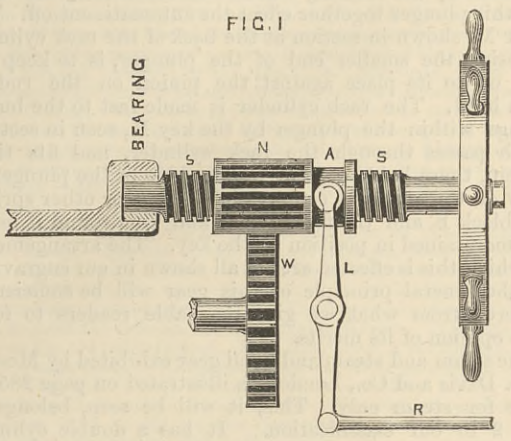
STEERING GEAR IN THE NAVAL AND SUBMARINE EXHIBITION.

Although many mariners still urge arguments that are very far from groundless against the use of steam steering gear, and indeed any of the modern steering gear by which the tiller chain or rope is rigidly held, the employment of the steam engine for this purpose has made rapid progress during the past few years. Made in the first instance for the largest ships only, it may now be found in vessels of but a few hundred tons register. The work has been done often enough by steam to make mariners impatient of the slowness of the old hand gear, and of the employment of half-a-dozen men to do the easy work of one assisted by steam. It still remains a disadvantage belonging to many of the modern gears that they hold the tiller chain with unrelenting firmness in any sea, and hence rudders and rudder connections are severely strained or broken at dangerous times. This however is not the case with all gears, and plainly the balance of advantage is in general on the side of steam gear, especially for the vessels on which it is desirable to steer either from the bridge or deck. In the Exhibition there was a good representative collection of steam and of steam and hand gear by the principal firms engaged in its manufacture. The steam gears are chiefly of three kinds—(1) those having double cylinder engines geared direct to a hauling drum by means of a worm on the crank shaft, and worm wheel on the drum shaft; (2) those having double cylinder engines geared to pitch chain or messenger hauling wheels, by means of a worm on the crank or secondary shaft; (3) those having double or triple cylinder engines connected by spur gearing only, to the hauling drum or pitch chain wheel; and (4) those having one large steam cylinder the piston of which gives direct pull to the tiller ropes through the medium of a rack and pinion operating a rope sheave or a messenger wheel. The combined steam and hand gears vary so much that it would be difficult to classify them, for while one is so arranged that the steering may be done indifferently by hand or steam, or both at the same time, some have one clutch for throwing either the steam or the hand into gear, while one has three clutch handles to attend to. Like the steam gear alone, however, they may be divided into those which have rotating engines connected to the hauling drum or messenger wheel through a heavy worm on the crank or secondary shaft, and those which work with spur gear.

FIG. 1

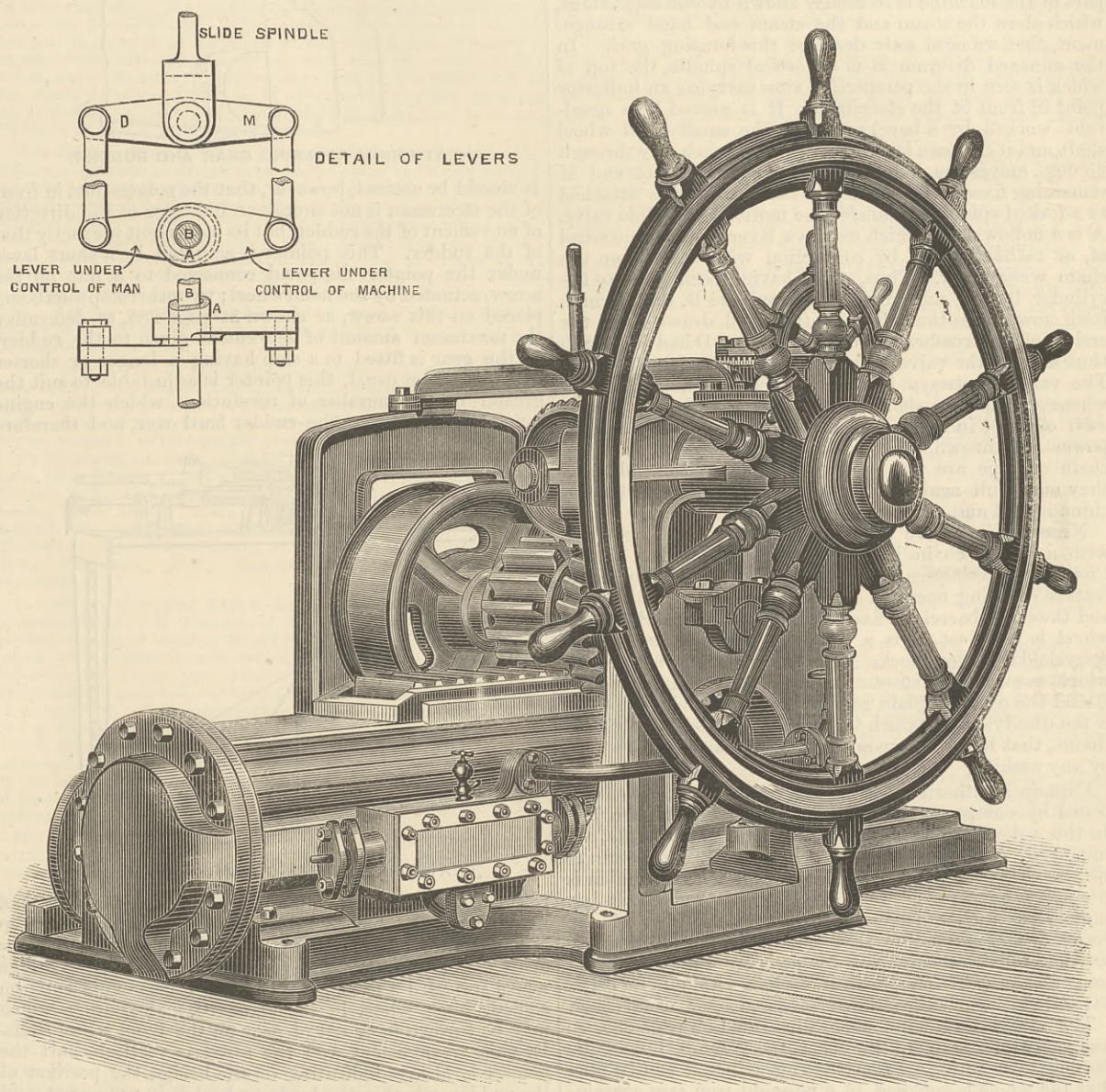


HUNTING VALVE GEAR.

In almost all these the distribution of the steam to the cylinder or cylinders is effected by a separate distributing valve, operated by screw hunting gear, the rotating engines having, of course, the usual slide valves, either D or piston form as usual. There are, however, two exceptions to this form of hunting gear to which we shall refer. For those unacquainted with screw hunting valve gear we may briefly explain its principle. Upon or connected directly with the hand wheel shaft is a screw, as shown at S in the above sketch. Upon or about the middle of this is a pinion nut N with a clutch groove A. Into this groove takes a clutch lever L, connected to the steam distributing valve by the rod R. Gearing with the pinion N is a wheel W, either upon the hauling drum shaft or directly connected therewith. Now, then, it will be seen that if the hand wheel is turned either way the lever L and the rod R will be correspondingly moved, thus admitting steam to the engine cylinder or cylinders. As, however, the wheel W is directly connected with the hauling wheel, it will be seen that immediately the engine begins to work, this wheel puts the pinion back to its central position, at which steam is cut off, and so if a further pull on the rope or chain is required the hand wheel must be again moved. The movement to be given to the steam steering hand wheel is thus exactly similar to that for hand steering, except that the wheel is perhaps not more than 18in. or 2ft. in diameter, instead of 4ft. or 5ft. The arrangement above indicated is that adopted by two or three makers, but though differently arranged, the principle upon which all the screw hunting gears are made is the same. The hand wheel opens the steam valve, and the engine immediately commences to close it, and does so in a greater or less number of revolutions, or even a half revolution, according to the movement given to the hand wheel.

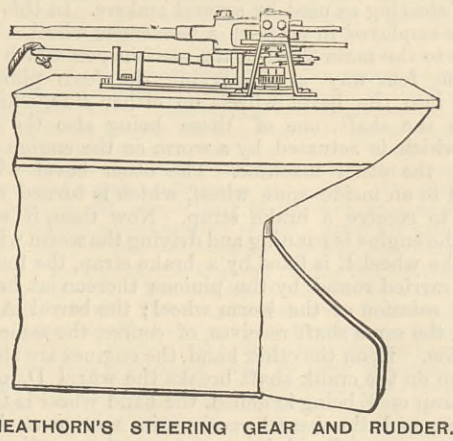
We will now refer to the gears exhibited, taking them in the order of the numbers of the stands on which they are exhibited. In this way we first come to that of Mr. Douglas Coulson, of Sunderland, which is the gear above referred to as having the unique arrangement by which either hand or steam-power may be used indifferently. This gear is illustrated by the annexed engravings, which are not complete as to detail, but they show the general arrangement and the principle of its construction. From these it will be seen that the hauling drum or wheel B is connected to the piston-rod of the large steam cylinder. From the transverse section it will be seen that the wheel B is centrally a worm wheel carrying at its sides the grooves for chains or ropes. From the side elevation it will be seen that under the upper part of the frame there is a large screw A, which gears into the wheel B. This screw acts as a screw when steering is done by hand, the wheel B being turned by it and the ropes hauled according to the movement of the large steering wheel. When the large steering wheel is not moved this worm is fixed, and upon using the small steering wheel, steam is admitted to the cylinder, and the wheel B moves outwards or inwards, at the same time revolving, owing to the screw A acting now as a rack; the ropes are thus hauled according to the direction the small steering wheel is turned. The valve gear is not all shown in our engravings, but from them it will be seen that immediately the piston actuating the wheel B moves, the nut attached to its crosshead causes the screw S to revolve, and thus the distributing valve bevel wheel I—see page 284—by which it is connected to the distributing valve V. As soon as the hand wheel is moved the nut N on the top spindle moves the distributing valve spindle and the engine starts, and by its connection through the wheel B, the rod J, and the lever R, commences to move the nut back as before described, the fine screw S operating the pointer. This steam gear takes up little room, is completely boxed in, and is compact, and the valve gear is arranged so that it is very sensitive, and may be said to follow the movements of the hand wheel exactly, but the compactness has not been obtained without some loss of accessibility of parts. The change from hand to steam steering or *vice versâ* is made by one movement of a clutch lever on the hand wheel shaft, and the chain which passes over the hauling wheel W and under two guide sheaves is not absolutely rigidly held against the rudder, as it is free to pull against the steam.

The next steam and hand gear is that of Messrs. Donkin and Nichol, of Newcastle-on-Tyne. This is one of those in



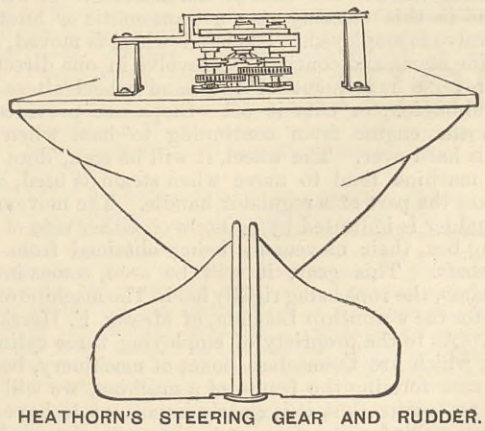
MESSRS. R ROGER AND CO.'S STEAM AND HAND STEERING GEAR (SIMEY'S PATENT) *See next page.*

moves in the direction from which the hand wheel has just moved it, and thus it shuts off steam until the hand wheel is again moved. This, it will be seen, takes place whichever way the hand wheel is moved, just as it does in the diagram given above. An advantage which this arrangement possesses is, that when the rudder receives a very heavy blow, it is not rigidly held by the hauling ropes, as these may give under exceptional strains by pulling the piston against the steam pressure, which forms thus an excellent extension buffer or cushion.



HEATHORN'S STEERING GEAR AND RUDDER.

The next gear we come to is the "Steam Quarter Master," as it is termed by the inventor, Mr. Higginson, of Liverpool. In some respects this resembles an ordinary crab winch fitted with pitch chain wheel in place of a barrel, and with an engine and hunting cut-off gear. The engine has three small cylinders P P; on the crank shaft of which the pitch chain or hauling wheel is carried loosely, but attached to the large spur wheel, into which gears the pinion on the outer end of the engine crank shaft. The hunting gear is in the upper part of the machine, the screw being part of the hand wheel shaft, the end of which is fitted with a our second classification, namely, those in which a messenger wheel is connected to the engine by a large worm which acts as a continuous pawl and rigidly holds the chain or rope. It has a double-cylinder vertical engine, which drives a horizontal shaft by means of a worm on the crank shaft, and this shaft is connected to the large worm for driving the hauling wheel by mitre gear. The worm wheel C driven by the worm on the crank shaft is loose on the horizontal wheel shaft, or is caused to drive it by means of the clutch and its lever E. When hand power only is used, this clutch is thrown out of gear and



HEATHORN'S STEERING GEAR AND RUDDER.

the clutch A is thrown into gear with the pinion B, by which the worm on the chain wheel shaft is placed in gear with the large hand wheel In using steam the mitre wheels H and I are worked so as to operate the distributing valve on the spindle K. When the messenger wheel shaft revolves, the bell-crank lever shown in the elevation is moved by the nut held by its lower arm, and this raises or lowers the spindle by the nut at L, thus tending to shut off steam directly it has been admitted by the hand-wheel through the medium of the bevel wheels H and I. The principle of the action of the admission

and cut-off gear is thus the same as that shown in our diagram, though carried out in a different way. The distributing valve is of the ordinary D form, and the pinion H is operated by the small hand wheel which is on a small spindle within the hollow spindle operated by the large hand wheel. To prevent the large hand wheel or the small hand-wheel from revolving when steam or hand power respectively are employed, as they would tend to do under the influence of friction, the set screws O and P respectively are set into holes, the one in the boss of the large hand wheel, and the other in the boss of the pinion H. In this steering gear there are, it will be seen, no large spur wheels, but there are two power worms and worm wheels, and the general arrangement differs in several respects from any of the others in the Exhibition.

The next steam and hand gear on the list is that of Mr. Simey, as made by Messrs. Robert Roger and Co., of Stockton-on-Tees. In this we have a large steam cylinder connected by a rack direct to the messenger wheel shaft, and the hunting gear is of a different character, as shown by the engravings. The general arrangement of the main part of the machine is so clearly shown by our engravings, which show the steam and the steam and hand arrangement, that we need only describe this hunting gear. In the annexed diagram B is a vertical spindle, the top of which is seen in the perspective view carrying an indicator point in front of the steersman. It is moved by a quadrant worked by a bevel pinion on the small hand wheel shaft, and it carries a lever which, moving each way through 45 deg., moves the end of a crosshead D, the other end M remaining fixed. The centre of the crosshead is attached to a forked spindle to transfer the motion to the slide valve. A is a hollow shaft which carries a lever under the control of, or rather moved by connection with a worm on the chain wheel shaft. Thus, steam having been given to the cylinder by the movement of the spindle B, the machine itself now moves the hollow shaft A, and draws back the end M of the crosshead as much as the end D had advanced, thus moving the valve back again, and shutting off steam. The valve is always in position for shutting off steam whenever the two short levers on A and B are opposite each other or in line. In this machine the hand or steam power are thrown into gear by one clutch lever, and the chain or rope are not rigidly held against the rudder as they may pull against the steam as a cushion. The machine is well and very strongly made.

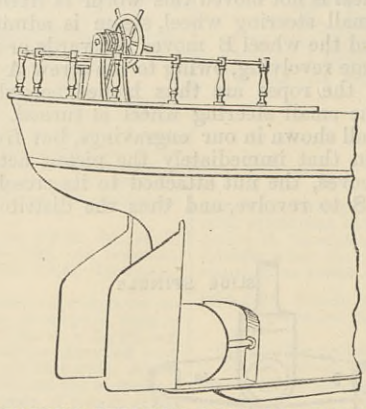
Near to the above steam gear is Archer's hand gear with a volute chain barrel, as exhibited by Mr. G. H. Chaplin, of Bishopsgate-street. This gear has the novel feature of being operated by means of epicycloidal gear, and thus the barrel is fixed at any point at which the wheel is left just as is a weight by the self-sustaining epicycloidal pulley blocks. The arrangement is thus one which secures the steersman from the dangers which attend the common plain gear in heavy weather, but there is the disadvantage which belongs to all these rigidly held chains, that the shock upon the rudder gear is not lessened by any cushion.

Captain Heathorn's steering and checking gear as illustrated by our several engravings is the next on the list. In this a double rudder, or two rudders side by side, are employed, and double curved links are employed to operate them. Besides this is a second lever, to which is attached a hand rope. This sets the two rudders at any angle from each other, so as to check the way of the vessel, or places them so that they point ahead, in which position they are employed for steering the ship when going sternward. The illustrations herewith, and on pages 281 and 284, clearly show the purpose and action of this gear.

The steam and hand gear, illustrated on page 285, as designed and exhibited by Mr. E. E. Wigzell, London, is the next in order. From the engravings it will be seen that the whole is enclosed in a wrought iron case containing one of Wigzell's three-cylinder engines, connected by spur gearing and a worm on a short spindle to a worm wheel in the middle of the hauling drum, on either half of which the chain or rope winds. On the short shaft carrying the worm is a pinion K movable on a feather by a clutch lever. This pinion is shown in gear with the spur wheel G on the hand wheel shaft, and thus the steam engine is not in use. If now this pinion is moved to the left it gears with A on the engine shaft, and thus the worm is driven by the engine and not by the hand wheel. The same hand wheel is however used as a continuation of its shaft, is fitted with wheels E F G, one of which carries a crank pin, upon which is a rod actuating the distributing valve at the back of the machine. It will be seen that in this steering gear not automatic or hunting cut-off valve is employed. The hand wheel is moved, and the engine starts and continues to revolve in one direction until a reverse movement of the hand wheel alters the steam admission, or cuts it off. Stops are provided to prevent the engine from continuing to haul when the rudder is hard over. The wheel, it will be seen, does not in this machine tend to move when steam is used, as it only takes the part of a regulator handle. The movement of the rudder is indicated by pointers on either side of the enclosing box, their movement being obtained from the worm shaft. This gear, it will be seen, comes into a second class, the rope being rigidly held. The machine exhibited is for the steamship Lucinda, of Messrs. F. Herskind and Co. As to the propriety of employing three cylinder engines, which are themselves boxes of machinery, boxed up in a case forming the frame of a machine, we will not express an opinion, but it is clearly important to have the greatest possible facility of access to the parts of a machine playing so important a part as a steam steering gear does on a ship.

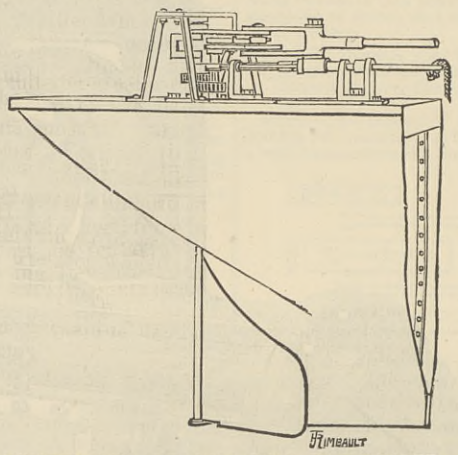
The steering gear which we illustrated in our impression of the 24th ult., as made by Messrs. J. H. Wilson and Co., Liverpool, is next on the list. This is a strong heavy gear for steam and hand, two clutch levers being employed to make the change from hand to steam or *vice versâ*. A screw hunting gear, in combination with a pair of slotted links and excentrics is employed for distributing the steam and effecting reversal, and the arrangement is one which employs the rigidly held messenger wheel and guide sheaves.

We now come to the steam and the steam and hand gears exhibited by Messrs. Amos and Smith, of Hull, and illustrated by the engravings on page 285. The steam gear belongs to class 2, and the automatic cut-off is exactly that shown by Fig. 1, page 281. The arrangement is very neat, and the movement of the chain is very sensitively controlled by the hand wheel and the screw gear. The arrangement is so fully shown by our engravings that we need not stop to describe it, the letters on the engraving, page 285, corresponding with those on our diagram Fig. 1.



HEATHORN'S STEERING GEAR AND RUDDER.

It should be noticed, however, that the pointer just in front of the steersman is not simply an indicator of the direction of movement of the rudder, but its movement is exactly that of the rudder. This pointer is actuated by a short lever under the pointer disc, and connected to a nut on the screw, actuated by the hand wheel; two other stop nuts being placed on this screw, as shown at page 285, to determine the maximum amount of movement given to the rudder. If the gear is fitted to a ship having a longer or shorter tiller arm than usual, this pointer is adjustable to suit the greater or less number of revolutions which the engine must make to bring the rudder hard over, and therefore



HEATHORN'S STEERING GEAR AND RUDDER.

to suit the greater or less number of revolutions that must be given to the hand-wheel, for which purpose the stop nuts must of course be set at a greater or less distance apart. For operating the gear from the deck or bridge wheel standard a light pitch chain is used. This runs on a small pitch wheel in the standard, and another which may be thrown in or out of gear on the hand wheel shaft. By this arrangement and the separate vertical shaft the pointer is always indicating on the bridge the position of the rudder, whether the bridge wheel is in use or not, and the wheel does not revolve when not used. The short spindle of the deck or bridge steering wheel is made of brass or gun-metal, as owing to its being in the direction of the length of the ship, it becomes slightly magnetised if of iron or steel, and as it is always in close proximity to the binnacle it would affect the action of the compass if made of either of the latter metals. Messrs. Amos and Smith exhibit also a large strong hand and steam steering gear, one of the details of which is shown by the section of the compensating motion on page 285. By their application of this gear they are enabled to do away with clutches for making the change from hand to steam or steam to hand steering as used by several makers. In this gear a barrel is employed in place of a messenger wheel. This is fixed on to the main shaft of the machine, on which is also fixed the four-way arm carrying the four pinions C gearing into the bevel wheels on either side, which are loose on the shaft, one of these being also the worm wheel, which is actuated by a worm on the engine crank-shaft in the other machine. The other bevel wheel is attached to an inside spur wheel, which is turned on the outside to receive a brake strap. Now then, it well be seen, if the engine is running and driving the worm wheel D, and if the wheel E is fixed by a brake strap, the four-way arm is carried round by the pinions thereon at half the speed of rotation of the worm wheel; the barrel A being fixed on the same shaft receives, of course, the same speed of rotation. If, on the other hand, the engines are stopped, the worm on the crank shaft breaks the wheel D, and the brake strap on E being loosened, the hand wheel is thrown into gear, and the barrel receives its motion as before. Messrs. Amos and Smith have made another application of this gear, namely, to ships having two hand gears, each connected to the rudder by an independent chain. In this case both the bevel wheels are fitted with a brake strap, and the one or the other screwed up so as to set either the one or other fast, according as it is necessary or desirable to steer with the one or other gear. It will be seen that this gear is very strong, as the strain is distributed over so many cogs.

A hydraulic steering gear, made under the patent of Messrs J. K. Kilbourn and G. Fossick, is exhibited by Messrs. T. Piggot and Co., of Birmingham, for the Improved Steering Gear Company, London. The general principle upon which this is constructed is shown by the engraving, page 284, which is taken from the patent specification of the inventors; but there is of course a pumping engine to supply the water under pressure for this gear, the pumping engine being placed in the main engine-room. It consists of a duplex direct-acting steam engine actuating two double-acting piston and plunger pumps, of such a capacity that, at a piston speed of 60ft. per minute, the rudder would be put over from hard-a-port to hard-a-starboard in fifteen seconds. The valve of each steam cylinder is reversed by the motion of the piston-rod in the other, and so arranged that there is a moment's rest at the end of each stroke sufficient for the valves to get quietly to their seats. With this arrangement of valves it is not possible for the engine to stop in any position where it will not instantly start on admission of pressure. At the rudder head B—see page 284—there are two hydraulic cylinders F F^1, each having a differential ram F^2, which together actuate the rudder stem through shrouded steel racks and pinion L^1. The two cylinders—which are shown, the one in section and one in plan, at page 284—are connected to one system of pipes leading from the pumps. The annular space in each cylinder is always under pressure, while the full area of each cylinder is either pressed or relieved with each change in the position of the rudder. The man at the wheel or on the bridge moves a valve which sets the machinery in action; the rudder follows this motion, and automatically stops at the point determined by the extent of the motion given to the hand wheel. In order to avoid the impact strains which would otherwise be visited upon the rudder and rudder connections, the double buffer springs shown at F are employed, and through these the water pressure is transmitted to the rudder and chains. Working in a small cylinder V is a plunger W, the cylinder being connected to the valve chamber, in which is a valve operated by the steering wheel. The motion of the valve and this plunger together effect the automatic cut-off. The roller M, shown in section at the back of the rack cylinder enclosing the smaller end of the plunger, is to keep the rack up to its place against the pinion on the rudder stern head. The rack cylinder is made fast to the buffer springs within the plunger by the key K, seen in section, which passes through the rack cylinder, and fits tight therein, there being of course a slot hole in the plunger to allow of the alternate compression of one or other spring, the block K and the forked rod and ring round it being also maintained in position by the key. The arrangements by which this is effected are not all shown in our engraving, but the general principle of this gear will be sufficiently gathered from what we give to enable readers to form some opinion of its merits.

The steam and steam and hand gear exhibited by Messrs. G. D. Davis and Co., London, is illustrated on page 285, as made for steam only. This, it will be seen, belongs to class 2 in our classification. It has a double cylinder engine, the connecting rods of which take on to the pins on two crank discs on the shaft, between which is a strong worm, which is not seen in our engraving. This worm gears into a strong worm wheel on the end of the screw grooved barrel seen beneath the strong frame on which the engine is mounted. On the end of the hand wheel shaft is a small worm wheel, gearing into the upper part of the large worm, and having a long boss, which runs in the bearing shown. This boss is a screw nut, and the end of the hand wheel shaft is a corresponding screw. About the centre of the hand wheel shaft, as will be seen, is a crosshead between two collars, the crosshead being fixed on the end of the rod of the distributing valve. Above the hand wheel shaft is a short screw spindle, carrying a pointer, which works backwards and forwards between the two bearings as the hand wheel is turned, the motion being communicated by small spur wheels, which are made of considerable width to allow of the lateral movement of the lower one with the hand wheel shaft. The operation of this automatic cut-off hunting gear is as follows:—The hand wheel is turned, say, from left to right, and its spindle screws into the small worm wheel nut over the crank shaft worm. The distributing valve is thus pulled forward towards the crank shaft, steam is admitted to the cylinders, and the crank shaft is turned; the worm wheel nut above it is thus set in motion, and by it the hand wheel shaft is sent back and steam again shut off until the hand wheel is again turned, and thus the number of turns the engine makes depends exactly upon the number of turns or the parts of a revolution given to hand wheel in either direction. The nut on the pointer screw above the hand wheel shaft meets with the bearings or stops at the end of the screw, and thus prevent the hand wheel being turned too far in one direction. This is a very strong gear, and the movement of the chain barrel is sensitively in accordance with the movement of the hand wheel. An arrangement of this gear combined as a hand and steam gear is exhibited, but we shall not describe it in this impression. In order to overcome the objection to the rigidly held rudder chain, Messrs. Davis and Co., when desired, place an extension spring buffer somewhere between the chain connections, and thus avoid the heavy shocks to the rudder and tiller. This may, of course, be done by the other makers of gear, which rigidly hold the chain or rope

PUMPING MACHINERY AT THE NEW GRAVING DOCK, RIO DE JANEIRO.

Some time since tenders were asked for in this country, by Messrs. Knowles and Foster, for pumping machinery for a large graving dock at Rio de Janeiro. The contract was obtained by Messrs. Lawrence and Porter, Parliament-street, Westminster. We commence this week illustrations of this important work, of which we shall give a full description and additional engravings in an early impression. The pumps lift 54,000 gallons per minute, a fact which will give some idea of their dimensions. We give on page 290 a plan of the engines and boilers.

Naval Engineer Appointments.—The following appointments have been made at the Admiralty:—George Hunt, chief engineer, to the Sultan, commissioned; Robert Burridge, Henry G. Bourke, Edwin Bell, and Albert Martell, engineers, to the Asia, additional, for the Don, vice Long.

RAILWAY MATTERS.

A picturesque guide to Lancashire and Yorkshire is about to be published by Messrs. Marshall and Son, under the authority of the Lancashire and Yorkshire Railway Company. It is compiled by Mr. Percy Lindley.

On Friday last Major-General Hutchinson inspected an extension of the Great Eastern Railway from Cawston to Broom-green. The extension will greatly facilitate communication between East and West Norfolk. Traffic will be commenced over the extension on the 1st of May.

The servants on all grades of Swiss railways comprises 13,248 individuals, who possess a sick and accident fund of £155,000, raised partly by their own efforts and partly by contributions from the companies. The number of accidents to persons—including servants—in 1880 was only ninety-one, of which no more than forty-one resulted fatally.

An international exhibition of railway plant is projected at Vienna, to be held on the Prater, in 1884, under the auspices of the Minister of Commerce. The Society of Arts *Journal* says the organising committee includes the names of Herr von Banhaus, formerly minister, Herr Prenninger, and Herr Obermayr.

The Barcelona and district tramways are extending their steam traction. Messrs. Merryweather, who have up to the present delivered thirty-one engines, are now executing a substantial order for several additional engines. Although foreign makers have endeavoured to get the trade by means of "cutting" figures, the English machine still holds its own.

The Hellenic Government have granted to a Greek banker at Constantinople the concession of a railway from Volo to Larissa, in Thessaly, and the engineers of a French company having completed the tracing of the whole line, work has been commenced at the western end. The railway is eventually to join the one to be made from Athens *vid* Lamiæ to Larissa.

The Great Western Railway Company started a regular service of trains on the new Didcot and Newbury Railway on the 13th inst., and there was a very satisfactory amount of traffic throughout the day. Ten trains will be run daily—Sundays excepted—conveying passengers to Didcot Junction at such times as will enable them to proceed thence by fast trains to the North and also to the West of England.

In this column of our impression of the 31st ult., reference was made to the Graham's Town and Port Alfred Railway Company. It should have been stated that the legislative powers were obtained last May by the passing of a special Colonial Act of Parliament, and the "first sod" was cut by the Hon. J. K. Merriman, Chief Commissioner of Public Works last October, during a visit which was paid to the Colony. The works are now in an advanced state, and, it is hoped that the first section of thirty miles will be opened for goods traffic in August or September next. Mr. Samuel Abbott, of Lincoln, of whom we spoke as the engineer of the line, is one of the directors; Mr. R. Elliott Cooper, of Westminster, being the engineer.

Extensive railway work is immediately to be put in hand in East Prussia. The two most important lines are, first, the Königsberg, Kobbelbude, Zinten, Allenstein-Hohenstein, to join the Warsaw-Mlawka line, and which will open up the Port of Königsberg to Poland; and secondly, the Königsberg, Laban, and Tilsit line, to meet the Russian line at Schaulon-Kovno. This latter line follows the old military road. Both these lines, it is expected, must bring a large trade to Königsberg, and the latter perhaps to Memel also. The other lines are more of a secondary nature—from Insterburg to Prostken, Grajevo, &c. The districts provide the necessary land gratis for the Government, and the State will build the various railways.

The total length of Swiss ordinary railways in running order is at present 2571 kilos. (1594 miles); of special lines, funicular, and short mountain railways, 85 kilos. (33 miles), making a total of 1627 miles, exclusive of the St. Gothard system, which does not yet figure in the mileage returns. The capital invested in Swiss railways reaches a total of 962,165,525f. (£38,492,621), of which 339 millions have been been raised by shares, 82 millions by cantonal and other subsidies, and 540 millions by loan. The average cost of their construction per kilometre is 303,710f. (£12,148) for the ordinary, and 211,850f. (£8474) for the special lines, which is equal to £7532 and £5254 respectively per mile. This difference arises from the fact that, although the actual making of mountain lines is more expensive than the making of ordinary lines, the value of the land over which they run is, for the most part, little more than nominal.

On Tuesday afternoon a collision took place on the Cockermouth, Keswick, and Penrith Railway at Cockermouth, which, if truly reported, points to imbecile thoughtlessness on the part of some officials, and to an alarmingly narrow escape of passengers. The *Times* says:—"On a North-Eastern Company's train arriving at Bassenthwaite Lake, it was found that the van had become detached. The engineman and stationmaster at Bassenthwaite Lake station got on to an engine and went back to look for the van, which they discovered on the line, being pushed forward by another train that was coming from Keswick. The engine then reversed in order to get out of the way, and the stationmaster and fireman jumped off. The train and the engine came into collision shortly afterwards, and the driver was knocked off the engine, which, with no one in charge, then ran on to Cockermouth station, where it dashed into a passenger train, breaking the carriages and van to matchwood, and greatly damaging itself and part of the station. Fortunately the passengers had been warned, and were able to escape."

In 1880 the number of travellers on Swiss railways was 21,608,581, of whom 312,065 took first-class, 3,862,707 second-class, and 17,433,809 third-class tickets. The average journey made by each passenger was 20·70 kilometres—12·85 miles. The weight of merchandise and baggage carried in the same period was 5,817,008 tons, whereof 103,753 tons were live stock. The revenue from passenger traffic amounted to 23½ million, and from goods traffic to 31½ million francs. Adding miscellaneous receipts, the gross total was 60 millions—£2,400,000. The receipts per kilometre varied from 2325f. on the Wohlen-Bremgarten to 54,177 on the Rigi-Vitznau line. The latter, a mountain railway, although idle the greater part of the year, gives by far the best result of any railway in the Confederation. The average receipts all round were at the rate of 23,391f. the kilometre. The working expenses, including maintenance of permanent way, were 31½ million francs—£1,260,000—equal to 52·48 per cent. of the gross receipts. The balance available for dividends and interest was thus 28½ millions—£1,160,000—from which it follows that the net yield per kilometre was 11,116f.—£444 13s.

A pamphlet has been published by Baron Marius de Vantheleret—engineer—containing the details of his scheme for a tunnel under Mount St. Bernard. Under his plan there would be a principal tunnel 6 kil. 625 metres in length, 7 kil. 123 metres of secondary tunnels, and 82 kil. 752 metres of approaches. The total cost of this work, including rolling stock, would, according to his estimates, be 48,500,000f. or about £1,940,000 sterling. The following is a list as given by the *Railway News* of the principal Alpine mountains traversed by tunnels with their height in metres and the length of the bore in metres:—Col de Fenêtre, 1870, 6600; Col de l'Hospice, 1800, 6600; Col de Menouve, 1800, 5800; Col Septimer, 1776, 8160; Col Luckmanier, 1616, 12,460; Col Saint-Bernardino, 1616, 7400; Col Grand Saint-Bernard, 1585, 6625; Col La Cristallina, 1500, 11,000; Col Bocareccio, 1500, 9250; Col Splugen, 1450, 14,200; Col de la Forchetta, 1410, 8800; Col du Retico, 1400, 12,180; Col du Mont-Cenis, 1335, 12,240; Col du Mont Blanc, 1200, 10,500; Col Saint-Gothard, 1145, 14,900; Col Simplon, 710, 18,507. The pamphlet contains a long list of the savings of distances between leading cities and countries which would be affected by the construction of this tunnel.

NOTES AND MEMORANDA.

Mr. J. West, chief gas engineer to the Manchester Corporation, in the course of an address delivered before the Manchester and District Union of Gas Engineers, at the Smoke Abatement Exhibition, on Saturday, said that, although it might be surprising to some, he was not convinced of the advantages claimed by the use of the atmospheric burner in stoves. Most of them in use certainly created more smell than a properly constructed burner with jet or fish-tail burners arranged so that they did not touch the vessel being heated, and they were certainly not more economical in their use.

The members of the Cleveland Institute of Engineers held their fifth meeting for the session, on Monday evening last. A discussion took place on Mr. Ottiwell's paper on rivetting; and then an interesting communication was read from Mr. Allison, of Guisbrough, on the geology of the Cleveland district. Mr. Allison said that there are now 223 ironstone mines in operation, yielding from seven to nine million tons per annum. They are all worked on the board and pillar system. Blasting is everywhere employed for getting the stone, the total annual quantity of powder used being 2000 tons.

One is able mentally to compute the area of a circle by simply remembering that the area of one is to the area of another as the squares of their diameter. The application of this is thus suggested by the *American Manufacturer*:—"For instance, if we happen to remember that the area of an 8in. circle is 50 square inches, it is easy to mentally calculate the area of 1in., 2in., 4in., 16in., 32in., or any other binary diameter. Thus we say: area of 2in. circle : area of 8in. circle :: 4 : 64 or 1 : 16; or, in other words, the 2in. circle has an area of one-sixteenth of that of the 8in. circle, that is to say, 50 : 16 = 3⅛ square inches approximately."

The limiting depth to which light penetrates in water was some time ago stated to be 40 metres for Lake Leman by Professor Forel, who used albumenised paper in his experiments. M. Asper has recently made similar experiments on the Lake of Zurich by a slightly different method. He used the photographic plates called emulsion plates—more sensitive than albumenised paper—and immersed them during the night of August 3rd to depths of 40, 50, 60, 70, 80, and 90 metres. They were brought up after remaining twenty-four hours in the water, and treated with oxalate of iron. All the plates, without exception, were distinctly affected by the light. Thus the chemical rays penetrate in clear water to at least 90 metres deep.

The annual rate of mortality during the week ending the 7th inst. in 28 of the largest English towns averaged 22·3 per 1000 of their aggregate population, which is estimated at 8,457,514 persons in the middle of this year. The rates of mortality in the several towns, ranged in order from the lowest, were as follows:—Halifax, 14·7; Huddersfield, 16·9; Sheffield, 18·5; Cardiff, 18·7; Birmingham, 19·5; Bradford, 19·7; Newcastle-on-Tyne, 20·1; Hull, 20·4; Bristol, 21·1; Birkenhead, 21·1; London, 21·4; Norwich, 21·7; Leeds, 21·8; Derby, 21·8; Preston, 21·9; Nottingham, 22·9; Salford, 23; Sunderland, 23·7; Leicester, 24; Liverpool, 25·1; Wolverhampton, 25·2; Oldham, 27·5; Bolton, 27·9; Portsmouth, 28·9; Blackburn, 28·9; Manchester, 29·1; Brighton, 31; Plymouth, 31·5.

A method of making leather and raw skins impermeable has been discovered by M. Trencké, of Bucharest, and patented. The method consists of shaking the substance in a solution of gelatine mixed with a mineral salt, which causes it to coagulate. The following mixtures are used:—Water, 1200; gelatine, 5; bichromate of potash, 5; or water, 1500; gelatine, 50; bichromate of potash, 30. The temperature of the solution varies from 50 deg. Fah. to boiling point—212 deg. When the solution is not rich in bichromate it is used cold, and the leather or skin remains immersed for 24 hours. The solution of bicarbonate may be replaced by the following:—Water, 1000; alum, 100; gelatine, 10; acetate of lead, 100. In every case after shaking one or two sides the leather or skin will be prepared with paraffine.

Mr. K. Pearski has made a list of the longest bridges at present existing, which are the following, their lengths being given in metres—about 3ft. 3⅜in.:—Parkesbury Bridge, (U.S.A.), 2147; St. Charles Bridge, over the Missouri, 1993; Ohio Bridge, near Louisville, 1615; Bridge over the East River, 1500; Delaware Bridge, Philadelphia, 1500; Victoria Bridge, over the St. Lawrence, 1500; New Volga Bridge, near Syssran, 1485; Hollands-Diep, Bridge, near Moerdyk, 1479; Bridge over the Pongabuda, near Gooty (India), 1130; Dniester Bridge, near Kiew, 1081; Rhine Bridge, near Mainz, 1028, Dnieper Bridge, in Pultawa (Russia), 974; Mississippi Bridge, near Quincy, 972; Missouri Bridge, near Omaha, 850; Weichsel Bridge, near Dirschan, 837; Danube Bridge, near Stadlan, 769; Po Bridge, near Mezzana Corti, 758; Tamar Bridge, near Saltash, 665; Leck Bridge, near Knilenberg, 665; Mississippi Bridge, near Dubuque, 536; Bridge over the Gorai River (India), 529; Britannia Bridge, near Bangor, 464; Saane Bridge, near Freiburg, 382; Theiss Bridge, near Szgedin, 355. The new Volga Bridge, near Syssran, is accordingly the longest in Europe.

In their report to the Local Government Board on the water supplied to London for the month of March, Messrs. Crookes, Odling, and Tidy, say so much stress being often laid upon the excess of organic matter commonly alleged to be present in the water supply of London, we would call special attention to the results of our determinations of organic carbon made during the past three months. The average amount of organic carbon, found in the twenty-three samples of water examined for this constituent in January, was 0·196; that found in the twenty-three samples examined in February, was 0·150; and that found in the twenty-seven samples examined in March, was 0·144 part in 100,000 parts of water; showing a gradual decrease in the proportion of organic carbon, and consequently of organic matter, with the advance of the season. Taking the whole of the seventy-three samples of water examined for organic carbon during the period January 1st to March 31st, the average proportion amounted to 0·162 part in 100,000 parts of water. Multiplying this proportion of organic carbon by 2½, to get roughly the proportion of organic matter, the average quantity of organic matter is in this way found to constitute $\frac{1}{2800}$th of a per cent. of the water; or to amount to somewhat over a quarter of a grain—0·28 grain—per gallon. Calculating on the same basis, in one sample only of the seventy-three did the quantity of organic matter amount to half a grain per gallon, and in two other samples only did it approach to that proportion.

At a recent meeting of the Physical Society Mr. Shelford Bidwell read a paper on "The Electric Resistance of a Mixture of Sulphur and Carbon." These experiments were begun in December, 1880, to ascertain if the mixture in question was sensitive to light like selenium. Sulphur was melted and mixed with powdered plumbago—the best proportions being 20 parts by weight of the sulphur to 9 parts of the plumbago. The mixture was poured into moulds, and quickly cooled, yielding plates and sticks. When exposed to the light of a gas flame, an increase in resistance was noticed, and was proved to be due to the heat of the flame, not the light, by experimenting with different sources of light and coloured screens of glass. As both carbon and sulphur decrease in resistance under heating, the opposite effect of the mixture is anomalous, and Mr. Bidwell explains it by supposing that the mixture is mechanical, and that heat expanding the size of the insulating sulphur crystals, separates the conducting carbon particles further apart, and increases the resistance of the mass. Cells of this compound were made like selenium cells by spreading it between the parallel turns of two fine platinum wires wound round a mica plate and the rise of resistance for temperature carefully measured. At 14 deg. C. the resistance was 9100 ohms; at 55 deg. C. it was 5700 ohms, and the rise was in greater ratio than the rise of temperature. Mr. Bidwell also found that these cells would transmit speech when connected in the circuit of a battery and a Bell telephone.

MISCELLANEA.

The blacksmiths employed in the shipbuilding trade of the upper reaches of the Clyde have had their wages advanced by ½d. per hour on time payment and 7½ per cent. on piecework rates.

Following the recent decline in the London metal market, the Cornish smelters on Monday reduced the tin standard £8 per ton. The standards are now—common, £94; refined, £95 per ton.

The entries for the annual meeting of the Bath and West of England Society, which is this year to be held at Cardiff, in Whitsun week, closed on Wednesday. This the second visit of the society to Cardiff. The local committee have provided a large sum to be laid out in special prizes of £10 to £25 each.

On Tuesday afternoon the machinery of the South-Eastern Railway Company's steamer, Albert Edward, which left Boulogne at noon for Folkestone, broke down, and a tug had to be sent out to look for her, and eventually picked her up a few miles from Boulogne, where she had, one telegram says, anchored, and another, run aground.

A new catalogue of the machinery made by Mr. C. E. Hall, Sheffield, formerly the Saville-street Foundry Company, has just been issued, descriptive of Mr. Hall's stone-breaking and ore crushing machinery, bone mills, and disintegrators, coal-breaking and grinding mills, elevators and chain pumps, mortar and ganister mills, and road makers.

The local authorities of Sedgeley have received and approved a draft of the provisional order for the supply of gas to the Sedgeley district which the Local Government Board are willing to issue, in accordance with the application which has been already mentioned. The objections preferred to the scheme by the Dudley Gas Company have not proved successful.

The Brazilian Government have ordered of Messrs. Yarrow and Co., Poplar, four torpedo boats of the largest size of the class which has yet been built. They will be 110ft. long, and will be rigged for sailing across the Atlantic during the autumn of the present year. They will be constructed after the firm's well-known Batoum type, and will carry four Whitehead torpedoes.

Active preparations are being made for the forthcoming Trades Union Congress to be held in Manchester, and an executive committee, with Mr. Robt. Austin, the general secretary of the Amalgamated Society of Engineers, as chairman, has been appointed to carry out the necessary arrangements. The Mayor of Manchester is to be asked to grant the use of the Town Hall for the meetings.

The ceremony of cutting the first sod of new waterworks for the burgh of Girvan took place a few days ago. The works, which are being carried out in accordance with plans by Mr. Sale, C.E., Glasgow, embrace a reservoir capable of containing 6,000,000 gallons, or forty-six days' supply for 5000 inhabitants at the rate of 25 gallons per head. The reservoir is situated at a height of 200ft. above the town.

At the Royal Institution Mr. E. B. Tylor gave on Tuesday the first of a course of four lectures on the "History of Customs and Beliefs;" Professor Dewar gave the first of a course of eight lectures on the "Chemical and Physical Properties of the Metals" yesterday, April 20th; and Mr. F. Pollock will give the first of a course of four lectures on the "History of the Science of Politics" to-morrow, April 22nd.

The death is announced of M. Henri Giffard, the engineer and aeronaut, who, born in 1825, made his name known the world over by his invention of the injector. He devoted many efforts to the steering of balloons, and in 1852 made an ascent in a balloon provided with a steam engine, and he designed the captive balloons of 1867 and 1878-79. A prize was awarded him by the Academy of Sciences in 1859 for the invention of the injector.

The opponents of the Channel tunnel scheme are endeavouring to enlist the support of "the leading men among the working classes and especially the officers of Trades' Councils and Trades' Societies," to whom circulars have been sent inviting them to join in the protest against the tunnel project. The Manchester and Salford Trades' Council have referred the matter to the consideration of the respective trades' societies.

Mr. Consul Payton, in his report on the trade of the port of Mogador, Morocco, issued on Tuesday, says:—"England only sent one lot of iron to this port during the year 1881, and that was a consignment of old or scrap iron valued at £55, while Sweden is credited with £1890 for 18,331 bars, weighing 185½ tons, which, it may be remarked, came through England. Such significant hints as this should not be without their effect on our ironmasters."

In a suggestive paper on the pitch of rivets in wrought iron bridges, recently read before the Cleveland Institution of Engineers by Mr. A. D. Ottewell, it is proposed to place the rivets much farther apart in the tension boom than is now common, and in the case of the bottom flange of a girder 23ft. 4in. long and 2ft. deep the author, instead of putting all rivets of the same pitch or a little greater than in the top flange, would have them vary from a little greater at the ends to four times the pitch in the centre.

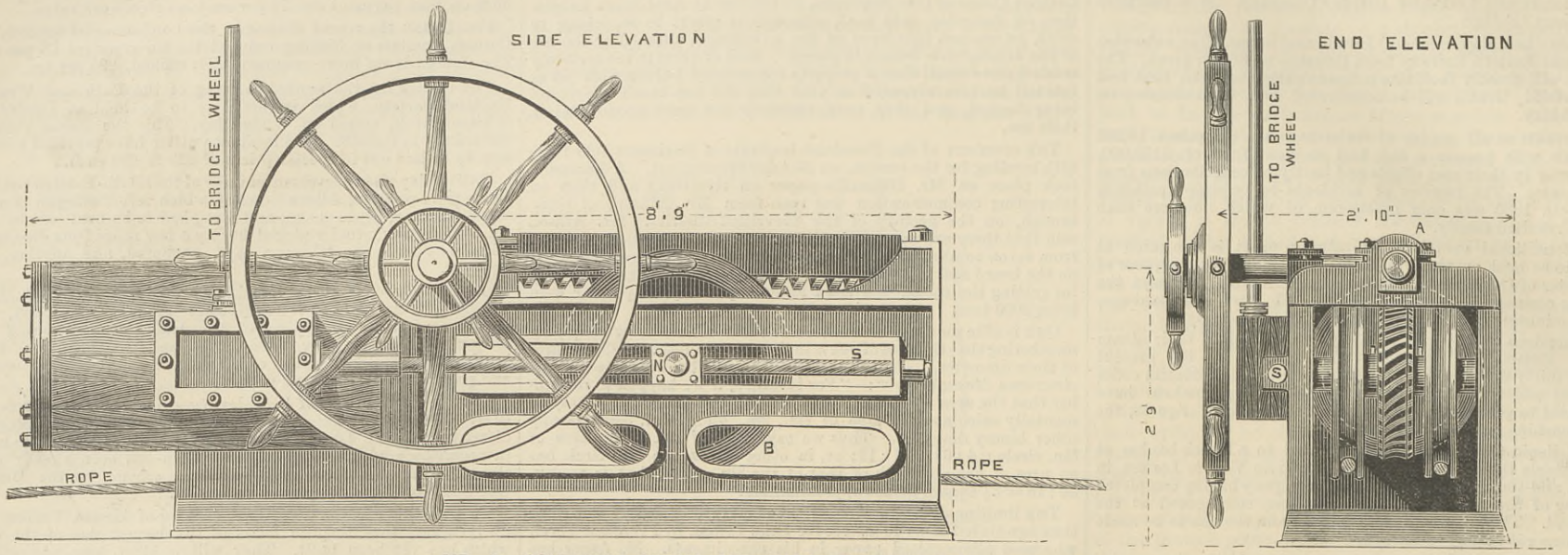
At a meeting of the Executive Committee of the City and Guilds of London Institute, held on Monday, the 17th inst., Mr. John Perry, M.E., of Queen's University, Ireland, was elected to the professorship of mechanical engineering and applied mathematics at the Technical College, Finsbury. The department of engineering will, it is expected, be complete and ready for the reception of students at the commencement of next session, when the new college in Tabernacle-row will be opened. It is also contemplated to add a department of applied art to the Finsbury College.

The trade of the Port of London is shown by the following figures, for the week ended April 8, 1882:—Number of vessels entered in, 329; tonnage, 129,563. Number of steamers entered in, 110; tonnage, 72,614. Number of vessels entered out, 130; tonnage 76,167. Number of steamers entered out, 84; tonnage, 54,711. Cargo vessels cleared out, 135, tonnage, 76,029. Cargo steamers cleared out, 91; tonnage, 57,621. Total British vessels cleared out, 107; British tonnage cleared out, 65,290; British steamers cleared out, 77; tonnage of British steamers cleared out, 50,963; British sailers cleared out, 30; tonnage of British sailers cleared out, 14,327.

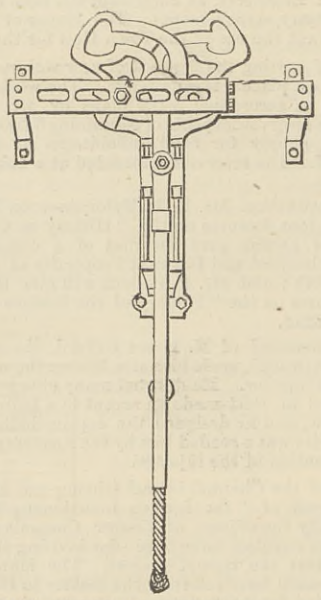
A movement has been growing to prevent the re-erection of the Eddystone Lighthouse upon the Plymouth Hoe, and it is now taking a definite form. On Monday, at an influential meeting in the town, it was resolved: "That, in view of the comparatively confined space of which the Hoe consists, it was inexpedient to place the Smeaton lighthouse on that public site, especially as the building itself does not truly represent the erection originally designed by the eminent Smeaton." A committee was appointed to ask the Town Council to re-erect the lighthouse somewhere else, within the limits of the port, where it might serve a useful as well as an ornamental purpose.

The adjudicators in the industrial section of the Smoke Abatement Exhibition, at South Kensington, have decided on the second award of prizes as follows:—Fire bridges, bronze medal, Messrs. Chubb, London, for their cast iron semicircular fire bridge; bronze medal, Messrs. Ireland and Lownds, Leek, Staffordshire, for cast iron tubular fire bridge, fire-bars, and grates; silver medal, the Wavish Patent Fuel Economiser Company, London, for the application of vertical grates in steam boiler furnaces; bronze medal, J. Farrar and Co., Barnsley, for Barber's under-feeding step grate; bronze medal, Mr. J. Collinge, Oldham, for Blocksege's external inclined grate; a silver medal, the Livet Boiler and Furnace Company, Finsbury-pavement, for Mr. Livet's method of setting boilers and for fire-bars; furnace door, bronze medal, W. A. Moreton and Co., Blackfriars-road, for a balanced fire door; bronze medal, the Great Britain Smoke Consuming and Fuel Saving Co., Limited, Mansion House-chambers, E.C.

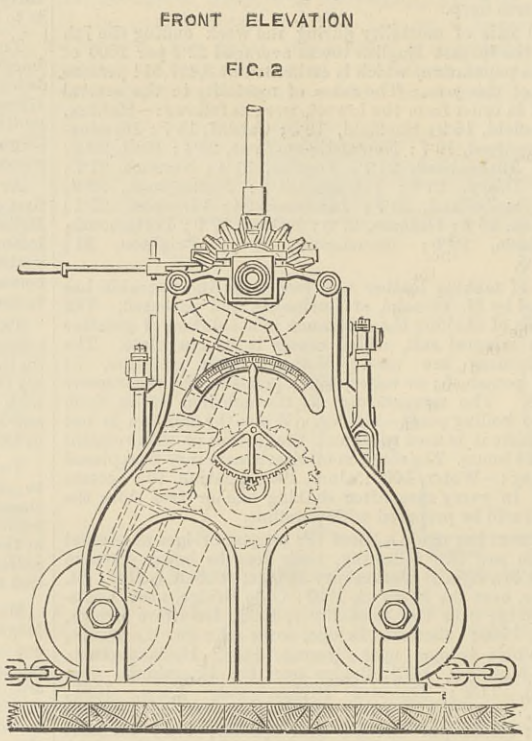
STEAM & HAND AND HYDRAULIC STEERING GEAR IN THE NAVAL & SUBMARINE EXHIBITION.

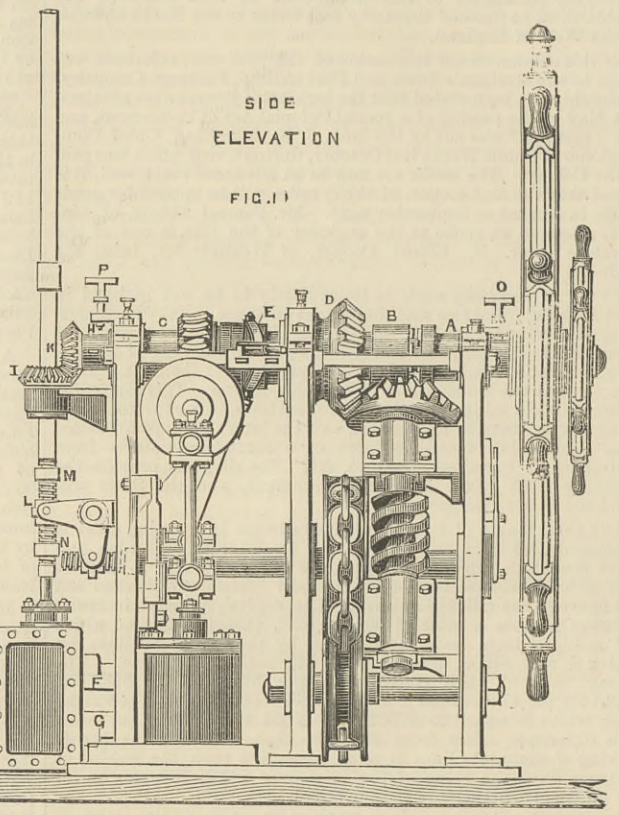


MR D. COULSON'S STEAM AND HAND STEERING GEAR (See page 28).

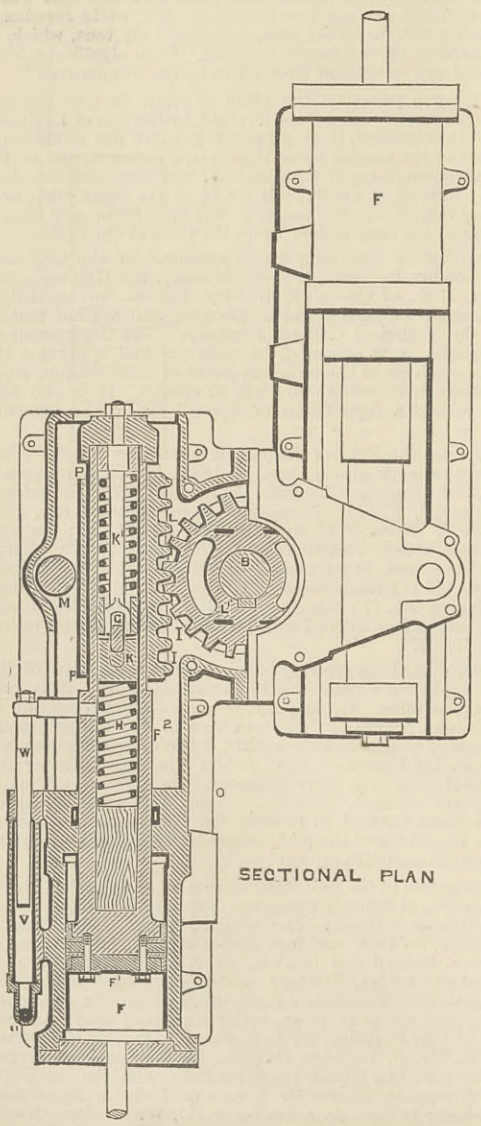


HEATHORN'S STEERING GEAR (See page 282)

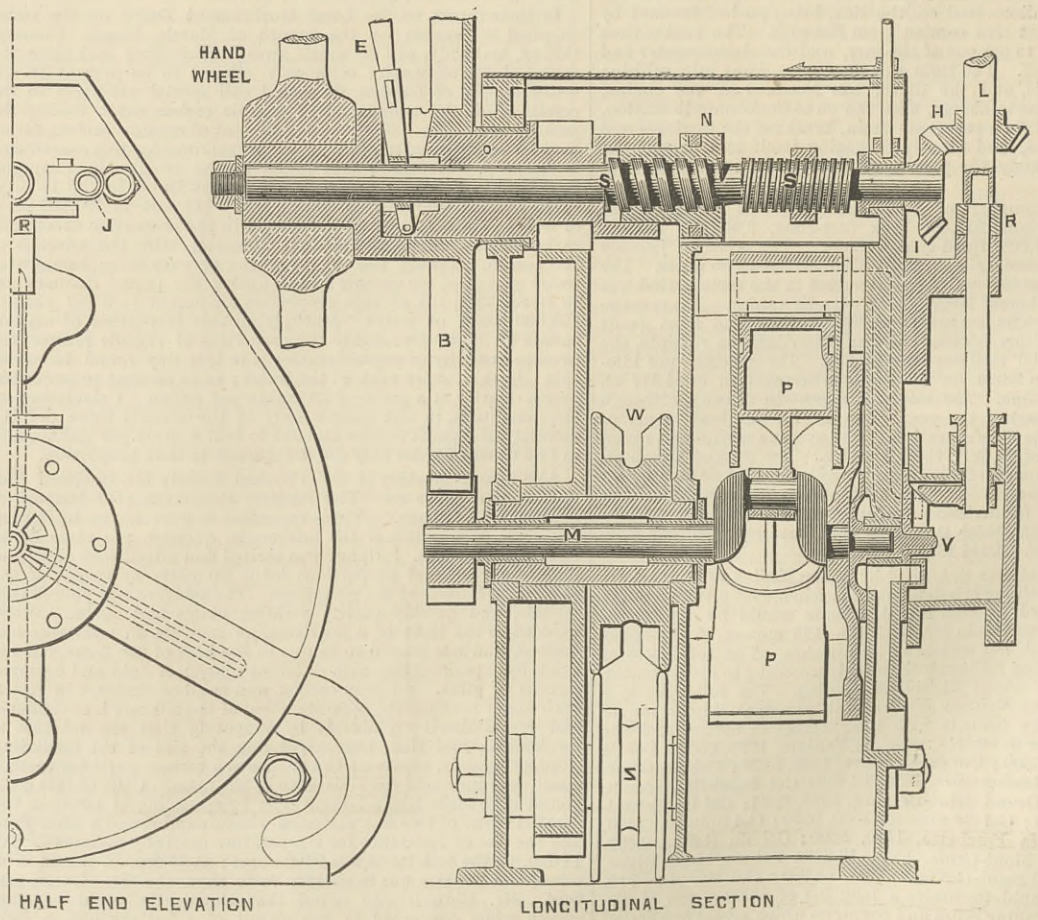




MESSRS. DONKIN AND NICHOL'S STEAM AND HAND GEAR (See page 281).



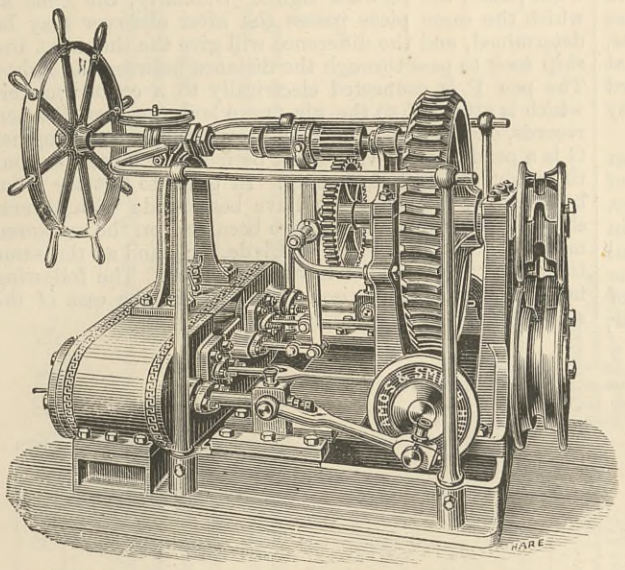
MESSRS. T. PIGGOTT & CO.'S HYDRAULIC STEERING GEAR (KILBOURN AND FOSSICK'S PATENT) (See page 282).



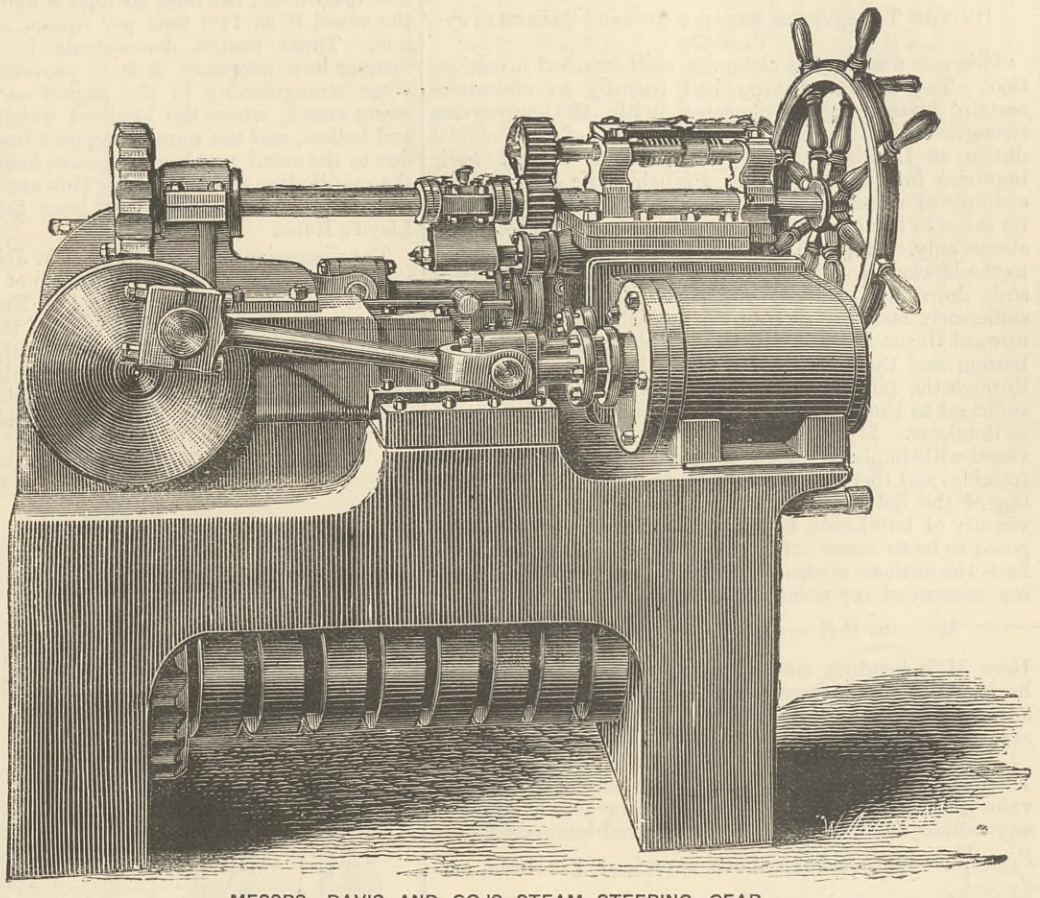
MESSRS. HIGGINSON AND CO.'S STEAM AND HAND STEERING GEAR (See page 281)

STEAM AND HAND STEERING GEAR IN THE NAVAL AND SUBMARINE EXHIBITION.

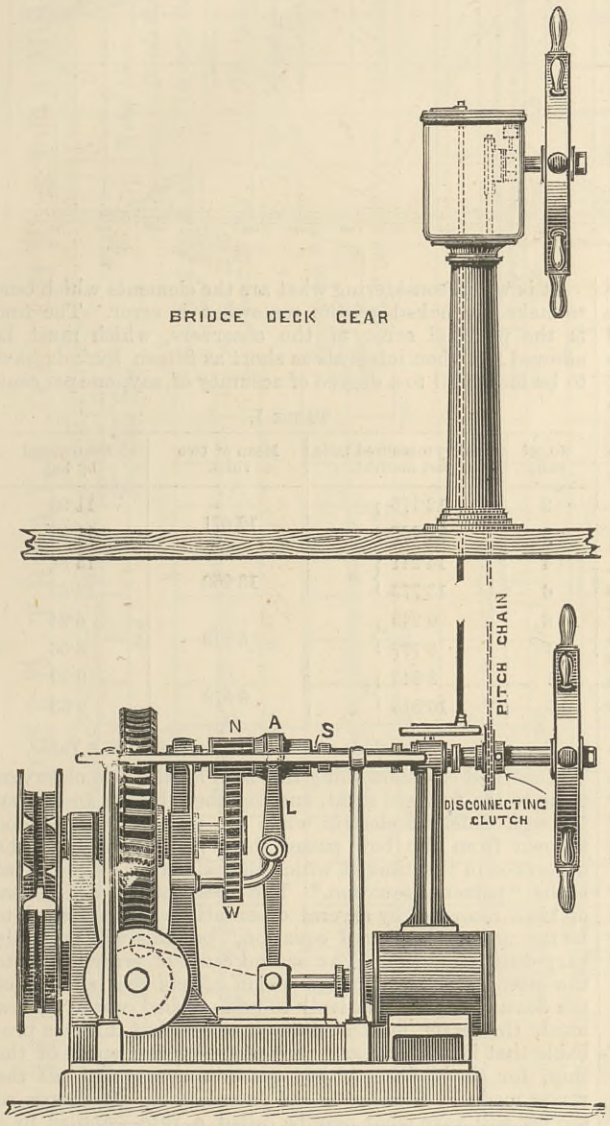
(*For description see page* 282)



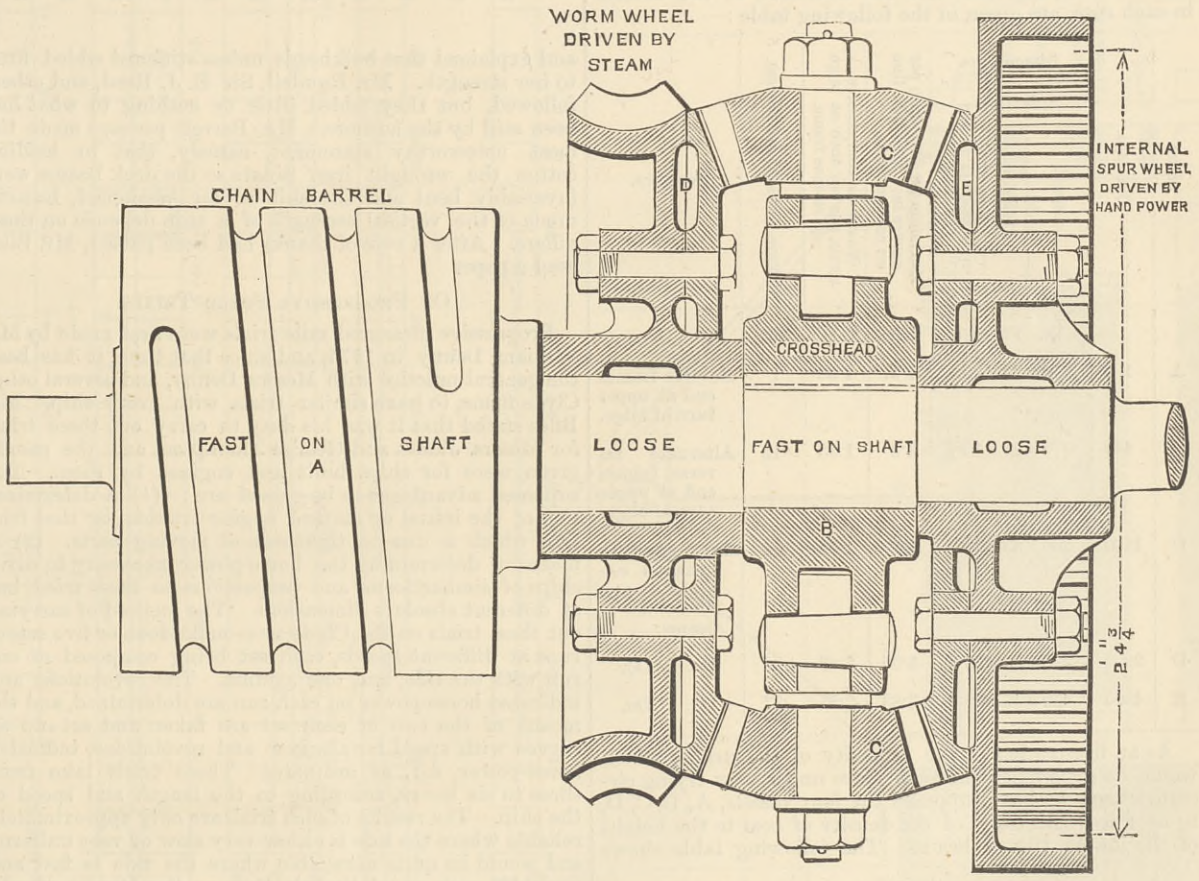
MESSRS. AMOS AND SMITH'S STEAM STEERING GEAR.



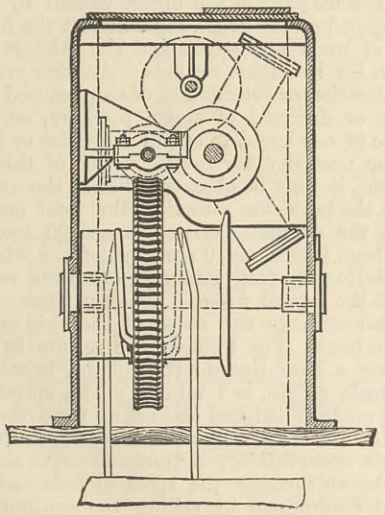
MESSRS. DAVIS AND CO.'S STEAM STEERING GEAR

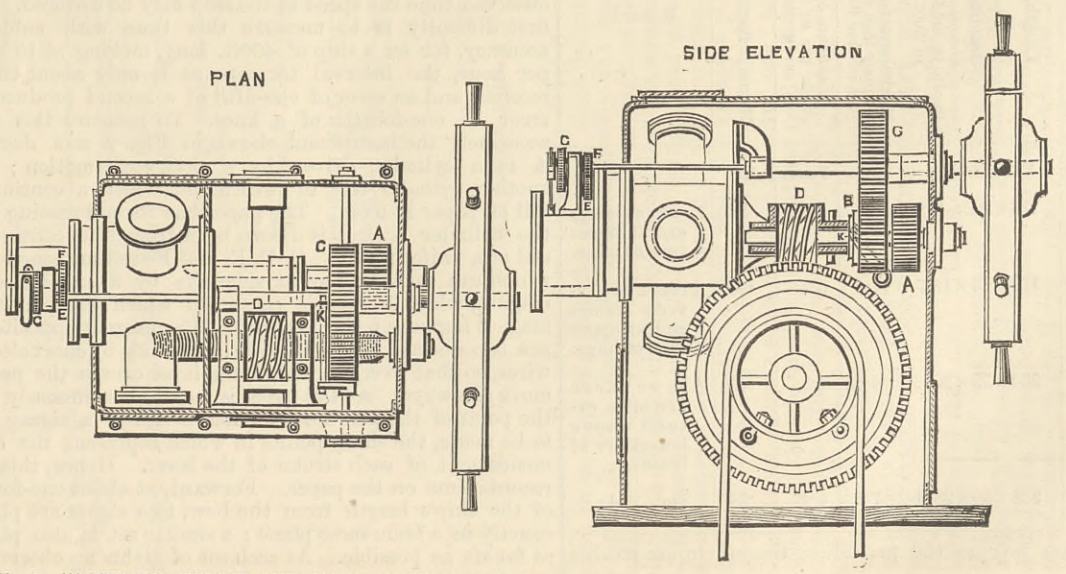


MESSRS. AMOS AND SMITH'S STEERING GEAR.



DETAIL OF MESSRS. AMOS AND SMITH'S STEAM AND HAND GEAR





MR. E E. WIGZELL'S STEAM AND HAND STEERING GEAR.

THE INSTITUTION OF NAVAL ARCHITECTS.

On Friday March 31st, after the reading and discussion of Mr. West's paper "On the Quality of Materials Used in Shipbuilding," which we published last week, a paper by Messrs. Read and Jenkins was read

On the Transverse Strains of Iron Merchant Vessels.

This was a somewhat elaborate mathematical investigation. The authors having had recently to undertake certain investigations connected with the transverse strength of iron vessels during the course of their official duties at Lloyds' Registry, were led to extend their inquiries into this subject. Probably the most simple example of transverse straining arises when a vessel with no cargo in her hold is docked and held upright by breast shores only. Here the whole of the weight is transmitted to the blocks through the keel, and the sides of the vessel sink down until the several parts of the structure are sufficiently strained to insure equilibrium. Part of the upward thrust from the blocks is employed in bending the bottom and the sides, and the remainder is transmitted through the pillars to the beams, its amount being just sufficient to bend the beams upwards to the same extent as the floors. It will be evident that the keelsons in the vessel will simply move up or down with the transverse framing, and therefore offer little resistance to the bending of the bottom, except such as may arise from the vicinity of bulkheads, by which the keelsons may be supposed to be to some extent held. Taking these facts as a basis the authors worked out their equations. The bending moment at any point of the bottom framing will be

$$M_{l-x} = R\,(l-x) + \frac{w\,(l-x)^2}{2} - M - Qy.$$

Here M is bending moment, R upward vertical force, Q horizontal outward force. Similarly, the bending moment at any point of the side between the bilge and the beam arm will be given by the equation

$$M_{l-x} = R\,y + M - Q\,(l-x).$$

Having found M at any point of the bottom or side, the value of p, the maximum compressive or tensile strain at any section, can be found from the well-known formula $\frac{p}{y} = \frac{M}{I}$. The process above explained has been employed for five flush-decked vessels, varying in size from 160 tons to 4800 tons, the scantlings in each being those required by Lloyd's Rules for the highest class, and the maximum strains experienced in the bottom and sides of these vessels, together with the deflection of the bottom in each case, are given in the following table :—

Vessel.	Tonnage.	Dimensions. Length.	Breadth.	Depth in hold to top of floor.	Maximum tensile strain per square inch at middle line on reverse frame.	Maximum compressive strain per sq. inch at bilge on reverse frame.	Maxm. deflection of bottom.	Remarks.
		Ft.	Ft.	Ft.	Tons.	Tons.	In.	
A	160	118	20	9	1·97	1·98	·1	Reverse frames end at upper turn of bilge.
B	480	178	26	13·7	2·2	1·83	·12	Alternate reverse frames end at upper turn of bilge.
C	1300	260	33	20	2·87	1·84	·21	All reverse frames extend above lowest tier of beams.
D	2900	348	39	28·3	3·05	2·47	·29	Do. Do.
E	4800	430	46	32·8	3·83	2·55	·37	Do. Do.

As an illustration of the intensity of the strains which would be experienced in such cases under very trying circumstances, we have supposed the four vessels, A, B, C, D, to be filled with cargo of the density of coal to the height of the lowest tier of beams. The following table shows

Vessel.	Tonnage.	Dimensions. Length.	Breadth.	Depth in hold to top of floor.	Maximum tensile strain per square inch at middle line on reverse frame.	Maximum compressive strain per sq. inch at bilge on reverse frame.	Maxm. deflection of bottom.	Remarks.
		Ft.	Ft.	Ft.	Tons.	Tons.	In.	
A	160	118	20	9	8·3	4·81	·32	Reverse frames end at upper turn of bilge.
B	480	178	26	13·7	11·8	6·4	·50	Alternate reverse frames end at upper turn of bilge.
C	1300	260	33	20	8·45	4·5	·49	All reverse frames extend above lowest tier of beams.
D	2900	348	39	28·3	7·2	4·9	·58	Do. do.

in the same way as the preceding the maximum strains experienced in the bottom and sides of these vessels under the assumed conditions, together with the deflection of the bottom, on the assumption that no appreciable change takes place in the value of the modulus of elasticity.

Here it will be observed that the strains are of considerable magnitude, reaching so high a figure in the case of the vessel B as 11·8 tons per square inch at the middle line. These results demonstrate in an unmistakable manner how necessary it is to provide additional transverse strengthening in the engine and boiler space in steam vessels where the localised weights of the engines and boilers, and the want of support from the deck above, due to the small number of beams, increase the strain at the middle line and the bilge. This necessity for increased transverse strengthening has been fully recognised by Lloyd's Rules.

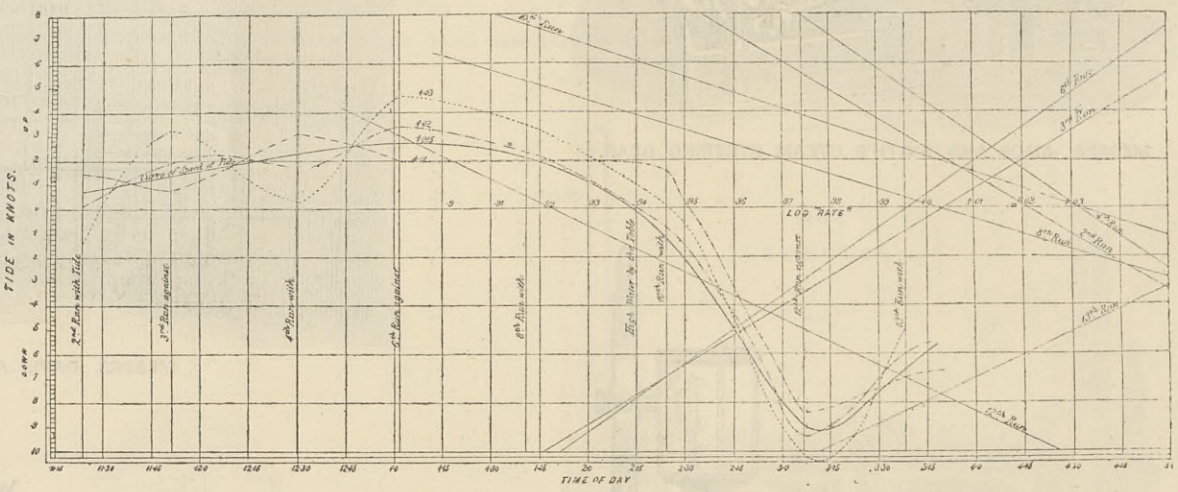
The discussion was opened by Mr. John, who said that this paper supplied another instance of the great value of the training given at the School of Naval Architecture. Graphic integration promised to be of the utmost value in dealing with questions of static strain, and a great deal was due to Professor Cotterill for the development of the system. He then proceeded to consider the relations of certain portions of the structure of a ship to each other, and explained that bulkheads unless stiffened added little to her strength. Mr. Rundell, Sir E. J. Reed, and others followed, but they added little or nothing to what had been said by the authors. Mr. Barrett perhaps made the most noteworthy statement, namely, that in loading cotton the wrought iron pillars to the deck beams were invariably bent and the ship so far weakened, because much of the vertical strength of a ship depends on these pillars. After a vote of thanks had been passed, Mr. Biles read a paper

On Progressive Speed Trials.

Progressive measured mile trials were first made by Mr. William Denny in 1875, and since that time it has been the general practice with Messrs. Denny, and several other Clyde firms, to have similar trials with every ship. Mr. Biles stated that it was his duty to carry out these trials for Messrs. James and George Thompson, and the results given were for ships built and engined by them. The supposed advantages to be gained are :—(1) A determination of the initial or statical engine friction, or that friction which is due to tightness of moving parts. (2) A means of determining the horse-power necessary to drive ships of similar forms and proportions to those tried, but of different absolute dimensions. The method of carrying out these trials on the Clyde is to make four or five sets of runs at different speeds, each set being composed of one run with the tide, and one against. The revolutions and indicated horse-power on each run are determined, and the means of the two of each set are taken and set up on curves with speed for abscissæ and revolutions, indicated horse-power, &c., as ordinates. These trials take from three to six hours, according to the length and speed of the ship. The results of such trials are only approximately reliable where the tide is either very slow or very uniform, and would be quite unreliable where the tide is fast and variable, such as at Stoke's Bay, or the Maplin Sands. The purpose of his paper was to describe a method he had been trying to measure the time that a certain part of the length of the ship takes to pass an object thrown from the bows of the vessel, well clear of the side. From this observed time the speed of the ship may be deduced. The first difficulty is to measure this time with sufficient accuracy, for on a ship of 400ft. long, moving at 15 knots per hour, the interval to measure is only about twelve seconds, and an error of one-fifth of a second produces an error of one-fourth of a knot. To measure this time accurately the instrument shown in Fig. 2 was devised. A is a cylinder driven by a clockwork motion ; B is another cylinder free to revolve, on which a continuous roll of paper is fixed. The paper has its end passing over the cylinder A, and is drawn by it from the continuous roll at a uniform rate. C, D, E, and F are four pencil pens which can each be moved sideways by a small electro-magnet, when an electric circuit in which the particular magnet happens to be, is closed. The magnet opposite the pen is connected to a well-made lever clock by short electric wires, so that every stroke of the lever causes the pen to move sideways. As the paper is moving continuously past the point of the pen the side motion causes a zigzag line to be made, the sharp points in which represent the commencement of each stroke of the lever. Hence, this pen records time on the paper. Forward, at about one-fourth of the ship's length from the bow, two sights are placed exactly in a transverse plane ; a similar set is also placed as far aft as possible. At each set of sights an observer is placed, and from him electric wires are led to the instrument and connected, so that when he makes contact, the pens D and E respectively are made to move sideways. Hence, if a piece of wood be thrown from the bow, and the forward observer makes contact exactly at the instant it passes his plane of sight, a break will be made in the line in which this pen is working. This break squared over on to the line which the pen C is marking will enable one to say, exactly, the time at which the piece of wood passed the forward sights. Similarly, the time at which the same piece passes the after observer may be determined, and the difference will give the time that the ship took to pass through the distance between the sights. The pen F is connected electrically to a contact maker, which is attached to the air pump lever, so that this pen records, on the same paper, the revolutions of the engine. G is a pendulum, of very short period, which records, continuously, the heel of the ship. In order to test the reliability of the method, trials have been made with several ships. The ordinary runs have been run on the measured mile at Skelmorlie, Firth of Clyde, &c., and at the same time the "log" results have been taken. The following table shows the comparison of the two in the case of the s.s. Spartan.

Fig. 3.

CURVE SHOWING THE METHOD OF DETERMINING THE TIDE CURVE AND LOG "RATE"



It is worth considering what are the elements which tend to make the naked results somewhat in error. The first is the personal error of the observers, which must be allowed for when intervals as short as fifteen seconds have to be measured to a degree of accuracy of, say, one per cent.

Table I.

No. of run.	Speed by measured mile, post method.	Mean of two runs.	Mean speed by log.
2	12·175	12·071	11·93
3	11·967		11·92
4	14·241	13·952	13·81
6	13·773		13·83
8	6·249	6·513	6·24
10	6·777		6·56
12	8·845	9·578	9·59
13	10·315		9·53

The results of the whole of the trials were given in a Table.

The method of determining this is to let the two observers come to the forward sight, and together observe and signal through different electric wires the time at which wood thrown from the bow passes their plane of sight. The difference in the time at which they signal the same event is the "personal equation." The mean of the differences of time recorded by several observations was assumed to be the actual "personal equation," but this will probably vary during the run. The second cause of error is due to the stream line disturbance which affects the position of the floating object relatively to undisturbed water. How much this error is it is difficult to say, but it seems probable that it is a constant percentage of the speed of the ship, for the floating object gets an average of all the waves made by the ship as she passes by it. If this is so the log will have what may be called a rate—similar to a chronometer—which may be applied to it as a correction. It will be shown later on that this assumption appears reasonable. If the wood be thrown at unequal distances from the ship's side the percentage or "rate" will probably vary. A further cause of error of a similar nature is that due to the surface drift of the object caused by the wind, but this cannot be very great, especially at the high speed, for a piece of wood 6in. square and 1in. thick is not likely to be driven far in fifteen seconds. Another error is that due to acceleration or retardation of ship, caused by either an increase or decrease of steam pressure, or a passage from a tide of one speed to one of a greater or less speed. To show the necessity for taking notice of this in exact investigations, it may be observed that in the s.s. Spartan, from which the table was compiled, the total mean steam pressure in the engines did not exceed 90 tons, while a force of at least 9 tons, or 10 per cent. of the whole power of engines acting for four minutes—the time required to do a knot at the rate of fifteen knots per hour—would be necessary to accelerate the speed of the ship one quarter of a knot an hour. Fig. 1 shows the results in a graphic form. Along a base line the time of day is set off generally to a scale of 2in. = 1 minute. The speed for each observation made is deduced and set up from the base on a scale of 1in. = 1 knot, at a time corresponding to the middle of the observation. A freehand curve shown by a full line is drawn through the spots so obtained, and the mean speed determined by taking the arithmetic mean. The mathematical investigation on which the "rate" of

PROGRESSIVE LOG SPEED TRIALS OF THE STEAMSHIP SPARTAN.

RESULTS.

No. of Run.	Mean Speed by Posts	Mean of Runs	Mean Speed by Log
2	12·175	12·071	11·93
3	11·967		11·92
4 & 5	14·241	13·937	13·81
6	13·773		13·83
8	6·249	6·313	6·24
10	6·777		6·56
12	8·645	9·578	9·594
13	10·315		9·534

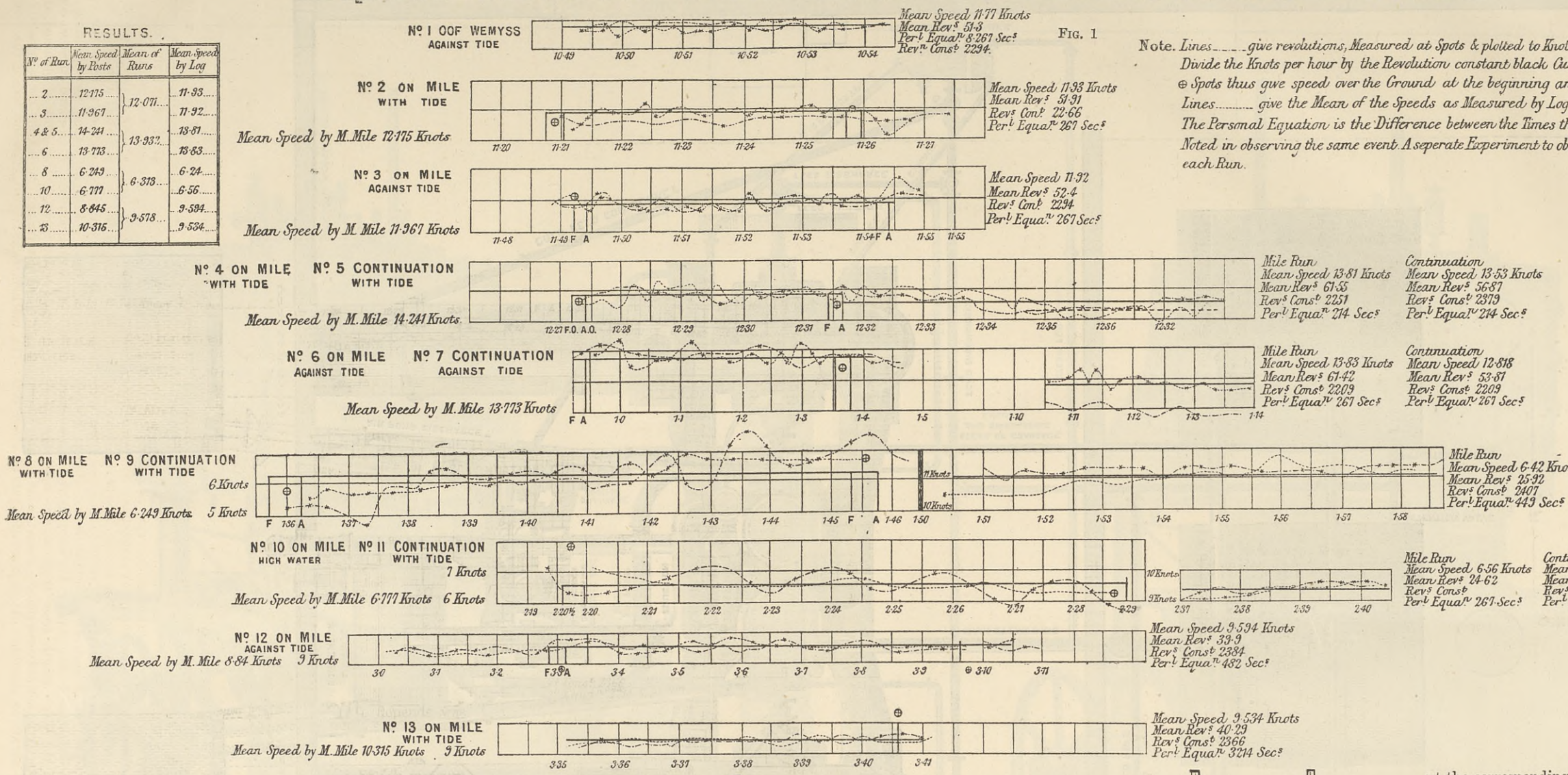
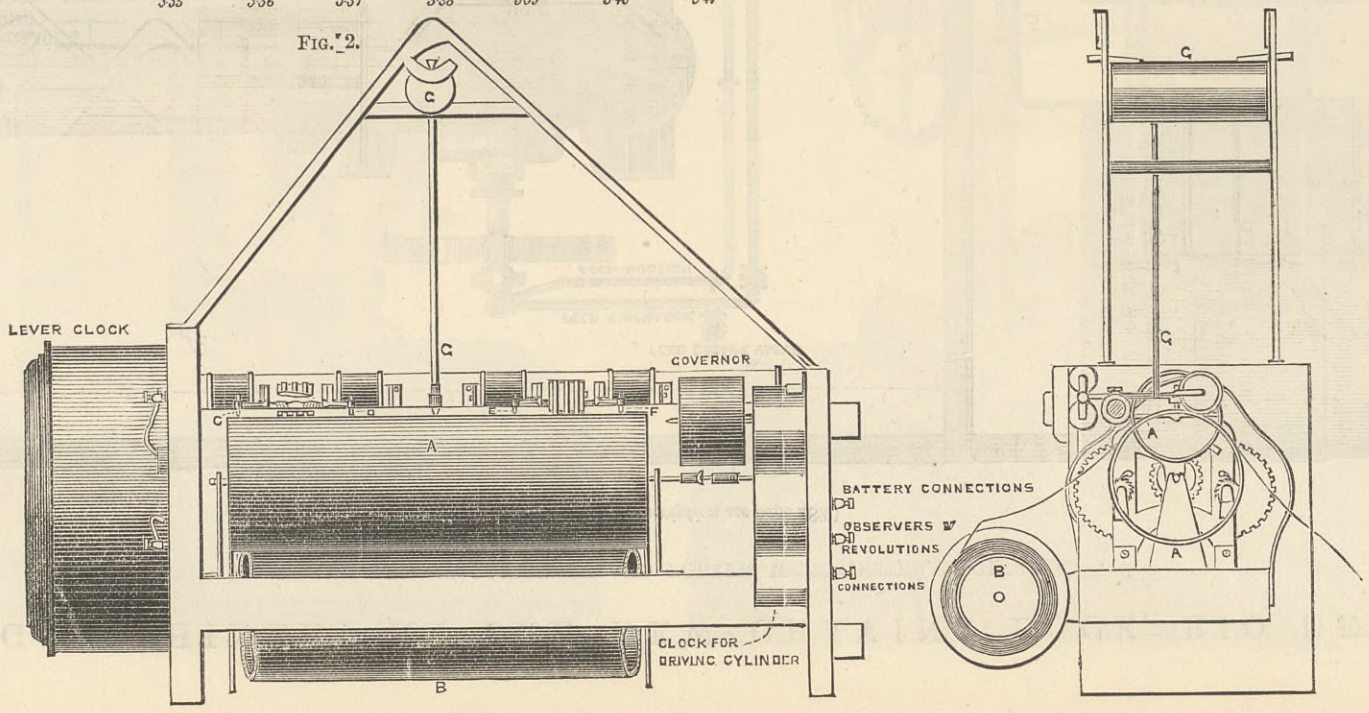


FIG. 1

Note. Lines ____ give revolutions, Measured at Spots & plotted to Knots per hour to get actual revs. Divide the Knots per hour by the Revolution constant black Curves give speed of Ship in Knots per hour. ⊕ Spots thus give speed over the Ground at the beginning and end of Mile. Lines ..... give the Mean of the Speeds as Measured by Log. The Personal Equation is the Difference between the Times that the forward and after observers. Noted in observing the same event. A seperate Experiment to obtain this was made at the end of each Run.

the log due to the stream line disturbance depends was given in an appendix, but the principle of it is quite simple. In two runs made at approximately the same speed through the water—one with and one against the tide—the difference of the speeds so obtained is a measure of the speed of the tide. The "log" gives a speed which it is assumed is a constant proportion of the true speed; it will only be necessary to know what this constant proportion or "rate" is in order to deduce the speed of the tide. If we assume a series of values for this "rate" and determine the tide speed, we may set these results off and form a curve. The tide curve will not be likely to have any abrupt changes in its character, so that any tide curves deduced on certain assumed values of the "rate" which have a zig-zag form may be thrown out, and the assumed value of the "rate" that gives the curve which appears most reasonable may be taken as the most probable value of the "rate." This investigation was made, and the "rate" which appeared the most probable was 1·013. The tide curve determined is shown in Fig. 3, the dotted ones given being those which were obtained on other assumed values of the "rate," and which did not appear to be probable curves. The whole of the "log" speeds were corrected for this "rate," and the speeds as measured by the mile posts were corrected for the actual speed of tide determined. The results correspond in a remarkable degree. Resistance curves, as deduced by model experiments, generally show humps and hollows, as was shown by Mr. Froude in his very able paper last year;

FIG. 2.



ut the corresponding peculiarity does not develope itself indicated horse-power curves of ships frequently, as the speeds at which the ship is run are too few to detect them, and the speeds at which these humps and hollows exist is rather higher than that generally obtained by ordinary ships.

The discussion which ensued was not worthy of the paper, and was principally confined to the asking of questions and the making of statements which were for the most part wholly uninteresting truisms. For example, one speaker stated that he discovered by experience that when a ship was to be put on the measured mile it was always necessary to go some distance away in order that the ship might have attained her full speed before she got on it. One good point was made, namely, that if this plan can be reduced to satisfactory practice, it will save the necessity of having a measured mile. We gathered from Mr. Denny's remarks that he was greatly in favour of the scheme, because it saved his father much annoyance when on trial trips. Mr. Biles, in replying, brought down the house by stating that when a float "was not seen it was not observed." He of course used the last word in a technical sense, but the fact was not at first noticed.

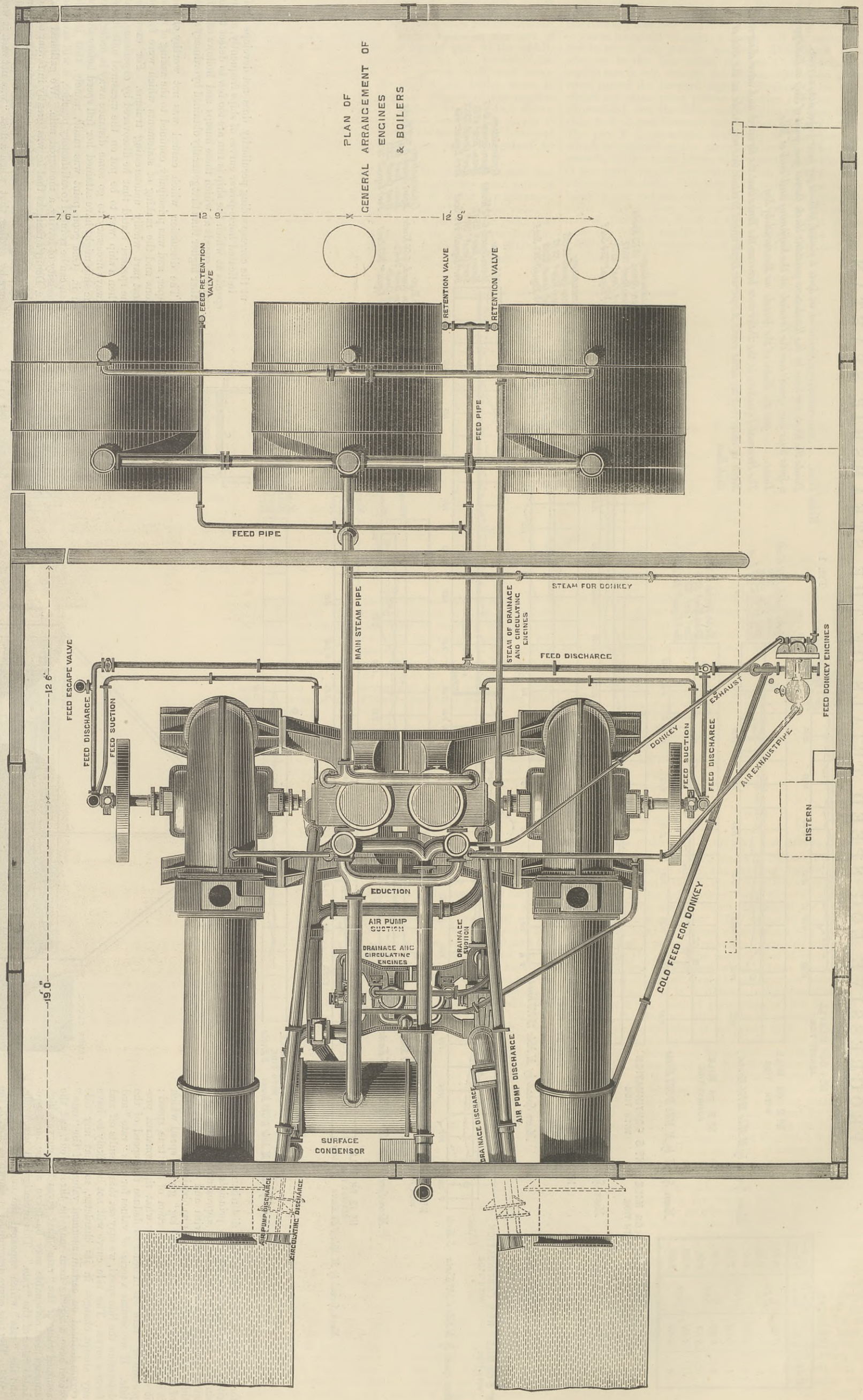
There is a great deal too much talking for the sake of talking done by the Institution of Naval Architects now, and all that those present would have said with advantage on this paper might have been said in five minutes.

Mr. Phillips then read a paper on "The Construction of Yachts," which we hold over for the present.

PUMPING MACHINERY AT THE NEW GRAVING DOCK, RIO DE JANEIRO.

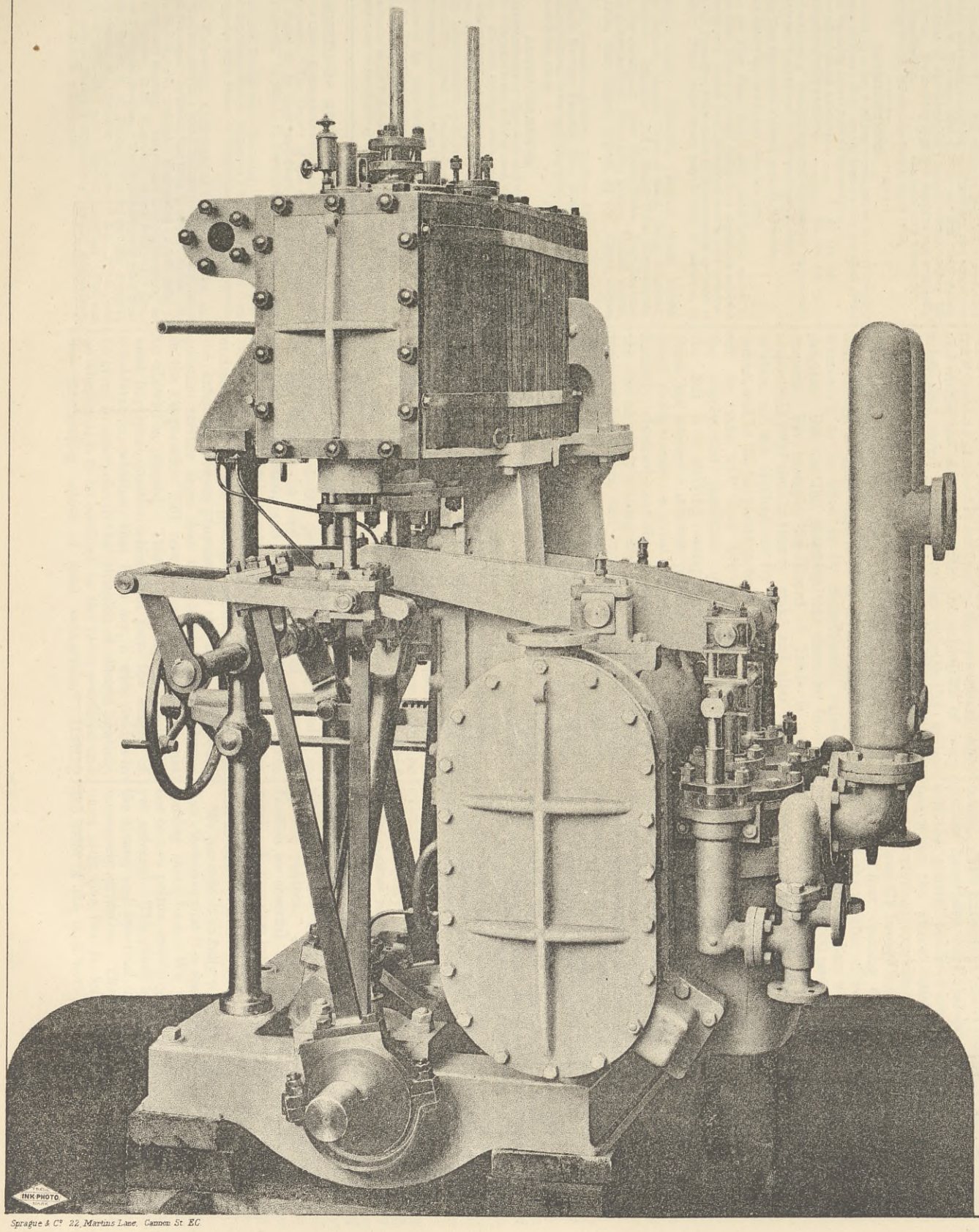
MESSRS. LAWRENCE AND PORTER, WESTMINSTER, ENGINEERS.

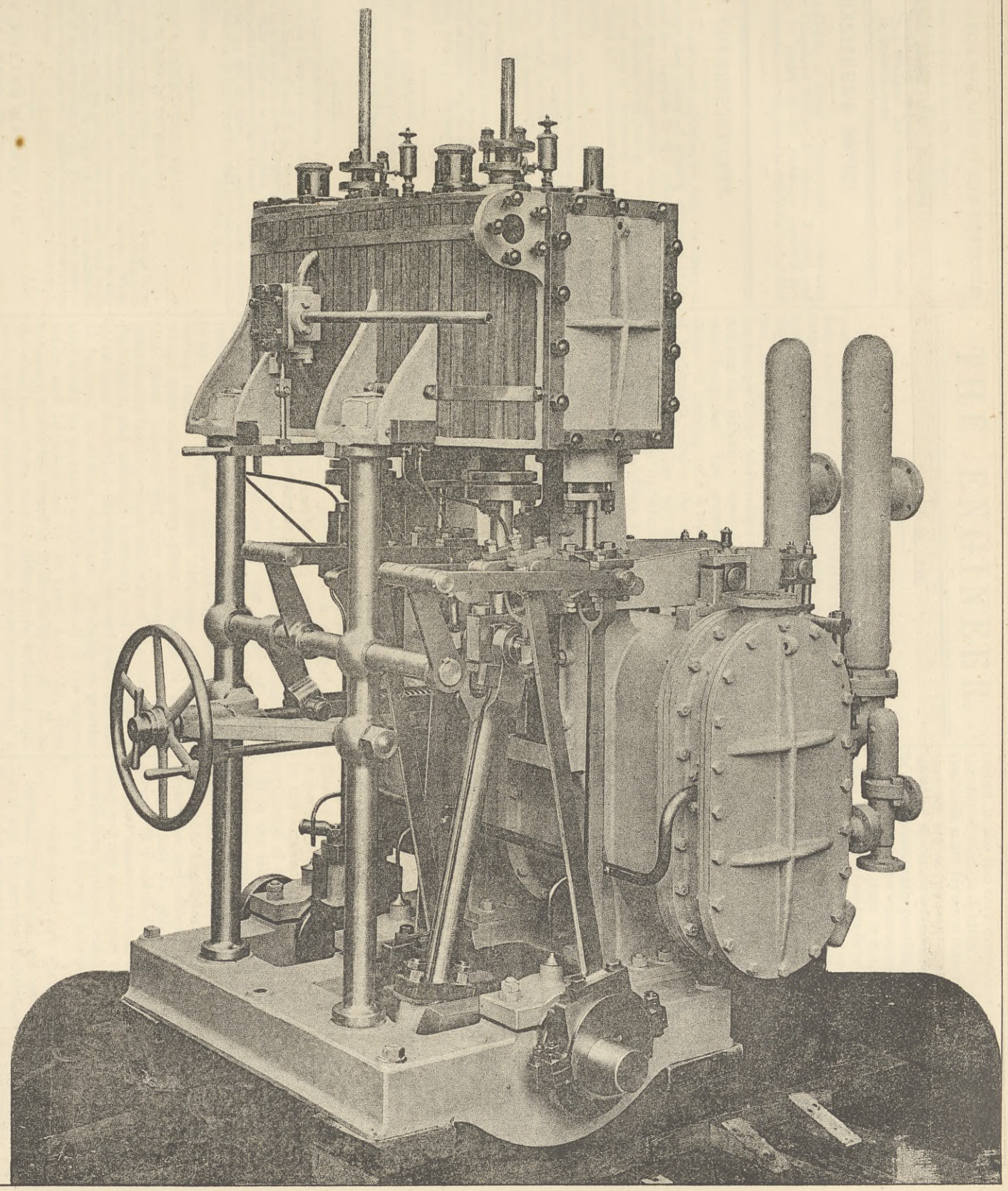
(*For description see page 282.*)



20 H.P COMPOUND MARINE ENGINE.

MESSRS. CHARLES BURRELL & SONS, ENGINEERS, THETFORD.





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*** *With this week's number is issued a Supplement, representing a 20-Horse Power Compound Engine, by Messrs. Burrell and Sons. Every copy as issued by the Publisher contains this Supplement, and subscribers are requested to notify the fact should they not receive it.*

TO CORRESPONDENTS.

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

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

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

Ganger.—*The number of inventions patented and tried for securing wood keys in railway chairs, or substituting something for wood, is countless.*

Erratum.—*In the article on Lifting and Hauling Machinery at the Naval and Marine Exhibition, in our last impression, Mr. W. R. Curel's name was wrongly spelt Carel.*

MACHINE FOR BENDING COPPER PIPES.

(*To the Editor of The Engineer.*)

Sir,—We want a machine for bending copper pipes without filling them. Can any of your correspondents tell us whether such a machine is made? W., H., and S.

Leeds, April 13th.

CHILLED CAST WHEEL BOXES.

(*To the Editor of The Engineer.*)

Sir,—If your correspondents "R. and F. K." would give a sketch or state what sort of box he is in trouble with, I might be able to help him out of the difficulty. Chills ought to be quite plain. How can you get them out of the casting with a recess cut into them? Again, fire-clay is about the worst thing he can use for cores; it's sure to cause a blown place. A core can be fitted on to the top of the chill to make a recess for grease without difficulty. Foundry Manager.

Ashford, Kent, April 18th.

TURTON'S PATENT CRANK SHAFTS.

(*To the Editor of The Engineer.*)

Sir,—Will you allow us to correct a mistake in your last week's issue. In the notice of the Naval and Submarine Exhibition, you state that the shaft illustrated on page 270 was cast in steel by Messrs. Jessop. We do not wish to detract from the merits of that well-known firm, but in duty to your readers and ourselves, we beg to say that the shaft was made by us, in what many authorities claim to be for marine crank shafts the more reliable material of fibrous wrought iron. Four duplicate halves—as per your illustration—were forged and finished complete by us for the ss. Virginian and Valencian. Ince Forge Company.

Wigan, April 19th.

CASK MAKING MACHINERY.

(*To the Editor of The Engineer.*)

Sir,—We notice in your paper of the 7th inst., under the head of "Cooperage Machinery," by S. Worssam and Co., you illustrate a cask head turning machine purporting to be made by them. We shall be obliged, in justice to ourselves, if you will state in your next issue that the machine in question was designed by Mr. G. Thornley, and was made and supplied to Messrs. S. Worssam and Co. by our firm, they undertaking that any machines of the kind they might obtain orders for should also be made by us. We may say that this machine was originally designed for Messrs. Bass and Co. Buxton and Thornley.

Waterloo Engineering Works, Burton-on-Trent, April 18th.

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

MEETINGS NEXT WEEK.

The Institution of Civil Engineers.—Tuesday, April 25th, at 8 p.m.: (1) Paper to be discussed, "The Theory of the Gas Engine," by Mr. Dugald Clerk. (2) Paper to be read and discussed, "Harbours and Estuaries on Sandy Coasts," by Mr. L. F. Vernon-Harcourt, M.A., Inst. C.E.

Society of Telegraph Engineers.—Thursday, April 27th, at 8 p.m.: "On Attraction and Repulsion due to Sonorous Vibrations, and a Comparison of the Phenomena with those of Magnetism," by Mr. Augustus Stroh.

Society of Arts.—Wednesday, April 25th, at 8 p.m.: Foreign and Colonial Section, "The Character and Social Industries of the Inhabitants of China, Japan, and Formosa," by Lieut. the Hon. Henry N. Shore. Sir Rutherford Alcock, K.C.B., will preside. Wednesday, April 26th, at 8 p.m.: Nineteenth ordinary meeting, "Telephonic Communication," by Lieut.-Colonel C. E. Webber, R.E. Thursday, April 27th, at 8 p.m.: Applied Chemistry and Physics Section, "The Manufacture of Steel from Phosphoric Pig Iron," by Mr. S. G. Thomas, F.C.S., and Mr. Percy C. Gilchrist, F.C.S. Professor W. Chandler Roberts, F.R.S., F.C.S., will preside. Friday, April 28th, at 4 p.m.: Special meeting, "National Necessities as the Bases of National Education," by Dr. Richardson, F.R.S. Mr. E. Chadwick, C.B., will preside.

THE ENGINEER.

APRIL 21, 1882.

THE ELECTRIC LIGHTING BILL.

In the Bill now before Parliament we have probably the most striking proof of the remarkable progress which has been made during the last few years in the practical application of electricity to lighting purposes. It seems but the other day that the electric light was only a curiosity to the general public, and now we have prepared for consideration, and not before it is needed, a Bill designed to do for the electric light undertakers what the Gasworks Clauses Act and the Railway Clauses Acts did for the gas and railways companies. The preparation of such a Bill, and its successful nursing until it shall attain the form of an Act of Parliament, involve the careful consideration of many things and possibilities; and the fact that electric lighting is even yet only in its infancy, and that scarcely a day passes without the addition to our stock of knowledge of some material discovery, necessitates that the attention of the Legislature should be bestowed on the subject with even more than ordinary care.

The Bill, as submitted to the House of Commons, provides two methods of empowering undertakers to set up works and supply electricity in a given district. The undertakers may be either the Local Authority, or a company, or a person or persons; and for the purpose of obtaining the necessary powers which the Act will supply, they may either apply to the Board of Trade for a licence authorising them to supply electricity, or they may seek through the same source a provisional order, to be confirmed in the usual manner by Act of Parliament. If the former course be adopted, and the applicants be not the Local Authority, the consent of the latter must be first obtained. The licence will be in the first instance for five years only, but it may be renewed by consent, and upon terms to be approved by the Board of Trade, and it shall contain all such regulations as to the limits within which, and the conditions under which, a supply of electricity is to be compulsory or permissive, and for enforcing the performance by the undertakers of their duties, and generally such stipulations as the Board of Trade may require. Of course, no form of such proposed licence is attached to the Bill; and, indeed, it is not easy to suggest what could be a common form, having regard to the great difference of conditions which must exist in every place. But it is evident that these licences will give someone or another a great deal of trouble. Each will be in effect a little Act of Parliament, and although omissions and defects may be cured upon renewal of the licence, yet very great care will be required in settling this form. Probably in practice they would be privately settled on behalf of the undertakers and be submitted to the Local Authority, when necessary, and to the Board of Trade for approval. If, on the other hand, there may be difficulty in obtaining consents, or other circumstances make it more convenient, a provisional order may be got, and when undertakers are so authorised the particular local authority may within six months after the expiration of a period of seven years from the date of the Act confirming the provisional order, and within the same time after the expiration of every subsequent seven years, by notice require the undertakers to sell their undertaking, and the Board of Trade is to act as arbitrator to determine any question which may arise in relation to the purchase. These are the principal heads of the Government scheme, and we have said enough to show that it is to a very large extent a framework to be filled in by departmental rules and practice. But the Bill preserves this character in other respects. For example, the Board of Trade is to be empowered from time to time to make and alter rules in relation to the applications for licences or provisional orders, and to the payments to be made in respect thereof; and to make and alter bye laws with reference to the supply and insulation of electricity. In fact, the Bill is a striking example of what during late years has become a common practice with the Government draughtsmen—a great deviation from that which formerly obtained—namely, to frame their bills with the sole object of settling the principle of the particular piece of legislation, and imposing upon various public officers the duty of elaborating the necessary procedure. No doubt the increased demand upon the time of the Legislature is the main cause of this departure from former practice. It has its advantages, but it has also its drawbacks, and there should generally be some controlling power vested in Parliament to approve or not departmental rules—a power which is not contemplated in this case.

It is scarcely to be expected that a comprehensive scheme such as that proposed by this Bill will fail to receive a large amount of attention and criticism, not only by inventors and promoters of systems of electric lighting, but by the various local authorities throughout the kingdom. Indeed, we have already had an important instalment. The Corporation of Manchester, to which an advance copy of the Bill was referred by the Government, has addressed, through the town clerk, the Board of Trade for the purpose of recommending strongly that the powers in the Bill should, in the first instance, be confined to municipal corporations and local authorities, and it is urged that the "true position of electrical patentees is to make contracts with local bodies, and that it is on the ground of public policy undesirable that the patentees should be invested with the extensive powers proposed by the Bill." The Corporation further urges that the electric lighting clauses in the Corporation Bill now before Parliament should be allowed to proceed. This latter raises precisely the most important question which will form the subject of consideration, whether, that is to say, a wide field is to be given to enterprise in the direction of electric lighting, or whether it is to be confined to the more restricted and less enterprising action of local authorities. Having regard to the fact that everything which can be done in the way of electric lighting on a large or sufficiently practical scale must for some time be purely experimental, and that we are at present a long way from ascertaining which of the many schemes before the public is the best, or even economically possible, there seems little doubt that at present it is the wiser course to encourage private enterprise and not to place it in the power of local authorities either to waste their funds in pure experiment, if they are disposed to be enterprising, or practically to prohibit experiment within their districts if they are disposed to be careful. Indeed, it is difficult to see why, if the proposal of the Manchester Corporation be accepted, similar exclusive powers should not be vested in the large metropolitan gas companies. The Board of Trade has replied to the letter of the town clerk by pointing out that the scheme of the Bill is in strict accordance with the recommendations of the Select Committee of 1879, namely, that "Municipal authorities should have power to give facilities to companies or private individuals to conduct experiments," and that "when the progress of invention brings a demand for facilities to transmit electricity as a source of power and light from a common centre for manufacturing and domestic purposes, it may be expedient to give to the municipal authority a preference during a limited period to control the distribution and use of the electric light, and failing their acceptance of such a preference, that any monopoly given to a private company should be restricted to the short period required to remunerate them for the undertaking with a reversionary right on the municipal authority to purchase the plant and machinery on easy terms. Under the Bill as framed the Local Authority will always be able either to obtain the necessary licence itself, or to control and impose conditions on the grant of any such licence to a private company. Mr. Farrer on behalf of his department, in the correspondence which he has forwarded to us, and which, no doubt, will receive the attention it deserves, further points out very justly that it would be impossible to clothe local authorities with a monopoly without fencing it round by elaborate provisions for universal supply, which provisions it is equally impossible at present to get, having regard to the experimental stage through which the practical application of electricity is now passing.

It is the intention of the Government to submit the Bill to the consideration of a strong committee, and it certainly is much to be desired that the scope and details of the whole measure should be most carefully studied, not only by the Legislature, but by electrical engineers, Local Authorities, and others, who, from their experience and position, may be able to give valuable assistance and advice. It would be in the highest degree disastrous if this initiative measure should by its imperfections or insufficiency put any check upon the course of investigation and experiments, without which we cannot hope to see the electric light brought into general and economical use.

THE NAVAL AND SUBMARINE EXHIBITION.

Several weeks ago we stated our belief that the Naval and Submarine Exhibition would be a success. We did not write thus until we had made ourselves fully acquainted with the measures which Mr. Barnett had taken to insure a satisfactory termination for his undertaking. The Exhibition closed yesterday, and our anticipations have been fully realised. So far as exhibitors and the general public were concerned, the Exhibition has given the utmost satisfaction; and there was an almost universal expression of regret that it did not remain open for twenty instead of for ten days. Almost from the first opening the Exhibition was popular. Although the number of visitors on Easter Monday only reached about 5000 there was a daily increase, and on one occasion nearly 10,000 persons passed the turnstiles. This is a noteworthy fact when it is borne in mind that there were no pictures, or objects of art, furniture—if we except some cabin fittings—carriages, dresses, or indeed any one of the multitude of objects which international exhibitions contain. The Naval and Submarine Exhibition apparently only appealed to a special class, and yet some seventy thousand persons responded to that appeal. It is not easy to say why. Days spent in the Hall supplied no solution of the difficulty, for the visitors did not congregate in special places; they pervaded the building in every part. It is quite true that a great deal of interest centred round the large diving tank; but although there was always a crowd about it, crowds could be found in other parts of the building as well. The solution of the problem seems to be that English people take a great natural interest in all that concerns the sea; and they found much in the Agricultural Hall that gave them new ideas, supplied them with novel conceptions of facts, and no doubt furnished them with information in a very pleasant and palatable way. There was, in a word, a good deal to be seen, and it could be seen well. The Hall was bright and clean, the stands of the exhibitors attractive, and the weather fairly fine. The exhibitors quickly found that they were going to make a good thing of it; on every side the result of our inquiries is that orders poured in. On some stands every article exhibited was sold; and we know that not a few engineers left the Agricultural Hall a week ago with their books so full that they refused to take another order. This naturally made exhibitors cheerful, and the feeling was reciprocated by the visitors. There never was, perhaps, held in London so cheerful an exhibition, if we may use the word. A nameless influence pervaded it. Everyone was pleased, and already people ask, when is the next exhibition to be?

We have dealt so fully with the contents of the Exhibition elsewhere that it is needless to express an opinion concerning them here. We may, however, call attention to one or two points worth notice, to which we have not as yet referred. The great central tank, the operations of the divers, and the trial of life-saving apparatus proved immensely attractive. They might have been made much more attractive but for an unforeseen circumstance. In the sides of the tank were placed numerous square glass

windows, and it was intended that the visitors should see through these windows what went on in the tank, just as the fish can be seen in an aquarium. Unfortunately nothing could be seen in this way. The water supplied by the New River Company was not transparent. Again and again the tank was emptied and swept out, always with the same result. As a last resource several hundredweights of alum were dissolved in the 80 tons of water which the tank held. This threw down a great deal of mud and cleared the water; but the moment the divers entered, the mud was again stirred up, and nothing could be seen. If a second exhibition of the kind is ever held, unless specially filtered water can be obtained, it will be best to dispense with windows altogether and construct a staging round the tank with hand rails, so that visitors can see from above what is going on. The small stage attached to the tank in Islington accommodated very few persons, and was, we need hardly say, of necessity reserved for a limited number besides the judges of the life-saving apparatus. The numerous models of that great steam mercantile fleet which has made Great Britain famous constituted never-ending sources of attraction. Concerning these models we shall have a great deal more to say. The models lent by the Admiralty, again, gave thousands of persons a fair idea of what the war ship of the present day is, and this class of exhibit proved extremely attractive. It is worth notice that little or no second-rate machinery was to be found in the Hall; we could count on our fingers the downright bad specimens of engineering design, workmanship, and material exhibited; while in many respects a better display of high-class work was never got together. The launch engines shown were, in many instances, perfection; and it was worth notice that the old style of engines with cast iron frames, was conspicuous by its absence; the new torpedo type, with the cylinders carried on vertical cylindrical steel rods, having completely taken their places in all but the cheapest work. But excellence was not confined to launch engines, it was manifest all round.

The management of the Exhibition reflects the utmost credit on Mr. Barnett and his staff. There was no complaining, no grumbling; everyone was satisfied, and everything about the Exhibition was thoroughly well done. In this respect it constituted a remarkable exception to the annual International Exhibitions, which came to an untimely end some years ago at South Kensington. There, if an exhibitor had a grievance to speak of, or a request to make, he had to find his way to the result he wanted to obtain through the Circumlocution Office. In nine cases out of ten he did not get what he wanted at all. Mr. Barnett conducted his business on a totally different principle. He and his staff were always on the spot, always accessible, always ready to meet, as far as possible, the wishes of others; but at the same time he exercised sufficient authority to let it be known that no one must annoy his neighbour for his own good. He had a difficult part to play among the exhibitors of steam whistles and fog-horns, and, on the whole, he did it well. We have often expressed ourselves as entirely opposed to exhibitions, and we have not altered our opinion. But there are exhibitions and exhibitions, and it is one thing to keep one representing the manufactures of the world open for half a year, and quite another to show for ten days what special manufacturers do. Mr. Barnett and his staff worked hard to achieve success, and if giving universal contentment to all who exhibited and all who visited the Exhibition be success, they have attained their object in the fullest sense of the word, and we congratulate them on the result.

THE ACTION OF CUTTING TOOLS.

It is not often that the papers read before the Royal Society are of a sufficiently practical character to draw the immediate attention of engineers. An exception, however, is to be found in a paper by Mr. A. Mallock on the above subject, published in a recent number of the "Proceedings." Mr. Mallock was associated with the late Mr. Wm. Froude in many of his researches, and has therefore had an excellent training in that combination of theoretical insight with practical skill, in which Mr. Froude equalled, if he did not excel, many other investigators. The subject here attacked, though of high practical importance, is one on which very little is to be learnt from books, whether in its practical or theoretical aspect. Of the latter class, Mr. Mallock only refers to two papers, by Professor Willis and Mr. Babbage respectively; but he does not seem to be acquainted with the valuable researches of M. Tresca, described at the Paris meeting of the Institution of Mechanical Engineers. Combining the French and English sources of information, we will endeavour to trace out what really happens when a "cutting" of metal is removed in a planing machine or a lathe. The use of the word "cutting" is, however, inaccurate; for such tools act, not by cutting like a penknife or razor, but by shearing like a ploughshare. The difference between the two is important. In cutting the tool forces its way between the two portions which are to be separated, and pushes them apart from each other, but without distorting either. Thus the fine sections of animal and vegetable tissues, made with the razor by physiologists, would be almost useless if they were seriously distorted and injured by the act of cutting them. In shearing, on the other hand, the tool pushes its way across the surface of division, driving one portion of the mass in front of it, while the other is kept at rest. Thus, if we suppose two elements originally opposite to each other on either side of the plane of division, the face of the one will be torn directly away from the other in the case of cutting, while it will be pushed laterally past the other in the case of shearing. It is true that this explanation may not be rigorously true. The action of cutting, owing to the very small space over which it extends, is very difficult to watch; and it is possible that within that small space it may partake of the nature of shearing rather than of tension. But so far as the two main portions formed by the division are concerned, the facts are as stated. No one, in fact, who watches the action of a tool taking a heavy cut, whether in planing or turning, can fail to notice the way in which the metal immediately in front of the tool is wrinkled up into a sort of wave, pushed forward, and finally detached from the block and forced up the face of the tool. It is in this wrinkling and distortion, far more than in the actual separation of the surfaces, that the power of the machine is expended, and consequently it is important that this subsidiary action should be made as slight as possible. It is from this point of view that the minute phenomena attending the formation of the cutting deserve so much attention on the part of engineers.

Mr. Mallock has observed these phenomena for a great number of substances—including wrought iron, steel, cast iron, gun-metal, &c.—both by examination with a microscope during the process of cutting, and by etching sections of the cuttings afterwards with acid. Diagrams of many of these sections are given, and they nearly all show a sort of cleavage of the cutting into thin shreds or layers, whose planes of division make an angle of about 30 deg. with the direction of advance of the tool. Even in a brittle material, like cast iron, the same is apparent, though the layers in this case are a good deal broken up. There is one marked exception in the case of unlubricated copper, where the streaks of cleavage radiate in all directions from the point of the tool, and the cutting forms an irregular wedge, such as would evidently present an enormous resistance. These lines of cleavage are explained by Mr. Mallock to represent the planes along which each successive layer separates or shears itself away from the solid block. Taking the case of planing, it is evident that this plane of separation cannot be horizontal, since the cutting cannot bury itself entirely in the untouched metal in front. Neither can it be vertical, since this direction would be at right angles to that of the force causing the rupture. It must therefore lie at some angle with the horizon, and this angle appears in general to approximate to 30 deg. The successive layers will shear one after another along such inclined planes, and will then move upwards along the face of the tool—being pushed up by the rising of the layers beyond as the tool advances—until they either break off or curl out of the way.

The main fact is thus tolerably simple, and is brought out with great clearness by Mr. Mallock's diagrams. We cannot, however, profess ourselves altogether satisfied with his explanation of it, or with the theoretical and practical deductions he founds thereupon. Owing to some uncorrected printer's errors it is not easy to follow his demonstrations, and his leading principles are not very fully set forth. He regards the rupture of the material as due, not directly to tearing or shearing, but to distortion; his idea being apparently that when a rectangular section of any substance is distorted into a parallelogram, fracture eventually takes place, not by the shearing of the upper part over the base, but by tearing along the elongated diagonal. From thence he deduces the startling conclusion that if a tool were perfectly sharp it would plane off a shaving without the exertion of any force whatever. But this conclusion seems to be reached only by ignoring the possibility of shearing at all. Now the two methods described above of separating the adjacent faces of two elements must clearly exist, and which of them will be followed in any particular case must depend on the direction of the separating force, and on the proportion between the resistances of the material to tearing and shearing respectively. If the edge be perfectly sharp the effect will be one of shearing only; for the tearing force will diminish to zero, as Mr. Mallock supposes, but then it will produce no effect. If this were not so, the apparent shearing resistance of any body would diminish to nothing as the two shearing blades were made to approximate to each other. Thus, if a rivet were inserted into two plates $\frac{1}{16}$in. apart, it would show four times the apparent shearing resistance which would be found if they were only $\frac{1}{64}$in. apart. Nothing of this sort has ever been observed; it is, in fact, wholly against experience. We have no doubt that the sliding of the layers of the cutting upon each other, of which the cleavage remains as the evidence, is a true shearing action; although at the bottom of the layer, where it actually parts company from the mass of the block, the action would seem to partake of a tearing character. The inclination of the plane of shearing, on this hypothesis, can be readily found by equating the shearing resistance of the material, multiplied by the area of the plane, to the component in that direction of the thrust of the tool. It will then be found that the angle of the plane of shearing will in all cases be 45 deg.; and probably this is the angle assumed when the tool first strikes the edge of the block. But another force is immediately brought into play, at least with tough materials, namely, the downward pressure of the layers which have already been separated, and are being pushed up the face of the tool. This pressure will tend to flatten the inclination of the plane of shearing, and would therefore very well account for its observed value of about 30 deg.

But there is a further element in the case, of which Mr. Mallock fails to take account, but which is fully illustrated in the paper by Tresca already referred to. The work done by the tool is not entirely absorbed, as Mr. Mallock supposes it to be, in distortion, and bending, and friction. Before the actual shearing of each layer, if not during that process, a vast amount of work is done in causing *flow* of the material. This word flow, as relating to metals, is one which M. Tresca has made peculiarly his own, and his researches on the subject are so well known that we may assume our readers to be familiar with the idea. As applied to cutting tools, it is abundantly illustrated in the paper already referred to. The fact of flow is proved incontestably by the fact that the cutting, when measured, is in all cases found to be much shorter than the bed or surface from which it was divided. In the case of a planing from a wheel tire, and of a transverse cut from a double-headed rail, the shortened length was in the ratio of about 4 to 10 to the original; but in very thin shavings it is much less, and may even reach the proportion of 1 to 10. This shortening can only result from the fact that the metal, before it gives way, is actually forced in upon itself by the pressure of the advancing tool, and made to occupy less space than it did before. All such action is clearly a waste of power, and it is therefore desirable to reduce it to the lowest possible amount. Hence the fact ascertained by Tresca—that the shortening is greater as the shaving is thinner—assumes great importance. For it follows, as already pointed out by him, that, so far as this loss of effect is concerned, it will be less as the cut is deeper; in other words, as the thickness removed at each stroke of the tool is greater. The consideration of the equation obtained for the inclination of the plane of shearing, points in the same direction. For it will be found that this inclination will be steeper, the resistance to shearing remaining the same, as the cut is deeper. But the steeper the inclination the less will be the area on which the shearing resistance is concentrated, and consequently the less will be the force required to produce rupture, as compared with the thickness of metal removed. Here, again, it appears that the cut should be as deep as is practicable, all circumstances being taken into account. On the other hand, Mr. Mallock's theory leads him to the result that all the sources of resistance to the tool, except two, which ought to be insignificant, are proportional to the thickness of the shaving; and, therefore, whether any given thickness be removed at one cut or at several, it makes no difference to the work required for the removal. According to this view, the only advantage derived from deep cuts is the saving in the general frictional work of the machine, and, we may add, in the time of completing the job. Here, then, we have a distinct difference of result between the two theories, and we venture to assert with some confidence that the decision of practice will be in favour of M. Tresca and against Mr. Mallock. The practice of recent years hardly leaves room for doubt that the taking deep cuts does produce a great economy, not merely in time, but in the actual work required to remove a certain thickness of metal. The case of screwing lathes is specially to the point. There the mere friction of the machine, taken as if running light, is very small, and yet the saving from the use of deep cuts is found to be immense. We are almost afraid to mention the thickness of metal which is being removed at one cut from large screws in some of our foremost engineering works—works, too, which have a high reputation for quality to sustain, and are by no means likely to adopt a coarse and rough method of working for the sake of economy or anything else. In fact, the surface left after such a cut, as we can bear witness, is quite as clean and good as that due to the far lighter cuts with which we were formerly satisfied; the only requisite being that the machine and toolholder should be made thoroughly strong and stiff in all their parts. We have little doubt that if these cuts were measured, it would be found that the reduction in length, as compared with the original, was much less than the lowest of those recorded by M. Tresca; and, if so, this can mean nothing else than a reduction in the energy expended, as compared with the useful effect. While, therefore, we hold that engineers owe a debt of gratitude to Mr. Mallock for his investigation into this important subject, we are by no means satisfied that he has spoken the last word which is to be said upon it. We rather hope that the tool-makers and tool-users of England will be stirred up to attempt a full investigation and discussion of a matter, than which, insignificant as it may appear at first sight, there are few more important to each of these great fraternities.

NORTHERN STEAM SHIPOWNING.

One of the causes of the great activity in the shipbuilding trade in the North of England that has been very much overlooked is the largeness of the fleets of vessels owned by the ports from the Tyne to the Tees, and the frequent replacements that are inevitable in such a case. In 1852, it appears that there were only 237 steam vessels registered at the five chief ports—Newcastle, Shields, Sunderland, West Hartlepool, and Stockton—and the gross tonnage was only 5141 tons. But in the present year there are at these five ports over 1000 steamers registered as owned, and the tonnage of these is over 518,000. In 1852 West Hartlepool owned only 3 steamers, of a tonnage of 68; but at the present time there are registered as owned at that port not fewer than 167 steam vessels, with a tonnage of 127,922—a rate of growth that is certainly unequalled, and at the present time the addition to the steam fleets of the North is at a rate that is in excess of that of the past. Steam shipping has been found to be very profitable, and there has been a rush of capital into the business; whilst the falling off in the tonnage of wooden sailing vessels has been marked; and thus the iron shipbuilders have had a three-fold vacancy to fill from their yards. They have had to fill the vacancies that the losses that are inevitable at sea have made in the fleet of iron vessels. They have had to replace the tonnage of wooden vessels that have passed off the register; and they have had to build to meet the growing trade and the growing disposition to embark capital therein. When the aggregate tonnage—in iron and wooden vessels, ships, and steamers—is looked at, it will be seen that there is far from such great progress. The five ports had thirty years ago a gross tonnage of 578,550 on the register, but they have now about 700,000 tons on their register. In the interval the tonnage of sailing vessels has fallen from 573,400, to about 200,000, and it is by the growth of the steam fleet that the deficiency has been made up. And there is a probability of a still further growth, though it is tolerably certain that the next few years will greatly reduce further the tonnage of wooden sailing vessels; and the substitution of iron steamships will for some time to come give brisk work to the shipbuilders of the North of England. The figures that have been given show how the steam fleet has grown, and probably indicate how it will continue to grow.

STEEL FOR RAILWAY TIRES AND AXLES.

Amongst the "other selected papers" in vol. lxvii. of the "Proceedings" of the Institution of Civil Engineers, is a paper by Mr. B. Baker, giving the results of tests of half a dozen pairs of railway axles and tires. These were obtained from six leading makers at home and abroad, no particular mode of manufacture or price being specified. The results showed how very necessary it is that satisfactory tests should be insisted upon. The tensile strength of the steel in the twelve tires ranged from 32·25 tons to 49·5 tons per square inch, and the extension from 5 per cent. to 25 per cent.; whilst under the "drop-test" one tire failed at the second blow of a weight of 1 ton falling 10ft., and the next only did so at the twelfth blow from the increased height of 30ft., the respective bendings before fracture varying from no less than $\frac{6}{16}$in. to 28in. in the 3ft. tire. Similarly the tensile strength of the steel in the axles ranged from 27·35 tons

to 40·7 tons per square inch, the extension from 17·6 per cent. to 23 per cent., and the number of blows sustained before fracture from 3 to 35. The tests indicate that a high rate of elongation affords no guarantee that a tire or axle will behave well under the drop-test, and confirms what we have previously maintained, namely, that no efficient substitute is likely to be found for the rough-and-ready test of endurance afforded by the bending and straightening blows of a weight of, say, 1 ton falling 20ft. or 30ft. A sample of steel may be cut from a tire or axle and be tested with perfectly satisfactory results as regards tensile strength and elongation, and yet the tire or axle as a whole may fail under moderate shocks. Mildness, great elongation, and an ability to withstand the "temper" test, do not always insure the steel being able to withstand the shock and jar of traffic. Mr. Baker considers that "Experience has proved that steel, having a tensile strength as high as 50 tons per square inch, is quite trustworthy for use in tires in ordinary climates if the tires will stand a proper drop-test. Similarly experience in shipbuilding yards and elsewhere has led to the specification of mild steel having a tensile strength of from 26 tons to 32 tons per square inch, that quality being found best able to sustain without injury the contingencies of working. Probably a limit of 46 tons to 50 tons in the case of tires, and of 27 tons to 30 tons in that of axles, with proper drop-tests, would, on the whole, be the best to specify in order to secure the most suitable steel for the respective purposes."

THE VACUUM BRAKE IN AMERICA.

The New York papers are to hand with the account of another accident attributable entirely to the failure of the Smith vacuum brake on the Elevated Railroad, New York. From the *New York Herald* we learn that the driver states that on attempting to apply the vacuum brakes, he found they would not work, and on coming to a standstill he found that the brake coupling between the engine and the first car had parted. In answer to the question, whether there were any witnesses present when he made the examination, by whom he could prove that this was the case, the driver replies, "Yes, sir. It is not in any way by fault of mine that the accident occurred. Similar ones resulting from the failure of the air brakes have been quite common on the elevated railroads, and the company knows that this is so." If this is the case it is not unlikely that the managers of the Elevated Railroad in New York will follow the example of other American and English railways and discontinue the use of such a "safety appliance!"

STEAM ENGINES AT THE NAVAL AND SUBMARINE EXHIBITION.

Although there were no large marine engines at the Naval and Submarine Exhibition, steam machinery for the propulsion of small craft was well represented. The largest engine shown was a compound screw engine capable of indicating about 120-horse power, exhibited by Messrs. Burrell, of St. Nicholas Works, Thetford. The term "agricultural engineer" has almost lost its significance, all the principal firms formerly so styled now making machinery which is not even remotely connected with agriculture. The first firm to make a wide departure from existing practice in this direction were Messrs. John Fowler and Co., who, more than a dozen years ago, built locomotives for the London, Chatham, and Dover Railway Company's goods traffic. Messrs. Burrell have, in building marine engines, made another departure. They have several orders in hand for engines of the size and type shown, principally intended for coasting steamers and tug-boats. We illustrate Messrs. Burrell's engine in a supplement, calling in the aid of photography for, we believe, the first time in an engineering journal. In this way we are able to reproduce with more fidelity than is any other way practicable the characteristics of the machine illustrated. The engine in question has a high-pressure cylinder 12½in. and a low-pressure cylinder 22in. in diameter, with a stroke of 18in. The surface condenser tubes are packed with glands, a system of construction now retained by comparatively few firms, save those who build for the Admiralty, and one which Messrs. Burrell will find it worth while to discard in favour of wood ferrules. The engine calls for no particular description. It is strong and well finished, a good job, and likely to give satisfaction; it weighs 7 tons, and works at a high pressure. Steam is supplied by double furnace boiler, 9ft. by 9ft., not exhibited.

Messrs. A. Wilson and Co., of the Vauxhall Ironworks, showed very well-made compound engines, concerning which we shall have more to say when we illustrate them, which we propose to do in an early impression. They are fitted with Peyton's balanced slide valve, which, although circular like Church's and Webb's, differs from both in several important particulars. Messrs. Wilson's stand was full of "Vauxhall" donkey pumps and other steam machinery, all good of its kind. It will not be out of place to mention here that Mr. Stannah, of Southwark Bridge-road, exhibited several of his now well-known, curious, and efficient pendulum pumps, and a very well-designed and neatly-made launch engine, with one cylinder 3½in. diameter and 4in. stroke, complete with pump and reversing motion. The three excentrics are all turned out of the solid, and the whole engine is substantial and well put together.

Entering the Agricultural Hall from Islington Green, the visitor found in the arcade a launch, of wood, built by Messrs. Forrestt, of Millwall, 20ft. by 5ft. by 2ft. 6in. It is fitted with a small single cylinder engine, by Verey, with a modified Joy's valve gear. Although the engine was rather a rough strong job, than a neat and well-finished one, the valve gear appeared to be simply and ingeniously worked out in a way to make it likely that it will find favour in small boats. The same firm exhibited a vertical compound engine, unlagged and almost unpainted. We have seen cleaner castings and better finish, but the proportions are good, the bearings being very large. The engine is wrought iron framed, of the torpedo boat type. The air pump, with a very short stroke, is worked by a lever from one of the crossheads in the usual way. The links are of the double box type, with brass dies. This engine has cylinders 12½in. and 20¾in. diameter, and 12in. stroke. It is intended to run at a high speed. The surface condenser was not exhibited, nor was the centrifugal circulating pump driven by a separate engine, or the fan for forced draught. The working pressure is 130 lb.

Messrs. Forrestt also showed a drawing of a steel screw launch for the London Missionary Society, which launch has to be shipped in pieces to Lake Tanganyika, in Central Africa. This launch was designed by Mr. Gilbert S. Goodwin, of Liverpool. The machinery is intended to occupy the least possible space, and is placed very far aft in the boat; steam is supplied by one of Cochran's vertical boilers, which have proved to be admirably adapted for launch purposes. The boiler is made entirely of steel, and will be sent out in pieces and put together in Africa. The engine will have a single cylinder 7in. diameter and 9in. stroke, and will run very fast. It will have a steel shaft, and manganese bronze bearings. It will be of the best possible materials and workmanship, to run for years without repairs. It, also, is being made by Messrs. Cochran, of Birkenhead.

Close by was a steel launch by Messrs. Halsey. This boat has teak water ways and a small cabin. She is in fact a pleasure launch. No boiler was shown, but instead a dummy of sheet iron. She is fitted with a pair of non-compound engines, with the valve chests outside and the cylinders between them. She has a two-bladed propeller below the rudder. Several small engines were also shown by this firm, standing on the ground round the launch.

Messrs. Vosper showed in the body of the hall a 22ft. by 4ft. 9in. teak launch, fitted with one of their four-cylinder engines, too well-known now to need more description than to say that two pairs of single-acting cylinders, set at an angle of 90 deg. with each other, drive the screw shaft. The boiler is horizontal, and fed by one of Stannah's feed pumps. The engine is stowed very low down, under a thwart almost, and in a very inaccessible place. The smoke-box door is just over it, and whenever the tubes are swept, the engines, unless extraordinary precautions are taken, must be covered with soot and ashes. The coal bunker is arranged in the stern sheets, and holds but little. We understand that Messrs. Vosper build this class of launch for yachts, and they have, in our opinion, sacrificed too much in order to keep coals and engine out of sight. In other words, they have cramped up the propelling power of the boat in a very unsatisfactory fashion. However, we presume that they fully understand their customers, and if yachtsmen like to sacrifice efficiency to neatness in this way, we shall not find fault with Messrs. Vosper for meeting their wishes. Messrs. Ruck and Burt, of Portsmouth, showed three engines, one compound, one single-cylinder, and one small diagonal compound, weighing under 1 cwt., complete, with cylinders 2⅛in. and 4in. diameter, and 4in. stroke. The largest engine has cylinders 7¼in. and 11⅛in. diameter by 8in. stroke; the single-cylinder engine, 5¼in. diameter by 5¼in. stroke. All these engines are fitted with Tipping's patent reversing gear. We have already stated that the engines made by this firm are among the very best launch engines made, and we gave complete detailed illustrations of one of them in our impression for August 20th and 27th, 1880. The engines shown maintained the reputation of the firm for good workmanship.

The gem of the Exhibition, as far as launch engines are concerned, was shown by Messrs. Copley and Co., Vulcan Works, Middlesbrough, in the shape of a compound engine, similar to one fitted in Lord Alfred Paget's steam yacht Miranda. These engines are of the torpedo boat type, and run at 400 revolutions per minute; everything about them that can be made of steel is of steel, down to the cylinder lids, which are less than ½in. thick in the flanges. They are stamped into shape in a die, and subsequently turned. The finish of the engines shown was superb, the only deficiency being in some of the coppersmiths' pipe work, which, although strong, was not what it should be, one pipe in particular, bent to a series of awkward curves, had suffered untold miseries. We believe that this was the result of haste to get the engines finished in time for exhibition. We shall illustrate them in an early impression; meanwhile we may say that the two vertical cylinders are carried on six steel columns. On the crank-shaft near the after end is a large endless screw, which drives a worm-wheel carried on a short shaft at right angles to and lying above the crank-shaft. The second shaft has a crank at each end, one of which actuates a horizontal air, and the other a similar circulating pump; both these are cast of solid brass, and are fitted with slide valves worked by excentrics. The pump crank-shaft makes 100 revolutions, while the screw shaft makes 400. As much as 28in. of vacuum is easily obtained when the barometer is high, as the circulating pump is very large in proportion to the size of the engines, which are worked with 140 lb. steam.

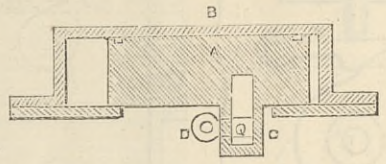
The Agricultural and General Engineering Company, Walbrook, E.C., showed a large launch engine with a vertical boiler. The engine is well designed, with a fairly long connecting-rod. Reversing is effected by a screw feather on the crank shaft, which causes the rotation of the single excentric through about five-eighths of a revolution. The boiler has a number of tubes open at the top and closed at the bottom, ferruled into the crown plate, and projecting at an angle down into the fire-box. The fire door is close beside the engine; a bad locality, as ashes, coal, &c., are certain to get into the engine bearings.

Messrs. T. Bates and Co., Sowerby Bridge, show two beautifully finished double-cylinder non-compound launch engines designed by Mr. Wigzell. The cylinders are carried on six wrought iron turned columns; the links are very long; the excentric rods are of phosphor bronze; the slipper guides are of very large dimensions. The only defects in design we could see in these engines is that the steam ports are very long, the valve chests are outside the cylinder, and the valve faces a good distance from them. These are very high-class engines, both in material, design, and workmanship. We illustrate them on page 292.

Mr. Gabriel Davis, of Abingdon, an engineer who has been doing a great deal of work in a very unobtrusive way, exhibited several admirable launch engines. Two in particular—non-compound with double-cylinders, 8in. stroke and 6in. in diameter—deserve notice. The cylinders are supported on six steel cylindrical columns; the bearings are of phosphor bronze; the guide bars are of the slipper type; the excentrics are in one with the shaft; the valve chests are in the middle between the cylinders. These engines leave nothing to be desired in design, material, or workmanship. Two similar engines are used to propel the Thames, a large launch carrying passengers during the summer months between London and Oxford. A single-cylinder engine, 5in. by 6in., was also shown. The cylinder is carried on three steel legs, and the arrangement is extremely neat. Mr. Davis uses locomotive type boilers for all his launches, and runs his engines up to 400 revolutions per minute. Some of his launches of comparatively small size attain a speed of sixteen miles an hour.

Mr. Joseph Bernays, of Newgate-street, exhibited one of his double-cylinder patent engines, which have been illustrated in The Engineer. The Dorset Iron Foundry Company, of Poole, make these engines. We believe that a considerable number of them are now at work doing good service. They deserve the attention of launch owners who like very compact and low-lying engines.

A very curious set of engines was shown in a stand close to that of Messrs. Copley and Co., by Mr. Somerset Mackenzie, of Great St. Helen's, London. A launch engine was exhibited in which a single cylinder is made to drive two screws revolving in opposite directions. One shaft a tube, the other solid. The solid tube revolves inside the tube. Each is fitted with a small propeller at one end, and at the other with a crank. The two crank pins are turned to face each other. The piston rod is fitted with a broad dog link in which slide two dies, one on each crank pin. As the dog link rises and falls, the two cranks revolve in opposite directions, the dies passing each other in different planes in the breadth of the link. This is no mere "idea," the engine shown having been worked for about five years regularly in a 43ft. launch, with, we understand, most satisfactory results. Mr. Mackenzie states that actual experiments made during the five years in question prove that right and left-handed propellers of only 1ft. 3in. diameter, driven at 130 revolutions, would do more haulage, and lift greater weights, than a single propeller of 2ft. diameter having the same superficies as the two small together, making nearly double the number of revolutions, while the vessel could be stopped in less than half the time; thus showing the advantage of the system for shallow draughts and for towing, consequently for canal purposes, while it is manifestly superior to the twin screw plan in not being overhung on brackets under the vessel's quarters, and in having only one stern tube. Mr. Mackenzie also exhibited an engine which has been at work now for some time in a small tug boat, and in which it will be replaced. An illustration of this engine will be found in our advertising columns. The engine is like two Mackenzie pumps, with the place of the pumps taken by two projections, in which are slots, in which work die blocks on the crank pins. The annexed sketch will make our



meaning clearer. B is a section of the cylinder in which works the very long piston A; the projection is shown at C, in which moves the die on the pin of the crank D. Mr. Mackenzie also exhibited a little steam capstan, which has done much service in a trawler. This compact and handy capstan and rope winch combined, is self-contained, either drum being rotated at will independently, enabling one man to attend to two cables, veering or hauling on one cable or both, and having control through the lever-handle and foot-brake over both the steam power and the cables. It was a noteworthy fact that Mr. Mackenzie exhibited nothing which had not been at work for some years, so that he cannot be accused of introducing new-fangled notions. He is certainly ingenious, and his inventions deserve more attention than they have as yet received.

At Stand 59 Mr. Mackenzie had under steam the only engine of foreign construction—a "Tegnander compound rotative," somewhat larger than one of a similar type built at Gothenburg, in Sweden, now working at the Crystal Palace Electrical Exhibition, where it gives good results. A striking feature in this engine is the steadiness with which it runs at high speeds, and the almost noiseless action of the double disc, in one of which are the cylinders and the variable expansion gear, which by a ball-and-socket arrangement gives rotation to the other, in its turn trunnioned to the disc forming the driving end of the shaft. This engine was decidedly one of the most novel in the Exhibition. It would be impossible to make its construction intelligible without drawings, and even with drawings the task would not be easy. It must suffice to say that the four cylinders drive the screw shaft on a principle much resembling that involved in the action of Bishop's disc engine, the "Z" engine, and West's well-known six-cylinder engine, but all the details are entirely different from either. The engine is remarkably well made, and reflects credit on the engineers of Gothenburg.

Among the models shown, none attracted more attention than that of the engines of the Britannic, by Messrs. Maudslay, Sons, and Field. This was a model which left absolutely nothing to be desired, being in every respect, down to the smallest nut, a reproduction in miniature of one of the most successful pairs of engines that ever crossed the Atlantic. They have been fully illustrated in our pages already. The model was shown in motion, making fifty revolutions per minute, being driven by a small and beautifully-finished gun metal vertical engine, supplied with steam from a boiler not far distant.

Sectional cardboard models of the Dominion Line engines of the Sarnia and Oregon were exhibited by

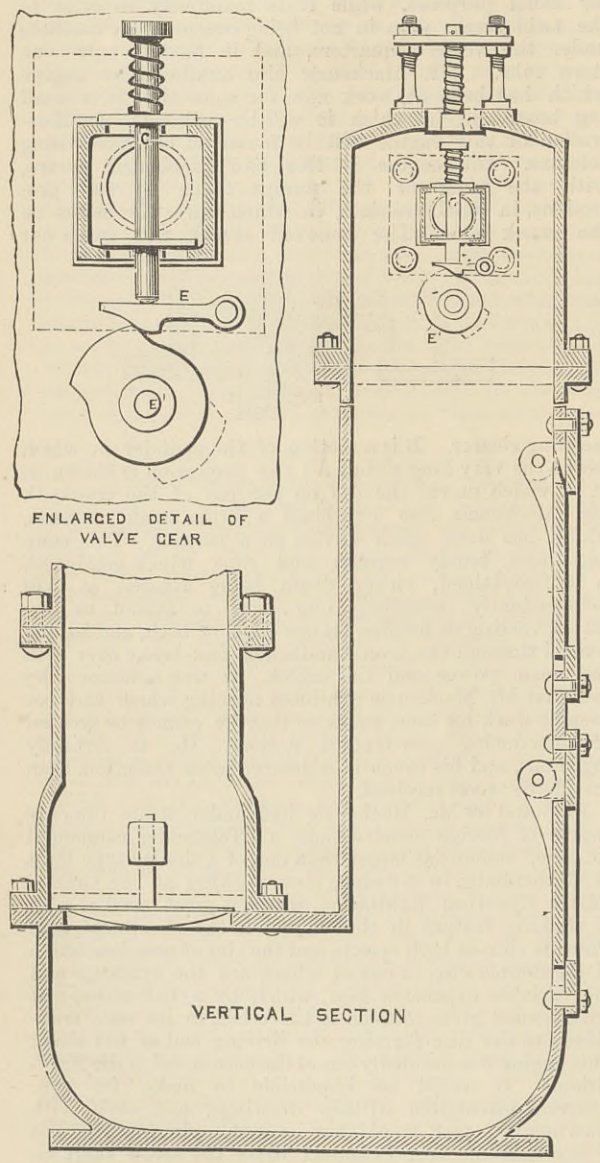
Messrs. Flinn, Main, and Montgomery, Liverpool. The ships named are 3700 tons, 360ft. long, 40ft. beam, and 32ft. 6in. deep. The engines have cylinders 48in. and 87in., with 4ft. 6in. stroke, steam being supplied by three boilers with fourteen furnaces, working at 80 lb. on the inch.

The "Generator Du Temple" was exhibited. This is a French invention, concerning which more particulars can be obtained by those who want them from the works, 2, Rue Champ de Mars, Cherbourg. The boiler is of the water tube type, consisting of a large number of wrought iron horizontal ⊐ tubes opening from a water casing at the back. The steam is collected in a horizontal drum on top. The engine calls for no special comment, being of the usual complex French type.

Steam engines were exhibited by Messrs. Ransomes, Head, and Jefferies, of Ipswich; Robey, of Lincoln; and several other firms, which require no special mention. There were also shown two rotary engines, one by Mr. Dexter, of Bourne End Engine Works, Maidenhead, and the other by Mr. Brossard, of Swansea. The Dexter engine is, we believe, too well known to require description. The Brossard engine is quite new, but as it has not as yet done any work, a few words about it will suffice. The engine in the Exhibition had a cast iron shaft about 10in. in diameter, but the inventor did not care to put it under steam without a wrought iron shaft, which could not be got ready in time. Two fine boilers, 16-horse power semi-portable, were provided by Messrs. Davey Paxman and Co. to work it, but their services were not required. The engine is fitted with a very elaborate and ingenious governor gear, which at present we need not take up space by describing. Nothing can decide the value or worthlessness of such an engine but the test of hard work. No large rotary engine yet made has been successful. Perhaps Mr. Brossard's will prove the exception to the rule. We shall see.

A great many steam pumps were exhibited, but there was not sufficient variety of type or construction to render a special article devoted to them necessary.

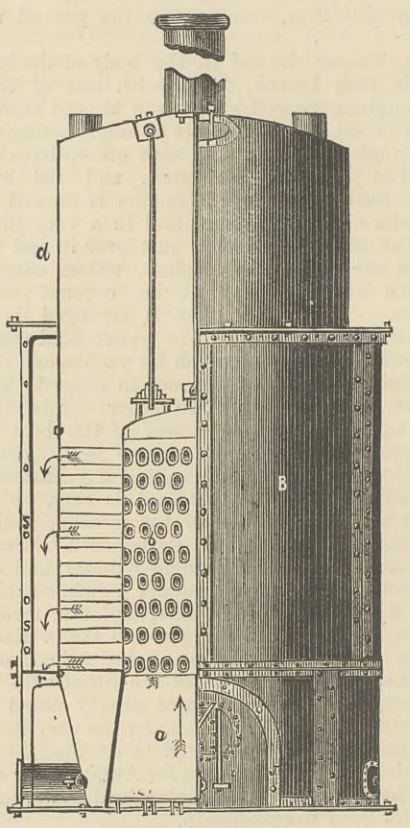
The most remarkable invention of the kind exhibited was Kidd's patent water elevator, which we illustrate. This is an exceedingly simple steam pump. Two vertical pipes are united at the lower ends as shown; one opens overboard, the other is fitted with flap valves of any size and put anywhere. In the upper part is fixed a double beat equilibrium valve, which can be caused to rise and fall by



KIDD'S STEAM PUMP.

a small cam on a horizontal shaft, a child can turn this shaft. High-pressure steam is led to the valve chamber by a pipe. In the top of the chamber is an air valve opening inwards. If a ship springs a leak water will find its way through the flap valves into the vertical syphon. On causing the shaft to rotate by hand the steam valve is opened. The steam rushes in and expels the water instantaneously. The valve is now closed, and air and water both enter the syphon, the air through the air valve at the top, the water below. The steam is again admitted, and so on. The pump can make 40 strokes per minute, and the syphon may be 5ft. or even 10ft. in diameter. The curious feature about the water lifter is that the temperature of the water is not sensibly raised, nor is there any appreciable condensation of steam, the whole of the water being expelled through the enormous foot valve in a moment. However, after the cam shaft has been turned once and the apparatus started, it be left to itself, it will, curiously enough, go on working, just as the pulsometer works, but at a comparatively slow speed, the temperature of the water being sensibly raised. Here is a neat puzzle for young engineers—shall we say even for full-grown men? It would be a pity to give the reason why, until a fair chance of solving the conundrum has been afforded to our readers. It must not be forgotten that air has free access to the interior of the syphon. Why, under the circumstances, steam should work the valves of itself remains to be seen. We think we are correct in stating that no one was more puzzled to explain the phenomena, which was totally unexpected, than was Mr. Kidd.

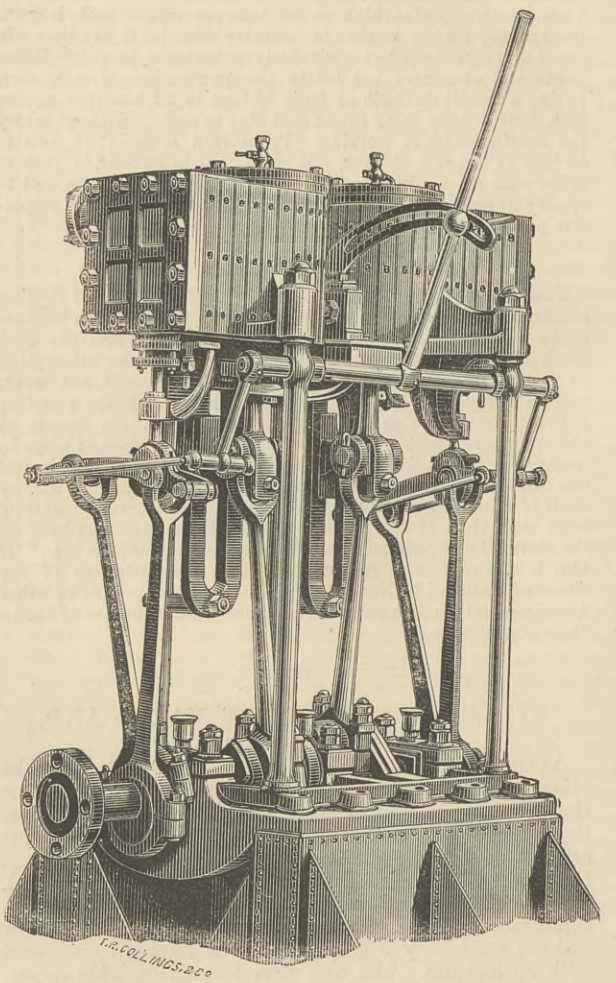
Among the various boilers exhibited we may mention a fine semi-portable, shown by Messrs Davey Paxman and Co., of Colchester, of excellent design and workmanship; a large winch boiler, by Messrs. Cochran and Co., of Birkenhead, of the type used in a great number of Atlantic and other mail steamers; a substantial 5-horse boiler, shown by Messrs. Wilden, King, and Co., of Liverpool; a boiler shown by Messrs. Duncan Brothers, fitted with Welton's patent smoke-preventing apparatus, and Green's patent water grate. Mr. David Midgely, of Stanningley,



MIDGELY'S BOILER.

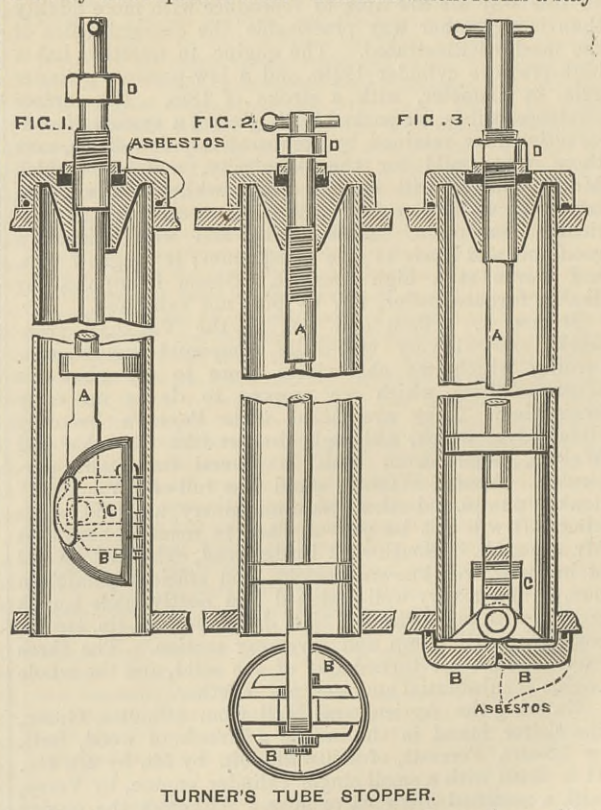
Leeds, showed one of his patent boilers, the construction of which is very simple. It is a vertical boiler, with an internal cylindrical fire-box. This fire-box communicates with the outside of the boiler shell all round through a great number of tubes of small diameter, and about 10in. long, set like so many stays. The boiler is surrounded by an outer casing of plate iron lined with specially made fire-bricks, which acts as a smoke-box. The bricks are built into segmental frames of iron, hinged to each other all round, so that when the tubes have to be cleaned one of the hinge pins has to be withdrawn at a time, and the tubes opposite the opening so formed can be at once swept out. The flame space is nowhere above the water-line, and the flue leaves the boiler at the lowest point opposite the firing door. We illustrate the boiler, so that its construction will be readily understood. We understand that about ninety of these boilers are now at work, and giving much satisfaction.

The finest specimens of boiler, smith, and flanging work in the Exhibition were those exhibited by the Leeds Forge Company. These comprised, amongst other things, three and four-flue furnace front plates for circular marine boilers, 13ft. 6in. and 15ft. diameter respectively, and of steel plate rolled by the company from Siemens' steel ingots, and flanged to take each furnace tube, each flange being pressed at one operation, and as clean as though only an inch or two in diameter and of soft copper. The flues are Fox's corrugated, and are 3ft. and 3ft. 2in. diameter, and 7ft. 3in. and 6ft. in length. These flues are now almost universally admitted to afford not only greatly increased strength as compared with the plain flue, the excess being four or five times that of the plain flue, as shown by the experiments recorded in The Engineer about two years since, but a greater and more effective heating surface is obtained. These corrugated flues are now fitted in boilers in one or more vessels of all the leading steamship lines, and in some of the largest ships such as the Servia. The Leeds Forge Company have so increased their business in this class of work, owing to their making these flues, that from a couple of sheds employed on this work two years ago there is now a large establishment engaged in it, provided with the most complete machinery for boring the circular pieces out of boiler fronts, and for flanging them after these are cut out, as well as the machinery for corrugating the flues. Mr. Fox has made a great many experiments and some costly machinery, with a view to rolling weldless flues. All attempts in this direction have, however, failed. It is found impossible to roll these endless plates, chiefly because there is no opportunity of getting the fresh start as is done in passing an ordinary plate backwards and forwards between the rolls. After numerous trials with special machinery this has now been practically given up, and instead Mr. Fox is experimenting, and so far successfully, with molten metal poured within a rapidly revolving internal cylindrical mould. With bronze or gun-metal the success of the experiments has been complete, a thin tube of about 9in. in diameter and two or three diameters in length, free from flaw or unsoundness of any kind, being one of the articles exhibited. Experiments on a large scale are soon to be made, and the results will be looked forward to with interest. It will be remembered that Sir Henry Bessemer, we believe, took out a patent some years ago for a method of making steel bars direct from Bessemer steel by running it in a trough between two revolving rolls, but this does not seem to have been successful.



MESSRS. T. BATES AND CO.'S LAUNCH ENGINE.

Turner's tube stopper, shown close to Mr. Mackenzie's stand, is an admirable invention. The object of this apparatus is to afford increased facility for closing up boiler tubes in the event of fracture in the body or leakage at ends between the tube and tube plates while under steam, without drawing the fire or reducing the pressure. The mode of operation is very simple, as shown in Figs. 1, 2, 3 in our engraving, and can be effected in a very short space of time. The instrument forms a stay

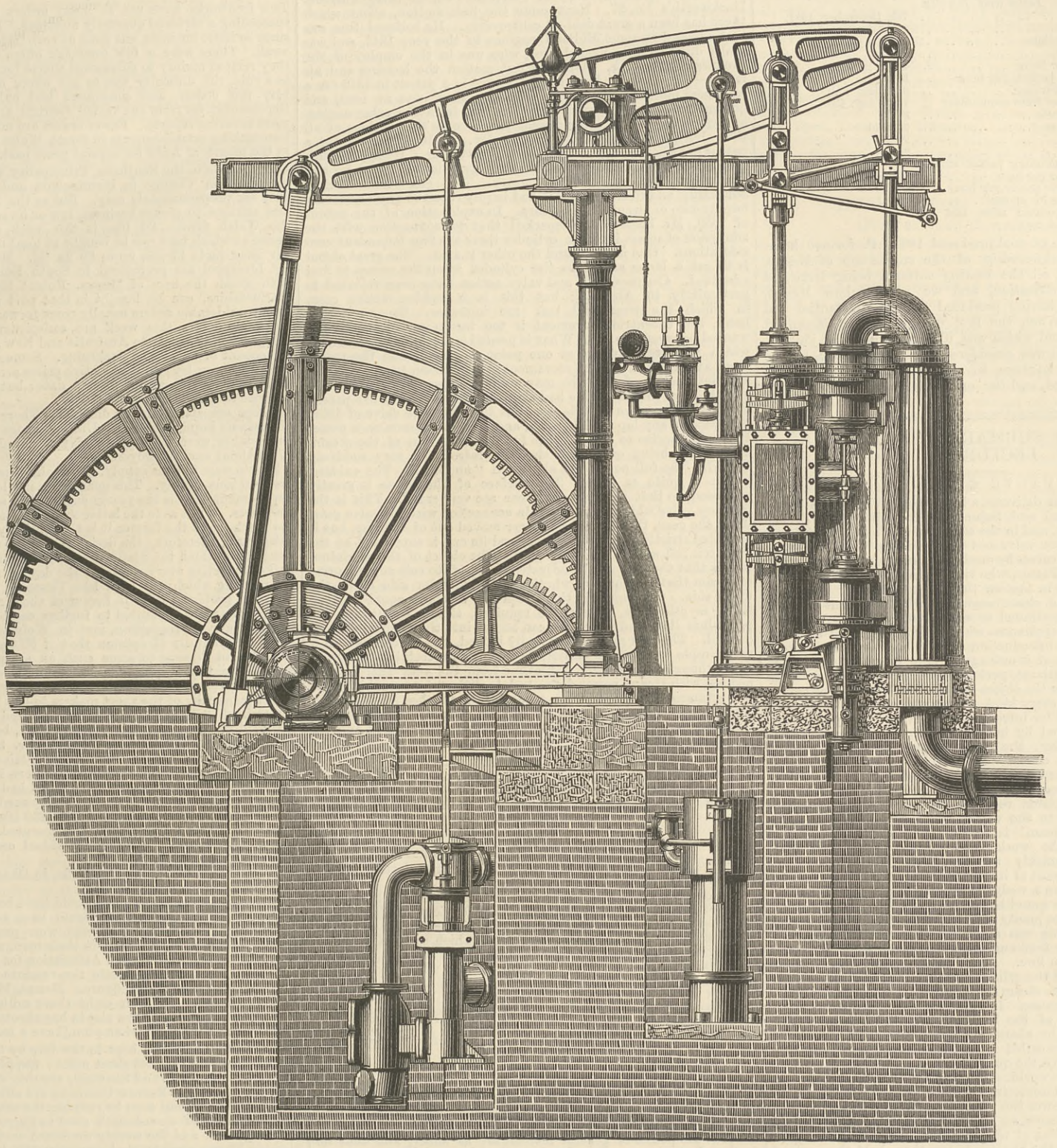


TURNER'S TUBE STOPPER.

to tube plates, and is so constructed that it can be readily taken out if required. The stopper consists of a wrought iron bar A having a cap at each end, the peculiarity being in the construction of the back cap in the combustion chamber, which consists of two malleable cast iron flaps B B, which, when in place, form a circular cover, the joint being formed between the two halves of the cap and the tube plate by means of asbestos—Fig. 3. These flaps are connected to the bar by a wrought iron link C, lugs being cast on the back of the flaps, and an eye formed in the bar for this purpose. Fig. 1 shows the way in which the cap is folded up to pass through the tube. When the cap enters the combustion chamber the flaps fall by their own weight and assume the position shown in Fig. 2. By turning the nut D at the front end of the stopper the back cap is drawn up

COMPOUND MILL ENGINE, ROYAL FLOUR MILLS, LONDON.

MESSRS. SIMPSON AND CO., PIMLICO, ENGINEERS.



to its place, as in Fig. 3, and the joint formed with the tube plates at both ends of tube, thus completely preventing the escape of steam and water into the combustion chamber or smoke-box. The front cap is so constructed as to shield the operator from the rush of steam or water at the smoke-box end. This will be readily understood from the drawing. To withdraw the stopper, slacken back the nut D, push back the bar, and turn it half round, when the flaps will fold up by their own weight, as before, and the stopper can be easily withdrawn.

We believe we have now noticed all the steam machinery calling for special attention. Certain miscellaneous exhibits remain which we cannot find space to illustrate or describe until next week.

We cannot let the opportunity pass without saying that the utmost credit is due to Mr. Barnett and his principal engineer assistant Mr. W. D'Alton for the care with which all the arrangements for supplying steam to the great number of engines at work were carried out. Steam had in many instances to be carried long distances in pipes, both overhead and under foot, but there were no leaking joints, nor was any trouble experienced from moisture. When it is borne in mind that many yards of steam piping had to be got in place, and hundreds of joints made, and the pipes clothed or protected in some way in almost literally a few hours, it will be seen that the task accomplished was no light one, and the exhibitors of steam machinery did their work well. The arrangements, indeed, throughout were admirable.

COMPOUND MILL ENGINE—ROYAL FLOUR MILLS.

We give above an engraving of a compound mill engine, recently designed and made by Messrs. Simpson and Co., engineers, Grosvenor-road, Pimlico, London, for Mr. P. Mumford, Royal Flour Mills, Vauxhall, London. Messrs. Simpson and Co. have long been known as makers of pumping and mill engines; but this is the first engine they have made for driving a flour mill in London, and as it has been so successful, we think it will much interest our readers to give an engraving of it and the results of a trial.

The engine is capable of exerting 350-horse power, but at present is only doing about 260. It is placed by the side of one previously erected, and works on to the same crank shaft; it was therefore necessary to put down a beam engine, as to have arranged a horizontal engine to work on to the first motion shaft direct, at 100 revolutions per minute, would have caused too serious and expensive an alteration in the design of the engine-room and mill. Mr. Mumford decided on having a compound engine, as with that type more regularity of motion is given to the shafts, a most important point in milling. The low-pressure cylinder is 38in. in diameter by 5ft. 6in. stroke, and the high-pressure cylinder 24½in. diameter by 3ft. 5in. stroke; the barrels of both are steam jacketted with boiler steam, a supply being taken from the main steam pipe before the engine stop valve, so that the cylinders can be kept warm when the steam is shut off from the valve chest. This is a great advantage, as it enables the engine to be thoroughly heated up before starting, instead of having to start with cold cylinders, and is an arrangement Messrs. Simpson always adopt. The engine is fitted with a surface condenser, the vacuum in which, on January 16th, attained the great height of 29·65in. of mercury, 28·5in. being the usual height when the barometer is about 30. The single-acting air pump is driven from the beam as shown, the feed pump being worked by the same crosshead and drawing its supply from the hot well; the circulating pump which draws its water from the Thames, and forces it through the condenser tubes, is double-acting and placed on the crank side of the beam, the quantity of water delivered by it per minute being about 700 gallons. Although no doubt a jet condenser would have been cheaper as regards first cost, yet we consider that Mr. Mumford did well in putting down a surface condenser, for in London, where works are by the Thames, plenty of water can easily be obtained, which, although not fit to put into a boiler, is clean enough to go through a condenser tube. The boilers are fed with the condensed steam, which is clean pure water, and does away with the necessity of cleaning out the boilers, or of using composition. With the previous engine the injection water was taken from the river, and as feed was taken from the hot-well, much mud was pumped into the boilers, and they had to be frequently cleaned out. The pipe laid from the river to the cold water pump was not in proportion to the quantity of injection water required, and as a consequence there was also a severe blow in the pipe, and very frequently a stoppage through something breaking or getting out of order. Messrs. Simpson and Co. laid down for the new engine a properly proportioned suction pipe, and made a circulating pump designed in accordance with their practice. The result has been all that was anticipated; no blow in the suction pipe or pump or stoppage through shortness of water has ever occurred. The engine is fitted with a Porter's governor, which works an equilibrium throttle valve of special design, and which very efficiently controls the speed of the engine.

The distribution of the steam is regulated in the high-pressure cylinder by a slide valve having cut-off plates adjustable by hand from outside on the back, and in the low-pressure by piston valves, one at top and one at bottom. To prevent any leakage of air into the exhaust pipe, Messrs. Simpson have adopted a water packed stuffing-box for the bottom piston valve; the arrangement which is clearly indicated in our engraving is as follows:—The links from the way shaft levers are connected as shown to a strong casting, to the bottom of which the rod carrying the piston valves is fastened; this casting, which is full of water up to the stuffing-box shown on the top of it, works outside a long projecting pipe on the bottom piston valve box, the end of this pipe being always in water.

A trial was made of this engine on December 6th, 7th, and 8th, 1881, and we give below the results of the second day's trial. Ordinary small coal was used during the trials, and samples tested by Mr. F. W. Hartley, A.I.C.E., in a Thompson's calorimeter, gave an average evaporation of 12·98 lb. of water from and at 212 deg. per lb. of coal. Good Welsh coal gives about 15 lb. of water evaporated from and at 212 deg., so that the evaporative efficiency of the coal used on the trial was not good; but when the difference of price between it and Welsh coal is taken into account, it will be readily seen small coal is the cheaper to use. The difficulty in using it is that it produces smoke unless mechanical stokers are used, as at Mr. Mumford's. During the trials the mill was doing its ordinary work with thirteen pairs of stones, ten sets of Ganz and Buckholz rollers, eight cleaning machines, and eighteen silks; the sack hoists, elevators and worms were working all the time. The average turn-out was 232 sacks of flour in eleven hours, and was almost constant on all three days. The average horse-power as calculated from indicator diagrams, which were taken from the top and bottom of each cylinder every quarter of an hour, on the trials, was 267·94, which compares very favourably with the quantity of flour made, bearing in mind the power absorbed by the modern machinery used in high-class milling. The measurement of the feed-water is most important, as it gives the efficiency of an engine independently of the boilers, and by comparing it with the coal used the evaporative duty of the coal and boilers is ascertained. To give only the amount of coal used per indicated horse-power per hour is no doubt the unit of measurement practically valued by millowners, but as coal varies so much in quality and price, the weight of water used ought to be taken, and the coal and water separated on every trial made.

From the results given on the next page, we find that 21 sacks of flour are turned out with the consumption of 585 lb. of coal, costing, delivered into the yard, about 10s. per ton, each sack thus requiring 28 lb., and the cost being 1½d. per sack—a result

which we think all millers will agree in saying is unprecedented. In considering the coal per 1-horse power per hour, the fact that the coal used was what is called "rough small" must not be forgotten, for on most trials the coal used is at least 20 per cent. better, and this must be taken into account when comparing this result with others.

Data and Results.

Date	7th December, 1881.
Duration of trial	11 hours
Steam pressure in boilers	73·52
Lb. of coal per hour	585
Lb. of feed-water per hour	4848
Water drained from jackets per hour	389·5 lb.
Temperature of feed-water	61·7 deg. Fah.
Temperature of water from economiser	120 6 deg. Fah.
Revolutions per minute	34·22
Indicated horse-power	267·946
Barometer	29·8
Vacuum	28·5
Lb. of feed-water, including jacket steam per 1-horse power per hour	18·09
Lb. of coal per 1-horse power per hour	2·18
Lb. of feed-water per lb. of coal	8·28
Lb. of water evaporated from and at 212 deg. per lb. of coal	9·77

Therefore, 1s. worth of coal produced 103-H.P. for one hour. The design and workmanship of the engine are of Messrs. Simpson's usual class, all the bearing surfaces being large and well arranged for lubrication, and we congratulate Messrs. Simpson and Co. on having produced such a substantial and economical engine. When the first engine for Mr. Mumford was erected in 1874, and which was illustrated in this journal, vol. xxxix. page 178, it was considered most economical, but so great has been the advance in mechanical science that it has had to be discarded, and the one just described has taken its place.

NAVAL AND SUBMARINE EXHIBITION LECTURES.

VALVE GEAR.

Mr. John Hackworth delivered a lecture on "Valves and Valve Gearing," at the Naval and Submarine Exhibition, on Friday morning, the 14th inst., and in the course of his lecture exhibited his patent "*ne plus ultra* valve and valve gearing." He said that the practice of moving valves by mechanical means was commenced by the boy Humphrey Potter, who tied a string to the beam of an engine to set the valves in motion that he might be at liberty to go to his play. The steam engine at that moment became automatic, and it has continued so with more or less perfection to the present day. The appliances which he was about to speak of are still used for the introduction of a "bit of steam" into a cylinder and the taking of it out again, care being taken that it shall not come out without performing the work which it is required to do. That is the object of the slide valve and of valves and valve motions of every kind. Among the various apparatus which had been devised for introducing steam into the cylinder are the common cock worked by hand, the four-way cock, the drop valve, the piston valve, the long valve, the short valve, the D valve, and the cut-off valve. The valves are actuated by certain given movements, which are called the valve motion. At first tappets were used, and afterwards cams, excentrics, cranks, connecting rods, and piston rods. There are various means by which motion is given to the valve. The great desideratum in introducing "a bit of steam" is to put it in at the right time, to make it do all the work that can be done, and then to get it out as quickly as possible. The tappet was done away with on account of its sudden action. The excentric is, nothing more or less than a wedge worked in a circular direction. It takes the whole circle round before it gives a back and forward movement, and this gives plenty of time for the gear to move round without any shock. This was applied to the early locomotives, among which were the first engines which were sent upon the Stockton and Darlington line. These engines had valves without lap. These valves filled the cylinder with steam from end to end, and they failed to use the steam to the best advantage and were a very extravagant appliance. In consequence of this, there was a proposal that the use of the locomotive on the Stockton and Darlington line should be abandoned; and Timothy Hackworth, the lecturer's father, was called in and was asked what was the best mode of dealing with the question of haulage upon that line —the first railway in the world. Timothy Hackworth replied, "If you will let me make a locomotive my own way, I will engage to make one which will answer the purpose." This he did, and the engine made its appearance on the line in September, 1827, just two years after the opening of the line. The use of this engine showed that it could do the haulage at less than half the cost of horse power. This engine was named the Royal George, and it was constructed with what is called "lap" upon the valve to the extent of half an inch. It worked with great economy, and it decided the question whether more locomotives should be employed. In 1829 Timothy Hackworth made an engine called the Sanspariel. This also had lap upon the valve. It worked to the year 1863, and was then transported to the South Kensington Museum. Hackworth next devised "The Globe." It was designed by him in 1829, and manufactured by Stephenson in 1830. This was the first engine which had a single lever to reverse the motion, and the new feature was a great improvement. This also had lap upon the valve. The distinction in this case was that there was a gab at the end of each excentric, and the two excentrics shifted from one driver to another in opposite directions. "The Globe" engine opened the Middlesbrough branch of the Stockton and Darlington Railway, and ran at the rate of fifty miles an hour. Next came Gray's motion, which was called the first-leg motion. It is not much known now. In this case the valve had lap about equal to half the traverse—that is to say, the two ends, taken and summed up into one lap, were equal to about half the movement which the valve had at its extreme. Gray is justly entitled to the credit of having introduced to the world a variable expansion. In the year 1836 the lecturer took the first locomotive engine into Russia which ever went there. The valve gear of that engine has been the germ for almost all the valve gears which have been made since that time. It had no excentrics, and was worked entirely from the piston movements of the engine. The engine was a double trunk engine working out at both ends of the cylinder. It was of extraordinary proportions, such as would astonish engineers of the present day. It had a 4½in. trunk and a 21in. cylinder. While he was in Russia he hit upon an idea for reversing the motion of an engine. He had a tube fitted on the shaft, say ¾in. thick. This tube had an excentric on each end, the excentrics being at right angles with each other. The two excentrics harmonised exactly with the angles of the crank shaft. Through the tube he put two spiral grooves, one diametrically opposed to the other; and in the shaft he had two straight grooves. He surrounded the tube with a clutch that had pins and dies to enlarge the surface. By drawing the clutch across over with a bell crank bow to catch the two pins of the clutch, he could turn the excentric round two-thirds of a revolution at pleasure. He made a ring about 1in. thick of the common width of an excentric, and at one side of it it had two arms on the edge of it. These arms were extended out. He had, beyond the circle of the ring, a brass box hooked on at each end. To provide for the moving in the required way he had a stirrup round the heel of the crank, and from this he branched off two arms rather nearer to the heel than the centre of the shaft. The ring with its two arms on the side had boxes that went on to the flat arms, and it would slide and cross over the shaft. In one box he had a square eye with a tongued spanner. That spanner was hinged upon a pin in the centre of the shaft. It may be called a bell crank, the other arm of the bell crank being square with the shaft. Taking the end of the bell crank, he could work the excentric backwards and forwards to the extent required. The pressure of working the valves could not move it, for it had a basis to stand upon, while the arms were on the side to guide it. By throwing across with these bell cranks he could reverse the action beautifully. That was simply a form of what is now called Dodd's wedge motion, and he introduced it into an engine in the year 1837, that engine being Timothy Hackworth's No. 27. Next came the link motion, about which there has been a great deal of controversy. He believed this was first adopted on some Midland engines in the year 1843, and was really due to a man named Hoe, who was in the employ of Mr. Timothy Hackworth. After the link motion the lecturer and his father—Mr. Timothy Hackworth—joined in a patent in 1849 for a combined motion from the two engines. There was no lead, and one engine worked the traversing reverse from the other engine, and *vice versâ*. This arrangement has become the nucleus of all the valve movements of the present day. In 1859 he took out a patent for what he called his dynamic valve gear. He applied this gear to an engine which he sent to Egypt in 1862, and he had previously used it in this country. The gear had worked admirably, and in some cases it had hardly required any repairs for twenty-two or twenty-three years. In explanation of the patent of 1859, Mr. Hackworth remarked that in connection with the admission of steam into the cylinder there are two important considerations. One is time, and the other is area. The great object is to get a large area into the cylinder when the steam is first admitted. Corliss valves and valve action have been resorted to particularly in America; but this is a sudden action gear, in which the wear and tear are immense. On the other hand, the excentric movement is too tardy; and something is wanted between the two. What is needed is a combined movement which will work quickly at one point and neutralise the movement at the other. If the movement is taken from two points, the combined action of the two may produce a regularity which will exactly meet the case. He had attained this result by his patent of 1859. The valve in this case, like the old slide valve of 1838, has scarcely any lap at either end, and the port as soon as it passes the centre begins to open at once for the admission of the steam. The action being quick, the steam is introduced very suddenly indeed. The full port is got almost in "no time." The exhaust action is quite as quick. The surface of the valve is greatly increased, so that the wear and tear are very small. This is the last new valve which he has used in connection with his valve gear. As to the gear, the valve rod is never moved out of the line, but it is guided strictly in a straight line, and its end is supported at the excentric rod with a pendulum link. The object of the pendulum link is that the gear can be adjusted or set off to suit any quantity of steam that is required, whether on the under side or on the upper side. Consequently the steam can be made equal on both sides, or otherwise, as may be required, simply by altering the pendulum link, and the steam can be put into the cylinder just as desired. The gear moves very easily indeed, and is reversed in a very simple way. This motion he regards as certainly the best, and although he has spent a lifetime from the year 1827 in connection with steam power developed in different ways, this is the last arrangement which he has made. It is the best, not only for action and for the power which can be deduced by means of it from a given quantity of steam, but also for durability and for easy manipulation.

LETTERS TO THE EDITOR.

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

THE SELLON SECONDARY BATTERY.

Sir,—In your issue of last week appear two letters on the subject of the new secondary batteries.

The object of the first, from the president of "La Société la Force et la Lumière," must be sufficiently obvious to all. Under the guise of private correspondence which he publishes before he can receive my answer, he makes statements, which, so far as my knowledge goes, are absolutely without foundation. In my reply, I give my view that the Law Courts form the only arena in which such matters can be satisfactorily dealt with, and I deprecate the appearance in print of such correspondence in anticipation of legal proceedings. The letter bearing the signature of M. Faure raises altogether a different issue. In reply, I would only suggest that he should at once prepare the proofs of his assertions, for they will most assuredly be required. I leave it to the common sense of those who take an interest in this discussion whether, had M. Faure been able at the dates mentioned to have so constructed his batteries as to have avoided the difficulties and failures which up to the present moment have, in the opinion of most scientific men been inherent to them, would he not have done so? It seems to me that the points of general interest are as under, and that no further discussion can be of use until they are settled:—(1) Are the batteries constructed by the Electrical Power Storage Company of the superiority over the "Faure" which is claimed for them? (2) If so, are the points which bring about this result protected by patents, and are these patents the property of the company? (3) Are they in any degree tributary to any valid claims of the "Faure" Company? (4) Are the "Faure" plates as recently constructed tributary to the Sellon-Volckmar claims?

Why any personal ill-feeling is to be imported into the determination of these points is a mystery to me. For one inventor to be after another in his ideas is no disgrace, it is only his misfortune. The only ground for ill-feeling which occurs to me would be on the part of any of the public, if they have through misrepresentations been induced to embark money in either undertaking. I may mention that the Electrical Power Storage Company is now taking steps to have the above referred to four points determined scientifically and legally—we have already proposed to the English Faure Company a reciprocal examination of the respective batteries as shown at the Crystal Palace, but as yet without response—and I will only ask your readers to suspend all judgment until full and definite decisions have been arrived at.

Meanwhile, as soon as the manufacture on the large scale being prepared for, is sufficiently advanced, the new batteries will be offered to the public under guarantee of indemnity against any action on the part of the Faure Company.

Ilfracombe, April 19th. John S. Sellon.

BULKHEADS.

Sir,—I was glad to see your comments on the delusion of bulkheads as at present constructed considered as a so-called means of safety at sea. I think experience has proved that they are not a safeguard against foundering, except when backed up by either cargo or spars or have the advantage of being navigated through a very smooth sea.

Instead of putting an additional weight of either plate or angle iron into the bulkhead to make it stronger, I think it will be better to dispose of the iron so as its tension can be brought into play, by making the bulkhead form the sixth or eight part of a circle on the plan of the steamer. Such a bulkhead, so built, will not buckle further, and would not have the tendency to separate from the vessel's side that the flat ones have; it will also take a smaller weight of iron for a stronger bulkhead.

As a set off against these advantages, I am aware that for packages or square stowage there will be a little loss, but I think this will be a trifle compared to the safety insured. Log Chip.

The Electric Lighting Bill.—On the motion of Mr. Chamberlain, it was resolved on Wednesday that the Select Committee on the Electricity Bill should consist of fifteen members, nine to be nominated by the House—viz., Mr. Chamberlain, Mr. Whitley, Mr. Slagg, Mr. Boord, Mr. Henderson, Mr. Henry Northcote, Mr. William Fowler, Mr. Molloy, and Mr. Brooks—and six by the Committee of Selection.

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

(*From our own Correspondent.*)

The ironworks have not as many orders as usual in the week succeeding a series of quarterly meetings. It has been a long time since so little business was done at such meetings as was done last week. There were a few *bonâ fide* offers upon the market, but they related mainly to galvanised sheets for roofing purposes; but, as a rule, the difficulty was to get offers made. Merchants held very few orders, and consumers had only little need to buy. Representatives from the varied districts are this week making no more cheering reports. Fewer orders are now reaching the leading iron-making establishments in South Wales than has been the case in the month of April for several years past.

Bars made in the Southern Principality are consequently more abundant on 'Change in Birmingham and Wolverhampton, and they are proportionately easy. But as the local firms are scarcely less anxious to secure business, few or no sales can be effected by the Welsh firms. £6 10s. is this week scarcely the minimum figure at which bars can be bought at local mills. Yet the marked bar firms quote £7 10s. up to £8 2s. 6d. Medium bars for export *viâ* Liverpool are prejudiced in South Staffordshire by the ease with which the bars of Messrs. Robert Heath and Sons, North Staffordshire, can be bought in that port at £7. At about th time considerable orders usually come forward for bars from India but such orders this week are conspicuously absent. Nor are things much better as to Australia and New Zealand, whilst buying on account of Canada is slackening. Some of this is due to holding off, because lower authoritative prices are believed by merchants to be unavoidable at no distant date; but it is in part traceable likewise to a decreased requirement.

Hoops are slackening in demand. There is an especial absence of business inquiry from the United States. Hoops of a serviceable quality were procurable to-day in Birmingham at well under £7, without securing buyers.

Sheets were in over supply. The total capabilities of the district are 2500 tons weekly. This quantity is not less in excess of current requirement than is the yearly out-turn of seven million boxes of tin-plates. While as to the latter the production is one millions boxes too much, as to the former it is too much by 20 per cent. By the chief firms, therefore, the desire is that an understanding may be come to by which the Staffordshire steel mills shall for the present be kept inactive every week till the day turn of Wednesday. At the meeting which was held last Thursday about 80 per cent. of the firms professed to be in favour of the arrangement. The committee who were appointed to further consider the question, and to formulate a proposition, met in Wolverhampton on Monday, and were generally of opinion that if 90 per cent. of the whole could be got to come to some such an arrangement, then that it might be entered upon, for the committee could well see the remaining 10 per cent. with a view to universal action.

At the meeting of the sheet makers to-day in Birmingham, it was determined that the make should be reduced 25 per cent., and that it should be brought about by Wednesday, being the day for the resumption of work weekly. To-day Mr. Samuel Meriton, coalmaster, of Oakham, near Dudley, and a Mines' Drainage Commissioner, died suddenly at the Great Western Hotel, Birmingham.

Reliable galvanising sheets were to be had to-day at, for singles, £7 15s. upwards; doubles, £8 15s. upwards; and trebles, £10. Yet there were trebles which realised £10 10s., and trebles of a less valuable kind for which £9 10s. was accepted. The business doing was mostly in small lots, an individual order for 30 tons being above the average.

Boiler plates were dull at £8 10s. to £9 and £9 10s. per ton at the works.

Galvanised corrugated sheets could have been sold in fairly large quantities, if the galvanisers would have accepted the very low terms offered; but the firms who were prepared to take prices nearest to buyers' terms were, in their turn, nearer to the £14 10s. per ton standard fixed by the Association for sheets up to 24 w.g. than would suit buyers, while the resolute firms would look at nothing under that crucial figure. Messrs. Morewood, of Birmingham, are keeping all their eight sheet mills running upon their own requirements, and have also to buy sheets; and the Corrugated Iron Company, of Wolverhampton, have a month's work ahead.

The steel question is kept to the fore by the growing consumption of blooms in the best sheet mills. Supplies, hitherto obtained mostly from Landore and Sheffield, are this week being augmented from Barrow. The Barrow Company are offering Siemens-Martin blooms here, and will soon be running the other districts hard, for the production of open-hearth steel in Barrow is fast increasing. Not long hence and the weekly combined outturn of Bessemer and Siemens-Martin steel by that company will, in the form mainly of rails and blooms, reach the grand total of 15,000 tons—a total which, it will be remembered, Messrs. Bolckow, Vaughan, and Co., too, are aiming at.

The firms who in this district buy steel blooms are growing customers also for hematite pigs. Yet the whole consumption is not enough to keep prices strong. Tredegar pigs are now to be bought at 70s., and there are certain Cumberland pigs which are procurable at from 67s. 6d. down to 65s. per ton. To-day, Staffordshire pigs were being quoted at, for the Bradley brand, ordinary forge, £2 2s. 6d.; best, £2 16s. 3d.; ordinary melting, £2 5s., and best £2 17s. 6d.

The coal trade continues very dull, and the pits are in only very partial employment. Forge coal is being put into boats at Cannock Chase in a few cases well under 6s. per ton. Prices of common kinds are nearly as low as ever, yet wages are 7½ per cent. higher than when the same figure was last touched.

There is likely to be a meeting of the Ironmasters' Association convened to take joint action touching a matter which has recently engaged the attention likewise of the ironmasters in Cleveland—the higher rating of blast furnaces. For union purposes the blast furnaces of this district have been revalued, and mostly an enhanced assessment put upon them. The proprietors affected complain, and are about to apply to the chairman of the association to convene a meeting to determine the course to be pursued in the interest of the trade.

The demand for machinery and engines is decidedly less active than a couple of months or so ago, and new orders are not taking the place of those worked off as fast as of late. But at present the chief firms in and around Birmingham keep active, and in numbers of instances busy upon, in much part, contracts booked some little while ago.

Messrs. Tangye continue very busy, and they are pushing on rapidly with their works extensions, which, it is understood, will cost them some £30,000, and enable them to increase the present number of their operatives by half a thousand. Steam engines and machine tools of a miscellaneous sort are the description of goods that are affording most work. Central and Southern America are the biggest buyers, notwithstanding United States competition. Indeed, the United States themselves continue to order machine tools from Birmingham.

Australia is taking machinery of much value to help in developing her mining resources, and she is also buying lathes and other machine tools. Upon the Continent, France and Russia are the best customers. Of late the Russian demand has been much below the average, but it is now satisfactorily reviving.

Gas engines are a rapidly growing trade with the Birmingham engineers, and preparations are being made on several sides to cultivate the business with increased energy.

Amongst the foreign engineering requirements which have recently found expression in this district are some from South America for tanks of large size for water storage.

In the cable and anchor trades there is a lot of work being got out at date around Dudley, Tipton, and Netherton.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—The business doing in the iron market here continues to be restricted to the most limited proportions, notwithstanding that the engineering and other iron using branches of trade are generally busy. The explanation given for this state of things is that consumers, to a very large extent, are still working upon iron bought at low prices; and in view of the enormous production, which they believe will compel makers to give way, they are not inclined to renew their contracts at the prices which are at present being asked. Makers, however, although the market here is steadily going against them, are not yet prepared to give way to the extent expected by buyers, and transactions for the most part are confined to comparatively small purchases for current requirements.

The Manchester market on Tuesday was tolerably well attended, but with very little doing, and prices, as a rule, easier. A few "bear" inquiries for forward delivery at considerably under current rates were reported, but these did not lead to business. Lancashire makers of pig iron still quote nominally 47s. to 48s., less 2½ for forge and foundry numbers delivered equal to Manchester, but these figures are not being obtained, and foundry iron especially is bad to sell. Sales of forge iron are, however, being made at slightly under 47s., less 2½, and local makers would be open to offers for good orders. In district brands some business has been done in Lincolnshire iron on the basis of 47s. to 47s. 6d., less 2½ delivered here, and Derbyshire iron is quoted at about 1s. per ton above these figures. Middlesbrough iron is altogether out of this market, and I do not hear of any transactions worth naming.

Finished iron makers report only a very limited amount of new business coming in, and the old contracts which have been keeping them going are being worked off much more rapidly than they are being replaced. This is causing makers to be more anxious for specifications, and following the recently announced reduction in Staffordshire, some giving way in the price of local iron has been necessary. Generally makers are holding for £6 15s. per ton for bars delivered into the Manchester district, but in some cases £6 12s. 6d. would be taken to secure orders, and hoops, which are only in poor demand, are offered from as low as £6 5s. upwards, whilst common Staffordshire plates are quoted at £7 7s. 6d. to £7 10s. per ton delivered here.

Satisfactory reports as to the generally active condition of the various branches of the engineering trades continue to be received from sources representing both the employers and the men. Works generally are reported to be well engaged, and the last month's returns from the various Lancashire branches of the Amalgamated Society of Engineers are, as a rule, more encouraging, both as regards the condition of trade and the continued reduction in the numbers of men out of employment, there being at the present time fewer members on the books of the society in receipt of out-of-work donation than has been the case for the last seven years. Applications for men are also reported as coming in from the various towns, especially for smiths and patternmakers, and with regard to the latter, there are none at present in the Manchester district on the books as out of work. There is no doubt that the men generally were never in a better position, either as regards wages or employment, considering that they are now receiving the high rates of a few years back, with at the same time a considerably lessened cost of living. So far as the employers are concerned, although their establishments continue well supplied with work, the number of new inquiries coming in seems to have fallen off recently, and those which have come forward during the last couple of months have not resulted in the amount of new work anticipated. This, however, does not at present materially affect the position of trade, the chief ground of complaint being that to secure new orders prices have still to be cut very low. In connection with the present activity in the engineering trades there is, however, one point which is deserving of notice, and that is the large extent to which it is due to the extraordinary amount of iron shipbuilding at present going on throughout the country. As an indication of the amount of work going on in this direction, I may mention that whereas a normal condition of the iron shipbuilding trades would represent about half a million tons in course of construction, returns which I know to be reliable and authoritative show that at the present time there is no less than a million and a-half tons under construction in the various iron shipbuilding yards of the country.

The wages question in the engineering trades, which was recently amicably settled in Manchester by the concession to the men of the 2s. per week taken off three years ago, is still in course of agitation in the Liverpool district, where the return to the old rates has only been partial. In those cases where the men have as yet only received an advance of 1s. per week steps are being taken to enforce the return of the full 7½ per cent. reduction.

The coal trade continues very dull, with quotations nominally unchanged, but actual selling prices very irregular and tending downwards.

Barrow.—The state of the hematite pig iron market this week has been the worst that has been known for a considerable period. Sales are few, inquiries weak, prices have gone down, and a general state of weakness characterises the market. 54s. 6d. is the present quotation for mixed samples of Bessemer; but so far as this particular district is concerned very little business is being done at that price. The reduction in price of 1s. 6d. per ton is very considerable, but perhaps the time of the season is accountable to a certain extent for so great a fall. The present quotation is felt to be too low to do business at to any extent, and makers refuse to quote it for contracts of any bulk. The output of metal stands at the same figure. The amount of metal which is being shipped abroad shows a considerable increase, while the deliveries over local railways have been well maintained, notwithstanding the Easter holidays. Stocks in makers' hands have decreased, partly owing to the increased shipments. Steel rails have fallen 2s. 6d. per ton, being now quoted at £6. The mills are very busily employed, but inquiries are not being made so freely. Makers, however, have their hands full for some time to come. I have heard nothing of any moment taking place in connection with the iron shipbuilding industry, but local builders are fairly well placed for orders. Engineers occupy a steady position, while ironfounders, boilermakers, and others are in receipt of steady employment. Iron ore is in full request at 13s. 6d. to 15s. per ton on trucks at the mines. Shipping better employed.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

The Cleveland iron market held at Middlesbrough on Tuesday last was very well attended, and the uninitiated would have supposed from the animation which seemed to pervade the market that a considerable amount of business was being transacted. This, however, was not the case. Very little iron changed hands. The struggle between the smelters on the one hand, and the merchant "bears" on the other, continues and grows keener day by day. The former had their usual meeting before market, and decided to quote no one lower than 43s. 6d. for No. 3 g.m.b., and to this resolution they strictly adhered. It is said by the ironmasters that by the end of the present month all contracts with merchants will have expired, and that the latter will be bound to give the full price for such iron as they may require to fiulfil their contracts with consumers. They assert further that even should that climax not be reached precisely at the date they fix it, they are fully able to do without selling until June 30th.

Meanwhile the "bears" have not been idle. Recognising the fact that the ironmasters are strong enough to hold their own for some weeks, and are thoroughly roused and determined to resist to the utmost a present fall in prices, they are confining their operations to the third and fourth quarters of the year. They are, in fact, offering pig iron for delivery in July or subsequently, at 42s., or 1s. 6d. below the present minimum. The effect to be expected from such offers is to alarm present holders of warrants, and to induce them to sell out now for fear of having to accept worse things. It tends also to discourage buyers, and to induce them to keep out of the market for the present. The general result aimed at is a panic or a glut of the market, and a downfall of prices, to the benefit of the under bought "bears," and to the discomfiture of the refractory ironmasters. The course of the struggle mainly depends, however, on the future state of consumption compared with production. All reports seem to concur in showing that the former is continuously exceeding the latter, at all events as regards Cleveland pig iron. The stocks in Connal's stores have diminished during the week by 4447 tons.

Shipments have not been quite so brisk as last month, but that is to be accounted for by the holidays and by the small difference—only 4s. per ton—which now exists between Cleveland and Scotch pig iron. A short time since it would not have been believed that under such circumstances any trade with Scotland could have existed at all, for it is clear that the price of Glasgow iron must be less, delivered in that city, than Cleveland iron is. Nevertheless it continues to be bought and used even under these circumstances, proving that a mixture of the two kinds is better and worth more than Scotch only. It may here be observed that the offers by bears to supply for July delivery at 1s. 6d. per ton below present prices do not seem to be at all readily accepted by consumers. They doubt whether they will get delivery of iron so bought. They have had some difficulty on this score of late, and they argue that it is possible, if not probable, that defeat awaits all the bears, and that then—well, what then?

The manufactured iron trade continues quiet, if not stagnant. There is little direct buying and selling. Holders of second-hand lots are doing what business there is, at about 5s. under official prices. These are exactly the same as last week.

The arbitration upon ironworkers' wages was held partly upon Saturday last, and partly upon the preceding Wednesday. The general question was, after much discussion, narrowed down to whether there should be a rise upon current rates of 7½ per cent., or any portion thereof, from February 1st to October 31st of the present year. The powers of the arbitrator were decided not to extend so far as to admit of a reduction in any case during the above period. The sliding scale, which was arbitrarily upset by the workmen at the beginning of February, is not to be re-enacted; but both sides expressed themselves willing to consider the concoction of a new one on some different basis, to come into operation after October. On the special claim for an advance on the wages of certain leading operatives employed in the plate mills, both sides submitted their cases as clearly and forcibly as they could, and each case viewed apart from the other, seemed plausible enough. Accurate returns were put in by the employers, showing the actual net earnings of the claimants since February 1st of the present year, and also for the five months preceding that date, when the last advance took place. From these returns it appears that shinglers, forge rollers, and heaters are now earning an average of 12s. to 15s. per day; shearmen are earning 20s., and plate rollers 33s. per day; and these are the men who want more! In the case of plate rollers, the above figures are very far from representing the maximum earnings at the best laid out heavy plate mills. It is asserted by the manager for a Stockton company, that one of his rollers recently took home £29 clear after paying all help for one week's pay! and this case is not by any means an uncommon one. One of the outcomes of the arbitration referred to, was the appointment of a committee of three employers and three operatives, with Mr. Dale as umpire, to draw up a uniform scale of extras to be allowed to puddlers. Hitherto the Board of Arbitration has not taken cognisance of extras, but only of the main tonnage rates. This afforded a loophole through which individual employers and operatives could virtually escape from the Board's decisions. Concessions in extras were offered in some cases and forced in others to such an extent as practically to nullify the decisions of the Board, and throw everything into confusion. It has now been decided that in future the Board shall take cognisance of everything which may affect, directly or indirectly, the remuneration of the men, and the appointment of the committee referred to is the first fruits of this resolution.

The announcement of another terrible colliery explosion, with loss of thirty-five lives, has once more spread consternation throughout the North. Several of the Cleveland ironworks depend more or less for their fuel on the group of collieries connected with the one which has explodod, and as all these are temporarily laid off, there is likely to be a scarcity. It is a grievous pity that nothing seems capable of being done to prevent these overwhelming calamities. Perhaps the Employer's Liability Act which has just cost another coal-owning firm some thousands of pounds for a similar accident, may prove to be the stimulus towards greater safety for colliery life and property for which we have long been waiting.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

The condition of the South Yorkshire coal trade is somewhat puzzling. Taking the collieries which send largely to Hull, it is clear that during the past quarter a much larger tonnage has been sent than in the corresponding period of last year. There are 104 collieries on the official list, and for the three months ending March last the quantity of coal sent to Hull was 279,246, or an increase of 48,679 tons on the corresponding quarter of last year. The exports for the last three months were 113,989, or an increase of 40,469 tons over the first quarter of 1881. Last month there was also a great increase, the quantity being 100,846 tons, as compared with 87,063 in March last year.

It is interesting to note how the coal is distributed from the various pits. Denaby Colliery Company, from its peculiarly advantageous position, again head the list, having forwarded during the last month 12,104 tons, of which 8160 went by water. A marked decline is shown by the West Riding and Silkstone Collieries, which usually occupy the second place. In March, 1881, they sent 10,966 tons, while last month they only sent 3790 tons. Carlton Main, on the other hand, forwarded 3134 tons against 1680 last year; Elsecar, 5144 tons as compared with 2684 in March, 1881; Glass Houghton, from which no coals were sent last year, sent 1948 tons; Kilnhurst, 2104 tons—by water—against 1228 last year; while Lundhill, from which 620 tons were despatched last year, sent last March 1368. Wharncliffe, Silkstone, sent a mere trifle in March, 1881 (28 tons), while in March last 3808 tons were so forwarded; and Mitchell's Main sent 1056 tons as compared with 78 tons in March last year. Thryburgh Hall sent 4124 tons by water, and Tankersley 1428; Swaithe Main, 972 tons against 380 in March of last year. Manver's Main, again, exhibits a falling off, having sent 2040 tons last month, against 2733 tons, and 8270 tons during the quarter. Still, in spite of this remarkable increase in quantities, prices seem drooping still lower. According to the natural law of supply and demand, the increased demand ought to have ensured firmer prices. As it is, the increased output of coals is being obtained by diminished labour at all the pits. The capacities of the South Yorkshire collieries must now be immense when full time is being wrought.

In the iron trade there is rather more activity, now that the result of the quarterly meeting of ironmasters is to leave prices remaining as they were—Staffordshire marked bars, £7 10s. per ton. There is an excellent business doing, but the means of supply being far in excess of the consumption, an advance in prices was out of the question. Indeed, in several important quarters, though not in this immediate district, several blast furnaces have been blown out. It was somewhat shortsighted, in view of the fact that any anticipation of increased values should be entertained.

In the staple trades of the town there is no change to report. Cutlery and general hardware keep in brisk request for nearly all leading markets, particularly for the States, the Australian colonies, and the majority of the home districts. A revival is reported from the Indian markets. The crucible steel trade has been in a very healthy condition for fully eighteen months, and I hear of very good orders coming freely forward this quarter. Bessemer steel has also been in brisk request, particularly in the selected and special makes, which are now so widely used in place of lower classes of crucible. In no branch of local industry has so much progress been made of late years as in the improvement of Bessemer steel, which is now used for many purposes the manufacturers never anticipated in the earlier days of its invention.

A Sheffield manufacturer, writing in the *Sheffield Telegraph* last week, stated that Herr Krupp had secured part of the contract for steel rails for the Hull and Barnsley Railway. The statement was promptly contradicted, but it turns out to be true after all. From Middlesbrough we hear that Messrs. Bolckow, Vaughan, and Co., and two Sheffield firms—Messrs. Charles Cammell and Co. and Messrs. Steel, Tozer, and Hampton, I am told—secured the bulk of the contract, and that Messrs. Krupp and Co. were successful in obtaining the order for the second lot which was given out.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

A very large business was done in the Glasgow warrant market towards the close of last week as a result of unfavourable reports with reference to the condition of the iron trade generally. For some time previously warrants had been scarce, holders keeping them up in the expectation that prices would advance. The futility of this anticipation was shown by the tone of business at the quarterly meetings in England, and besides that, the output of Scotch pig iron had been increased by about 400 tons per week, while storing had recommenced on a limited scale. The consequence was that a most extensive business was done on Friday by holders who pressed their warrants for sale, and the market has since been flat, with a tendency to decline in prices. The volume of the pig iron trade, however, has not materially contracted; the shipments are good for the season, and the home consumption is universally admitted to be larger than it was at this time last year. There is hardly any probability of a better business opening out with the United States, and opinions are divided with reference to the prospects on the Continent. Some merchants think that trade will now be dull, while others point to the fact that, except in Austria, there are no stocks to speak of remaining. There are about 500 tons more in Messrs. Connal and Co.'s Glasgow stores than a week ago.

Business was done in the warrant market on Friday morning at from 47s. 9d. to 47s. 5d. cash; and in the afternoon, 47s. 5d. to 47s. 7d. cash, and 47s. 6d. to 47s. 8d. one month. On Monday morning transactions were effected at 47s. 6d. to 47s. 7d. and down to 47s. 4d. cash, the afternoon quotations being 47s. 5½d. to 47s. 7d. cash, and 47s. 7½d. to 47s. 8d. one month. The market was flat on Tuesday forenoon, with business at 47s. 6d. to 47s. 3d. cash, and 47s. 5½d. to 47s. 5d. one month; in the afternoon the quotations were 47s. 3d. to 47s. 1½d. cash, and 47s. 3½d. one month. Business was done on Wednesday at 47s 1d. cash, and 47s. 3½d. one month. To-day—Thursday—the market was flat, with transactions down to 46s. 8d. cash, and 46s. 9d. one month.

In consequence of the breakdown of the warrant market, the quotations of makers' iron are nearly all lower this week, as follows:—Gartsherrie, f.o.b. at Glasgow per ton, No. 1, 57s. 6d.; No. 3, 50s. 3d.; Coltness, 57s. 9d. and 53s.; Langloan, 58s. 3d. and 53s.; Summerlee, 57s. and 48s. 6d.; Carnbroe, 51s. 6d. and 48s.; Calder, 56s. 6d. and 49s. 6d.; Govan at Broomielaw, 48s. and 46s.; Monkland, and Quarter, 48s. and 46s.; Shotts at Leith, 58s. and 54s.; Carron at Grangemouth, 48s. 6d. (specially selected, 53s.) and 47s. 6d.; Kinneil at Boness, 47s. 6d. and 46s.; Glengarnock at Ardrossan, 51s. 6d. and 48s.; Eglinton, 48s. and 46s. Dalmellington, 48s. and 46s.

The manufactured iron trade continues busy throughout almost every department, and a very healthy activity characterises nearly every branch of the engineering trade, both general and marine. From Glasgow a good export business is being done in machinery and in casting and railway materials, as well as in sewing machines and a variety of other manufactures.

The steel trade is decidedly quiet. The different works in the West of Scotland have still a fair amount of employment, but the pressure of business has materially slackened, and orders from America are not so numerous. The hematite trade is dull with prices declining, and some ironmasters are transferring their furnaces from hematite to ordinary pig.

There is a better feeling prevalent in the coal trade, the orders on hand being on the whole satisfactory for the season. The shipping trade of the past week has been about equal to what it was in the corresponding week of last year. A large business has been done at the ports. There is no change in prices, and the miners are everywhere working quietly.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

Mr. Edward Martin, of Blaenavon Ironworks, has been appointed to the general management of the Dowlais Works, Mr. Darling having the direct control of the steel works. I have not yet heard who is to be appointed to the works at Blaenavon. Mr. Martin has had the advantage of being personally trained by the late Mr. Menelaus, and is thoroughly conversant with his plans. Mr. Menelaus had in contemplation the addition of tire and wire works, so that with the manufacture of iron and steel, and also tin-plate, dowlais would have been one of the largest industries in the kingdom.

Mr. John Evans, assistant engineer at the Bute Docks, Cardiff, died suddenly last week.

The Ocean Collieries Company have declared an advance of 5 per cent., and the men are now working upon it. This may arouse discontent amongst the other colliers. All round there can be no question but that the scale of the Association is the best for the colliers. It answers better for the men when prices are low, and much better when they are high; and the successive "falls" and "rises" constitute the history of the coal trade of the port.

A good deal of discontent has been awakened about the shorn condition of the Swansea Bay Bill. They must go in for powers next session to improveit.

In the House of Lords Committee some modification of local railway bills may be expected, but the great interest of the Cardiff owners is centred on the fate of the Bute Dock Bill. The fight will be a stubborn and a costly one. A large section is in opposition, and almost as large a number support the promoters.

Ynyscedwin Works are going into steel, so too Cyfarthfa, but the action is a tardy one. At present the iron trade is not very brisk, and the condition of things in America is not favourable to restarts. I hear of large orders for railroad iron and steel in America being sent back into stock. If America should be favoured with a good harvest the cloud which seems lowering may be averted. In Swansea Vale the rail trade is pretty good.

There has been a rumour abroad respecting a probable re-start at Plymouth Works. A strong wish, I believe, exists to do something, and offers have been made, but nothing certain can be stated at present.

A good movement may now be reported in the Swansea anthracite district. Several capitalists in London have entered into the development of the anthracite coal in connection with the Ynyscedwin Works, and prospects are hopeful. A very large output took place last week at the Cymner Colliery. During three working days 4573 tons were raised, giving an average of 1500 tons per day. The ventilation of the pit, which is a very fine one, owned by Insole and Co., is by one of Waddle's fans. Winding engine by Harvey, of Hayle. The yard is lit by the electric light, Brockie's system.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

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

Applications for Letters Patent.

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

11*th April*, 1882.

1707. Drying Organic Substances, B. H. Remmers, J. Williamson, and W. Fairweather, Glasgow.
1708. Lacing Studs, W. R. Lake.—(*M. Bray, U.S.*)
1709. Steering Gear, T. Britton, New Hendon.
1710. Ordnance, R. S. M. de Ricci, London.
1711. Bleaching Matters, E. & R. Jacobsen, Berlin.
1712. Lamp Burners, W. Lighbody, London.
1713. Electric Arc Lamps, J. Brockie, Brixton.
1714. Whistle, J. Cran, Leith.
1715. Hydraulic Engines, &c., B. and F. W. Walker, Leeds.
1716. Washing Coal, T. Bell, jun., Saltburn-by-the-Sea, and W. Ramsay, Tursdale Colliery.
1717. Gas Engines, J. A. Drake and R. Muirhead, Maidstone.
1718. Dressing Fabrics, A. M. Clark. -(*La Compagnie Générale de teinturerie et apprêts "Système André Lyon," Paris.*)
1719. Water Meters, A. J. Boult.—(*E. C. Terry, U.S.*)
1720. Files, W. P. Thompson.—(*G. Nauerth, U.S.*)

12*th April*, 1882.

1721. Lead Peroxide, F. M. Lyte, London.
1722. Metallic Pens, W. Morgan-Brown.—(*B. Lawrence New York, U.S.*)
1723. Tube Expander, G. Lohf, Berlin.
1724. Colouring Matters, J. Erskine. —(*Farbwerke vorm: Meister Lucius, and Brüning, Germany.*)
1725. Soap, F. C. Glaser.—(*O. Liebreich, Berlin.*)
1726. Signalling, E. Tyer, London.
1727. Current Director, W. Fisher, Birmingham.
1728. Glycerine, B. Young.—(*J. Battershall, U.S.*)
1729. Measuring Liquids, J. Wetter.—(*A. Tavan, France.*)
1730. Colouring Substances, J. Wetter.—(*O. Bredt and Co., Germany.*)
1731. Bevelling Glass, T. Parsonage, London.
1732. Warping, &c., Machines, J. S. Sewell, E. Hulton, and J. Bethell, Manchester.
1733. Fountain Pens, W. Lake.—(*M. C. Stone, U.S.*)
1734. Clearing Tram-rails, J. Remfry, Calcutta.)
1735. Piston Packing Rings, A. Rickaby Sunderland.
1736. Looms, T. Blackhurst, Preston.
1737. Aerostat, A. J. Boult.—(*J. Jouanique, France.*)
1738. Tables, W. R. Lake.—(*H. U. Alcock, Melbourne.*)
1739. Sprays for Baths, W. P. Thompson.—(*W. H. Seymour, New York, U.S.*)
1740. Stove, A. Brown.—(*L. Bregha, Saxony.*)
1741. Filling Bottles, J. J. Varley, London.
1742. "Mousseunade," F. P. Beck, Brussels.
1743. Fuel, I. Lilley and F. Morris, Swansea.
1744. Sewing Machines, A. Guillaume and A. Lambert, Fosses, Belgium.
1745. Steam-boilers, R. Brandon.—(*C. Gamper, Sielce.*)
1746. "Economisers," T. Sykes, Manchester.
1747. Dynamo-electric Machines, D. A. Chertemps and L. Dandeu, Paris.
1748. Pneumatic Brake, F. W. Eames, Leeds.
1749. Roofing Tiles, C. Major, Bridgwater.

13*th April*, 1882.

1750. Sheet Lead, W. Burr, Long Ditton.
1751. Window-cleaning Chairs, W. P. Thompson.—(*A. Dormitzer, New York, U.S.*)
1752. Sulphuric Acid, W. Weldon.—(*Société de la Manufacture de Javel, Paris.*)
1753. Sulphide of Sodium, W. Weldon.—(*W. Helbig, Aussig, Germany.*
1754. Gas Motor Engines, F. Anderson and F. W. Crossley, Manchester.
1755. Ascertaining Gradient, P. Jensen.—(*E. F. Macgeorge, Melbourne.*)
1756. Pneumatic Brakes, J. Wetter, London.
1757. Water-gauges, J. Thurlow and A. Sykes, York.
1758. Billiard Marking, P. Mara, Putney, and J. Winson, London.
1759. Plates, W. and J. Plant, Moseley.
1760. "Dynamo" Machines, J. B. Rogers, London.
1761. Keys, F. Petit, London.
1762. Wire, J. Westgarth, Warrington.
1763. Iron, &c., H. C. Bull, Liverpool.
1764. Bicycles, G. Rixon, Wellingborough.
1765. Two-wheeled Vehicles, W. King, Linslade.
1766. Trimming Corrugated Tubes, S. Fox, Leeds.
1767. Disengaging Boats, F. G. Crofton, Dublin.
1768. India-rubber Springs for Buffers, R. Jähns, Cologne.
1769. Secondary Batteries, J. H. Johnson.—(*C. A. Faure, Paris.*)
1770. Baths, W. H. Luther, Glasgow.
1771. Steel, S. Fox and J. Whitley, Leeds.

14*th April*, 1882.

1772. Balloons, F. Wilkins, London.
1773. Colouring Matters, J. Erskine.—(*C. Rumpff, Germany.*)
1774. Electrical Circuits, A. Muirhead.—(*J. A. Briggs and F. Kinsman, Bombay.*)
1775. Bleaching, A. C. Henderson.—(*A. Demeurs, Belgium.*)
1776. Sewing Machines, J. T. Glasier and A. R. Briggs, Southport.
1777. Metallic Tubes, S. Fox, Leeds.
1778. Burning Coke, J. Cropper, Birmington.
1779. Crushing Seeds, H. Holt, Hull.
1780. Horseshoes, J. H. Johnson.—(*J. Moore, Paris.*)
1781. Vehicles, J. Wetter.—(*D. Mourisse, France.*)
1782. Measuring, G. Grütter, Berlin.
1783. Percussion Caps, T. Spencer.—(*O. Adams, U.S.*)
1784. Hot-air, &c., Engines, M. Boulton, Tew Park.
1785. Ventilating, T. Rowan, London.
1786. Sleeping Berths, W. Lake.—(*J. Alexander, U.S.*)
1787. Dynamo-electric Machines, B. Antill, London.
1788. Hot-air Engines, M. P. W. Boulton, Tew Park, and E. Perrett, London.
1789. Treating the Magmas Arising from Wash Liquors, W. H. Beck.—(*C. Violette, A. Buisine, and A. Vinchon, France.*)
1790. Locomotives, W. R. Lake.—(*Messrs. Debarnot and Jacquot, Paris.*)
1791. Wire, E. Richardson, Birmingham.
1792. Ventilators, A. Reddie.—(*A. Huber, Germany.*)
1793. Velocipedes, J. White, Coventry.
1794. Generating Currents, E. L. Voice, London.
1795. Rivets, &c., A. M. Clark.—(*A. Marland and T. Neely, Pittsburgh.*)

15*th April*, 1882.

1796. Furnaces. C. R. Wymer, Belvedere, Kent.
1797. Marking Ground, G. J. Piercy, Bournemouth.
1798. Boots, J. Wetter.—(*S. K. Hindley, U.S.*)
1799. Starting, &c., Engines, A. W. Pattie and G. W. Robertson, Glasgow.
1800. Braces, C. D. Abel —(*J. W. Höltring Germany.*)
1801. Motive-power Apparatus, T. C. Boutet, Paris.
1802. Obtaining Motive-power, G. Wilson, London.
1803. Incandescent Lamps, A. R. Leask, London.
1804. Traction Engines, H. G. and W. Woodbridge, Chipping Sodbury.
1805. Locks, A. Budenberg and A. Timpê, Manchester.
1806. Casing for Ships' Torpedo Boats, A. L. S. Leighs, London.
1807. Preparing Fabrics, S. Fulda, London.
1808. Pickling Metal Plates, J. R. Turnock, Dafen.
1809. Cooling Ice, W. Keates, Sutton.

17*th April*, 1882.

1810. Spindles, W. Holms, Glasgow.
1811. Preventing Collisions, H. O. A. E. Grünbaum, Stratford.
1812. Tricycles, W. Morgan, Birmingham.
1813. Traps, E. A. Brydges.—(*E. d'Aubigny, Vienna.*)
1814. Automatic Alarm, L. A. Groth.—(*J. Nilsson, Stockholm.*)
1815. Automatic Obturator, L. A. Groth.—(*L. Freyre, Sevilla, Spain.*)
1816. Treating Fibres, C. D. Abel.—(*E. Frémy and V. Urbain, Paris.*)
1817. Sugar, J. H. Johnson.—(*A. Wernicke, Prussia.*)
1818. Purifying Water, L. Swift, London.
1819. Collecting, &c., Water from Mains, T. Pullin and H. Bonser, Newcastle-under-Lyme.
1820. Saving Life, D. R. Jones, Carmarthen.
1821. Copper, &c., J. Mewburn.—(*L. Weiller, France.*)
1822. Electric Lamps, A. Church.—(*J. B. King, U.S.*)
1823. Fire-arms, S. P. Wilding.—(*F. Drevenstedt, Germany.*)
1824. Distilling, W. T. Y. Dicey.—(*C. Bilroth, Vienna.*)
1825. Pistons, G. W. von Nawrocki.—(*P. Langenstein, Bohemia.*)
1826. Refining Metals, W. A. Barlow.—(*J. L. Seyboth, Vienna, Austria.*)
1827. Slate, &c., W. P. Thompson.—(*M. H. Prodhomme, Bruxelles, Belgium.*)
1828. Securing, &c., Window-sashes, A. Smith, York.
1829. Looms, W. McNichol, Batley, and J. Hollingworth, Dobcross.
1830. Transporting Goods, F. Jenkin, Edinburgh.
1831. Reducing, &c., Metals, R. S. Ripley, London.
1832. Regulating Lubricators, W. A. Barlow.—(*F. Holtschmidt, Germany.*)

Inventions Protected for Six Months on Deposit of Complete Specifications.

1708. Lacing Studs, W. R. Lake, London.—A communication from M. Bray, Newton, U.S.—11*th April*, 1882.
1719. Water Meters, A. J. Boult, London.—A communication from E. C. Terry, Litchfield, U.S.—11*th April*, 1882.
1738. Billiard, &c., Tables, W. R. Lake, London.—A communication from H. U. Alcock, Melbourne.—12*th April*, 1882.
1745. Steam Boilers, R. H. Brandon, Paris.—A communication from C. Gamper, Sielce, near Sosnowice. —12*th April*, 1882.
1755. Ascertaining Gradients, P. Jensen, London.—A communication from E. F. Macgeorge, Hawthorne, near Melbourne.—13*th April*, 1882.
1790. Locomotives, W. R. Lake, London —A communication from Messrs. Debarnot and Jacquot, Paris. —14*th April*, 1882.
1791. Wire, E. Richardson, Birmingham.—14*th April*, 1882.

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

1446. Preventing, &c., Fires, A. J. Boult, London.—12*th April*, 1879.
1454. Lamps, G. Bray, Leeds.—12*th April*, 1879.
1540. Saw Benches, T. Lees, Hollingwood, Manchester. —19*th April*, 1879.
1502. School Furniture, G. W. Butler, Sparkbrook. —17*th April*, 1879.
1529. Knitting Machinery, W. R. Lake, London.—18*th April*, 1879.
1630. Gun Carriages, G. W. Rendel, Newcastle-on-Tyne.—25*th April*, 1879.
1480. Drying, &c., Vegetable Substances, S. C. Davidson, Belfast.—16*th April*, 1879.
1494. Glass Bottles, G. E. Eunson, Sunderland.—17*th April*, 1879.
1535. Flexible Printing Films, A. M. Clark, London. —18*th April*, 1879.
1552. Treating Wood, P. P. de la Sala, London.—19*th April*, 1879.
1593. Boots and Shoes, T. Cowburn, Gloucester.—23*rd April*, 1879.
1624. Propelling Vessels, J. H. Johnson, London.—25*th April*, 1879.
1482. Spinning, &c., Cotton, J. Tatham, Rochdale.—16*th April*, 1879.
1527. Driving Belts, M. Gandy, Liverpool.—18*th April*, 1879.
1645. Hats, J. H. Johnson, London.—26*th April*, 1879.
1457. Breaking Double Twists in Spinning, A. C. Henderson, London.—15*th April*, 1879.
1468. Measuring, &c., Grain, W. Brierley, Halifax.—15*th April*, 1879.
1478. Treating Refuse, A. Fryer, Wilmslow.—16*th April*, 1879.
1479. Weaving Carpets, J. Lawson, Glasgow, and J. R. Lawson, London.—16*th April*, 1879.
1488. Hydraulic Cranes, C. R. Parkes, London.—16*th April*, 1879.
1505. Reaping, &c., Machines, A. McGregor, Leigh. —17*th April*, 1879.
2387. Soda, E. Solvay, Brussels.—16*th June*, 1879.

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

1365. Spinning, &c., Yarns, H. Illingworth, Bradford. —15*th April*, 1875.
1375. Cutting up Loaf Sugar, H. M. Burton, Ipswich.—15*th April*, 1875.
1460. Kneading, &c., Peat, C. E. Hall, Leeds, and C. E. Bainbridge, Middleton-in-Tees.—21*st April*, 1875.
1576. Sulphates of Soda, J. Hargreaves and T. Robinson, Widnes.—29*th April*, 1875.
1630. Tire Fastenings, S. Carlton, New Swindon.—3*rd May*, 1875.
1384. Printing, E. Beech, London.—16*th April*, 1875.
1400. Spring Rollers, E. Putnam, London.—16*th April*, 1875.

Notices of Intention to Proceed with Applications.

Last day for filing opposition 5*th May*, 1882.

5362. Drying Agricultural Produce, E. Outram, Greetland.—7*th December*, 1881.
5381. Water-closet Apparatus, D. Gill, Weston-super-Mare.—9*th December*, 1881.
5382. Lighting, &c., Gas, F. Wirth, Germany.—Com. from C. Westphal.—9*th December*, 1881.
5408. Gas, J. F. G. Kromschröder, London.—10*th December*, 1881.
5411. Spanners, B. Godfrey and F. Brittain, Sheffield. —10*th December*, 1881.
5425. Preserving Meat, &c., H. H. Lake, London.—Com. from A. Fowler.—12*th December*, 1881.
5433. Locks, &c, W. H. S. Aubin, Bloxwich.—13*th December*, 1881.
5452. Electrical Batteries, W. R. Lake, London.—Com. from J. F. Aymonnet.—13*th December*, 1881.
5466. Locks, W. and S. Bash and N. S. Damsa, Manchester.—14*th December*, 1881.
5477. Electric Lamps, W. R. Lake, London.—Com. from C. F. de la Roche.—14*th December*, 1881.
5536. Dynamo-electric Machines, J. E. H. Gordon, London.—17*th December*, 1881.
5541. Tip-vans, &c., W. Bowen, London.—17*th December*, 1881.
5608. Boxes or Cases, W. R. Lake, London.—A communication from J. M. Douarin.—22*nd December*, 1881.
5619. Net-hauling Winches, C. R. Mitchell, Aberdeen.—23*rd December*, 1881.
5656. Working Electric Clocks, E. G. Brewer, London.—Com. from C. E. Buell.—24*th December*, 1881.
5662. Shafts for Vehicles, A. M. Clark, London.—Com. from A. Villière.—24*th December*, 1881.
5682. Velocipedes, J. White and J. Asbury, Coventry. —27*th December*, 1881.
79. Vehicle-axles, C. Pieper, Berlin.—A communication from J. F. Schmid.—6*th January*, 1882.
316. Telephone Transmitters, E. G. Brewer, London. —Com. from J. Olmsted.—21*st January*, 1882.
990. Checking the Speed of Trains, G. F. Redfern, London.—A communication from J. H. M. Waldrop. —1*st March*, 1882.
1024. Working Junction or Switch Apparatus, W. E. Irish, Sunderland.—3*rd March*, 1882.
1150. Adjusting Lawn-tennis Nets, J. Osmond, Leeroad, Kent.—9*th March*, 1882.
1226. Propelling Ships, W. T. Lithgow, Port Glasgow. —14*th March*, 1882.
1400. Electric Lamps, T. E. Gatehouse, London.—23*rd March*, 1882.
1426. Valves, W. Jones, Glasgow, and J. McLeod, Birkenhead.—24*th March*, 1882.
1451. Cigarette Papers, A. G. Goodes, London.—25*th March*, 1882.

Last day for filing opposition, 9*th May*, 1882.

5426. Two-wheeled Cabs, A. Forder, Wolverhampton. —12*th December*, 1881.
5437. Counters, D. and F. H. Orme, Oldham.—13*th December*, 1881.
5443. Steaming Fabrics, H. Webster and J. Clegg, Dewsbury.—13*th December*, 1881.
5445. Galvanic Batteries, O. C. Ross, London.—13*th December*, 1881.
5448. Sensitive Paper, W. T. Morgan, Greenwich.—13*th December*, 1881.
5449. Twisting Silk, H. H. Lake, London.—A communication from A. Bertholm.—13*th December*, 1881.
5454. Repairing Boots, J. Lewis, Birmingham.—14*th December*, 1881.
5455. Screw Propellers, J. Taylor, Birkenhead.—14*th December*, 1881.
5456. Motor Engines, H. Williams, Southport.—14*th December*, 1881.
5457. Separating Dust from Air, R. Howarth, Rochdale.—14*th December*, 1881.
5460. Fences, &c., D. Rowell, London.—14*th December*, 1881.
5461. Dividing Dough, J. W. W. Drysdale, Glasgow. —14*th December*, 1881.
5473. Opening, &c., Taps, T. G. Sharpe, Huddersfield. —14*th December*, 1881.
5475. Wheels, G. L. Scott, Manchester.—14*th December*, 1881.
5481. Secondary Batteries, D. G. FitzGerald, Brixton.—14*th December*, 1881.
5483. Gas-motor Engines, S. Griffin, Bath.—15*th December*, 1881.
5484. Bicycles, &c., A. Lafargue, Kensington.—15*th December*, 1881.
5886. Copying Pictures, A. A. Hely, London.—16*th December*, 1881.
5487. Gas Engines, W. Watson, Leeds.—15*th December*, 1881.
5490. Electric Lamps, W. R. Lake, London.—A communication from J. Mondos.—15*th December*, 1881.
5493. Making Button-holes, A. Helwig and J. Dewdney, London.—15*th December*, 1881.
5496. Preparing Cotton, J. Cryer, Dukinfield.—15*th December*, 1881.
5531. Flyers, S. Ingham, Luddenden.—17*th December*, 1881.
5540. Slide Rules, J. H. Thomson, Shoeburyness.—17*th December*, 1881.
5559. Rendering Fabrics Water Repellant, C. B. Warner, London.—Partly a communication from L. P. Britt.—19*th December*, 1881.
5616. Refined Sugar, J. H. Johnson, London.—A com. from M. Weinrich.—22*nd December*, 1881.
5617. Cyanurets, J. H. Johnson, London.—A communication from V. Alder.—22*nd December*, 1881.
5622. Automatic Harmonica, W. P. Thompson, London.—A com. from M. Harris.—23*rd December*, 1881.
5633. Spreading Sand, R. G. Garvie, Aberdeen.—23*rd December*, 1881.
5642. Refrigerators, G. C. Roberts, London.—23*rd December*, 1881.
5646. Mechanical Musical Instruments, W. P. Thompson, London.—A communication from M. Harris.—24*th December*, 1881.
5718. Mechanically-played Instruments, W. Thomson, London.—A communication from M. Harris.—30*th December*, 1881.
5733. Wind Musical Instruments, W. P. Thompson, London.—A communication from M. Harris.—31*st December*, 1881.
12. Axle-boxes, W. Clark, London.—A com. from C. E. Candee and A. G. Story.—2*nd January*, 1882.
236. Article of Diet, W. R. Lake, London.—A communication from L. Chiozza.—17*th January*, 1882.
286. Portable Forges, L. C. Gomant, Paris.—19*th January*, 1882.
458. Coal-getting, M. and C. Burnett, Spennymoor. —30*th January*, 1882.
634. Veneering Walls, T. Brindle, Southport.—9*th February*, 1882.
655. Excavating, P. W. D'Alton, London.—10*th February*, 1882.
868. Tell-tale, M. Levy, Knighton, and F. Lowe, Aylestone Park.—22*nd February*, 1882.
940. Taps, J. E. Chambers, Smethwick.—27*th February*, 1882.
1046. Cutting Holes, J. Rowland, Sunderland.—4*th March*, 1882.
1052. Velocipede, T. H. Ward, Tipton.—4*th March*, 1882.
1159. Percolating Coffee Jugs, E. Jones, London. —10*th March*, 1882.
1225. Gauging Carbon Filaments, M. Evans, Renfrew.—14*th March*, 1882.
1257. Stop-valve, W. Whiteley, Lockwood.—A communication from R. N. Pratt.—15*th March*, 1882.
1293. Cutting Earth, H. A. Bonneville, Paris.—A com. from G. Dubois.—17*th March*, 1882.
1299. Drafting Patterns, W. T. Philpott, Colchester. Com. from J. A. Wilson.—17*th March*, 1882.
1365. Moving Rollers of Rolling Mills, F. Asthöwer and T. Bicheroux, Westphalia, Germany. —21*st March*, 1882.
1373. Railway Chairs, H. Bridgewater, Watford.—21*st March*, 1882.
1408. Facilitating Administration of Fluids, F. Kingston, London.—23*rd March*, 1882.
1433. Rollers and Belts, J. Lewthwaite, Halifax.—24*th March*, 1882.
1453. Colouring Matters, J. A. Dixon, Glasgow.—A com. from C. Koenig.—27*th March*, 1882.
1473. Moreen Fabrics, E. Wade, Bradford.—27*th March*, 1882.
1503. Opening Cotton, A. M. Clark, London.—A com. from A. A. Goldsmith.—28*th March*, 1882.
1505. Paper Files, &c., A. Ellis, Lewes.—29*th March*, 1882.
1515. Steam Motors, W. R. Rowan, Hamburg.—29*th March*, 1882.
1531. Fasteners for Gloves, J. W. Pritchett, Clapton. —29*th March*, 1882.
1708. Lacing Studs, W. R. Lake, London.—A communication from M. Bray,—11*th April*, 1882.
1719. Water Meters, A. J. Boult, London.—A communication from E. C. Terry.—11*th April*, 1882.
1738. Tables, W. R. Lake, London.—A communication from H. U. Alcock.—12*th April*, 1882.

Patents Sealed.

(*List of Letters Patent which passed the Great Seal on the* 14*th April*, 1882.)

4248. Petroleum Lamp-burners, B. Schwarz and R. Huppertsberg.—1*st October*, 1881.
4501. Saccharification of Raw Grain, A. Manbré, London.—15*th October*, 1881.
4503. Fasteners for Doors, &c., C. Gall, Halifax.—15*th October*, 1881.
4506. Ventilating, &c., Mines, J. Onions and W. H. Tooth, London.—15*th October*, 1881.
4528. Corking Machines, F. H. F. Engel, Germany.—17*th October*, 1881.
4529. Indicators, F. H. F. Engel, Germany.—17*th October*, 1881.
4533. Electric Lamps, R. R. Gibbs, Liverpool.—18*th October*, 1881.
4534. Rinsing Bottles, J. Dollheiser, Cologne, Germany.—18*th October*, 1881.
4539. Tires, W. H. Carmont, Manchester.—18*th October*, 1881.
4542. Velocipedes, F. W. Eicke, Beulah-hill, London. —18*th October*, 1881.
4543. Boots and Shoes, H. Ovans, Merchants Quay, Dublin.—18*th October*, 1881.
4546. Steam Boilers, E. Crompton and J. T. Cochran, Birkenhead.—18*th October*, 1881.
4550. Steam Generators, R. Mills, Victoria-street, London.—18*th October*, 1881.
4594. Hydraulic Buffer-brake, W. H. Beck, Cannon-street, London.—20*th October*, 1881.
4618. Preventing the Purloining of Letters from Letter-boxes, G. Nobes, Harrow-road, London.—21*st October*, 1881.
4658. Watches, S. M. Morgan, London.—25*th October*, 1881.
4659. Lighting by Gas and Electricity Combined, R. H. Courtenay, London.—25*th October*, 1881.
4672. Steam Pumps, T. H. Ward, Tipton.—25*th October*, 1881.
4682. Locks, J. Jackson, jun., and C. Sheekey, London.—26*th October*, 1881.
4701. Fish-hooks, &c., T. Morgan, Redditch.—27*th October*, 1881.
4737. Beam Scales, &c., W. B. Avery, Birmingham.—29*th October*, 1881.
4757. Straining or Timsing Slip or other Semi-fluids, W. S. Scott, Southwick.—31*st October*, 1881.
4781. Frillings and Trimmings, E. A. Cowper, London.—1*st November*, 1881.
4801. Sizeing Paper, W. R. Lake, London.—2*nd November*, 1881.
4819. Motors, W. L. Wise, London.—3*rd November*, 1881.
4820. Electric Lamps, W. L. Wise, London.—3*rd November*, 1881.
4889. Mining or Getting Marls, &c., J. Mills, Hanley, and T. D. Brown, St. George's, near Wellington.—8*th November*, 1881.
4957. Ships' Pump Valves, J. Gwynne, London.—12*th November*, 1881.
5011. Permanent Way, J. Livesey, London.—15*th November*, 1881.
5390. Purifying Sewage, F. Petri, Berlin.—9*th December*, 1881.
5453. Preserving Milk, H. W. D. O. von Roden, Hamburg.—14*th December*, 1881.
45. Roller Mills, A. V. Newton, London.—4*th January*, 1882.
232. Permanent Way for Electric Conductors, H. R. Meyer, Liverpool.—17*th January*, 1882.
310. Governors, W. Knowles, Bolton.—21*st January*, 1882.
340. Cigarette Papers, A. G. Goodes, London.—23*rd January*, 1882.
402. Sawing Wood, T. N. Robinson, Rochdale.—26*th January*, 1882.
444. Dyeing Yarns, F. A. Gatty, Accrington.—28*th January*, 1882.
557. Dyeing Yarns, F. A. Gatty, Accrington.—4*th February*, 1882,
695. Tobacco Pipes, C. Morris, London.—13*th February*, 1882.
709. Horseshoes, J. Camp, Lowestoft.—14*th February*, 1882.
832. Propelling Vessels, W. R. Lake, London.—21*st February*, 1882.
834. Electric Lamps, W. R. Lake, London.—21*st February*, 1882.
838. Dynamo-electric Machines, W. R. Lake, London.—21*st February*, 1882.
854. Locking Nuts to Screw-bolts, A. M. Clark, London.—21*st February*, 1882.

(*List of Letters Patent which passed the Great Seal on the* 18*th April*, 1882.)

4572. Self-feeders for Threshing Machines, R. Moore and J. Lee, Cambridge.—19*th October*, 1881.
4577. Treating Iron, P. Jensen, London.—19*th October*, 1881.
4585. Double-barrel Guns, L. Gye, London.—20*th October*, 1881.
4600. Velocipedes, G. Singer, Coventry.—20*th October*, 1881.
4601. Ornamenting Glass, J. W. Savage, London.—20*th October*, 1881.
4603. Fire-grates, T. F. Clarke, Minehead.—20*th October*, 1881.
4604. Finishing Corn, E. Foden, Sandbach.—21*st October*, 1881.
4606. Tea, J. C. Marillier, London.—21*st October*, 1881.
4615. Fastener for Waist-belts, L. Dee, London—21*st October*, 1881.
4629. Gland Stuffing-boxes, J. G. Stidder, London. —22*nd October*, 1881.
4631. Vans, &c., H. Mousell, Gloucester, and O. Lythgoe, Manchester.—22*nd October*, 1881.
4636. Paste-board Match-box, A. M. Clark, London. —22*nd October*, 1881.
4638. Ventilating Lamps, &c., F. H. Smith, London —22*nd October*, 1881.
4644. Cleaning Hair, E. S. Norcombe, Birmingham. —24*th October*, 1881.
4655. Regenerative Hot-blast Stoves, J. Hartley, Barrow-in-Furness.—24*th October*, 1881.
4669. Brakes, W. H. Marks, London.—25*th October*, 1881.
4673. Mixing, &c., J. Melvin, Glasgow.—25*th October*, 1881.
4681. Fastening Ties, H. Scott, Liverpool.—26*th October*, 1881.
4724. Discharging Water, H. G. Grant, Manchester. —28*th October*, 1881.
4734. Combing Cotton, P. C. Marsden and W. Pendlebury, Bolton.—29*th October*, 1881.
4736. Safety Letter-boxes, A. J. Little, Twickenham. —29*th October*, 1881.
4740. Purifying Wax, &c., A. J. Boult, London.—29*th October*, 1881.
4749. Spring Balances, J. Linacre, Brecon.—29*th October*, 1881.
4764. Rock-drilling, W. Morgan-Brown, London—1*st November*, 1881.
4784. Ships' Rudders, W. Cooke and D. Mylchreest, Liverpool.—2*nd November*, 1881.
4803. Keels, W. Cooke and D. Mylchreest, Liverpool. —3*rd November*, 1881.
4804. Filtering Paper, S. H. Johnson, Stratford.—3*rd November*, 1881.
4811. Displaying Clothing, F. M'Ilvenna, Manchester. —3*rd November*, 1881.
4833. Locks, H. J. Haddan, London.—4*th November*, 1881.
4846. Pleating, &c., O. McC. Chamberlain, London.—4*th November*, 1881.
4926. Digging, &c., T. C. Darby, Chelmsford.—10*th November*, 1881.
5073. Cutting, &c., Roots, W. M. Nicholson and W. Mather, Newark-upon-Trent.—19*th November*, 1881.
5389. Metallic Alloys, G. A. Dick, London.—9*th December*, 1881.
5391. Cesspools, W. R. Lake, London.—9*th December*, 1881.
5580. Protecting Bags, C. E. Buck, Delaware, U.S.—20*th December*, 1881.
5614. Boring Rocks, J. T. Jones and J. H. Wild, Leeds.—22*nd December*, 1881.
40. Grape-sugar, W. R. Lake, London.—4*th January*, 1882.
87. Valve Gear, J. W. Hackworth, Darlington.—7*th January*, 1882.

241. HOLDING STAMPS, C. A. Drake, London.—17*th January*, 1882.
295. URINALS, S. H. Terry, London.—20*th January*, 1882.
308. APPLYING SPRINGS, H. Smellie, Kilmarnock.—21*st January*, 1882.
498. CUTTING HOLES, A. Muir, Manchester.—1*st February*, 1882.
656. SUPPLY, &c., for MARINE STEAM-ENGINES, A. Brossard, Swansea.—10*th February*, 1882.
733. SPINNING, &c., R. H. Maxsted, Galgate.—15*th February*, 1882.
735. SECTIONAL WARPING, R. Hall and J. Walmsley, Bury.—15*th February*, 1882.
781. INDICATING DOOR FASTENINGS, A. Ashwell, London.—17*th February*, 1882.

List of Specifications published during the week ending April 15th, 1882.

3337, 2d.; 3488, 6d.; 3517, 2d.; 3580, 8d.; 3588, 2d.; 3591, 4d.; 3607, 2d.; 3609, 6d.; 3637, 6d.; 3645, 2d.; 3653, 6d.; 3654, 6d.; 3659, 10d.; 3665, 8d.; 3679, 6d.; 3682, 6d.; 3693, 6d.; 3699, 6d.; 3700, 6d.; 3714, 8d.; 3719, 6d.; 3720, 8d.; 3724, 8d.; 3732, 6d.; 3733, 6d.; 3734, 1s. 2d.; 3739, 10d.; 3741, 6d.; 3752, 6d.; 3754, 6d.; 3767, 6d.; 3772, 6d.; 3773, 6d.; 3805, 2d.; 3808, 6d.; 3809, 6d.; 3811, 6d.; 3813, 10d.; 3817, 4d.; 3827, 8d.; 3829, 6d.; 3834, 6d.; 3863, 6d.; 3866, 6d.; 3884, 6d.; 3889, 6d.; 3890, 6d.; 3902, 6d.; 3915, 6d.; 3951, 6d.; 3953, 2d.; 3963, 4d.; 3964, 2d.; 3966, 2d.; 3971, 2d.; 3973, 2d.; 3974, 2d.; 3977, 2d.; 3982, 2d.; 3983, 2d.; 3991, 2d.; 3993, 2d.; 3994, 2d.; 3997, 2d.; 3999, 4d.; 4000, 2d.; 4005, 2d.; 4007, 4d.; 4009, 2d.; 4015, 4d.; 4017, 4d.; 4018, 4d.; 4019, 6d.; 4020, 6d.; 4024, 2d.; 4025, 2d.; 4027, 2d.; 4030, 2d.; 4033, 2d.; 4035, 4d.; 4040, 2d.; 4218, 4d.; 4675, 6d.; 5369, 8d.

*** Specifications will be forwarded by post from the Patent-office on receipt of the amount of price and postage. Sums exceeding 1s. must be remitted by Post-office order, made payable at the Post-office, 5, High Holborn, to Mr. H. Reader Lack, her Majesty's Patent-office, Southampton-buildings, Chancery-lane, London.

ABSTRACTS OF SPECIFICATIONS.

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

3337. FISH-PLATES AND RAILS FOR RAILWAYS, &c., *T. D. and H. W. Swift, Lancaster.*—2*nd August*, 1881.—(*Provisional protection not allowed.*) 2*d.*

The object is to avoid the jolting of trains when passing over the joints, and which is caused by the contraction of the rails leaving a space between the adjacent ends, and it consists in forming a projection on the fish-plate to fit a slot in the upper surface of one of the rail ends, such projection rising level with the rail top and formed to correspond with the contour of the rail.

3488. SCREW PROPULSION FOR SHIPS, &c., *J. Wilkinson, Blackpool.*—12*th August*, 1881. 6*d.*

This consists in the use of two shafts working at the stern of the vessel, one bearing a number of single-bladed propellers to work in a right-handed direction, and the other a number of single-bladed propellers to work in a left-handed direction, the two being coupled together so as to revolve towards each other, means being provided to uncouple the shafts so as to enable them to assist in directing the course of the vessel.

3517. TREATMENT OF SACCHARINE JUICE, *C. Pieper, Berlin.*—13*th August*, 1881.—(*A communication from C. U. Yates, near Manchester, and Dr. P. Degener, Brunswick.*)—(*Provisional protection not allowed.*) 2*d.*

The object is to treat saccharine juice so that the generation of molasses will be effectually limited and the formation of crystallised sugar accelerated and increased, and it consists in creating a vacuum of 35 millimetres of pressure or less in the vacuum apparatus, and heating the juice at the utmost to 45 deg. Centigrade.

3530. WEIGHING MACHINES, *T. H. Ward, Stafford.*—17*th August*, 1881. 8*d.*

This relates to the platform weighing machine described in patent No. 4294, A.D. 1876, in which the weight of a load is ascertained by measuring the deflection from its normal path of struts, tumblers, or rockers, upon the principle of the parallelogram of forces. Two rails to receive the truck are carried on girders rocking on knife edges fixed to a number of struts, tumblers, or rockers, having a motion parallel to each other, and rocking or deflecting on lower knife edges, constituting fulcra, which form the base or foundation plates of the machine. So as to insure perfect parallel motion, the fulcra are rigidly connected together, whilst the rocking girders above fix the top knife edges. To one of the rockers is attached a horizontal lever, the outer end of which bears on the plunger of a shallow hydraulic cylinder, the water from which is conveyed into the office through a small tube terminating in an inverted syphon of mercury. The far legs of the syphon connected with each rail are connected with a breeches pipe discharging into one glass tube common to both syphons and graduated, and containing a column of liquid, which by its rise and fall will show the resultant load of the two sides of the truck.

3538. REGISTERING BY ELECTRICITY THE NUMBER OF PICKS WOVEN PER INCH IN LOOMS, *G. J. Porritt, near Huddersfield*—11*th August*, 1881. 6*d.*

The inventor attaches to the inside of the breast beam of the loom an apparatus actuated at each beat up of the slay or other going part, so that the result is indicated at a distance.

3539. ELECTRICAL APPARATUS, *W. R. Lake, London.*—(*A communication from C. Williams, jun., F. W. Harrington, and T. W. Lane, Mass., U.S.*—15*th August*, 1881. 8*d.*

This invention relates to apparatus, switch boards, &c., for putting into or cutting out the generator from the circuit. One part of the invention describes apparatus for automatically putting the generator in circuit as well as causing the armature of the magneto-generator to rotate.

3588. DAMPING AND REGULATING THE SUPPLY OF WATER TO LITHOGRAPHIC STONES AND ZINC PLATES DURING THE PRINTING OPERATION, *J. Meinschock.*—17*th August*, 1881.—(*Not proceeded with.*) 2*d.*

One end of a felt, moleskin, or other absorbent sheet of fabric dips into a water trough, and the other end projects outside and lies on a felt-covered roller, arranged to be in contact with a damping board or pad, which has a to-and-fro motion in the machine.

3591. GLASS-HOLDERS OF GASALIERS AND LAMPS, *H. W. Sambidge, Birmingham.*—18*th August*, 1881.—(*Not proceeded with.*) 4*d.*

The object is to prevent the glass falling out in whatever position it is held, and it consists in the form of the arms of the holder and the angle of the parts.

3607. MARKING AND INDICATING THE LENGTH OF YARN ON WEAVERS' BEAMS, *A. Hitchon, Accrington.*—19*th August*, 1881.—(*Provisional protection not allowed.*) 2*d.*

A revolving disc bearing figures is employed, and a presser operated by levers is caused at intervals to descend and press the yarn between the figures or letters, which are supplied with ink, so as to mark and indicate the length of warp on the beam.

3609. STRETCHERS, &c., *J. Furley, Sevenoaks.*—19*th August*, 1881. 6*d.*

This consists, First, in forming the sides of the stretcher of light straight-grained wood, in which is inserted nearly from end to end a piece of iron. At each end of the stretcher are two radius bars pivotted together at one end and to the sides of the stretcher at the other, so that it can be folded up. The two bars are locked in the open position by a pin inserted through one bar which is prolonged. A canvas sheet is secured to the sides by a cord passed through eyelet holes. A pillow and head covering are raised into position as the stretcher is open. A wheeled carriage is provided to convey the stretcher from place to place.

3637. SEWING MACHINES FOR STITCHING SACKS, BAGS, SHIPS' SAILS, &c., *W. Webster, San Francisco.*—20*th August*, 1881. 6*d.*

This relates to improvements on patent No, 3725, A.D. 1880, in which an intermittent serrated chain feed movement for the material and a screw feed for the needle carriage are employed, both actuated by an excentric, link, and pawls and ratchet wheels, and it consists in effecting the intermediate movement of the material and also the feed of the needle, by the use in combination with the spiked feeding chain and the needle carriage, of a tangent or worm wheel, and a suitably formed cam placed upon any shaft of the machine having the same number of revolutions as the rotating needle, such cam being what is known as the "drunken screw," or screw of varying pitch The curved needle is formed with teeth and actuated by a toothed wheel or segment. The presser foot is mounted on a stud at the back of the machine and provided with an arm reaching forward to carry the foot proper, such presser foot being actuated by a spring round the stud, and provided with a handle and latch to lift and hold it while placing new work in the machine.

3645. SHOEING HORSES, *G. W. H. G. Scrope-Ferrers, Martlesham, Suffolk.*—22*nd August*, 1881.—(*Provisional protection not allowed.*) 2*d.*

A casing for the hoof of the animal is formed of iron, steel, phosphor bronze, or other material, such casing being jointed and secured to the hoof by binders or metal straps, and the wearing shoe secured to it.

3653. ORE GRINDING AND AMALGAMATING MACHINES, *T. A. Readwin, Bloomsbury-square.*—22*nd August*, 1881. 6*d.*

This relates to machines for grinding ore and amalgamating gold or silver with mercury, in which an arm carried round by a vertical spindle suitably driven causes a pestle to rotate about its own axis, and to roll obliquely on the inner surface of a circular pan whose half vertical section approaches the form of the rounded surface of the pestle, and it consists in forming the bearings for the vertical spindle of hard wood or asbestos, water being used as a lubricant. The pestle axis is made of hardened steel and is removable from the pestle body, in which it is fixed so that it can be shifted lengthwise or renewed at pleasure. The pan is recessed at the bottom to receive a hollow cylindrical hardened steel cup in which the lower end of the pestle axis works. A long trough runs the length of each set of pans and contains a screw which propels the material from one end of the trough to the other, apertures being formed opposite each pan.

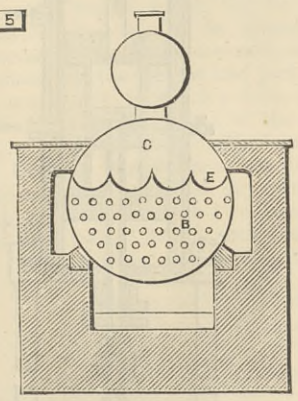
3654. BREECH-LOADING FIRE-ARMS, *P. Mauser, Württemberg.*—22*nd August*, 1881. 6*d.*

This relates to "Mauser" breech-loading fire-arms, and it consists in making the firing bolt stouter than usual in its central part, its smaller cylindrical hind part fitting snugly in a hole in the small lock. A nut unites the bolt, and the lock and is prevented from working loose by a nose sliding in the groove in the breech piece. A safety pin is kept in contact with the nut by a spring which forces its head into a recess in the nut. The small lock has a nose which slides in the groove in the breech piece and engages the trigger catch. To eject the cartridge cases they automatically receive a short blow which makes them jump from the breech piece.

3665. STEAM BOILERS, *J. W. de V. Galwey, Warrington.*—23*rd August*, 1881. 8*d.*

The boiler consists of the cylindrical shell provided with a nest or nests of tubes B. The upper portion of the shell of the boiler is prolonged at C so that it forms

3665



a cover or top to the combustion chamber. The overhanging end C has its underside (being the top of the combustion chamber) formed of corrugated plates E, or in some cases the underside of the overhanging end C may be made plain, and supported and secured by stays.

3679. IMPROVEMENTS IN ELECTRIC LIGHT REGULATORS, *S. Pitt, Sutton, Surrey.*—23*rd August*, 1881.—(*A communication from S. J. Burrell, Brooklyn, New York.*) 6*d.*

Fig. 1 represents the regulator and upper carbon, which is movable. The action is as follows:—Core C D of coil A is in two sections. Core section C has two ears—see Fig. 2—to which lower end of section D is pivotted. The ends C^1 D^1 of the two sections of the

3679

FIG. 1.

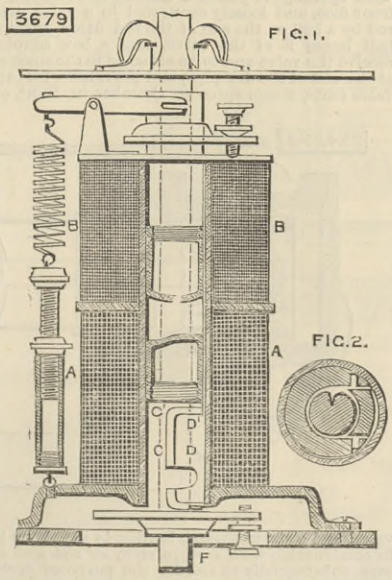


FIG. 2.

core being of similar polarity repel each other; this causes D^{11} end of section D to be pressed against and grasp carbon F, and the whole core being also free to move upwards the upper carbon is separated the required distance from the lower one. Coil B is of thin wire, and acts as a shunt circuit for maintaining a constant resistance. The current is conducted to the carbon by the rollers shown.

3682. MEASURING AND REGISTERING THE FLOW OF LIQUIDS, *W. B. Healey, Westminster.*—24*th August*, 1881.—(*A communication from W. L. Hunt, New York.*) 6*d.*

One arrangement consists of a cock, the plug of which is of a fixed capacity, and which is provided with two passages, one to admit the liquid, and the other for its exit, such passages being brought to coincide with similar passages in the shell when the plug is turned. An excentric on the stem of the plug actuates suitable registering mechanism.

3693. FLUID METERS, &c., *H. C. V. Ahrbecker and H. E. J. Hamkens, Lambeth.*—24*th August*, 1881. 6*d.*

A casing is employed having a lower chamber with an inlet for the fluid, and closed at top by a cap, with an open recess on its underside leading from the chamber into lateral curved passages in the cap, which taper from inlet openings of considerable width at the central recess to narrow exit openings at the periphery of the cap, from which openings the fluid issues in small oblique streams. On top of the cap is a disc or wheel on a recessed spindle running on a pin fixed to the top of the cap, and passing up through a boss on a partition in the upper part of the casing. The disc projects beyond the case, and on its underside are fixed curved vanes, against which the streams of water strike, causing it to revolve, and actuating registering mechanism.

3699. HEM-STITCHING AND OTHER SEWING MACHINES, *J. Sefton, Belfast.*—25*th August*, 1881. 6*d.*

The object is to simplify the motions in hem-stitching and other sewing machines, and it consists, First, in mounting a curved feed lever on a universal joint at the end of the machine, provided with a suitable regulating screw and spring near the centre to act upon the face of a rotating cam. The free end of this feed lever passes through the lower part of the pressure foot or back leg of the machine. The latter is hung on a pivot passing right over the top of the shifting head of the machine, and in a vertical line over the centre of the claw pin at foot, the pivot being cranked back to take an india-rubber band to impart the necessary pressure to the foot. The Second part consists in mounting an on-and-off hem lever in guides, and worked by a cam wheel direct to head for shifting the needle on and off the hem of the material.

3700. EXHIBITING ADVERTISEMENTS, &c., *J. Cooper, Nottingham.*—25*th August*, 1881. 6*d.*

This relates to a clockwork mechanism which causes a sheet bearing the advertisements to move slowly across an opening in a suitable enclosing case.

3714. FURNACES, BOILERS, PANS, &c., FOR THE MANUFACTURE OF SALT, *T. Barrow, Chester.*—25*th August*, 1881. 8*d.*

This relates, First, to the construction of furnaces consisting of a circular flue, in which is fitted a system of travelling fire-bars or fire-brick slabs; Secondly, to a boiler of vertical cylindrical form with a dome top, the interior of which consists of concentric chambers, forming water spaces and heat spaces; Thirdly, to pans with inclined ends and straight sides, so that the salt may be scraped lengthwise of the pan; Fourthly, to a raking appliance consisting of a flat vertical board with a handle running in the space between the covering boards; Fifthly, to an apparatus for condensing the smoke and noxious gases; Sixthly, to an apparatus to granulate the lump salt; and Seventhly, to passing the granulated salt through a series of sieve trays placed one over the other.

3719. RULING MACHINES, *J. Wetter, New Wandsworth.*—29*th August*, 1881.—(*A communication from E. W. Blackhall, Toronto.*) 6*d.*

This consists, First, in mechanism by which the paper may be passed through the machine like a continuous web; Secondly, in an arrangement by which the pens are suspended above the pen roller and only brought into connection as the paper passes below them; Thirdly, in arrangements for adjusting the pens to rule various sized paper; Fourthly, in an arrangement by which individual pens may be raised and dropped automatically without interfering with the others; Fifthly, in an adjustable gauge for feeding inaccurate paper regularly into the machine; Sixthly, in a receiving box to assist the delivery of the paper; and Seventhly, in a new form of ruling pen to which the ink is delivered from channels cut in the face of a flat piece of brass.

3720. STOPPERING BOTTLES, &c., *W. R. Lake, London.*—25*th August*, 1881.—(*A communication from P. J. Carmien, near Paris.*) 8*d.*

This relates to a plate hinged to the bottle and fitted with spring clips to take over the neck, a screw working through such plate and carrying at its lower end a cover to fit over the mouth of the bottle.

3724. SHIPS AND VESSELS, *A. M. W. Samson, near Southall, Middlesex.*—26*th August*, 1881. 8*d.*

The vessel is formed on three keels, two lower ones running in parallel straight lines from the ends where the stern posts are to be built towards the stem, near which they curve towards each other until they meet, whilst an upper keel runs centrally between the lower ones.

3732. PROCESSES FOR CHEMICAL AND PHYSICAL ENGRAVING BY MEANS OF PHOTOGRAPHY, &c., *A. M. Clark, London.*—26*th August*, 1881.—(*Not proceeded with.*) 6*d.*

This relates to engraving plates by photo-engraving called galvano-engraving or "physical engraving," and by photo-chemical engraving.

3733. STARTING TRAMWAY CARS, &c., *E. A. Brydges, Berlin.*—26*th August*, 1881.—(*A communication from Lieut. L. Helm, Berlin.*) 6*d.*

This relates to a presser foot brought in contact with the road, and serving to assist in starting the car.

3739. RAILWAY BRAKES, &c., *J. Pilbrow, Tunbridge Wells.*—27*th August*, 1881. 10*d.*

This consists in the peculiar combination of brake or friction blocks or surfaces F and G and attaching them to a suspended frame, which is placed on a

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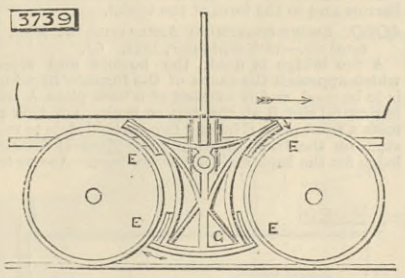

movable centre, whereby one of the friction surfaces may be brought into contact with the rail or road, by which, or from the effect of which, the friction surfaces or brake blocks E, or some of them, are brought into contact with the periphery of the wheels.

3741. REFRIGERATING APPARATUS FOR PRODUCING LOCAL ANAESTHESIA, *O. Möcke, Leipsic.*—27*th August*, 1881.—(*A communication from L. von Lesser, Leipsic.*) 6*d.*

This consists in applying, by means of good conducting surfaces, hollow vessels to the part of the body to be numbed, a low temperature being obtained by the evaporation of certain fluids, such, for instance, as ether.

3752. EASEL FOR BLACKBOARDS, *J. Kellett, Bradford.*—29*th August*, 1881. 6*d.*

This relates to means for adjusting the height of the easel carrying the blackboard, and consists in suspending it from a cord, to the other end of which a counterbalance weight is secured.

3754. IMPROVEMENTS IN SHEATHING OR COATING METAL SURFACES, &c., *W. Elmore and J. J. Atkinson, London.*—29*th August*, 1881. 6*d.*

The inventors employ an electric motor hung upon rods around the work to be coated, and driven by this motor a hand emery wheel for cleaning the spots or metal required to be covered. They also use an electrical depositing tool consisting of a conducting rod, carrying at its end a disc of the metal to be deposited, which forms the anode. This disc is covered with a pad of felt, moistened with a solution of the above metal, it is then brought into contact with the surface to be coated. The cathode wire of the circuit is then connected with the metal to be coated and the wetting pad applied, when a deposit of the metal is effected on the cleaned surface. Thus the coating of the spots that have been cleaned is effected with great rapidity.

3767. STEAM ENGINE FOR PUMPING, PROPELLING SHIPS, &c., *J. H. Fox, Farnborough.*—30*th August*, 1881. 6*d.*

The valve in the steam chest is worked by means of a connecting-rod attached to a lever or cross piece worked from the piston-rod or rods of the engine; this connecting-rod gives direct action in the usual manner to a rod which carries a travelling rotary piece at one end, in which a right-hand and a left-hand screw

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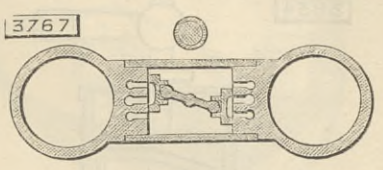

thread are cut, uniting with each other on different sides of the same; a pin or roller is fixed so as to give a rotary motion to the travelling rotary piece on the rod, which carries it by means of the backward and forward motion of the rod, one end of which

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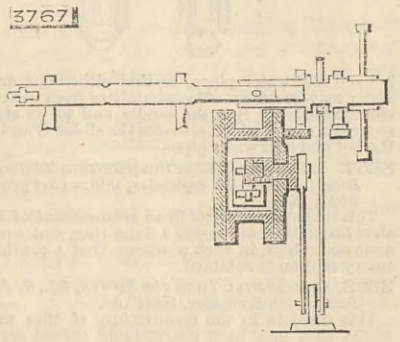

travelling rotary piece fits and works into the lengthened axle of a wheel, to which it communicates circular motion by means of slots cut in the axle of the wheel and pins fixed to the travelling rotary piece and working in these slots.

3772. REMOVING TIN FROM THE SURFACE OF TIN-PLATES, *A. Gutensohn, London.*—30*th August*, 1881. 6*d.*

This consists in the method of removing metallic tin from the surface of tin-plate by subjecting the tin-plate to the action of sand or other abrasive powder in a moving cylinder, which can be heated by a furnace or other means if desired.

3773. CASE OR BOX FOR HOLDING SOAP, TOOTH-BRUSHES, &c., *W. R. Lake, London.*—30*th August*, 1881.—(*A communication from S. Haslett, New York.*) 6*d.*

This relates to a case for holding soap, tooth-brushes, and other toilet articles, and consists in the use of an inner perforated cover, whereby the articles may be locked up, and at the same time be freely exposed to the air for ventilation and drying.

3805. VELOCIPEDES, *J. Humpage, Bristol.*—1*st September*, 1881.—(*Void.*) 2*d.*

This relates to the mode of constructing the wheels and of steering bicycles.

3811. TILES FOR LINING OR FACING WALLS, &c., *H. Hall, London.*—1*st September*, 1881. 6*d.*

Each tile is formed with a lip along one edge, such lip being rebated below the face of the tile to an extent equal to the thickness of the body of the tile. When in position the bottom edge of one tile overlaps the flange of the one below it, and thus conceals the nails used to fix it.

3817. AIR COMPRESSORS, *A. Chapman, Liverpool.*—2*nd September*, 1881. 4*d.*

This consists in constructing air compressors with

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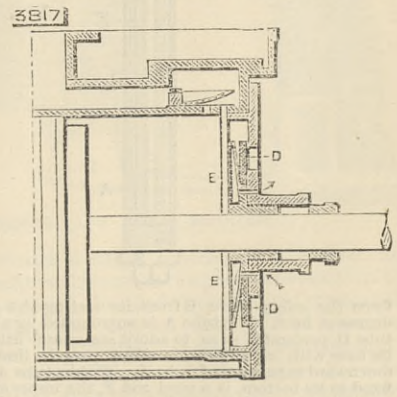


the guards E of the inlet valves D made hollow, and causing water to circulate through the said guards.

3822. AN IMPROVED ELECTRIC LAMP OR REGULATOR, *A. Turbini, London.*—2*nd September*, 1881.—(*Not proceeded with.*) 2*d.*

This invention consists in the regulation of carbons resembling the Jablochkoff candles, and covered with a non-conducting substance, which carbons are placed side by side, and the distance between them regulated by the action of a solenoid coil and core in the circuit.

3827. MACHINERY FOR THE MANUFACTURE OF RUCHED, KILTED, OR PLEATED FABRICS, *C. D. Abel, London.*—2*nd September*, 1881.—(*A communication from H. Bukofzer, Berlin.*) 8*d.*

This relates to an improved construction of machinery for the manufacture of ruched, kilted, or pleated fabrics, wherein the mechanism for pleating or folding the fabrics is combined with the mechanism for sewing the same after being pleated or folded, in such a manner that the pleating mechanism first forms a number of pleats or folds in a length of fabric, the sewing mechanism being stationary at the time, whereupon the pleating mechanism in its turn remains stationary while the pleated fabric is being sewn.

3829. DAMPING APPARATUS FOR LITHOGRAPHIC PRINTING OR OTHER MACHINES, *W. Powrie, London.*—2*nd September*, 1881. 6*d.*

This consists in automatically supplying water to

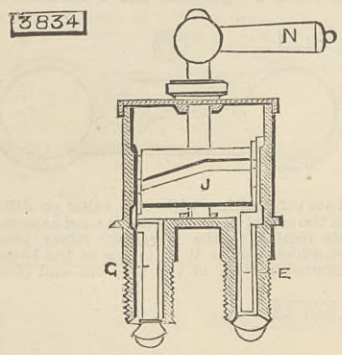
the damping table or slab by the application and use of a trough containing water, and placed across the machine immediately under the delivery table or in any other suitable position.

3832. IMPROVEMENTS IN MACHINERY FOR WINDING OR COILING WIRE UPON ANNULAR ARMATURES FOR ELECTRO-MAGNETIC OR MAGNETO-ELECTRIC MACHINES, *W. R. Lake, London.—2nd September*, 1881.—(*A communication from A. Haase and J. P. Recker, Indianopolis, Ind., U.S.*)—(*Not proceeded with.*) 6d.

This invention relates to machinery for rapidly and compactly winding wire upon armatures. The machine has a clamp adapted to be secured to and urround the rim of the armature, a rim adapted to surround and revolve upon the clamp arms, one of which carries a spool containing the wire, and the other a counterbalancing weight, and fastening, guiding, and driving mechanism, as explained in the specification.

3834. FAUCETS OR TAPS, *W. P. Thompson, Liverpool.—3rd September*, 1881.—(*A communication from C. Whittaker, Chicago.*) 6d.

The object is to provide a faucet with but one handle which is adapted to be connected with both



hot and cold water pipes, so that either hot or cold water may be drawn off separately or from both pipes simultaneously. N is the handle, and to its stem is secured a cam J which actuates the slides G and E in the hot and cold water pipes.

3857. A PERPETUAL ELECTRO-MAGNETIC MOTOR, *C. Le Sueur, Paris.—5th September*, 1881.—(*Not proceeded with.*) 2d.

This invention consists in an arrangement of horse-shoe magnets, some inside a fixed ring, and some in a movable shaft, in such positions that a continuous rotary motion is obtained.

3863. ORNAMENTAL TILES FOR STOVES, &c., *G. Jobson, Derby.—6th September*, 1881. 6d.

This consists in the manufacture of tiles so that whilst they may have considerably curved surfaces, their edges may fit accurately together and to their places.

3866. FIRE-ESCAPE APPARATUS, *W. R. Lake, London.—6th September*, 1881.—(*A communication from R. Bustin, St. John, Canada.*) 6d.

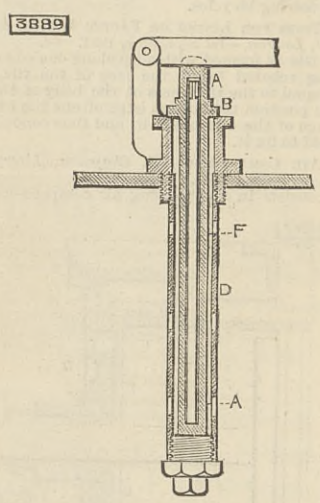
This relates to apparatus to be attached to a portion of the burning building, and to the body of the person escaping.

3884. BOOTS AND SHOES, *T. Laycock, Northampton.—7th September*, 1881. 6d.

This consists of a boot or shoe having an "insole" in two parts, one of such parts being placed into the boot or shoe after the boot or shoe has been taken from the last or lasted, the second "insole" forming a sock for covering the tacks, tingles, wax, and the like, being secured to the middle sole, welt, heel, or outer sole from the outside.

3889. SAFETY VALVES, *T. Davies, Sheffield.—8th September*, 1881. 6d.

The object is to provide safety valves with an auxiliary means of force which will prevent the valves sticking or locking when the pressure in the boiler is superior to the load on the valve, and it consists in a tube of copper or other metal which expands with heat and contracts with cold to a degree sufficient to



force the safety valve B from its seating at a given degree of heat. The tube A is surrounded by a steel tube D, perforated so as to admit steam and fitted at its base with an adjustable screw plug to limit the downward expansion of tube A. Within tube A, and fixed to its bottom, is a steel rod F, the upper end of which is connected by a link to a pointer moving over a segmental indicator.

3902. PACKING CHLORIDE OF LIME, &c., *J. C. Steele, Glasgow.—8th September*, 1881. 6d.

The packing case formed of wood, paper, or cardboard when filled is dipped into molten wax.

3915. VIOLINS, &c., *E. Edwards, London.—9th September*, 1881.—(*A communication from F. Von Zebrowski, Gnesen, Germany.*) 6d.

This relates to improvements in the bridge, damper, and chin rest.

3946. IMPROVEMENTS IN OR APPLICABLE TO TELEPHONES, *W. E. Irish, Sunderland,—12th September*, 1881.—(*Not proceeded with.*) 2d.

This invention consists in the substitution of a piece of platinum or carbon, supported by an insulated spring, so as to reach the centre of the diaphragm, where another contact piece is carried for the usual magnet; the battery and line wires are connected to the respective contacts.

3951. REGENERATIVE FURNACES, &c., *S. Pope, Newburn.—13th September*, 1881. 6d.

This consists in the adaptation and application to regenerative furnaces of independent connecting flues between the draught flue leading to the chimney (or any substitute therefor) and the regenerative chambers either in addition to the flues leading to the reversing valves or in substitution for the same.

3953. CAPSTANS, *J. Wetter, New Wandsworth.—13th September*, 1881.—(*A communication from C. Arentsen, Arendal, Norway.*)—(*Not proceeded with.*) 2d.

The driving mechanism is encased in a cylinder or other casing, and the main driving axle of the capstan is vertical.

3963. APPARATUS FOR CHECKING AND REGISTERING THE ISSUE OF TICKETS, &c., *W. M. Riddell and H. Wickens, London.—14th September*, 1881. 4d.

By the action of this apparatus the passenger is made aware of the registering of his ticket by a bell or gong; the amount received by the conductor is notified on the ticket by a punch, and a registry is obtained by the consecutive numbers which are printed on the tickets. The distance travelled by the passenger is registered by the pieces contained in the respective reservoirs, and also the amount paid to the conductor.

3964. NEEDLES, *T. Perks, Headless Cross, Worcester.—14th September*, 1881.—(*A communication from R. Crowley, New York.*)—(*Not proceeded with.*) 2d.

This consists in forming two eyes of different sizes one below the other.

3966. PORTABLE GAS APPARATUS, *P. M. Justice, London.—14th September*, 1881.—(*A communication from A. J. Clavel, Brussels.*)—(*Not proceeded with.*) 2d.

The apparatus is contained in a case, and consists of three principal parts, viz., the motive power mechanism, the air apparatus, and the carburetter.

3971. APPARATUS FOR SECURING HORSES, &c., AND PLACING THEM IN A LYING POSTURE IN ORDER TO FACILITATE SURGICAL OPERATIONS, *J. C. Mewburn, London.—14th September*, 1881.—(*A communication from J. Davian, Marseilles.*)—(*Not proceeded with.*) 2d.

This consists in attaching the horse when standing by straps and other connections to a platform or table, when the latter is in a vertical position, and in then tilting this platform together with the animal by means of simple mechanism into a horizontal position.

3973. LAMPS, *J. Wetter, New Wandsworth.—14th September*, 1881.—(*A communication from H. Naumann, Leipzic.*)—(*Not proceeded with.*) 2d.

This consists in replacing the globe or reflector commonly used with lamps by a transparent vessel, containing water or other suitable transparent liquid.

3974. BOILER FURNACES, *J. Wetter, New Wandsworth.—14th September*, 1881.—(*A communication from G. Permet, Bellevue, France.*)—(*Not proceeded with.*) 2d.

This relates to semi-tubular boilers, and consists in making them light, and therefore applicable as semi-portable or portable boilers by constructing the furnace of iron and brickwork combined.

3977. SEWING MACHINES, *A. J. Boult, London.—15th September*, 1881.—(*A communication from J. Jarlan, Toulouse.*)—(*Not proceeded with*) 2d.

This consists in special forms of an attachment to the "presser feet," the object being to sew on without preliminary basting the cords or beads, known in France as passe-poils, and used especially for military trousers.

3982. FASTENING OR CONNECTING DEVICE FOR THE STRAPS OF CARRIAGE DASH-BOARDS, *H. H. Lake, London.—15th September*, 1881.—(*A communication from C. F. Littlejohn and H. Ford, New Haven, Conn., U.S.*)—(*Not proceeded with.*) 2d.

This relates to a connecting device for use with the straps on carriage dash-boards as a means of fastening the boot-flap.

3983. PISTONS FOR STEAM ENGINES, &c., *F. H. F. Engel, Hamburg.—15th September*, 1881.—(*A communication from C. A. Zirn, Hamburg.*)—(*Not proceeded with.*) 2d.

This relates to metallic pistons furnished with ring packing for steam and other engines, and consists mainly of a novel mode of attaching the rings to the body of the piston.

3991. MANUFACTURE OF INDIA-RUBBER VALVES, &c., *J. M. B. Baker, Hammersmith.—16th September*, 1881.—(*Not proceeded with*) 2d.

The india-rubber is covered with asbestos, or the two are combined together.

3993. APPARATUS FOR HEATING WATER, &c., FOR BATH AND OTHER PURPOSES, *W. Wyman, Gloucester.—16th September*, 1881.—(*Not proceeded with.*) 2d.

This relates to the employment of metallic discs and a cone, inside the latter being a gas burner, which heats the water which falls from disc to disc.

3994. LUBRICATORS, &c., *H. F. Lawrence and H. Stokes, Birmingham.—16th September*, 1881.—(*Not proceeded with.*) 2d.

This relates to the general construction of lubricators for the bearings of bicycles, &c.

3997. CONTROLLING WIRE ROPES, *H. Cheesman, Hartlepool.—16th September*, 1881.—(*Not proceeded with.*) 2d.

A pair of excentrics are employed; one of these excentrics consists of a sheave so arranged that it may be operated by a screw and lever handle or the like; the other excentric consists of a segment of suitable size, and provided with a spring for automatically throwing it out of gear when not in operation.

3999. PREPARATION OF MEAT EXTRACT, *L. A. Groth, London.—16th September*, 1881.—(*A communication from H. Block, Copenhagen.*) 4d.

This consists in the method for the preparation of meat extract in the form of jelly by heating the meat in water to extract glutinous matter and fat, again heating and boiling for about six hours in a fresh quantity of water, and afterwards separating the fluid extract from the fibres and again boiling it. A method is described for preparing the extract in the form of powder.

4000. RAILWAYS AND TRAMWAYS, *T. W. Bunning, Newcastle-upon-Tyne.—16th September*, 1881.—(*Not proceeded with.*) 2d.

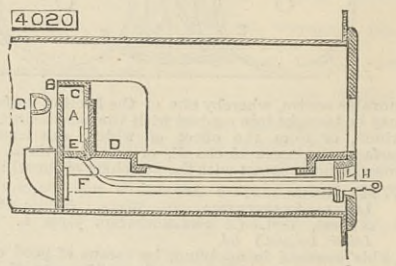
An india-rubber washer or filling piece is inserted between each joint of the rails.

4007. APPARATUS TO BE USED FOR CARRYING AND POURING OUT SUBSTANCES OR LIQUIDS, *G. White, Wilden.—17th September*, 1881. 4d.

This relates to the general construction of wheelbarrow and to the form of the wheel.

4020. SMOKE-CONSUMING APPARATUS, *G. West, Nottingham.—19th September*, 1881. 6d.

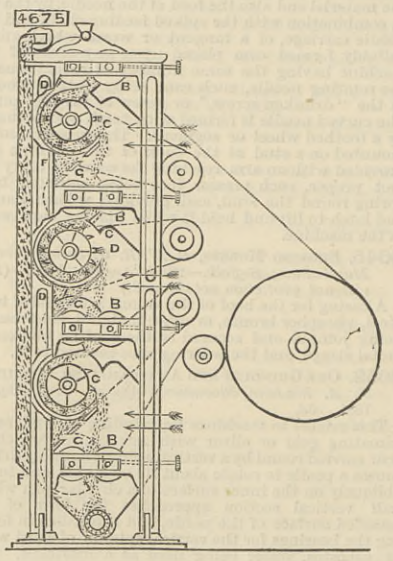
A fire bridge is used, the bottom and sides of which approach the shape of the furnace in which it is to be used, and it consists of a back plate A with a horizontal slot B at the top or back. On this plate rests a front plate C having two vertical slots to receive studs on the back of an angular plate D forming a ledge for the back ends of the fire bars. Access to the



space between the plates is obtained through an opening behind the fire-bars, and which can be closed by a door E actuated by a rod extending beyond the furnace doors and formed with notches on its underside to engage with brackets H, so as to regulate the opening of door E. Pipes F pass through the back plate and are continued upwards vertically, an orifice G being left at the upper end towards the back of the flue. By these means the passage of air through the bridge can be regulated at will.

4675. GRINDING MILLS, *A. J. Boult, London.—25th October*, 1881.—(*A communication from W. N. Cosgrove, Minnesota, and R. Morrell, New Jersey, U.S.*)—(*Complete.*) 6d.

This relates to mills in which the grain is subjected to repeated grinding by successive pairs of co-operating grinding mills, and in which the fine flour and middlings is separated and removed from the product of each grinding, and the remaining portion passed to the next pair of rollers; and it consists essentially in the combination of two or more pairs of rollers B, the rolls of each pair of which run at differential speeds, with a revolving fan C and a concave screen D



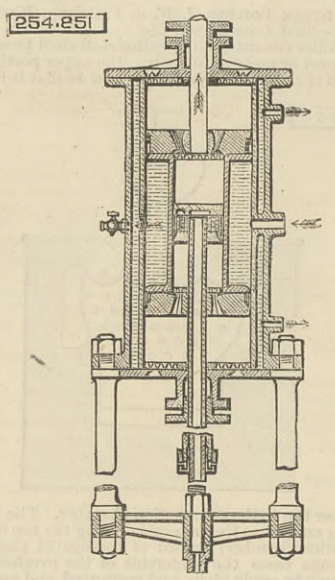
arranged between each pair of rolls, and also an air trunk F, into which the separated flour and middlings are delivered; perforated deflectors G for directing the material into the trunk, and an exhaust at the top of the trunk to cause a current of air to pass through the coarse material as it falls from each fan to the next pair of rolls, and so cool it, and whereby the fine dust is drawn out of the trunk and delivered to a suitable receiver for further treatment.

SELECTED AMERICAN PATENTS.

From the United States' Patent Office Official Gazette.

254,851. AIR COMPRESSOR, *John B. Waring, New York, N.Y., assignor of one-half to Milan C. Bullock, Chicago, Ill.—Filed May 21st*, 1881.

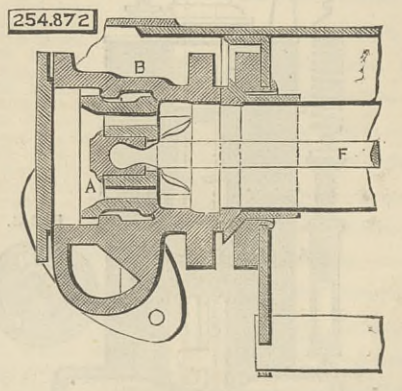
Claim.—The combination, in an air compressor, of a stationary outer cylinder, a movable inner cylinder, piston heads fitting said outer cylinder and movable with said inner cylinder, a stationary piston fitting



said inner cylinder, and the several valves, substantially as described, for admitting air to each end of the outer cylinder for controlling the passage of air from the outer to the inner cylinder and for the discharge of air from the inner cylinder, substantially as and for the purpose specified.

254,872. THROTTLE VALVE FOR LOCOMOTIVES, *Samuel J. Hayes, Henry Schlacks, and G. Fillmore Starkweather, Chicago, Ill.—Filed September 5th*, 1881.

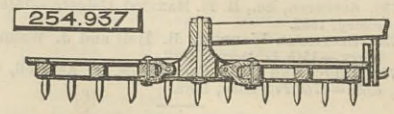
Claim.—(1) A throttle valve having its body provided with openings or passages leading from its rear to its front face, and loosely connected to a valve stem or rod by a ball on the end of the rod fitted within the half boxes E of the valve, and a box adapted to receive the valve and to be attached in the smoke arch at the end of the dry pipe, and provided with interior valve seats, steam space or chamber in front of the

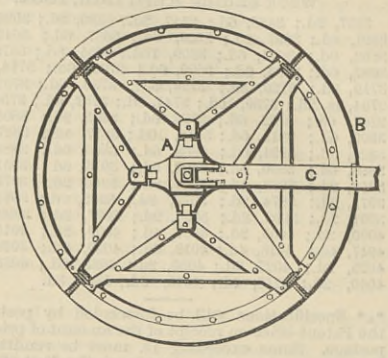


valve, and a steam passage leading to the steam pipes, in combination with a valve stem or rod and a dry pipe, substantially as and for the purposes specified. (2) The combination, with the valve box B, having seats on its inner face, of the valve A, provided with exterior seats and steam passages A^1 and with a central opening, the half boxes E, fitted in the central opening of the valve and having a recess receiving a ball F, upon the end of the valve rod F, and the nut G, said members being constructed and arranged for operation substantially as described.

254,937. ROTARY HARROW, *Alphonzo H. Doty, Marshland, Wis.—Filed July 18th*, 1881.

Claim.—(1) In a rotary harrow consisting of quadrantal flexibly connected sections, the combination of a continuous sectional edge and endwise projecting flanges, a flexibly-connected central head, and a centrally-pivotted draw beam provided with anti-

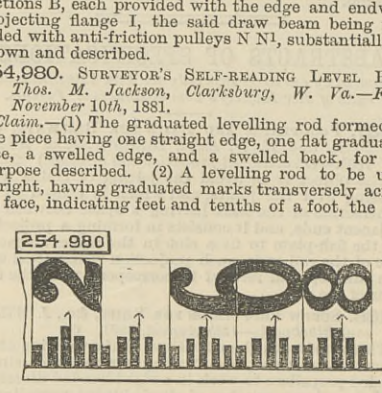




friction pulleys, substantially as shown and described. (2) The combination of the centrally pivotted draw beam C with the central head A, and flexibly-connected sections B, each provided with the edge and endwise projecting flange I, the said draw beam being provided with anti-friction pulleys N N^1, substantially as shown and described.

254,980. SURVEYOR'S SELF-READING LEVEL ROD, *Thos. M. Jackson, Clarksburg, W. Va.—Filed November 10th*, 1881.

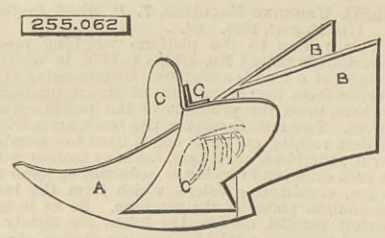
Claim.—(1) The graduated levelling rod formed of one piece having one straight edge, one flat graduated face, a swelled edge, and a swelled back, for the purpose described. (2) A levelling rod to be used upright, having graduated marks transversely across its face, indicating feet and tenths of a foot, the feet



being designated by figures two-tenths of a foot in length, and the even tenths by figures only one-tenth of a foot in length, the long and short bars of different colours indicating hundredths of a foot, and arrow heads applied to the longest bars indicating the exact centre of each tenth of a foot, the whole being arranged as shown and described. (3) A levelling rod having a bevelled straight edge A, the graduating marks extended only to the inner angle of the said bevel, the swelled back, and swelled right hand-edge, substantially as described.

255,062. FURROW ATTACHMENT FOR SEED PLANTERS, *Isaac P. Watson, Clifford, Ind.—Filed January 5th*, 1881.

Brief.—Mould boards made adjustable on a seed opener. *Claim.*—The combination of the runner A,



having blades B B and bolts, with the mould boards C C, having brackets F, provided with vertical slots E, and the bridge piece G, substantially as and for the purpose set forth.

CONTENTS.

THE ENGINEER, April 21st, 1882.

SOUTH KENSINGTON MUSEUM.—Visitors during the week ending April 15th, 1882:—On Monday, Tuesday, and Saturday, free, from 10 a.m. to 10 p.m., Museum, 24,080; mercantile marine, building materials, and other collections, 17,457. On Wednesday and Thursday free, from 10 a.m. till 6 p.m., Museum, 4564; mercantile marine, building materials, and other collections, 4895. Total, 50,996. Average of corresponding week in former years, 49,551. Total from the opening of the Museum, 20,892,223.