THE ANTWERP EXHIBITION.

No. VII.

It will be remembered that the main engines of the Phlégéton are free from all incumbrances in the shape of pumps, the whole of the pumping being done by special engines, which we illustrate on page 318. Although something of the same kind has been done in this country, it has never been done to the same extent, and in no case has a centrifugal pumping engine also been employed to drive reciprocating pumps. The engines are compound, of the overhead type, and, indeed, very similar to those used in screw propulsion. The cylinders are carried on wrought iron columns; the high-pressure cylinder is 11·8in. diameter; the low-pressure, 19·68in. The stroke of both is the same, 9·8in. There are two air pumps driven by wrought iron levers, the hot well, of copper, being recessed to let the cross-head into it, and acting as a kind of air vessel. The valves are india-rubber flaps. The diameter of each pump is 17in.; its stroke, 7·5in. At one end of the crank shaft is the centrifugal circulating pump, the diameter of the wheel being 3ft. 7in. At the extreme opposite end of the shaft is a crank, which works a bilge pump. On the crank shaft is mounted a large endless screw. This runs in a worm wheel, at each end of the axis of which is placed one of two feed pumps. These are 5·43in diameter and 6in. stroke. The worm wheel and the worm are multi-threaded, and the feed pumps make 100 revolutions per minute, while the air pumps make 200. The bilge pump is 5·66in. diameter and 5in. stroke. The whole machine has been very carefully designed in the light of long experience, and our engravings will be found, we think, to repay study. The nominal number of revolutions is 200 per minute, but this may be increased to 300, at which all the pumps are found to perform well, and may be reduced to 80 revolutions without difficulty. The diameters of the cylinders are such that the pumps can be worked with the lowest pressure of steam that will run the main engines. One of the great advantages of the system is that the main engines can always be started with great facility, and the safety valves are arranged to blow into the condenser, so that the fires can always be kept up to their full intensity, even when the main engines are stopped—a matter of very great importance in a war ship, which, in a night attack, for example, can creep into a harbour or along a coast with the utmost silence and caution, while at the same time ready to start at full speed without a moment's delay. This advantage cannot possibly be obtained when fires have to be banked, or even when dampers have to be closed.

In the annexed table we summarise a few of the most important particulars of the machinery we have illustrated:—

Number of main engines	2
Indicated horse-power	1700
Number of revolutions	160
Piston speed, in feet, per minute	473
Ratio of expansion	6 to 12 times.
Cooling surface in condensers	3000 sq. feet.
Number of pumping engines	2
Total number of air pumps	4
Total number of circulating pumps	2
Weight of water discharged per hour	393 tons.
Number of boilers	4
Total heating surface	3600ft.
Number of forced draught fans	2
Diameter of disc	4ft. 2in.
Number of revolutions	800
Number of exhaust fans in engine-room	2
Diameter of disc	2ft. 10in.
Number of revolutions	240

The forced draught fans are noiseless and supply under a pressure equal to 2in. of water, the quantity of air necessary for the combustion of two tons of coal per hour. This is but 2·6 lb. per horse per hour, but Messrs. Claparede are confident that this is sufficient to leave no doubt whatever that a larger quantity than that stated can be burned. The total grate surface is 86 square feet, so that 2 tons per hour would be 51 lb. per square foot, a comparatively moderate rate of combustion. Torpedo boats burn twice as much.

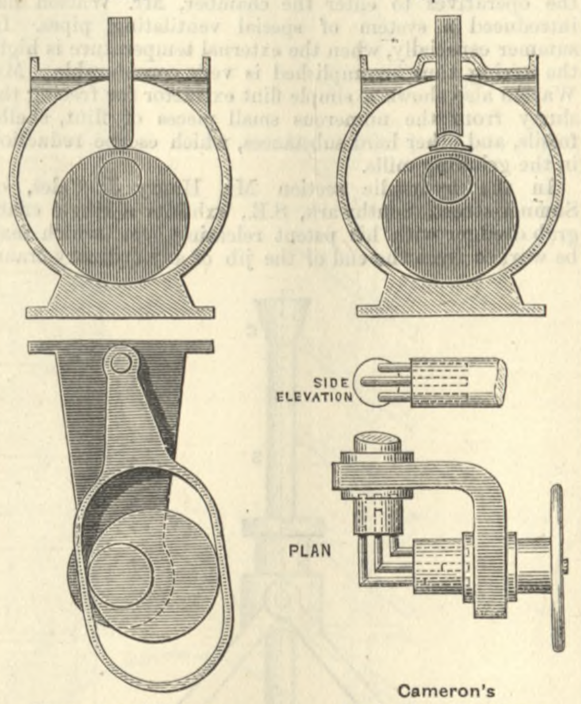
We cannot conclude our notice of this most interesting exhibit without expressing our thanks to Messrs. Claparede for the courtesy with which they have placed in our hands complete dimensioned drawings of the machinery of the Phlégéton, thus enabling their professional brethren all over the world to see what French engineers are doing. We need hardly repeat that the machinery we have illustrated is the embodiment of the most recent innovations in the construction of engines for ships of war. Messrs. Claparede and Co. have long enjoyed a high reputation for the construction of machinery. The principal establishments of the society are situated at St. Denis in the department of the Seine. A branch establishment at Rouen affords facilities for carrying on marine work. The average number of hands employed is 2000. Up to the 1st of June, 1885, the company had made more than 400 fixed and marine engines, of a power varying from 50 to 3000 horses, over 1000 steam boilers of all kinds, 1400 sets of machinery such as portable engines, cranes, compressed air engines, installations for factories, &c. &c., and some 200 locomotives. They have also carried out important contracts for the State, such as dock gates, and other hydraulic work, such as the turbines and pumps at St. Maur, for the water supply of Paris. As marine engine builders the work done by Messrs. Claparede and Co.—or to give the company its correct title, La Société Anonyme des Anciens Etablissement Claparede—has been very important, including more than 80 vessels of war, including 29 tug-boats of 100 to 1000-horse power, 32 gun-boats of 100 to 300-horse power, four despatch vessels with paddle-wheels, of 400 to 500-horse power, 24 torpedo boats, and many other vessels too numerous to mention. At the present time the society are building 11 torpedo boats, representing three different types, at a cost of 3,660,000 francs. It will be admitted, we think, that the work turned out by such a firm may, perhaps, contain something from which even English engineers can learn a little.

ROTARY ENGINES.

No. II.

One of the earliest rotary engines was that in which a cylindrical excentric was secured to the main shaft and made to revolve in a fixed cylinder, the axis of which coincided with the axis of the shaft, and against whose internal surfaces the excentric cylinder touched sufficiently to prevent steam passing from one side to the other. Radiating from the centre of the shaft, and extending from one end of the cylinder to the other, was a reciprocating block. This block, while always pressing against the revolving excentric piece, rose sufficiently to allow the excentric to make a complete revolution. The internal space was therefore kept divided into two by the rising and falling block. Into one division steam was made to enter, and by its force urge round the excentric and shaft, at the same time expanding into the larger space formed; the other division was opened out to exhaust. Upon this pattern, which most will recognise, are based the engines of Yule, Hall, and Napier. In this it will be seen that the reciprocating piece is not dispensed with, and that, from the way in which its movement is caused, a great deal of wear must take place at the end against which the excentric cylinder rubs. Again, the number of parts entering into the composition of this engine is as great as that of those entering into that of the simple reciprocating engine. In the first place, there is the reciprocating piece working in the cylinder frame, which we may consider to correspond to the piston and rod working in its cylinder; there is also the excentric cylinder and shaft, analogous to the crank shaft of its rival; there remains therefore the connecting-rod of the latter to meet by an equivalent piece of mechanism in the former. As regards this latter point, it must be allowed that in some of the engines of the above description this piece is quite dispened with, but at the same time the inventors have been obliged to use a joint of a most insufficient character. The junction between the reciprocating block and the excentric cylinder is of such a nature that the curvature of the excentric presented to the block is continually varying in position, and therefore the junction cannot be more than a mere line. Such a rubbing surface ought not to be admissible when leakage has to be prevented and wear reduced; in high speed engines it would be absurd. Supposing this defect remedied, a new piece would have to be introduced, a piece so constructed as to fit fairly with the reciprocating piece and at the same

Yule. Napier.



Simpson and Shipton. Cameron's Mechanical Movement.

time allowed to oscillate sufficiently to press fairly against the revolving cylinder to suit its varying position. Such a piece is introduced in the engines of Napier. The engine being thus completed, the new piece added is evidently that corresponding to the connecting-rod of the reciprocating engine.

In the engine of Simpson and Shipton we have an apparently simple combination of parts, but yet it has a reciprocating piece in the swinging chamber, and counts up as many limbs as the ordinary engine, except where an incomplete joint is suffered. As with the previous class of engines, a shaft is provided with an excentric cylinder, and made to revolve in an oblong chamber whose major axis always passes through the centre of the excentric cylinder. This chamber is made sufficiently long to allow the excentric piece to work freely inside. That it may accommodate itself to the various positions of the revolving gear it is suspended from a joint, and is therefore capable of an oscillating movement. The pin about which the swinging chamber oscillates is secured to a framework, in which are provided the bearings for steadying the main shaft. Steam entering by suitable channels alternately above and below the excentric cylinder compels the mechanism to be set in motion, by enlarging the chamber to make space for itself. The engine is thus composed of the swinging block oscillating on its pivot, and the shaft constrained in its bearings, the two pairs being connected together by the suitable shaping of the chamber and excentric piece. In this case a piece is saved, but at the expense of having to rest contented with such a steam-tight joint as can be afforded by two pieces touching each other in a straight line. If efficient jointing is provided, no simplicity would occur in this engine, as far as the number of parts entering into its composition is concerned.

Everyone must admire the ingenious spherical engine invented by Mr. Towers, and though this admiration might be somewhat lessened after having compared it with other engines of a similar character, yet it still is a wonderful production, not on account of having discovered a short road to rotary motion, but by reason of the close packing of the necessary pieces and movements. It is wrong to suppose that in this contrivance the natural reciprocating movement is at all dispensed with; many who judge of the engine principally from its exterior, and who have not carefully examined the working parts, are inclined to suppose such motion is avoided; even the manufacturers themselves in their prospectus claim as one of its advantages that it has no reciprocating action. As, however, each semicircular half of the peculiar piston is at one end of an enclosed space at one part of the revolution of the main shaft, as it is at the opposite end of the chamber after half a turn of the shaft has been made, and as at the end of a complete revolution it is back again from where it started, it seems hardly possible to say that reciprocation is avoided. The motion is disguised to some extent by the fact that what may be termed the ends of the chamber are continually altering their position, but relatively to these movable ends the movement is plainly reciprocating. A modification of this engine, invented by Fielding, and fully illustrated in this journal a few weeks back, shows more distinctly the existence of a definite reciprocating movement. The inclined revolving shafts and the intermediate rocking piece employed in the Tower engine are reproduced in principle in the Fielding engine. But in the Fielding engine the pairing of the rocking piece to the shafts is obtained by fitting it with pistons playing into cylinders constructed on the revolving shafts themselves, the cylinders being curved round in such a way that these axes are circles having their centres at the point of intersection of the inclined shafts. The whole piece of mechanism is set in motion by the action of steam forcing the pistons forwards and backwards in their respective cylinders. Here, relatively to the revolving cylinders, the motion is still reciprocating; and anyone inclined to lower the character of these engines might say that after all they have not done away with the objectionable movement complained of in the ordinary engine, and have, into the bargain, managed to introduce two revolving shafts instead of the only one of direct use. This would be nothing more, however, than a superficial opinion, for considered as pure pieces of mechanism, both the Fielding engine and the Tower engine contain just the same number of working pieces as other engines. Both these engines have dead points, and by referring to the diagrams of the Tower engine it will be seen that both halves of the rocking piece are at the ends of their reciprocations at the same time; therefore it should be compared, in estimating the number of its parts, with the single cylinder engine. In this engine we see there are four pieces paired together, the piston and gear, connecting-rod, crank shaft, and the main frame, in which are secured the cylinder and steadying bearings. In the Tower engine, there are two shafts, one rocking piece, and the frame holding the steadying bearings, thus making four distinct pieces. The pairing of the rocking piece with the spherical chamber is in addition to that required for the mere mechanical movements, as also are two of the perpendicular joints on the rocking piece; the first required for chambering, the latter for stiffness. If the inclined shaft engines be compared to a double cylinder reciprocating ordinary engine, the two piston-rods of which are rigidly secured together, and in addition the two connecting-rods secured so as to be virtually in one piece, then the principal difference existing between the two is that, whereas in the one two shafts are used and one cylinder, in the other there are two cylinders and one shaft.

A feature consequent upon the reciprocating movement always required in fluid-pressure engines is the existence of dead points. No engine has yet been constructed that has not this difficulty existing at those times when the reciprocating piece is at the end of its travel. If it is claimed for any engine that there are no dead points, this must be considered to mean that special arrangements have been introduced by which the natural dead points are passed over; for, in the operation of causing the reciprocating piece to pass backwards and forwards in its chamber, its movement at each end of the stroke must be reversed, and therefore at the end it must be brought to rest. At that particular instant the steam pressing on the piston may be at its greatest pressure, yet, whatever tendency there is on the part of the piston to move, will be as much to carry the shaft back through the half-revolution it had already made as in the direction necessary to produce a continuous revolving action. Dead points occur not only in fluid-pressure engines, but also in any motor in which the moving force is of a reciprocating character.

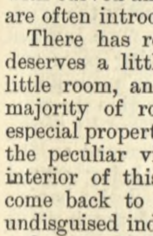
In all rotary engines the dead point exists, and can only be overcome by attaching a fly-wheel to the revolving shaft, or by adding a second engine or chamber, so that the reciprocating pieces may not be on the dead points together. In the Tower engine, though there is a double action going on in each of the two divisions of the spherical chamber, yet, as the action is such that the reciprocating pieces are at the ends of their respective chambers together, there still remains the dead point difficulty. To this engine, however, must be given the credit for packing all the essential mechanisms into a very narrow space, and hence it has great merit for compactness; but yet, as we have seen, it has just the same difficulties as the common engine, and contains just as many moving parts. Very similar remarks apply also to the Fielding engine.

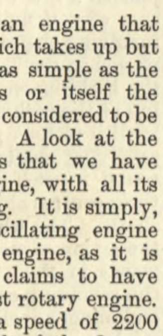
So many engines of the rotary description have been constructed, that it seems quite superfluous to suggest another; but even though many are condemned as impracticable, it is interesting to note the various forms they may take. In the Inventions Exhibition, stowed away in an unfrequented spot, and classed among the modest and meagre exhibits of the mechanical movement group, is an elegant device for transmitting rotary motion from one revolving shaft to another placed at right angles to it. The two shafts are in the same horizontal plane, and steadied in bearings secured to a common stand. Those ends of the shafts which are near to each other are drilled with holes parallel to their axes, and situated at a radia distance of an inch or so from them. Elbow pieces of metal, with the arms at right angles, are rounded so that each arm may enter into the corresponding holes in each shaft, the elbow pieces when in position being in the same plane as the two shafts they serve to connect. A number of these elbows are placed around the shafts. As one shaft is turned, the connecting pieces convey the motion to the perpendicular shaft and, in order to accommodate themselves to the various positions of the shaft, slide in and out of the holes into which they were shipped. In all positions of the shafts these pieces still retain their position in a horizontal plane. Here we have a complete piece of mechanism in which, during rotation, the enlargement and contraction of a space takes place. Supposing that passages are arranged so that steam may enter and exhaust from these chambers against the elbow-resisting pieces, the whole mechanism would be set in motion. We should thus have a rotary motion produced by fittings collected into a very small space, of a very simple character, and the chambering gear of such a shape as would apparently be very much more easy to keep steam-tight and to manufacture than if we employed spheres, cylinders with curved axes, or any other of the peculiar forms that are often introduced.

There has recently been brought out an engine that deserves a little attention, an engine which takes up but little room, and from the outside looks as simple as the majority of rotary engines. This claims or itself the especial property of high speed so generally considered to be the peculiar virtue of the rotary engine. A look at the interior of this piece of machinery shows that we have come back to the old, plain, original engine, with all its undisguised indirect movement and gearing. It is simply, and pretends to be no other, than an oscillating engine with very large trunnions. The Otway engine, as it is called, however ordinary in construction, claims to have attained a speed rivalling that of the fastest rotary engine. Some of these are stated to have attained a speed of 2200 revolutions per minute. Taking this result of the Otway engine, and considering the fast speeds realised by the Brotherhood three-cylinder type, it seems that the rotary engine has strong competitors in engines of the parent pattern, even in its own special department. R.

HOWELL'S BICYCLE WHEEL RIM.

Mr. Price Howell, of the National Cyclists' Union, Barrow-in-Furness, has brought out a new form of rim for bicycles and tricycles, which he designed to meet requirements which are known to experienced riders, namely, the necessity of a rim being designed so that a broken spoke may be taken out, and a new one inserted without interfering with the rubber tire. With the present method of fastening, it becomes necessary to drill the broken piece of spoke out of the hub almost invariably when a spoke breaks. Although several forms of rims have been invented with the object of overcoming these two difficulties, there has not previously been one that would overcome these objections. In the arrangement marked A, the rim is simply one of the ordinary U rims, with a web on the inner side, through which the spokes are inserted alternately on either side. With a rim of this section a lighter one than ordinary may be used, as the web increases the strength in the most essential part. The opposite ends of the spokes are passed through small flanges fixed on the hubs, and the spokes nutted on the inside. The angle of the spokes is not so great as to injure them. In the section marked B laced spokes may be used. The rim is made in halves and fastened together, the small angular rim on the inside having holes drilled in for the spokes to be passed through and nutted on the outside. In either case the rubber tire is not interfered with, and in the event of a broken spoke, a new one could be instantly replaced, as there is no part where a spoke could break in.





OCEAN METEOROLOGY.—RAINFALL AT SEA.

Mr. W. V. Black, F.R.M.S., states that occasion was taken during a voyage round the British Islands in the s.s. Ceylon, from August 6th to 20th last, to take observations of the rainfall and evaporation at sea, and the following abstract of records, it is thought, might be interesting. The rain gauge and evaporating disc were placed on the top of the wheel house, where they were fully exposed to the weather, and free from molestation, and they were examined and noted every morning. The total rainfall amounted to 1·61in. for fourteen days complete, or ·11in. per diem; 3·56in. for the month, or about 1in. above the London average only. The greatest part of this—1·15in.—fell at Cork Harbour, August 8th and 9th, during a cyclone that passed across it from S.W. in the Atlantic Ocean, going N.E. to Scotland, having winds veering from S.S.W. to W.S.W. The next highest amount—·20in.—fell at Glengariff Harbour, August 12th, when a small eddy cyclone followed the previous one from the S.W., going inland to the N.E., with winds veering from W.S.W. to W.N.W. The remainder—·26in.—was made up of small amounts by drizzling mists amidst the Western Isles of Scotland and passing showers in the open sea. Rain was absent for five days at Leith roads, Dublin Bay, and the Thames Estuary, and adjacent seas of each.

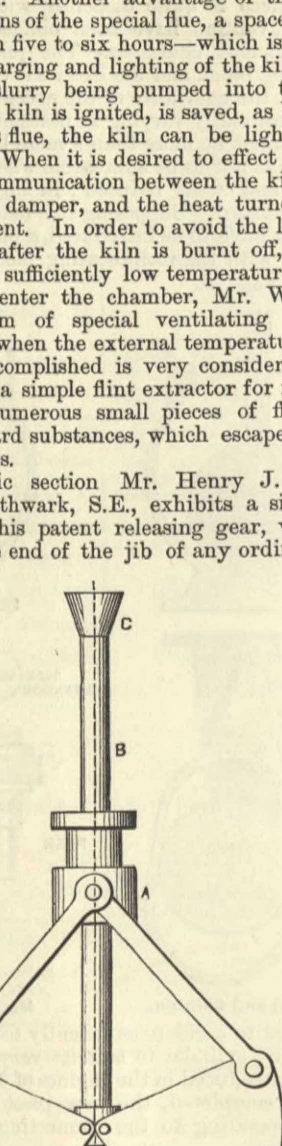
The total evaporation amounted to 1·46in. for fourteen days complete, or ·10in. per diem, and 3·23 for the month, or 1in. about below the London average. The greatest amount of vaporisation was recorded—·30in.—in the Irish Channel, August 13th, after the cyclone had passed, and brisk northerly winds were blowing, with fine weather and clear sky. The next large amount—·23in.—was registered August 15th, after passing through the Irish Seas and North Irish Channel *en route* to the Western Isles of Scotland, when the weather was fine and the winds veered from N. to S.E. The remainder of the amount was made up of small figures recorded in the seas of the eastern coasts chiefly, and when a brisk north-westerly wind prevailed. Real dampness or no evaporation was formed only on two days at Cork Harbour after the gale of August 8th—9th, and in the seas of the Isle of Skye during the heavy mists of August 10th. Though the ship floats on the water, yet the superposed air was then nearly as dry as on land, owing to the prevalence of drying winds both night and day that absorb any moisture as fast as it is eliminated. This moisture seemed not to be derived from the sea, but from the clouds that deposited it from above, as real dampness only occurred then during wet weather, and not during fine weather when the sun was shining.

MISCELLANEOUS MACHINERY AT THE INTERNATIONAL INVENTIONS EXHIBITION.

Messrs. Kerr, Stuart, and Co., Bucklersbury, E.C., exhibit a number of sections of their light railways, from 18in. to 40in. gauge, with steel sleepers, and with rails varying in weight from 10 lb. to 20 lb. per yard; also a selection of portable crossings and turntables for use in connection therewith. One of the sections is fitted with the firm's latest spring clip for fastening the rails to the sleepers, which dispenses with all bolts and nuts, and it is claimed that by means of this clip a set of rails can be laid in one-third of the ordinary time. Another section is jointed with a kind of spigot and faucet arrangement, the spigot, which is attached to the end of one rail, merely sliding into the socket, which is fixed to the other, so obviating the use of fish-plates, and affording great facility for removal and re-erection. There is also a number of narrow gauge wagons and carriages, such as are used on these light railways, and a 30in. gauge locomotive, having a pair of 4½in. steam cylinders by 6in. stroke, which is capable of hauling a train weighing 20 tons. The weight of the locomotive itself is 3¾ tons when empty.

Models of improvements in cement kilns are shown by Mr. John Watson, Gateshead-on-Tyne. During calcination of the cement-making materials, combustible gases are given off, which are generally permitted to escape in such a manner as to cause great waste of heat. In the new kiln Mr. Watson collects these gases by exhaustion through a suitable flue, and makes use of the heat developed by their combustion for generating steam, creating an artificial draught, or for heating the air before it enters the kilns, this latter method especially being a source of considerable economy, as it enables ordinary coals to be used in place of the more costly fuel at present employed. Another advantage of the arrangement is that by means of the special flue, a space of time—never less than from five to six hours—which is at present lost between the charging and lighting of the kiln, in order to permit of the slurry being pumped into the drying chamber before the kiln is ignited, is saved, as by turning the gases into this flue, the kiln can be lighted immediately it is filled. When it is desired to effect the drying of the slurry, the communication between the kiln and the flue is closed by a damper, and the heat turned into the chamber, as at present. In order to avoid the loss of time which takes place after the kiln is burnt off, while it is cooling down to a sufficiently low temperature to enable the operatives to enter the chamber, Mr. Watson has introduced a system of special ventilating pipes. In summer especially, when the external temperature is high, the saving thus accomplished is very considerable. Mr. Watson also shows a simple flint extractor for freeing the slurry from the numerous small pieces of flint, shells, fossils, and other hard substances, which escape reduction in the grinding mills.

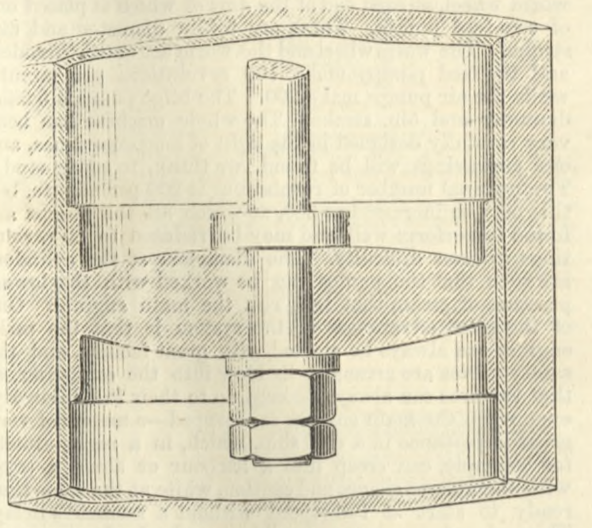
In the hydraulic section Mr. Henry J. Coles, of Sumner-street, Southwark, S.E., exhibits a single chain grab dredger with his patent releasing gear, which may be worked from the end of the jib of any ordinary crane,



COLE'S SINGLE CHAIN GRAB DREDGER.

whether steam, hydraulic, or hand, and by means of which it is claimed that a greater amount of work can be performed than is possible by any other system at present in use. So far as the mere digging portion is concerned, the construction is similar to those which have been in use in various forms for many years, the special feature being the application of the patent releasing gear, which enables the whole cycle of operations to be performed with only once lowering and raising the bucket or grab. In this way complication in working is avoided, and an important saving of time effected, because the discharging and lowering operations are performed by the brake alone. The bucket is formed with a crosshead A in which is a circular projection or catch. Within the crosshead slides the hollow stem B, the lower end of which carries the centres on which the tines or bucket blades open, while on the upper is a cone C. The lifting chain is attached to the stem. The mode of working is as follows:—When the bucket has been filled it is hoisted up sufficiently to cause the projection on the sleeve A to engage with a pair of hinged catches, suspended at a suitable height from the jib end. The crane is then slewed round to any convenient position for discharging, the bucket being held by the chain and the catches. When the discharging point is reached, the chain is slacked off, and as the crosshead A is still held by the catches, the sliding stem descends and causes the jaws to open, as shown in the sketch. When the contents are discharged a further slight lowering of the chain brings the cone C in contact with the suspended catches, which are forced open, releasing the crosshead A, and permitting the whole bucket with the jaws open to be lowered for taking a fresh charge, the crane being at the same time slewed round into the proper position. When the jaws have penetrated the surface that is being dredged, the tightening up of the lifting chain closes the bucket, which is then ready for hoisting up into the catches.

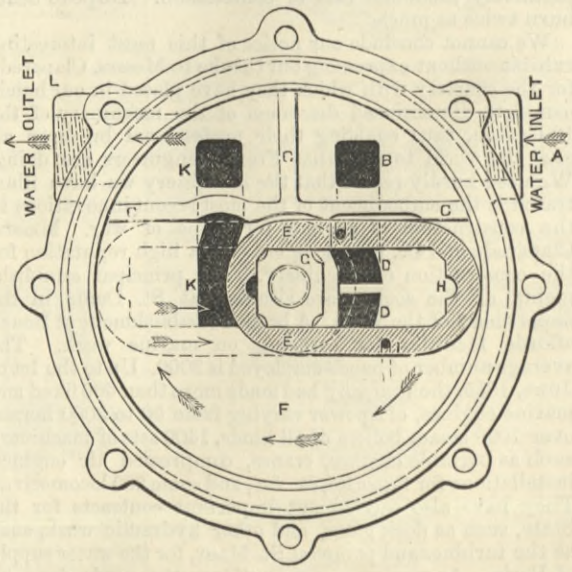
Melling's patent water meter is shown by Messrs. Duncan Brothers, Queen Victoria-street, E.C. This is a positive meter, with cylinder and piston, the peculiarity of which lies chiefly in the construction of the piston and valve gear. The piston is shown in the annexed sketch. It consists of a block of specially prepared vulcanite, thinned down at the edges, so as to act in the same manner as a cupped leather. The valves, which are of the piston type, are formed in precisely the same manner, the vulcanite, though sufficiently elastic to form a tight moving joint, yet being stiff enough to take no harm in passing over the ports. Both cylinder and valve casing are brass lined. The valves are actuated by a link motion



MELLING'S WATER METER.

from an extension of the piston-rod, and being perfectly in balance, neither they nor the gearing are at all affected by variations of either the initial or back pressure, no matter how great such variations may be. The tumbling weight is controlled by a dash pot, which brings it to rest quietly, and obviates the noise which accompanies the working of nearly all other positive meters. The clock-work or registering apparatus, which is also driven from the piston-rod by means of double pawl gear, is made to record not only the number of strokes, but also the travel of the piston in the measuring cylinder, so as to eliminate all error which would arise from variation in the length of stroke. It is claimed for this meter that it is strictly accurate in measurement, both for very large and very small quantities of water, and that it is at the same time durable and not likely to get out of order. Melling's patent water motor is also exhibited by the same firm. This is a compact little machine, suitable for organ blowing, and working printing, washing, and other machinery. It is of almost identical construction to the meter just described, but the length of stroke is capable of alteration by means of a small hand wheel, which moves the wipers for actuating the valves. The motor also acts as a meter, and registers the quantity of water it consumes.

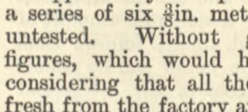
Mr. George Kent, of High Holborn, W.C., exhibits a positive water meter of entirely novel design. It is called the "Uniform" meter, and is shown in plan by the



KENT'S "UNIFORM" METER.

engraving herewith, in which the top cover is supposed to be removed. Excepting the piston, which is of vulcanite, all parts are made of gun-metal to standard gauges, so as to be interchangeable. The piston is shown by the dark hollow oblong E. It moves between the bottom plate F and an upper plate which is not shown, and is accurately fitted to the square centre-piece G, which it causes to revolve in the direction shown by the arrows, and along which it slides in changing from the position shown by the dotted lines to that shown by the full ones. The depth of the piston is not very great. The water inlet and outlet passages A and L are divided off from the working chamber by the diaphragms C, and only communicate with it by means of the ports B and K. The water enters the meter at A, and flows through the port B—a duplicate of which is formed in the top cover—and openings D, into the working chamber. When the piston E is in the position shown by the dotted lines, the water fills the whole of the chamber F, and exerts its pressure between the inner end of the piston and the square hub G, entering by means of the semicircular opening H, and forcing the piston diametrically across the chamber, into the position shown by the full lines. Water then passes through the small port I in the piston, into the recess shown in the diaphragm, so that the piston is forced out, and swung round on the centre in the direction of the arrows. The moment it leaves the diaphragm, water passes through the ports D, and entirely swings it round to the position shown by the dotted lines, pushing before it, and out through the ports K, the water that entered and filled the chamber F at the previous stroke. That quantity of water having been measured, by means of suitable registering gear actuated from the centre, the water again exerts pressure between the inner end piston and the square of the hub G, and pushes the piston over ready for another operation, the water from the interior being at the same time expelled through the ports K. From the foregoing description it will be seen that although a positive meter, the piston is balanced, so obviating the necessity of tight packing and doing away with friction and consequent wear and tear. With regard to accuracy, in addition to having before us copies of reports of tests made independently by Mr. Baldwin Latham, Mr. Oswald Brown, and Messrs. Joseph Quick and Sons, on a 19 mm. "Uniform" meter, which show a maximum error of ·96 per cent., with a delivery of nearly 2000 litres per hour and a variable flow, we had ourselves an opportunity of experimenting with a series of six ⅝in. meters, previously untested. Without giving actual figures, which would hardly be fair, considering that all the meters were fresh from the factory and unadjusted, we may say that under variable pressure and draught the inaccuracies were very small, and in all the meters were in the same direction and of almost precisely similar extent. In bulk, the "Uniform" meter has a decided advantage, and it can be placed conveniently in positions where there would not be room enough for a positive meter of ordinary construction. A very slight pressure will suffice to work it, and we understand it will register accurately with a head of 4in. If desired, the manufacturers will contract to keep the meters for domestic use in repair at a charge of 2 per cent. per annum on the cost.

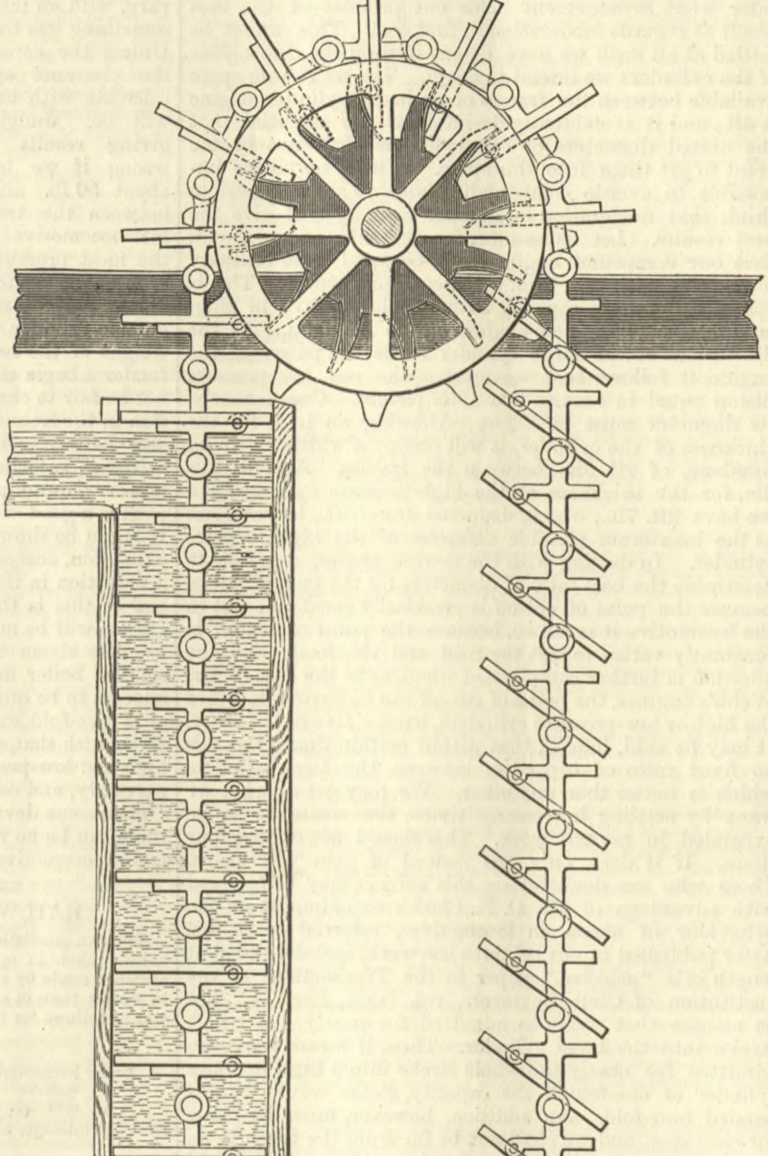
Mr. Sealey Allin, Queen Victoria-street, E.C., shows a patent balanced float water motor, with which he claims to obtain a working efficiency of over 90 per cent. It is illustrated herewith, and consists of a series of feathering floats, hinged to a chain, which works over a pair of drums, the floats on the descending side being enclosed in a casing so as to form a series of moving chambers which are successively filled with water as they enter the casing. A cross section of the casing is shown in the annexed sketch.



A A are planed grooves, in which slide projecting pieces forced on each link of the chain, the clearance being limited to $\frac{1}{64}$th of an inch. The clearance of the floats themselves can, therefore, be made very small, and the inventor states that in this way he has been able to reduce the loss from leakage to a comparatively insignificant amount. The feathering of the floats is automatic, and is regulated by the level of the tail water, for so long as the pressure of water behind is greater than the resistance in front, the chain is pushed forward. As soon, however, as the resistance exceeds the pressure, the floats fall away from the chain and rise nearly vertically out of the water. The power is taken off from the top drum, which is provided with specially formed teeth, which take each link of the chain as it passes over. The speed of the chain is about 180ft. per minute. Assuming that the difficulties of construction have been overcome, there seems no reason to doubt that the efficiency of such a motor as this will be much greater than that of even the best water-wheels, as a greater percentage of the fall can be utilised. It must not, however, be forgotten that hitherto in the majority of cases where water-wheels have been applied, economy of water has been a secondary consideration, and there is, after all, something very fascinating in the simplicity of a water-wheel. What it may be in the future is, of course, a different matter. Probably if any serious attempt is made to take advantage of the power to be derived from natural falls of water, or, as Mr. Allin proposes, of the rise and fall of the tide, more attention will be paid to efficiency, and if, as is stated, about 93 per cent. of the actual energy can be given off in useful work, there may be a considerable field for Mr. Allin's invention.

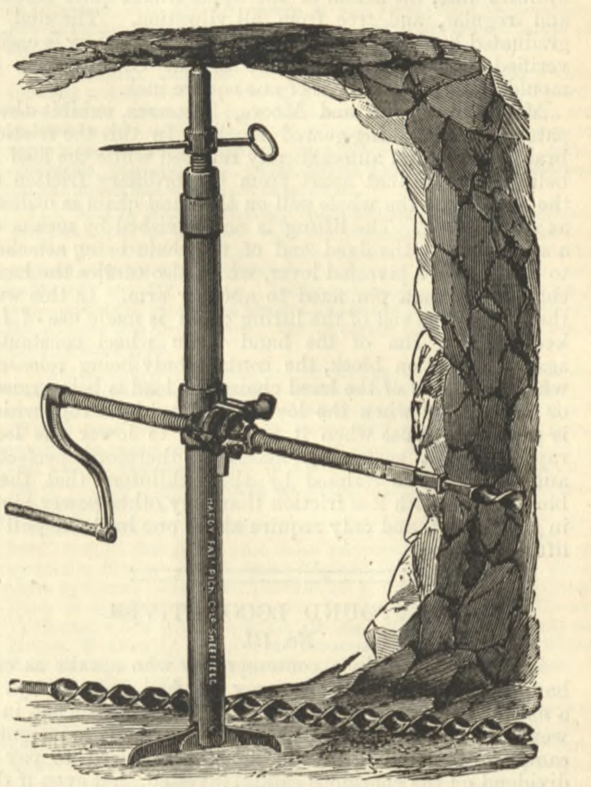
The Hardy Patent Pick Company, Sheffield, exhibits a large and varied collection of its patent picks, and small drilling machines for rock and coal boring, mainly intended for the use of colliers. The "Universal" pick is claimed to be the most effective and economical one in use. It is specially designed for the use of navvies, and has been adopted by several of the largest railway companies and contractors. One of these tools is said to have the wearing power of three common picks before requiring to be sharpened, and, being made of welding steel, can be very readily repaired. Another pick, for miners' use, is the patent single wedge "Acme," a large number of which are in use in the various colliery districts. Notwithstanding the advantages claimed for this pick, the cost is said to be less than that of the old-fashioned kind.

Of late years many improvements have been made in



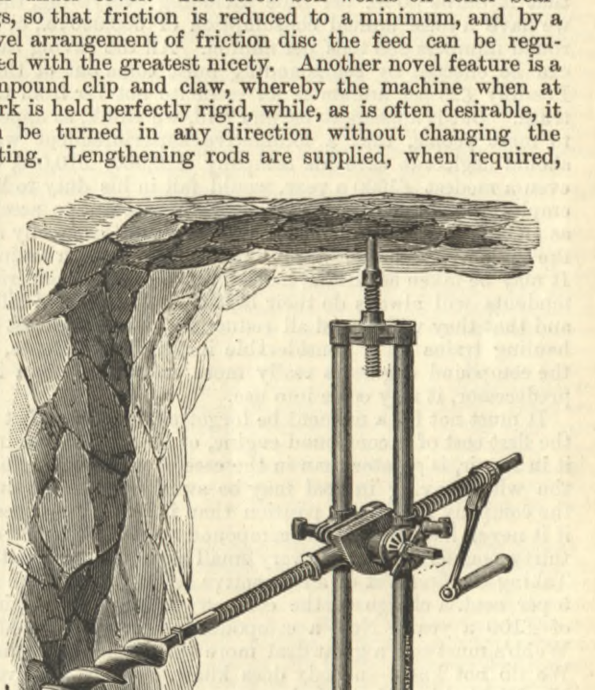
ALLIN'S WATER MOTOR.

appliances connected with mining, but perhaps none are more worthy of note than the improved methods of boring. Until a comparatively recent date all such work was done by the ordinary round or octagon drill held by one workman, while another wielded a large sledge hammer, until by dint of hard work the required hole was made. Almost every class of mining necessitates the use of powder, or other explosive, to blast the coal, stone, or other material, and all such blasting requires the drilling of holes to receive the charge. This may be considered, in many cases, the chief cost of prosecuting mining operations, and any means of cheapening this is, of course, of the greatest importance. The Hardy Patent Pick Company has laid itself out to supply this want, and is making a number of most effective and cheap drilling machines, some of which are exhibited at South Kensington. All of these are hand-power machines of low cost and very simple in construction. The "Boss" machine consists of a single boss or screw nut with a claw cast on each corner. A screw thread is cut through the entire length of the boss in order to receive a propelling screw. These, together with the handle and drills, constitute the entire apparatus. To put the drill to work, all that is necessary is to fasten a prop or plank between the roof and floor of the cutting, and bore a hole through it sufficiently large to allow the propelling screw to pass through. On placing the boss on the side of the plank next to the face that is to be bored and setting the drill in position, a few turns of the handle causes the claws to fasten themselves in the wood, and so secure the boss. In this way coal or soft stone can be penetrated as rapidly as the handle can be turned. The "Acme," which we illustrate below, is another coal-boring machine of rather more



THE ACME COAL BORER.

elaborate construction, which can be worked at any angle. It is set on a single hollow standard, and though light, is very strong, and capable of ready adjustment, being provided with a peculiar clip, by which the workman can turn the drill in any direction without having to move the standard. With this appliance boring can be carried out very close to the roof. Another machine is the Universal perforator, invented by Messrs. Wainwright and Stayner, which is also illustrated below. This is a powerful apparatus, mounted on a double standard, and specially designed for tunnelling in mines. All the mechanism is well under cover. The screw box works on roller bearings, so that friction is reduced to a minimum, and by a novel arrangement of friction disc the feed can be regulated with the greatest nicety. Another novel feature is a compound clip and claw, whereby the machine when at work is held perfectly rigid, while, as is often desirable, it can be turned in any direction without changing the setting. Lengthening rods are supplied, when required,



THE UNIVERSAL COAL BORER.

for long borings. Many other ingenious contrivances are shown, which want of space prevents one noticing. We understand that all parts of the various machines manufactured by the Hardy Patent Pick Company are made to standard gauges, and are usually kept in stock, so that in case of accident or breakage, parts for repairs can be immediately supplied.

A neat and compact little machine for testing cement is exhibited by Mr. J. L. Spoor, Gateshead-on-Tyne. The machine is constructed on a bed-plate measuring 18in. long by 10in. wide, carrying an upright square hollow column, inside of which is suspended from a volute spring a hopper filled with shot, by which the spring is extended. The hopper is connected with the clips by a pair of levers working on knife edges. To test the tensile strength of cement, the briquette is placed in the clips, which are tightened by a turn of a small wheel beneath. The shot is then allowed to run gradually out of the hopper. As the spring contracts, owing to the lessened pull on it, the levers are moved, so applying a pull to the cement under text. Immediately fracture occurs, the flow of the shot is arrested and the pull automatically registered by means of a rack and pinion connected to the spring, and acting on a pointer moving round a circular dial. When the shot is returned to the hopper the machinery is ready for another test. The strain being applied gently, and at a uniform rate, the action of the apparatus is quite smooth and regular, and free from all vibration. The dial is graduated by actual dead weights, and its accuracy is easily verified. The clips are made to suit Grant's form of mould, having a test area of one square inch.

Messrs. Swallwell and Moore, Battersea, exhibit their patent self-sustaining geared blocks. In this the friction brake is fully and automatically released while the load is being raised, so that apart from the ordinary friction of the apparatus, the whole pull on the hand chain is utilised as useful work. The lifting is accomplished by means of a snatch block, the fixed end of the chain being attached to one arm of a pivotted lever, which also carries the hand chain wheel on a pin fixed to another arm. In this way the pull on the end of the lifting chain is made use of for keeping the rim of the hand chain wheel constantly against a friction block, the contact only being released, when by means of the hand chain, the load is being raised or lowered, or when the lever is moved by a rope which is provided for use when it is desired to lower the load rapidly. The sustaining action is therefore perfectly automatic. It is claimed by the exhibitors that these blocks work with less friction than any other power block in the market, and only require about one half the pull to lift a given load.

COMPOUND LOCOMOTIVES.

No. III.

It is maintained by a contemporary who speaks as one having authority, that economy of fuel on railways is a matter of no practical importance whatever. That, in a word, the cost of fuel burned by locomotives is so insignificant, as compared with the amount required to pay a dividend on the enormous capital invested, that even if the whole of the coal bill could be saved and engines run without any fuel whatever, only a minute fraction of a dividend would be represented by the saving. This is a startling statement, and will no doubt come as a surprise to a great many locomotive superintendents. To no one, perhaps, more than to Mr. Webb, whose compound engines were built specially to save fuel; indeed, if they are not more economical than ordinary engines, compound locomotives should have no place on our railways, because it can be shown that they possess no other advantage. Let us see what the facts are. It may, for the purpose of discussion, be assumed that a modern locomotive makes 20,000 miles a year. Let us suppose further that it burns 30 lb. per mile including everything, then we have a total annual consumption of 600,000 lb., or in round numbers 268 tons per annum. All the saving that can be effected by compounding must come out of this. Possibly £20 per annum is an estimate not far from the truth. But it appears to us, and will, we think, so appear to most people, that a locomotive superintendent who should neglect to save his company £20,000, £10,000, or even a modest £5000 a year, would fail in his duty to his employers; nor would his directors be content to accept as an excuse for negligence in that respect that really all the saving he could effect was but a trifle not worth having. It may be taken as certain, indeed, that locomotive superintendents will always do their best to cut down coal bills, and that they will regard all reductions in the coal cost of hauling trains as of considerable importance. Hence, if the compound engine is really more economical than its predecessor, it may come into use.

It must not for a moment be forgotten, however, that if the first cost of a compound engine, or the cost of keeping it in repair, is greater than in the case of a simple engine, the whole saving in coal may be swallowed up, leaving the company in a worse position than it would have been if it never had adopted the compound system. Twenty or thirty pounds sterling is a very small margin to play with. Taking the first cost of a locomotive as £2000, we have at 5 per cent. a charge to the company owning the engine of £100 a year. Now a compound engine such as Mr. Webb's must cost a great deal more than a simple engine. We do not know—nobody does know, perhaps not even Mr. Webb himself precisely—how much more his compounds cost than the engines which they supplanted. There are three cylinders and valve motions—three distinct engines, in fact—instead of two. The frames have to be made double in order to secure the big low-pressure cylinder firmly, and there are many structural changes of considerable importance. We do not think we shall be at all outside the mark if we say that Mr. Webb's compound engine must cost £300 more than the normal London and North-Western engine of the same power. If this is the case, then the value of the saving effected in fuel becomes evanescent. After interest is paid on the £300 the £5 available out of the £20 we have named above will not suffice to pay for the extra oil, and stuffing-box packing, and piston rings wanted by the compound engine. This illustrates the point which we are about to urge, namely, that if the compound engine is to cost much more than the non-compound engine it will not be worth having at the price. Is it possible to build a compound locomotive at nearly the same price as a simple engine (?)

It is obvious that the cheapest compound engine which it is possible to build is that with two cylinders only, and we may go further and point out that the engine should, if possible, be so designed that the application of the compound system shall not introduce changes likely to augment price. Take, for example, Mr. Worsdell's compound engine on the Great Eastern Railway. There is no room to doubt that this engine must of necessity be much cheaper, *cæteris paribus*, than the Crewe engine is, yet Mr. Worsdell found it impossible in his first engines to get in his cylinders without using a bogie, by which the cost of the engine was considerably enhanced, as well as its weight; for in the case of the bogie all is not gold that glitters. It is a very expensive and heavy addition to a locomotive. However, it may be urged, on the other hand, that, compound or not, the locomotive with a bogie is better than one without it, so that it is not quite fair to charge the bogie to the compound system. Still, here is a fact worth notice, that the cost of a bogie was incurred because it could not be done without. No one is better aware than Mr. Worsdell that it is quite possible to build a two-cylinder compound engine which shall not need a bogie, but it was not possible to retain an engine of the pattern to which compounding was first applied on the Great Eastern Railway, and dispense with the bogie.

Taking as proved that the compound engine of the future must have but two cylinders, we may go on to consider what arrangement holds out promise of the best result as regards moderation in first cost. This cannot be settled at all until we have determined on the dimensions of the cylinders we intend to adopt. The maximum space available between the frames of an inside-cylinder engine is 4ft., and it is evidently desirable, if not essential, that the united diameters of two cylinders shall not be too great to get them into this space. It is by no means impossible to overdo compounding, and we are disposed to think that moderation in cylinder capacity will give the best results. Let us assume, for the sake of argument, that our compound engine shall be equal to an ordinary locomotive with two 19in. cylinders, 26in. stroke. This is considerably more capacity than any locomotive in England has, save the new engines on the Midland. As the dimensions of the large cylinder settle the power of the engine, it follows that we must make our low-pressure piston equal in area to two 19in. pistons. Consequently, its diameter must be 26⅞in. Allowing an inch for the thickness of the cylinder, it will occupy a width, in round numbers, of 2ft. 5in. between the frames. Add to this 2in. for the thickness of the high-pressure cylinder, and we have 2ft. 7in., which, deducted from 4ft., leaves 17in. as the maximum possible diameter of the high-pressure cylinder. In dealing with the marine engine, it is easy to determine the best ratio of diameters for the two cylinders, because the point of cut-off is practically constant; but in the locomotive it is not so, because the point of cut-off is constantly varied to suit the road and the load; and the question is further complicated when, as in the case of Mr. Webb's engines, the point of cut-off can be varied in either the high or low-pressure cylinders, irrespective of the other. It may be said, indeed, that within certain limits there is no fixed ratio of capacities between the two cylinders which is better than any other. We may get at what we want by settling how many times the steam is to be expanded in normal work. This should not exceed four times. If it does, only loss instead of gain will ensue. Those who are doubtful on this subject may be referred with advantage to Mr. D. K. Clark's experiments on the behaviour of steam in locomotives, referred to in his letter published in our columns last week, and described at length in a "selected" paper in the Transactions of the Institution of Civil Engineers, vol. lxxii., Part II. Let us assume that steam is admitted for nearly the whole stroke into the large cylinder. Then, if steam were also admitted for nearly the whole stroke into a high-pressure cylinder of one-fourth the capacity, steam would be expanded four-fold. An addition, however, must be made for clearance, and we shall not be far from the truth if we say that the proportions just stated would give a five-fold expansion at least. If, now, steam were cut off at half stroke in the high-pressure cylinder, then the steam would be expanded ten times. As it is desirable that a considerable amount of expansion should take place in the high-pressure cylinder, it must have a larger capacity than one-fourth of the low-pressure cylinder.—Here it is proper to remark that it is a matter of quite second-rate importance whether the power developed respectively in the two cylinders is or is not the same, a locomotive operating under conditions quite different from those of a marine engine.—The area of our low-pressure piston is 567in. We have seen that it is just possible to get a 17in. and a 27in. cylinder between frames 4ft. apart.* Let us then make these the respective diameters of our high and low-pressure cylinder. The former then will have two-fifths the capacity of the latter. Taking steam for half stroke, the space filled will be 0·1 that of the large cylinder, and the expansion will be ten-fold. If it takes steam full stroke the expansion will be five-fold. It is clear, therefore, that if we cut off at any point in the high-pressure cylinder before the piston has completed its stroke we shall expand the steam too much; cutting off earlier in the low-pressure cylinder will of course not mend matters. The only way to get over the difficulty lies (1) in reducing the size of the large cylinder, or (2) in augmenting the capacity of the high-pressure cylinder. The first we cannot do without diminishing the whole power of the engine, because the capacity of the low-pressure cylinder is the measure of that power. The second we cannot do, because, as we have seen, it would be impossible to get a cylinder more than 17in. in diameter between the frames. There remains the method adopted by Mr. Webb, who uses two high-pressure cylinders, with a united capacity almost one-half that of the low-pressure engine. This, as we have seen, at one swoop enormously augments the cost of a locomotive, and also the running expenses.

The problem, then, stands thus: If the compound is not to be more expensive than the simple engine, it must be built on nearly the same lines as the latter—that is to say, it must have only two cylinders. If, however, we have two inside cylinders, expansion must of necessity be carried a great deal too far for economy. It cannot possibly be otherwise. We showed last week that a low average pressure in a non-condensing engine was a source of direct waste, so much power being expended in doing useless work in comparison with the total power exerted. If the expansion is ten-fold, and initial pressure is 175 lb. absolute, then the terminal pressure can only be 17·5 lb. absolute, or 2·5 lb. only above the atmosphere. With 175 lb. absolute initial pressure and a five-fold expansion, the terminal pressure will be only 35 lb., or 20 lb. above the atmosphere, which is as low as it is justifiable to go. In the former case the average pressure will be only 57·7 lb., or 42·7 lb. above the atmosphere. In the latter case it will be 91 lb., or 76 lb. above the atmosphere, a very much better proportion.

If we think proper to abandon the inside cylinder arrangement we can get out of our difficulties at once. Retaining a 26⅞in. cylinder at one side, we can place at the other side a cylinder of one-half the capacity, that is to say, 19in. in diameter. If steam is cut off at half stroke in this, then the virtual expansion will be about five-fold. As such an engine must be of the intermediate-receiver type, the back pressure in the small cylinder will vary, with an initial pressure of 175 lb. absolute, between something less than 87 lb. and something more than 35 lb. Unless the capacity of the intermediate receiver and the clearance spaces are known, it is impossible to calculate with accuracy what the average back pressure will be. Judging from diagrams before us, however, giving results of practice, we shall not be far wrong if we take the average receiver pressure as about 50 lb. absolute, and the distribution of power between the two cylinders would be sufficiently equal for locomotive purposes. This then appears to be the most promising direction for the compound locomotive. It is not to be denied, however, that such an engine as we hint at must be more expensive than an ordinary outside-cylinder engine of the same power. The great weight of the two immense cylinders would, for example, render a bogie essential. This, however, it would perhaps not be fair to charge to the compound system. An alteration in the frames as compared with present practice would also be necessary, in order to get the centres of the cylinders sufficiently close to each other. The design is, however, quite practical, and promises, as we have said, to give a good compound engine at the lowest first cost. If it can be shown that, by adopting a moderate amount of expansion, economy will be realised, then it follows that a reduction in the dimensions of the boiler can be made; and if this is the case, the extra cost of the compound system will be more than met. Of course, if the engines use less steam they will use less coal and water, and a smaller boiler and a smaller tender can be adopted. It appears to be quite clear, however, that anything in excess of a five-fold expansion must result in disappointment. Even with that, some amount of superheating between the high and low-pressure cylinders would be desirable, if not necessary, and could be easily obtained in the smoke-box. Unless some device of this kind is adopted, we fear that there can be no real economy derived from the use of compound locomotives.

* Mr. Worsdell's engine has inside cylinders 18in. and 26in. diameter.

RAILWAY AXLES IN GERMANY.

German statistics for 1884 show about the same number of axles broken in operation as in the previous year, and from an abstract made by the *Railroad Gazette* it appears that less breaks in winter than in summer. The average life of the broken axles was as follows for the last two years:—

	1884. Yrs.	mos.	dys.	1883. Yrs.	mos.	dys.
Under locomotives	14	11	14	14	8	—
„ tenders	19	2	4	14	7	25
„ cars	17	1	20	15	0	7

And the mileage, allowing 0·6 miles per kilo.:—

	1884. Miles.	1883. Miles.
Under locomotives	235,113	208,013
„ tenders	233,210	191,057
„ cars	210,594	204,856

The average loads for the broken axles were as follows in pounds:

	Standard maximum.	Actual loads when broken.
Locomotives	25,696	25,676
Tenders	15,446	14,159
Cars	14,747	14,208

In only ten cases were the axles overloaded when broken, and in these cases the average overload was 3·7 per cent. of the standard maximum. Of the broken locomotive axles, thirty-two were driving and three ordinary; of tender axles broken, 96 per cent. were axles used with brakes; and of car axles, 33 per cent. Of axles broken, 67 per cent. were iron and 33 per cent. steel, against, respectively, 77 per cent. and 23 per cent. in 1883. The oldest axles broken had been thirty-two years in use—antiquity which, even in statical Germany, makes its origin unknown. As to the location of the breaks, they were as follows:—

	1884. Per cent.	1883. Per cent.
In the journal	57	49
Just inside the hub	16	16
In the hub	14	28
Toward mid-axle	3	3
At mid-axle	4	1
Not stated	6	3
	100	100

The proportions of old and fresh breaks were:—

	1884. Per cent.	1883. Per cent.
Fresh breaks	15	16
Slight old breaks	18	26
Serious	43	35
Rubbed surface in break	7	13
Not stated	17	10
	100	100

Of the old breaks, 24 per cent. were of such character that careful inspection would probably have revealed them. The axles broken in operation were to those found broken by inspection and changes as 1 to 10½.

Important Sale of Electric Lighting Plant.—An important sale of high-class manufacturing and electric lighting machinery, constructing tools, and patent rights is now proceeding on the premises of the Hammond Electric Light and Power Supply Company, in liquidation, at the works, Appold-street, Finsbury, and at the incandescent lamp factory at 182, Bermondsey-street, S.E. The sale commenced on the 20th, and continued through three days, and will re-commence on Tuesday next, and continue until Friday, the 30th inst. All the machinery, lamps, machine tools, stores, office furniture, and materials are being sold by Messrs. Wheatley Kirk, Price, and Goulty.

RAILWAY MATTERS.

A Board of Trade report on the accident which occurred on the 7th September at Liverpool-street station, on the Great Eastern Railway, concludes:—"This accident would doubtless have been attended with worse results had not the train been fitted with a continuous brake applicable by the guards as well as by the driver, and had not the rear guard promptly applied this brake on finding that the rear vehicle had left the rails."

An attempt was made to upset the down mail train on Tuesday on the Midland Great Western line, between Manulla and Castlebar stations. Two large stones were placed on the rails, and the engine-driver, perceiving the obstruction, but being unable from the velocity of the train to stop in sufficient time, considered the only resource was additional speed to prevent an accident. Some of the stones were driven 44 yards off the rails, but the train received only a slight shock.

Although the rumours are probably premature, some New York capitalists are reported to have formed a syndicate for carrying out an extensive system of railway construction in China, under concessions which the Government of that country will be asked to grant. The last Pacific mail steamer from San Francisco carried General Wilson, the agent of the syndicate, who will offer terms for the concessions. Certain English and German firms are reported to be also competing.

The construction of the Transcaspian Railway is said to be progressing rapidly. The rails are being laid at night as well as in the daytime, and trains have commenced to run. The Odessa correspondent of the *Times* says the line to Merv is now being proceeded with. This last-named place, it may be remembered, is only 220 miles, or twelve marches, from Herat. From Merv the line will probably be carried on to Bokhara and Tashkend, in the expectation that it will be enormously beneficial to Russia, both from a commercial and a strategical point of view.

Finished iron is now actually being sent from Stockton to South Staffordshire by sea, and that at a lower rate than any railway company will deliver it. The ordinary railway rate for undamageable iron is 15s. per ton in four ton loads. The cost by sea is about 1s. per ton less, and some hundreds of tons have already been sent. The route is from Stockton to London by steamer, and thence by barge through the canal which connects the Thames with Staffordshire. All the large consumers' works in the latter district are situated on the banks of the canal, so that the goods can be delivered to the very spot required.

In concluding a report on a collision which occurred on the 21st July last at Bridge Mill siding, near Girvan, on the Glasgow and South-Western Railway, Major-General C. S. Hutchinson says:—"The man in charge of this agricultural siding, and the points connected with it, was not a regular company's servant, but only a blacksmith living close to the spot, and who had undertaken the duty about a year ago. A person of this description can hardly be expected to appreciate the importance of facing-points, and the petty economy effected by the partial employment of such persons in responsible posts connected with passenger lines is certainly not conducive to the safety of the travelling public."

The Birmingham Town Council, on Tuesday, accepted the report of the Public Works Committee, which recommended the construction of cable tramways within the borough. The report dealt exhaustively with investigations made by the committee on the working of different cable tramway systems. They had paid a visit to Highgate, and had communicated with the mayors of towns in which the cable system had been in operation. The result was eminently satisfactory. As regards economy, cleanliness, convenience, humanity, and safety, nothing could be desired. The accidents at Highgate, they found, were due to defective working, but with the precautions which had been devised for the Birmingham system no such accidents could occur.

The ironmasters are this week congratulating themselves upon an important concession in railway rates which has just been granted by the London and North-Western, Great Western, and Midland Railway Companies, in response to the agitation which the Freighters' Association have been carrying on. The companies have advised that on and after the first of next month the rates upon cokes entering South Staffordshire from Lancashire, Derbyshire, and South Wales will be reduced 1s. per ton. The new rates will be an average of 3s. 10d. per ton, instead of, as now, 4s. 10d. This will mean a decrease in the cost of production of, it is estimated, about 1s. 6d. upon pig iron, 2s. 6d. upon sheets, and perhaps as much as 5s. per ton upon some descriptions of hardware.

An important deputation, representing the Railway Rates Parliamentary Committee—of which Lord Henniker is chairman—the Municipal Corporations' Association, the Associated Chambers of Commerce, the Birmingham and District Railway Rates Association, and other bodies waited upon Mr. Joseph Chamberlain, M.P., at his residence on Wednesday. The deputation urged the necessity for the abolition of terminals. Mr. Chamberlain, in reply, said that he would be glad to push forward in the new Parliament a similar Bill to that last introduced by him. He could not, at present advised, see his way to modify the clause dealing with terminals, since, if it were modified, he thought the Bill would have no chance of passing. His personal opinion would be in favour of a fixed terminal charge to be settled by some tribunal—either Parliament or the Railway Commissioners.

The Hull and Barnsley Railway Company is already experiencing some of the trials and difficulties of carrying companies' undertakings. Carlton Main Colliery is an important concern, producing from 700 to 1000 tons a day, situate close to the main line of the Hull and Barnsley Railway, with which it has connection, and it is the nearest colliery to the Barnsley end, 2s. 10d. is the tonnage rate, and the Carlton Company say that this is the same rate charged to collieries on the Midland Railway, the coal from which has to be conveyed by the Midland Railway to Cudworth, and from thence over the entire length of the Hull and Barnsley line to Hull. This is considered as amounting to a case of undue preference shown to competing collieries, and the Carlton Company, which has been required to make prepayment for the conveyance of its coal, does so under protest, and states that it will seek redress at the hands of the Railway Commissioners.

The tilted caisson for the north-western of the group of four columns forming the Queensferry main pier of Forth Bridge has been successfully raised and righted. The caisson was 15ft. out of position, and tilted over towards the north at an angle of 25 deg. Being 70ft. in diameter and about 75ft. high, and with the concrete placed in it to serve partially as ballast, it weighed about 4000 tons, and was thus no little thing to deal with. In the attempt to raise the caisson in March last, an unsuspected weak place, situated below the level of the water, gave way, admitting the water and unfortunately causing the death of two men, who were killed by the fall of the interior timber strutting carried away by the inrush. It was then determined to case the whole caisson with strong timber sheathing, as mentioned in our last impression, strengthened internally against the very unequal strains to which it would be subjected by ring girders and struts and ties of iron, as well as by a perfect skeleton of strong timber shoring, both horizontal and vertical. After six months of patient labour, occupied in carrying out the above work, and in assisting by means of dredging the return of the structure to its normal position, and when the engineers had fully satisfied themselves by searching experiments that there was no flaw in its armour, the word was given on Monday to pump out, and in a very short time the huge vessel gradually regained its upright position, and finally floated clear of the bed on which it had been lying for more than nine months. We may here mention that the diving working connected with this difficult task as well as the whole of the diving work connected with the numerous caissons and pier work has been done by the diving apparatus of Messrs. C. E. Heinke and Co., of Great Portland-street, London.

NOTES AND MEMORANDA.

By reducing the pressure of solid nitrogen down to 0·004 metre of mercury, K. Olszewski has succeeded in obtaining the lowest temperature known —225 deg.

The estimated value of the natural gas used in the United States in 1884 was 1,460,000 dols., as against 475,000 in 1883. The value is computed from that of the coal superseded by natural gas.

The number of births registered in the Punjab during the year 1884 was 809,912, giving a birth rate of 42·98 per thousand. On the other hand, the number of deaths was 660,298, or at the rate of 35·04 per thousand, an increase of 184,557 over the previous year.

The *Vossiche Zeitung* reminds its readers that two centuries ago the population of Berlin was 17,400, of whom over 5000 were French, chiefly Huguenot exiles, on account of the revocation of the Edict of Nantes. Thus nearly every third person to be met in Berlin was a Frenchman.

Picture frames are now, it is said, made with a composition consisting of paper pulp, glue, linseed oil, and carbonate of lime or whiting, which is heated and mixed to the consistency of thick cream; it is allowed to cool, after which it is poured into suitable moulds and allowed to harden. The frames are then gilt or bronzed in the usual manner.

A new process for preparing chemical fibre by the use of sulphurous acid has been devised. It is intended also to prepare vegetable fibre for spinning and other uses, eliminating the silica and other incrustating substances that bind the fibre together. The principal feature of this process is the treatment of vegetable fibre with a solvent containing hydrofluoric acid and sulphurous acid.

According to Ryland's blast furnace returns, the total number of furnaces built on September 30th, 1885, was 892; total number of furnaces in blast September 30th, 1885, 424; decrease in the number of furnaces built since June 30th, 1885, 7; decrease in the number of furnaces in blast since June 30th, 1885, 4; furnaces blown out since June 30th, 1885, 15, including Cumberland, 3; Derbyshire, 2; Durham, 1; Glamorganshire, 1; Lanarkshire, 3; Lancashire, 1; Staffordshire, South, 1; Yorkshire, West Riding, 1; Yorkshire, North Riding, 2. Eleven furnaces have been blown in since June 30th, 1885, including Ayrshire, 2; Durham, 1; Glamorganshire, 1; Lanarkshire, 1; Lancashire, 1; Monmouthshire, 1; Northamptonshire, 2; Staffordshire, North, 1; and Staffordshire, South, 1.

The little town of Tréberg, long known for its manufacture of clocks, contains about 2500 inhabitants. It is situated at the bottom of the Gutach Valley, some 2300ft. above the sea level, and is surrounded on all sides by hills of some 1000ft. in height. The Gutach forms, not far from there, a celebrated waterfall, one of the finest in Germany. In the neighbourhood of the waterfall there is a number of factories, but scarcely any effort has been made to utilise the great flow of water. Until recently the streets of the town have been miserably lighted by petroleum, but, in order to satisfy the numerous visitors to so picturesque and so salubrious a locality, it has been decided to adopt electricity as the illuminant. The installation has been put down by Messrs. Weil and Neumann, of Freiburg, who have used their own plant for the purpose. It includes twelve arc lamps of 1500-candle power, of which three are spare, supplied with current by a dynamo driven from a turbine. The total cost has been £744. That of maintenance, &c., is about 50 per cent. greater than with the ancient method, but more than ten times the amount of light is given.

The *Patent Blatt* describes a process, introduced by M. Rosenthal, of Frankfort, for making artificial lithographic stones. The ingredients consist simply of cement. In the first place a sufficient quantity of finely ground cement is mixed with water, and allowed to harden into slabs either in the open air or in an oven. When the cement has set, these slabs are wetted and heated, until they crack in all directions; it is then reduced to a fine powder, and is well mixed with an equal quantity of fresh cement. This mixture is put in a dry state into strong cast iron moulds, and is subjected in them to a pressure of from 35 to 30 atmospheres. A sufficient quantity of water is then introduced on one side of the mould, and is drawn through the mass of dry powder by means of a pump connected with the opposite side; this water contains a certain quantity of extremely finely powdered cement, which is thus caused to penetrate through the mass, expelling at the same time the air and cementing it firmly together. The artificial stone is subjected to further pressure. In this manner slabs of the required size can be formed economically. Carbonate of lime may be substituted for cement, in which case the stones are of a lighter colour.

The production of electrolytic copper is making steady progress in America, and is likely, the *Engineering and Mining Journal* says, to receive a great development in the future, especially in the separation of the precious metals from copper. The Balbach Works in Newark, New Jersey, which are probably the largest in the world, produce about six tons of copper a day. The electricity is generated by four dynamos, furnished by the Excelsior Electric Company, of Brooklyn, New York. The three larger generators produce a current of 30,000 watts each, while the fourth is a smaller machine of 15,000 watts capacity, procured by the firm about two and a-half years ago to test the value of the electrolytic process, before entering into the business on a large scale. The work is going on day and night, with but a short intermission each day to oil and clean the engines and dynamos. The foundry for casting the anodes, the mechanical appliances for handling and transporting them and the finished plates, the arrangement of the tanks and their connection with the dynamos, are all designed with the object in view of reducing to a minimum the manual labour required. The plant will probably be enlarged in the near future. The St. Louis, Mo., Smelting and Refining Company is another large works for the production of electrolytic copper, and the separation of the precious metals. There are also some other less important works on this coast, and the interest shown in the results obtained indicates a rapid growth in electro-metallurgy, and in the business of supplying the necessary machinery and appliances.

At the recent meeting of the British Association a note on "Deep Borings at Chatham" was read by W. Whitaker, F.G.S., A.I.C.E. A few years ago the Admiralty made a boring in the Chatham Dockyard extension, to the depth of 903½ft., just reaching the lower greensand, and in 1883-84 followed this by another boring near by. After passing through 27ft. of alluvium and tertiary beds, 682ft. of chalk, and 193ft. of gault, the lower greensand was again reached; but, on continuing the boring, was found to be only 41ft. thick, when it was succeeded by a stiff clay, which, from its fossils, is found to be Oxford clay, a formation not before known to occur in Kent. At its outcrop, about seven miles to the south, the lower greensand is 200ft. thick, and is succeeded, a little further south, by the weald clay, there 600ft. thick. Not only, however, has this 600ft. of clay wholly disappeared, but also the whole of the next underlying set of deposits, the Hastings beds, which crop out everywhere from beneath the weald clay, and are also some hundreds of feet thick. More than this, the Purbeck beds, which underlie the Hastings beds near Battle, are absent, and also the Portlandian, Kimmeridge clay, corallian, &c., beds which have been proved above the Oxford clay in the sub-wealden boring, to the great thickness of over 1600ft. We are, therefore, faced with a great northerly thinning of the beds below the gault, a fact agreeing in the main with the evidence given of late years by various deep wells in and near London. Three other deep borings have been made, or are being made, near Chatham, all of which have passed through the chalk into the gault, and one has gained a supply from the sand beneath. The practical bearing of the Chatham section is, however, to enforce the danger of counting on getting large supplies of water in the London basin.

MISCELLANEA.

The Naval and Military Club, Piccadilly, is the first club in London to adopt electricity as its means of lighting.

The number of visitors to the Inventions Exhibition for the week ending October 17th was 41,884, making a total since the opening of 3,358,692.

The city of Palermo will shortly be lighted by electricity. The experiments recently made for lighting the tunnel at the Col di Tenda have been successful, and it has been decided to light it definitely by electricity.

Messrs. William Arnold and Co., of Barnsley, have been awarded a silver medal at the Mining Exhibition, Glasgow, for their patent rolled non-collapsing furnace and flue rings, for their steam boilers, also for steam generator and water circulator.

The electric lighting at the Leicester Exhibition of the Sanitary Institute of Great Britain was carried out by Messrs. Woodhouse and Rawson, with the arc lamps of the Crompton-Crabbe make, Elwell-Parker machine of recent type, and incandescent lamps of the Woodhouse and Rawson type.

The Simplex Telegraph Code Company has published a code specially arranged for the use of those in the iron, steel, and hardware trades. Arranged on a thick cardboard, 18in. by 23in., are the code words under the heads requesting quotations, replies to quotations, delivery, payment, specifications, quality and tests, quantities, rails, pig iron, offers, sheets acceptance, miscellaneous and old materials, and to all is an index.

The Maxim-Weston Electric Company has, we are informed, just completed its contract with the Government for the lighting of the Post-office Savings' Bank, Queen Victoria-street. The original contract was for three gas engines of 40-horse power each indicated, and 700 lamps. Finding, however, that the engines were capable of running a greater number of lamps, nearly double the number has been fixed. The dynamos used are the Weston shunt wound type.

The economic employment of natural gas in nearly all the iron-works at Pittsburgh is creating an entire revolution in the labour market, the output of iron and steel at Pittsburgh being about 750,000 tons per annum, and some fifty bushels of coal being required to make one ton of iron, at least 38,250,000 bushels of coal will be dispensed with in the yearly consumption, throwing out of employment an enormous number of miners, firemen, ashmen, roadmen, and others.

Messrs. Clark, Bunnett, and Co., of Rathbone-place, W., have received during the past week instructions to fix one of their hydraulic lifts at the Bank of England, being the second fitted there by them. Also one hydraulic lift for the National Provincial Bank of England in Manchester, five hydraulic lifts for Messrs. Pilkington's new premises at St. Helens, and one hydraulic lift for Messrs. S. Carsley and Co. of Montreal. They are also fitting their hand-power lifts at Ingestre for the Right Hon. the Earl of Shrewsbury and Talbot.

The Seventh Exhibition and market of the brewing, malting, distilling, licensed victualling, and allied trades, opens on Monday next, for the week, at the Agricultural Hall, Islington. Nearly the whole of the ground floor is filled with machinery exhibits from all parts of the world. There are over 250 exhibitors, and this year the tasting stalls for wines, spirits, &c., will be fully representative. During the progress of the exhibition there will be a Brewers' Congress and a Mineral Water Trade Congress, both of which are being actively supported by the leading men in the particular trades.

The proposal for an improved water communication between Birmingham, Wolverhampton, and Shrewsbury, and the Bristol Channel ports, plans of which have been prepared by Mr. William Keeling, Westminster, is receiving support from merchants at Cardiff, Newport, and Swansea. One firm has promised traffic to the amount of £20,000 annually. The plan proposes to widen and deepen the Birmingham and Worcester Canal, so that steam barges can go direct from Birmingham to Cardiff. The railway charges now are 9s. 2d. per ton, but the cost would, if the scheme were to be carried out, be reduced to 5s. 6d. The estimated cost of the undertaking is £600,000.

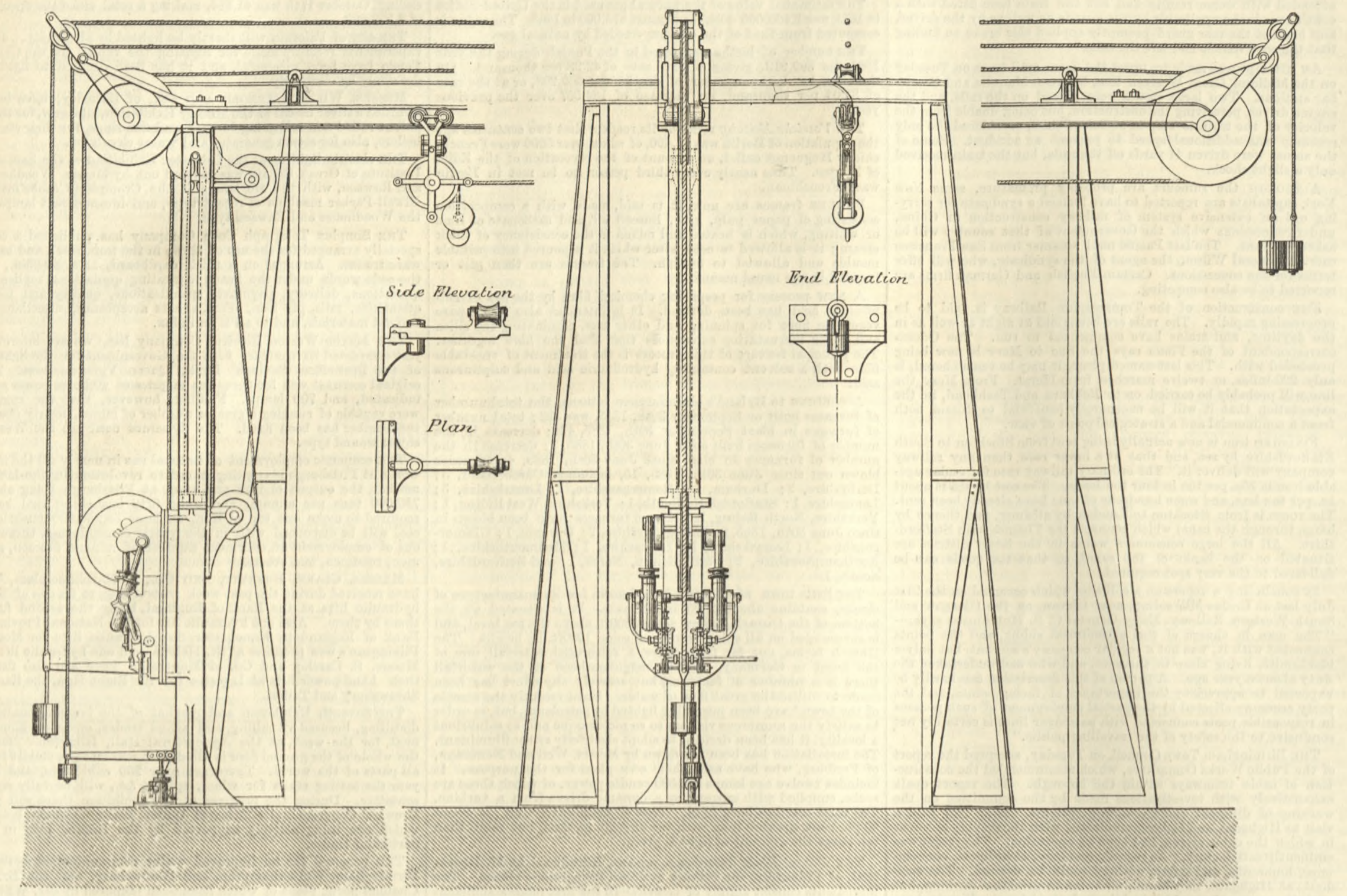
Besides the Nile line-of-battle ship to be laid down at Pembroke, the Admiralty has decided to construct another ship, to be called the Trafalgar, of the same dimensions as the Nile, and equal to the largest first-class ironclad of the British navy afloat. She will be laid down whenever the drawings are completed at Portsmouth. The new vessels will be planned upon Sir E. J. Reed's model. They will differ from the Admiral class now being built, in that their citadels will be longer and higher, so as to secure more initial stability and greater range. The citadels will be constructed of 18in. armour, and the waists of the ships are to be belted with steel armour-plating of the most approved type.

The Arctic steamer Alert returned to Halifax on the 18th inst. from Hudson Bay with the observation party, who have spent fifteen months there testing the practicability of that route for navigation from the Canadian North-West to Europe. The result of the observations shows that the average temperature is not so low as was expected, nor so low as the average winter temperature in the North-West. The lowest monthly average was 30 deg. below zero. The ice observations show that the Hudson Straits and Bay are navigable by properly built and equipped vessels for from three to four months—from July to October. The movements of the ice vary, and vessels must keep in the open water wherever there is a sound, or where the ice is thinnest. Vast wealth is said to have been found there in furs, fish, and minerals. While this report is somewhat favourable, doubts are expressed in Canada whether the Hudson Bay route can ever be made practicable.

On Saturday last, October 17th, the members of the Society of Architects and their friends paid a visit to the aqueduct over the Wandle Valley of the Clapham to Putney overflow sewer, now in course of erection. The members assembled at Clapham Junction at three o'clock, and walked from thence to the office of the contractor, Messrs. Waddell and Sons, of Edinburgh, where they were met by the resident engineer, Mr. Grant. The aqueduct extends across the valley, in a curve of large radius, upon brick arches in four rings, except over the Lower Merton-road, where strong wrought iron girders of excellent design are used. The culvert itself is of egg-shaped section, built entirely of bricks laid in cement and sand, and is encased in Portland cement concrete, over which a carriage-way is being formed. The members of the Society were particularly struck with the centering used to support the large arches during their construction, and the series of manholes at the Putney end of the aqueduct. The engineer is Sir Joseph W. Bazalgette, acting as engineer to the Metropolitan Board of Works.

In his report on the analysis of the metropolitan water supply during September, Dr. Frankland states that some of the water exhibited a marked increase in the amount of organic matter as compared with the exceptionally small proportion present in the previous month's samples. This increase in organic matter, which is relatively large, although absolutely small, is the result of the breaking up of the summer drought. All the waters were clear and bright on delivery. The water drawn from the Lea by the New River Company, and from the Thames and the Lea by the East London Company participated in the increase in organic matter already noticed. The New River Company's supply, however, contained less organic matter than any of the other river waters, while the East London Company's water ranked, in this respect, with the best of the Thames samples. Both waters were delivered in a clear and bright condition. The deep-well water distributed by the Kent and Colne Valley Companies, and by the Tottenham Local Board of Health was, as usual, of excellent quality for drinking, and the Colne Valley Company, by softening their supply with lime, thereby rendered it also well fitted for all domestic uses.

THWAITE & NEVILLE'S HOISTING AND TRAVERSING CRANE.

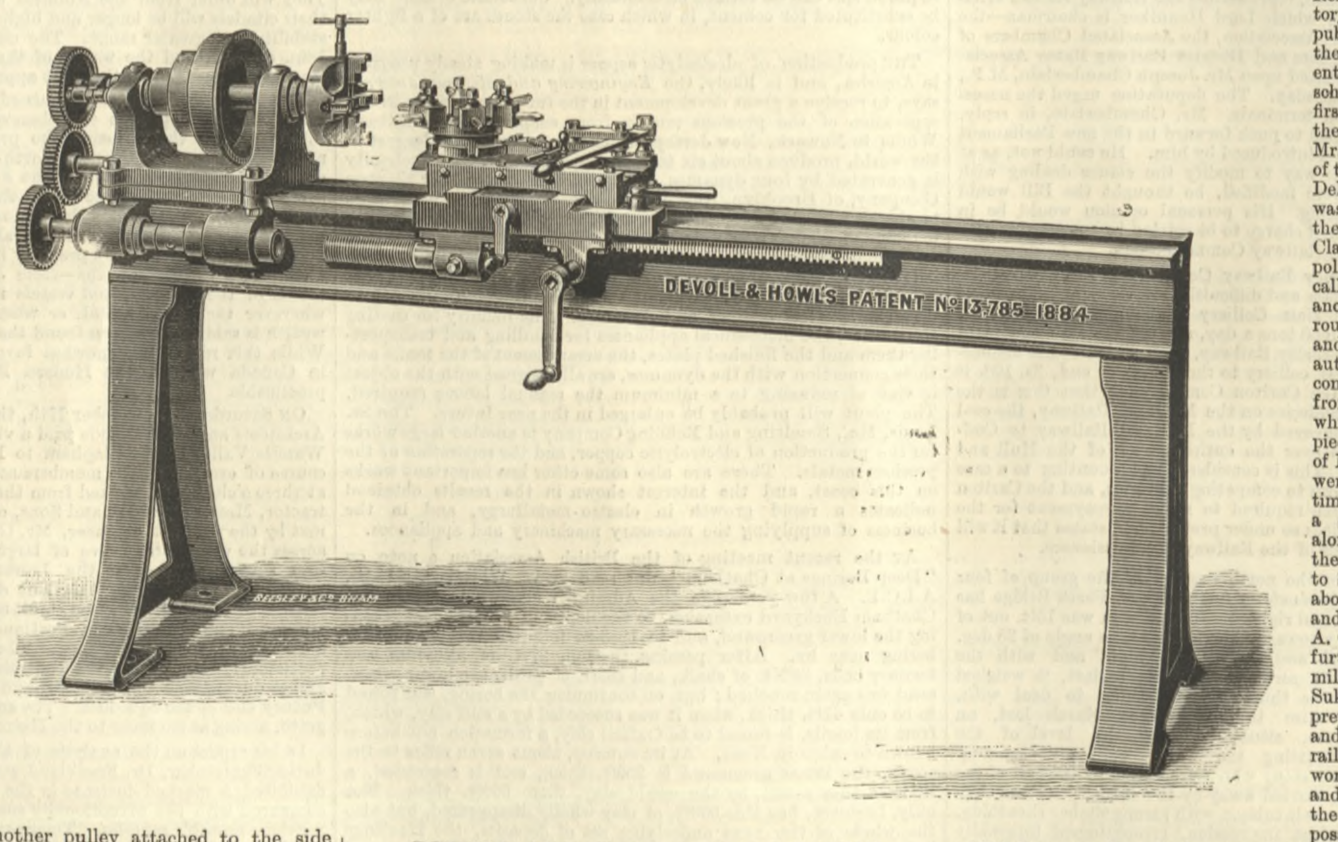


THWAITE AND NEVILLE'S HOISTING AND TRAVERSING CRANE.

The crane illustrated above contains several novel points constituting a new departure in the arrangement of lifting and traversing cranes. It is a joint invention, and is being brought out by Mr. B. H. Thwaite, of 37, Victoria-street, Liverpool. The crane is here shown in its application to dock warehouses. The goods can be loaded direct from the vessel into the warehouses. The arrangement can also be applied to several floors of a warehouse, each floor crane being actuated and controlled independently and from any floor.

The elevating is effected by means of a hydraulic ram, the sides of the cylinder of which are continued upwards to form a guide for the head of the ram, and are attached at their upper ends to the traversing girder, the girders being either slung to the roofs of the upper floors of the warehouse, or are supported on light iron stanchions or columns in such a way as to offer no obstruction to the passage of the goods to be hoisted. It will be seen that the rope is attached to the end of one of the arms of the traversing carriage; the rope passes under the girder to a large pulley mounted on the end of the traversing girder. After passing over this pulley, the rope is then continued over the guide rollers until it arrives at the opposite end of the traversing girder, where it passes over another pulley to the drum of the hydraulic engine, and after passing round the latter, it then passes over the roller at the head of the hydraulic ram, and then passes down and under another pulley attached to the side of the cylinder of the ram. The rope is then passed upwards and over a pulley mounted on the underside of the traversing girder, to the pulley carried by the traversing carriage, and is terminated by the ordinary hooks, &c. The action of the hoist is as follows:—

The goods having been secured to the rope, water pressure is applied to the ram, and as it ascends it shortens the distance from the end of the rope to the ground, and the goods are therefore hoisted to the height desired; the water pressure is then diverted to the water engine, and as one end of the rope is permanently attached to the traversing carriage, and the other end of the rope supports the load, therefore both ends of the rope are rigidly held to the carriage, constituting the rope an endless one. The revolution of the drum of the water engine can be made to draw the goods either towards or from it for the full length of the traversing girder—which can be continued to a great length—by simply revolving the drum of the hydraulic engine in one direction or the other. By the attachment of ropes—as shown—to the levers actuating the hydraulic ram and engine, and the continuation of such ropes above and along the girder to any position desired, the action of the hoist is completely controlled. If this crane is used over the hatch of a ship, it will admit of one, two, four, and up to eight hoists being used at will and independently of each other, without the use of stages or men on deck.



DEVOLL AND HOWL'S BRASS LATHE.

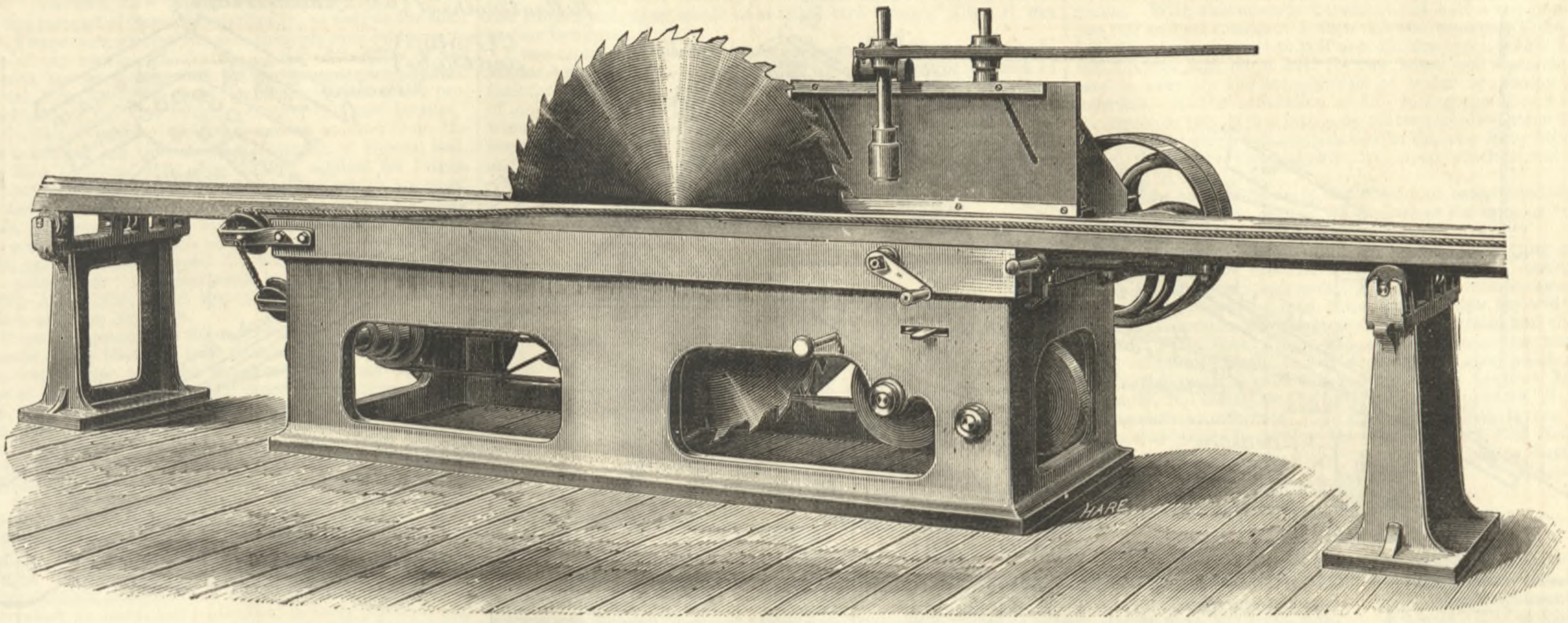
The accompanying engraving represents a brass lathe made by Messrs. Devoll and Howl. The lathe has a quick and simple means of chasing threads of the kind generally used in brasswork without the use of change wheels, and is fitted with an improved compound sliding and traversing turret rest. The top slide of this rest is fitted with a lever motion or pull-up slide for forcing, drilling, and tapping, an arrangement by which a great saving of time is effected. The bottom slide or saddle is also fitted with a simple but effective brake action, which, by a slight touch on the lever shown, will hold the slide and rest firm on the bed for turning, boring, facing, or drilling, by the tools fitted in the turret. By this means six operations may be performed on any work in the chuck at one setting. The work may then be screwed by releasing the small brake handle and moving the rest forward until the male and female screws are in contact. For screwing, ordinary chasing tools are fitted in a tool-holder in the turret rest. The cross slide regulates the depth of cut in connection with an adjustable stop. The lathe is made reversible by the overhead motion. An examination of the engraving will explain the further details of this very handy tool.

The Institute of Chemistry.—The Institute of Chemistry has obtained a Royal charter of incorporation from the Privy Council.

The Quetta Railway.—Referring to the early history of the Quetta Railway, published in our columns of the 9th inst., a correspondent says:—"The original scheme for such a line was first publicly proposed about the time of the mutiny by Mr. Andrew, the chairman of the Scinde, Punjaub, and Delhi Railway. No progress was made, however, till, in the autumn of 1876, Sir A. Clarke, foreseeing that the policy then initiated practically entailed the maintenance of at least one open route between British India and Afghanistan, asked for authority for the immediate construction of a railway from Sukkur to Quetta, which had just been occupied. With the occurrence of Lord Lytton, the surveys were begun, and at the same time the Kussmere Bund, a series of embankments along the further bank of the Indus, from Kussmere to Sukkur, a distance of about 70 miles, were restored and strengthened under Sir A. Clarke's directions. He further collected about 200 miles of permanent way at Sukkur in order to be fully prepared for an immediate and rapid prosecution of the railway. The Kussmere Bund works were duly carried out, and it is due to them that the existing railway became possible. In December, 1876, however, the plant accumulated was abruptly dispersed by order of the then Home Government. The engineer camp at Sukkur was at the same time broken up, and all the preparations made with so much care and forethought were rendered useless. When on September 21, 1879, orders were received to commence work only $19\frac{1}{2}$ miles of rails remained of the original stock, while but 35 miles of rails and 28 miles of sleepers all told were within reach by direct railway communication. The result was that the first section of the railway was made of a medley of material embracing three different classes of permanent way—while one of these classes contained two and another four distinct types of plant. The confusion and difficulty of construction entailed under these circumstances may easily be imagined. For some reason it has come to be assumed that the Quetta Railway has all along been the special pet of one political party, and the circumstances attending its birth are in danger of being forgotten."

COMBINED RACK AND ROPE-FEED SAW BENCH.

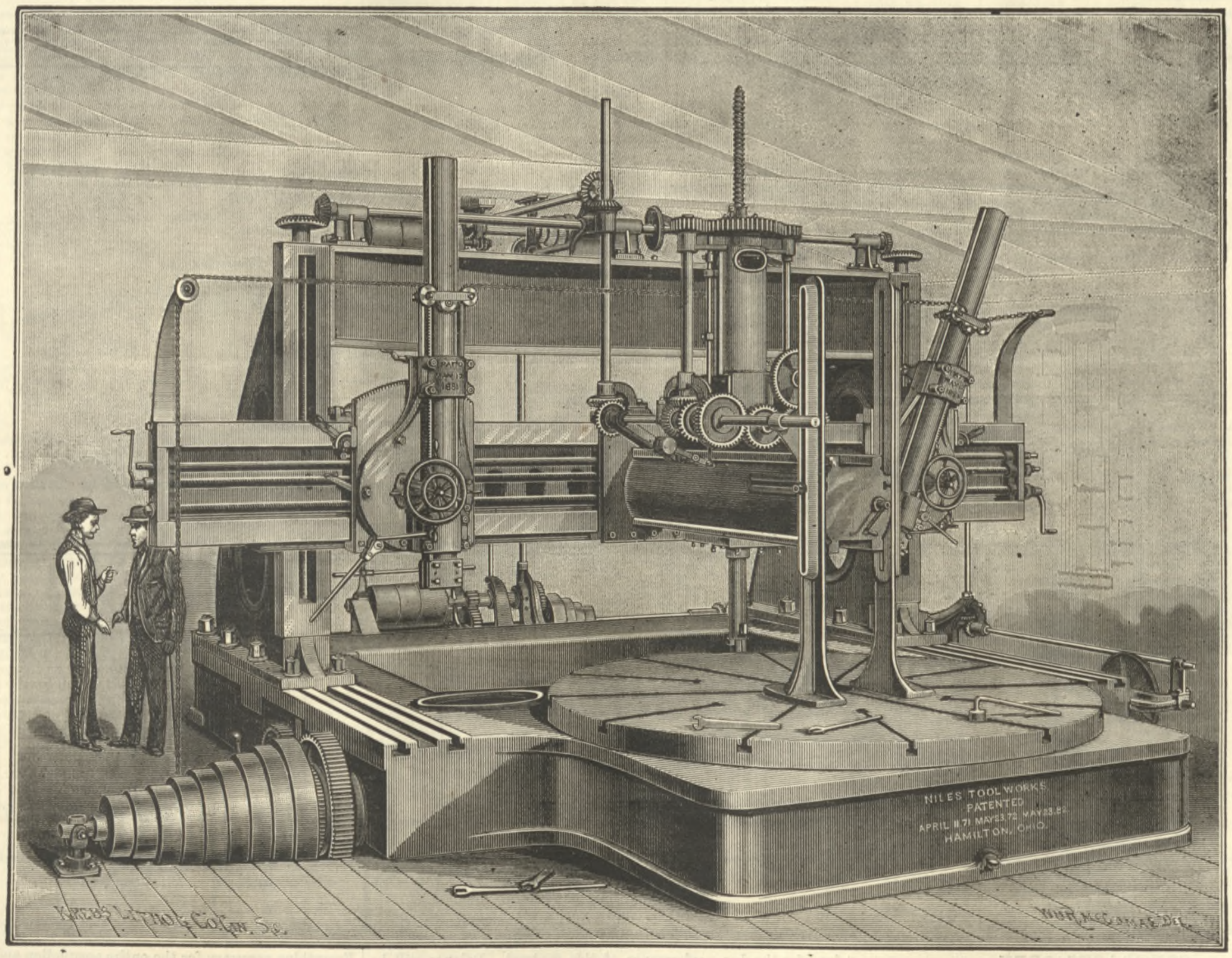
MESSRS. W. FURNESS AND CO., BANKHALL, LIVERPOOL, ENGINEERS.



COMBINED RACK AND ROPE-FEED SAW BENCH.

This bench is a combination of the rack saw bench with a self-acting top and the self-acting saw bench with rope-feed. It is claimed that it is a most useful machine for opening up round or square timber, and cutting into boards, scantlings, &c. The bench is in one entire casting, of great weight, strength, and solidity. The spindle, which is of steel, runs in long gun-metal bearings; one in the bench, and one outside the fast and loose pulleys, in a strong bracket, bolted to bench. The fence is adjustable, and is fitted with pressure roller, for deal cutting. The travelling table, which is cast iron, planed on both sides, is in two parts, one on each side of the saw, and is carried on brackets holding friction rollers. The table can be moved forward at rates varying from 10ft. to 40ft. per minute, and there is a quick return motion. The feed gear, both for rope drag, and travelling table, is very powerful, and has four rates of speed. The size of bench-frame is 8ft. by 3ft., to carry a 48in. diameter saw; and the travelling top, 25ft. long.

LARGE BORING AND TURNING MACHINE.



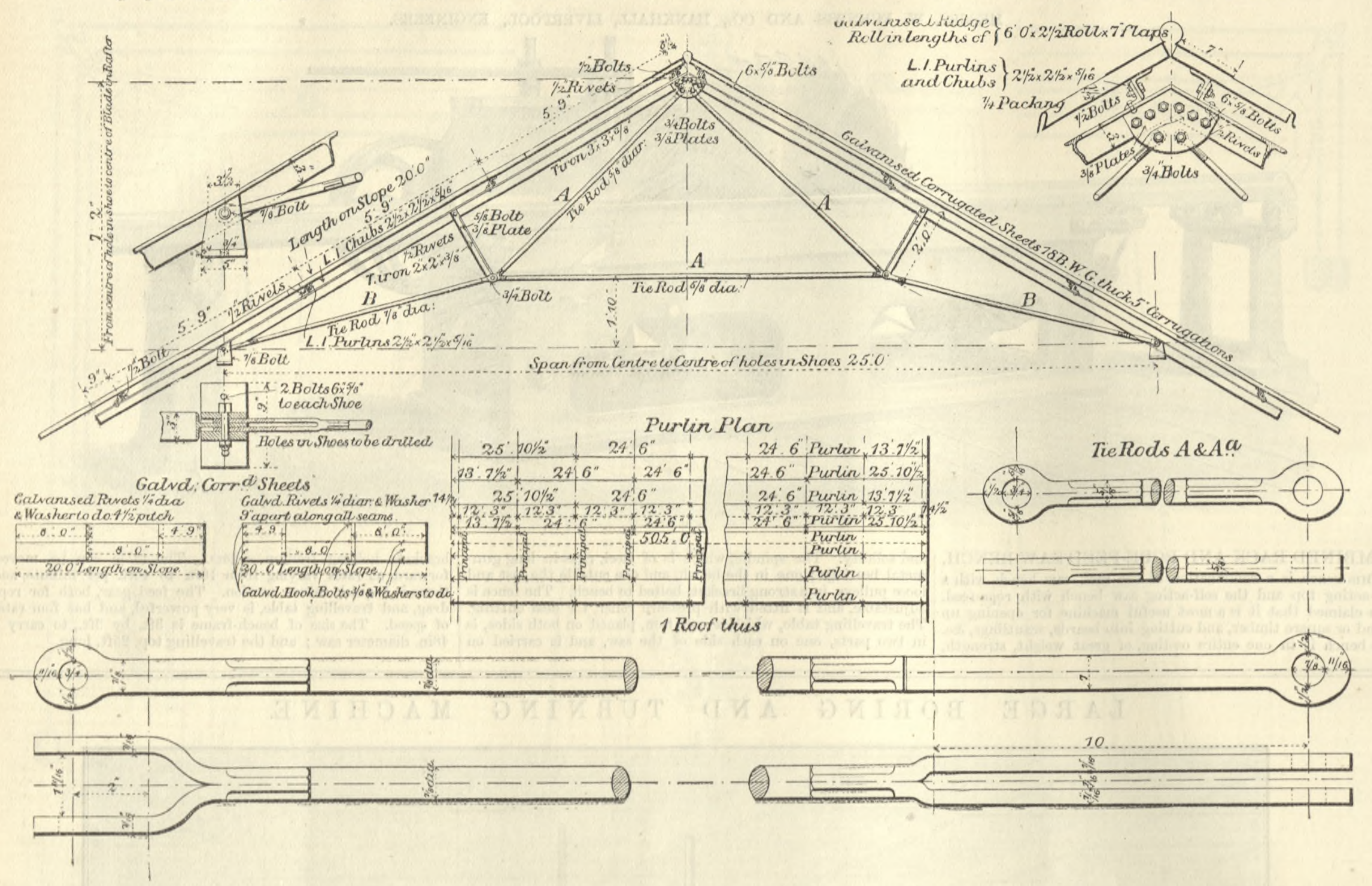
LARGE BORING AND TURNING MILL.

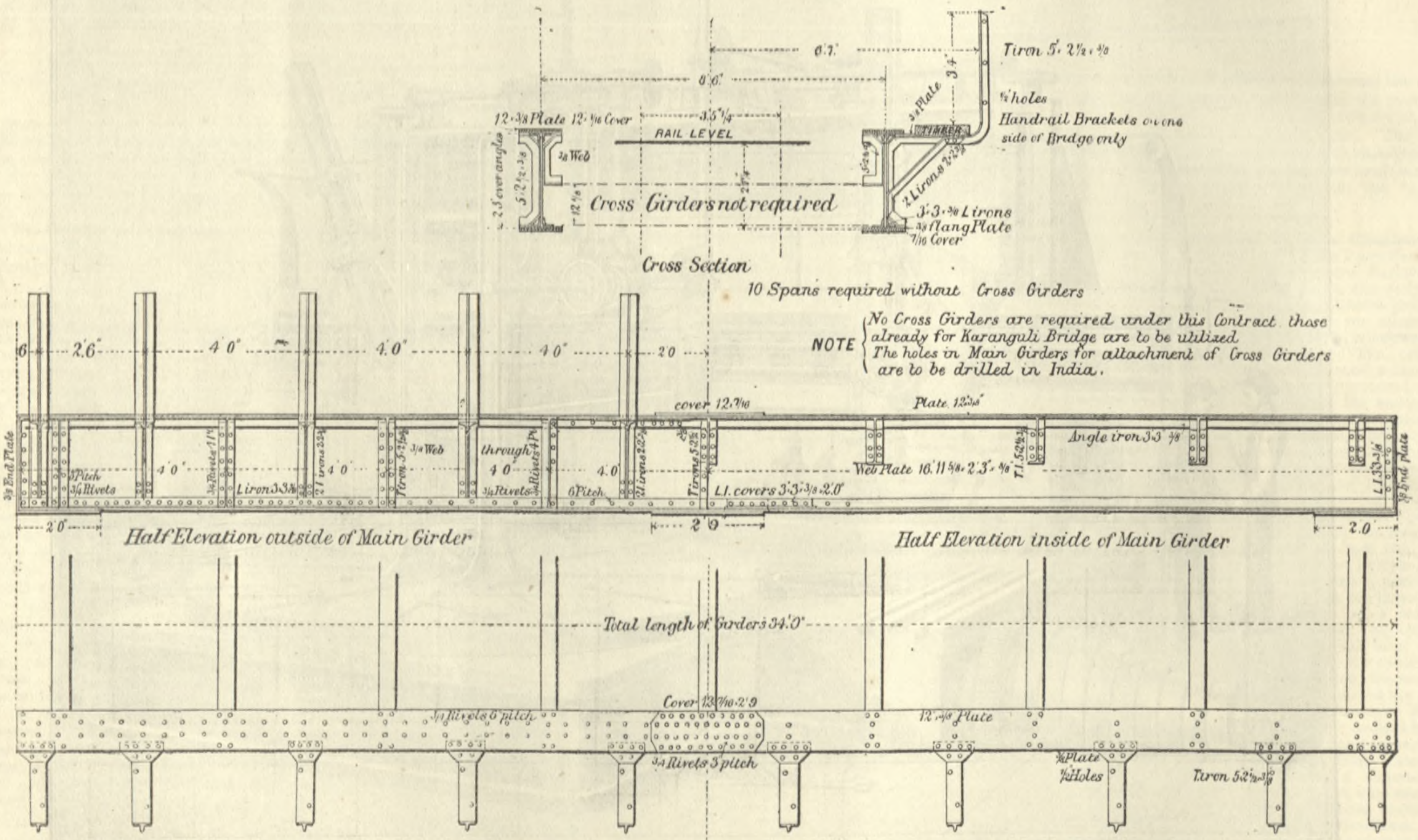
The machine we illustrate above is a new boring and turning mill, recently brought out by the Niles Tool Works, of Hamilton, Ohio, designed to meet the wants of shops whose occasional needs require a machine to turn work of 20ft. diameter or more. For the ordinary requirements of these shops a mill to swing 14ft. is ample, but, at the same time, it is important when the need arises they can operate on much larger work. The purchase of a mill 20ft. swing involves a very large outlay, too large an investment in one machine for the amount of work there is to do. Constructed as this mill is, the additional investment to enable it to operate on large work is but little greater than the necessary investment in a 14ft. mill. This is a 14ft. mill, provided with extension bed-plate and power apparatus for moving the housings and entire upper works back so as to take in work over 14ft. diameter. All the movements required are made by power, and the changes from 14ft. to 20ft. can be made very quickly. The mill is made to carry two good cuts at the extreme swing, 20ft. The extension bed-plate can be made for any required swing; 20ft., however, is as large as is usually required.

As illustrated, it is built to take in work 5ft. high, but this height can be increased. The table is 10ft. diameter. The driving cone has nine steps, and is strongly back geared, affording eighteen changes of speed. The boring bars have 48in. traverse. They are counterweighted and have quick return. The bars are counterweighted by a single weight, arranged so that the strain is always directly through the axis of the bar. The bars are easily and quickly handled, and undue wear in the bearing prevented. Each head has quick hand traverse by rack and pinion. The bars may be set over to operate at any angle. They are brought exactly to the centre of the mill, so that double end cutters may by used for boring. The feeds are operated by a friction disc, the construction of which is patented. The table is very heavy, and is driven by heavy spur gearing cut from the solid. It is free from all the lifting, chattering tendencies of bevel geared machines, and is provided with a massive spindle of considerable length, which runs in bearings adjustable for wear, and is carried at the bottom by a steel step, adjustable in height by the small screw head seen at the front of the base.

When the weights of the parts are thus carried by the step the machine moves freely but solidly, and is thus used for the lighter kinds of work. There is an annular bearing under the outer edge of the table, and when very heavy pieces are to be worked the step is relieved and the table allowed to seat upon this outer bearing; thus adjusted, the machine works with all the steadiness of the heaviest planer and all the precision of the most accurate lathe. For boring a very efficient attachment to the machine has been devised, by means of which the boring may be done while turning, and the device can also be used for key-seating. It consists of a rail attached to the centre of the cross-slide of the mill, carrying a head with boring spindle. This attachment is driven independently of the mill itself, consequently the table of the mill can be run at the proper speed for turning large diameters, and at the same time the boring spindle can be driven at the proper speed for boring simultaneously. The boring head can be brought close up to the cross-slide of the mill, so that it can be used on all diameters. The boring and key-seating attachment is provided with the necessary feeds, operated by power, and every appliance to make a complete machine. It has ample power for boring holes up to 20in. diameter.

CONTRACTS OPEN—IRON ROOFS, SOUTH INDIAN RAILWAY.





CONTRACTS OPEN.

SOUTH INDIAN RAILWAY.

General conditions.—This contract comprehends the manufacture and delivery of the roofing herein specified, in accordance with all the conditions of this specification, and with the drawing hereinafter mentioned. The contract is to be executed in the most approved, substantial, and workmanlike manner, and to the satisfaction of George Barclay Bruce and Charles Douglas Fox, or of the company's engineers or engineer for the time being, who shall have full power and every facility for inspection either in person or by deputy during the progress of the work, &c. The decision of the engineers to be final upon any dispute. Engineers have power to alter or vary the work without invalidating the contract; any additions to or deductions from the contract quantities being valued by engineers according to prices set forth in tender. Contractor to pay cost of all templates, gauges, and carriage of samples. No part of tender to be sublet without the written consent of engineers. In default of contract being completed by the date set forth in tender, the contractor shall pay to the company the sum of £5 for the first week, £10 for the second, and so on, the sum increasing by £5 for every successive week beyond the day for delivery. Payment will be made monthly in cash, on the certificate of the engineers, upon deliveries advised during the preceding month, 10 per cent. being deducted from the amount of each certificate, and retained, without interest, as a guarantee fund for the due performance of this contract. Balance will be paid on completion of contract.

General description.—The roof included in this contract is shown in the engraving above, and all ironwork, whether wrought or galvanised, all holding-down bolts, bolts and nuts, and all other fittings necessary for the complete erection of the roof are to be provided, with the exception of the timber. The following are also to be supplied under the contract, viz.:—5¼ tons of angle iron, 2in. by 2in. by ⅜in., in lengths not less than 15ft.; No. 1025 corrugated galvanised iron sheets, 8ft. 6in. long by 2ft. 3in. wide. The holes in the principals throughout are to be drilled to template by the contractor.

Manufacture.—Castings to be made from best metal, perfectly clean, sound, &c. All plates to be equal in quality to the best Staffordshire plates, perfectly free from defects. All angle, bar, rod, and T iron shall be equal to B.B. merchant bar of the best manufacture, which will not crack or split in working. None but the best Staffordshire rivets may be used. No iron to be used unless it will stand the following tests:—

Description of material.	Tensional breaking strain per square inch not less than tons	Contraction of area at fracture, average per cent. not to be less than
Wrought iron in rods	22	20
,, L and T iron	21	15
,, plates lengthway ..	20	10
,, ,, crossway	18	4
,, bolts, nuts, and rivets	23	25

Everything necessary for the entire completion and erection of the ironwork in India must be provided by contractor, with an allowance of 10 per cent. additional of rivets and bolts. Tenders will not be received unless sent in, in duplicate, upon the proper form, without being detached from the specification. They are to be delivered on or before Tuesday, the 27th day of October, 1885. Forms of tender may be obtained at 55, Gracechurch-street, London, E.C.

Bridgework.—General conditions same as for roof. Manufacture, quality of material, and tests as for roofing. The contract comprises the supply of the ironwork for ten spans 30ft. each, of main girders and handrail on one side of bridge, and does not include any cross girders, rail bearers, or wind bracing. Two sets of tools are to be sent, each set to consist of two rivetting hammers, two sledges, three ⅞in. snaps, six ⅞in. drifts, one ⅞in. dolly, one holding-up hammer, two pairs of pliers, two cold sets, two ⅞in. rimers, four ⅞in. spanners. The contract drawing is numbered as follows, viz., 20,569. Tenders in same time and place as roofwork.

South Kensington Museum.—Visitors during the week ending Oct. 17th, 1885:—On Monday, Tuesday, and Saturday, free, from 10 a.m. to 10 p.m., Museum, 12,744; mercantile marine, Indian section, and other collections, 3877. On Wednesday, Thursday, and Friday, admission 6d., from 10 a.m. to 4 p.m., Museum, 1611; mercantile marine, Indian section, and other collections, 161. Total, 18,393. Average of corresponding week in former years, 17,314. Total from the opening of the Museum, 24,375,164.

LETTERS TO THE EDITOR.

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

PATENT LAW ADMINISTRATION.

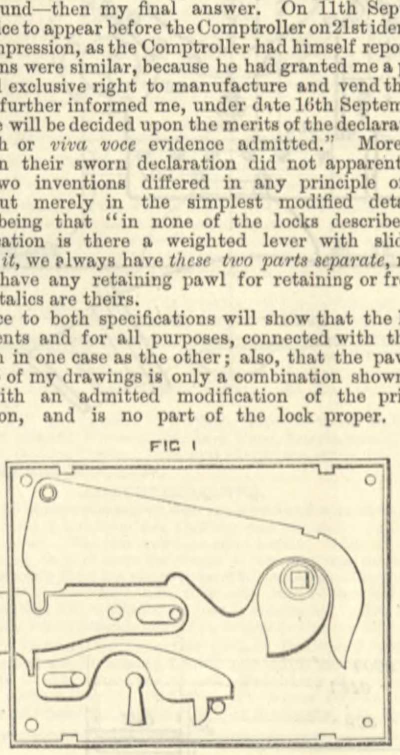
Sir,—In the interest of inventors generally, as well as for their information, I hope you will permit me, through your columns, to state a case of my own as illustrative of the absurdities of the existing patent law as interpreted by the Comptroller-General. Under date 4th July, 1884, I applied for letters patent, under provisional specification, for "improvements in locks and latches," No. 9798. On 21st December, 1884, I received a letter from the Comptroller informing me that Samuel Guinery, of Epsom, had, under date 23rd October, 1884, No. 14,058, applied for letters patent for "improvements in locks and latches," which appeared to comprise the same invention as that described in my specification No. 9798. Under date 22nd May, 1885, I received from the Comptroller a similar report to the effect that Frederick Brown, of Luton, Beds, and aforesaid Samuel Guinery had jointly applied for letters patent for "improvements in locks and latches," No. 4851, 20th April, 1885, which appeared also to comprise the same invention as mine, No. 9798.

It would therefore appear that Samuel Guinery, having satisfied himself by some means that the lock described in his provisional specification was similar to mine, which at that time had been made for me at Willenhall in the form described in his provisional specification, viz., the bolt and lever arm in one piece, though my specification had not been published, abandoned his provisional specification, and joined Frederick Brown, on 20th April, 1885, in making application for letters patent, under a distinct and complete specification, for an invention which was virtually a modification of his first provisional application, also of mine No. 9798, which modification was distinctly described, illustrated, and claimed in my final specification rendered 23rd March, 1885.

On the above-mentioned report of the Comptroller, and having satisfied myself that the lock described and figured in Brown and Guinery's specification, comprised as reported, was unmistakeably the same invention as mine, being identical in every principle and novelty involved, I entered an opposition, on a 10s. stamp form, to the grant of a patent to these joint applicants. Subsequently I had to submit statutory declarations in support, to which Brown replied—Samuel Guinery, the original applicant, keeping in the background—then my final answer. On 11th September I received notice to appear before the Comptroller on 21st idem. I went under the impression, as the Comptroller had himself reported, that the inventions were similar, because he had granted me a patent for the sole and exclusive right to manufacture and vend the lock described, had further informed me, under date 16th September, 1885—"The case will be decided upon the merits of the declaration filed, and no fresh or *viva voce* evidence admitted." Moreover, the applicants in their sworn declaration did not apparently assert that the two inventions differed in any principle of novelty involved, but merely in the simplest modified detail, their contention being that "in none of the locks described in our said specification is there a weighted lever with sliding bolt *connected to it*, we always have *these two parts separate*, nor do we in any case have any retaining pawl for retaining or freeing the bolt"—the italics are theirs.

A reference to both specifications will show that the lever arm is, to all intents and for all purposes, connected with the sliding bolt as much in one case as the other; also, that the pawl figured Nos. 4 and 5 of my drawings is only a combination shown in that drawing, with an admitted modification of the principle of my invention, and is no part of the lock proper. In both

FIG 1



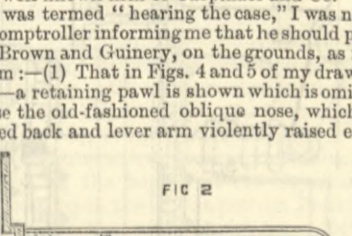
BROWN.

specifications the nose of the bolt is similarly projected from the lock case by the falling weight of the lever arm or tail of the bolt, and is again withdrawn in a precisely similar manner by raising the tail or lever arm by turning the door handle either way.

Under these circumstances I felt convinced that letters patent could not possibly be granted to Brown and Guinery for apparently precisely the same invention as that for which I had received a patent. I therefore appeared personally, without counsel, before the Comptroller, the other applicants being represented by the well-known firm of Carpmael and Co.

After what was termed "hearing the case," I was not a little surprised at the Comptroller informing me that he should proceed to seal the patent to Brown and Guinery, on the grounds, as far as I could understand him:—(1) That in Figs. 4 and 5 of my drawings—Figs. 2 and 3 annexed—a retaining pawl is shown which is omitted by applicants, who use the old-fashioned oblique nose, which requires the bolt to be forced back and lever arm violently raised every time the

FIC 2



WETHERED.

door is closed. (2) That there is an ordinary slot and guide pin in applicant's bolt—Fig. 1 annexed—which there is not in mine. I would particularly draw attention to the last mentioned difference—a point not raised in applicants' sworn declaration, or even referred to by their agent, that I am aware of, the Comptroller having gone out of the way to ask me the following absurd question as nearly in substance as I can remember:—"If you were to remove the lever arm from the pin *b* which connects it with the bolt, the inner end of your bolt would drop, and the bolt figured by applicants would not do so." Of course this is the case, but what on earth would be the use of the bolt in any position in either of the locks in question, if the lever which actuated it, and the pin which supported it, were removed?

There is nothing new in a guide pin to a bolt thus placed. I have it in other locks, and can apply it to this lock if requisite, but it is only needless friction when the lever arm holds the heel of bolt. I enclose for your inspection specifications of both inventions, and if it were possible to give a small sized illustration of mine and Brown and Guinery's, your readers would be able to see at once that both inventions are the same. I would also be glad if you could publish the following correspondence with Comptroller, which speaks for itself, lettered A, B, C. I did intend appealing against the Comptroller's decision, but after receipt of his letter of 26th September, 1885, in which he informs me, "If Brown and Guinery's invention differed from yours in one respect only they would be entitled to a patent," I felt it was useless to appeal.

I was under the delusion that the Patents, Designs, and Trade Marks Act, 1883, was framed in the interest of inventors, and to facilitate their obtaining letters patent without the costly expedient of employing patent agents; also that a well-paid staff of examiners were appointed at the Patent-office to guard the interests of the inventor who had purchased his patent rights from the possibility, as far as could be avoided, of letters patent being sold to a subse-

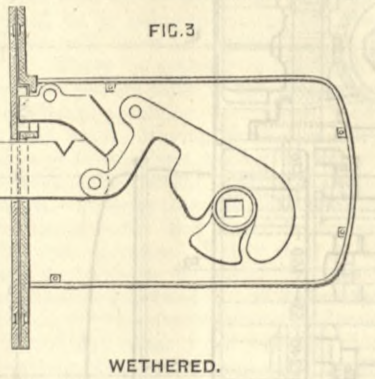


FIG. 3

WETHERED.

quent applicant for a similar invention. But if the Comptroller's interpretation is in accord with the letter of the Act, then the Patent Act was drawn up for the benefit of patent agents, lawyers, and the Patent-office itself; for if the Comptroller can say, when any two specifications are not "identical," as stated in his decision of 21st September, 1885, even in the merest modification of detail, then the more patents that are sealed for the same invention the more money flows into the Patent-office, the more work is given for employés, necessitating a lawyer, and more costly staff.

To sell to A the sole and exclusive right to manufacture and vend the article described in his invention, and subsequently to grant letters patent to another inventor on a specification embracing every principle and novelty contained in A's specification, on the ground that they are not identical in some outside detail; in other words, to sell to B the same rights to vend and manufacture the article as previously sold to A, leaving A to defend his purchased rights in a court of justice if he has the money, would, in the commercial world, render the vendor, and not second purchaser, liable to legal consequences.

E. R. Wethered.

Herbert-road, Woolwich, October 21st.

A. [Copy.]

Patents, Designs, and Trade Marks Act, 1883.

In the matter of an application by Frederick Brown and Samuel Guinery for Letters Patent, No. 4851, of 20th April, 1885,
and
In the matter of the opposition of Edwin Robert Wethered thereto.

Hearing before the Deputy-Comptroller-General on 21st September, 1885.

Decision.

Having heard Mr. Carpmael as agent for the applicants, and the opponent in person, I find that the invention now sought to be patented by Messrs. Brown and Guinery is not identical with the invention comprised in Colonel Wethered's Letters Patent, No. 9798, of 1884. I shall therefore seal a patent upon the application No. 4851 of 1885.

Dated this 21st day of September, 1885.

(Signed) J. Clark Hall,
Deputy-Comptroller-General.

[Copy.]

B. 4851-85. 100, Herbert-road, Woolwich,
23rd September, 1885.

Sir,—With reference to your letter of the 21st instant, transmitting copy of your decision relative to the grant of a patent to Messrs. Brown and Guinery,

As you have decided to seal a patent on application No. 4851, of 1885 (which your own office reported to me under date 22nd May, 1885, as appearing to comprise the same invention as that contained in my specification, No. 9798, of 1884, having at the time both specifications before you), on the grounds that the invention described in said specification of "Brown and Guinery" is not *identical* with the invention "comprised in Colonel Wethered's letters patent, No. 9798, of 1884," I beg to request that you will be pleased to furnish me with a note of the points considered not similar to mine, either in principle or detail, as it will be necessary that I should know these particulars before I obtain advice as to my future proceeding; this is rendered the more necessary, as, being rather deaf, I did not correctly catch what points you referred to at the hearing.

I have the honour to be, Sir,
Your most obedient servant,
(Signed) E. R. Wethered.

The Comptroller, Patent-office.

[Copy.]

C. 4851—85. Patent-office, 25, Southampton-buildings,
London, W.C., 26th September, 1885.

Sir,—With reference to the application, numbered as above, and in reply to your letter of the 23rd inst., I beg to say that it is not the practice in such a case as the present to enumerate the points in respect of which the two inventions appear to differ. It is unnecessary to do so, because if Brown and Guinery's invention differed from yours in one respect only they would be entitled to a patent. Whether they can use their invention without your sanction is a question for you to take into a Court of Justice if you think fit.

I am, Sir, your obedient servant,
(Signed) J. Clark Hall,
Lieut.-Col. Wethered. Pro. Comp. Gen.

Sir,—You may easily satisfy yourself that I am not guilty of the profanity of trying a practical joke on an editor in sending you the enclosed specification of a recent invention (?) by procuring a copy for yourself from the Queen's printers, or by inspecting the original document itself at the Patent-office.

When the recent alterations in the patent laws were under discussion, we were told that under the new *régime* about to be set up there really was to be an intelligent examination of applications for patents, and that inventions for making railways to the moon would not be protected by Royal Letters Patent in the future. But, Sir, what shall be said of the capacity of a great public office which gravely issues a State document recording the fact that her Majesty has for herself, her heirs, and successors given and granted to this poor fellow of an "inventor" patent rights in the painful farrago of nonsense set forth in this specification. I say "painful" advisedly, for although at first sight his invention may provoke one to mirth, it is really pitiable to find any human being outside of Colney Hatch Asylum capable of the self-deception that this "commercial clerk" displays, and it is simply contemptible that the Commissioners of Patents should stoop to the meanness of taking the £5 which this inventor has parted with in stamps, for as you will see the patent for this precious invention has been completed. After this, I shall not be surprised to find that Mr. Fool (not Fell) has obtained a patent for a "Method by Ballooning and Raking for Recovering or Getting Silver Linings from Clouds."

20, Daleham-gardens, Fitz John's Avenue, N.W., October 1st. J. A. Mays.

"Method, by Boiling and Baking, for Getting Gold from Wheat.

"*Complete specification.*—I, Harry Fell, of 'Fairlight,' Avenue-road, South Norwood Park, in the county of Surrey, mercantile clerk, do hereby declare the nature of my invention for getting gold, by method of boiling and baking, from wheat and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

"I cut up the whole wheat straw into little square snips the width of the straw and mix this with an equal measure of the grains. With this mixture I measure out half a two-quart saucepan full and set it aside. I then fill the saucepan three-quarters full of water and set it to boil over the fire, upon which I pour in the mixture and let it boil for two hours and a-quarter, taking care to keep up the complement of water by adding more at intervals. At the conclusion of this boiling operation I strain off the liquor in thin layers into soup plates and allow same to rest for thirty-eight hours—the temperature in this case being 48 deg. Fah.—and then bake these slowly dry, upon which I find the gold adhering to the plates.

"Having now particularly described and ascertained the nature of my said invention, and in what manner the same is to be performed, I declare that what I claim is,

"The 'method, by boiling and baking, for getting gold from wheat,' comprising the following features:—The measuring out the half a two-quart saucepan full of the mixture composed of the whole wheat straw cut into little square snips the width of the straw mixed with an equal measure of the grains and the setting it aside. The then filling the saucepan three-quarters full of water and the setting it to boil over the fire, upon which the pouring in the mixture and the letting it boil for two hours and a-quarter, the taking care to keep up the complement of water by adding more at intervals. The allowing the thin layers of liquor in the soup plates to rest for thirty-eight hours—the temperature in this case being 48 deg. Fah.—and the then baking them slowly dry. "Harry Fell.

"Dated this 18th day of April, 1885."

THE DEVELOPMENT OF INVENTIONS.

Sir,—Referring to the letters from your correspondents on the above subject, perhaps you would kindly find space for a few more remarks. Since the advance of education in the various branches of science, &c., the great want of an association or company—probably the latter is the better term—for the purpose of developing inventions has shown itself, to take them in hand from the earliest stage of an idea, or from the more matured state after provisional protection has been taken, or from the completion of the patent.

A powerful company should be formed—not powerful only from the monetary point of view, but that it should have connected with it influential men of science and manufacturers, from which to form an executive capable of dealing with the very varied subjects that would necessarily come before it.

The company must be a commercial undertaking to ensure the business being thoroughly carried out, empowered to discuss the merits of inventions and deal with the patents or inventions by sale or otherwise for the benefit of the inventor and the company. The profits on these transactions will necessarily vary as "W. S." suggests; but an executive chosen from the class of men above named, a good profit on nearly all transactions can be anticipated. The rules of the company may be so formed that not only inventors shall be benefitted, but the general public would be induced to become shareholders and obtain advantages other than their dividends, by having the opportunity of purchasing valuable inventions which otherwise they would never hear of. Thereby inventions are advertised, and inventors and the public brought together, and both benefit.

It might be said that inventors would fight shy of bringing their inventions to a public company to be developed, but a company with an executive formed of men of such varied information and ability would materially advance the interest of an inventor and lead to a better commercial result than any private firm could ensure, and giving greater confidence to purchasers of patents.

F. F. Ommanney.

14, Hetherington-road, Clapham, S.W., October 14th.

HALL AND VERITY'S FLEXIBLE CRANK SHAFT.

Sir,—In reply to "Rotifer" and Mr. Proudlock's letters on the above subject, in your last issue, I beg to say, in the first place, in reply to "Rotifer," that the essence of the invention patented by Mr. John Verity and myself lies in the use of a circular bush with a convex periphery fitting into a corresponding concave bearing, formed partly in the solid web of the crank and partly in an adjustable ring plate and the general arrangement of the same. If "Rotifer" or Mr. Proudlock or any other person can point out to me any single arrangement in the slightest degree identical with this I should esteem it a great favour. I know of course that as far as the crank pin being permitted freedom in one of the webs, the idea is as old as the paddle engine or thereabouts; but I think that after the above explanation both "Rotifer" and Mr. Proudlock will agree that to draw a similarity between our crank shaft and those they speak of is about on a par with drawing a similarity between a modern locomotive and Stephenson's "Rocket." I may add that this crank was awarded the only prize for crank shafts—a silver medal—at the Inventories Exhibition, and that at the present time we are fitting one on to an important passenger steamer that has quite recently broke two solid shafts. J. F. Hall.

Brightside Steel Works, Sheffield, October 14th. (William Jessop and Sons.)

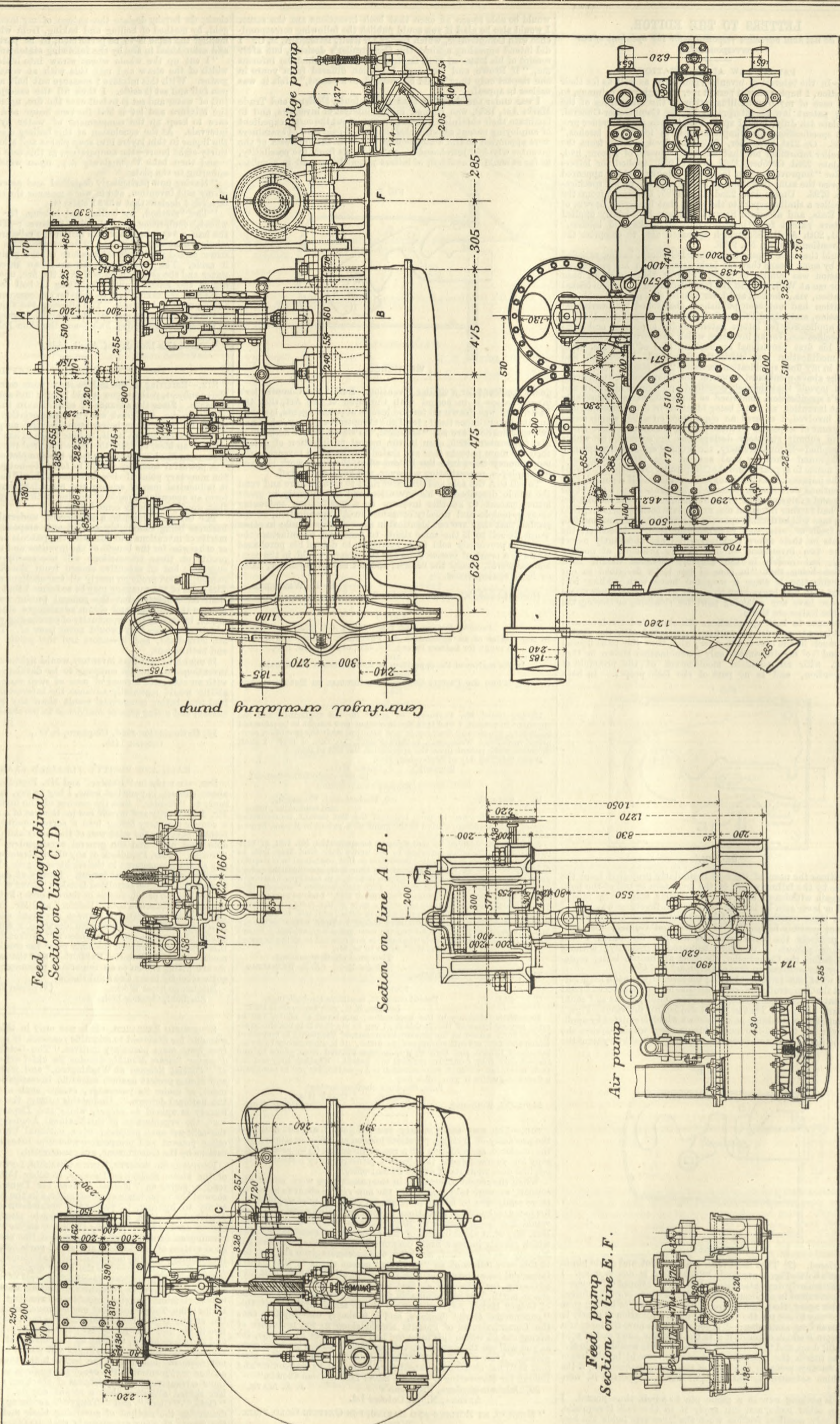
Scientific Research.—It is not only in this country that the clamour for State-aid to scientific research is seen to be far from free from more pecuniary motives. The October number of the *Popular Science Monthly* devotes its chief article to a discussion of "Official Science at Washington," and makes a characteristic and strong protest against scientific investigations by the Government, or under its patronage, except such as "are essential to the national defence." Under this ruling, the work of the Coast Survey is upheld as proper, while the Department of Agriculture, the organisation of the National Academy of Sciences, and the scheme once proposed of a national University, and many other present and prospective scientific investigations and institutions by the Government, are condemned.

Engineering Society, King's College, London.—At a meeting of the above Society on Tuesday, October 13th, Mr. F. Saunders read a paper on "Motive Powers for Dynamos." The author showed the importance of good motors in the application of electricity to lighting, to prevent a breakdown of any kind. He described a method of having a duplicate plant ready to start in case of accident, and possibly the spare engine and dynamo always running at a small speed. He showed the necessity of having a good system of lubrication, and of all parts being easily accessible for cleaning, and the importance of maintaining a constant speed. The author then alluded to the many engines patented expressly for electric lighting, and described several of the newer engines, which he illustrated by diagrams, including Matthew's "compound triplex tandem" engine, capable of running 7000 incandescent lamps; the Tower spherical engine, much used for train lighting, the engine and dynamo being fixed to the foot-plate of a locomotive in an iron box 4ft. by 2ft.; the Fielding high-speed engine; and the Davy motor, working by the condensation of steam at the atmospheric pressure, the cylinder and piston being of bronze, and not requiring lubrication, the boiler being thus kept clean. The author next mentioned the use of gas engines as a source of power, their advantages being quickness of starting, and their requiring less skilled attention than a steam engine. He alluded to the "Otto," "Clerk," and "Tangye" as being the best known, describing the method of governing their motion, and showed as the result of many experiments that 1000ft. of gas used to produce incandescent lighting by means of a gas engine would afford twice as much light as if burnt direct.

THE ANTWERP EXHIBITION—PUMPING MACHINERY OF THE PHLÉGÉTON.

LA SOCIÉTÉ ANONYME CLAPAREDE, ST. DENIS, FRANCE, ENGINEERS.

(For description see page 309.)



TO CORRESPONDENTS.

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

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

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

FERRO.—*It is quite true that steel castings are imported in quantity from Germany. English makers do not seem to be able to get below 26s. a cwt.*

TRACTION (Wivenhoe).—*The highest speed attained by steam on a common road for any distance was fifteen miles an hour, reached by the Raper, Indian road steamer.*

GROOVING MILLERS' HARD STEEL ROLLERS.

(*To the Editor of The Engineer.*)

SIR,—Will any reader kindly say where steel can be procured to stand the grooving of hard steel rollers for millers' use, or how such fluting can be done? A. D. E.

October 21st.

CARRON'S LUBRICATORS OR GREASE-BOXES.

(*To the Editor of The Engineer.*)

SIR,—Will you allow us to ask the name of the makers of Carron's lubricator or grease-box? S. AND S.

Hamburg, October 17th.

DEATH.

On the 15th inst., at Upper Norwood, EDWIN CROSLEY, A.I.C.E.

THE ENGINEER.

OCTOBER 23, 1885.

THE PURIFICATION OF THE THAMES.

THE Metropolitan Board have recently had under their consideration at least nine different schemes, devised for the purpose of settling the sewage question as concerns the purity of the Thames. On the assumption that the Board are really at a loss to know what to do with respect to the main drainage outfalls, or are rather disposed to do nothing at all, sundry communications have been addressed to the Home Secretary, in the hope that the imperial authority would be exercised upon the Metropolitan Board, so as to force the latter into the path of action. But the most probable issue is, that all the schemes thus emanating from outside parties will suffer rejection, the fact being that the Board are not so utterly without resource on this subject as some people have supposed. There can be little doubt the Board are fully aware that the time has arrived when they must take decided steps to satisfy the public demand for a clean river, and it will be found there is much more activity at Spring-gardens with regard to the drainage outfalls than is commonly supposed. There is even reason to hope that the peculiar difficulty of dealing with the enormous volume of the London sewage has led to experiments and efforts which, in their practical results, will greatly aid the settlement of the sewage problem generally. In proof we may mention that Leicester has just copied the process now on trial at Crossness, with the most gratifying results, the need in this instance being just exactly that of London, except that the provincial example is on a smaller scale. It seems idle to talk about the Tottenham difficulty when Leicester, with a population more than twice as great, is able to purify its river almost *instanter*. East London has been in agony about the river Lea, while the Leicester authorities have quietly taken a survey of Crossness, and turned the knowledge so acquired to good account. Mr. J. O. Phillips, who is perhaps the best authority extant on the administration of the gas supply, has made a proposal in regard to the London sewage, and has drawn a considerable amount of attention to his scheme. But Mr. Phillips' proposal, clever as it is in itself, only comes in at the final stage of a huge undertaking. The sewage has to be treated chemically, subject to stringent conditions as to cost, and beset with prodigious difficulties as to the creation of nuisance and the necessity for continuous action. When all this has been overcome, including the pressing of the sewage sludge into semi-dried cakes, Mr. Phillips' scheme simply provides for carrying the aforesaid cakes out to sea, and throwing them into the German Ocean. If the pressed sludge is to be got rid of as being absolutely worthless and useless, we should say Mr. Phillips' plan was a very good one, and he is to be thanked for his trouble in bringing it forward. But a letter in the *Times* will not settle this question. Mr. Phillips must deal with the Metropolitan Board. He will have to say what he is going to charge for the service rendered, and he will have to explain exactly how he means to do it. There is nothing impracticable in his scheme. The screw colliers come to the great gasworks at Beckton, and discharge a million and a-half tons of coal per annum at that spot. Having done this, they return empty, on their way to the Tyne, taking in water for ballast. There is nothing to prevent them from taking away the pressed sludge. Perhaps this will not be altogether so dry as Mr. Phillips expects. But it will be dry enough to make it portable and harmless. Fairly clear of the estuary, the steamers can perhaps discharge the cargo into the sea, and no more need be known of it. If it were really dry, the stuff would float for a time until saturation drove out the included air; but if the cakes were tolerably damp they would be so destitute of buoyancy as to sink forthwith.

How fine a sequel this would be to all the stories as to the market value of sewage manure! Here would be the highly-prized article, offered to anybody for nothing, and the whole consignment going to the bottom of the sea, the Metropolitan Board contentedly paying the Chartered Gas Company a *pro rata* remuneration for perpetuating the waste. It might be hoped the case was hardly so desperate as this. Surely somebody will take the compressed sewage as a gift, without being paid for taking it away? Of all residual products, is this alone good for nothing? Without asking for a profit, is there nothing to be got out of the material as a little set-off to the cost? Surely there is, or will be, a fortune here for somebody who can find out a useful purpose which the sewage blocks can be made to serve? If, however, no man of genius or common sense comes to the rescue, we may suppose that the Beckton colliers must take the lot, and send it down among the fishes. If this happens, then we may expect by-and-bye—let us hope it will be a long time hence—some Royal Commission will present a report, declaring that dangerous shoals are being created off the eastern coast of England, the result of casting innumerable cargoes of half-dried sewage into the sea. Samples of the mud will be fished up and analysed, and positive evidence will be adduced to show that the London sewage is once more asserting itself, acting like an unruly ghost which absolutely refuses to be got rid of. We may almost rest assured that so long as there are chemists in the world, we shall hear about sewage. It will be a bad day for the chemists when the sewage question is settled. It will be like the finishing of one of those old lawsuits which made the fortunes of the Chancery lawyers—too wise to kill the golden goose. But chemistry is making progress even with regard to sewage, and it is distinctly to the interest of the Metropolitan Board to get rid of this trouble as soon as possible. The project which is now being ripened is that of treating, first, the sewage, and then the effluent. Precipitation takes out the suspended matters, but has no appreciable effect on the matters in solution. Yet it is possible so to treat the effluent as to attack the final source of impurity and destroy it. That which a year or two ago would have been intolerably expensive is now being compassed at an outlay which, although large, is moderate compared with any other plan. There is daylight at last with regard to that darkest of problems—the final disposal of the London sewage. Some golden dreams have long vanished away, but the sober reality is less frightful than it once appeared to be. We cannot coin sovereigns out of sewage, but if we can render it harmless at a moderate cost there will be good reason for thankfulness.

Dr. Pole, the secretary to the late Royal Commission on Metropolitan Sewage Discharge, has reminded the public that casting the sewage cakes into the sea was one of the proposals entertained by the Commissioners. Hence, Mr. Phillips has not thrown any new light on the subject. Perhaps, however, he has proposed a plan which will materially reduce the cost of transport. What the Metropolitan Board will say to the scheme we have yet to learn. Dr. Pole also refers to the necessity of further purifying the effluent if the views of the Commissioners are to be carried out. We have already signified that the Crossness experiments provide for this. Curiously enough, a letter from "A Distressed Agriculturist" appeared in the *Times*, deploring the wastefulness of throwing "blocks of guano compost into the sea," and praying that a Minister of Agriculture may be appointed, so as to save us from such an absurdity. If this gentleman really believes in the virtues of London "guano," he had better make a bid for it. A penny a ton might buy it if he would faithfully take it away.

TRANSMISSION OF POWER TO SHORT DISTANCES.

FEW engineers will assert that either of the three methods in common use for transmitting power from prime movers to the machines they actuate is so good that nothing better need be desired. Toothed wheels, flat belts, and endless rope have respectively useful qualities peculiar to themselves, rendering each better adapted to given conditions of work than either of its companions. Nevertheless, none of them can claim to be quite perfect. In cases where as, for example, in clockwork, the relative rotative positions of a number of wheels must always remain the same, toothed wheels only can be used, and for such work they are well adapted. The speeds, with the exception of a portion of the striking gear, are slow and the strain uniform. The advantages of toothed gear over either belts or ropes in other respects are compactness and certainty of action. Perhaps as regards waste of power in friction it will also compare favourably with anything else. We say perhaps, because we are not aware that any investigations have been instituted to determine the relative frictional losses of the different systems. Indeed, as the conditions of service subject to which teeth and belts respectively work, leave the engineer or millowner little choice of selection, even were experiments made, the information derived from them could only be taken advantage of in a comparatively small number of cases. The leading evils attendant on toothed gearing are noise and "backlash." Much has been done, however, to reduce these defects, and where due attention is given to forming the teeth properly, as well as to their subsequent fitting up for work, and mode of driving, backlash and the noise arising from it are now trivial at moderate speeds. Other things besides well-shaped and carefully geared teeth conduce to smooth running. Indeed, their absence will cause the very best gear to rattle. If teeth are to work smoothly their driving angle must not be too great. What we mean by this is that the angle formed by the two lines which may be drawn from the centre of each wheel respectively to the point where the pair of teeth first come into contact ought to be as small as possible. Its magnitude is dependent upon the proportion existing between the diameter of either or both wheels and the pitch of their teeth. As a consequence, the finer the pitch, *cæteris paribus*, the smoother will run the gear. In this, however, as in other matters, theory and practice have to part company at a certain point. Wheels, for given work, cannot, for practical reasons, have less than certain pitches, but then also they need not have more, and the minimum should be carefully sought and adhered to. An old-fashioned rule states that no pinion if it be a "flyer," or one driven by another pinion or a wheel, should have less than fourteen teeth. Since that rule was framed great improvements have been made in the design of toothed wheels, and modern exigencies of construction have jointly, with such improvement, contributed to set it aside, but the soundness of its principle remains the same. All the teaching of the mathematician, all the skill and the labour of the draughtsman, pattern-maker, and moulder, go for nothing if the pair of wheels are improperly centred. In setting toothed gear, three—we may indeed enumerate four—points must be carefully acted upon. The first is, that inasmuch as the pattern must have a slight "draw" to facilitate its removal from the mould, the wheel when cast has necessarily also a slight difference in the thickness of its teeth on one face from that existing on the other. In fact, the teeth are to a minute extent tapered; all this is equally the case with the companion wheel or pinion. Of course we are now referring to spur gear. It becomes then of the greatest importance that when a pair of such wheels are mounted for work, their respective tapers shall be so arranged as that the teeth shall touch each other evenly across their entire breadth, and this can only be effected by setting the base of taper of the one on the same side as the apex of the taper of the other. Of course this does not apply to machine cut wheels, but thousands of wheels are used annually just as they come from the foundry, or at most "tapped" in a lathe. This brings us to the second point, namely, the necessity that the axles of both wheels shall be set absolutely parallel with each other, as well as perfectly in the same plane; neglect of these points will spoil the running of any gear. The third point is that the shafts upon which the wheels are mounted shall be so placed apart that the distance between their centres will be precisely equal to the united radii of the pitch circles of the wheels. Unless they are so placed the rolling circles of the two sets of teeth will not coincide. If the axles are farther apart, the gear will be loose, one wheel having room for some movement, however small, independent of the other, causing rattle, and allowing "backlash" in running. On the other hand, if the shafts are too close, a certain locking of the teeth takes place, causing grinding, friction, and conducing to hot bearings.

Next to toothed gearing comes the belt, and although indispensable as a transmitter of power, it is far from being a perfect contrivance of its kind. Some authorities assert that no belt runs absolutely without slip; where there is slip there is friction and resulting waste of power. If a person otherwise familiar with the relations existing between surfaces in contact was shown an ordinary belt pulley for the first time, and observed its smoothly polished face, and also considered the glazed working face of a belt, his intelligence would instinctively reject the suggestion that the one could impart power to the other by the mere adhesion of their faces together. In fact, such adhesion is subject to the same laws regulating the bite of a driving wheel on a rail; the absence of slip is simply due to the excess of insistant pressure forcing the two faces of belt and pulley or wheel and rail into contact and its coefficient over the resistance of the machine or train to be moved. What destruction is wrought upon the rail by the wheel is familiar to all engineers. In the case of belts, as generally worked, the adhesion is gained in the first instance by proportioning the breadth of the belt to the work to be done, and subsequently by tightening it sufficiently. This last item brings us to another evil attending belting, namely, the friction caused in the bearings of the driving and the driven axle.

Text-books and records of experiments state that friction is proportionate to load only, area of face forming no factor in the calculation; hence it follows that the resistance of the axles of belt pulleys is of necessity increased more and more the tighter the belts are drawn. Some of our readers will, perhaps, think we are merely repeating truisms. We must remind them, however, that there are certain truths often apt to be forgotten by men in the hurry and absorbing cares of business, but to which, nevertheless, it is highly expedient their attention should be from time to time directed. There is one use to which such truisms can always be turned, which we may point out, as follows: Things already familiar, practised by every engineer and mechanic, are, it is to be feared, so universally in vogue simply from tradition, and after tradition, habit. Whatever is, is right—a maxim unworthy of everyone deserving the noble title of engineer. We would prefer as a professional motto, "Whatever is, may perhaps be found susceptible of improvement." Applying this motto, then, to the subject under notice, we may ask, Is it impossible to improve on existing methods of transmitting power by belts? Belt gearing, if we may coin a phrase, is used in two ways. The one as a transmitter of prime power, exemplified in main driving bands. This is never, save under extraordinary circumstances, such as an accident involving danger to or rescue of life or limb, and not therefore needing notice here, thrown out of gear. This, consequently, works subject to different conditions from those influencing machine tool belts, such as are present to a specially great extent in the case of planing machines, whose belts are periodically shifted from back gear to working gear, and in lesser degrees with all the tools in a shop. With all such it is, of course, requisite that resistance to the side motion of a belt should be as little as possible, but we shall return to this presently, preferring to deal with the prime mover first. We have directed attention above to the truism that friction is proportionate to pressure, and is irrespective of area. We will supplement this with another, as follows:—Coefficients of friction under equal pressures are greater with some bodies than with others. The coefficient of the friction of repose of leather on iron dry is ·62, and if damp, ·80; therefore damp leather belting will, with the same tension, transmit a power greater than when dry, in proportion to these coefficients. It is commonly held by all concerned that it is bad for leather belts to wet them with water. So far as we are aware, however, no experiments have been made with a view to determine whether moisture in other forms could or could not be applied with advantage. Dubbin is certainly resorted to occasionally, as also is resin or other gum, but these soon make a thick and objectionable coat on the leather, sometimes injurious to it, and troublesome to remove. In the case of prime movers the adoption of some pulley surface other than iron might perhaps be tried with advantage. Thus, driving pulley rims might be hooped with some description of india-rubber, or other slightly yielding substance—the experiment could be made at small cost. In nothing is the truth of the adage, "that seeing is believing," more forcibly exemplified than it is in waste of power by probably preventible friction. Where it is known by long and bitter experience that inattention will bring the Nemesis of hot bearings and cut brasses, every effort is made, every attention given, to avoid such evils; but where friction only wastes power without any acute symptoms making themselves visible, things are "left to drift."

In Lancashire, rope gear has long been "fashionable;" its advocates claim for it less cost than leather belts, better adhesion, that it may be worked in exposed places as wet will not damage it, a breakage of a rope will not instantly remove load from the engine, and cause racing and breakdown. This sort of gear, however, is by no means new; it gave place to leather, and, presumably, because the latter was, at least at the time, deemed the better of the two. In one department, namely, that of "throwing on and off" work, it can obviously find no place, unless all existing tools have friction or other clutches substituted for their present pulley gear—an extremely improbable event. To sum up the matter, it is possible that experiments on various kinds of pulley rims would supply much useful information; there is ample room to supplement what is already known on the subject. The need for a trustworthy means of driving dynamos has stimulated thought, and directed attention to high speed engines, a matter in itself good, but still to some extent due to the imperfections of existing methods of transmitting power, thus showing a field for investigation open to engineers still imperfectly explored.

THE FALL OF THE HUDDERSFIELD STATION ROOF.

In our reference to this subject we referred to four principals which had been erected in the contractors' yard for the purpose of testing. It appears, however, that the coroner's inquiry was completed without any test of these principals having been made. Why this was done does not appear, but in a case where a coroner's verdict on the death of men caused by the fall of a structure, it is exceedingly unsatisfactory that no attempt should be made to ascertain by experiment whether the opinions offered by some witnesses as to the causes of failure were correct or not, especially when the necessary preparations for such experiment had been made. A report on this roof failure, written by Mr. W. J. S. McCleary, has been sent us, and in this the author enters into some detailed discussion of the defects in the roof design, and on the assumption that the possible load on the roof would reach 40 lb. per square foot—a very usual assumption—he arrives at the conclusion that several of the chief members of the structure were lamentably inferior to the stresses likely to be visited upon them. Several of the compression members were of unusual length, and the sections very light, while some of the sections of the ties were as ridiculously large, if Mr. McCleary's calculations are correct, as they appear to be. It may, however, be remarked that the load was very far below 40 lb. at the time of the accident, and apparently not enough to cause failure if that be looked for in consequence of smallness of sectional areas. But as the lengths of compression members were great and the section small, sagging and consequent buckling may have occurred. In fact, appearances are in favour of the supposition that the designer showed no capacity for assigning sectional areas in accordance with the character as well as intensity of the stresses. Mr. McCleary agrees with Mr. Waugh as to the want of strength in the columns, especially of those at the ends of the roof, and as to the disastrous effect of the want of wind or counterbracing. We may publish Mr. McCleary's report in another issue.

THE HOURS OF LABOUR.

Speaking at Sheffield on Tuesday, Lord Roseberry brought to the front of public questions the hours of labour worked by railway servants and other employés. Disclaiming any desire to interfere with the hours of labour all round, he instanced several exceptional cases where he thought there was reason for legislation. "How would you like yourselves," he said, "to get into a railway train to get to any particular place when you were aware that the engine-driver had been sixteen or seventeen hours on duty, and that you had to travel over some points which were regulated by some man half-asleep from overwork." That constituted a great danger, and he held with the congress of the Amalgamated Society of Railway Servants at Leicester, that ten hours a day is ample and sufficient for railway men's duties." There was also the case of omnibus and tramcar employés, men who wrought hours which gave them no leisure for health or for life, who never saw their children, who could hardly be said to exist at all. Public opinion had exercised a salutary effect in Birmingham, where the tramway company had reduced the hours of the tramway drivers from fourteen to twelve hours. He considered twelve hours should be regarded as the maximum time to work. In Australia there was no legislation with the view of shortening the hours of labour, but there was the practice of a day of eight hours. He was not advocating a day of eight hours, for in Australia they were extremely favourably circumstanced for that condition of things. Their labour market was not overstocked, they had hardly any manufactures, and what manufactures they had hardly entered into competition with each other. He relied more on the force of public opinion than on legislation, but the subject was one which would have to be faced, and in view of the thousands of unemployed at Birmingham and elsewhere, the question of emigration had to be dealt with boldly and in a fair spirit. He thought that a little money applied in helping the unemployed to emigrate would not be ill-spent.

THE EXPORT RAIL TRADE.

It is some time since we glanced at the position of the iron and steel rail trade as far as the export branch is concerned. But in the first nine months of this year there was a further decline in the amount of the exports of steel rails, whilst the less important branch of iron rails shows a slight increase. The quantity of iron rails exported in the first nine months of 1884 was 10,747 tons, and in the corresponding month of the present year there was the slight increase to 11,263 tons, the increase being due to the larger demand from the British East Indies. Of steel rails, on the other hand, there was a decrease from 421,206 tons in the first nine months of the year 1884 to 396,547 tons in the corresponding period of the present year. Generally it may be said that the decrease is due to the lessened demand from the European countries, and from the Argentine Republic and Chili, but British North America has bought more freely, and the British East Indies nearly doubled the quantity taken. Australia, however, has decreased its requirements. As to the United States, the shipments fell off from 16,118 tons in the first nine months of 1884 to the very small quantity of 5071 tons in the same period of this year. It may be added, too, that the United States has ceased to buy iron rails from us, none having been sent this year. Thus the tendency of the rail trade at the present time is to leave us as far as the European customers are concerned generally, whilst we get more orders from extra-European countries, the United States excepted. But it is worth the reminder that the United States is at all times a precarious buyer, for it supplies its own needs in times of the most intense depression; but the time comes when there is a revival of trade, and then it has to buy of others, first raw materials and then finished articles. It now seems inclined to buy such articles as scrap iron, and in time it will probably buy crude iron more freely than it has been doing of late.

THE BELGIAN GIRDER QUESTION.

Much was made at the recent sitting of the Northern Iron Trade Arbitration Board of the growth of continental competition. Mr. Jeremiah Head referred to the development of this competition during the last ten years, and illustrated the Belgian girder question. Rolled joists, he pointed out, can now be bought in Belgium at £4 2s. 6d. per ton f.o.b., whilst the lowest figure at which they can profitably be made in the North of England is £4 12s. 6d. per ton. This is certainly a considerable difference, and the wages have, without doubt, not a little to do with it. But it is satisfactory that the native manufacture of rolled joists and similar building iron is marked with increasing success. An enlarged number of constructive engineers, who have contracts for supplying ironwork for buildings, are sending their orders to the North of England. Staffordshire engineers are prominent in this respect. Our home-made joists, we understand, only go up to 16in. depth at present. Still that is a decided advance upon the former state of things, and greater depths will doubtless be gradually turned out by Messrs. Dorman, Long, and Co. The production of this firm in this class of iron is estimated just now at somewhere about 700 or 800 tons a week, and engineers express themselves well satisfied with the quality of the work. The English competition is waking up the representatives here of Belgian makers. Representatives who before found no occasion to leave London are now deeming it necessary to travel the provinces. The indications point to a sure advance of the business in building iron of English manufacture.

THE INLAND WATERS OF CEYLON.

The *Ceylon Observer* recently devoted an article to the advocacy of a system by which it maintained that a complete *entourage* of island inland navigation could be secured. On a reference to the map of that island it is apparent that what would appear to be at first sight almost an impossibility is not by any means to be so characterised. From some cause or other—very possibly owing to the character of the coral formations which have been pushing outwards the littoral lines of the island—there have been found along its shores, and following parallel to their course, inland seas extending for hundreds of miles, such as may be observed in these islands, only of much less extent, upon the coast of Suffolk. Where these already established waters do not exist, the *Ceylon Observer* states that there are vast tidal flats. These, that journal proposes, should be embanked, with due provision for flood outlet; and it is claimed that the retention of the tidal waters within such embankments would constitute almost a completing link between the several inland seas before described. An island which could possess the means of complete still-water communication around its entire area would certainly have exceptional advantages. It is apparent that the outlay to secure these must be small in comparison to them. The Dutch appear, during their tenure of the island, to have been fully alive to this capacity for carrying out in it their favourite system of communication, and it is singular that the English, throughout nearly a century of their occupation, have done little or nothing towards developing it.

Naval Engineer Appointments.—The following appointments have been made at the Admiralty:—William J. Black, assistant-engineer, to the Jumna; James D. Chater, chief engineer, to the Pembroke, for the Swallow; John S. Watch, engineer, to the Asia, additional; Harry Lane, engineer, to the Asia, for the Colossus; William J. Mullinger, engineer, to the Cyclops; Joseph H. Pill, engineer, to the Asia, for the Edinburgh; Henry A. Madge, engineer, to the Asia, for the Cordelia; Richard A. Shapcott, engineer, to the Vernon, additional; Albert V. Blake, assistant engineer, to the Asia, for the Mercury.

LITERATURE.

Elementary Mechanics, including Hydrostatics and Pneumatics. By Oliver J. Lodge, D.S.C., London, Professor of Experimental Physics in University College, Liverpool. W. and R. Chambers, London and Edinburgh. 1885.

This is a very remarkable little book; a small octavo of 208 pages. The student who has thoroughly mastered its contents in an intelligent way will have anything but rudimentary knowledge of the subjects with which it deals. We welcome its appearance because in it we find the first ripe evidence that the old order of things in the matter of teaching mechanics is passing away. We have persistently urged in this journal that improvement was specially wanted in the matter of definition, and here we have a marked advance. There is, as we shall show presently, room for further improvement; but Dr. Lodge has gone as far perhaps as is justifiable at the moment. Every phenomenon has two aspects—one, its nature, species, and characteristics, which are entirely independent of numbers; the other, its quantities and amounts. Thus, for example, we may speak of a given force, define its cause, its nature, and the method of its action, without saying a syllable about its dimensions. On the other hand, omitting all reference to its cause or nature, we may not only speak of its amount, but define this in precise figures. Thus, when we say that a lump of lead weighs 10 lb., and will fall 16ft. in a second, we deal only with the numerical aspect of gravity. If we talk of Le Sage's theory, attraction, and so forth, we deal with the phenomenal side of gravity, and each side may be treated without reference to the other. Any man undertaking to write a text-book on mechanics will find ready to his hand a vast amount of accumulated information concerning the numerical side of his subject—information concerning which there can be no dispute or dissension of any kind; and there are many text-books of this type in existence. They serve a good purpose, no doubt, as far as they go, just as the multiplication-table serves a good purpose. But almost any writer of text-books with brains or mind feels that a little more than this is wanted, and that among his readers he will certainly come across, now and then, a troublesome student, who will want to get at the back of things; and not content with being told, for example, that a stone falls 16ft. in a second, will ask why it falls at this particular rate. The result of this has been that very many text-books on dynamics, statics, hydraulics, &c., mix up the two things, namely, the phenomenal and the numerical aspects of questions, with a result wholly or partly unsatisfactory; and it is so for two reasons, the first being that the writer has no very clear notions of his own concerning natural phenomena, and the second being the conviction that under no possible circumstances must he admit that he does not know. It is an article of faith that a science teacher must be ignorant of nothing. This assumption of infallibility worked very well for a long time, and works still with a certain type of student. But its day is past, and the teacher of the future will admit gravely, and even sadly, that there are many things that he does not know; much that he does not understand; that most of the statements he makes are professions of faith, not enunciations of fact, and that he is himself a student differing from those whom he teaches not so much in the amount of his knowledge as in the depth of his ignorance.

Now Dr. Lodge, if he has not succeeded in emancipating himself from the idea that he knows a great deal, fully understands the truth that neither he himself nor any other man living knows everything, and he possesses the transcendent merit of not only thinking with extreme lucidity, but the invaluable qualification of expressing what he has to say in terse and admirable English. He can say more, and say it intelligibly, in one page than any other writer with whose works we are acquainted can in two, and for this reason the little book before us is a jewel of its kind. It is a mass of information crystallised into the shape of all others most likely to be of use to the student; and, all round, very unlike in tone, style, and method to other works of its class. We cannot make what we mean clear to our readers in a better way than by giving them some examples. We shall, however, confine our attention to the way in which Dr. Lodge has handled the phenomenal aspect of mechanics, because the numerical side of the subject is comparatively beaten ground. When we have said that his numerical explanations are perfectly lucid and his examples admirably chosen, we have said all that we have space to say on this point.

Beginning at the beginning, Dr. Lodge defines mechanics as "that branch of natural philosophy which treats of the different effects of Force on Matter. Other branches of natural philosophy, summed up under the name of *Physics*, treat of the different ways in which force may originate, and are concerned with different forms of energy—the force generator—just as chemistry is concerned with different kinds of matter; mechanics accepts both force and matter, and discusses only the effects of one on the other." This is a very pregnant passage, not written, we may be sure, without a great deal of thought, and possibly many erasures and recantings. We have in it two most important words—Force and Matter—and we have a proposition never before put in this precise form in an elementary text-book—that energy is the force generator. We are here in some doubt as to whether Dr. Lodge uses the word energy in an empirical sense, or as representing a physical entity—some thing known in nature. Going on, however, to page 15, we find that Dr. Lodge identifies energy with motion. He says: "We have spoken of force as exerted by matter. Strictly speaking this is hardly correct. Matter does not of itself exert force; it must be set in motion, or have some other form of energy conferred on it before it can exert force." Contrast this statement with that with which most text-books of mechanics begin, "Force is the cause of motion or of change of motion in a body." Dr. Lodge, on the other hand, admits what has long been patent to everybody not blinded by a special mode of study, namely, that motion is a cause of Force. This is taking new ground with a vengeance. Turning back, however, to the first page of the book, we find that Dr. Lodge has cast to the winds the old definitions, and actually produces what is—*qua* text-books—an entirely new definition of Force. "By the term Force," he writes, "we are to understand muscular exertion, and whatever else is capable of producing the same effects. Muscular action impeded gives us our primitive idea of Force. Our sense of muscular exertion itself is a primary one, for which we have special nerves, and it is not resolved into any simpler. When any inanimate agent produces an effect on bodies exactly similar to that which would be produced by muscular exertion on the part of an animal, it also is said to exert Force." This is a wonderful passage. Here by one stroke of the pen a man of sense, writing sense, clears away the thick clouds of mystery which have hung over the word force for years and years. We can quite understand that writing like this will be an abomination in the eyes of some men of the old school. To paraphrase Dr. Lodge, he says simply "I don't know what force is; I only know that when I pull a garden roller or lift a heavy book, I do something which evokes a peculiar sensation, and this sensation sets up within me a concept which I call force. The result of the force which I feel that I exert on the garden roller is the motion of that roller. When a locomotive pulls a train after it, the pulling of the train sets up again in my mind the concept of the sensation I felt when I pulled the roller, and I say that the locomotive is exerting force on the train." Something of the same kind has been said before by Herbert Spencer; but Spencer is not a science teacher, and no greater gain has been won by the art of mechanical science teaching for many years than Dr. Lodge's definition of Force. Advancing further, Dr. Lodge places definitely before the student that which is but too often entirely overlooked, namely, the truth that there can be no such thing as an isolated force. "In other words, force is always the mutual action of *two* bodies against one another, and the amount of the force is precisely equal to the amount of the resistance." If we said much on this point we should probably re-open a discussion recently carried on in our columns, in which Dr. Lodge took an active part. We cannot resist saying, however, that the passage as it stands will prove a hard nut for the student to crack. If he is told, on the one hand, that force is the cause of motion, and on the other that no force exists that is not precisely balanced, he will want to know how it is that the force can produce motion. He will say "Dr. Lodge defines force as a push or effort exerted by me. I am raising a book at arm's length; I push the book up just as much as the book pushes me down, no more and no less. Why does the book rise? What change would occur in the amounts of the two forces if the book were to fall slowly, carrying my hand down, instead of rising slowly, my hand carrying it up?" Concerning all this Dr. Lodge is entirely silent. We do not for a moment assert that his own views on the subject are not perfectly clear. We are supposed, however, to know nothing of what is in Dr. Lodge's mind, save as it is set forth in the book before us, and this book leaves the question we have put into the mouth of a student unanswered. Dr. Lodge has, however, it will be well to remark, not explicitly said that force is the cause of motion; but our experience leads us to believe that the student will miss this point, especially as Dr. Lodge implies it in several places, as, for example, on page 16, where he says, "A force may be measured by the amount of motion it can produce in a given piece of matter in a given time."

If the student will turn to page 120 he will, unfortunately, find that which will make matters more than ever obscure. Speaking of the equilibrium of two forces, Dr. Lodge writes: "The conditions which two forces have to satisfy in order to balance each other, and have no effect on the motion of the body to which they are applied, are very simple and obvious, namely: (1) The forces must both lie in the same straight line; (2) they must act in opposite directions; (3) they must be equal." Now it is clear that the proposition which we have already quoted covers all this ground. If a force cannot exist unless an equal and opposite force exist also, it is as clear as logic can make it that (1) Forces must always both lie in the same straight line; (2) that they must always act in opposite directions; (3) that they must be equal. But, says Dr. Lodge, under these conditions there can be no motion produced; we have equilibrium. What, then, the student will ask, is the difference between the conditions when a body is movable by force and when it is not movable? On this point clear explanation was essential. Dr. Lodge's proposition of the equality of forces in direction and amount on page 14 is absolutely identical, as it stands, with his definition of the conditions of equilibrium on page 120. We think we know what Dr. Lodge had in his mind when he wrote both, but on this point we have no right to speak positively. Although Dr. Lodge speaks of resistance as a force, he draws a mental distinction between the two. The force which produces motion belongs to the active, the force which resists motion to the passive order. At least, this is, we imagine, the opinion held, consciously or unconsciously, by most persons. But the forces with which Dr. Lodge deals when he speaks of equilibrium are both active.

Leaving Force, let us see what our author has to say concerning Motion:—"A body is said to move when it is in different positions at different times. This is to be regarded as the essential characteristic of motion—it involves a reference to both space and time." This is a capital definition, satisfactory in every respect. In a foot-note on page 17 we find the same notion as that on which his definition of force is based brought in to explain motion. "It is probable that our idea of motion—that is, of free muscular action—precedes and suggests our idea of time; and that our notion of equal intervals of time depends on our recognition of uniform motion. Every measurer of time is simply a uniformly moving body." We have here an instance of the care with which Dr. Lodge thinks. To at least nine-tenths of his readers the statement that every measurer of time is simply a uniformly moving body will come as something quite new. Of course it is not new at all, but it is quite worth saying, and will tend to give the student a further insight into the nature of motion, which is very far from being the simple thing that it seems to be at first sight. So far, for example, as the human mind is concerned, we could have no cognisance at all of motion if only one thing existed. Just as every force is dual, so is motion dual. We say that a thing moves when it alters its distance from other bodies, and if there were no other bodies we could not tell whether one body moved in space or not. It may be said that we are trenching upon metaphysical ground. Perhaps so; but it is very difficult to think of what goes on around us without becoming a little metaphysical. Dr. Lodge himself has not succeeded in escaping. Thus, speaking of the curvilinear motion of a point, he says, "a point moving in a curve, besides any acceleration it may have along the curve increasing its velocity, possesses an acceleration at right angles to the curve, or normal to the direction of its motion; this acceleration being proportional to the curvature of the curve, and affecting only the direction and not the magnitude of the velocity. Its magnitude is the rate at which velocity normal to the curve is gained by the point. This normal acceleration is called centripetal acceleration, and is further discussed in Sec. 54—57, where it will be found to be proportional to the square of the velocity of the point as well as to the curvature of the curve, to be equal in fact to $v^2 \times \frac{1}{r}$." This is by no means the most satisfactory passage in the book. It is immediately followed by, "Although the point is always gaining velocity normal to the curve or along its radius at this rate, it does not follow that it ever possesses any such velocity. It is, in fact, impossible for a point to possess any velocity except that along the curve or at right angles to the radius of curvature; for as fast as velocity along the radius is generated, so fast does the direction of the radius change, in the same sort of way that a promise for to-morrow need never be fulfilled because to-morrow never comes." We have no doubt that Dr. Lodge's morals are better than his logic. Leaving the last few lines out, we have a species of metaphysical conundrum presented to the student. The whole passage might be rewritten with considerable advantage. Dr. Lodge is not original here, and he has adopted a lumbering mode of expression which is not pleasant reading. The normal student will not be slow to ask how it is that a body can at one and the same time possess an acceleration and not possess it. How it can be accelerated and yet not move faster; and the student a little more advanced will see that there is no connection at all between the idea involved in the to-morrow promise and the change in the direction of the radius.

We find it extremely difficult to put Dr. Lodge's book down, with the determination that we will write no more about it, because almost every page evokes comment. The space at our disposal is limited, however, and we must hasten to a conclusion, leaving the great bulk of the book untouched. It may be said, how does it come to pass that so much ought to be written by a reviewer concerning a comparatively tiny volume? The answer is simply that there is so much in the book to write about. We have deemed it imperative that we should point out the weak places, or what appear to us to be weak places. We would much rather leave these alone; but we have above all things the interest of the student at heart, and it is for his sake that we point out defects, few and far between, and quite capable of removal in a second edition. We have always insisted on accuracy of definition as beyond all things essential, and we cannot consistently avoid calling attention to any failure in this respect. Take, for example, the following passage on page 41. Dr. Lodge is defining the motion of a particle, and he says:—"Now, matter possesses a certain characteristic property called inertia, or power of re-acting against a force applied to change its state of motion." The student reading this passage cannot fail to gather from it that matter can resist motion, or, to be more accurate, can resist a force tending to put it in motion. But we do not suppose that Dr. Lodge intends to convey anything of the kind. Matter is entirely inert in the affair; and the force required to impart a given velocity to a given amount of matter is not a question of resistance but of mass and time. "Since inertia, then, is a characteristic property of all matter, it will serve to measure the quantity of matter in any given mass." This is quite true, but it is also true that it may be employed to measure the time during which any force acts, or, the time and the mass being given, to measure the force. "To recapitulate, then, mass means quantity of matter, and is measured by inertia." But inertia, Dr. Lodge ought to have added, is measured by time as well as by mass.

One word in conclusion. We have said that Dr. Lodge has made vast strides in the matter of definition, and this is in no way inconsistent with our criticisms; be it remembered that we have dealt only with the few imperfections of the book, leaving its perfections to take care of themselves. In a great many places Dr. Lodge writes in a way that can leave the student for not one moment in doubt. His illustrations are so well selected, and he speaks such common-sense straightforward English, that there can be no mistake or confusion of mind. All that part dealing, for example, with the composition and resolution of forces is as nearly perfect as anything of its kind can be. We are sorely tempted to quote, but we must forbear. Our last word concerning the little volume is that it is the best elementary text-book of mechanics that has yet been written, and to the student who is teaching himself it will prove invaluable. The price of the book is only three shillings, so that it is within the reach of the multitude.

Tables for Setting-out Curves from 101ft. to 5000ft. Radius. By H. A. Cutler and F. J. Edge. London: E. and F. N. Spon. 1885. 47 pp.

This is a handy little pocket-book of lengths of normal offsets from tangent lines of given lengths for curves from 101ft. to 5000ft. radius, advancing by 1ft. up to 150ft., by 2ft. from 150ft. to 250ft., by 5ft. from 250ft. to 500ft., by 10ft. from 500ft. to 1000ft., by 20ft. from 1000ft. to 2000ft., by 50ft. from 2000ft. to 5000ft. A brief, but clear, explanation of their use is given, from which any one who had not the slightest idea of the way to set out a curve could learn in a quarter of an hour; and it is needless to say that the tables are useful and in a handy form for every one who has to set out curves for any purpose. The only tables of any value which have hitherto been published are Kennedy and Hackwood's "Tables," published by Spon, and Beazeley's "Tables," published by Crosby Lockwood. The latter is exclusively based upon Rankine's method, which requires the use of a theodolite; Kennedy and Hackwood's tables give both methods, but are not arranged in the form of Cutler's tables, being limited to radii of chain measurements, whereas Mr. Cutler's are all in feet, and the offsets in feet and inches.

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Elements de Statique Graphique, Appliquée aux Constructions. By H. Muller-Breslau and T. Seyrig. Text and plates. Paris: Baudry et Cie. 1885.

The Panama Canal: its History, Political Aspects, and Financial Difficulties. By J. C. Rodrigues, LL.B. London: Sampson Low and Co. 1885.

A Multiplication Table Extended to 100 times 113. Manchester: A. Heywood and Son. London: Simpkin, Marshall, and Co. 1885.

The Marine Steam Engine: a Treatise for the Use of Engineering Students and Officers of the Royal Navy. By Richard Sennett, R.N. Second edition. London: Longmans, Green, and Co. 1885.

The Windmill as a Prime Mover. By Alfred R. Wolff, M.E. New York: J. Wiley and Sons. London: Trübner and Co. 1885.

Proceedings of the Institution of Civil Engineers. Vol. lxxxii. London: The Institute. 1885.

Principles of Economy in the Design of Metallic Bridges. By Charles B. Bender. New York: J. Wiley and Son. London: Trübner and Co. 1885.

Trigonometry: Analytical, Plane, and Spherical, with Logarithmic Tables. By De Volson Wood. New York: Wiley and Son. London: Trübner and Co. 1885.

Arithmetical Physics, Part II., Magnetism, and Electricity. By C. J. Woodward, B.Sc. London: Simpkin, Marshall, and Co. 1885.

Numerical Examples in Heat. By R. E. Day, M.A. New edition. London: Longmans, Green, and Co. 1885.

John Wyatt, Master Carpenter and Inventor. Compiled from original manuscripts. London: Hamilton, Adams, and Co. 1885.

Manual of Telegraphy. By W. Williams. London: Longmans, Green, and Co. 1885.

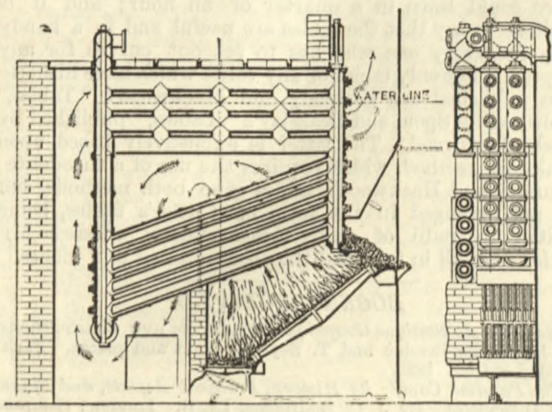
THE TELPHER LINE AT GLYNDE.

The experimental telpher line at Weston, under the system of the late Professor Fleeming Jenkin, has resulted in the construction of a telpher line to do real work at Glynde, on the estate of Lord Hampden, near Lewes. Professor Fleeming Jenkin had begun the construction of the Glynde line, Mr. Arthur Brewtnall being his assistant. After the death of Professor Fleeming Jenkin in June last, Professor Perry was appointed his successor as the engineer to the Telpherage Company. The Glynde line has now been completed, and was formally opened on Saturday last by Lady Hampden, who started a loaded train on the line electrically. A special train conveyed a large number of visitors from Victoria station to Glynde, among the company being Sir Frederick Abel, Admiral Sir Edward Inglefield, Mr. M. R. Pryor (chairman of the Telpherage Company), Mr. W. H. Preece, Mr. Latimer Clark, Mr. Edward Woods, Mr. T. R. Crampton, Mr. Swan, Mr. E. A. Cowper, Mr. W. H. Massey, and Mr. Charles Wood. The line is a double one, nearly a mile in length, and is composed of two sets of steel rods, ¾in. in diameter, supported on wooden posts of T-shape, and about 18ft. high. The wires are supported one on either end of the cross-piece of the T, which is 8ft. long. The carriers, or skips, as they are technically termed, are iron trough-shaped buckets, each holding about 2 cwt., and suspended from the line by a light iron frame, at the upper end of which is a pair of grooved wheels running on the line of rods. A train is made up of ten of these skips, which are in electrical connection with each other, and with an electrical motor, which is placed in the middle of the train, having five skips in front of and five behind it; the dynamo machine used as the motor is of Reckenzaun's design. At a point about midway of the length of the line is the engine-house, in which is a steam engine for driving the dynamo machines. From these latter the current is led to the line, and thus to the electrical motor which moves the train. The use to which the line is put is to carry clay from a pit to the Glynde railway siding, whence it is delivered into trucks and transported by rail to the works of the Newhaven Cement Company. At the charging end of the telpher line the skips are loaded each with about 2 cwt. of clay, the train thus carrying 1 ton. A labourer, by touching a key, starts the train, which travels at a speed of from four to five miles an hour along the overhead line to the Glynde station. Arrived there another labourer upsets each skip as it passes over a railway truck, into which the clay is thus loaded. This upsetting, however, will eventually be performed automatically by means of a lever on each skip, which will come in contact with a projecting arm as it passes over the truck. The labourer at the discharging end of the line has full control over the train, and can stop, start, and reverse it at will, as can also the man at the other or loading end. There are two trains at Glynde, but only one is at present used, that being found sufficient to deliver 150 tons of clay per week at the station. The trains need no attention when running, as they are governed to run at the same speed both on rising and falling gradients. An automatic block system is provided, so that as many as twenty trains can be run on the line without the possibility of collision. The telpherage line at Glynde being the first erected is still capable of improvement in detail, but it successfully demonstrates Jenkin's proposals for working the equivalent of a wire-rope railway by electricity instead of by the teledynamic system of Hirn and others, although time is necessary to prove its comparative practical utility and efficiency.

Mr. John Clare.—The death is recorded of Mr. John Clare, of Liverpool, a well-known nautical inventor. Deceased was one of the persons who suggested the protection of war vessels by means of iron plates, out of which theory the existing system of iron shipbuilding was developed. On the ground that his suggestions had been practically adopted and carried out by the officials of the Government dockyards, Mr. Clare made a claim upon the Government for a sum of about a million sterling for compensation. The claim was rejected, and the matter was several times brought under the attention of Parliament, but with an unfavourable result. In 1856 Mr. Clare published his correspondence with the Admiralty under the title of "Mechanical Defects of things resembling Iron Ships, but constructed upon the Tin-pot Principle." In 1868 he published a work entitled "Life Preserving Ships, hydrodynamically developed upon Metallic Principles, and now forming the National Defences of great Britain."

THE DEVELOPMENT OF A WATER-TUBE BOILER.

(For description see next page.)



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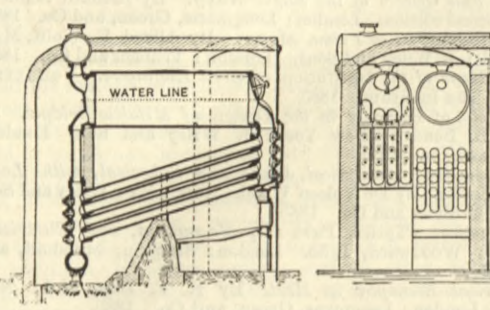

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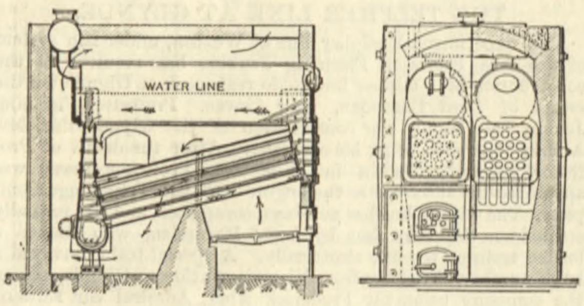

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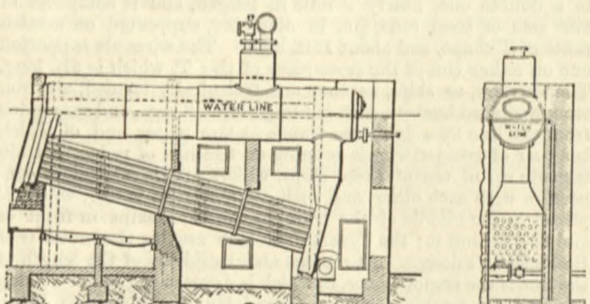

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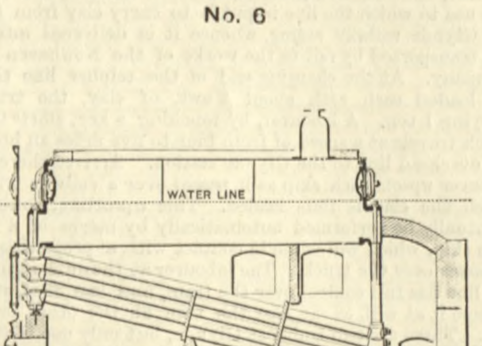

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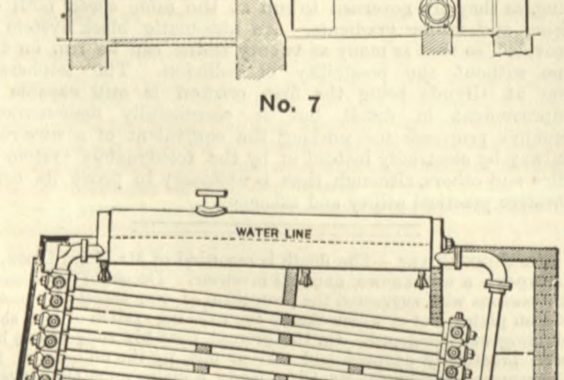

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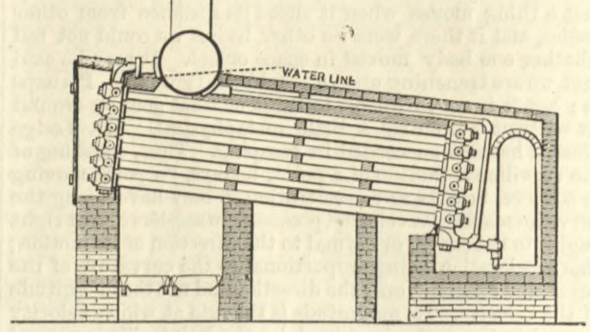

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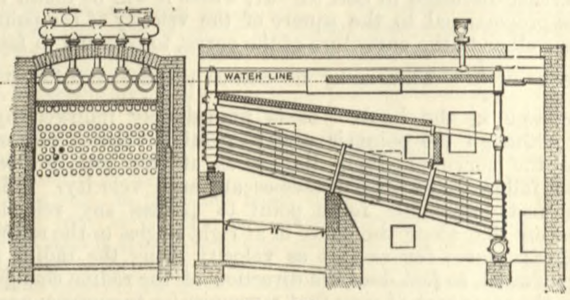

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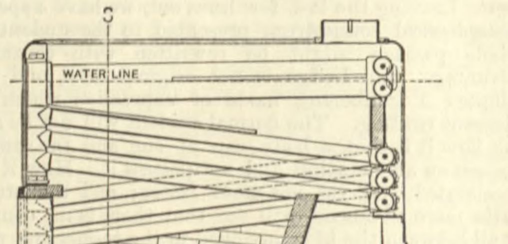

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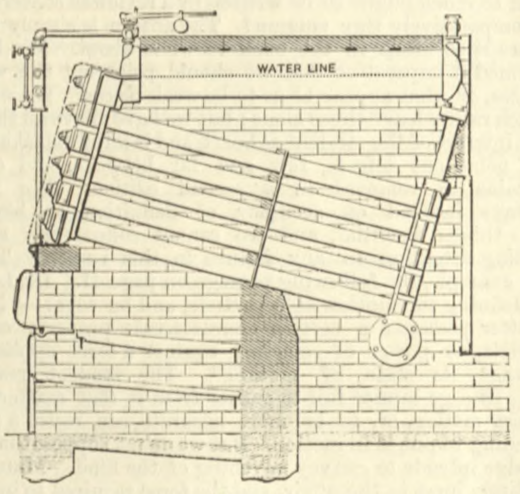

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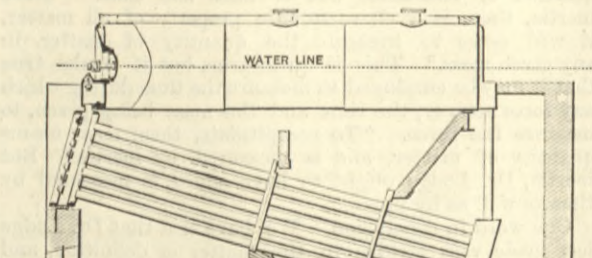

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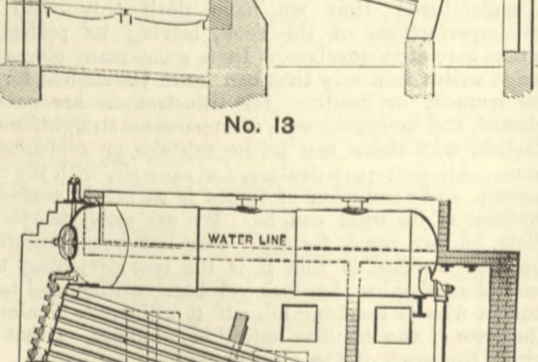

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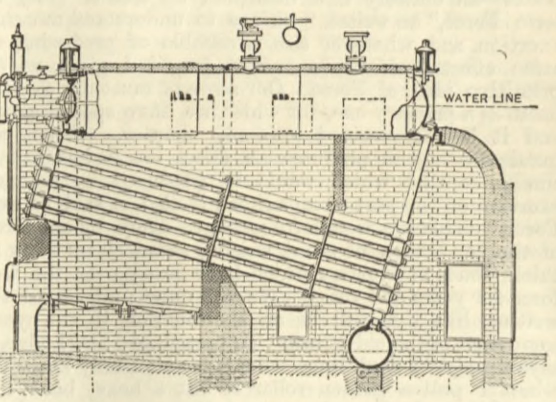

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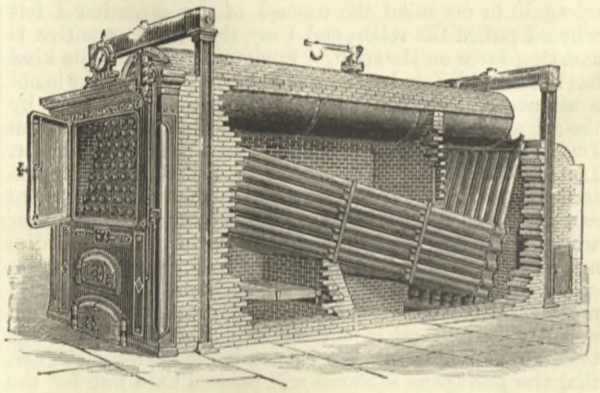

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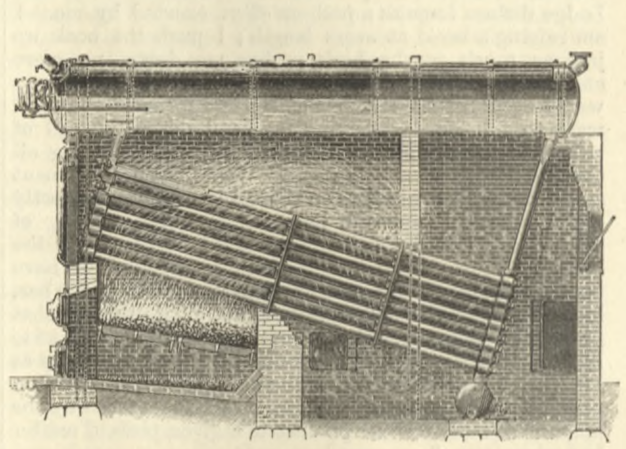

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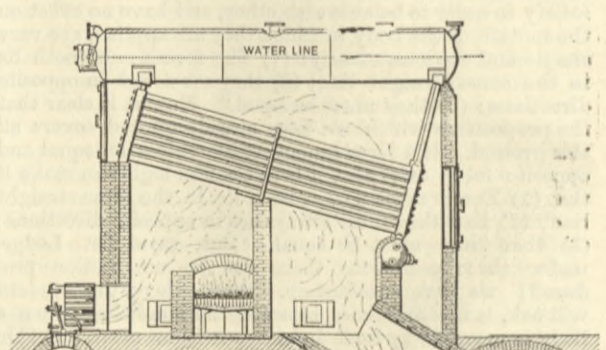

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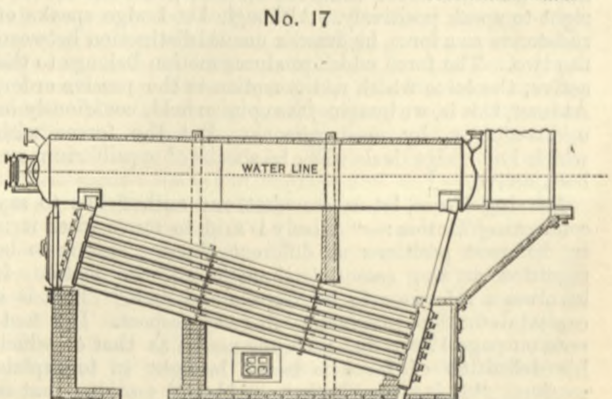
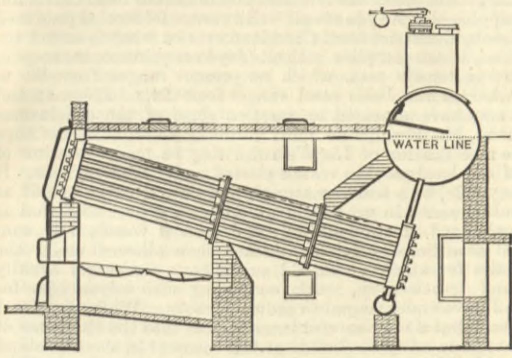


No. 18

THE DEVELOPMENT OF A WATER-TUBE BOILER.



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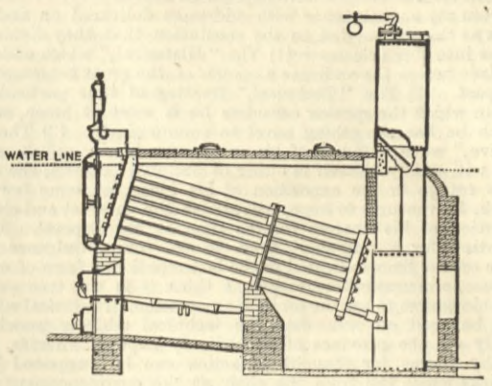

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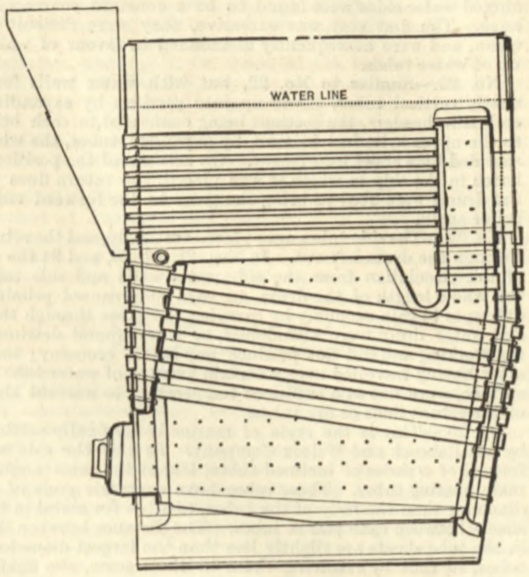

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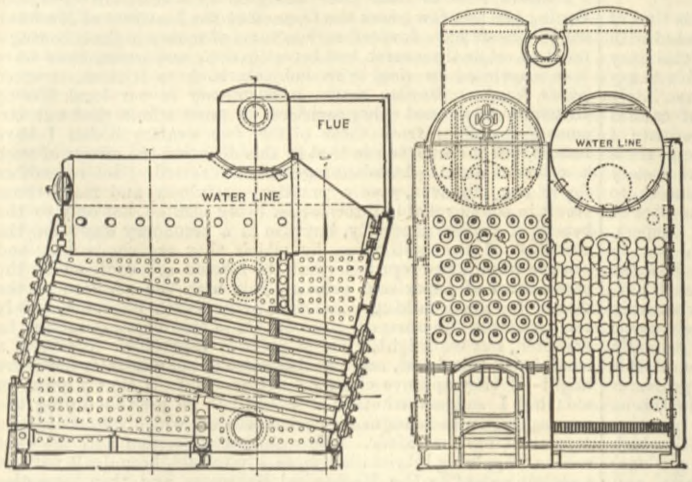

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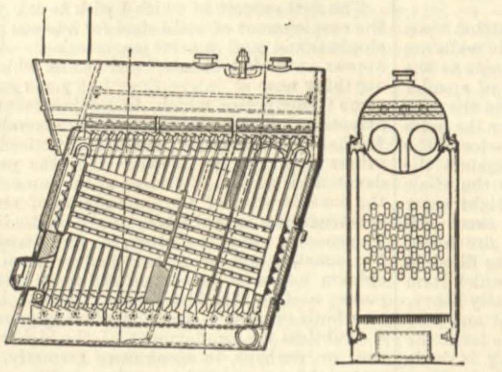

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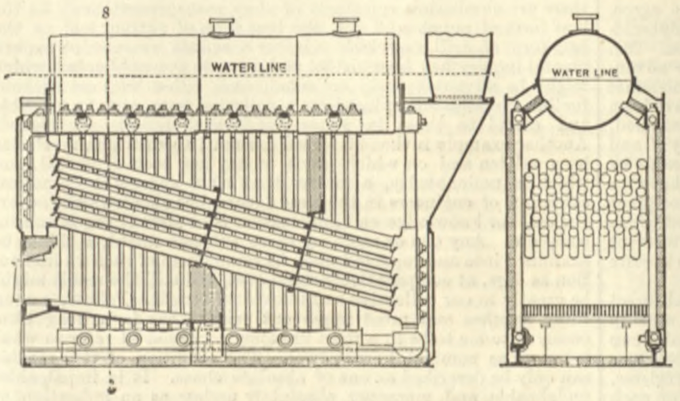

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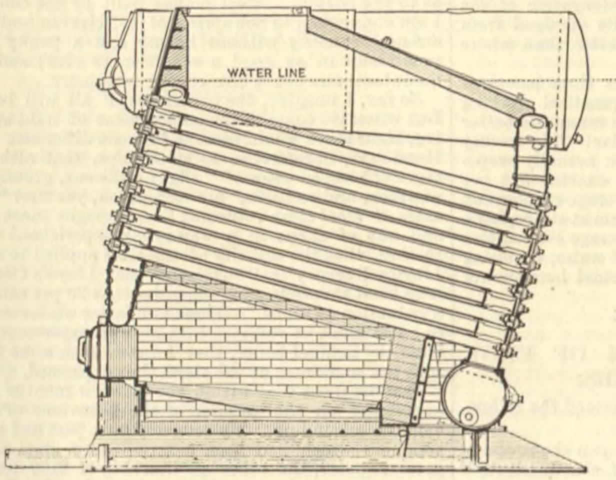

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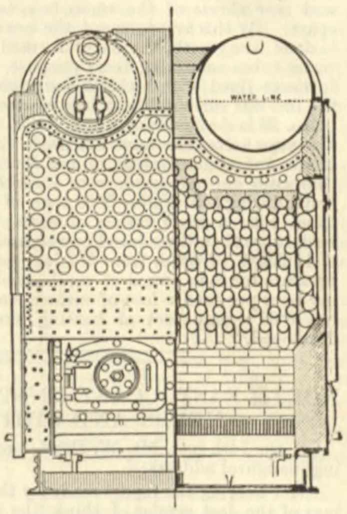

No. 25

THE GROWTH OF A SUCCESSFUL WATER-TUBE BOILER.

The Babcock and Wilcox Company has recently published in the United States an account of the process of development which the water-tube boiler made by the company has undergone. This paper contains much that can hardly, we think, fail to interest our readers. It is a record of those failures which are more instructive than successes, and may supply valuable information to many individuals who fancy that they have already invented a better water-tube boiler than any in the market. The Babcock boiler was brought out in 1867. The engravings not only show styles which were, at the time they were built, put out as their regular manufacture, but also many forms with which extensive experiments were made to determine their practical value, and include several styles of boilers originally built by other parties, the patents for which were subsequently purchased by the Babcock and Wilcox Company, on account of their close approximation to their system of inclined heating tubes connected to an elevated steam and water reservoir, having a continuous circulation of the water through the same, and a passage of the heated gases at right angles to the line of the tubes. These principles they have adhered to in all constructions. Where only slight modifications in the general design have been tested no special cuts are given, a brief description answering every purpose. Each modification has been numbered for convenience of reference.

No. 1 (page 322).—The original Babcock and Wilcox boiler. The main idea was safety; to it all other elements were sacrificed wherever they conflicted. The boiler consisted of a nest of horizontal tubes serving as steam and water reservoir, placed above, and connected at each end by bolted joints to a nest of inclined heating tubes filled with water. Internal tubes were placed in these latter to assist circulation. The tubes were placed in vertical rows above each other, each vertical row and its connecting end forming a single casting. Hand holes were placed at the end of each tube for cleaning.

No. 2 (no engraving).—The internal circulation tubes were found to hinder, rather than help, circulation, and were left out. Nos. 1 and 2 were found to be faulty in both material and design, cast metal proving itself unfit for heating surfaces placed directly over the fire, cracking as soon as they became coated with scale, and unable to transmit the heat received to the water inside.

No. 3 (no engraving).—Wrought iron tubes were substituted for the cast iron heating tubes, the ends being brightened and laid in the mould, the headers cast on. The steam and water capacity was insufficient to secure regularity of action, having no reserve upon which to draw when irregularly fed or fired. The attempt to dry the wet steam produced, by superheating in the nest of tubes which formed the steam space, was found to be impracticable; the steam delivered was either wet, dry, or superheated, according to the demands upon the boiler. Sediment was found to lodge in the lowest point of the boiler at the rear end, and the exposed portion of the castings cracked off when subjected to the heat.

No. 4.—A plain cylinder boiler carrying the water line at the centre, leaving the upper half for steam space, was substituted for the nest of tubes. The sections were made as in No. 3, and a mud-drum added to the rear end of the sections at the lowest point farthest removed from fire; the gases passed off to the stack at one side without coming in contact with it. Dry steam was secured by the great increase of separating surface and steam space, and the added water capacity furnished a storage for heat to tide over the irregularities of feeding and firing. By the addition of the cylinder boiler it lost one of its elements of safety; but, on the other hand, it became a serviceable and practical design, retaining all the other elements of safety except small diameter of steam reservoirs, which never exceed the 36in. in diameter and are removed from the direct action of the furnace. The difficulties encountered in securing sound joints between the wrought iron tubes and the cast iron headers made a change of this detail necessary.

No. 5.—Wrought iron water legs were substituted for the cast iron headers; the tubes were expanded into the inside sheets, and a large cover placed opposite the front end of the tubes for cleaning. The staggered position of tubes, one above the other, was introduced and found to be more efficient and economical than where the tubes were placed in vertical rows. In other respects it was similar to No. 4.

No. 6.—A modification of No. 5, in which longer tubes were used with three passages of the gases across them, to obtain better economy. A number of this type were built, but their excessive first cost, lack of adjustability of the structure under varying temperatures, and the inconvenience of transporting the last two styles, together with the "commercial" engineering of several competing firms then in the market, who made a selling point of their ability to add power to any given boiler after it had once been erected, led to

No. 7.—In this, separate T-heads were screwed on to the end of each inclined tube; their faces milled off, the tubes placed on top of each other, metal to metal, and bolted together by long bolts passing through each vertical section of tubes, and the connecting boxes on the heads of the cylinder.

No. 8.—Experiments were made on four passages of the gases across the tubes, and the downward circulation of the water at the rear end of the boiler was carried to the bottom row of heating tubes.

No. 9.—An attempt to reduce the amount of steam and water capacity, increase the safety, and reduce the cost. A drum at right angles to the line of the tubes was tried, but found to be insufficient to secure dry steam or regularity of action. The changes in Nos. 8 and 9 were not found to possess any advantages.

No. 10.—A move in the same direction. A nest of small horizontal drums 15in. in diameter were used, instead of the single drums of large diameter; a set of circulation tubes being placed at an intermediate angle between the main bank of heating tubes and the horizontal tubes, which formed the steam reservoir, to return the water carried up by the circulation to the rear end of the heating tubes, allowing the steam only to be delivered into the small drums above. The result was exceedingly wet steam, with no improvement in action over No. 9. The four passages of the gases did not add to the economy in either Nos. 8, 9, or 10.

No. 11.—A trial of a box coil system in which the water was made to traverse several times through the furnace before being delivered into the drum above. The tendency was to form steam in the middle of the coil and blow the water out from each end, leaving the tubes practically dry until the steam found an outlet and the water returned. This boiler had a defective circulation and a decidedly geyser-like action and produced wet steam. All the above types, with the exception of Nos. 5 and 6, had a large number of bolted joints between their several parts, and many of them leaked seriously from unequal expansion of the parts as soon as the heating surfaces became scaled; enough boilers having been placed at work to demonstrate their unreliability in this particular.

No. 12.—Water boxes formed of cast iron of the full width and height of the bank of tubes were made of a single casting, which were bolted to the steam water drum above.

No. 13.—A wrought iron box was substituted for the cast iron. In this stays were necessary and were found, as is always the case, to be an element to be avoided wherever possible. A slanting bridge wall underneath the drum was introduced to throw a larger portion of its surface into the first combustion chamber above the bank of tubes. This was found to be of no special benefit and difficult to keep in good order. The company then made a thorough investigation of all their previous experiments, examined their boilers in use and settled down on the style next shown.

No. 14.—Each vertical row of tubes were expanded at each end into a continuous header cast of car wheel metal, the headers having a sinuous form, so that they would lie close together and admit of a staggered position of the tubes in the furnace. Bolted joints were discarded, with the exception of those connecting the headers to the front and rear end of the drum and the bottom of the rear headers to the mud drum. Even these joints were found objectionable and were superseded in No. 15, two cuts of which are given in order to more thoroughly explain its construction.

No. 15.—The general form of construction of No. 14 was adhered to, but short pieces of boiler tube were used as connections between the sections and the drum and mud-drum, their ends being expanded into adjacent parts with a Dudgeon expander, the same as the rest of the tubes. At this time an increased length was given to the tubes, bringing them up to a maximum of 18ft., and it was found necessary to employ tubes of 4in. in diameter instead of the 3½in. tube previously used. This boiler was also suspended entirely independent of the brickwork by means of columns and girders, and the mutually deteriorating strains of the boiler and the brickwork, where one was supported by the other, were avoided. A fancy cast iron front was used, and of this style a large number of horse-powers have been built. It is still used where a fancy job is desired.

No. 16.—Flanged steel drumheads were substituted for those made of car-wheel metal; the drum is longer than the previous ones, giving greater steam and water capacity. Wrought iron is substituted for cast in the fronts, to avoid cracking. This is their standard boiler for regular work. Special settings and designs are built where special service is required.

No. 17.—Shows the boiler as erected to fire with blast-furnace gases.

No. 18.—Erected to economise the waste heat from a puddling furnace.

Nos. 19 and 20.—For fire protection purposes the chief requirements are ability to raise steam quickly and hold the pressure, economy of fuel and dryness of steam being of secondary consideration. To accomplish this a boiler with a large amount of grate and heating surface containing a small quantity of water is used, two very successful forms being shown in Nos. 19 and 20, both of which serve their special purposes admirably, but would not be either economical or desirable where steady power is required. Their small water and steam capacity demand close attention to regularity of feeding and firing, and the steam delivered is not sufficiently dry to secure the best engine economy. The ability safely to carry high pressures and place an equal amount of heating surface weighing 25 per cent. less into 20 per cent. less space than is required for the ordinary form of high-pressure marine boilers, led to early experiments in this field.

No. 21.—A design similar to No. 5, the cylinder boiler being replaced by a return tubular, to increase the surface. A setting formed of stayed water sides, rivetted to and opening into the drum above, was used. The surface added by the return tubes was not found desirable, on account of the difficulties in cleaning it, and their tendency to cause priming by keeping the whole disengaging surface in a state of ebullition.

No. 22.—A larger boiler, similar in design to No. 21, having three passages of the gases across the tubes. The water sides formed in sections of water slabs, and all joints between the parts made by expanded tubes, as in No. 15. The rear end of the two cylinder boilers, forming the steam and water space, were tapered to allow the gases to pass off between them to the stack. The stayed water sides were found to be a constant source of annoyance. The first cost was excessive, they were difficult to keep clean, and were consequently abandoned in favour of walls made up of water tubes.

No. 23.—Similar to No. 22, but with water walls formed of nearly vertical tubes, made up into sections by expanding their ends into headers, the sections being connected to each other and to the upper cylinders in turn by expanded tubes, the whole surrounded by a sheet iron jacket. On account of the position of the hatch in the ship in which it was placed, the return flues through the drums were used to bring the gases to the forward end of the boiler again.

No. 24.—The side tubes were placed vertically, and the return flues through the drum left out. In Nos. 21, 22, 23, and 24 the delivery of the circulation from the side water walls and side tubes into the whole length of the drum on each side caused priming. All attempts to gain economy by carrying the gases through the steam and water drum were abandoned, as it was found detrimental to the working and did not produce any better economy; the gases, after having travelled over a certain amount of water-tube heating surface, were not at a sufficient temperature to warrant the use of either return flues or fire tubes.

No. 25.—This is the style of marine boiler finally settled upon by the Babcock and Wilcox Company. In this the side walls are formed of a series of inclined tubes, laid at the same angle as the main heating tubes. These tubes have excentric ends of smaller diameter than the body of the tubes, to allow for metal in the tube sheets between each pair of tubes. The distance between the holes in the tube sheets are slightly less than the largest diameter of the tubes, so that by revolving them in their seats, one against the other, before expanding, a line-to-line contact is made the whole length between each two tubes, forming a practically tight water wall without stays, which is in turn enclosed by a sheet iron jacket, caulked and made tight against air, gas, and fire leaks, the small spaces not protected by the side tubes being filled in with special make of fire brick. The ends of the tubes which form the main heating surface of the boilers are made especially heavy, and are run through and expanded into both the front and rear sheets forming the water-boxes, the end projecting to form the hand-hole seat for the cap which covers it. An opening is made through the top and bottom side of each tube, between the front and rear sheets of the water-box, to connect it with the water space. By this arrangement the use of the ordinary form of stays is done away with, the stays formed by the prolongation of the water tubes answering every purpose. The results obtained from furnaces lined with firebrick were found to be better than where the fire was surrounded by heating surfaces.

No. 26 is designed for a tug. For large powers three passes of the gases across the tubes are used. As to the practical working of the water-tube system, as set forth above, we cannot do better than copy one paragraph from their latest circular:—"In twenty tests, during which over 3000 tons of water were actually evaporated with a great variety of coals, the boilers exerted 34½ per cent. more than their rated power, and gave an average evaporation of 11·292 lb. of water from 212 deg. made into steam at atmospheric pressure for each pound of combustible. The average evaporation per hour per square foot of surface was 3·71 lb. of water, requiring but 8·08 square feet of heating surface per actual horse-power developed."

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.

On the 14th inst. Mr. W. Boyd, president, delivered the following inaugural address:—

After hearing the report made by the Council upon the proceedings of the last session, I think the members of this Institution may congratulate themselves that the present position of affairs is as favourable as the most sanguine could have hoped for twelve months ago. A list of 452 members, of all classes, indicates that the society has supplied a want of the district, in a manner and to an extent that was desired by its promoters. The state of our finances shows, I hope, that we are building up our Institution on a sound basis, and that due economy and care has been exercised by the secretary and Council. Thirdly, but certainly not last in importance, whether regarded from the point of view of the immediate present, or whether reviewed in reference to its influence on the more distant future of the society, comes the question of the papers read before us throughout our first session. I regard the retrospect as eminently satisfactory. It would not have been wonderful, indeed, had it been, to some extent, otherwise. You will remember that it was not until the month of November last that our preliminary labours were completed, and that the inaugural meeting was not held till November 28th. At that time no papers were actually promised, but between that date and May of this year we were able, by the great energy of our late hon. secretary, and by the goodwill and hard work of some of our members, to present six papers for your consideration, all of them of value, and all of them communications of the type and character we wish to encourage. On each of these papers discussions took place, in some cases of special interest and value, and it is to these discussions that special attention and every possible encouragement ought, in my opinion, to be given. Short, well-considered papers on interesting subjects may be the means of giving rise to valuable debates; and if I may venture to add a word of caution, it is only to say that these debates should, in the first place by the speakers themselves, and secondly by the chairman, be rigidly confined to the subject under discussion, otherwise they are liable to become discursive, feeble, and parochial. The opportunities for satisfactory debates and discussions are greatly increased when a synopsis of the paper can be in the hands of members prior to the meeting. The Council were able to accomplish this in some of the concluding papers of last session, and I imagine they will, if possible, extend the system during the present winter. There is another subject to which I should here like to direct some attention. It is that of the graduate section of the Institution. At present it is in a state of infancy. We must not expect to accomplish everything all at once, and I can assure the members generally that during last session the efforts and energies of the Council were so occupied with endeavours to get the Institution as a whole into working order, that they had no leisure or opportunity to give special attention to this matter. At the close of the last session we had thirty-nine enrolled graduates, and I feel convinced that a considerable accession to these members ought, and must, be made without delay. If one considers the number of young men in a state of pupilage employed in shipbuilding and engineering works in this district, it must be evident there ought to be a large and fertile field for the enlistment of recruits, to whom familiarity with the usages of such a society as this, and by degrees the acquirement of the power of expressing their opinion and ideas before an assemblage of critical friends, would prove an immense advantage and gain to them in after-life. Whether it would be well to aim at the establishment of a separate graduate section is a matter for careful consideration, and on which I am hardly prepared to offer a definite opinion. The constitution of our society differs in some respects from that of the similar society in Scotland, insomuch as many of those who in that society find a place in this graduate section are, with us, full-blown "members." Moreover, I am one of those who believe in the maxim that "unity is strength," and that we should be careful lest, in modifying too rapidly our present constitution, we weaken the efficiency of the whole. Be this as it may, I do without hesitation commend this matter not only to the Council, but to the general consideration of our members, feeling sure that means may be devised to give encouragement and afford attraction to the younger members of our profession—by whom, after all, our science is to be carried forward—without incurring the penalty of the weakened and divided efforts which I have deprecated above.

From my acquaintance with addresses delivered on such occasions as this, I am led to the conclusion that they divide themselves into three classes:—(1) The "Historical," which endeavours to place before the audience a *résumé* of the great achievements of the past. (2) The "Technical," treating of that particular subject in which the speaker considers he is most at home, or about which he has something novel to communicate. (3) The "Suggestive," when, diffident of his own powers to accomplish anything that will satisfy himself in either of the above classes, the speaker seeks refuge in the exposition of his ideas on some few topics which, he ventures to hope, will arouse the interest and claim the attention of his hearers for the time at his disposal. It is my intention, for a very short time, to ask your indulgence while I move on the lines indicated in the last-mentioned form of address, because, amongst other reasons, I think it is the true and most suitable course to pursue on such an occasion. Historical addresses may be read *ad nauseam;* the technical address trenches too closely on the province of an ordinary paper; whereas, if any worthy theme for thought or action can be suggested by the remarks which fall from the chair at the commencement of the session, the objects for which such-like societies are formed may be helped forward and assisted.

The first subject to which I wish to ask your attention is that of the employment of mild steel for various purposes connected with shipbuilding and marine engineering. At first sight this may appear an "oft-told tale," and one on which it is impossible to say anything new or interesting; but some considerations have lately come to my notice which, in my judgment, are worthy of careful attention. Those among us who are members of the Institute of Mechanical Engineers will have noticed—and doubtless some others have done so likewise—that the president of that society devoted his address, delivered at the summer meeting in Lincoln, to the consideration of the applicability of steel to a large number of constructions, ranging from the Atlantic liner to railway sleepers. The success which has attended the introduction of mild steel in the construction of marine boilers is so marked that but one opinion exists as to the suitability of this material for such purposes; and, as Mr. Head says, "marine boilers are now scarcely ever built of iron." One contributing cause for this development is doubtless the employment of the higher pressures now in daily use; or, perhaps, to speak more correctly, the capabilities of this material have assisted to render possible such advances in pressures as would otherwise have been out of the question. But, be this as it may, call it as you like, cause or effect, there can be no question as to the success. Steel boilers built by the company with which I am connected, in the spring of 1878 (seven and a-half years ago) are now running without having cost a penny for repairs, and practically in as good a condition as ever; and doubtless other manufacturers could bear similar testimony.

So far, I imagine, the experience of all will be found to agree. But when we come to the employment of mild steel for shipbuilding, then there would seem to be some difference of opinion. Mr. Head says, in reference to steel ships, that although the advantages of steel in cases of "slight collisions, grounding in moderate weather, and so forth," are undoubted, yet that "there have been cases of steel ships returning from voyages more or less strained, and out of shape in a way rarely experienced previously;" and further, that the severity of the tests applied to steel materials by Lloyd's Registry is "suggestive that Lloyd's Committee have for long been themselves apprehensive that 20 per cent. is far too great a reduction to allow." These two latter statements seemed to me to be so much at variance with my own experience, and so different from the general belief, that I have taken some trouble to inquire into the soundness of the views thus expressed.

It so happens that within the last few months I have had direct experience on the question of the behaviour of iron and steel in cases of grounding. My company have just had under repairs two steamers which had been ashore—one a steel ship of 1351 tons gross register, the other an iron ship of 2190 tons gross register. I do not propose to trouble you with a detailed description of each accident; but in the case of the steel ship the bottom of the vessel was severely indented for a distance of upwards of 30ft. The point which first came in contact with the rocks was situated on the port side, about 5ft. or 6ft. outwards from the keel, and about 20ft. or 25ft. from the stem, and the indentations continued for a length of about 30ft. abaft of this point. These indentations existed between each frame about 2½in. to 3in. deep in the worst places, gradually diminishing towards the after end of the ship. About one dozen of the frames were cracked and broken through the rivet holes, and a very large number of the small intercostal plates were curled up exactly as if they had been flanged in a smith's fire. Notwithstanding this severe punishment, thirteen shell plates out of fifteen were heated in the furnace, straightened, and replaced. The remaining two plates, however, were so severely crushed by the heel of the frame to which they were attached as to be condemned; but they showed no signs of fracture, and all the small intercostal plates were straightened and replaced. To such an extent was this restoration carried on, that 78 per cent. of the material damaged by the accident was repaired and restored to its original place in the vessel.

In the case of the iron ship the damage caused by the accident was much more severe. The injury lay more in the centre of the ship, and extended from about 20ft. abaft of the stem for a distance of some 170ft. towards the stern. The bar keel was forced up or hogged some 3in. or 4in., which was transmitted through the centre keelsons and hold stanchions to the 'tween and upper decks, even resulting in the fracture of the hatch combings. About eighty-four shell plates were damaged, with corresponding injury to floors, frames, and reverse bars, as well as the fore and aft girders in the water ballast tank. According to the best estimate I can make only about 33 to 35 per cent. of the damaged material could be worked in again. I do not wish it to be understood that in this case of the iron ship the damage could, under any circumstances, have been limited to the extent to which the steel ship suffered, for I must admit that in the iron ship the seat of the injury lay in that part of the vessel where it was most readily communicated to the rest of the structure, but notwithstanding this admission, I do believe that if she had been built of steel the injury would have been less extensive and more localised. The difference seems to me to lie in this, that the more pliable material lends itself more easily to local injury, and that the damage is thus confined within narrower limits, whereas, in the case of the more brittle material of iron, the local injury is more thoroughly transmitted into the general structure of the vessel, and in this way becomes more extensive. In addition to this the softer material can be straightened and replaced in a manner not possible, to the same extent, with iron plates and angles.

With regard to the "straining" of steel ships, and the "reduction of 20 per cent." in the scantlings, no direct evidence has come under my personal notice, but the first authority in the country, Mr. Martell, the chief surveyor for Lloyd's Registry, speaking at Glasgow, says that his attention having been called to the matter, he has made himself, and has caused to be made from Lloyd's surveyors at the outports, "exhaustive inquiries," and that in no case could he find it clearly proved that a steel ship "had failed for want of general constructional strength," even after "having done heavy work, carrying deadweight cargoes." He did find, however, that some steel ships had strained locally, but that this was due to oversight, where "the continuity of strength was not kept up." This is Mr. Martell's evidence, and I consider places the matter on a very different and much more satisfactory footing. In his speech in Glasgow, Mr. Martell made no reference to the 20 per cent. reduction of scantling, and I therefore took the liberty of communicating with him direct, and in reply to my question he writes to me, "No reliable evidence, to my knowledge, has been adduced showing that the 20 per cent. reduction from iron, admitted by Lloyd's Registry, was too great as a maximum." This question of the employment of a pliable material, such as mild steel, is of paramount importance to this district, for this reason, that for the production of the material now in use our local Cleveland iron is inapplicable. As you are all well aware, mild steel is produced in the Cleveland district from Cleveland ores on what is called the basic process, which complies with all Lloyd's requirements except in regard to the tensile test, which at present ranges from 28 to 32 tons, whereas the basic steel ranges from 24 to 27 tons; and though I may have appeared to question some of the conclusions of my friend, Mr. Head, I do most cordially join him in the hope that some modification of Lloyd's rules may be made to allow of the use of our local steel in vessels classed under their register. It will, at any rate, be a tested material, and this, to some extent at least, would possess, in my judgment, advantages over such iron as is commonly used in shipbuilding; and even if vessels were constructed of scantlings somewhat thicker than allowed under the present rules for steel, we should surely have structures equally reliable and trustworthy, while combining such advantages for repairs as I have endeavoured to indicate above. While I write I am informed that a very careful investigation into the character of this basic steel is being conducted at this moment in the Cleveland district by Lloyd's surveyors, and the result of that inquiry will be looked for with great interest by all concerned in the shipbuilding and shipowning of the North-east Coast.

I desire now to lead your thoughts in a different direction. During the last few years the Council of the Institute of Mechanical Engineers have devoted certain sums of money to the encouragement of original research and investigation, and committees have been appointed to deal with subjects such as friction, rivetted joints, &c. &c. Similar action is customary in our local Mining Institute and several other societies. I must admit that our circumstances differ from those of the two wealthy bodies I have named, but it seems to me that in this direction the efforts of such a society as ours might advantageously be exerted. Such researches do, in my judgment, give a practical usefulness, and many times result in sound reliable information being elicited, not only to the benefit of science generally, but also in a secondary way raise the standard of the institution by which they are conducted, and remove from it the reproach that its labours are confined to the expenditure of paper and printer's ink, with the addition of the vice of too much talking. In an extreme youth like ours, barely removed from the nursery, great efforts in this direction cannot be expected, but we might, I fancy, make a beginning. We have a small balance in hand, and possibly some of our wealthier members might—if they approve of such a course—make a timely grant in aid; but I suggest whether it would not be possible during the coming session to inaugurate such a custom which might lead to greater things hereafter. The question of friction and the best mode of applying lubricants has, as I have said, been dealt with to a certain extent by the Mechanical Engineers, and they have also dealt very fully with rivetted joints, but in each of these cases there is still a wide field for further inquiry left remaining. Then there are numberless questions of shop management, such as the best form of punch and die, the best form of cutting tool, or the best form of drill, on which subjects a certain amount of experimental inquiry has been made, and given to the public, but which might be advantageously collected, and, either with or without further investigation, placed in a collected form, and be valuable and useful to those in whose hands such reports are placed. Another example is that of forced draught, about which much has been written and on which much money has been expended, and which is, undoubtedly, a matter that must engage the practical attention of engineers in the near future, but about which, nevertheless, our knowledge and information is at present vague and incomplete. Any one or more of these subjects might, I think, be examined into and reported upon by committees of such an institution as ours, at comparatively small cost, and still the result might be greatly to our collective and individual benefit. Following upon these, another and most important subject has for a long time occurred to me to be in a most unhappy condition—I refer to what is known as nominal horse-power. The condition of this matter can only be described as one of absolute chaos. It is impalpable, undefinable, and, moreover, absolutely useless as an indication of relative value. Some may say that the question is entirely a commercial one, and as such ought not to come within the range of our attention as a scientific or practical body. With this view I do not concur, for the simple reason that some convenient mode of comparative definition of the power of machinery is absolutely necessary, and if such a society as this could contribute to place such a matter on a sounder basis, and one which should, at one and the same time, be scientifically correct and commercially convenient, its efforts would not, I think, be wasted.

It may be within the recollection of some present, that, in the year 1878, an inquiry into this subject was commenced by the Board of Trade and Lloyd's Registry, and the views of many engineers were solicited thereupon. Among those who went most exhaustively into the question was my friend Mr. F. C. Marshall, who drew up a very careful report of the whole subject, and proposed certain formulæ for general adoption. Time will not allow me to lay these before you in detail; suffice it to say, that Mr. Marshall took as his starting point that the stroke of the piston and the working pressure in the boiler should form elements in the calculation instead of confining it to the simple diameter of the cylinders as was then, and is still, the very insufficient method in use. At that time the triple expansion engine was unknown, and the formulæ proposed merely had reference to four types, the compound screw, the compound paddle, the simple expansion screw, and the simple expansion paddle engine. The value of the suggestion was fully admitted by the two bodies I have named, but Mr. Parker, reporting to his committee in September, 1878, stated that as the difficulties in formulating a rule universally applicable were, apparently, so great, and as the description "registered horse-power" was so misleading, he recommended that it should be omitted altogether from the register book. The committee did not, however, see their way to adopt Mr. Parker's recommendation, and the matter was allowed to drop. Mr. Traill also wrote in July, 1878: "The more we go into it, the more apparent the difficulties become." Where such eminent authorities have failed, it seems presumption for others to expect any measure of success; but events move fast now-a-days, and it is seven or eight years ago since this inquiry was made, and in view of the able men we number among us, capable, as engineers, of dealing with the vendor's side of the question, or as shipbuilders and shipowners with the purchaser's side, it does not strike me as wholly beyond the bounds of possibility that a renewed investigation of the matter at this time might lead to a report from such a society as ours, which might, at any rate, usefully call attention to present anomalies and absurdities, and be the means of assisting those in authority, and others concerned, to adopt some more sensible, scientific, and sound calculations. The newer types of engines now coming into use seem to point to the present as a singularly opportune moment at which to approach this inquiry. Old ideas will have to be abandoned, and old methods improved upon, and I can conceive it possible that careful inquiry might recommend the entire disuse of the misleading term of "nominal horse-power," substituting in its place that of "indicated" or "developed horse-power;" but in spite of the difficulties, which must be obvious to the most cursory observer, I venture to commend the matter to your attention, and especially to that of the Council of the Institution. I cannot resist the opportunity of alluding to one more subject—though, I fear, I have detained you too long already—and it is one to which I also made reference last year.

Professor Lyon Playfair, in his address to the British Association, reminded his hearers that it was only 300 years since we became a manufacturing country, and that, according to Professor Dewar, in less than 200 years more the coal of this country would be wholly exhausted, and in half that time difficult to procure. Even the shorter period may appear sufficient to serve our purpose, for, I suppose, long before this, the coal, like the land, will be divided up into three-acre plots, with a cottage, and garden, and pig; but the professor used the above statements as a strong advocacy of what he pithily designated as the "intellectual factor of production," and I may humbly claim that it is this theme on which I dwelt last year, when I spoke of the necessity for "economy of production." We are met on all sides by falling values, and it appears as if it were impossible, except by the operation of the natural laws of supply and demand, to effect any alteration on this side of the account; but there is abundant evidence to show that the other side of the account will respond instantaneously to intelligent, well-directed effort. Those who are old enough to remember the marine boiler of twenty or twenty-five years ago, and compare it with the structures of to-day, need no further evidence. The exchange from the brute manual labour of that period to the intelligent operations of to-day, is most striking; not only is work now produced which would have been totally impossible then, but it is procured at comparatively less cost, and the workman himself is raised by the process; instead of his labour being expended in coarse, unintellectual efforts, it is now employed in the intelligent direction of the machine tools of all kinds, which have in so many cases taken the place of the sledge hammer and the anvil, the hand-drill and the hammer and chisel. In no direction is this more evident than in wood-working machinery, which has been enormously improved of late years, and now-a-days, not only is cost reduced, but a mathematical accuracy of parts and a beauty of finish is obtainable, which was beyond our reach formerly. Again, the opportunity has lately been afforded me of visiting a shipyard on the Wear, where, in spite of very great natural difficulties in the site, marked advance has been made in economising the unproductive labour employed in the transport of material and such like matters. Such operations have not been left solely to old custom or to chance, but have been deliberately and intelligently dealt with; the substitution of hydraulic appliances for hand labour has not only materially reduced the cost of production in many important items, but has also much improved the character of the work. I merely quote this instance as an additional support to the arguments I have laid before you, and do not in any way attempt a detailed description of the several novelties and improvements which will indeed be more specially referred to in a paper which will be read to you later in the session. But the advances which have been made in this direction, and of which the foregoing are merely a few typical examples, ought not to content us; they should rather act as an incentive to further studies in the same direction, to further working out and experimenting in the many similar fields still untrodden, that lie to our hand, any one of which will, like the orchard in the fable, repay the necessary labour if it be only honest and thorough. Let us not be satisfied that because a process, or design, or mode of manufacture has served us well in the past, that it is good enough for to-day, still less that it will meet the requirements and competition of to-morrow; and though we should make sure of each single step as we progress, let us not be content short of perfection, or, as George Herbert puts it—

> "Sink not in spirit: who aimeth at the sky
> Shoots higher, much, than he who means a tree."

Could the urgent necessity for such investigation, and the pressing need compelling us boldly and manfully to gird ourselves to the task of collective and individual improvement, be brought home to each and all of us more forcibly than has been done by two simple unadorned statements which have within the last week appeared in our daily papers, if we had only eyes to read and appreciation to realise them? Mr. Price, speaking at Jarrow the other day, gives to us the simple fact that at this moment vessels of war can be built at the northern ports of Europe at prices which, leaving a fair profit to the foreign capitalist, are nevertheless below the actual cost price of similar vessels at Jarrow. Do you realise what this means: that we have it on unquestionable and high authority that, notwithstanding the extra cost of material, our foreign competitors, whether by reason of cheaper labour or better technical skill on the part of their officials, or by better organisation, either by all these combined or by one singly, are passing us in the race for work of this special description; and, as Mr. Price pointedly observes, if the information conveyed to him refer only at present to vessels of war, the step is but a short one to those vessels of peace with which we in this district are more particularly connected, and that the greatest efforts are successfully being made to overtake us in this department also, is within the personal knowledge of many in this room. But, strangely, this statement is most remarkably borne out by a report of the Société John Cockerill, which was given in yesterday's *Chronicle*. This magnificent establishment employs 10,315 persons, has turned over work during the year ending June last amounting to no less than £1,472,396, and though the resulting profit does not, perhaps, seem to our minds to be excessive, still it is substantial. But there follows a statement to my mind most noteworthy. Whereas the work in hand on June 30th amounted to £314,400, at the end of September it was £400,000. We do not, of course, know precisely what is here meant by these words, "work in hand," but it is evident that whereas during the last two months we in this country see daily records of ironworks closed and shipyards empty, and employment for our workmen daily diminishing, this great company has received large accessions of trade, and thereby gives us ample proof of vitality and progress. I can only wish that my eloquence was more powerful, my knowledge greater, and my influence more extensive, to enable me to accentuate these striking facts more fully. It may be asked, what can we do? First, I say let us each strive earnestly to improve that small portion of the production of our beloved country which lies under his own hand; and secondly, I would ask whether this Institution cannot now take some definite place in improving the technical education of our own district. The extended efforts and the new departure which is just about to be taken by the College of Physical Science is known to all of you, and you may have had the correspondence which has recently taken place in public on the subject, and have noticed the desire expressed by a relative of my own—who was one of the earliest promoters of the college—to embrace in the term "engineers" not only those mining engineers in view of whose education the idea of a technical college was first originated, but also the "Marine Engineer and Naval Architect." Cannot we, the members of this Institution, respond in some way to this appeal, and even in the midst of our own depression, and though the tide be low, show in some slight degree that we do recognise the value of high scientific attainments in our daily work, and endeavour to render some slight moral, if not pecuniary support to this movement, which may be so valuable to ourselves, and still more so to those that come after us? My simple duty now remains to thank you for your patient attention, to hope that if the views I have expressed have not been wholly adopted by all present—indeed it is not natural or desirable that they should be—yet that you will believe they are the outcome of some thought, and of such attention as I have been able to bestow on a few of the multitude of interesting questions that spread themselves before our eyes to-day; and I feel that I cannot summarise and condense my hopes and wishes for the future of this Institution in any better words than by recalling to you the lines of our great English poet:—

> "Men, my brothers, men the workers, ever reaping something new;
> That which they have done but earnest of the things that they shall do."

Two powerful vessels are now being constructed at the Elswick Works for the Japanese Government. They are called the Naniwa Kan and the Takachiho Kan, and both are armed with two 10in. and six 6in. Krupp guns. No official trial has yet taken place, but at the preliminary trial the former exhibited a speed of 19 knots an hour. Some Japanese officers have already arrived to take charge of them, and a full complement of officers and men will be sent from Japan to take them out. It is expected that they will be ready to sail about the end of the year.

AMERICAN NOTES.

(*From our own Correspondent.*)

NEW YORK, October 10th.

TO-DAY'S reports from the leading iron brokers of this State show less business for the week, a falling off in inquiries, and a generally lessened activity. Scotch iron is advancing slightly. There is more inquiry for Bessemer pig; a few sales have been reported, aggregating 100,000 tons. Spiegeleisen is wanted, and there are inquiries for steel slabs. The movements in metals have been rather quiet; copper, lead, and zinc are firm. The exports of copper are heavy, and exporters are looking forward to a steady demand.

In railroad circles there is a great deal of uncertainty as to what will be done next year. Frequent efforts are made by trunk line managers to adjust difficulties that have long kept them apart. The chief interest at present is centred on the dispute between the officials of the State of Pennsylvania and the officers of the Pennsylvania Railroad Company. The former is seeking to prevent the transfer of two competing lines to that company. In Chicago railroad matters are complicated, owing to the repeated failures of the managers there to agree upon traffic rates and traffic distribution. The trouble with American railways is one that will not be easily overcome, and perhaps the only solution will be found in the suspension of active railway construction until there is a greater demand for railway services.

The steel rail mills need but very few orders until after January 1st. Brokers have inquiries for large lots, but railroad builders do not have confidence in any artificial combination to maintain prices 15 to 20 per cent. above the rates fixed by competition for the past year.

Forge irons are selling at 14 to 15·50 dols.; foundry irons, 16 to 19 dols.; Scotch irons, 17 to 22 dols., according to brand. Muck bars have advanced in Pennsylvania mills to 28 dols. for the best makes. Nails have advanced to 2·50 dols., owing to the continued suspension in the West. Inquiries are in hand for some 2000 tons of bridge iron, but there is no urgency for supplies, and builders will wait for lower prices.

The lumber dealers are expecting to advance rates on lumber for export. The weekly production of furnaces in blast is 71,608 tons, against 100,000 tons of idle capacity. The anthracite production is 20,316 tons, the bituminous production 43,234 tons. Five furnaces will blow-in this month. Virginia furnace managers are offering large winter supplies at prices which will enable them to place large orders, and prices in this market advanced 50 cents. The anthracite coal companies are crowding prices a little, owing to the heavy manufacturing demand from New England States and the West.

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

(*From our own Correspondent.*)

TRADE this week is much the same as that of last week. New orders placed since the quarterly meetings are not of great account, and work upon the books is being executed more rapidly than new orders are arriving. Still, this is only what might be expected just now, since consumers having recently bought in large quantities, their chief necessities must by this time have been covered.

There is no lack of orders at the sheet works, and makers in this branch still speak with cheerfulness of the volume of business doing. Prices stand this week at £6 10s. to £6 12s. 6d. per ton for hard sheets of 20 gauge, £6 15s. to £6 17s. 6d. and £7 for 24 gauge, and an average of £7 17s. 6d. for 27 gauge.

Thin sheets for working-up purposes are brisk at £10 to £11, and for stamping purposes at £11 to £12. Orders for Northern Europe and for Canada are being pressed forward with all possible despatch, so as to get them in before the ports are ice-bound. The same remark applies to orders for tin-plates.

In the bar trade orders are not so numerous. The demand for chain and cable iron continues quiet. Marked bars continue at £7 10s. to £8 2s. 6d.; second-class bars at £6 10s. to £6 5s.; ordinary, £6; and common, £5 10s. down to £5 5s.

Hoops show no increase in actual business, but inquiries are coming in with some steadiness from Australia and some other of the export markets. The Lancashire competition in this branch is severe, since the manufacturers there, being so near to Liverpool, they can accept export orders at prices decidedly below those of Staffordshire. Common hoops are quoted £5 10s., and superior £6.

Orders for gas tube strip are not arriving with the average activity for this time of the year, when the tube makers should be getting busy. Prices are named as £5 5s. upwards at works. Preparations, I understand, continue at the Dowlais Iron and Steel Works for rolling tube strip with a feather-edge out of steel upon the patent which has been taken out by a leading Staffordshire man, and to which I referred some little time back. Special mills are being put in for the purpose, and it seems likely that tube makers here will find the article at once economical and serviceable.

The project for erecting new tube works in the Cardiff or Newport districts to manufacture wrought iron tubes under the new Staffordshire patent, is I am told, gradually taking body and form.

Steel continues to be offered in large quantities to local consumers, and at prices which are very favourable. This week Blaenavon Bessemer plating bars are offered at as low as £5 10s. per ton, while Siemens-Martin Welsh ditto are quoted £6 delivered. The £5 10s. figure is possible only by the adoption of the most economical methods of production, whereby the bars are rolled down hot from the ingot when it has remained a short time in the soaking pit, and without any re-heating being necessary. A pretty brisk business is doing in tin bars, which are offered here at £5 7s. 6d. per ton, and blooms and billets are an average of £5, though some sorts are £4 15s.

Sales in the pig iron market are not large this week, but the current production is going steadily into consumption. Upon former stocks held by makers not much impression has, however, yet been made. Hematites occupy the strongest position upon the market. Vendors quote 53s. upwards for Welsh sorts, and 54s. for west coast brands. Native all-mines are 55s. to 57s. 6d. and on to 60s. Part-mines, 37s. 6d. to 45s.; and cinder pigs, 32s. 6d. to 35s. Northampton pigs are about 38s., and Derbyshires 39s. to 40s.

The concession this week announced by the London and North-Western Railway, Great Western Railway, and Midland Railway, will place the Staffordshire common pig makers on a far superior footing than before for competing with the large Northampton makers, who are sending heavy quantities of pigs into Staffordshire, and in this lies its chief value. Of late years, while the production of Staffordshire pigs has steadily declined, the make in Northampton has increased three-fold, the result, in great measure, of the lower rates charged that district for the conveyance of cokes.

The railway companies refused any concession till certain leading Staffordshire makers announced that unless relief were granted they would blow out their furnaces, since it was impossible to compete against the Northampton and Derbyshire pig prices.

On Wednesday a large special meeting of the Birmingham Chamber of Commerce was held to consider the action of the council in answering, without consulting the chamber, the questions issued by the Royal Trade Commission. A resolution was proposed condemning the action, and dissenting especially from the answer recommending import duties upon manufactured goods. After an animated discussion between the Free-Traders and Fair-Traders, the motion was carried by sixty-two votes to forty-nine.

The Wolverhampton Chamber of Commerce are taking up the question of the inquiry of the Royal Commission with a good deal of interest. In addition to sending a list of categorical replies, they have this week appointed a committee to arrange for giving evidence. It is probable that two prominent members will give evidence, and they are likely to lay particular stress upon needed further reform in the railway rates.

Makers of steam and hand pumps report a pretty steady demand at date. Orders are fairly distributed over home and export buyers, the colonies and the Continent being the best customers. There is at present no necessity to increase the number of hands employed at the large works, and not much change is looked for between now and Christmas.

Complaints continue to be made of the injury which is being done to the Australian trade by the heavy consignments of hardwares which are constantly being sent out to Melbourne, Adelaide, Sydney, and other cities. Galvanised sheets, wire netting, and wire nails can now be bought at Melbourne at as low, or lower, prices than are charged for the goods at the manufacturer's doors here.

Makers of cultivating tools are still pretty full of work, mainly on account of Australia, east coast of South America, and India. Some firms can almost see full employment up to the end of the year. The Army authorities are just now inquiring for deliveries of picks and other tools under contracts given out last April.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—A generally dull tone prevails throughout the iron trade of this district; there is very little buying going on either in pig or manufactured iron, and a tendency towards weakness characterises prices. As compared with the excessively depressed state of trade some two or three months back, the market still maintains an improvement, and there is no disposition to sell at the low cutting prices which were then being taken, but there is a gradual receding from the prices which makers have recently been asking. Nominally late rates are still being quoted in some instances, but generally there is a disposition to entertain offers at under list rates, and amongst merchants and dealers there is a good deal of under quoting to secure orders. This, of course, applies to pig iron both as regards common and hematite qualities, finished makers, who have practically never been able to establish any advance, remaining at the low basis of prices which previously prevailed.

There was only a very quiet market at Manchester on Tuesday, and the actual business reported was extremely small. Here and there sales are made at low prices, but there are very few orders offering, and these are only being secured where sellers are prepared to offer some substantial concession upon current rates. For local brands of pig iron makers still quote 39s. to 39s. 6d., less 2½, delivered equal to Manchester, but on the basis of these figures they are being undersold by district brands, even where they are more favourably situated than Manchester as regards rates of carriage. For some of the distant brands quotations are also still maintained on the basis of 39s. to 39s. 6d., less 2½, delivered equal to Manchester, but others are to be got at quite 1s. per ton under these figures, and where business is beirg done the prices actually got do not exceed about 38s. 6d. per ton, less 2½, delivered here. In outside brands there are also sellers open to take considerably under makers' nominal prices both for Scotch and Middlesbrough iron.

Although moderately large sales of hematites have been made in some districts, the business doing here is very small, and for delivery equal to Manchester, good foundry qualities are quoted at about 52s. per ton, less 2½.

In the manufactured iron trade makers in a few exceptional cases are still busy, but generally the forges are getting quieter, as orders at most of the works are being worked off more rapidly than they are being replaced. Prices, so far as any practicable business is concerned, remain on the low basis of £5 5s. for bars, £5 15s. for hoops, and £6 15s. to £6 17s. 6d. for local made sheets, with North-country plates offering here at under £5 5s. per ton.

The condition of the engineering trades remains without material change, slackness being still the general report in nearly every branch of industry.

An entirely new system of rolling plates for boilers, of which a description was given in THE ENGINEER a year or more since, is now being brought into practical application, and the first plant which has yet been erected is now being completed by Messrs. Daniel Adamson and Co., at their Hyde Junction Engineering Works, near Manchester. By this plant, which is termed a vertical ring plate mill, and which is being laid down from the designs of Mr. John Windle, of Manchester, circular weldless boiler plates, 4ft. wide, and up to 16ft. internal diameter, can be produced, so that a boiler can be built up without any longitudinal seams. This plant is being built for the Victoria Steel and Forge Company at Barrow, and is throughout of very massive construction. The rolling mill is carried on a foundation base plate 35ft. in length by 17ft. in width, and weighing about 90 tons. The main driving roll is 22in. diameter and 4ft. wide between the flanges, and the bearings are 12in. diameter in the necks. The set-up roll, which works vertically against the main roll in much the same way as the top roll in an ordinary horizontal mill, is 18in. diameter and has a total range of 16in., the pressure against the main roll being given by hydraulic power. The weight of the mill complete is about 140 tons, and it is driven by a pair of powerful engines by means of a vertical spindle geared to the engines, which are placed directly underneath. The gearing is effected by a pair of steel bevel wheels, 7in. pitch and 21in. across the teeth, each wheel weighing upwards of 12 tons. The bottom of the vertical shaft is carried upon a foundation base with footstep and pedestals, weighing upwards of 30 tons. The engines are of the horizontal type, and have 40in. cylinders with 4ft. stroke. The crank shafts are 27ft. long, 16in. diameter in the necks, and are divided in the centre by means of solid flange couplings. The crank pins are 10½in. diameter and 11in. long. The cylinders are fitted with the Wheelock patent automatic expansion gear, which can be adjusted by hand from the different platforms without any throttle valve being used, the intention being to get as nearly as possible boiler pressure on the piston at all grades of expansion. The engine bed is of the truncated guide type, bored out for the reception of the slides, the flange connection to the cylinder being faced at the same operation, thus ensuring perfect accuracy. The engine complete will weigh about 140 tons, and at 100 revolutions will work up to 3000 indicated horse-power. The total weight of the plant when fitted up complete will be nearly 300 tons.

Quite a new branch of work in another direction has also recently been set on foot at the above works, and for some months past Mr. Adamson has been engaged in the construction of an experimental breech-loading steel gun, in which several novel features are being introduced. This gun is 6ft. in length, and constructed to fire 10 lb. shot, and it is made in one piece, bored out of the solid steel. The chief features are in the breech action for opening and closing, and a novel arrangement of the trunnion. The breech is placed well inside the block, and is opened and closed by a wedge piece actuated by a quick-pitched screw, and behind this wedge piece the block is bored through for the reception of the charge from the extreme end of the gun. The trunnion for holding the gun is arranged as a ball socket in which the gun rests, and by this means it can be swivelled vertically or horizontally 28 degrees without altering the position of the carriage. The gun is at present smooth-bored, but this, and the special form of shot, are important details with respect to which Mr. Adamson has not as yet come to any definite decision.

On Thursday last the employés of Messrs. Hulse and Co., Ordsal Tool Works, Salford, were entertained at dinner at the Tatton Arms Hotel, Northenden, to celebrate the marriage of Mr. Joseph Whitworth Hulse to Miss E. M. Drabble, of Sharston Hall. The party, to the number of 150, were conveyed in omnibuses to Northenden, and at the dinner Mr. H. M. Howell, the works' manager, occupied the chair. During the evening Mr. W. W. Hulse, the head of the firm, delivered a short address to the men, in the course of which he congratulated them on the good relationship existing between all connected with the concern, and which had enabled his employés to be fellow-workers and thinkers with himself in the development of the Ordsal Works, and in the production of machine tools of an excellence of which they were all justified in feeling proud.

The only approach to activity in the coal trade is still confined to the demand for house fire coals; other descriptions for iron making and steam purposes still meet with but a very slow sale, and both common round coals and engine fuel continue more or less a drug in the market. At the pit mouth prices average about 9s. for best coals, 7s. 6d. to 8s. good second qualities, 6s. common house coals, 5s. 6d. steam and forge coals, 4s. 6d. to 4s. 9d. burgy, 3s. 6d. to 4s. best slack, with common sorts to be got at from 2s. per ton upwards.

Shipping is very quiet, and good steam coal delivered at the high level, Liverpool, and the Garston Docks does not average more than 7s. to 7s. 3d. per ton.

With regard to the wages agitation, it has been decided that a ballot of the miners shall be taken as to whether they will send in notices for an advance of 15 per cent., and as an alternative in the probable event of the men not going out on strike, it is arranged that at the next miners' conference the question of a restriction of the output shall be discussed.

Barrow.—I can learn of no new features which are in any way likely to bring about an early or even a future change in the condition of the hematite pig iron trade. The demand from home, foreign, and colonial or continental sources is very indifferently maintained, and there is no immediate need to increase the output of the furnaces, although at the present time the production of the district is below half of its capabilities. The demand for pig iron for general purposes is equally small, with the inquiry for iron for the purposes of conversion into steel. The value of pig iron remains as previously reported, viz., 42s. 6d. for mixed parcels of Bessemer 1, 2, and 3, prompt delivery, and 43s. 6d. for forward deliveries. Stocks are large, and are not likely to be reduced so long as delivery engagements keep at the present rate. Steel makers find no new orders of moment, and it is evident that they, along with makers of iron, will experience a very dull winter's trade. Shipbuilders are in receipt of no new work, but the marine engineering departments are for the moment busier than they have been for some time. Ironfounders are fairly, but not fully, employed. Iron ore is in quiet request; coal and coke dull, but firm in price; shipping still very poorly employed.

The work of pulling down the defective tower of the municipal buildings at Barrow has been suspended for the moment, owing to a difficulty between the contractors and the Corporation of Barrow. It is expected that either the job will be thrown up by the contractors, or that litigation will ensue. Owing to the cracks in the masonry, it will be necessary to pull the tower down to its foundations, and rebuild on a better basis.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

Messrs. Newton, Chambers and Co., Thorncliffe Collieries and Ironworks, have erected gigantic new pumping machinery for draining their extensive collieries at Thorncliffe. The site of the new pumping station is near the Old Hall, Tankersley Park, and the works are stated to be amongst the largest of their kind in the country, being believed to be capable of pumping over 10,000 gallons of water per hour. The water will be conveyed along a drift which runs from the station to Elsecar.

Considerable interest was recently excited by the closing of the ironworks at Milton and Elsecar, carried on successfully for so many years by Mr. George Dawes. These works afforded employment at one time for several hundred people, whose wages amounted to £1000 a week. It has been freely alleged that the impossibility of obtaining reduced terms from the landlord, the Earl Fitzwilliam, was the cause of the stoppage. I have the best authority for stating that this was not the case. The works were carried on at a profit for many years because of a valuable bed of ironstone close to them. This has now been worked out, and remunerative iron production there is now out of the question. If any good firm made Lord Fitzwilliam a reasonable offer to restart the Elsecar and Milton establishment, there is little doubt the offer would be accepted.

Messrs. Wm. Jessop and Sons have completed their new steel foundry at Brightside. Mr. J. F. Hall, the general manager to the company, presided at a commemoration dinner at Sheffield, which was attended by 150 of the managers and workmen employed in the steel foundry department. He stated that there was no secret as to what had induced the directors of their company to erect this new and costly plant. It was because it was found impossible to make the old plant pay, and he called upon all those present, now that they had got that magnificent plant, to pull together and show the directors their confidence had not been misplaced, and to make it a remunerative undertaking for the shareholders who had intrusted them with their money. They had an exceedingly difficult task before them. The general trade of the country had never been worse, and the competition in this particular branch—steel castings—was assuming alarming proportions, more particularly from foreign countries. At the present time many thousands of pounds' worth of steel castings were being imported into this country from the Continent at prices which English manufacturers could not even make them. It was entirely a question of wages. The continental steel-founders earned about one-half of what their English brethren did. This state of things could not go on if they were to do any trade at all. One of two things must happen—either the continental workman must go in for higher wages, or the English workman must be satisfied with less. He sincerely trusted it would not have to be the latter. What they had to do, now that they had got probably the finest plant of its kind in the country, was to turn out such good quality of castings as to induce their customers to give an extra price for superior workmanship. Mr. S. Pope, who had superintended the erection and working of the new furnaces in connection with the foundries, described them as the finest steel foundry plant in the world. As for the furnaces, there was nothing like them anywhere, and he spoke from vast experience. It is pleasant to see these signs of progress in the steel manufacture, which, after all, is the staple trade of the town next to—and certainly not inferior to—cutlery and general hardware.

The witnesses selected from Sheffield for the Royal Commission are able gentlemen, well qualified to speak on the industries with which they are connected; but I find a pretty strong feeling that cutlery is not adequately represented, and it is probable that further names may be added.

On Monday the Duke of Norfolk distributed the medals, prizes, and certificates awarded at the recent Industrial Exhibition of the Cutlers' Company. The number of prize winners was 460, and the ceremony was witnessed by a large concourse of working men and representatives of the middle and upper classes. After the ceremony the Duke entertained the whole of the exhibitors, numbering nearly a thousand, to luncheon at the Corn Exchange. The Exhibition has been a decided success, and very important results are expected to flow from it in the way of stimulating the handicraftsmen of Sheffield to higher excellence in the production of their goods. Mr. Mundella, M.P., who was present at the distribution, expressed the opinion that the movement was one of great consequence, and, speaking after an extended tour over the Continent, he states that our great care must be that excellent brain and abilities of our workpeople should not be lost through the competition of foreign rivals who were devoting extraordinary attention to technical education. It was announced at the meeting that the Duke of Norfolk had subscribed £3000 towards the Sheffield Technical School which has recently been established. The idea has been thrown out that the exhibition should take a permanent form, the leading articles being selected for the purpose of preservation in order that they may be examined by the workmen of the future. It is intended to have a similar exhibition after a period of years, and a permanent collection of the works done this year would then be of great importance as showing what progress had been made in the interval. It was remarked by several of the subscribers that while in lower-class goods Sheffield productions were sometimes beaten out of the market, in higher grades, where quality of material and workmanship were the prime essentials, no foreign rivals could equal the Sheffield artisans.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

The value of Cleveland pig iron has now again fallen to the low level at which it stood at the end of August, just before the "newspaper boom" commenced. There was but a poor attendance at the market held at Middlesbrough on Tuesday last, and very little business was transacted. Merchants offered No. 3 g.m.b. at 32s. per ton for prompt delivery, and some of them would even accept that figure for delivery to the end of the year. Consumers, however, are holding off, and buy only what they require for immediate use. Makers are not yet in want of orders, and therefore keep out of the market. There are very few inquiries for forge iron, and the price has fallen to 31s. 3d. per ton, and even 31s. has been accepted by some sellers.

Owing to the continued fall of values, warrants are not so firmly held as they were. Some of the more timid holders are anxious to sell at 32s. 3d. per ton, but most of them will not accept less than 33s.

The stock of pig iron in Messrs. Connal and Co.'s Middlesbrough stores continues to increase, but not so rapidly as it did a few weeks since. The quantity held on Monday last was 107,230 tons, being an increase of 2185 tons for the week.

The stormy weather of the last few days has hindered shipments considerably, and consequently the quantity of pig iron exported from the Tees this month is much less than during September. By Monday last 48,515 tons had been sent away as against 53,097 tons during an equal portion of September.

There is no change in the finished iron trade. Makers find it impossible to keep their works going fully, and seem determined to close altogether rather than take less than the prices now ruling. Dr. Watson's award is anxiously looked for. Prices are as follows: Ship plates, £4 12s. 6d. to £4 15s. per ton free on trucks at makers' works; angles, £4 10s. per ton; common bar iron, £4 17s. 6d. per ton; steel plates, £6 12s. 6d. to £6 15s. per ton, all cash 10th less 2½ per cent. Puddled bars are £3 per ton net.

The accountants to the Cumberland Coalowners' and Miners' Association have certified that the net average selling price of coal for the three months ending September 30th was 4s. 8·32d. per ton. Wages remain unaltered.

Many English and continental engineers remember well Mr. Edward Crowe, at one time chief superintendent of the municipal waterworks at Warsaw, and afterwards manager of the rolling mill department of Messrs. Hopkins, Gilkes, and Co., Middlesbrough. Mr. Crowe died some ten years since, leaving a widow and several sons. One of the latter being ill went a sea voyage for the benefit of his health. Being in the engine-room one day during heavy weather, a lurch of the vessel caused him to fall among the machinery, and he was so severely injured that he died next day. The other three sons, inheriting in a marked degree their father's mechanical talent, were apprenticed at various engineering works in the district. During their leisure hours, and with their spare cash, which must have been limited in amount, they fitted up a workshop with the requisite appliances, and occupied themselves by attempting to improve certain mechanisms in which they were specially interested. Chief among these was the gas engine, and it would appear that they have succeeded in devising and manufacturing one which has characteristics and merits peculiar to itself, and which promises to exceed in economy anything previously made. Near the working cylinder, but separate from it, is a chamber lined with fire-brick, which performs functions analogous to those of the boiler of a steam engine. Into this little boiler the engine pumps a certain definite quantity of gas, and a proportionate quantity of air, every revolution. The two combined form by the combustion gaseous products, to be afterwards utilised in the working cylinder, when admitted thereto by the valve gear. There is a manifest advantage in producing the gases to be used for pressure in a vessel separate from the cylinder; for, in the first place, the so-called boiler can be kept at a nearly constant temperature—high—and the cylinder at a nearly constant temperature—low. Whereas, when the explosion takes place in the cylinder itself, the combustion cannot be so good or complete as it would be in a permanently hot chamber, and there is a greater tendency to condensation and deposit of tar. If to avoid the effects of chilling the combustible gas at the time of explosion the working cylinder were kept hot, as Messrs. Crowe do with their boiler, then lubrication of the piston and piston-rod would become difficult or impossible. Several manufacturers, some of them occupying leading positions, have been in negotiation with Messrs. Crowe for the acquisition of their patent, but as yet no definite arrangement has been made. They are, however, occupied in making a larger example than the experimental one just completed, and when that is fully tested and the economy accurately ascertained, there is no doubt that the engine will be properly introduced to the public.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

The Glasgow iron market was much depressed at the end of last and beginning of the present week, and warrants went down as low as 41s. 7d. cash. Some improvement has since occurred, but the condition of the market is still unsatisfactory. The week's shipments were poor, aggregating 8223 tons, as compared with 9250 tons in the preceding week, and 10,245 tons in the corresponding week of 1884. An extra furnace has been lighted at Coltness, and there are now ninety-one in operation compared with ninety-five twelve months ago. In consequence of the small shipments the storing of pig iron has been on the increase, and the week's addition to the stock in Messrs. Connal and Co.'s Glasgow stores has been upwards of 2200 tons.

Business was done in the warrant market on Friday at 42s. 4d. to 42s. 2d. cash in the forenoon, and 42s. 2½d. to 41s. 11d. cash in the afternoon. On Monday forenoon transactions occurred at 41s. 10d. to 41s. 9½d. and 41s. 10½d. cash, the afternoon quotations being 41s. 10d. to 41s. 7½d. cash, buyers offering a halfpenny less. Tuesday's markets showed more firmness, with business at 41s. 7½d. to 41s. 8½d. cash, the quotations in the afternoon being from 41s. 8d. to 41s. 9d. cash. Business was done on Wednesday at 41s. 10½d. to 41s. 9½d. cash. To-day—Thursday—business took place from 41s. 7½d. to 42s., closing with buyers at 41s. 10d. cash.

The current values of makers' iron are without much alteration, as follow:—Gartsherrie, f.o.b. at Glasgow, per ton, No. 1, 46s.; No. 3, 43s. 6d.; Coltness, 49s. and 45s. 6d.; Langloan, 47s. 6d. and 45s.; Summerlee, 47s. 6d. and 43s. 6d.; Calder, 51s. 6d. and 43s. 6d.; Carnbroe, 45s. 6d. and 43s.; Clyde, 46s. and 42s.; Monkland, 42s. 3d. and 40s.; Quarter, 42s. and 40s.; Govan, at Broomielaw, 42s. 3d. and 40s.; Shotts, at Leith, 47s. and 46s. 6d.; Carron, at Grangemouth, 51s. and 47s.; Kinneil, at Bo'ness, 44s. and 43s.; Glengarnock, at Ardrossan, 48s. 6d. and 42s.; Eglinton, 42s. and 39s.; Damellington, 43s. and 40s.

The arrivals of Middlesbrough pigs at Grangemouth for the week were 6570 tons, and the total imports to date show an increase of 95,393 tons, as compared with the arrivals of last year.

The shipments of iron and steel goods from Glasgow in the past week embraced eight locomotives, valued at £20,000, for Bombay; two ditto, £6000, for Adelaide; machinery, £4314; sewing machines, £1568; steel goods, £6060; and general iron manufactures, £27,290.

In the malleable iron trade there is a fair amount of business at the low prices which have prevailed for so long a time. The makers of cast iron pipes are in some cases very busy, while in other instances they are much in need of additional orders. Tubes, bars, sheets, and pigs are in request for India and the Australian colonies, and a fair trade is also being done in galvanised iron and railway materials. Several contracts have been arranged in the shipbuilding trade since last report, but there is still much room for improvement in this as in other departments.

The coal trade is quiet in most of its branches, but the shipments of the past week are in a number of cases larger than they were a week ago. From Glasgow, 27,834 tons were despatched; Greenock, 3128; Ayr, 6640; Troon, 7716; Irvine, 2212; Grangemouth, 10,217; and Leith, 4953 tons. In the steam coal trade there has been rather more doing, and household coals are in fair demand for the season.

The experiences of the Niddrie and Benhar Coal Company have in the past few years been very unfortunate, inasmuch as the directors have had to contend with both fire and water in the mines. At the general meeting of the shareholders, held a few days ago at Edinburgh, Mr. Robert Bell, the chairman, reported that the pits were now clear of water. The output at the Niddrie pits was now increasing considerably; in fact, it might now be said to be paying itself. They were now sinking a new pit, which would cheapen the cost of raising both coal and water.

The death occurred early this week at his residence, Park-circus, Glasgow, of Mr. Walter Macfarlane, of the Possil Foundry. From comparatively small beginnings, the business founded by Mr. Macfarlane grew till it became one of the largest in the kingdom, and his special and ornamental castings are known all over the world.

The first sod of new waterworks to be provided for the town of Lockerbie, in Dumfriesshire, was cut on Monday last.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

The examination of coal sales, as shown by the Sliding Scale Committee held in Cardiff a few days ago, necessitates a reduction to the extent of 2½ per cent. in colliers' wages. This will come into effect on the first of next month, and is to include stokers and enginemen. It is now certain that a reduction in all ironworks and collieries is now agreed upon, and, without being an alarmist, I only hope it will stop at that. Times are wretchedly bad, and the long stagnation is beginning to tell upon all business. Naturally, shipowners are suffering and railway receipts falling off. On the Brecon Railway the men have been put upon three-quarter work daily, a much better alternative than a reduction in numbers. Coal exports foreign last week showed better, Cardiff sending off 8000 tons more, and Newport 13,000 tons extra. It must be noted that Newport foreign coal shipment for the preceding week was one of the smallest known, amounting to only 20,000 tons. Last week the total was 33,000 tons. Cardiff total was 127,000 tons in round numbers, and as the preceding week was only 119,000 tons, and the week before slightly over the 100,000 tons, there seems some hope that we are again on the ascending scale.

Mr. W. T. Lewis and Sir George Elliot return early next week from America, and will find their hands full with the trade, railway, and other complications which have arisen. I hear that their impression of American coal working is unfavourable; that "we are fifty years ahead." Their report will be looked forward to with great interest.

I have no good news from the iron and steel works. Less than 4000 tons left Wales this week, one important cargo being 2000 tons for Calcutta. How the great establishments are kept going is a mystery. Cyfarthfa expended a quarter of a million sterling in the adaptation of the works to the new methods, and Dowlais has gone to an outlay of £50,000 in extensions, additions, &c. The latest addition has been a special press engine for steel sleepers.

Tenders are out for the construction of the new reservoirs for the Cardiff Corporation in the Taff Valley, and already contractors have been down examining the spot. The tenders are based on existing conditions, namely, that as the nearest railway station to the site is 6½ miles distance there will be heavy cartage of materials to the spot. It is remarkable that the promoters of these waterworks have not considered the feasibility of constructing a short line to the place from the Cefn station. This would expedite the work and lessen cost. By this line, which would take the hill side, ample store for masonry and lime could be obtained, and by this line the pipes might be laid.

Small coal is quoted at 4s. 6d., and is quiet. House coal is slightly better. The Dowlais Company has withdrawn from the prosecution of its colliers for neglect of work. Swansea coal and patent fuel trade begins to look up, and, indeed, patent fuel is improving throughout the district.

Tin-plate maintains its encouraging features. The last two works out of eighty-two have now joined the combination. Last week was the stop week, and it was well maintained. Quotations are hardening; 15s. 6d. can now be had for coke tin, best brands, and 14s. 6d. is about the lowest figure. The best demand is for Siemens and Bessemers. The first are quoted at 15s. 6d. to 16s. Bessemer steels sell readily from 14s. 9d. to 15s. 3d. Wasters even fetch 13s. 9d.

I note that tin-plate exports, especially from the Swansea district, have been heavy, 2700 tons for America, 120 tons for the River Plate, being amongst the heaviest items.

There is a prospect now of a settlement of the Gwerna coal dispute by arbitration.

At the assessment meeting of the Merthyr Union on Saturday, a number of coalowners appealed for a reduction of their assessment, and were allowed 5 per cent. in consideration of the bad state of trade.

LAUNCHES AND TRIAL TRIPS.

On the 15th inst. a trial trip was made with the steamship Basil, belonging to Messrs. Alfred Booth and Co., recently fitted with new engines and boilers of the compound surface condensing, inverted direct-acting type, cylinders 27in. and 55in. diameter respectively, with a stroke of 39in. and boiler constructed of Siemens steel, carrying a working pressure of 90 lb. In addition to this, the hull has received a thorough overhaul, new decks, and a large midship-house, containing all the necessary accommodation for officers, &c. A new steam-steering gear has also been fitted. The vessel proceeded down the Mersey, the engines working very smoothly at 72 revolutions per minute, and on the measured mile her average speed was 11¼ knots per hour, indicating 850-horse power. The above work has been carried out under the superintendence of the company's engineer, Mr. Beckett, and Mr. Garland, their marine superintendent, by Messrs. David Rollo and Sons, Fulton Engine Works, Liverpool. The same firm recently fitted new boilers and converted engines of the compound and the triple expansion system in the Red Cross steamer Manauense. The Manauense was built at Glasgow about twelve years ago, and was supplied with compound engines, her net tonnage at that time being about 800 tons. Recently, the vessel has been undergoing extensive alterations, rendered necessary more particularly on account of the engines. By the conversion of the engines to triple expansion and the substitution of new boilers of Siemens steel, capable of working at a pressure of 150 lb. to the square inch, some 200 or 300 tons extra cargo space has been obtained. There are now four cylinders to the engine—two high pressure, 17in. in diameter; one intermediate, 38in.; and one low pressure, 60in., having a stroke of 3ft. 6in. The high-pressure cylinders are worked by piston-valves, the intermediate cylinder is fitted with Church's patent slide valve, and the low-pressure one with Thom's slide valve. The glands have been packed with Rogers' metallic packing throughout. The engines worked smoothly at 74 revolutions per minute, and the vessel attained an average speed of 13 knots per hour on the measured mile.

NEW COMPANIES.

THE following companies have just been registered:—

British Marchant Engine Company, Limited.

This company proposes to adopt an agreement of the 8th ult. (unregistered) for the purchase of the British patents and rights of Mr. Robert Mudge Marchant, for "A method and process for the retention and circulation of steam in its application to engine power, and in the means employed therefor." The company was registered on the 10th inst. with a capital of £250,000, in £5 shares, with the following as first subscribers:—

	Shares.
R. M. Marchant, C.E., 69, Fenchurch-street ..	1
F. R. Manley Gossett, J.P., Portslade, Sussex ..	1
P. O'Halloran, 20, High Holborn	1
E. B. Dennison, 40, Ferne Park-road, Stroud-green, N., merchant	1
M. P. McCoy, 3, Ludgate-circus, merchant	1
D. F. Cooke, 53, Osney-crescent, N.W., clerk ..	1
W. Downie, 35, Lorne-road, Upper Tollington Park, managing director	1

The number of directors is not to be less than three nor more than seven; the first ordinary directors are to be elected by the subscribers, who may act *ad interim*; qualification for subsequent directors, 20 shares. Remuneration, £200 per annum to each director, and in addition an amount equal to one-tenth of the divided profits, provided such profits do not exceed £50,000 in any one year, in which case the fixed sum of £5000 will be divided amongst the members of the board, including the managing director. Mr. Wm. Downie is appointed managing director for three years at a remuneration similar to that of the other directors.

Campos Syndicate, Limited.

This syndicate was registered on the 12th inst. with a capital of £150,000, in 150 shares of £1000 each, to acquire the full benefits of a concession granted to Alberto de Rocha Miranda by the Provincial Government of Rio de Janeiro on the 12th of May, 1882, in pursuance of a decree dated 6th May, 1882, for the supply of filtered drinking water to the city of Campos, and for the construction of sewers for the removal of house sewage and rain-water from the said city and the vicinity thereof. The subscribers are:—

	Shares.
Alderman Wm. McArthur, M.P., 29, Holland Park	5
*Alderman James Whitehead, Highfield House, Catford Bridge	5
R. Pirkin, Apsley Hall, Notts	5
*A. J. Newton, 8, Leadenhall-street, steamship owner	5
W. C. Anderson, 6, Upper Thames-street, cement manufacturer	5
D. W. Bell, 14, Milton-street, merchant	10
*Clarence Smith, 4, Queen Victoria-street, stock-broker	5

The number of directors is not to be less than five nor more than seven; qualification, five shares; the first are the subscribers denoted by an asterisk, and Messrs. Alexander McArthur, Morgan Harvey, and William Curling Anderson. The company in general meeting will determine remuneration.

Climax Chimney Climber Company, Limited.

In Liverpool and elsewhere in the United Kingdom, this company proposes to manufacture and work a patent machine and invention known as "The Climax Chimney Climber," to be used for climbing chimney stalks, shafts, monuments, columns, steeples, and other like erections, for the purpose of building, pointing, straightening, setting, fixing lightning conductors, &c. The patent is No. 3435 of the present year. The company was registered on the 14th inst. with a capital of £10,000, in £5 shares, with the following as first subscribers:—

	Shares.
*J. Howard, 9, Chapel-street Liverpool, coal proprietor	1
*J. Pendleton, 147, Dale-street, Liverpool, iron-founder	1
*T. A. Jolliffe, 5, Chapel-street, Liverpool, steam-ship owner	1
W. L. Jackson, 10, Dale-street, Liverpool, chartered accountant	1
J. Woodburn, 3, India-buildings, Liverpool, solicitor	1
James Brown, 11, Seacombe-street, Liverpool, engineer	1
*T. A. Porter, 37, Chestnut-grove, Bootle, Liverpool, patentee	1

The number of directors is not to be less than three nor more than five; qualification, 20 ordinary shares; the first are the subscribers denoted by an asterisk. The company in general meeting will determine remuneration.

Sheather's Patent Sanoped Horseshoe Company, Limited.

This company was registered on the 14th inst., with a capital of £150,000, in £10 shares, to acquire and work the letters patent, dated 24th January, 1884. granted to Mr. Charles Sheather, F.R.C.V.S., for improvements in shoeing horses and mules; and in connection therewith, to manufacture horseshoes and nails and other articles of iron, metal, leather, and india-rubber. The subscribers are:—

	Shares.
Major H. F. Mills, Grange, Gosport	5
John Biller, 9, Old Jewry, iron merchant	5
John Austin, 103, Maida-vale	5
J. S. Maughan, Mountfield House, Turnham Green	5
H. S. Ritchie, 25, Crutched Friars, merchant ..	5
C. E. Pearson, The Park, Hull	5
F. Clackson Russell, Fulbon Corner, Finchley, solicitor	5

The number of directors is not to be less than three nor more than seven; qualification, £100 in shares or stock; the subscribers are to appoint the first. Maximum remuneration, £1000 per annum, with an additional £100 for each 1 per cent. dividend upon the ordinary share capital in excess of 8 per cent. per annum.

Rhenish Tunnelling and Mining Company, Limited.

This company proposes to construct tunnels or other engineering works in the United Kingdom or elsewhere, for the purpose of railway, engineering, mining quarrying, or other enterprises, and to experiment in preliminary works bearing on mining and quarrying or kindred operations. It was registered on the 12th inst. with a capital of £12,150, in 1200 "A" shares of £10, and 3000 "B" shares of 1s. each. The subscribers are:—

	B shares.
J. A. Bone, C.E., 19, St. Swithin's-lane	1
W. A. Armitage, 4, George-yard, Lombard-street, stock and share broker	1
E. C. Oillen, 111, Cheyne-walk, Chelsea, Clerk ..	1
J. Toms, 30, Great St. Helen's, secretary to a company	1
A. W. Fox, 10, Haverstock-street, City-road, clerk	1
W. Marlborough, 29, Bishopsgate-street, share dealer	1
C. B. King, C.E., 19, St. Swithin's-lane	1

Registered without special articles.

F. and J. Butterfield and Co., Limited.

This is the conversion to a company of the business of machine tool-makers and engineers, carried on by the firm of F. and J. Butterfield and Co., at the Midland Works and the Eagle Works, Keighley, Yorks. It was registered on the 13th inst. with a capital of £80,000, in £10 shares, with the following as first subscribers:—

	Shares.
*Francis Butterfield, 37, Chapel-lane, Keighley, tool-maker	1
*Hy. Packett, 51, Cliffe-street, Keighley, cashier	1
*N. Stell, 93, Devonshire-street, Keighley	1
J. H. Gill, Highfield-street, Keighley, foreman ..	1
*G. W. Carter, 42, Chapel-lane, Keighley, veterinary surgeon	1
Pickles Greenwood, Spring Bank, Keighley, foreman	1
S. Lund, 41, Bradford-street, Keighley, foreman	1

The subscribers denoted by an asterisk, and Mr. John Mitchell, are the first directors; qualification, shares or stock of the nominal value of £250. Mr. F. J. Butterfield is appointed manager for five years (provided he continues during that period to hold £5000 of the company's capital) at a salary of £350 per annum.

T. M. Hesketh and Sons, Limited.

This is the conversion of the business of cotton spinners and doublers, carried on by the firms of John Stones and Co., and T. M. Hesketh and Sons. at Astley Bridge, Lancaster. It was registered on the 8th inst. with a capital of £250,000, in £10 shares. The subscribers are:—

	Shares.
*T. M. Hesketh Astley Bridge, cotton spinner ..	1
*Thos. Hesketh, Astley Bridge, cotton spinner ..	1
*George Hesketh, Astley Bridge, cotton spinner	1
Mary Hesketh, Great Lever, married woman ..	1
Catherine Hesketh, Great Lever, spinster	1
Sarah Jane Hesketh, Great Lever, spinster	1
Minnie Hesketh, Astley Bridge, married woman	1

The number of directors is not to be less than three, nor more than six; qualification, 500 shares; the first are the subscribers denoted by an asterisk.

Farnsfield Gaslight and Coke Company, Limited.

This company proposes to erect works, and to supply the village of Farnsfield, Nottingham, with gas, coke, and gas products. It was registered on the 13th inst. with a capital of £700, in £10 shares. The subscribers are:—

	Shares.
Wm. Straw, Farnsfield, Nottingham, manufacturer	10
S. Field, Farnsfield, Nottingham, land valuer ..	10
G. Kirkland, Southwell, Nottingham	10
J. B. Truswell, Farnsfield, Nottingham, farmer	5
G. Straw, Farnsfield, Nottingham, grocer	10
John Kirkland, Southwell, Nottingham	10
Walter Straw, Sutton-in-Ashfield, potter	10

Registered without special articles.

LIVERPOOL ENGINEERING SOCIETY.—The ninth meeting of the current session was held at the Royal Institution, Colquitt-street, on Wednesday evening, October 14th; Mr. W. E. Mills, president, in the chair. A paper by Mr. Peter Evans, on the "Application of Compressed Air to Warehouse Requirements," was read by the author. After giving a general description of the hoisting machinery at the Boundary-street warehouses of the Warehouse Owners' Company, including a description of the engine and boiler house, with air compressors, air mains, receivers and connections to power hoists, the author described the system of cooling and improving cereals, and also of elevating and distributing same by means of compressed air. He then compared the first cost and working expenses of the different systems of transmitting the power for working the hoists, and showed the economy of compressed air in the case under consideration. The application of compressed air for refrigerating purposes was next dealt with, and he showed how warehouse cellars might be made valuable as stores for dead meat by exhausting into them the air after it had done its work in the hoists, the air on expansion producing an intensely cold, but pure, atmosphere. In conclusion, he pointed out the great demand for a reliable compressed air-power meter, by which consumers could be charged for the amount of power actually used.

THE FORESTS OF SIBERIA.—The Russian journal of the Finance Minister has published a long article on the forests of Eastern Siberia, of which the following are the principal passages:—"The immense forests of pines, larches, firs, cedars, birches, aspens, and limes which form almost the exclusive wealth of this vast region, belong for the greater part to the State. During a great number of years this source of wealth was almost entirely unproductive. It is only since 1869 that a more or less regular administration of forests has been estabiished, and at the present time the extent of the forests in Eastern Siberia is estimated at 72,335,330 deciatines—about 11 square yards each. These are divided between Tobolsk, Tomsk Semipalatinsk, and Akmolinsk. Of these forests, 21,355,760 deciatines have been accurately surveyed, and 50,979,570 have been valued approximately. One hundred and five forests have been conceded to the peasants, and they have an extent of 7,068,240 deciatines. In comparison with their enormous extent the forests of Eastern Siberia give at the present time but an insignificant revenue. The want of means of communication and an insufficient population greatly hinder its development. Still, the revenue is increasing, for in 1876 it was only 40,000 roubles, and in 1885 it was more than 111,000. The chief centre of the trade is the town of Tomsk, and then Tumen, which is the point of departure for the river traffic."

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

Applications for Letters Patent.

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

13th October, 1885.

12,151. Lubricating the Axles of Colliery Wagons, J. T. Key, London.
12,152. Double Grip Toe Plate, J. Latham.—(*C. Williams, New Zealand.*)
12,153. Floats for Paddle-wheels, G. Rodger, Liverpool.
12,154. Conveyance Penny Stage Fare Register, R. Jones, Birmingham.
12,155. Securing Metal to Wood, H. B. and A. B. Barlow, Manchester.
12,156. Ventilators, J. Bedford, Bradford.
12,157. Gumming the Edges of Paper, J. Robertson, Manchester.
12,158. Combined Meat Bastener and Fire Screen, J. McD. Smith, Birmingham.
12,159. Dyeing, S. Smithson, Bradford.
12,160. Multiple Sample Churn, J. A. Stephenson, near Carlisle.
12,161. Furnace Grates, C. Whitfield, Kettering.
12,162. Shaping Earthenware Toilet Ewers, E. Rigby, jun., Hanley.
12,163. Skip for Mill, &c., Purposes, J. S. Pearson, Rochdale.
12,164. Eclipse Steps and Ladders, R. J. Johnson, Downham Market.
12,165. Coupling Vehicles by Handles at Side, C. Buckley, Moston.
12,166. Drying and Finishing Gloves, W. D. Watson, Aberdeen.
12,167. Boots and Shoes with India-rubber Soles, M. Frankenburg, Leicester.
12,168. Wire Nail-making Machines, H. J. Allison.—(*C. Lovell, United States.*)
12,169. Forming Small Nails or Tacks from Wire, H. J. Allison.—(*C. Lovell, United States.*)
12,170. Galvanic Battery, H. J. Allison.—(*E. M. Gardner, United States.*)
12,171. Water Level Indicators, E. H. A. Heinke, Upper Teddington.
12,172. Chronographs, J. Y. Johnson.—(*La Société Louis Brandt et fils, France.*)
12,173. Valves of Fluid Pressure Engines, R. Richardson, Glasgow.
12,174. Gloves, M. Wedlake, London.
12,175. Gas Engines, R. Skene, London.
12,176. Window Blind Rollers, J. W. Hancock, London.
12,177. Hinges, W. A. S. Benson, London.
12,178. Baking Powders, A. G. Brookes.—(*T. S. Nowell, United States.*)
12,179. Saws for Cutting Metal, T. Fowler, London.
12,180. Holders for Stair-rods, W. Dick, London.
12,181. Electro-magnetic Speed Registers, B. Faymonville, London.
12,182. Coating Riggers, &c., G. Hurn, London.
12,183. Breech-loading Fire-arms, H. F. Clark, London.
12,184. Apparatus for Receiving Coin and Delivering Goods in Exchange, C. H. Russell, London.
12,185. Jointed Paper Fasteners, F. Hochuly.—(*A. Lotz, France.*)
12,186. Brushes, J. Raper, M. Pearson, and F. Gill, London.
12,187. Non-charing Wicks, S. C. Joyce, W. Smith, and W. Neall, London.
12,188. Knife Cleaning Machines, G. J. F. Tate, London.
12,189. Making Ice, &c., A. G. Southby and F. D. Blyth, London.
12,190. Pencil-cases, E. H. Schmidt, London.
12,191. Window Sash Holders, A. M. Clark.—(*A. Ayers and W. R. Wilson, United States.*)
12,192. Electrical Railways, J. F. M'Laughlin, London.
12,193. Electric Temperature Regulators, W. P. Thompson.—(*C. A. Tucker, United States.*)
12,194. Attaching Sun Blinds to Frames, C. Wild, Liverpool.
12,195. Furnaces, W. P. Thompson.—(*A. Backus, jun., United States.*)
12,196. Spike, W. P. Thompson.—(*R. M. Boyd, United States.*)
12,197. Decorticating, &c., Grain, P. V. Gelder, Liverpool.
12,198. Steam Engines, E. Field, London.
12,199. Rotary Drilling or Boring Machines, W. L. Wise.—(*C. Bornet, France.*)
12,200. Steel Slabs, Plates, and Bars, E. W. Richards and F. Hilton, London.
12,201. Feeding, &c., Young Animals, F. A. Morse-Boycott, London.
12,202. Wheels, W. M'I. Cranston.—(*W. A. Wood, United States.*)
12,203. Hone, J. E. Glenister, London.
12,204. Steel Plates, S. Hannah, London.
12,205. Regulating Apparatus for Arc Electric Lamps, C. Dornfeld and H. Müller, London.
12,206 Purifying Water in Canals, E. Edwards.—(*J. Buisson, France.*)
12,207. Screw Stoppers for Bottles, W. Bartholomew, London.
12,208. Automatic Fire-extinguishers, W. R. Lake.—(*W. M. le Moyne, U.S.*)
12,209. Sewing Machines, W. R. Lake.—(*N. Wheeler, United States.*)
12,210. Type Writing Machines, C. Oakford, Pennsylvania.
12,211. Registering Mechanism for Locks, Brunel and Klein, London.
12,212. Mixing Apparatus, A. H. Reed.—(*C. Hornbostel, United States.*)

14th October, 1885.

12,213. Water-proof and Air-proof Fabrics, J. Hebblewaite, Manchester.
12,214. Water-proof and Air-proof Fabrics, J. Hebblewaite, Manchester.
12,215. Composing Sticks, C. M. Grow, London.
12,216. Single-acting Steam Engines, H. W. Pendred, Streatham.
12,217. Carrying Luggage up and down Stairs, W. J. Tanner, London.
12,218. Carrying Cartridges, G. Andrews, Ardoyne.
12,219. Knobs for Bedsteads, &c., H. Fenney, Birmingham.
12,220. Windows of Railway Carriages, D. Allport, London.
12,221. Preventing the Slamming of Doors, &c., D. Allport, London.
12,222. Working Window Sashes, S. Smith, Bolton-le-Moors.
12,223. Lever Action Tubular Siphon, R. C. F. Wyatt, London.
12,224. Indicating the Number of Doffings Effected by Spinning Machines, L. Hanson, Halifax.
12,225. Springs for Tricycles, J. R. Trigwell, London, and A. H. Trigwell, Brighton.
12,226. Velocipedes, J. R. Trigwell, London.
12,227. Photographic Plate Boxes, W. Griffiths, Birmingham.
12,228. Chlorate Mixture in Cartridges, E. H. B. Stephenson, London.
12,229. Cork Thread or Yarn, C. Moseley, Manchester.
12,230. Collectors for Electric Tramways, M. H. Smith, Halifax.
12,231. Fertilising Compounds, &c., J. Davies, Manchester.
12,232. Fire Lighters, W. Anderson and T. Morris, Gateshead-on-Tyne.
12,233. Advertising Vans, L. Noble, Bradford.
12,234. Expanding Chain Wheel, J. R. Trigwell, London.
12,235. Steering Tricycles, T. Bayliss, J. Thomas, and J. Slaughter, Coventry.
12,236. Lids of Cigar, &c., Boxes, A. de Stein, Birmingham.
12,237. Clothes Brushes, R. Condron, London.
12,238. Disinfectants, A. Boake and F. G. A. Roberts, London.
12,239. Malt, J. Hayes.—(*H. Hackmann, Bavaria.*)
12,240. Navagational Sounding Machine, Sir W. Thomson, Glasgow.
12,241. Ratchet Braces, W. H. Ratcliff and G. Townsend, Birmingham.
12,242. Scratch and other Brushes, C. Coxson, London.
12,243. Extracting Silver from Ores, &c., T. C. Huntington and M. Chiapponi, London.
12,244. Extracting Antimony from Ores, &c., T. C. Huntington and M. Chiapponi, London.
12,245. Bottles, T. Baker, London.
12,246. Stitching and Tying Pamphlets, &c., J. F. Haskins and G. D. Davis, London.
12,247. Carving and Shaping Wood, T. J. Roome and A. J. Smith, London.
12,248. Telephone Systems, W. P. Thompson.—(*E. Mauritius, Germany.*)
12,249. Substitute for Turpentine, S. Banner, Liverpool.
12,250. Chimney Pots or Terminals, R. J. White, London.
12,251. Uptake Ventilators and Smoke Cowls, W. McHaffie, Glasgow.
12,252. Glazing, A. Drummond, Glasgow.
12,253. Driving Ropes or Round Bands, R. Dick, Glasgow.
12,254. Driving Belts or Flat Bands, B. Dick, Glasgow.
12,255. Toy, G. F. Redfern.—(*J. Broussard, France.*)
12,256. Screw Stoppers, A. and M. Mackay and R. E. Goolden, London.
12,257. Stoving or Drying Japanned Ribs, W. A. Bindley, W. J. Gell, and A. F. Boham, London.
12,258. Fuel Economisers, A. Lowcock and T. Sykes, Manchester.
12,259. Fastenings or Couplings for Securing Vehicles together, H. Williams, London.
12,260. Driving Gear for Velocipedes, A. T. Clarke, London.
12,261. Disinfecting, &c., Sewage, &c., J. Hanson, London.
12,262. Steam or other Fluid Pressure Engines, G. Sellers, London.
12,263. Trunks, &c.. G. H. Wells, Boston, U.S.
12,264. Telephonic Switch Boards, W. R. Lake.—(*G. Péreire and G. F. Jarland, France.*)
12,265. Dephosphorisation of Iron Ore, A. Fehlen, London.
12,266. Ships' Telegraphs, &c., I. Tall, London.
12,267. Fittings for Roller Blinds, W. Hopkins, London.
12,268. Shooting Apparatus, J. C. Cowell, London.
12,269. Seats and Tables or Desks, W. L. Wise.—(*P. A. L. Suzanne, France.*)

15th October, 1885.

12,270. Cup or Feeder for Oil Cans, T. Marsh and J. Marsh, Birmingham.
12,271. Coupling and Uncoupling Railway Vehicles, J. W. Hadwen, Manchester.
12,272. Moulding into Shape Sandcloth, &c., Covers for Finishing Machines, H. Snow and S. Bennett, Leicester.
12,273. Stopping Bottles, J. S. Rodgers, London.
12,274. Keying Wheels upon their Axles, H. Theaker, London.
12,275. Marine Propellers for Ships and Boats, J. W. Wilson and F. Wilson, Sunderland.
12,276. Looms for Venetian Blinds, T. French and J. Monks, Hulme.
12,277. Self-cleaning Adjustable Corn Screens, W. Hornsby, R. Edwards, J. Money, and S. Manning, Grantham.
12,278. Spirit Levels, J. Thropp, Birmingham.
12,279. Breaks for Treating Dough, J. Vicars, sen., T. Vicars, and J. Vicars, jun., Liverpool.
12,280. Self-closing Taps or Valves, T. Kennedy, Glasgow.
12,281. Appliance to Judge Length, &c., T. R. Ablett, Blackheath.
12,282. Marine Governors, J. W. Balet, Rotterdam.
12,283. Galvanic Batteries, G. Nifosi, Newcastle-on-Tyne.
12,284. Ships' Warping or other Capstans, W. Hillyard, Gateshead-on-Tyne.
12,285. Water Meters, D. Fergusson, Portsmouth.
12,286. Water Meters, D. Fergusson, Portsmouth.
12,287. Window Sash Fastener, A. Lewis, London.
12,288. Secondary Batteries, H. Thame and J. R. Thame, London.
12,289. Looms for the Manufacture of Tufted Carpets, &c., Henderson and Co. and E. Buckley, London.
12,290. Heating Water, G. Brockelbank, Anerley.
12,291. Stands for Tea-pots, W. Soar, London.
12,292. Cooking Ranges, S. Hawkin and A. T. Clapton, London.
12,293. Reducing the Vibration of Bicycles, &c., A. W. Child and G. B. Childs, London.
12,294. Heating Wash, T. Webb, London.
12,295. Water-closet Basins, H. W. Buchan, Glasgow.
12,296. Sewing together Jacquard Cards, H. Sands, Glasgow.
12,297. Safety Valve for Steam Boilers, B. Hawerkamp.—(*R. Urbanitzky, Austria.*)
12,298. Extracting Carboniferous Materials, H. Stier, Saxony.
12,299. Composition Applicable for Fire-lighters, W. B. Dobell and B. Mott, Liverpool.
12,300. Pumps, W. Brandsma, Liverpool.
12,301. Locking and Unlocking Railway Carriage Doors, D. T. Gordon, Maryfield.
12,302. Rendering Leather Durable and Pliable and Proof against Damp, H. E. Howe, London.
12,303. Working, &c., Railway Signals, J. Puntis, Basingstoke.
12,304. Lowering and Raising Ships' Boats, W. R. M. Thomson.—(*R. H. Earl, Newfoundland.*)
12,305. Liquid Soap, R. Livesey.—(*Dr. Duncan, Russia.*)
12,306. Pianoforte Insulators, E. Bishop, London.
12,307. Tricycles, L. F. Appleton, London.
12,308. Blinds, W. C. Morton and A. C. Hardy, Birmingham.
12,309. Machine for Planing, &c., J. Kent, London.
12,310. Centrifugal Pumping Machinery, J. Gwynne and D. H. Morton, London.
12,311. Safety Saddle Bars for Ladies' and Gentlemen's Saddles, F. V. Nicholls, London.
13,312. Causing the Germination of Barley, &c., W. R. Lake.—(*G. Stollwerck, Germany.*)
12,313. Opening and Closing Electric Circuits, W. R. Lake.—(*G. Péreire and G. F. Jarland, France.*)
12,314. Attachment for Artificial Teeth, A. A. Bossert.—(*A. Friederik, Germany.*)
12,315. Coal Scuttles, W. R. Selkirk, London.
12,316. Spring Box for Measuring Tapes, W. Chesterman, London.
12,317. Wind Gauge for Fire-arms, W. W. C. White London.
12,318. Weaving Cut Pile Fabrics, Sachsiche Webstuhlfabrik (L. Schönherr) and O. Hallensleben, London
12,319. Wire Ropes, J. Humble and H. M. Morrison, London.
12,320. Corkscrews, H. J. Haddan.—(*A. F. Petersen, Denmark.*)

16th October, 1885.

12,321. Reeling or Winding Yarn or Thread, W. Noton, Oldham.
12,322. Wind Baffling Chimney-top, F. H. Smith, Belfast.
12,323. Operating Points or Switches, J. S. Edge, jun., Birmingham.

12,324. True North Compass, B. M. Dawes, Farnborough.
12,325. Electro-motors, J. Riley, Alfreton.
12,326. Screen Hinge, A. G. Spinney, Salisbury.
12,327. Bottles, J. Humphreys, Manchester.
12,328. Fire-proof Pillars and Columns, R. B. Lee, Manchester.
12,329. Automatic Sight-feed Lubricator, T. Winter, Blackburn.
12,330. Bedsteads, H. Beuttell, Halifax.
12,331. Marking Lawn Tennis Courts, S. W. and P. Baker, Bristol.
12,332. Flour Dressing Machines, J. W. Crosby, Bradford.
12,333. Safety Innocuous Coffins, &c., T. Martin, Guernsey.
12,334. Driving Spindles, A. King.—(*W. Baird, Canada.*)
12,335. Automatic Indicator and Governor for Locomotives, &c., J. Simister, Manchester.
12,336. Applying a Wind Blast to Flames, R. W. Hewett, Birmingham.
12,337. Supports for Shafting, &c., J. S. Taylor and S. W. Challen, Birmingham.
12,338. Warming and Cooking Food, &c., R. Jackson, Leeds.
12,339. Chimney Cap, H. Sloane, Belfast.
12,340. Bottle Stoppers, F. Fidler, near Sheffield.
12,341. Forks and Tongs for Domestic, &c., Uses, F. Fidler, near Sheffield.
12,342. Arc Lamp, C. S. Sibley, Cheltenham.
12,343. Treadle Mechanism for Tricycles, H. E. Hutchins, London.
12,344. Utilising Waste Liquors containing Calcium-chloride, J. Webster, London.
12,345. Wheel with Springs for Spokes and Felloes, J. E. Howard.—(*C. Wahl, Königsberg.*)
12,346. Primary Electric Batteries, C. W. Stewart, London.
12,347. Measuring Electric Currents, W. Thomson, Glasgow.
12,348. Railway Signals, W. S. B. Kempe and W. F. Rowell, Wimbledon.
12,349. Driving Mechanism for Velocipedes, P. L. C. F. Renouf and I. W. Boothroyd, London.
12,350. Velocipedes, P. L. C. F. Renouf and I. W. Boothroyd, London.
12,351. Combined Tell-tale and Indicator for Public Vehicles, J. P. James, London.
12,352. Steam Boilers, G. Kingdon, F. C. Simpson, J. B. and E. F. Denison, London.
12,353. Suspended Wickless Oil Lamps, J. Cox, London.
12,354. Freshening or Drying Tobacco, &c., T. Hill, London.
12,355. Blast Furnaces, W. Edmunds, London.
12,356. Washing Plates, G. W. B. Crees, London.
12,357. Cotton's Patent Frames, W. Tyler, London.
12,358. Bottoms of Chair Legs, Crutches, &c., J. Reynolds, Liverpool.
12,359. Steam Engines, T. Mudd, Liverpool.
12,360. Telegraphing Addresses, A. Featherstonhaugh, London.
12,361. Stoppering of Bottles, &c., R. G. Sanders, London.
12,362. Steering Apparatus for Vessels, J. I. Thornycroft, London.
12,363. Music Binders, J. S. Neil, Glasgow.
12,364. Filters, T. Swan, Glasgow.
12,365. Fly Rails for Tables, C. J. Day and R. Hetrick, Glasgow.
12,366. Corsets, E. A. Ford and J. Ford, London.
12,367. Producing Designs on Waterproof Fabrics, G. C. Mandleberg, H. L. Rothband, and S. Mandleberg, Lond
12,368. Camp Beds, W. E. Gedge.—(*E. Guilloux, France.*)
12,369. Oval Lathes, W. H. Barker, G. Barker, and G. Embrey, London.
12,370. Electric Bells, F. Wordley, London.
12,371. Controlling the Action of Dynamo-electric Machines, A. P. Trotter, London.
12,372. Regulating the Action of Dynamo-electric Machines, L. J. Crossley, W. T. Goolden, and A. P. Trotter, London.
12,373. Trousers Stretchers, A. S. Bishop and F. Down, London.
12,374. Holding Dry Plates in Cameras, T. Samuels, London.
12,375. Packing Cases, S. J. Pocock, London.
12,376. Omnibus and Tram Checks, G. V. Jameson and J. E. Tenison-Woods, London.
12,377. Bottles and Jars, H. Codd, London.
12,378. Galvanic Batteries, A. Schanschieff, London.
12,379. Latches for Doors, &c., G. R. Wynne, London.
12,380. Grenades for the Extinction of Fire, P. Jolin, London.

17th September, 1885.

12,381. Tricycle or other Cycle Motor, A. R. Norman, London.
12,382. Clothes Guide for Wringing Machines, G. Ashworth, Oxenhope, near Keighley.
12,383. Artificial Stones and Concretes, A. C. Ponton, Parkstone.
12,384. Electrical Submarine Vessel, J. F. Waddington, Birkenhead.
12,385. Steam Engines, E. R. Royston, Liverpool.
12,386. Shuttle Tongues used in Looms for Weaving, J. Pickering, Halifax.
12,387. Children's Toy Dolls, J. L. Hinde, Birmingham.
12,388. Leno Weaving, E. Smith, Manchester.
12,389. Screw Gill Drawing Machinery, A. Smith and H. W. Whitehead, Bradford.
12,390. Building Materials, J. S. Armstrong, Canada.
12,391. Bricks, H. Wiesen, London.
12,392. Safety Sash Fastener, C. Fellows, Wolverhampton.
12,393. Ventilators, J. Northwood, Birmingham.
12,394. Horse-shoes, W. E. Carmont and M. Dobsone, Manchester.
12,395. Lubricating the Bearings of Shafts, W. Butterworth, H. Shawcross, and B. Butterworth, Rochdale.
12,396. Fulling and Planking Woven, &c., Goods, J. Southworth and P. Richardson, Manchester.
12,397. Kitchen Ranges, T. E. Cleathers, J., W. R., and R. Green, Ecclesfield.
12,398. Regulation, &c., of Heat for the Artificial Incubation of Eggs, R. R. Kelly and W. H. Akester, London.
12,399. Polishing Surfaces of Marble, &c., W. Carter, jun., and G. McPherson, Glasgow.
12,400. Tire Fastener, J. Seddon and F. Hall, Bilston.
12,401. Portable Pens and Houses, J. Elwell, Birmingham.
12,402. Window Sashes of Iron, C. and R. E. Marshall, Cheltenham.
12,403. Flushing Cisterns, J. Deeley, Birmingham.
12,404. Armour for Ships of War, R. and C. B. Phillips, Chester.
12,405. Brick and Tiles, J. J. Allen, Leeds.
12,406. Feed Knives for Combing Machines, A. Benn, Bradford.
12,407. Metallic Combs, T. Nuttall, Ramsbottom.
12,408. Wrapping Wire Spirally upon Spindles, J. Walker and W. Pass, Manchester.
12,409. Regulating the Speed of Engines, H. B. Barlow.—(*J. W. Johnson, London.*)
12,410. Gas Pokers, F. C. Dixon, London.
12,411. Trusses for Hernia, E. de Tomanzie and M. E. de Tomanzie, London.
12,412. Stoppering Bottles, H. Brecknell, Bristol.
12,413. Cleaning Knives, H. A. H. Guhl, Hamburg.
12,414. Pens, G. Hopenstal, London.
12,415. Organs, E. H. Suggate, London.
12,416. Enabling the Points of Railway Lines to be Operated from the Vehicles, J. Y. Johnson.—(*G. Ripberger, Germany.*)
12,417. Apparatus for Weighing, W. Thomson, Glasgow.
12,418. Sectional Boilers, A. Bachmeyer, London.
12,419. Planing, &c., Machines, W. Gleeson, London.
12,420. Convertible Velocipedes, H. Morehen, London.
12,421. Carriage Springs, G. G. Tandy, London.
12,422. Knives and Forks, J. Ockermüller, London.
12,423. Suction Apparatus for Paper-making Machines, W. Raitt, London.
12,424. Gas Motor Engines, J. Southall, London.
12,425. Portable Stands for Music Books, A. Nicholson, London.
12,426. Cylinders for Printing Continuous Patterns, E. Vanoni, London.
12,427. Registering Temperatures, J. Y. Johnson.—(*Richard Brothers, France.*)
12,428. Carbons for Electric Arc Lamps, O. G. Pritchard, London.
12,429. Speed Indicators, G. Rung, London.
12,430. Claret Jugs, W. R. Selkirk, London.
12,431. Gas Burners, H. and M. Heale, London.
12,432. Flushing Valves, J. J. and T. I. Day, London.
12,433. Churn, W. R. Lake.—(*A. Vásárhélyi, Hungary.*)
12,434. Emptying Railway Wagons, W. R. Lake.—(*A. Wolcott, U.S.*)

19th October, 1885.

12,435. Inspecting Rifles from the Breech, &c., W. J. Jeffrey, London.
12,436. Cigarettes, W. Bradford and L. Blumfeld, London.
12,437. Mathematical Compass, J., T. C., and F. W. Waite, Derby.
12,438. Tools for Finishing Boots, &c., T. Gare, Stockport.
12,439. Gas Engines, T. H. Ward, Tipton.
12,440. Tricyles and Quadricycles, T. H. Ward, Tipton.
12,441. Aerated Drink, C. R. C. Tichborne and A. W. Orr, Dublin.
12,442. Felt Hats, J. Eaton, Stockport.
12,443. Metallic Bedsteads, S. B. and S. I. Whitfield, Birmingham.
12,444. Box for Flatirons, &c., G. Read, Deal.
12,445. Metallic Bedsteads, J. Brookes and J. E. Britton, Birmingham.
12,446. Winding Frames, F. Hebden, London.
12,447. Steam Boilers, H. Dent, London.
12,448. Sash Fasteners, H., J., and W. Ward, Leeds.
12,449. Forging Blank Bolts, &c., E. Davies, G. Partington, and A. Bullough, London.
12,450. Indicating Strengths of Powder Charges, F. W. Ticehurst, Birmingham.
12,451. Attaching, &c., Gear for Coal Tubs to Endless Ropes, J. Watson, Ashington Colliery.
12,452. Woven Fabrics, A. Mitchell, Bradford.
12,453. A Poison Guard, J. Wood, Barrow-in-Furness.
12,454. Medicating Saccharine, &c., Substances, A. Jones, London.
12,455. Boiler Tube Stopper, J. Rough, Newcastle-on-Tyne.
12,456. Cavalry and Field Boot, G. W. Dolman, Landport.
12,457. Slides for Optical Lanterns, A. Pumphrey, Birmingham.
12,458. Spokeshaves, Planes, &c., E. Preston, Birmingham.
12,459. Hanging Pictures, &c., M. Brown, Withernsea, near Hull.
12,460. Safety Guard for Cigars, &c., F. C. Leonardt, Birmingham.
12,461. Smyrna or Turkey Carpets, C. Spannagel, London.
12,462. Cutting and Lighting Cigars, T. B. Harrold, London.
12,463. Yeast, W. S. Squire, London.
12,464. Trusses for Hernia, A. Hodge, London.
12,465. Excentrics, J. Heald and E. Bray, Leeds.—14*th July*, 1885.
12,466. Lightning Conductor Points, B. F. Howard and T. L. Haig, London.
12,467. Velocipedes, &c., D. W. Crossland, London.
12,468. Water-closet Basin, J. Cushing, London.
12,469. Arm-holes of Waterproof Cloaks, J. Neville, Enfield.
12,470. Whitewash or Distemper Brush, T. Murphy, London.
12,471. Flushing Closets, S. Johnson, London.
12,472. Holders for Railway Tickets, A. J. Boult.—(*H. Meyer, Batavia.*)
12,473. Automatic Wagon Brakes, W. P. Thompson.—(*G. Reinke, Germany.*)
12,474. Photographs, E. Slater, Liverpool.
12,475. Electric Telegraph Insulators, J. S. Lewis, Liverpool.
12,476. Promoting Combustion in Furnaces, J. Shaw and N. Arthur, Glasgow.
12,477. Combination Cowl or Ventilator, G. Smith, London.
12,478. Scythe Hammer and Sharpener, W. R. M. Thomson.—(*E. Vadily, Hungary.*)
12,479. Folding Bedsteads, H. E. Newton.—(*F. S. Hall, U.S.*)
12,480. Fare Indicators or Bell Punches, A. Warner, London.
12,481. Cutting Rose Cutters, &c., P. P. Huré, London.
12,482. Bicycles, J. D. S. Campbell, London.
12,483. Gas Engines, A. M. Clark.—(*The Economic Motor Co., U.S.*)
12,484. Material for Lining Furnaces, &c., A. Brin, London.
12,485. Zincing Sheet Metal, F. W. Koffler and E. Zwierzina, London.
12,486. Fire-escape, J. Dettrick, London.
12,487. Protecting Fence Posts, &c., R. Griffiths, London.
12,488. Filters, W. C. Dickenson, London.
12,489. Revolving Tooth Brush, F. W. Tornberg, London.
12,490. Preventing the Rotation of Whirl Frames of Wire-rope Twisting Machines, C. Berta and J. Pollak, London.
12,491. Tricycles, T. Humber, London.
12,492. Extracting Oils from Waste Products, A. T. Hall, London.
12,493. Treating Broken Stone, &c., W. J. Chalk, London.

SELECTED AMERICAN PATENTS.

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

325,377. Gas Engine, *Cyrus W. Baldwin, Yonkers, N.Y.—Filed March 20th,* 1885.

Claim.—(1) The combination, with a casing or reservoir, and with a pump for exhausting the contents thereof, of a perforated pipe or tube communicating with a gas pipe and arranged between an air port and a port communicating with the reservoir to leave a narrow air passage adjacent to the perforations in the gas pipe, substantially as set forth. (2) The combination, with a casing or reservoir having an inlet provided with a valve, of a casing provided with an air inlet, and narrow air passage between the air inlet and the valve, and a gas pipe communicating with perforations opposite the said narrow passage, substantially as and for the purpose set forth. (3) The combination of a power cylinder and piston, a reservoir having an inlet opening and valve, a casing provided with an air inlet opening and valve and a perforated tube communicating with a gas pipe, and arranged between the two valves opposite a narrow passage, and a governor and valve controlling the flow of gas to the gas pipe, substantially as described. (4) The combination of a power cylinder and piston, a reservoir, a pump connected to supply the reservoir with gas and air, and a perforated gas pipe arranged opposite a contracted passage, through which the air flows to the reservoir, substantially as described. (5) The combination, with a power cylinder and piston and with a pump, of a perforated gas pipe arranged opposite a narrow passage through which the air is supplied to the pump, substantially as described. (6) The combination, with the power cylinder and piston, of a reservoir provided with inlet ports and valve, a casing containing a chamber communicating with said inlet ports and provided with air ports closed by a valve, and a perforated gas pipe arranged between the air ports and inlet ports opposite a narrow passage, and a pump connected to draw the air and gas into the reservoir upon its movement in one direction, and to compress the mixture upon its opposite movement, substantially as decribed. (7) The combination, with the power cylinder provided with a lateral inlet port, of a series of deflector plates, each projecting into the inlet port at the rear edge to a slight extent farther than the next lower plate, substantially as and for the purpose described. (8) The combination, with the power cylinder and inlet port, of a series of parallel deflector plates arranged at about right angles to the inlet port, substantially as and for the purpose specified. (9) The combination, with a power

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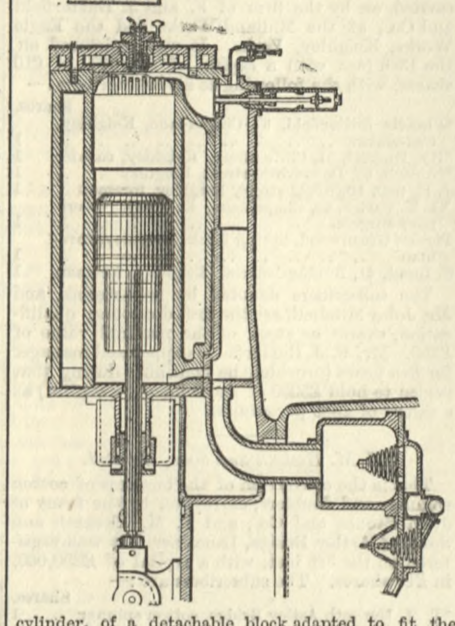
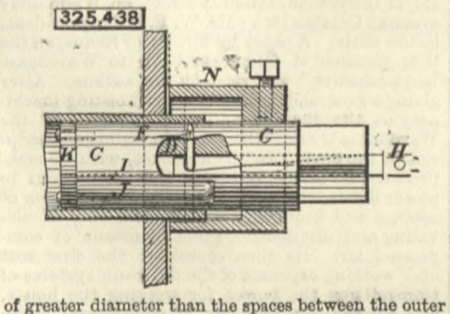


cylinder, of a detachable block adapted to fit the interior of the cylinder, and provided with parallel deflector plates, substantially as set forth. (10) The detachable block adapted to the bore of a power cylinder, provided with a series of parallel plates, each projecting at the rear edge beyond the plate below it, and cut away to form with the head of the cylinder a recess communicating with the inlet port, substantially as set forth. (11) The combination, with a power cylinder and air and gas pipes or ports, of a valve casing communicating with the gas pipe and provided with a valve, and a stem extending through the casing, a governor, and an arm connected to be operated by the governor and provided with a bevelled edge arranged opposite the end of the valve stem, substantially as set forth.

325,438. Boiler Tube Cutter, *George W. Odgers, Elizabeth, N.J.—Filed September 26th,* 1884.

Claim.—(1) The combination, in a tube cutter, of the cylindrical cutter stock, provided with a transverse slot, a cutter therein, a longitudinal aperture and adjusting bar therein, and longitudinal cylindrical recesses extending inward from the outer surface of the stock separate from the longitudinal aperture, and anti-friction rollers held within said recesses, and projecting beyond the face of the cutter stock, said rollers being of greater diameter than the space between the outer edges of the recesses, whereby the necessity of pivotting the roller is dispensed with, substantially as set forth. (2) A tube cutter consisting, essentially, in the stock C, provided with transverse slot D, longitudinal angular aperture G, and longitudinal recesses I, independent of the longitudinal aperture, anti-friction rollers J, projecting through said recesses and

325,438



of greater diameter than the spaces between the outer edges of said recesses, the removable cap plate K, secured to the forward end of the cutter stock for holding the rollers in place, the slotted cutter E, and the feed bar H, substantially as set forth. (3) A tube cutter consisting of the cylindrical stock C, squared at one end, and provided with transverse slot D, slotted cutter E, longitudinal central aperture made angular at G, longitudinal recesses I in the outer face of said stock and separate from the longitudinal recess, the anti-friction rollers J therein and of larger diameter than the space between the outer edges of the recesses, the removable end plate K, the feed bar H, inclined at its forward end and passed through the slot of the cutter, and the tubular adjustable excentric collar N, substantially as set forth.

325,489. Crank for Engines, *John L. Bogert, Flushing, N.Y.—Filed January 31st,* 1885.

Claim.—(1) The crank composed of the three pieces A B C and the bolts F, to clamp them together and bind the crank pin and shaft, respectively, substantially as set forth. (2) The combination, with the

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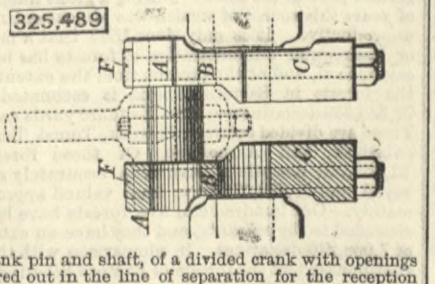

crank pin and shaft, of a divided crank with openings bored out in the line of separation for the reception of the crank pin and shaft, respectively, and the tie bolts that connect the parts of the crank and clamp the divided crank upon the shaft, substantially as set forth.

325,668. Car Axle-box, *Edward J. Frost, Philadelphia, and William Dawson, Montgomery County, Pa.—Filed November 14th,* 1884.

Claim.—The combination, with the journal and the journal-box, of the receptacle D, forming the bottom of said journal-box, the lateral flanges *d d*, the frame G, having elliptical springs H H, which rest upon said

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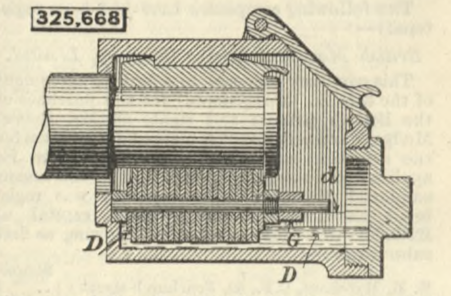

flanges, and the roll of absorbent material journalled in said frame, substantially as set forth.

325,681. Water Filter, *Osmund S. Lindon, San Francisco, Cal.—Filed August 4th,* 1883.

Claim.—(1) The herein-described filter comprising the chamber G, with end strainer chambers and the central filter chamber P, the outer case C, having the grooves and slitted ends, the clamping ring D, the

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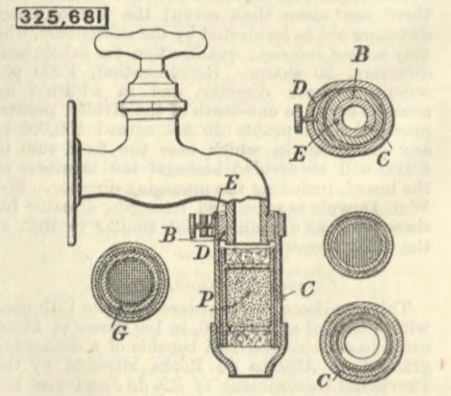

crescent-shaped clamping ring, and the set screw adapted to bear against the same, substantially as set forth. (2) In water filters, the clamping ring D and crescent clamp E, in combination with the grooved and slotted end of the outer case C, and the packing B, substantially as and for the purposes set forth.

325,860. Power Mechanism for Actuating Steam Hammers, &c., *John W. Pertz, Pittsburg, Pa.—Filed September 24th,* 1884.

Claim.—(1) In a power motor for actuating a tool, the combination of a steam cylinder and piston, an auxiliary air cylinder and piston, said pistons being coupled together, a valve for controlling the port of the steam cylinder, and an ejector, substantially as and for the purposes specified. (2) The combination, with a steam cylinder, of a valve chamber having a

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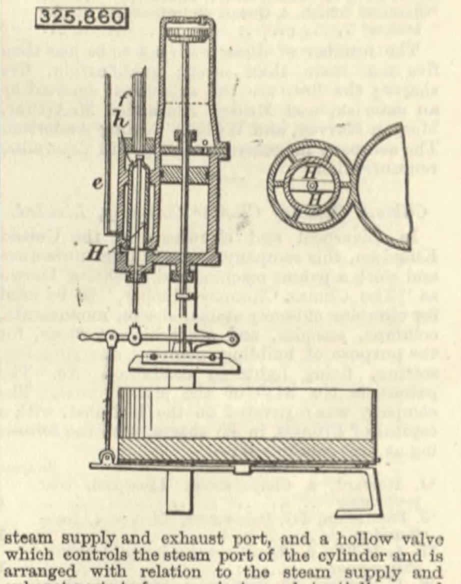

steam supply and exhaust port, and a hollow valve which controls the steam port of the cylinder and is arranged with relation to the steam supply and exhaust ports to form an ejector, substantially as and for the purposes specified. (3) The combination, with a steam cylinder having a port *a*, of the valve chamber having the steam supply pipe *e* and exhaust pipe *f*, and the hollow cylindrical sliding valve H, having the ports *h h*, substantially as and for the purposes specified.

325,915. Electric Locomotive Engine, *Leo Daft, Greenville, N.J.—Filed January 11th,* 1883.

Claim.—The combination, with the track connected to the source of electricity, of a field magnet, two armatures driven thereby, driving wheels supporting the engine, directly connected with the armatures

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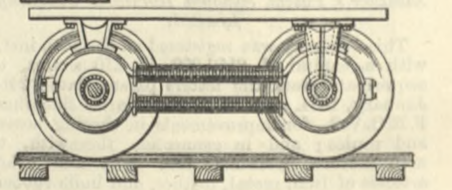

and adapted to receive the current from the track and circuit connections, substantially as described, whereby the current from the track passes through the wheels and to and through the armature and field magnet coils, substantially as described.

325,950. Bell Crank for Mowing Machines, *Dewitt C. Markham, Towanda, Pa.—Filed July 15th,* 1884.

Claim.—The knife of a mowing machine, in combination with a bell crank, which imparts reciprocating

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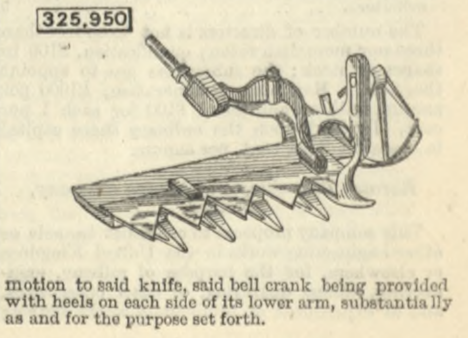

motion to said knife, said bell crank being provided with heels on each side of its lower arm, substantially as and for the purpose set forth.