup.
5681. COLOUR PRINTING, W. Lake.—(*A. Bisson, Paris.*)
5682. MAGNETO, &c., MACHINES, A. de Meuron and H. Cuenod, Geneva.

10th December, 1883.

5683. BREAKING COAL, &c., J. Woodward, Ancoats.
5684. ROPE, A. J. F. G. Telschow, London.
5685. SPRING MATTRESSES, A. J. Boult.—(*L. Leyx, St. Florentin, France.*)
5686. SADDLE for BICYCLES, W. P. Thompson.—(*T. J. Kirkpatrick, Springfield.*)
5687. ROCK-BORING APPARATUS, J. T. Jones and J. H. Wild, Leeds.
5688. PUMP, H. J. Haddan.—(*A. Reis, Antwerp.*)
5689. LOOMS for WEAVING, T. L. Daltry, Manchester.
5690. TOGGLE PRESSES, H. H. Lake.—(*E. B. Meatyard, Lake Geneva, U.S.*)
5691. BRUSH-MAKING MACHINES, F. Wirth.—(*Bürsten and Pinselfabrik Donaueschingen Mez & Co., Germany.*)
5692. TYPE-WRITING MACHINES, H. H. Lake.—(*J. L. Young, Tarrytown, U.S.*)
5693. STEAM HAMMERS, H. H. Lake.—(*E. B. Meatyard, Lake Geneva, U.S.*)
5694. SORTING GREEN MALT, F. Wirth. — (*G. Stein, Germany.*)
5695. PERAMBULATORS, G. E. Webster, Nottingham.
5696. PLEATING MACHINES, P. Hayman and H. S. Benjamin.—(*H. Rose, Berlin.*)

Inventions Protected for Six Months on Deposit of Complete Specifications.

5624. EXPLOSIVE COMPOUNDS, S. R. Divine, Loch-Sheldrake, U.S.—*4th December*, 1883.
5625. EXPLOSIVE COMPOUNDS, &c., S. R. Divine, Loch-Sheldrake, U S.—*4th December*, 1883.
5627. MULTIPLE PUMPS, A. W. L. Reddie, London.—A communication from D. S. Hines, W. A. Perry, and C. C. Worthington, U S.—*4th December*, 1883.
5632. GAS ENGINES, L. H. Nash, Brooklyn, U.S.—*4th December*, 1883.
5633. GAS ENGINES, L. H. Nash, Brooklyn, U.S.—*4th December*, 1883.
5637. WOVEN FABRIC, A. M. Clark, London.—A communication from A. Urbahn and A. G. Jennings, U.S.—*4th December*, 1883.

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

5018. STOCKINGS, H. J. Griswold, London.—*3rd December*, 1880.
5051. TIMEPIECES, W. P. Thompson, Liverpool.—*4th December*, 1880.
5083. TELEGRAPHIC, &c , CABLES, E. Berthoud and F. Borel, Switzerland.—*6th December*, 1880.
5094. VEGETABLE FIBRES, P. M. Justice, London.—*7th December*, 1880.
5097. HYDROCARBON LAMPS, D. P. Wright, Birmingham.—*7th December*, 1880.
5104. PULVERISING MINERALS, W. R. Lake, London.—*7th December*, 1880.
5276. WINDLASSES for SHIPS, G. D. Davis, Stepney.—*16th December*, 1880.
5302. REELS for COILING WIRE ROPES, W. H. Harfield, London.—*17th December*, 1880.
5312. APPARATUS for HEATING the HUMAN BODY, W. P. Thompson, Liverpool.—*18th December*, 1880.
5093. SCREW PROPELLERS, W. Cooke and D. Mylchreest, Liverpool.—*7th December*, 1880.
5119. SKATES, H. Bezer, London.—*8th December*, 1880.
5129. WORKING BRAKES by FLUID PRESSURE, C. D. Abel, London.—*8th December*, 1880.
5149. HYDRAULIC LIFTS, E. B. Ellington, Chester.—*9th December*, 1880.
5156. MANUFACTURE of GAS, A. P. Chamberlain, London.—*10th December*, 1880.
5150. MOULDS for CASTING, H. Gibbons, Hungerford.—*9th December*, 1880.
5179. SPINNING, &c., COTTON, T. Coulthard, Preston, and J. M. Hetherington, Manchester.—*10th December*, 1880.
5209. SHIRTS, W. and G. Benger, Stuttgart.—*13th December*, 1880.
5210. SHIRTS and DRAWERS, W. and G. Benger, Stuttgart.—*13th December*, 1880.
5296. SUGAR BOILING APPARATUS, C. D. Abel, London.—*17th December*, 1880.
5116. WATER-METERS, R. Schloesser, Manchester.—*8th December*, 1880.
5133. GRAPPLING, &c , APPARATUS, W. R. Lake, London.—*8th December*, 1880.
5134. PRODUCING LIGHT, &c., F. Wilkins, London.—*8th December*, 1880.
5142. BOBBINS, W. and J. Dixon, Steeton.—*9th December*, 1880.

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

4515. FLOATING LIGHTS, C. D. Abel, London.—*21st November*, 1876.
4780. GLASS, F. Siemens, Dresden.—*11th December*, 1876.
4821. HORSESHOES, H. Martin and R. Robertson, Coatbridge.—*13th December*, 1876.
4875. PREVENTING INCRUSTATION, &c., C. D. Abel, London.—*18th December*, 1876.
4827. HORSE RAKES, E. T. Bousfield, Bedford.—*13th December*, 1876.
4874. LOOMS for WEAVING, W. Smalley, Preston.—*16th December*, 1876.

Notices of Intention to Proceed with Applications.

(*Last day for filing opposition, 28th December*, 1883.)

3671. LAMPS, J. Harbottle, Newcastle-upon-Tyne.—*26th July*, 1883.
3760. AUTOMATIC FLUSHING, &c., TANK, F. J. Austin, London.—*1st August*, 1883.
3778. GONGS or BELLS for BICYCLES, &c., F. U. Bolton, Birmingham.—*2nd August*, 1883.
3790. AUTOMATIC BRAKES, E. B. Price, Portrush —*2nd August*, 1883.
3792. EGG DECAPITATOR, A. C. Henderson, London.—Com. from L. Olivier.—*3rd August*, 1883.
3797. SCREW NUTS, J. Heap, Ashton-under-Lyne.—*3rd August*, 1883.
3799. WEIGHING APPARATUS, H. J. Haddan, London.—Com. from C. Munnem.—*3rd August*, 1883.
3805. OVENS, &c , J. B. Petter, Yeovil.—*3rd August*, 1883.
3806. PRINTING from ENGRAVED PLATES, J. H. Johnson, London.—A communication from H. F. Marcilly and Utzschneider and Co.—*3rd August*, 1883.
3807. RAILWAY PASSENGER CARRIAGES, &c., T. Clapham, Keighley.—A communication from W. H. Holmes.—*3rd August*, 1883.
3311. RAILWAY CHAIRS, S. Leadbeater, Morley.—*4th August*, 1883.
3812. FOLDING BOXES or CASES, S. Cropper, London.—*4th August* 1883.
3823. SPRING MATTRESSES, &c., A. Lawrie, Birmingham.—*4th August*, 1883.
3829. TANNING, W. Clark, London.—A communication from G. dalla Zonca.—*4th August*, 1883.
3848. FIREPLACES, &c , W. Clark, London.—A communication from J. H. Burnam.—*7th August*, 1883.
3850. SIFTING, &c., APPARATUS, J. H. Johnson, London.—Com. from H. Cabanes.—*8th August*, 1883.
3861. WASHING and DRYING TEXTILE MATERIALS, &c., W. E. Gedge, London.—A communication from J. Chavanne and J. P. Balme.—*8th August*, 1883.
4011. GROOMING BRUSHES, A. Harvey, Ottawa.—Com. from R. W. Thompson —*21st August*, 1883.
4055. PROPELLING VESSELS, H. Imray, London.—Com. from E. Oppikofer.—*21st August*, 1883.
4114. CASTING BOXES, A. Sauvée, London. — *25th August*, 1883.
4146. TREATING STARCH-YIELDING MATERIALS, J. H. S. Wildsmith, London.—*28th August*, 1883.
4449. KILNS, J. Watt, Keith.—*18th September*, 1883.
4510. RAISING SUNKEN VESSELS, A. C. Henderson, London.—Com. from F. B. Picot.—*21st September*, 1883.
4663. HOT-BLAST STOVES, A. M. Clark, London.—A communication from C. Alger.—*1st October*, 1883.
4930. OBTAINING ALUMINIUM, H. A. Gadsden, London.—Com. from E. Foote.—*16th October*, 1883.
4990. GALVANIC BATTERIES, G. C. V. Holmes, S. H. Emmens, and F. E. Burke, London.—*19th October*, 1883.
5135. LAMPS, &c , J. Rogers, London.—*30th October*, 1883.
5193. LEAD COMPOUNDS, A. French, Morriston.—*1st November*, 1883.
5199. BICYCLES, R. C. Thompson, Brixton, and W. Spence, Surbiton.—*1st November*, 1883.
5224. PENCIL-CASES, &c., A. H. Woodward, Birmingham.—*2nd November*, 1883.
5238. ELECTRIC GENERATORS, H. J. Haddan, London.—A communication from the Bain Electric Company.—*5th November*, 1883.
5244. PRODUCING INTENSE WHITE LIGHT, C. D. Abel, London.—A communication from C. Clamond.—*5th November*, 1883.
5273. GRINDING, &c., FILE BLANKS, A G. Brookes, London.—Com. from A. Weed.—*7th November*, 1883.
5624. EXPLOSIVE COMPOUNDS, S. R Divine, Loch-Sheldrake, U.S.—*4th December*, 1883.
5625. EXPLOSIVE COMPOUNDS, &c., S. R. Divine, Loch-Sheldrake, U S.—*4th December*, 1883.
5632. GAS ENGINES, L. H. Nash, Brooklyn, U.S.—*4th December*, 1883.
5633. GAS ENGINES, L. H. Nash, Brooklyn, U.S.—*4th December*, 1883.

(*Last day for filing opposition, 1st January*, 1883)

3820. HOISTS, T. Brown, Walkden, and W. Brown, Little Hulton.—*6th August*, 1883.
3839. COMPOUNDS for ELECTRIC WIRE INSULATORS, W. P. Thompson, Liverpool —A communication from J. F. Martin.—*7th August*, 1883.
3843. TRAYS for BAKERS' OVENS, R. Morton, Wishaw.—*7th August*, 1883.
3845. BREECH-LOADING SMALL-ARMS, T. Woodward, Aston.—*7th August*, 1883.
3849. DIFFERENTIAL PULLEY BLOCKS, W. T. Eades, Birmingham.—*8th August*, 1883.
3851. GAS LANTERNS, J. H. Johnson, London.—A communication from R. Kraussé.—*8th August*, 1883.
3854. LOOMS, R. H. Brandon, Paris.—A communication from G. Crompton.—*8th August*, 1883.
3874. BREECH-LOADING SMALL-ARMS, T. Horsley, York, and C. Pryse, Birmingham.—*9th August*, 1883.
3879. MATERIAL SUITABLE for TRUNKS, &c., H. A. Silver, London.—*9th August*, 1883.
3881. SPINNING and DOUBLING COTTON, &c., J. Macqueen, Bury.—*10th August*, 1883.
3886. SECONDARY BATTERIES, A. J. Jarman, London.—*10th August*, 1883.
3898. HEATING, &c., APPARATUS, N. Whitley, H. Hoyle, and F. W. Thomson, Halifax.—*11th August*, 1883.
3919. RESERVOIR PENHOLDERS, J. D. Carter, London.—*13th August*, 1883.
3924. HARROWS, DRAGS, and CULTIVATORS, W. Ogle, Ripley.—*13th August*, 1883.
3944. TUBULAR WIRE and NAILS, W. R. Lake, London.—A communication from H. Bacon and A. Eppler.—*14th August*, 1883.
3967. INSULATING SUPPORTS for TELEGRAPH, &c., WIRES, S. Woolf, Mexborough.—*15th August*, 1883.
4013. FURNACES, C. D. Abel, London.—A communication from J. Ferrando.—*18th August*, 1883.
4040. SOLIDIFYING LIQUID or SEMI-LIQUID FATTY ACIDS, &c., E. A. Brydges, Berlin.—A communication from A. Marix.—*21st August*, 1883.
4076. APPLYING COLOURS to SURFACES, A. M. Clark, London.—A communication from H. Abbott and W. C. Garrison.—*22nd August*, 1883.
4080. GAS MOTOR ENGINES, S. Griffin, Bath.—*23rd August*, 1883.
4133. CASE or BOX for HOLDING POSTAGE, &c., STAMPS, S. R. Edwards, London.—*27th August*, 1883.
4207. PRODUCING a NEW SOLID BASE by REACTION of ALDEHYDE and HYDROCHLORATE of ANILINE, &c., J. Imray, London.—Com. from the Actien Gesellschaft für Anilin-Fabrikation.—*31st August*, 1883.
4224. GRINDING VALVES to their SEATS, A. M. Clark, London.—Com. from A. Case.—*1st September*, 1883.
4827. SURGICAL BELT and BED STAY, E. M. Moore, London.—*8th September*, 1883.
4447. COUPLINGS, &c , T. Greenwood, Elland.—*18th September*, 1883.
5038. SPLITTING or SKIVING LEATHER, W. H. Stevens, Leicester.—*23rd October*, 1883.
5061. APPARATUS for GETTING COAL, W. F. Hall and W. Low, Durham.—*24th October*, 1883.
5065. TRANSMITTING ELECTRIC ENERGY to TRAM, &c., CARS, M. H. Smith, Halifax.—*24th October*, 1883.
5133. MARINE ENGINES, J. Hargreaves, Widnes.—*30th October*, 1883.
5172. LOOMS, J. S. Hargreaves, Ashton-under-Lyne.—*31st October*, 1883.
5178. COLOUR BOXES, T. Foxall, London.—*31st October*, 1883.
5195. POROUS POTS and PLATES, T. Coad, London.—*1st November*, 1883.
5230. CARDING COTTON, &c., B. A. Dobson and W. I. Bromiley, Bolton.—*3rd November*, 1883.
5235. TREATING ORES, T. R. Jordan, London.—*5th November*, 1883.
5236. EXTRACTING METALS from ORES, &c., T. R. Jordan and J. Longden, London.—*5th November*, 1883.
5256. SOUNDING APPARATUS, J. B Hannay, Glasgow.—*6th November*, 1883.
5269. LINED CONDUITS, C. A. Day, London.—A communication from C. Detrick.—*7th November*, 1883.
5310. FILTERS, G. F. Marshall, Battersea.—*9th November*, 1883.
5327. CLEANING KNIVES, E. Greenfield, Bromley.—*10th November*, 1883.
5333. RETAINING and RELEASING WINDOW BLIND CORDS, &c., W. Kelly, Mount Brandon.—*12th November*, 1883.
5348. BRIDGES, &c., W. R. Kinipple, Greenock.—*13th November*, 1883.
5355. TREATING ORES, B. J. B. Mills, London.—A communication from P. Manhès.—*13th November*, 1883.
5357. HYDROCARBON FURNACES, A. J. Boult, London.—Com. from O. D. Orvis.—*13th November*, 1883.
5367. STEEL, W. Beardmore and J. M'C. Cherrie, Glasgow.—*14th November*, 1883.
5371. PRIMARY and SECONDARY BATTERIES, J. Noad and R. Matthews, London.—*14th November*, 1883.
5389. STEERING GEAR for SHIPS, W. H. Harfield, London, and G. T. Burden, Newcastle-upon-Tyne.—*15th November*, 1883.
5393. METALLIC TUBULAR COILS, T. B. Sharp, Smethwick.—*15th November*, 1883.
5637. WOVEN FABRIC, A. M. Clark, London.—Com. from A. Urbahn and A. G. Jennings.—*4th December*, 1883.

Patents Sealed.

(*List of Letters Patent which passed the Great Seal on the 7th December*, 1883.)

2886. STOVES, &c., S. C. Davidson, Belfast.—*9th June*, 1883.
2890. HOT-WATER BOILERS, J. Collier and H. Smith, Halifax.—*9th June*, 1883.
2910. FULLING and PLANKING HAT BODIES, &c , J. Southwood and W. Hamnett, Stockport.—*12th June*, 1883.
2913. BURNING SMALL PYRITES, &c., M. Finch, Silvertown, and W., J., and S. Willoughby, Plymouth.—*12th June*, 1883.
2918. BUOYS or FLOATS, H. J. Haddan, London.—*12th June*, 1883.
2932. COWLS, &c., J. W. Holland, London.—*12th June*, 1883.
2937. STEAM TRICYCLE, J. Imray, London.—*13th June*, 1883.
2940. GAS STOVES, H. J. Haddan, London.—*13th June*, 1883.
2982. LIFTS, H. J. Haddan, London.—*15th June*, 1883.
3014. ENGINES, C. Baumgarten, Berlin.—*18th June*, 1883.
3031. PRODUCING LIGHT by ELECTRICITY, W. P. Thompson, Liverpool.—*19th June*, 1883.
3059. IRONING MACHINE, R. Mindt, Berlin.—*20th June*, 1883.
3071. HEATED AIR MOTORS, L. P. Martin, Vienna, and F. W. Gilles, Cologne.—*20th June*, 1883.
3074. DYNAMO-ELECTRIC MACHINES, M. Deprez, Paris.—*21st June*, 1883.
3075. LOOMS, W. H. Tristram and H. Brereton, Halliwell.—*21st June*, 1883.
3105. STEAM GENERATOR, H. J. Haddan, London.—*22nd June*, 1883.
3106. PERAMBULATORS, C. Thompson, London.—*22nd June*, 1883.
3118. STOP-MOTIONS of DRAWING FRAMES, J. Macqueen, Bury.—*23rd June*, 1883.
3142. ROLLING MILLS, W. H. Ellis, Leeds.—*25th June*, 1883.
3167. INCANDESCENT ELECTRIC LAMPS, H. J. Haddan, London.—*26th June*, 1883.
3200. INDUCING AIR or GASEOUS FLUIDS from CHIMNEYS, &c., H. Burgin, Walthamstow.—*27th June*, 1883.
3229. CHROMATES of SODA, E. P. Potter and W. H. Higgin, Bolton.—*29th June*, 1883.
3233. ELECTRIC ARC LAMPS, C. Wüest, Zurich.—*29th June*, 1883.
3287. BOILER, G. Knowles, London.—*3rd July*, 1883.
3470. CONVEYING CASH, &c , APPARATUS, H. J. Haddan, London.—*13th July*, 1883.
3535. INDIA-RUBBER ASSISTANT BEARING SPRINGS, G. Spencer, London.—*18th July*, 1883.
3576. WATER METERS, J. Imray, London.—*20th July*, 1883.
3580. PURIFYING MINERAL OILS, W. R. Lake, London.—*20th July*, 1883.
3593. CIGAR-MAKING MACHINES, W. Clark, London.—*21st July*, 1883.
3826. TREATING BREWERS' YEAST, J. S. Lord, Newark-on-Trent.—*4th August*, 1883.
3 77. TREATING ALCOHOLIC LIQUORS, W. E. Gedge, London.—*9th August*, 1883.
4337. SULPHUROUS ACID, C. A. Allison, London.—*11th September*, 1883.
4415. CARBONIC ACID GAS, G. Jármay, Winnington.—*14th September*, 1883.
4428. PREPARING COLOURING MATTERS, A. P. Price, London.—*15th September*, 1883.
4491. TRAMWAYS or RAILWAYS, R. L. Urquhart, Edinburgh.—*20th September*, 1883.
4528. RAILWAY WHEELS, J. Holden, Swindon.—*22nd September*, 1883.
4585. GALVANIC BATTERIES, A. W. Warden, London.—*26th September*, 1883.
4803. SCHOOL SLATES, H. J. Haddan, London.—*9th October*, 1883.
4915. CARPET CLEANERS, A. J. Boult, London.—*16th October*, 1883.

(*List of Letters Patent which passed the Great Seal on the 11th December*, 1883.)

2929. WATER-CLOSETS, F. Piercy, London.—*12th June*, 1883.
2933. INDICATING, &c., APPARATUS, R. I. Barnes and H. S. Heath, London.—*13th June*, 1883.
2948. FOLDING PACKING CASES, &c., H. Greene, London.—*13th June*, 1883.
2953. STEAM HYDRAULIC and other MOTORS, T. Morgan, London.—*13th June*, 1883.
2957. TRICYCLES, &c., R. C. Jay, Bayswater.—*14th June*, 1883.
2960. LOOMS, W. H. Kenyon, Denby Dale.—*14th June*, 1883.
2967. STENCH TRAPS, J. E. Manock, Heywood.—*14th June*, 1883.
2969. WATER-CLOSET BASINS, R. M'Combie and W. Seaman, London.—*14th June*, 1883.
2971. BURNERS, Sir J. N. Douglass, Dulwich.—*14th June*, 1883.
2976. BUTTONS, &c., W. B. Fitch, Deptford.—*15th June*, 1883.
2977. RAISING, &c., CHIMNEYS of ENGINES, J. P. Coultas, Grantham.—*15th June*, 1883.
2931. AUTOTYPOGRAPHICAL MACHINE, L. A. Groth, London.—*15th June*, 1883.
2999. WASHING, &c., MACHINERY, J. and P. Hawthorn and J. P. Liddell, Newtown.—*16th June*, 1883.
3011. MARKING the GROUND for LAWN TENNIS, &c., J. G. Howard, Biddenham.—*18th June*, 1883.
3055. METALLIC PERMANENT WAY, W. P. Thompson, Liverpool.—*20th June*, 1883.
3089. AMMONIACAL PRODUCTS, L. Q. and A. Brin, Paris.—*21st June*, 1883.
3110. RAISING and LOWERING APPARATUS, H. Reichardt, London.—*22nd June*, 1883.
3172. YARNS, THREADS, &c., W. R. Lake, London.—*26th June*, 1883.
3176. FORGING HORSESHOE NAILS, A. J. Boult, London.—*26th June*, 1883.
3197. FIRE-ARMS, W. R. Lake, London.—*27th June*, 1883.
3208. BOBBIN NET or TWIST LACE MACHINES, A. C. Henderson, London.—*28th June*, 1883.
3210. PROPELLING AND STEERING STEAMSHIPS, &c., J. Stewart, Blackwall.—*28th June*, 1883.
3285. STOPPERING BOTTLES, &c., A. Kempson, Tunbridge Wells.—*3rd July*, 1883.
3318. HORSE GIRTHS and ROLLER BANDS, J. C. Odell, Coventry.—*4th July*, 1883.
3328. FRAMES for PRESERVING EDGES of BOOKS, &c., A. C. Henderson, London.—*5th July*, 1883.
3378. FEED APPARATUS for STEAM BOILERS, J. Imray, London.—*7th July*, 1883.
3538. OBTAINING FIBRES, &c., from VEGETABLE and other SUBSTANCES, A. Reddie, London.—*18th July*, 1883.
3548. EXPRESSING the JUICES of VARIOUS MATTERS, A. C. Henderson, London.—*19th July*, 1883.
3878. CRANK SHAFTS for STEAMSHIPS, J. Russell, Cardiff.—*9th August*, 1883.
3894. STEAM and other PISTONS, A. MacLaine, Belfast.—*11th August*, 1883.
3897. SPEED REGULATING APPARATUS, N. Macbeth, Bolton-le-Moors —*11th August*, 1883.
3933. TREATING LEAD, P. M. Justice, London.—*14th August*, 1883.
3946. GENERATING, &c., ELECTRIC CURRENTS, P. Higgs Leith.—*14th August*, 1883.
3976. CARBONIC ACID, W. L. Wise, London.—*16th August*, 1883.
4113. FORMING a GROUND in the MESHES of NET and OPEN-WORKED FABRICS, &c., C. J. Cox, Nottingham.—*25th August*, 1883.
4141. PRINTING MACHINERY, C. P. Huntington, Darwen.—*28th August*, 1883.
4312. MUSICAL INSTRUMENTS, J. B. Hamilton, Hammersmith.—*7th September*, 1883.
4353. COMBING COTTON and other FIBRES, W. Dobson, Douglas.—*11th September*, 1883.
4364. LOOMS, R. Brownridge and P. Bond, Macclesfield.—*12th September*, 1883.
4526. ROAD ENGINES, R. Peacock and H. L. Lange, Gorton.—*21st September*, 1883.
4554. SAFETY CATCH for BROOCHES, &c., D. MacGregor, Perth.—*24th September*, 1883.
4563. ARMATURES for ELECTRIC CURRENT GENERATING MACHINES, H. Haddan, London.—*25th September*, 1883.
4580. PACKING FRILLING, &c., J. MacCallum, Manchester.—*26th September*, 1883.
4593. GLYCERINE, J. Imray, London.—*26th September*, 1883.
4634. ASCERTAINING SHIPS' COURSES, G. C. Lilley, London.—*28th September*, 1883.
4644. TREATING CARBONACEOUS and other SUBSTANCES, H. Aitken, Falkirk.—*29th September*, 1883.
4645. SHIPS or VESSELS, A. E. Fairman, Glasgow.—*29th September*, 1883.
4667. UNIONS or COUPLINGS, N. Thompson, London.—*1st October*, 1883.
4699. DRYING and COOLING SUGAR, &c., C. A. Day, London.—*3rd October*, 1883.
4752. CHAINS and CHAIN CABLES, C. H. Reed, Sunderland.—*6th October*, 1883.

List of Specifications published during the week ending December 8th, 1883.

1497, 4d.; 1599, 6d.; 1869, 6d.; 1960, 2d.; 1978, 2d.; 1989, 8d.; 1997, 6d.; 2004, 6d.; 2005, 2d.; 2011, 2d.; 2012, 4d.; 2014, 2d.; 2015, 2d.; 2016, 6d.; 2017, 6d.; 2018, 2d.; 2020, 6d.; 2021, 4d.; 2023, 6d.; 2024, 6d.; 2025, 4d.; 2029, 2d.; 2030, 2d.; 2031, 2d.; 2034, 2d.; 2037, 6d.; 2038, 6d.; 2040, 1s.; 2041, 6d.; 2044, 6d.; 2046, 2d.; 2047, 4d.; 2048, 4d.; 2051, 2d.; 2053, 2d.; 2057, 1s.; 2058, 1s.; 2060, 2d.; 2061, 2d.; 2062, 6d.; 2063, 6d.; 2064, 6d.; 2065, 2d.; 2066, 6d.; 2067, 2d.; 2069, 8d.; 2071, 6d.; 2072, 4d.; 2073, 2d.; 2075, 2d.; 2078, 6d.; 2079, 6d.; 2080, 6d.; 2082, 2d.; 2083, 2d.; 2088, 4d.; 2089, 6d.; 2093, 2d.; 2094, 2d.; 2095, 4d.; 2096, 4d ; 2097, 6d.; 2098, 8d.; 2101, 6d.; 2103, 6d.; 2105, 2d.; 2111, 6d.; 2114, 6d.; 2116, 6d.; 2123, 6d.; 2125, 6d.; 2126, 6d.; 2127, 6d.; 2133, 4d.; 2134, 4d.; 2135, 6d.; 2139, 4d.; 2141, 2d.; 2151, 6d.; 2153, 6d.; 2157, 6d.; 2162, 6d.; 2169, 6d ; 2173, 6d.; 2177, 6d.; 2197, 2d.; 2207, 6d.; 2291, 6d.; 2995, 6d.; 3704, 4d.; 4131, 6d.

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ABSTRACTS OF SPECIFICATIONS.

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

1497. MANUFACTURE OF SUGAR FROM CANE, AND APPARATUS THEREFOR, *A. J. Boult, London.—21st March*, 1883.—(*A communication from C. Blandin, Guadeloupe.*) 4*d*.

The albuminous matters contained in the sugar-cane are coagulated by steam, hot air, or hot water, before the cane passes to the mill in which the extraction of its juice takes place.

1599. SMOKE PREVENTING AND FUEL SAVING GRATES AND STOVES, *A. F. Andresen, London.—29th March*, 1883. 6*d*.

The object is the construction of grates, stoves, and fireplaces in such wise as to allow of the regulation of the draught to and across the fire, as the exigences of the stages of ignition and combustion of the material under ignition or combustion may demand.

1869. TRAMWAYS AND THE WHEELS OF TRAMWAY CARRIAGES, *G. Wilson, London.—12th April*, 1883. 6*d*

This consists in making the wheels for tramwa