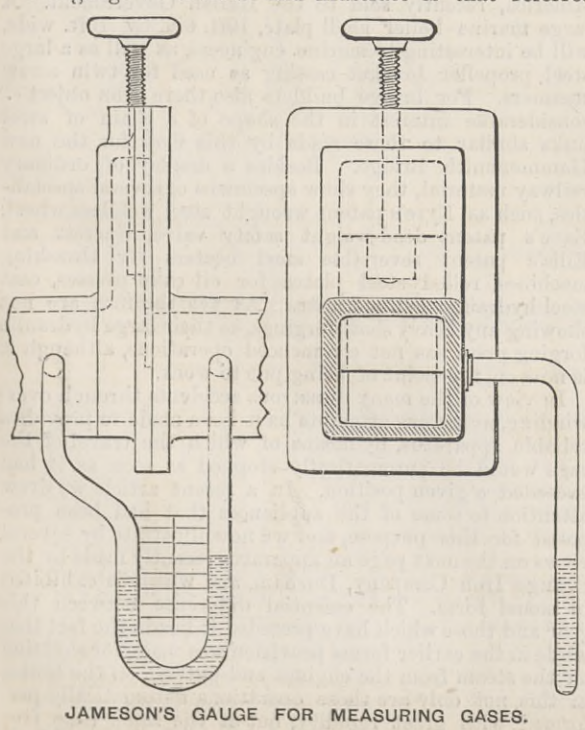
THE NEWCASTLE EXHIBITION.

MESSRS. WOODHOUSE AND RAWSON, London, are lighting the North Gardens and some buildings in the gardens by means of eighty-three arc lamps of the type they are introducing under the name of the "Diamond" arc lamp, made under Scharnweber's patents. The chief point about this lamp is its extreme simplicity and ease of management, and also the fact that the light maintains a central position in the globe during the whole time of burning. In all there are eighty-three of these lamps, each taking a current of ten ampères at an electro-motive force of fifty volts. To avoid a high potential, which the electric lighting committee of the Exhibition do not approve of, the lamps are run in series of four, each group of four being in parallel with the other groups. In the turrets there are four large arc lamps, each of twenty ampères, the groups running, as before, in parallel with the smaller arc lamps. The eighty-three 10-ampère lamps and the four 20-ampère lamps are run off one large dynamo capable of giving an output of fifty units and 220 volts at about 500 revolutions, and the dynamos are compound wound, so as to rise in potential from about 210 volts when no current is being taken from the machine to the full 220 volts with the maximum amount of current. This makes up for the resistance lost in the leads, and also makes the whole system practically self-regulating. Two sets of dynamos are provided so as to guard against any breakdown. These are joined up to a switch-board, from which the various lamp circuits are taken, so that one dynamo can instantly take the place of the other should there be any necessity for it. Messrs. Woodhouse and Rawson are also lighting part of the engine-room with five Jablochkoff candles running off an alternating Gramme machine. This same Gramme machine is used with three Gaulard and Gibb's patent secondary transformers for lighting some incandescent lamps at a great distance from the engine-room, and is also being used in connection with a transformer made by the United Electrical Engineering Co. for showing the new processes of electrical welding. As this is exhibited all day long, the public have an opportunity of comparing the rapidity with which welds can be made by electricity against the time it takes with an ordinary forge, one of which is close at hand. Messrs. Woodhouse and Rawson, who have turned their attention particularly to the transmission of power by electricity, have, under permission from the Council, constructed a tram line of about half a mile in length, which runs from the Exhibition buildings through the gardens to the toboggan ground. The car, which is capable of carrying fifty passengers, is propelled by electricity. The following particulars will be of interest to our readers:—The permanent way is constructed for the ordinary tram line gauge, over which the car travels at about twelve miles an hour, a third rail being laid between the two running rails as a conductor for the current. The two lines of running rails are joined electrically together, and are used as a return conductor, no attempt being made to insulate them. The centre rail is insulated roughly by being mounted on blocks of asphalted wood 4in. in thickness. The motor is mounted on one of the two bogey trucks on which the car runs, and is geared direct to one of the shafts of the bogey truck by double helical gearing. There is no intermediate gearing, since the motor runs at the slow speed of 800 revolutions a minute, and the shafts of the bogey truck runs at 200 revolutions a minute, thus making it quite possible to gear direct from one to the other. Each end of the car is fitted with switches and resistances which enable the speed to be varied to anything desired whilst running, and also with starting and stopping switches. The handle of the starting and stopping switches is removable, and is carried by the driver to the end of the car from which he drives; this is done to prevent the switches at the opposite end to which the driver is standing being tampered with by persons riding in the car. The motor developes 20 H.P. The generator, which is driven off the counter-shafting in the engine room, is of exactly the same size as the motor, the only difference being that it runs at a speed of 1000 instead of 800 revolutions a minute. A spare armature is provided, interchangeable with either the motor or the generator.

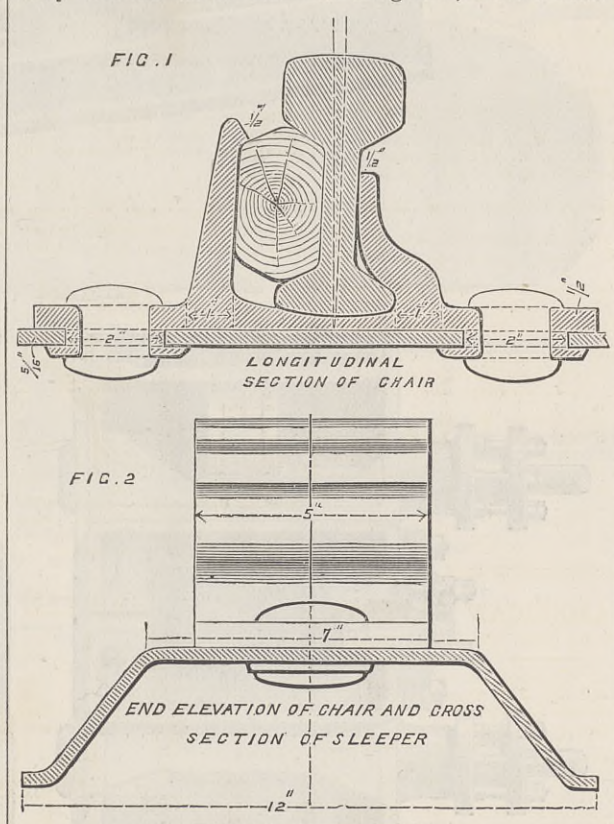
The gauge we describe and illustrate is that referred



JAMESON'S GAUGE FOR MEASURING GASES.

to in our article on the exhibit of the Jameson's Patent Coking Company at Newcastle-on-Tyne, on page 383. It was devised by Mr. Jameson for measuring the gas passing from a coke oven, the heat and foulness of which made measurement by meter impossible, but it is available for many other purposes. A disc of thin sheet iron having a rectangular orifice in its centre is fastened in the pipe, with a slide formed of similar sheet iron, capable of being moved so as to vary the area of the orifice, the exact position of this shutter being indicated by the position of the screw operating it, which is seen outside the pipe. In connection with this there is a syphon water gauge, the two limbs of which are made to communicate with the pipe, one being connected on each side of the disc. The velocity of the passage of gas through an orifice at a fixed pressure being a known quantity, the shutter is moved until the gauge indicates any desired difference of pressure between the sides of the plate. The actual quantity of gas passing is then found by multiplying the area of the opening in the plate by the velocity due to the difference of pressure. It will be seen that by coupling the water gauge at each end it is made independent of pressure existing in the pipe, and that it is available for gas of any temperature and pressure. The only precaution which it is found desirable to observe is to use a gauge with limbs of considerable diameter—say, ½in., or more—so as to avoid the possible error due to the clinging of the water to a false level, which might occur in a smaller pipe. It is suggested that this gauge will be found of great service in many cases where the quantity is too great to be measured by water.

Messrs. James H. Tozer and Son, Westminster, exhibit specimens of their patent chairs for permanent way. One of these is the cast iron chair with central pin, which was illustrated and described in THE ENGINEER in August last year, and which, we understand, has now been tried on one of our main lines, with the heaviest traffic, for more than six months, without exhibiting the slightest defect. In order to meet the wishes of engineers who desire to do away with the use of cast iron altogether, Messrs. Tozer

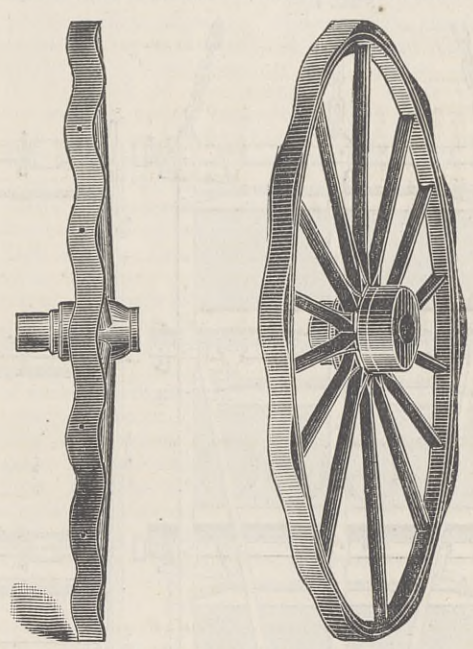


TOZER'S STEEL CHAIR.

and Son have designed the arrangement which we illustrate above, and in which steel is the only material used. The principal feature about this is the method of attaching the chair to the sleeper. This consists in flanging the material of the chair, so as to pass through the holes in the sleepers, and rivetting it back, the large rivet shown being then inserted to make the joint solid. The rivets therefore really pass through tubes formed out of the chairs, while their heads bear on the flanges. The chair is made from a rolled section, the lips being turned over afterwards. It is intended that the punching of the hole and rivetting shall be done by special tools, so that what at first sight appears to be rather an expensive process will, in point of fact, be done at a very slight cost indeed by means of hydraulic machinery.

Messrs. J. Johnston and Co., Manchester, exhibit a steam oven in which continuous baking can be carried on. The fireplace is separate and distinct from the baking part of the oven, the firing being done outside the bakehouse, so as to keep the interior of the oven perfectly free from dust, soot, and smoke. The oven is heated internally by means of a series of wrought iron tubes, hermetically sealed at both ends, and containing a small quantity of water. These tubes extend from the fireplace along the whole length of the oven, both above and below the baking space. One end of each tube projects into the fire, and as the water is heated it fills the tube with steam at a high pressure, and thus the temperature of the oven is kept quite uniform, and can be regulated by means of the damper and mercurial thermometer in the bakehouse with the greatest precision. The baking can be carried on for an indefinite period, the oven baking batch after batch of bread without having to be stopped for reheating. The oven embodies several improvements recently made by Mr. Johnston. In the first place, the front of the fireplace is formed in one casting, thus making the oven more substantial and durable, and an extra firing door is added for better access to the fire, the openings being formed so that every part of the fire chamber can be easily got at from the outside. Also, by adjusting the amount of heating surface and number of rows of tubes exposed to the fire, he has succeeded in equalising the top and bottom heats. Furthermore, in former ovens of this type it has been found that the back end has sometimes attained a higher temperature than the rest of the interior owing to the iron backplate radiating the heat more freely than the surrounding brickwork. Mr. Johnston overcomes this defect by covering the plate with a layer of thick asbestos millboard, which prevents any undue radiation of heat and causes an even temperature throughout.

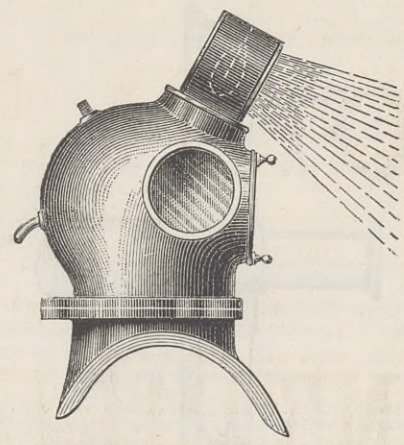
As usual on such occasions, the Leeds Forge Company has an exceedingly attractive exhibit. Besides Fox's patent corrugated boiler furnace flues, which are now so well known and so widely used as to require no description at our hands, they show Fox's patent flanged frame plates for railway rolling stock. These plates are made at one heat by a special hydraulic press. The object is to produce a frame for a locomotive, or indeed for any rolling stock, out of a single plate, without the necessity of introducing angle iron or other stiffeners. The plates exhibited are 21ft. 9in. long, and have three axle box guides of the North-Eastern Railway Company's standard tender frame pattern. It is claimed that frames made in this way are both cheaper in first cost and more endurable than those constructed in the ordinary manner. The anexed cuts illustrate William Fox's rolled corru-



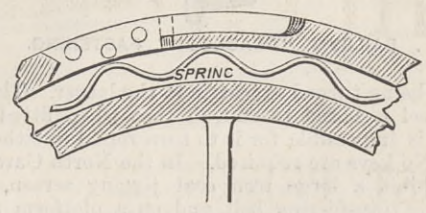
FOX'S PATENT CORRUGATED TIRE.

gated steel tire, which has been devised with the object of preventing the skidding and other inconveniences when crossing over tram lines at an angle. The tires are fixed in the ordinary way to the felloes, the apex of each corrugation projecting a little over the edge. It is said that the peculiar path described by the corrugations prevents the wheels from entering the tramway grooves, and also causes them to mount the inequalities generally to be found at the joint of the rails and paving, the latter being frequently worn down much below the surface of the rails.

Mr. R. Applegarth, 11, Queen Victoria-street, E.C., shows a number of submarine appliances. An object of interest is the lamp used at the wreck of the Vanguard, which is merely an oil lamp with an air supply from the pumps capable of regulation, the light being enclosed in a cylinder of glass open all round. This gave a diffused illumination, but was not powerful enough for submarine work, and was therefore replaced by an improved oil lamp of 30-candle power, in which the light is contained in a copper cylinder with a reflector and bull's eye. By this apparatus a beam of light was projected about 6ft. in front of the diver. A demand for even still greater illuminating power having arisen, Mr. Applegarth decided to adopt electricity in place of oil, and brought out the arrangement shown in the accompanying sketch. This



APPLEGARTH'S ELECTRIC LAMP FOR DIVERS.

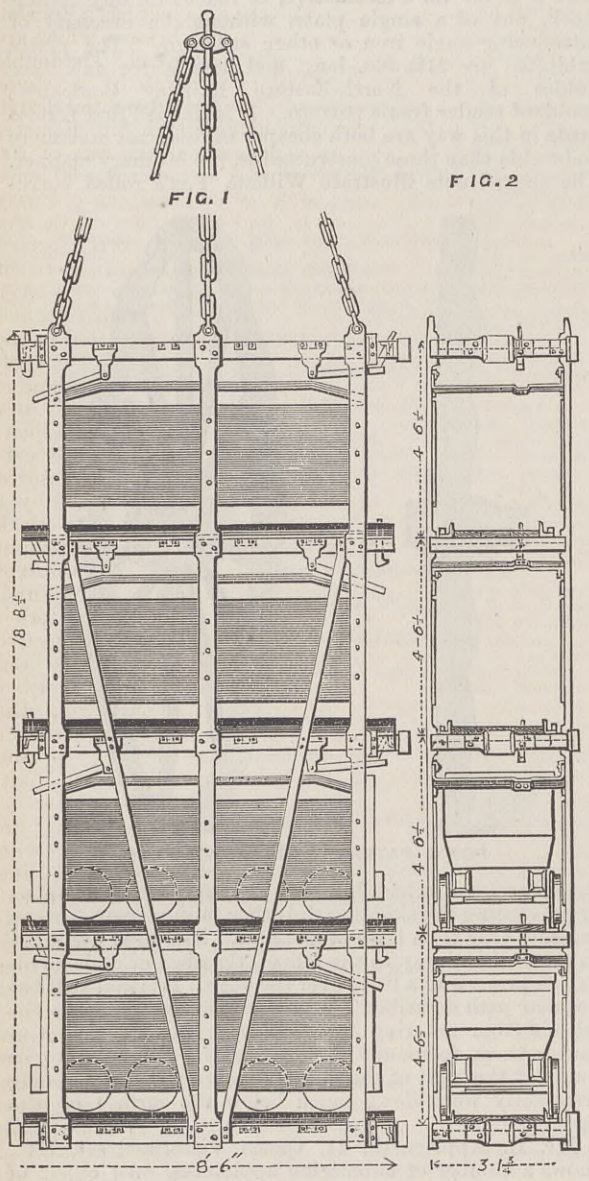


CAMERON'S PISTON PACKING.

consists of a brass casing A containing an incandescent lamp of about 100-candle power, which is screwed into the upper sight hole of the helmet. The casing has a reflector at back and a glass in front, so that a strong beam of light is reflected at an angle from above downwards, so as to

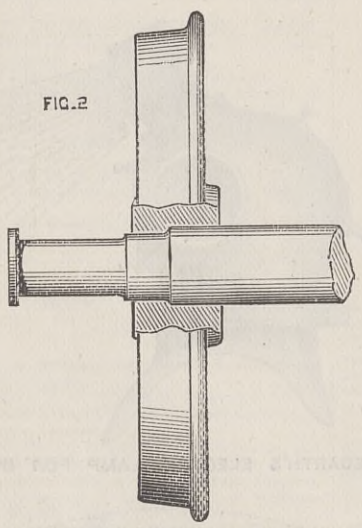
illuminate the object without dazzling the diver. Wires to the lamp are taken from a dynamo above. The other exhibits of Mr. Applegarth are of considerable interest, but we need only refer to a three-throw pump with improved frictionless packing for supplying air to divers, and Cameron's patent piston packing which, as many of our readers are aware, is constructed as shown in the annexed cut. This packing is very extensively used for marine and other purposes.

Messrs. Joseph Cook and Son, Washington Ironworks, Durham, exhibit in the North Court a large quantity of material for use in mines, the most striking being a very large steel four-deck cage, which we illustrate below. The cage is made of forged mild steel of welding quality, and weighs 65 cwt., exclusive of chains, which come to



COOK'S FOUR-DECK STEEL CAGE.

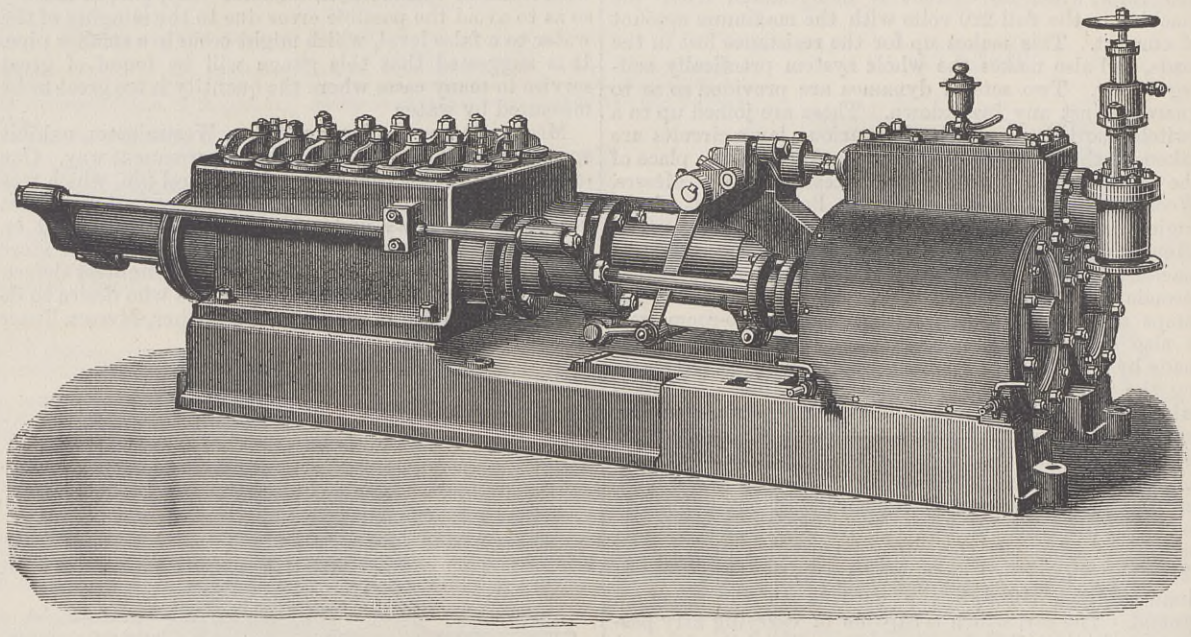
about 6 cwt. more. It is intended for use at the Marquis of Londonderry's Silksworth Colliery, and is constructed to lift eight tubs at a time, each tub containing 4 cwt. of coal, and weighing when empty 2 cwt. The principal dimensions are given in the cuts, and it is only necessary for us to say that the cage is an admirable specimen of work. All the recesses are planed, and all holes drilled. Messrs. Cooke and Son also show Bailey's patent "Deadlock" fastening for wheels and axles. This consists in forming the axle of two different diameters, the smaller

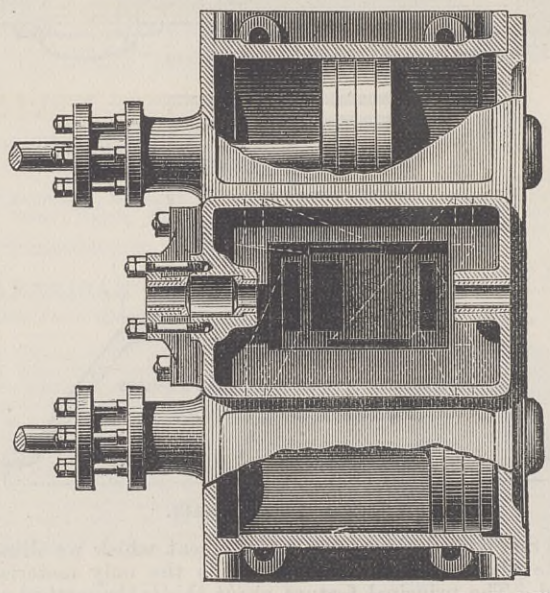


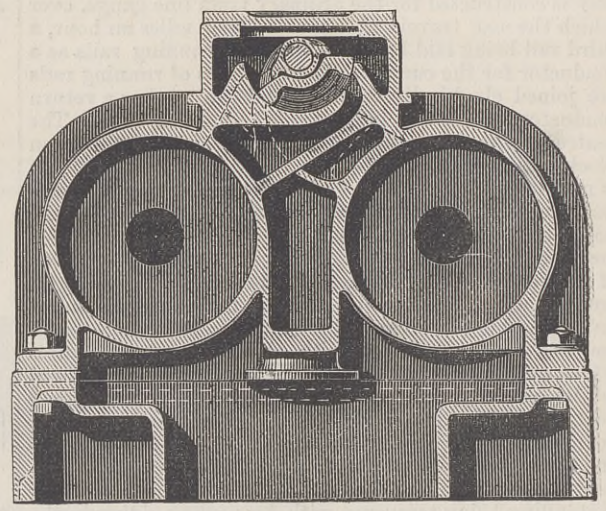
BAILEY'S "DEADLOCK" FASTENING.

portion being turned excentric to the larger. The hole in the wheel is bored to suit, so that when fitted on the axle it is impossible for it to turn round in either direction. No keys are required. In the North Garden they also exhibit a large iron coal jigging screen, with a travelling transferring belt, and on a platform above is a "kick-up" or teeming cradle for tipping the tubs. The screen and belt are driven by a special engine, and are shown in motion.

Messrs. Fielding and Platt, Gloucester, show one of Fieldings patent duplex pumping engines with steam cylinders 15in. diameter and 15in. stroke, and pumps 6in. diameter, capable of delivering 220 gals. of water per minute at a pressure of 225 lb. per square inch. A general view of this engine is given below, together with sections through the steam cylinders, showing the valve, which is of the semi-cylindrical or Corliss type, working on a concave bored face. Instead of each cylinder being fitted with its own slide, a single valve serves for both. This is reciprocated to and fro longitudinally by means of suitable levers from the crosshead of one engine, whilst from that of the other it receives an oscillating motion about its axis. The two motions are quite distinct from, and independent of each other. The former controls the steam admission and exhaust to and from one cylinder by means of ports placed in the usual way, while the latter controls the admission and exhaust to and from the other cylinder by means of a second set of ports at right angles to the first. The exhaust port is common to both cylinders. The pistons are cushioned in the manner usual in this class of engine, the ports into the cylinders being placed at a distance from the ends, so that the piston cuts off the exhaust at the proper time. Small valves are provided to admit steam for the next stroke until the piston again uncovers the main port. It will thus be seen that notwithstanding the reduction in the number of working parts, the whole of the requirements are perfectly fulfilled by the one valve. The same firm also exhibit a model of a 3000-ton forging press which has been previously described in The Engineer, also a pair of vertical plunger pumps with rams 2in. diameter and 5in. stroke, such as are used for operating Tweddell's hydraulic machine tools.







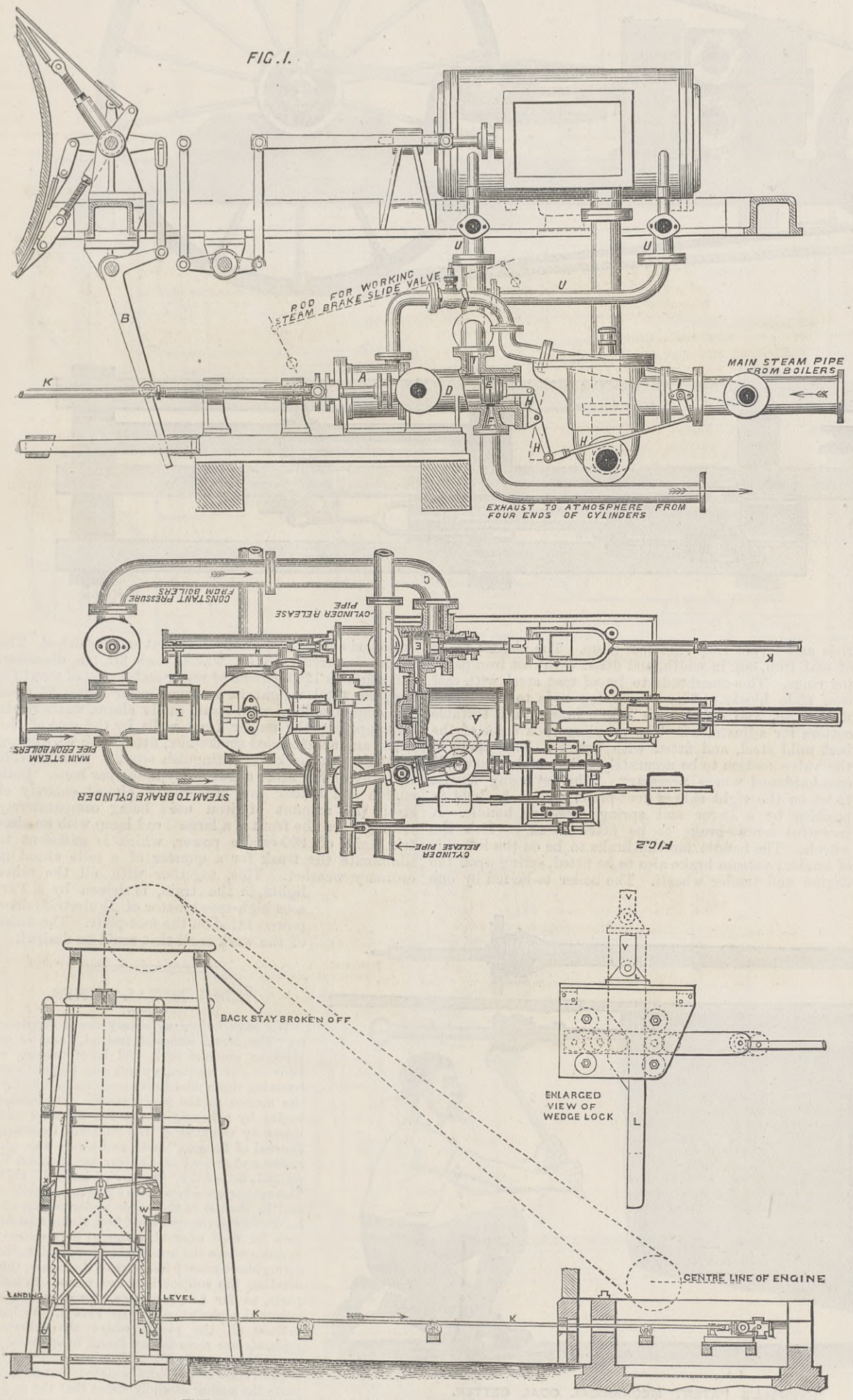
FIELDING AND PLATT'S DUPLEX PUMPING ENGINE.

Refrigerating machinery is represented by one of Lightfoot's patent cold dry air machines of the vertical type, combined with a steam engine, which is shown by Messrs. Siebe, Gorman, and Co., Westminster Bridge-road, S.E., in connection with an insulated chamber in which is stored frozen mutton and beef. The machine embodies all the latest improvements, and is similar in design to those illustrated in The Engineer of June 25th last year. Though the capacity is only small—some 4000 cubic feet per hour—the air is delivered at a temperature of 55 deg. below zero Fah., the cooler pressure being about 49 lb. The chamber is insulated with special flake charcoal between two layers of tongued and grooved boards, and excludes the heat so perfectly as to preserve a temperature, below freezing point, from Saturday night till Monday morning without working the machine. Messrs. Siebe, Gorman, and Co. also exhibit some very highly-finished submarine diving gear. A Royal Navy pattern double-action air pump is well worth examination. It is arranged to supply air for one diver in deep water, or for two divers in shallow water. In the latter case each diver can work independently of the other. Gorman's patent speaking apparatus is shown fitted to a diver's helmet. This is intended to obviate the use of the ordinary telephone, which is both expensive in first cost and too complicated, though answering perfectly well as a means of communication. In Gorman's apparatus the sound is transmitted mechanically through an air tube by means of a vibrating disc in a mouthpiece, and is received in a somewhat similar disc. The voice can be heard with great distinctness. The speaking tube is used as the life line.

Messrs. John Brown and Co. have secured an excellent position of considerable size, in which they show a large variety of their manufactures with good effect. In the centre there is a huge marine boiler furnace front plate, with four large furnace holes. This plate has been flanged in one heat, in one of their large hydraulic presses, and is a fine specimen of the class of work for which they have now a leading reputation. Next to this there is a superheater end plate of very unusual shape and dimensions, flanged on the inside and outside, and a pan 9ft. 3½in. by 2ft. 4in. deep, dished out of a flat plate, 10ft. 8in. diameter, in one piece, used for chemical furnaces. In the furnace front referred to, they show one of their latest specialities, a "Purves" patent ribbed flue, which has already received the full sanction of Lloyd's, and which it is expected will also pass the Board of Trade during the next three months, when the series of experiments now in progress will have been completed. The firm also show four pieces of armour plate, which have been tested, and which illustrate the progress of armour since its commencement. Among various steel castings we notice a large propeller blade weighing 85 cwt., which is a duplicate of those made by the firm for the Atlantic liner America, recently sold to the Italian Government. A large marine boiler shell plate, 19ft. 6in. by 10ft. wide, will be interesting to marine engineers, as well as a large steel propeller bracket casting as used for twin screw steamers. For bridge builders also there is an object of considerable interest in the shape of a chain of steel links similar to those made by this firm for the new Hammersmith Bridge. Besides a display of ordinary railway material, they show specimens of several specialities, such as Eyre's patent wrought steel weldless wheel, Eave's patent dead-weight safety valve, Garrett and Ellis's patent reversible steel beaters for thrashing machines, rolled steel plates for oil cake presses, cast steel hydraulic cylinders, &c. As yet the firm are not showing any heavy shaft forgings, as their large hydraulic forging press has not commenced operations, although it is now on the point of being put to work.

In view of the many disastrous accidents through overwinding, numerous attempts have been made to provide a reliable apparatus, by means of which the travel of the cage would be automatically stopped as soon as it had exceeded a given position. In a recent article we drew attention to some of the appliances that had been proposed for this purpose, and we now illustrate by several views on the next page an apparatus recently made by the Grange Iron Company, Durham, and which is exhibited in model form. The essential difference between this gear and those which have preceded it lies in the fact that while in the earlier forms provision was made for shutting off the steam from the engines and putting on the brake, in this not only are those operations automatically performed with great rapidity, but at the same time free communication is made between the atmosphere and both sides of the steam pistons; so that whatever steam is

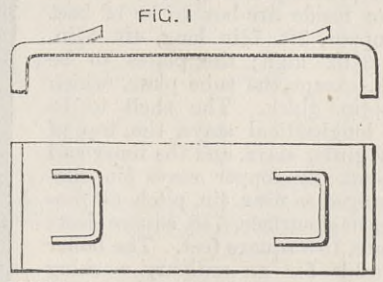
present is at once exhausted, and the brakes have no energy to absorb beyond what is stored in the moving parts at the moment the gear is brought into action. In this way great promptness is secured, and it has been found from experiments made at the Grange Ironworks that when running at a speed of 35 revolutions per minute the engines are brought to rest in one-quarter of a stroke, the shock scarcely being felt. The following is a description of the apparatus:—A is an ordinary steam brake cylinder, with rods in connection with the brake lever B. This cylinder is fitted with the usual slide valve and chest for working in the ordinary way, but, in wedge bar L. This allows the rod K, and the double piston valve to which it is attached, to move back with great velocity, and, by means of the ports previously referred to, simultaneously puts on the steam brake, shuts off the steam, and opens the ends of the cylinders to the atmosphere. In this way the ascending cage is almost instantaneously brought to rest. For further safety each cage is fitted with rack teeth, which engage with the pawls X X. The winding drums are provided with very powerful brakes on each rim, one brake being applied in the opposite way to the other, in order that the brake power may be equal for both directions of rotation. The



THE GRANGE IRON COMPANY'S OVERWINDING GEAR FOR MINES.

addition, a port C is cast on the opposite side and connected with another cylinder D, in which is a double piston valve E, one part of which covers the port C and the other the port F. The front of the piston valve is exposed to constant boiler pressure, and is connected to the rod K, while the back of the piston is exposed to the atmosphere, and is attached to the lever and rod H H for working the throttle valve I. The rod K passes forward to the pit shaft, and has on its outer end a head carrying a roller, which, by reason of the constant steam pressure on the piston, always bears against the vertical sliding wedge bar L, this bar being connected by the rods V to the lever W. On the top of cylinder D is a branch T, joined to both ends of the engine cylinders by the pipes and valves U. The action is thus: When a cage is drawn up beyond the safe working limit, it comes in contact with the lever W, and lifts the straps are made in four independent parts, so that in case of breakage only one-fourth of the brake power is likely to be lost. The automatic arrangement does not in any way interfere with the ordinary working of the brake by means of the foot gear. The particular gear illustrated has been applied by the Grange Iron Company to some winding engines recently built by them for the Australian Agricultural Company, Newcastle, N.S.W., under the instructions of Mr. J. D. Baldry, C.E., Westminster. The engines and gear were tested in the makers' works, and gave perfectly satisfactory results, showing the action to be sufficiently rapid and certain to prevent overwinding. As a precaution, at mines where the gear is now applied, the cage is purposely overwound each day, to make sure that everything is in proper working order. The engines and cages are ready for work again in from three to four minutes. It is rather remarkable that though the colonial coalowners are adopting this gear, it has not yet been applied in this country. Probably, however, the recent cases of overwinding, and the attention now directed to the subject, may cause steps to be taken by those interested in such matters. We understand that in several instances where the gear is in operation overwinding has been prevented, and in some cases loss of life also.

The Grange Iron Company also show a number of specialities, chiefly in reference to colliery and mining work. Among these we may notice a working model of an apparatus for sorting, cleaning, and screening coal. In these the main and nut screens are each driven by a triangular cam, an arrangement which gives a much quicker action and enables the screens to work at a much less angle than when excentrics are used, as in the ordinary method of construction. The cleaning belt has a division in the centre to receive the stones and brasses, which are carried down into a separate spout at the end. The double horizontal steam engine, which we illustrate by two views on page 461, is an example of good and substantial design and workmanship. The cylinders are each 8in. diameter and 12in. stroke, and when running at the rate of 200 revolutions per minute are capable of indicating 50-horse power. The expansion slide, which has the ordinary reciprocating movement, is angled on the edges, and works in a bored seating with angled ports, formed in the back of the main slide. It is turned to fit the seating, and is connected to the governor by a lever and rod in such a way that when the governor rises and falls the expansion valve spindle is partially rotated in one direction or the other, and so varies the point of cut-off. There are no screws within the steam chest. The engine has been specially designed for running continuously at a high speed. The wearing surfaces are large and adjustable, and easily got at. Means are provided for lubricating every part while in motion. On page 456 is represented a double-acting horizontal pump for mines, worked by a tail rope. The rope is kept continually taut, and the slack automatically taken up by the sliding carriage, the amount of tension being regulated by the weight A. The number of grooves in the pulley is varied according to the pull required. The same system is used for working hauling and other gear. The self-contained hauling engine, illustrated by two views on page 461, is a type of engine which has been specially designed for underground use, for working either with steam or compressed air. Instead of placing the spur wheel in the middle, between the drums, with the steam cylinders one on each side of the pinion, the wheel is put at the end of the drum shaft, and in this way the engines are brought over to one side, so as to leave a convenient space for the attendant. The engine frames, together with the gearing, are mounted on a strong wrought iron bed plate, so that the whole machine is self-contained. One of Haswell's patent mechanical coal getters is exhibited. This is illustrated by two views on page 456. It consists of two wedges W W, which are drawn together by means of a screw worked by scroll gear, and which force out the two steel pieces B B. Straps A A, forming guides for the pieces B B, bind the whole together, and are attached to the frame carrying the bearing for the screw and scroll gear. The scroll is actuated by a ratchet in the manner shown. Assuming a pull of 56 lb. to be exerted by a man at the end of the lever, the gearing is such that the blocks B B would be pushed out with a pressure of 325 tons, after allowing 33 per cent. loss for friction, but this may be considerably augmented, if required, by increasing the strength and proportions of the machine, while on the other hand it may be just as easily decreased. The whole apparatus is made of steel, either forged or cast. The Grange Company also exhibit Goodwin and How's patent safety clip for securing railway keys in chairs. This is a simple appliance, the use of which does not necessitate any alteration to the chairs in use in existing permanent way. The clip consists of a plate of tempered steel about $\frac{3}{32}$in. thick, upon which are formed flanges at the ends to suit the width of chair. On the side next the key tongues with sharp edges are made to project as shown in the sketch,



GOODWIN AND HOW'S CLIP FOR CHAIRS.

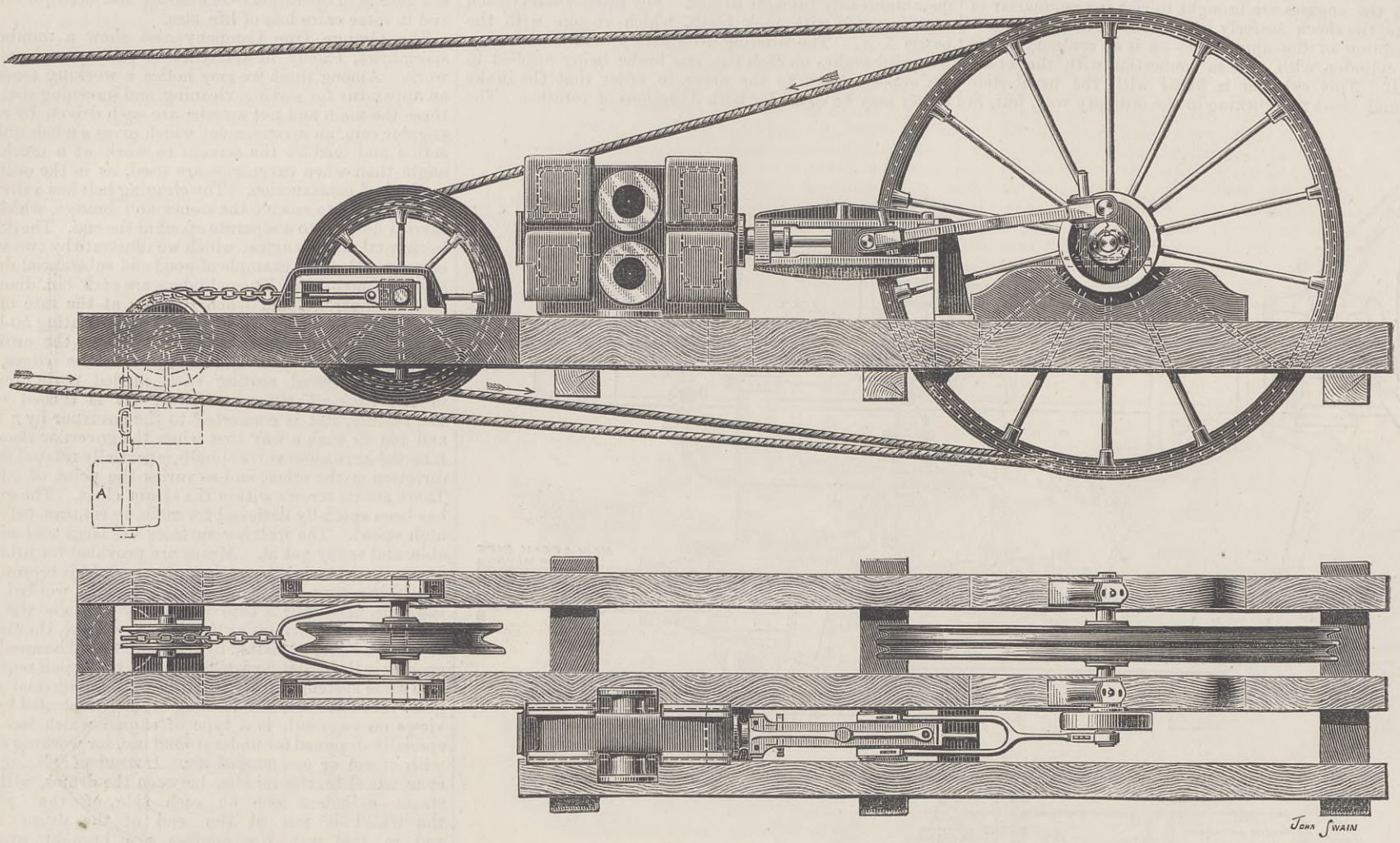
and these prevent the key from working back. The clips are readily put into position round the horn of the chair before inserting the key. The keys may, of course, be tightened up at any time in the usual way. It is stated that ordinary keys last much longer when used with these clips than those made of compressed wood do when used alone as they do not require such constant driving up. A number of the principal railway companies have had these clips down for several months, and we understand that the Great Northern Company, after a trial of nearly two years, were so satisfied that they ordered a considerable quantity, and are again contemplating an extension of the system. The clips have also been supplied to the Great Indian Peninsular Railway and the New South Wales Government Railways.

The locomotive which we illustrate on page 464 has been specially designed by Messrs. R. and W. Hawthorn, Leslie, and Co., Newcastle-on-Tyne, for an Australian railway, in order to meet the peculiar requirements of the country. The line is of what may be termed the exploring type, passing through an almost virgin country, and has consequently to be laid as cheaply and expeditiously as possible, compatible with substantial work. For the engines the following requirements were laid down:—The fixed wheel base not to exceed 8ft., so as to allow of the lines being

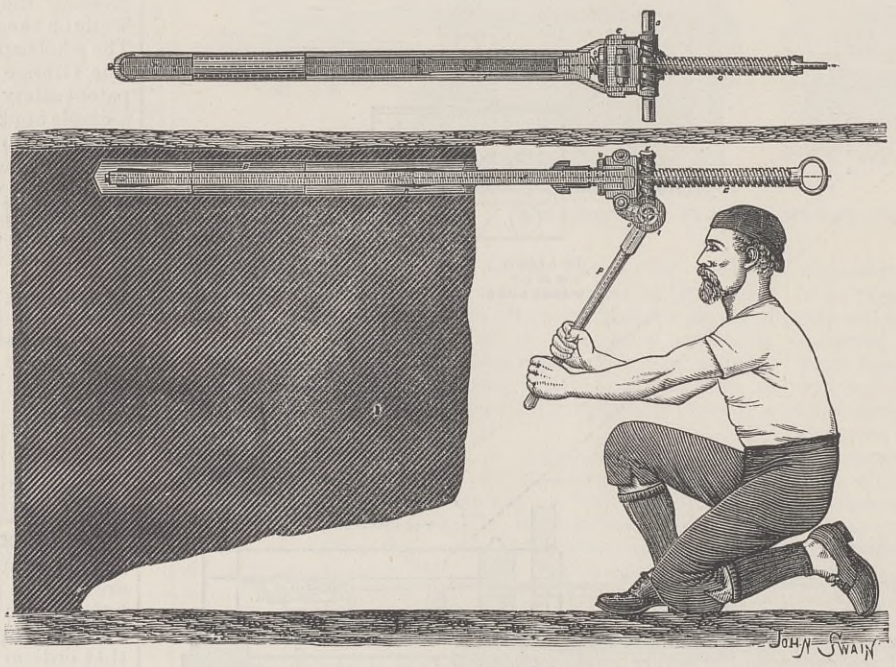
NEWCASTLE EXHIBITION—DOUBLE-ACTING HORIZONTAL MINE PUMP

THE GRANGE IRON COMPANY, DURHAM ENGINEERS.

(*For description see page 455.*)



laid to curves of not more than four to five chains radius; the weight per wheel not to be more than three tons, the rails weighing only 40lb. per yard; a load of 200 tons to be drawn up an incline of 1 in 60 at a rate of fifteen miles per hour, the fuel being wood; the total weight of engine in working order not to exceed 27 tons; the gauge of the rails to be 3ft. 6in. The engine exhibited is of the type known as a six coupled double-ender, fitted with "Hall" cranks, and radial axles at both ends. The use of Hall's cranks and outside frames allows of a very large fire-box, which is essential for burning wood. The following is the specification of the engine and tender:—The engine to be of the outside cylinder class, having ten wheels, six coupled, 3ft. 6in. diameter. The wheel base to be 8ft. fixed, 21ft. total. The boiler to be telescopic. The barrel to be 3ft. 5in. diameter, and 11ft. long, of plates $\frac{7}{16}$in. thick, secured by $\frac{3}{4}$in. rivets, $1\frac{7}{8}$in. from centre to centre. All the longitudinal seams and throat plate are to be double rivetted. The boiler and fire-box shell plates to be of the best selected steel; working pressure, 160 lb. per square inch. The fire-box shell to be 4ft. 2in. long, 4ft. 10in. wide, 4ft. 4in. below centre line of boiler, and of plates $\frac{7}{16}$in. thick at the sides and top, and $\frac{1}{2}$in. thick at front and back. The inside fire-box to be of best selected copper, 3ft. $7\frac{5}{8}$in. long, 4ft. $3\frac{3}{4}$in. wide, 4ft. $9\frac{1}{2}$in. high; the plates to be $\frac{7}{16}$in. thick, except the tube plate, which is to be $\frac{13}{16}$in. thick. The shell to be stayed by longitudinal stays, the top of the box by girder stays, and the inner and outer fire-box by copper stays $\frac{7}{8}$in. diameter, arranged as near 4in. pitch as possible. Heating surface, 748 square feet; grate surface, 15·8 square feet. The boiler to be suitable for an ordinary working pressure of 150 lb. per square inch, and to be tested by hydraulic pressure to 220 lb. per square inch. The tubes to be 123 in number, of brass $1\frac{7}{8}$in. diameter. A pair of $2\frac{1}{2}$in. Ramsbottom safety valves to be fitted on fire-box and held down by levers and Salter's spring. The frames to be made from one solid plate of steel $\frac{7}{8}$in. thick, strongly secured to one another by cross stays, and placed outside the wheels. Buffers and draw gear to suit rolling stock. The buffer beams to be of steel, and to have a central buffer. A cow-catcher to be fitted at front. The wheel centres to be of cast steel. The tires to be of crucible steel $2\frac{1}{2}$in. thick on tread of wheel, and 5in. wide. The axles to be of steel with journals, 8in. diameter, and 7in. long. The wheels to be forced on axles with hydraulic pressure of 10 tons per inch diameter of axle. Maximum weight on any axles to be 6 tons. The axle boxes and horn blocks to be of cast steel, with heavy brasses for bearings, and arranged for lubrication for either oil or grease. The springs to be made of the best spring steel, and tested for the weights they have to carry. The cylinders to be of the best hard close-grained cylinder metal 14in. diameter, and a stroke of piston of 20in. Waste water cocks to be fitted to each cylinder, and to be worked by rods and levers from the foot-plate. The pistons to be of cast iron, 3in. in width, and fitted with cast iron packing rings. The crossheads to be of cast steel with cast iron slide blocks. The connecting rods to be of best mild steel, and fitted with heavy brasses and suitable cotters for adjustment. The coupling rods to be of the best mild steel, and fitted with brasses. The whole of the valve motion to be accurately fitted, and afterwards case-hardened where necessary. The reversing handle to be on the right side of foot-plate, and to be held in position by a sector and spring catch on handle. A powerful screw brake to be fitted so as to lock the wheels. The handle for the brake to be on the left side of tender; a steam brake also to be fitted, acting upon the engine and tender wheels. The boiler to be fed by one No. 7 patent injector and one feed pump, with ram 3in. diameter. The steam pipes on engine, also feed, jet, and pressure gauge pipes to be of solid drawn copper. The tank to be placed on a six-wheeled tender, and to contain 1200 gallons of water when full. The coal bunkers to have a capacity of 300 cubic feet, and placed on tender. The engine to be fitted with glass water gauge, two gauge cocks, jet cock, steam pressure gauge, blow-off cock, injector steam cocks, whistles, two clack boxes for feeding boiler, mud plugs, and fusible plug in fire-box. The following tools to be supplied with the engine:—A lock-up tool box, containing a set of spanners, one movable spanner, one copper hammer, one lead hammer, one hand hammer, two files, two chisels, spare gauge glass, one oil can, one crowbar, one tallow kettle, one oil feeder, and one glass gauge lamp. A complete set of firing irons and shovel is also to be supplied. The engine to be painted with two coats of lead colour, two coats of approved colour, and finally lined out and varnished. The tender is carried on six wheels, each 2ft. 9in. diameter, and contains 1200 gallons of water and 3 tons of wood for fuel, the total weight in working order being 17 tons. The engine is fitted with steam cattle alarm, water raiser for supplying the tender from wells by the side of the track, and an extended smoke-box, fitted with wire gauze partitions, to check and extinguish sparks. It is capable of being driven up to about forty miles per hour. Both engine and tender are constructed almost entirely of steel, the amount of iron used being comparatively trifling. On the front is a large head lamp with an electric light of 800-candle power, which is sufficient to illuminate the track for a quarter of a mile ahead in ordinary weather. This, together with all the other lights in the train, is driven by a Parsons high-speed motor of $2\frac{1}{2}$ electric horse-power fitted on the foot-plate. The finish of the work is all that could be desired.



HASWELL'S PATENT MECHANICAL COAL GETTER.

IRISH METAL MINES.

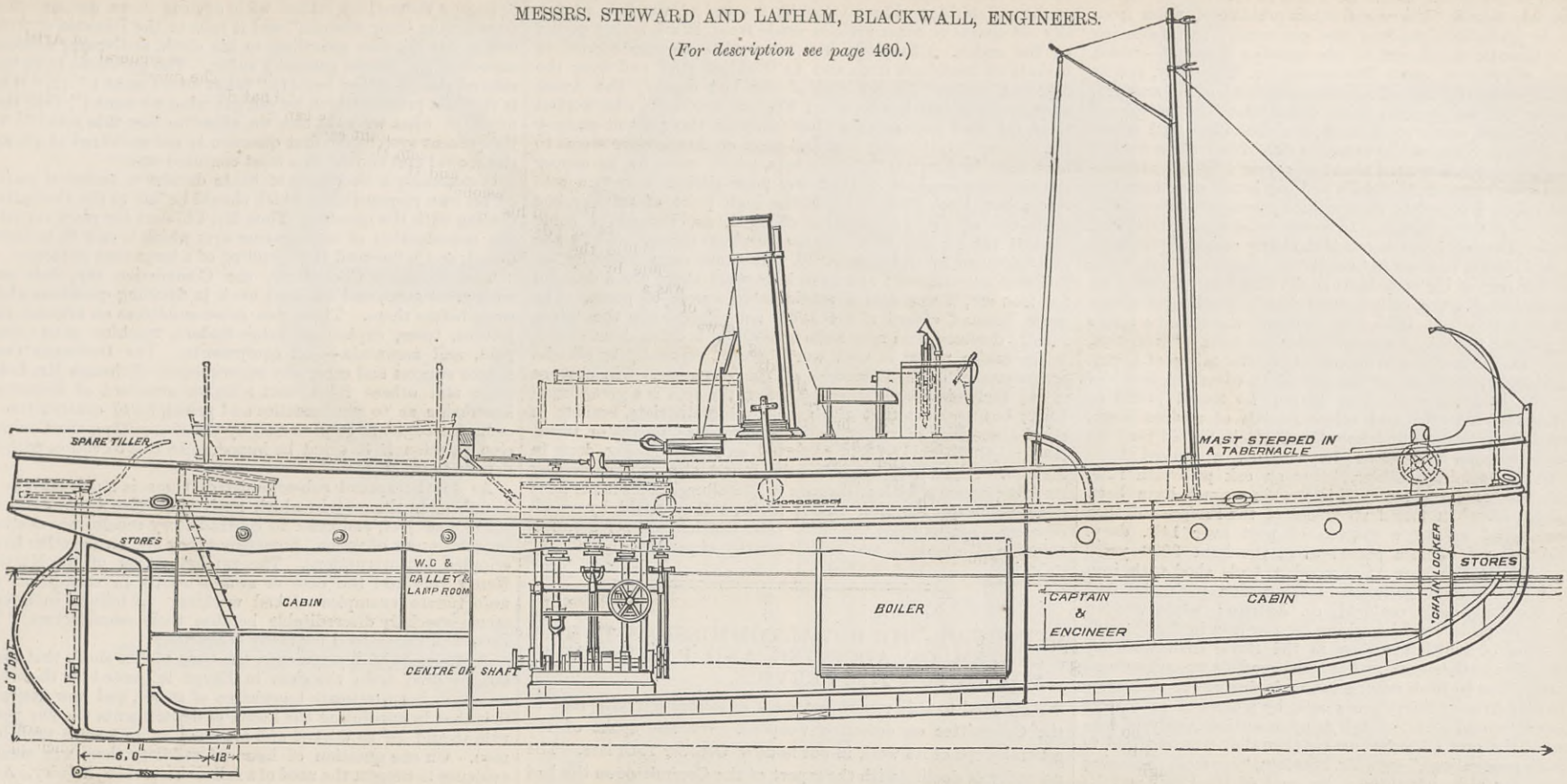
WE have before us a very excellent paper[1] on "The Metal Mines of Ireland," and as we think an abstract of it will be of interest to some of our readers, we put one before them, referring those who desire to go more fully into the matter to the paper itself. The author begins by referring to the list of mines published by Griffiths in the "Dublin Quarterly Journal of Science," 1861, and which was corrected and revised in Chapter xxi., Section V., pp. 361, &c., of the "Geology of Ireland," 1878. The author considers these again need revision, and he does so in the paper under notice, and he does so on the system of, first, giving separate lists for each mineral, arranged in counties or in fields where the ores are bedded; and second, giving short county histories of the mines, thus dividing the subject into two parts. In both parts, as far as practicable, the counties are arranged alphabetically. In Part I. the lists include all the places where the different minerals are recorded as found in appreciable quantities; and in Part II., when possible, the present state of the lodes is stated; but in both parts the author candidly states that the majority of the information given is on hearsay evidence, this being due to the unsatisfactory way in which the old mining accounts and records were kept. The history of the early Irish mining adventures is very vague. They are referred to by Griffiths, Kane, and other modern explorers, but they afford very little information. Griffiths states, however, that "Many of our mining excavations exhibit appearances similar to the surface workings of the most ancient mines of Cornwall, which are generally attributed to the Phœnicians." In a kind of introduction to his paper, Mr. Kinehan makes short quotations from a paper on "The Precious Metals and Ancient Mining in Ireland," and to a record in the "Annals of the Four Masters," A., No. 3656, where gold is mentioned as having been procured in Foithue Airthir Liffe, or in the mountains of Dublin and Wicklow; while at Lyra, Knockmiller, near Woodenbridge, Co. Wicklow, the ancient timberings in a placer mine were found. We also learn from the annals that in A.M., 3817, silver shields were made at

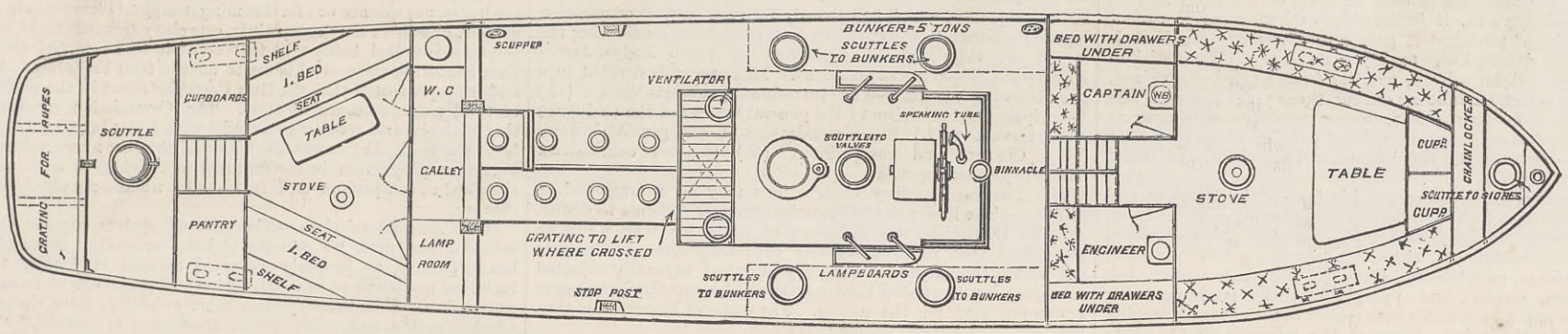
[1] Read before the Royal Dublin Society, March 24th, 1886, by Mr. G. H. Kinehan, M.R.I.A., &c.

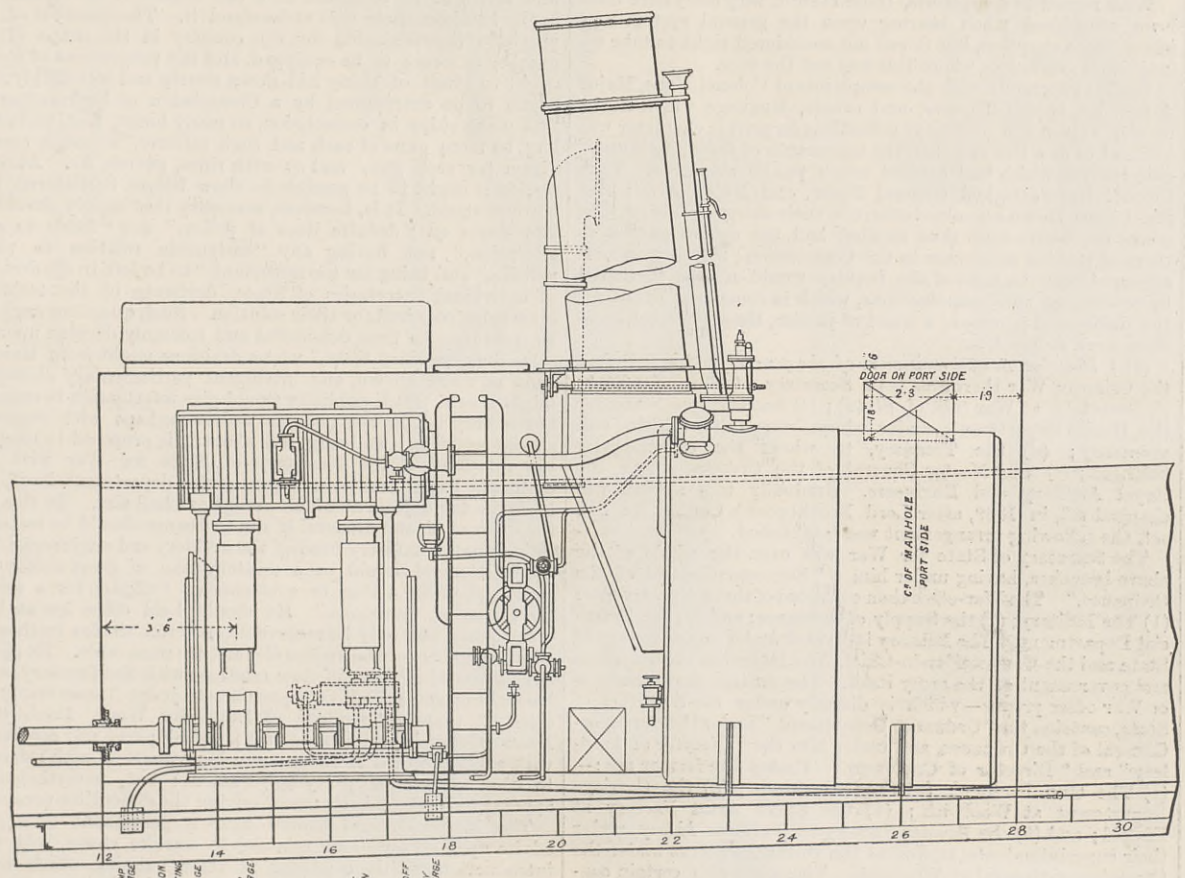
THE STEAM TUG "JUBILEE."

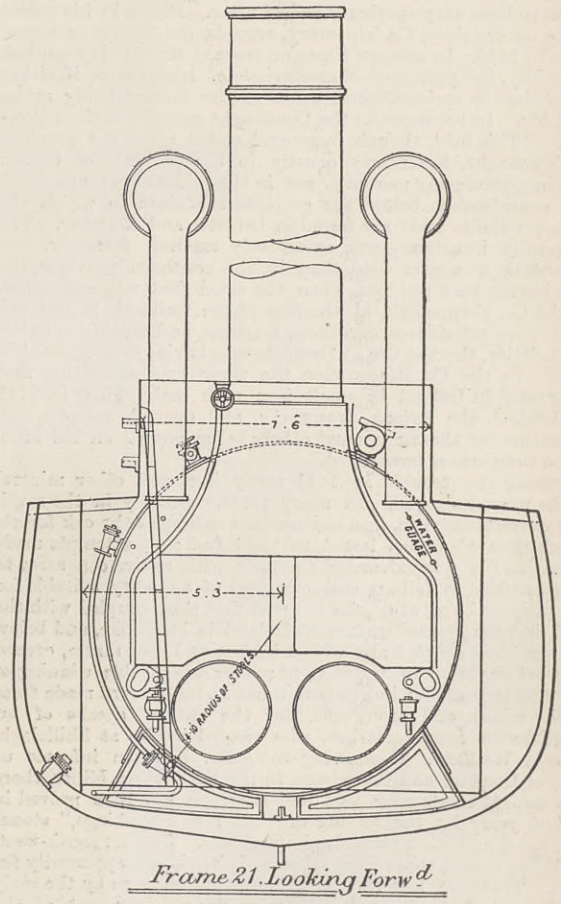
MESSRS. STEWARD AND LATHAM, BLACKWALL, ENGINEERS.

(*For description see page* 460.)

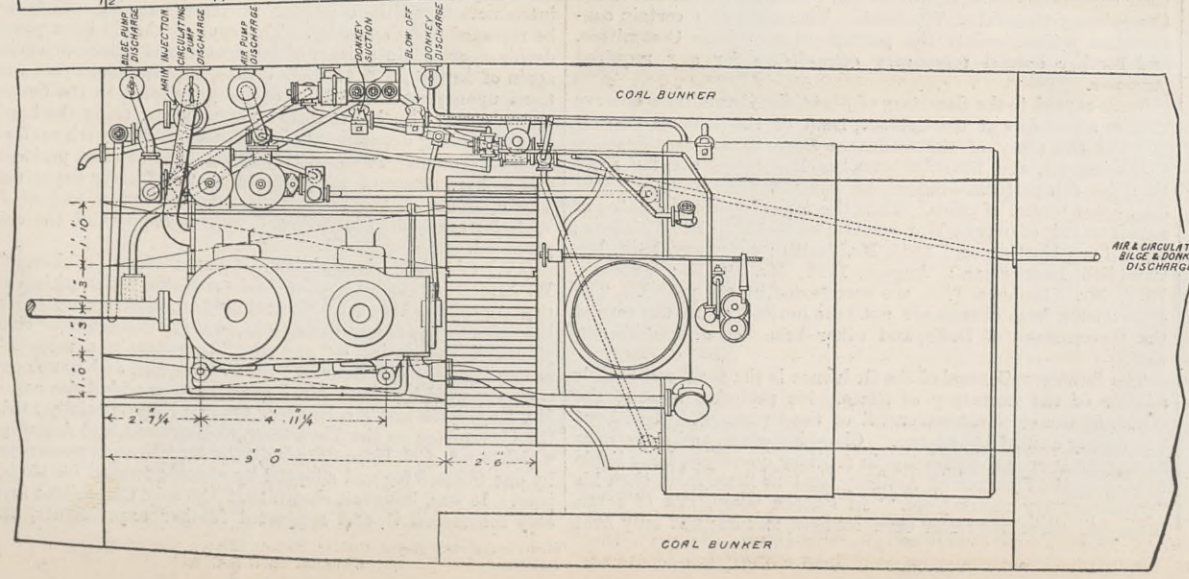




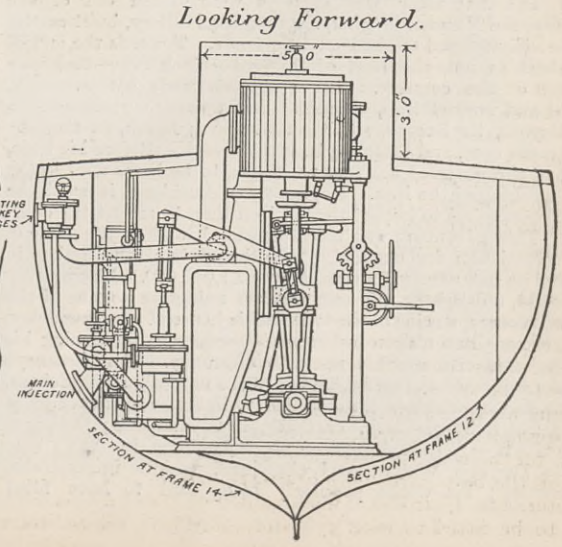




Frame 21. Looking Forwd



Looking Forward.



Argetros—silverwood—on the Nore, Co. Kilkenny. In this neighbourhood are the remains of the ancient mines at Ballygallior and Knockadrina, places at which in recent years native silver has been found. There are other prehistoric mines from which it is probable silver was also procured. The following places are likewise mentioned in the annals: Rosargid—which also means silverwood—near Toomavara, Co. Tipperary, and at Garrand, adjoining Kilnafuid, a little southward of Toomavara, is the *débris* of an ancient mine called the "Silver Mine." Further westward, south of Nenagh, are the village and mines of Silver Mines. Some of the mines in this village were worked so long ago, that when opened about the year 1860 the attals—pyrite and sphalerite—in the stalls and old levels were found to have undergone a complete change into peroxide of iron, with carbonate and silicates of zinc. In recent years some of the lead from this locality has given as much as eighty ounces of silver to the ton, in addition to some native silver.

In another part of his introduction Mr. Kinehan tells us of an old mine at Lough Derg, called "Old Men's Workings," which was broken into about 1855, and in them was found a man's skeleton and the remains of wooden and stone tools. "Nerenius, who wrote in the ninth century, mentions the mines of Lough Leane, Killarney; while about the year 1804, when Col. Hall was working the lead mine at Ross Bland, he found primitive levels, stone implements, and other records of ancient work. At Derrycarhoon, near Ballydehop, Co. Cork, in an old working there were wooden and stone implements, a curved tube of oak, and a primitive ladder, being an oak pole with rude steps cut out of its sides. This working must have been very ancient, as when found all traces of the surface entrance were smothered up by a growth of peat over 14ft. deep. This ought to represent a period of at the least 3000 years or more. About the year 1850 wooden tools shod with iron were found in ancient galleries in connection with the coal seam of the Ballycastle coalfield, co. Antrim; while wooden scoops were found in an old working for bog iron in the Queen's County, some of which are now in the Royal Irish Academy Museum. The author next makes some sensible remarks about the injuries done to Irish mining interests during the rush after them twenty-five or thirty years ago, by a class of promoters who misrepresented them, as well as by incautious analysts, who represented the ores more favourably than they were entitled to do. "Such proceedings," says Mr. Kinehan, "are most damaging to a mine; for although it may be good of its kind, and be capable of paying well, if judiciously worked, when it cannot give the 'riches' promised it gets into disrepute; or, if it is injudiciously overworked, to try and keep up its fictitious character, it will be robbed, and its future prospects ruined. In the history of the mining during those years it is now well known that more than one promoter exhibited specimens as representing the ordinary minerals of a lode, while in reality his sample exhausted all the mineral of that class to be found in the vein."

Mr. Kinehan, in drawing out his lists of Irish mines and minerals, arranges their products in the following order:—Gold, tin, native silver, lead and zinc, copper, sulphur ores and gossen, barytes, iron, manganese, antimony, arsenic, cobalt, graphite, nickel, titanium, molybdenite, alum and copperas, apatite, salt and gypsum, steatite and pyrophyllite, the products being arranged as much as possible with regard to the natural grouping of the ores in the veins. Some of the minerals in the above list have been very sparingly looked after. Boote, in his notice of the silver mines, Co. Tipperary, records quicksilver as found prior to 1640. In modern times no trace of this ore is recorded. Generally, the geological characteristic of Irish mines is either ordovician or carboniferous, some of the former being metamorphic. In reference to the Connaught coalfield is the following:—"This field, though in general called after the province of Connaught, lies nearly equally in the province of Ulster. The iron-producing measures are in the middle coal measures, and considerably below the geological horizon in which the more profitable beds are found in Leinster and Munster. The iron—clay ironstone—was extensively smelted formerly, and apparently at a later date than in the southern province, the fires having been put out when the wood fuel was exhausted. In the Co. Fermanagh, at the foot of the Cuilcagh Mountains, there were extensive excavations, furnaces, and mills, also in the Co. Leitrim, the last fire at Drumshambo having been put out in 1765. In the Co. Roscommon the three brothers Reilly first attempted in Ireland to smelt iron with coal. They in 1788 established the Arigna Ironworks, and opened coalpits, the adventure by themselves and others being carried on till 1808. Since then others have tried."

During the trouble in 1641 many iron and other mineral works were destroyed. In many parts, especially in the south and western districts, iron was smelted so long as the oak forests which then abounded lasted to yield fuel; all attempts made after this fuel was exhausted to smelt with native coal seem to have resulted in failure, coal measures of a quality suitable for the purpose being at depths so great that this, coupled with the fact that the general surface of Ireland is basin-like, and below the sea level, coupled also with a broken and poor strata, caused so great an influx of water as to render a profitable winning of the coal impossible; but in past times fortunes were made from Irish mines and ironworks, for the author speaks of an Englishman named Barber, who erected works at Shillelagh, County Wicklow. Concerning this, Mr. Kinehan informs us that at Connary and Cronebane, in the East Avoca Mines, there was ancient mining for lead and silver, as has been proved in recent years by the finding of "old men's workings," stone, hammers, and other primitive implements. Further south-west, at Moneyteigue, there were other early workings, apparently for iron. Tradition has it that iron was raised here by the early Irish, and that after the O'Helys were driven out of the country, the Norman knights, Raymond and Sillery, built castles in the vicinity, and worked an iron trade. Towards the end of Elizabeth's reign, the Earl of Stafford—Black Tom—took possession of the country. He, and afterwards his successor, mined and worked iron, through their tenants or ironmasters, the Paynes, the Bacons, and the Chamneys; Bacon, an Englishman came over, and built works at Shillelagh. Before his time, most of the charcoal was sent to Wales, to be there used in the final working of the iron. He, however, considered it would be more economical to import the pig iron than to export the charcoal. This adventure was most successful, and at the time of the commission for examining into the state of the timber in Ireland he had amassed a sum of over £1,000,000. Having only one child, a daughter, the bait was too seductive to one of the commissioners, a scion of the twice noble house of Cholmondeley, who became Bacon s son-in-law and successor, relinquishing his heritage and changing his name to Chamney. The Chamneys greatly increased the trade, having works not only at Shillelagh, where Bacon established the industry, but also in the Vale of Clara; at Bally-na-Clash, or Clash, in Glenmalure; at Garrynagowlawn — Woodenbridge — and Aughrim in the Vale of the Darragh Water; and elsewhere, besides innumerable bloomeries; his works popularly being said to have filled the country." In an old document there are records of some fifty-two or more distinct works in Wicklow, Wexford, and Carlow. The "Clash" and Shillelagh iron was of a very superior quality—cold blast charcoal usually is—and at the present day any old chains or other articles made from it are highly prized by the smith. Chamneys' iron ore and iron were carried in baskets on horseback from and to Wicklow port and from the different mines. At the end of the last century the Avoca mines were in the hands of an English syndicate, who worked them for lead and copper. But early in the present century the channel immediately east and west of Avoca river seems to have been broken up into five sets, which were let as copper mines, and when first worked any poor pyrites were run into spoil; but about 1840, owing to the high price of sulphur, the character of the mines quite changed, as, instead of being worked for copper, they became sulphur mines. While the great demand for sulphur lasted vast sums were made by the different adventurers; and as in late years there was a demand for iron ore, it was also a considerable source of profit. The great demand ceased about 1865, and afterwards the mines rapidly declined, and now little or nothing is being done.

The entire paper is well worth study, especially by all who are interested in the industries of the green isle. The absence of any fuel suitable for smelting ore on the spot is a great drawback; but it seems that the ore in many districts, bearing in mind the utility of railways and tramways as means of transport, might be worked and exported, as is now being done in Antrim. Might not a method be found also of successfully smelting ore even with anthracite? Metallurgical chemists have done much for the iron trade; perhaps they could by search discover a means to do this also. Mr. Kinehan's paper is full of valuable information, and is well worthy of perusal.

REPORT OF THE ROYAL COMMISSION ON THE SYSTEM OF ADOPTING AND PASSING WAR STORES FOR THE SERVICE.

We referred to this report last week in connection with that of the Committee on defective weapons. We also spoke of the general scope of its work in our issue of October 15th last. The necessity of dealing with the report of the Committee on the bad cutlass bayonets, which had already been the subject of question before Parliament, prevented us last week from considering the report of this Royal Commission, of which Judge James Fitz-James Stephen was president. This report is divided into the following sections:—(I.) Introductory observations. (II.) Description and criticism of the general system of the Ordnance Department. (III.) Recommendations on the general system. (IV.) Charges and complaints. (V.) General conclusions. There is also an appendix.

(I.) The introductory observations may be summarised as follows:—The limits of the investigation were difficult to define. Mr. W. H. Smith, the Secretary of State for War, while he recognised that much connected with his position and powers fell within the scope of the inquiry intended, naturally objected to discussing the policy that governed the quantity of reserve stores provided for the nation. The scope of inquiry was thus limited.

With regard to complaints, those even of very early date have been considered when bearing upon the general system and indicating corruption, but it was not considered right to take up individual grievances where this was not the case.

To deal effectually with the complaints of Colonel Hope, Major Armit, Mr. Lynall Thomas, and others, language which might involve unjust and irrelevant reflections on private character was listened to as a less evil than the appearance of failing to investigate charges which had excited much public attention. Thus Colonel Hope attacked General Boxer, and Major Armit and Mr. Lynall Thomas involved others in their charges. The persons whose characters were thus assailed had the option offered to them of making an answer to the Commission; but so soon as it appeared that the ends of the inquiry would not be furthered by continuing such examinations, which in some cases called for the duties and powers of a court of justice, these personal questions were dropped.

(II.) *Description and criticism of the general system.*—Before the Crimean War there was (*a*) a Secretary of State for War; (*b*) Secretary at War (not of State); (*c*) Secretary of State for the Home Department, under whom were the militia and yeomanry; (*d*) the Treasury, to whom the commissariat belonged; (*e*) the Master-General of the Ordnance, over the Royal Artillery and Engineers. Gradually this system was changed till, in 1869, after Lord Northbrook's Committee had sat, the following arrangement was established.

The Secretary of State for War was over the whole of the above branches, having under him a "Surveyor-General of the Ordnance." The War-office then consisted of three departments: (1) The Military; (2) the Supply of Ordnance; and (3) the Financial Department. The Military is divided under the Secretary of State and the Commander-in-Chief. The latter has the discipline and government of the army itself. The central department—or War-office proper—which is directly under the Secretary of State, contains the "Ordnance Department," under the Surveyor-General of the Ordnance, and under him the "Director of Artillery" and "Director of Contracts." Under the former are:—(1) The Gun Factory; (2) the Laboratory; (3) the Carriage Department at Woolwich; (4) the Small Arms Factory at Enfield; and (5) the Powder Factory at Waltham Abbey, under their superintendents, as well as the Ordnance Stores under the Commissary-General at Woolwich. There are also certain consultative bodies, mainly the permanent Ordnance Committee, and further special temporary committees for any required purposes.

With regard to the Secretary of State, the Commission observe that as a member of the Cabinet, head of the political department of the army, of the Ordnance Department, Fortification, Commissariat, and financial branches, his duties are far more than he can perform—indeed, he has not time to learn them during his tenure of office. Thus the following are the dates of appointment of recent War Secretaries:—1881, Mr. Childers; 1882, Lord Hartington; 1885, Mr. Smith; February, 1886, Mr. Campbell Bannerman; August, 1886, Mr. Smith; January, 1887, Mr. Stanhope (*i.e.*, six secretaries in six years). The evils arising from change are not here limited, as in the case of the Government of India, and other branches of administration.

The Surveyor-General of the Ordnance is the most responsible adviser of the Secretary of State. He performs most of the duties of the old Master-General of the Ordnance, but without his dignity and independence. Changing often, and sometimes having little or no experience in military questions, he is liable to lean on the Director of Artillery, and be little more than his "parliamentary mouthpiece." In sixteen years, out of seven surveyors three had never been soldiers, and one had only held a subaltern's commission. The general result appears to be that officers of various branches, with their own wants in view, ask for as much as they can, the Cabinet and Treasury "are led to occupy themselves rather with cutting down demands than ascertaining their wisdom," and it falls to the Director of Artillery to cut his coat according to his cloth, as General Alderson expressed it. Stores generally suffer. The questions to be considered should rather be—(1) "What do we want?" (2) "What is the least price at which we can get what we want?" (3) "How much of what we want can we afford to buy this year?" On the present system the first question is not answered at all, and the second and third "in a most confused way."

Occasionally a Secretary of State decides a technical matter on his own responsibility which should be left to the Committee dealing with the question. Thus Mr. Childers for years retarded the introduction of a magazine arm which is now to be introduced, and influenced the spending of a large sum of money.

The Ordnance Committee, the Commission say, deal only with great guns, and do good work in deciding questions which come before them. There are sub-committees on armour, projectiles, fuses, explosives, range-finders, machine guns—siege, field, and mountain—and equipments. The Ordnance Committee suggest and carry out experiments. Although Mr. Longridge and others think that a higher standard of theoretical knowledge as to mathematics and principles of construction of ordnance ought to be possessed by the Committee, the Commission question if it could be improved in this direction without danger to its character.

As to the special sub-committees, there is much fault to be found with the way in which such successive committees are set to a subject, and come to contradictory conclusions destroying continuity of action. Sometimes they are, on the other hand, crippled by instructions. The ratchet rifling of the Martini-Henry rifle and the case of swords spoilt in conversion are unfortunate examples of bad working. A failure in swords seems specially discreditable because their manufacture "has been well understood for many centuries."

As to heads of departments, the issue of star shells that could not be fired from the guns in Egypt is quoted to show how necessary is an intimate knowledge of stores, and how desirable it is that in appointing the heads of departments the five years' rule should be so worked and modified as to secure proficient men. On one question of issue of saddlery there was enough evidence to suggest the need of a full and searching inquiry. As to contracts, no evidence was forthcoming to suggest corruption in this matter, but there were complaints, especially from Sheffield, as to the steel supplied being sent to Woolwich to be tested at the Gun Factories, since steel is made at the Gun Factories. The makers represented that the Gun Factories stood in the position of rival manufacturers of steel. The Commission considered that material and some stores might with advantage be bought from the trade, but it was also observed that the manufacture of a certain proportion in Government factories give a valuable standard of comparison and furnished a wholesome check as to charges.

(III.) *Recommendations.*—The present system, say the Commission, has, first, no definite object; secondly, no efficient head; thirdly, no properly organised method of dealing with technical questions as to construction and purchase. "In other words, it requires more system, more publicity, more vigour in administration, and more special knowledge in council." The first step will be to ensure that the control of the ordnance is in the hands of those who understand it. The question of the provision that is needed for the country in the shape of the number of forces to be equipped, and the proportions of stores, ought to admit of being laid down clearly and intelligibly, and ought to be determined by a Commission of high authority. "So many ships in commission, so many horse, foot, and artillery, so many guns of such and such calibres, so much ammunition for each gun," and so with rifles, swords, &c. At each session it ought to be possible to show before Parliament how matters stand. It is, however, necessary that supply should be laid down on "definite lines of policy," not "liable to easy alteration," not having any "assignable relation to party politics," and being far too important "to be left to the decision of individual Secretaries of State, destitute of the technical knowledge required for their solution. Such questions ought to be from time to time considered and solemnly decided upon by some duly qualified body," whose decisions might from time to time be made known, and intelligent parliamentary discussion might result. Such publicity would give information to enemies, but secrecy is now not possible, unless perhaps with regard to special subjects. To bring this about it is proposed to readjust the relations of the Secretary of State for War with the Ordnance Department to reorganise the department itself, and to define the objects at which the latter shall aim. To this end the office of Master-General of the Ordnance should be restored, though not as military head of the artillery and engineers. The Master-General should be a military man of great ability and eminence, either a Peer or a commoner "eligible for a seat in the House of Commons." He should hold office for at least seven years, and only be removable on terms similar to those on which members of the Indian Council are removable. He should have financial advisers in close relations with the Treasury, while he ought on general military questions to judge "more firmly and clearly" than a Secretary of State for War. Doubtless a Master-General appointed by one political party and continuing with another would be in an anomalous position with reference to the system of party government; but, nevertheless, it appears to be the only means of solving the difficulties presented.

The Master-General should have a permanent council to advise upon all questions relating to warlike stores, both as to introduction and the condition of those existing, which should be reported upon annually. This council should have power to decide on complaints either of deficiencies and failure on service, or again of inventors as to their claims, and it should pass resolutions upon general questions of policy relating to the Ordnance Department. Such a council is intended to bring the heads of manufacturing departments into closer relation with each other than at present. It would be well for them to meet periodically and be kept aware of the progress in the various departments. The opinions of the great Duke of Wellington and of Lord Wolseley are quoted in different ways in support of the system proposed.

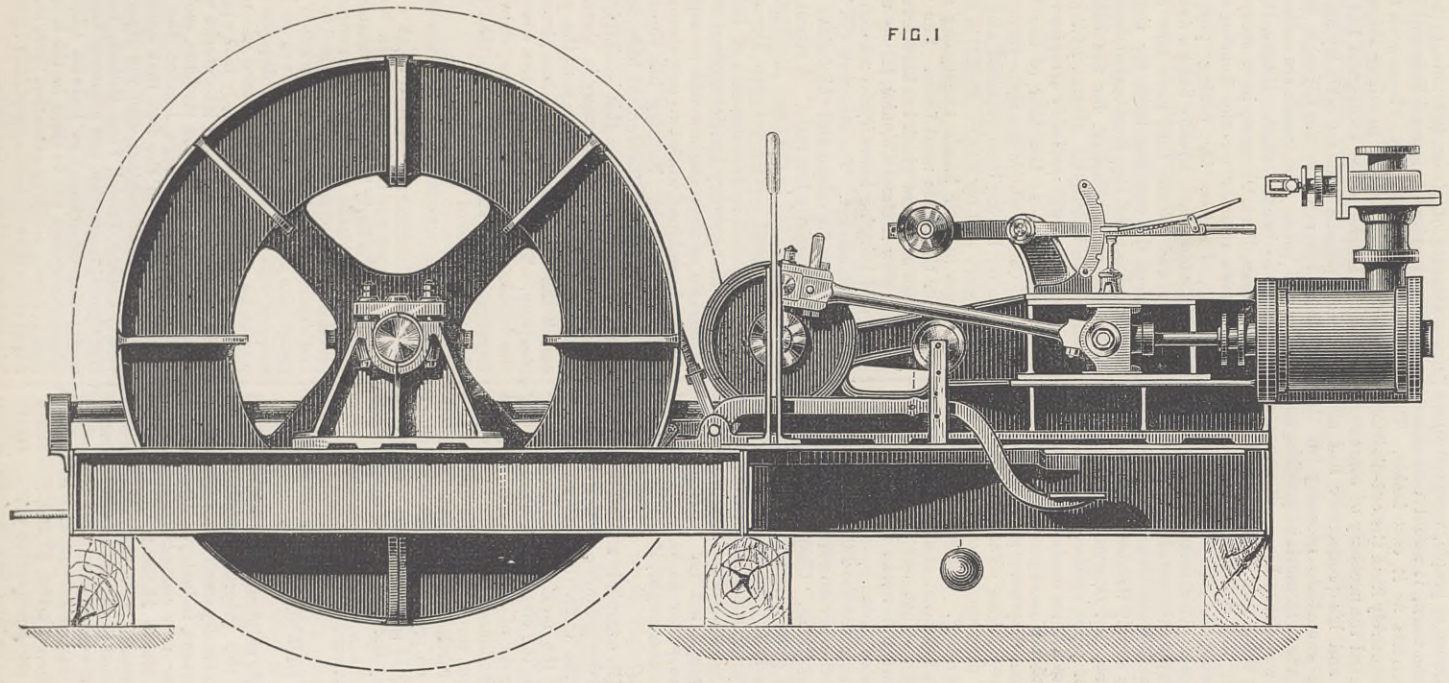
(IV.) *Charges and complaints.*—Colonel Hope (1) charged Sir W. Armstrong and Captain Andrew Noble with making a corrupt conspiracy between 1859 and 1862 to obtain orders for worthless guns to the amount of £1,087,000. (2) Colonel Hope charged officials with forming a "gun ring," to maintain a monopoly of orders for Elswick. General "Sir F. Campbell and some others" were specified by him. Mr. Lynall Thomas added the names of Mr. Engelbach and Mr. Hunter. Colonel Hope specially attacked the Committee on the Thunderer, Collingwood, and Active guns, which burst. Col. Hope stated that the Armstrong gun was rejected by one Committee and adopted by another formed for that purpose. It was, however, shown that the first Committee favourably considered it, and suggested further experiments, and a

MACHINERY AT THE NEWCASTLE EXHIBITION.

THE GRANGE IRON COMPANY, DURHAM, ENGINEERS.

(*For description see page 455.*)

FIG. 1



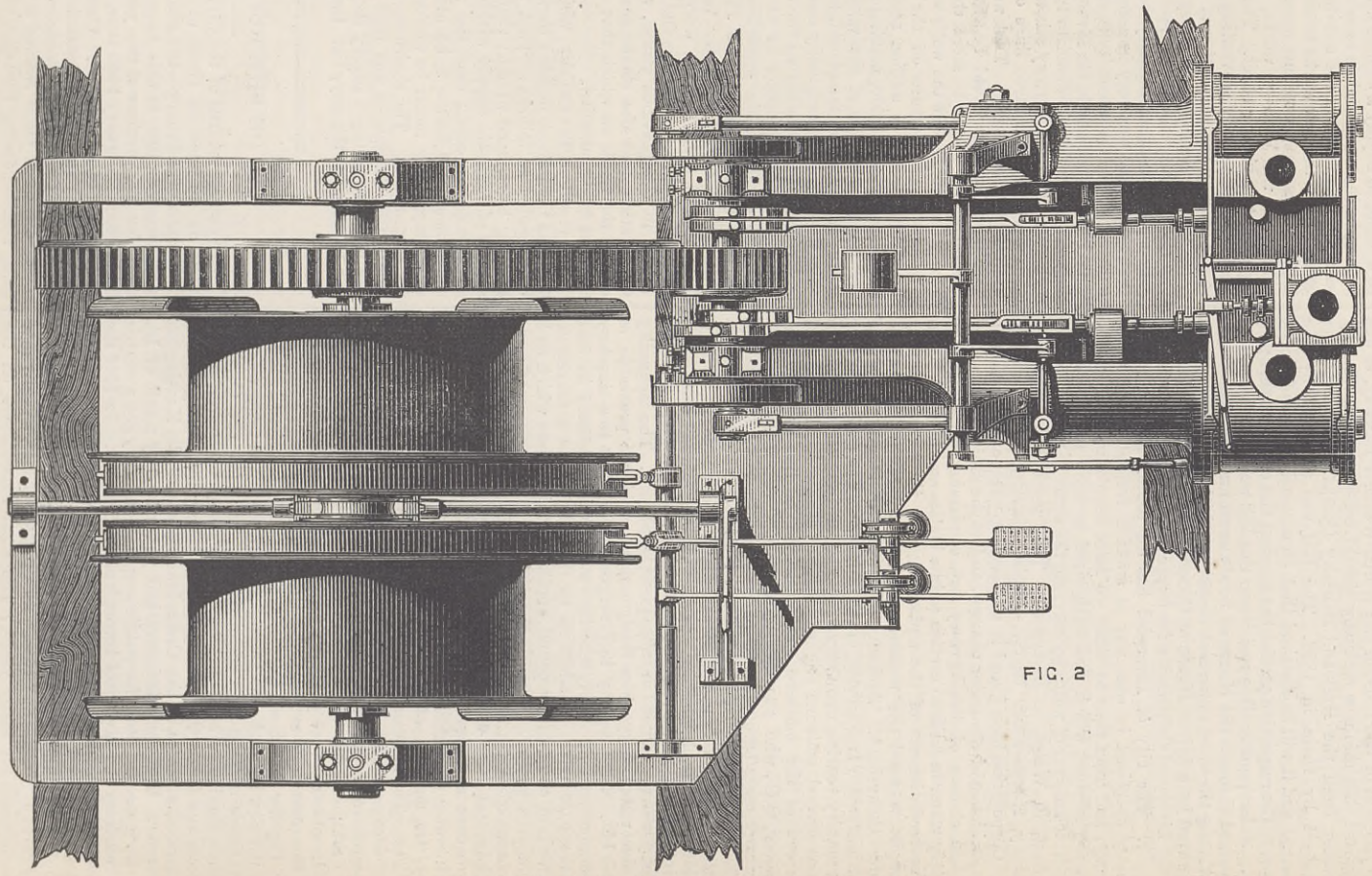


FIG. 2

SELF-CONTAINED UNDERGROUND HAULING ENGINE.

FIG. 3

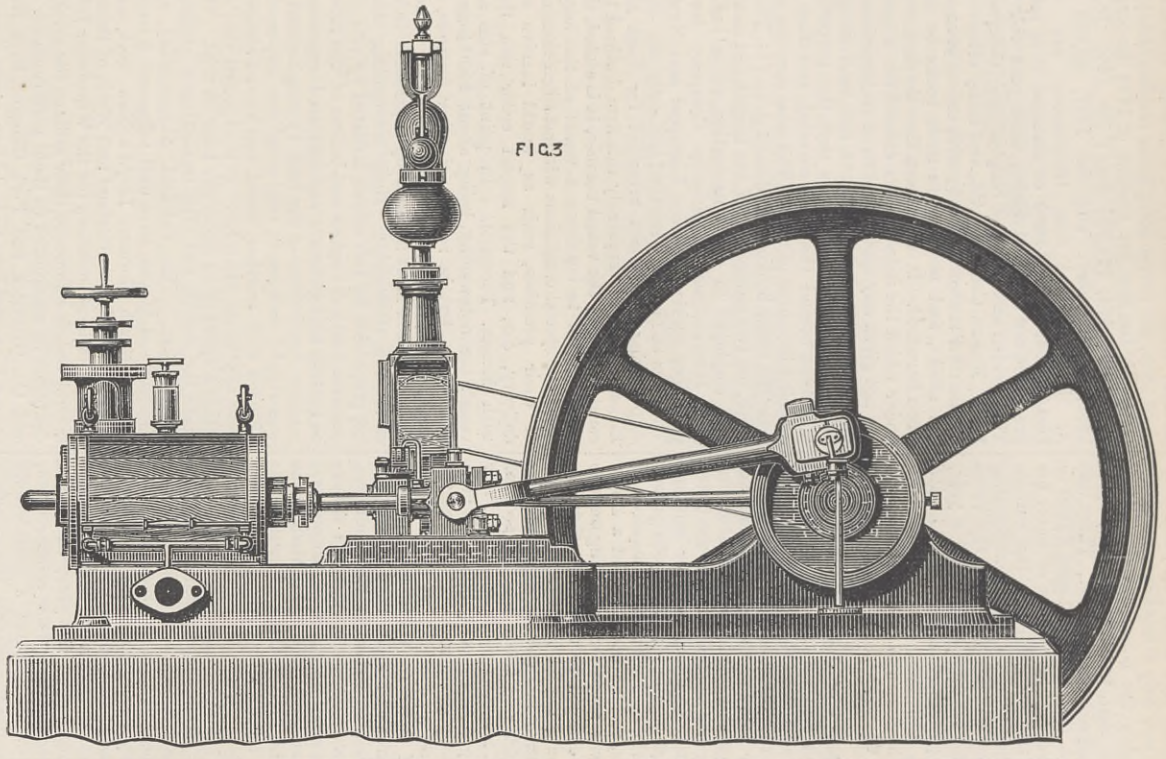
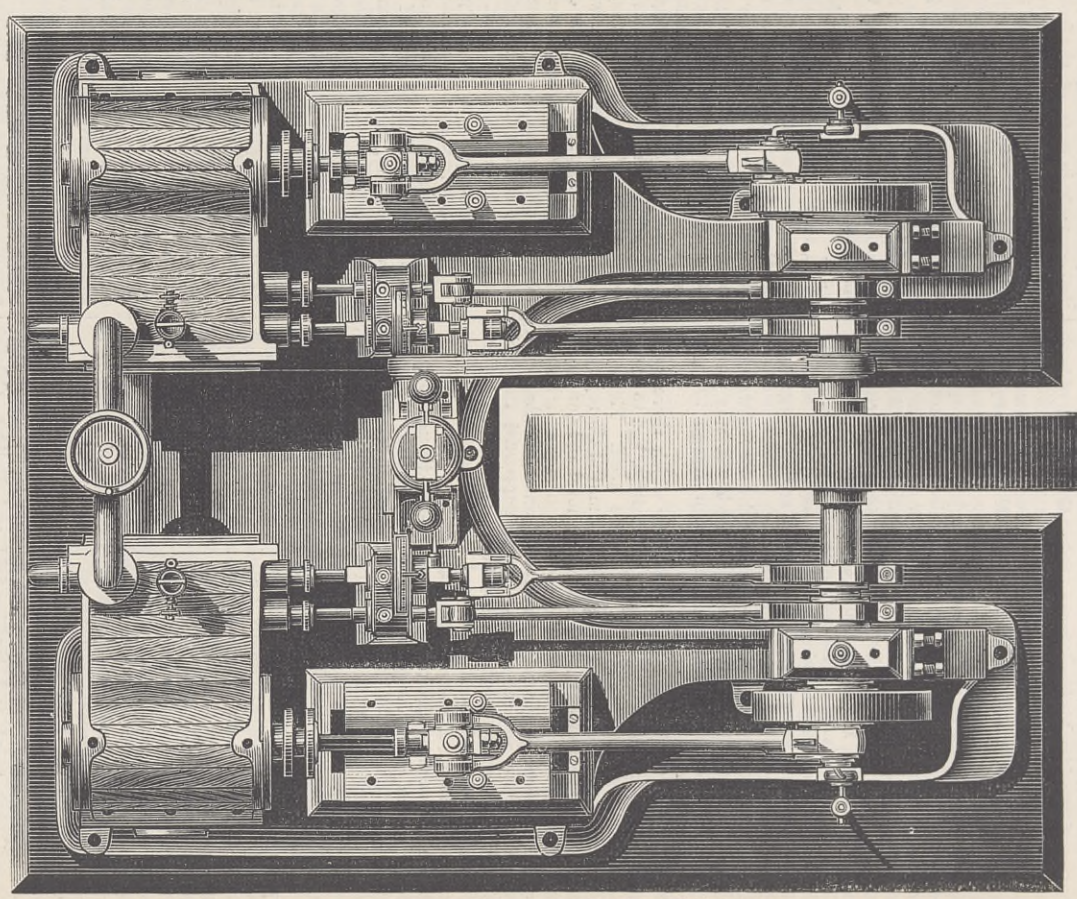


FIG. 4



HIGH-SPEED HORIZONTAL ENGINE.

PRIVATE BILL LEGISLATION.

PARLIAMENT having now entered upon the third and last division of the usual Session, the progress made by the various Private Bills becomes to the persons concerned in those measures a matter of considerable importance. Select Committees of both Houses had been fairly busy, except for the very brief Easter recess, and the results are to a large extent shown by the numerous Royal Assents and the third readings. Members are, however, likely to have rather a hard task for some time to come, owing to the number of the Bills still to be dealt with upstairs. There is, in fact, work enough for more members than are available; and, in consequence, a large number of Bills, although committed, have to wait much longer than promoters like. At the same time, Mr. Craig Sellars' Bill for the simplifying and cheapening Private Bill legislation is also delayed; but a strong compensating fact is that the Government propose to introduce a Bill of the same character in the House of Lords. Nothing final will probably be effected this year, but at least the groundwork of an improved system will be laid.

The Bill for continuing the City and Southwark Subway and Railway to Stockwell, which we described when it was passed through the House of Commons, has been agreed to by a Lords' Committee.

The Sheffield Corporation Water Bill, over which there was a long and stiff contest before a Lords' Committee, had to stand the fire of renewed opposition in the House itself. The third reading being proposed, the Earl of Wemyss moved the rejection of the Bill on the ground that it involved a novel and dangerous principle of public policy, namely, the compulsory substitution of a municipal monopoly, in the matter of water, for that of a private company; and the Duke of Argyll supported the Bill, but Lord Bramwell opposed it. Eventually Lord Wemyss withdrew his motion, and the Bill was read a third time and subsequently sent to the House of Commons.

Another measure which has been warmly, though briefly, debated is the Great Eastern Railway Bill. In the House of Commons Mr. Fitzgerald sought to get the Bill recommitted, because he objected to the proposal to carry the new railway across Coldham Common, near Cambridge. In this discussion the point of contention was only that of the preservation of commons for public use; and we need not follow it beyond mentioning that in the end Mr. Fitzgerald carried his amendment.

The Hull and North-Western Junction Railway Bill, which has passed through the House of Commons, is one of unusual importance and interest, alike in regard to its purpose and to its progress thus far. In view of its passage through the Upper House, the measure was recently submitted to a meeting of the proprietors of the Hull and Barnsley Railway and Dock Company, and upon that occasion Colonel Smith, the chairman, made an important explanatory statement, part of which it is desirable to reproduce.

The Bill of the Hull and Barnsley Company, now before Parliament, provides for the abandonment of the railways authorised by the Act of 1882, which lie west of Fenay Bridge. Between that point and Huddersfield and Halifax, Colonel Smith explained, the line was abandoned; but between Cudworth, which was their terminus, and Fenay Bridge, which was the junction of the London and North-Western Railway, it was proposed that this new company should construct that line by transfer from the Hull and Barnsley Company of the powers obtained by them in 1882. The Bill was approved by the meeting, and it will be observed that an unusual degree of accord between the respective parties has marked the career of this project. Subsequently all opposition to this Bill was withdrawn, and it passed through the House of Lords as an unopposed measure.

Among the more important measures which have already been approved by a Select House of Commons Committee, is the Bill of the Liverpool Corporation for improving their system of water supply. The city of Liverpool has for some years past been greatly exercised in one way or another respecting its water supply, and from time to time we have been reminded of the Vyrnwy scheme, which was authorised in 1880 to increase the available amount of water by carrying the water from the Vyrnwy district, in Wales, to Liverpool. That work has progressed steadily, if somewhat slowly, despite disputes and difficulties. The Corporation have found it necessary to effect an alteration in the incidence of the water charges, and at the same time to alter certain clauses of the Vyrnwy Act, confirming agreements to supply water in bulk to certain public bodies and persons within a specified distance of the aqueduct. For these purposes they brought forward the measure recently approved by a Commons Committee. Although the matter is one chiefly of administration and service, much of interest was evolved during the inquiry bearing upon structure and capacity of works, upon which several eminent engineers were examined. The general purport of the measure was explained in this way by Mr. Pember, Q.C., who was leading counsel for the Corporation:—In many cases boroughs made a profit on the water supplied to outside districts. He had had a list made, and out of twenty-three towns he found that seventeen had power to make a profit. Liverpool, however, was absolutely precluded from doing anything of the kind, and it has been so since 1847. That inability was reproduced in subsequent legislation. The inequality of the water-charge was freely expressed in the preamble of their bill. All property in Liverpool was subject to a sixpenny rate in respect of water, whether water was consumed in that property or not. In addition to that there was a maximum water-rent of 1s. in the pound, applicable to premises which took a domestic supply. Outside the city the only charge made was a charge of 1s. 3d. in the pound for premises taking a domestic supply, and there was no charge upon any property outside the city where a domestic supply was not taken. If a local board took water for public purposes, such as the watering of streets and the flushing of sewers, they paid for it 9d. per 1000 gallons. The sixpenny rate was payable in the first instance by the occupier, and he could retain as against the owner 3d. Occupier and owner between them paid in rates and rent 1s. 6d.; whilst outside of the city only 1s. 3d. was paid, and a great deal of property was not rated at all. In the course of a retrospect of the water question in Liverpool, Mr. Pember explained, *inter alia*, that although before 1843 the town was a borough, the paving and sewers in the town were in the hands of certain Commissioners. In 1843 the Commissioners obtained a local Act to obtain water for watering the streets and for extinguishing fire, and they made a system of waterworks known as the Green-lane wells and the Kensington reservoir. The Commissioners had power to levy a rate of 1d. in the pound for water for public purposes, and they got a contribution from the Liverpool borough of £500 a year. In 1846 the powers of the Commissioners were transferred to the Corporation, when the Corporation, instead of charging a penny rate for water supplied for public purposes, were empowered to levy what was known as a "sufficient" rate. As a matter of fact, a penny rate was sufficient for many years. The total expenditure on the Green-lane works was £65,000. In 1862, he also stated, the Corporation again came to Parliament and obtained a Bill which, as introduced, was unsound and inadequate, and ultimately they made the 6d. rate not only a maximum rate, but the fixed amount to be levied inside the borough, the property inside the borough paying 5 per cent. water rent and the property outside the borough nothing on that account. There was that anomaly in spite of the fact that Liverpool paid £2500 to the water account over and above that in respect of water for public purposes. Mr. Pember further described the various Acts that had from time to time been obtained, mentioning that the population of Liverpool was 590,000, and the value of the water consumed inside the borough was £6000 a year, that there had been no fresh powers given since 1843 with regard to the outside districts, and that the Bill was only opposed by six out the fourteen local boards of the district, the population opposing numbering 64,597, and that not opposing amounting to 81,073.

Mr. Parry, C.E., engineer in charge of the Rivington Waterworks, being examined, explained that these works would hold 4,000,000,000 gallons of water, and that the area of the city boundary was 5210 acres, and the limit of supply was over 100 square miles. A consumer outside the city limits took about 118 gallons for every 100 gallons taken by a domestic consumer inside the limits. The former used more than the latter and paid less for it. The quantity of water used for sanitary purposes last year was 205,000,000 gallons; 17,000,000 gallons being supplied to the outside districts. He had made inquiries as to the practice of other towns, and he did not find a single instance in which a less charge was made for supplying outside districts with water than was charged to the inside districts. The necessity for the Corporation going for the Vyrnwy scheme in 1880 was to meet the requirements of the increasing population in the outside districts. Last year Little Woolton took no water for public purposes, except for watering the streets. Prior to the construction of the Corporation works, Little Woolton took no water from Liverpool. Last year the township of Toxteth-park, with an area of 75 acres and a population of 15,000, used more than a million gallons of water for flushing the sewers, whereas Walton, with a larger area and more than double the population, did not use a gallon of water for that purpose. This witness having given further evidence to show the unfairness of the present system in its effect on the inside consumers, Mr. Mansergh, M.I.C.E., was examined. He stated that it was only a question of time for all the wells in the sandstone to be closed. It was quite out of the question that any of those local authorities could supply themselves with water for any length of time. Out of the whole area of 106 square miles, there was only fourteen square miles where the water could percolate through the soil at all; the rest of the area was impermeable.

Mr. Deacon, M.I.C.E., engineer to the Corporation, and engineer in charge of the Vyrnwy works, gave some interesting evidence as to those works, and as to the present position of the supply. It appeared to him, he said, that if the water charges proposed under this Bill had been applied last year, taking the quantity of water and other circumstances into consideration, to the out-townships, the latter would have had a considerable advantage over the city. To equalise the charges, the outsiders should be charged 22·8 per cent. more than those inside the city. The cost of laying mains was greater outside than inside. If a main, to supply a similar number of people, were ten times as long in the out-districts as in the town, it would cost seventeen times as much in the out-districts as it cost inside. The necessity for the new works arose entirely from the out-districts. He had on several occasions reported the necessity of some such scheme as the Vyrnwy works, and his predecessor had also reported to a similar effect. The immediate necessity for the works was put off by preventing waste as much as possible, and it was only by the prevention of waste that Liverpool was saved from a water famine about every third year. The year before last the quantity in the reservoir was reduced to 500,000,000 gallons, the holding capacity being 54,000,000,000 gallons, so that the famine was very imminent. That state of affairs was entirely due to the necessity to supply the out-districts, as there would have been ample for Liverpool itself. It would be almost impossible for the out-districts to supply themselves.

Referring to the Vyrnwy scheme, Mr. Deacon explained that they were to be in three lines of pipes, each carrying thirteen million gallons per day. That was a total of about forty million gallons, and which would be available next year. That supply from one pipe would be more than they were getting from the Rivington works, but the wells were falling off at the same time. The actual expenditure on the first section of the works had been so far about a million and a-half. The remainder would require about £400,000, making a total cost of about £2,000,000 for the first section of the works. That was about £350,000 more than was contemplated, but the works now carried out were not the works originally contemplated.

Mr. Pember, summing up the case for the Bill, explained the position of the question as to the agreements for supplying certain parties within prescribed limits. Clause 24 confirmed these agreements, and Clause 25 gave a general power to the Corporation to supply water to local authorities and others. That was to say, that the Corporation looked forward to the time when local authorities and persons, other than those mentioned in the previous clause, might ask for water from the Corporation, and the clause gave power to supply them, and settled the terms on which that water might, if the Corporation thought fit, be supplied.

The result of the enquiry, which occupied several days, was that the Committee decided that the preamble of the Bill must be amended as follows:—That the water rate as at present existing be reduced to 3d.; that the maximum rates for consumers of domestic supply within the city and without the city shall be 6¼ per cent.; that the rate of 2½ per cent. proposed under Sec. D of Clause 8 be abandoned; that the charges for water supply by meter be uniform throughout the district and for all purposes. The chairman further stated that the intention of the Committee was that no property within or without the city not taking a supply should pay for water. They paid the 3d. rate in the city, but they did not pay if they did not have it.

CLYDE SHIPBUILDING TRADE.

THE output returns of the Clyde shipbuilding for May, which show an advance on those of the preceding month and of the month of February—two abnormally small totals—represent a continued decline in this important industry. The monthly totals for the portions of the year now passed are:—January 15,400 tons February 5800 tons, March 22,300 tons, April 9662 tons, and May 15,200 tons. Compared with the month of May in previous years, the last-mentioned figure only exceeds that of 1886, when the tonnage launched was 14,674. All the others for the last ten years showed a higher output, the maximum being reached during 1881-2-3, when 36,100, 32,200, and 35,731 tons were the outputs for May in these respective years. In the same way, when the output over the first five months is considered, there is seen to be a gradual diminution in building since 1883, the lowest point being reached this year. The figures are:—For the first five months of 1883 the output was 150,860 tons; for 1884, 114,030 tons; for 1885, 78,360 tons; for 1886, 76,460 tons; and for 1887, 68,360 tons. Messrs. A. McMillan and Son, Dumbarton, are now without a keel in their yard, a state of matters, it is said, for which no precedent can be found during their past thirty years' history. The London and Glasgow Shipbuilding Company, Messrs. A. J. Inglis, Messrs. Caird and Co., and many others of the best firms on the river are working away with one or at most two vessels on the stocks, and nothing in their books to take their places when launched. It is thus seen that the dark cloud of depression under which the industry has existed for a considerable period has not given any decided token of an immediate clearing. The past few weeks, however, have not been altogether devoid of incidents calculated to show that the proverbial silver lining does exist behind the sable covering, and that it will be fully revealed in course of time. The most cheering circumstance has been the order booked by Messrs. J. and G. Thomson, of Clydebank, for two steamships of the largest and most powerful type now employed in ocean navigation, to be built for the Inman and International Steamship Company for its mail and passenger service between Liverpool and New York. Messrs. Thomson at first only received the order for one vessel, a sister ship having then been arranged for from Messrs. Laird, of Birkenhead. Subsequently this firm declined to undertake the construction of the vessel because, it is stated, they found themselves unable to lay down a vessel of the length necessary to meet the special conditions without alterations and arrangement of their premises, such as would involve serious delay in delivery, &c., and the second order was thereupon placed with Messrs. Thomson. In point of size alone these two vessels are noteworthy, being about 8500 tons gross measurement each, but in respect of other features, such as proportions, speed, means of propulsion, and structural character they will form most noteworthy departures in the development of modern steamships. Their outstanding characteristics will be, propulsion by two screws actuated by two separate and self-contained sets of engines and boilers of the most modern type, as regards high-pressure and increased expansion of steam, and minute subdivision of the hull by longitudinal and transverse water-tight bulkheads, rendering the ship unsinkable through collision with another vessel, and almost absolutely unsinkable from any cause whatever. It is expected that these vessels will attain a speed of 19 knots per hour on trial. These two vessels make the fourth and fifth transatlantic steamships now under construction. The Fairfield Shipbuilding and Engineering Company, of Govan, have well advanced a large screw steamer for the North German Lloyd's New York and Southampton service, and Messrs. Harland and Wolff, of Belfast, are building a couple of large steamers for the White Star Line. When these several vessels commence their sailings the greatest interest will doubtless be manifested in their performances. Messrs. Russell and Co, Greenock and Port Glasgow, have received an order from a Liverpool firm to build two screw steamers of 3500 tons each, to be engaged in the petroleum trade. The same firm of shipbuilders have been ordered by a London firm to construct a screw steamer of about 400 tons, to be engaged in passenger traffic on the river Amazon. This will make the sixth steamer now building by this firm, whose work for many years has consisted almost exclusively in sailing ships. It is announced that one of the London cable companies has decided to get two new steamers specially built for cable laying and repairing, and that the order has come to the Clyde, it is thought to Messrs. R. Napier and Sons. The vessels are each to be about 1800 tons, and are to be built of steel. Messrs. David J. Dunlop and Co., Inch Works, Port Glasgow, have secured a contract to build a steel screw steamer for the London and Tilbury Lighterage Company, London, for towing purposes on the Thames. Messrs. Dunlop have already built a number of vessels for this company, and the one they have now contracted for will be a duplicate of the one last built for the same owners. Messrs. Matthew Paul and Co., Dumbarton, have fixed with the African Lakes Company, Glasgow, for the building of a steel screw steamer 80ft. in length. Messrs. Paul and Co. will supply the machinery, and will probably arrange with a local builder for the construction of the hull of the vessel. The steamship Balmoral Castle, which was some years ago partially destroyed by fire, after having been repaired and thoroughly overhauled, was recently sold by Messrs. McMillan and Sons, of Dumbarton. She is now in their hands undergoing alterations necessary to fit her for the frozen meat trade. She will form the first of a new line of steamers which has been arranged for to the Australian and New Zealand Colonies, filling up at London with fine goods and bringing home frozen mutton from New Zealand to the British market. The steamers will be of the highest class, and fitted up for saloon and third-class passengers, who will be carried at specially low rates. A recent telegram from Brussels stated that, owing to the great dissatisfaction with the way in which the mail service between Dover and Ostend has been lately conducted by two steamers of Belgian build, the Government of that country has determined that these will either be withdrawn or their engines will be replaced by new and more powerful machines, while two new steamers of high speed will be built on the Clyde. Nothing has since been heard to confirm the report that the Government have decided to place the order with Clyde builders; but this is simply a matter of time. A Spanish shipbuilding company is about to add to its fleet of mail and passenger steamers, and the contract is expected by one of the Clyde firms, which has already built largely for that company. These and other orders now pending, together with the vessels actually contracted for, show that the aggregate of tonnage ordered amounts to more than the probable output at the present rate of production.

JUNIOR ENGINEERING SOCIETY.—At a recent meeting of this Society a paper was read by Mr. S. H. Wells, Wh. Sc., Stud. Inst. C.E., on "The Early Training of Mechanical Engineers." The subject was considered under the two general terms, theoretical and practical training, and was summarised to the effect that theoretical and experimental training and workshop practice coincident with completion of ordinary education was to be advocated, while such training with a view to reduce or dispense with usual apprenticeship was to be condemned. Reference was made to the movement in 1875 in which Professor Kennedy took a prominent part to institute engineering and mechanical laboratories where experimental work could be carried out by the students, such a one being opened in 1878 at University College, London, the success of which might best be judged from the fact that similar laboratories had been established in connection with the Mason Science College, University College, Bristol, Firth College, Yorkshire College, Cooper's Hill Central Institution, and Finsbury Technical College. The new engineering department at Dulwich College was also alluded to, where the system was to train in the laboratory during the latter terms of their ordinary education those students who were to afterwards enter the engineering profession. A well sustained discussion followed the reading of the paper.

RAILWAY MATTERS.

A LINE of railway from Numurkah to Ralhalia, Victoria, the *Colonies and India* says, is to be constructed by Mr. Richard Grant for £25,847.

THE new Tay viaduct is now virtually completed, and will be opened for traffic in eight or ten days. The *Dundee Advertiser* has published a large-sized supplement giving a detailed account of the construction of the bridge.

THE first train on the Canadian Pacific Railroad reached the Vancouver ocean terminus on Tuesday, the 24th ult. Hitherto the trains have stopped at New Westminster. There was a great celebration over the completion of the line.

THE directors of the Hull Tramways Company have resolved to abolish the twopenny fares charged for the use of the trams to the suburbs, and adopt a uniform rate of a penny for all distances on each branch of the service.

THE engineers of the Prince Henry Railway Company are casting about for a portable electric lamp with powerful reflector, directing rays of light capable of piercing the smoke from blasting, so as to permit of inspecting the roof of mine workings.

BY the kindness of Mr. Jas. Holden, the members of the Finsbury Technical College Engineering Society paid a visit to the locomotive works of the Great Eastern Railway at Stratford on June 8th. Mr. Holden's liquid fuel attracted much attention—very good results seem to have been obtained by its use. All the members were much interested in the use of the milling tool—for numerous kinds of work—with which very good results are obtained.

WE have received from Messrs. Robert Stephenson and Co. a lithograph sheet of line drawings of the past and present locomotives constructed by them. It commences with the "Locomotion," of 1825, followed by the "Twin Sisters," "Lancashire Witch," "Rocket" of 1829, the first after Rocket, and others leading up to the modern engine as illustrated by the new engine exhibited by the firm as constructed for the London and South-Western Company from the designs of Mr. W. Adams, and exhibited in the Newcastle Exhibition.

THE following from a contemporary may help some who are interesting themselves about terms and definitions. A railway sleeper is not often defined at length: "A sleeper is one who sleeps. A sleeper is that in which the sleeper sleeps. A sleeper is that on which the sleeper which carries the sleeper while he sleeps runs. Therefore, while the sleeper sleeps in the sleeper the sleeper carries the sleeper over the sleeper under the sleeper until the sleeper which carries the sleeper jumps off the sleeper and wakes the sleeper in the sleeper by striking the sleeper under the sleeper, and there is no longer any sleeper sleeping in the sleeper on the sleeper."

AT a recent meeting of the Port Elizabeth Chamber of Commerce, South Africa, a resolution was passed as to railway extension, in regard to which the following was unanimously carried:—"It is the opinion of this Chamber that the most advantageous extension, so far as the Cape Colony is concerned, of the railway system beyond the present territory would be from Colesberg through the Orange Free State towards Pretoria; and in the event of the neighbouring States evincing any desire to construct such a line, this Chamber would recommend that the Colonial Government should afford them every encouragement and assistance in doing so."

THE Mayor of Port Adelaide recently waited upon the Commissioner of Public Works, Hon. L. L. Furner, and asked that a revolving light might be placed on the Jervois railway bridge. It was pointed out that the present light was a fixture, and it was suggested that if a revolving lamp was placed on the top of the bridge so that it could be worked by the man stationed there it would be the means of preventing accidents. Dr. Bollen proposed that the lamp should have a red face, a green face, and two white faces, so that directly the railway train left the stations on either side of the bridge the man on duty there could turn the lamp and people could see from which end the train was approaching.

IT is expected that a portion of the line of railway which the Lancashire and Yorkshire Company is constructing between Pendleton and Hindley will be opened for traffic next Monday. That portion is the length between Pendleton and Swinton. The time-table shows twenty-three trains for each day of the week except Sunday. The new branch joins the old line at Windsor Bridge, Salford, and from thence runs alongside the permanent way now in use as far as Brindle Heath. There it turns in the direction of Swinton, and passes through a tunnel, about 200 yards long, under Bolton-road. After leaving Pendlebury station the route to Swinton lies along a cutting.

IN his new book on "State Purchase of Railways," Mr. Waring says:—"Government activity in the acquisition of railways has increased very much in quite recent years. In 1875 there were on the Continent 69,246 miles of railway, of which 14,268 miles, or about 20 per cent., belonged to Government. Seven years later the mileage had risen to 88,782, of which 32,563 miles, or about 36 per cent., were in the hands of the Government. Further acquisitions since 1882 have placed about 50 per cent. of the continental lines under the management of the State. In Germany the transfer of the entire railway system to the Government is nearly complete, and in Belgium it is only a question of time. Out of sixteen continental Governments twelve are proprietors of railways."

COMMENCING with the opening of the new Tay Bridge, several new trains are to be run from Edinburgh and Glasgow to Aberdeen by the North British Railway. Meeting at Larbert, the Edinburgh and Glasgow trains will cross the Forth by the railway bridge recently erected there, and will proceed through Fife *vid* Dunfermline and Thornton, crossing the Tay to Dundee by the new bridge, and running as at present to Aberdeen. The journey to the granite city will, it is expected, be accomplished in about four hours. The train from Aberdeen to the south, at 5.20 a.m., will reach Edinburgh at 9.30 a.m., and passengers will be able to leave for London by the "Flying Scotchman" at 10 a.m. The journey from Aberdeen to London will thus be accomplished in 13 hours 40 minutes, the train being due in the metropolis at 7 p.m.

RAPID progress is being made with the construction of the Birmingham cable tramway. The line between the town and Hockley Brook will, it is expected, be in operation before the end of the year, and the whole system will be completed by February or March next. The contract for the second portion of the line, that between Hockley and Handsworth, will be given out shortly. The depôt at Hockley Brook is nearly completed, and Messrs. Tangye have constructed the high-pressure horizontal winding engine, of about 250-horse power, which will keep the endless steel rope in motion at an average rate of from six to seven miles an hour. Another engine of equal horse-power will work the route between Hockley and Handsworth. Each engine will have six boilers. The steel rope, having a diameter of 1¼in., will have a safe-load strength of from 40 to 50 tons, and will run over pulleys in a slot about 17in. below the road level. The carrier pulleys are of cast malleable iron, are 3in. wide, have a diameter of 11in., and are fixed at regulated intervals. No definite pattern of car has yet been chosen, but cars for experimental trips are now being made by the Falcon Carriage-Building Company, Loughborough. To work a cable car a driver is stationed in front, and has control of a system of levers by which the gripper is operated.

NOTES AND MEMORANDA.

AN alloy of copper, 15 parts; tin, 2·34 parts; lead, 1·82 parts; antimony, 1 part, forming a bronze with the addition of lead and antimony, practically resists the attack of most acids and akaline solutions.

UNDER a new method of making porous earthenware lately used in Germany, the clay is tempered and worked to the proper consistency with a mixture of water and naphthaline. The objects, after being formed, are placed in a dry kiln and gradually heated until the naphtha is all expelled, leaving the object perfectly and uniformly porous. The dry kilns are so built that all the naphthaline is drawn off and condensed, so that it can be used over again.

IT is stated that from Orenburg to Ekaterinburg in Russia, the country is dotted with asbestos deposits, while near the Verkni Tagil Ironworks is a hill, called the "Sholkovaya Gora," or Hill of Silk, which is stated to be entirely composed of asbestos. The mineral is said to be of the best white quality, and adapted for all important purposes to which asbestos is applied. In the Goroblagsdat district of Perm similar deposits crop above the surface, and any quantity can be obtained for nothing, the mineral possessing no value in the Ural region.

IN an article on the condensation of gases, Mr. A. E. Tutton describes in *Nature* an apparatus with which liquid oxygen was lowered to a temperature of – 198 deg. C., air to – 205 deg. C., and nitrogen to – 213 deg. C., with a pressure of only 100 mm. mercury, and Olozewski has reached with oxygen – 211 deg. C.; at – 207 and 100 mm. pressure, he obtained solidified carbon monoxide, and solid nitrogen at – 214 deg. C. and 60 mm. By lowering the pressure over the solid nitrogen, Olozewski has reached – 225 deg. C., so that he has made a far nearer approach to absolute zero—273 deg. C.—than any other experimenter, or than was considered possible a year ago.

DR. R. H. MILL, writing on the "Temperature of the Western Lakes and Lochs," says the eastern fringe of the North Atlantic brings between the Western Islands water at a uniform temperature of 46 deg. An equal temperature prevails on the surface, except in the vicinity of land, where it is higher. In nearly land-locked sea lochs and basins the temperature of the mass of water is determined by the configuration, and varies from 47·5 deg. to 43·8 deg., according to certain definite laws. In fresh-water lakes, those that are shallow are at a temperature of about 45 deg.; those that are deep are cooler, varying from 43 deg. to 41 deg., and showing hardly any difference in temperature between surface and bottom.

A PROCESS has lately been patented in Germany by Haenisch and Schroeder for the manufacture of precipitated phosphates from any kind of the ordinary crude rock. The rough material is first reduced to a very fine powder, is treated with just sufficient sulphuric acid to transform the carbonate and any free lime into sulphate. The mass is then subjected to the action of aqueous sulphurous acid, which dissolves only the tri-calcium phosphate and leaves the other constituents as a sediment. The clear liquid is decanted and subjected to a gentle heat. Sulphurous acid is given off and reabsorbed in water, by means of a simple mechanical device, the phosphate itself being precipitated, washed, dried, and passed through a disintegrator. The preliminary treatment prevents the combination of the carbonate or free lime which would otherwise take place with the sulphurous acid, and averts the formation of a mixture of calcium sulphite in the final product. The phosphates from this process can hardly be cheap.

A PAPER on "The Direct Determination of the Differential Coefficient $\frac{dp}{dt}$, Relative to Saturated Vapours," was recently read before the Paris Academy of Sciences by M. A. Perot. It is shown that the mechanical equivalent of heat may be determined by the well-known relation—

$$L = \frac{1}{E} T (u' - u) \frac{dp}{dt},$$

which is obtained by applying to a liquid mixture and its vapour the principle of equivalence, and that of Carnot. In order, *Nature* says, to determine approximately this quantity, the author has undertaken to measure on the same sample of pure ether, at a temperature of 30 deg., the different parameters entering into the preceding relation—u', v, L, and $\frac{dp}{dt}$. To determine $\frac{dp}{dt}$ he employs a special method, which enables him to measure separately the two corresponding quantities dp and dt. The determinations have been made for the temperatures 29 deg. to 31 deg. inclusive, within which interval they may be represented by the formula—

$$\frac{dp}{dt} = 2{\cdot}2750 + (t - 29)\, 0{\cdot}0834.$$

AT a recent meeting of the Berlin Physical Society, Dr. Gross explained his theoretical views on the heat of solution of magnetised iron, and showed why, in accordance with these, the heat of solution of magnetised iron must be greater than that of unmagnetised. One result of these views was that a piece of magnetised and unmagnetised iron in a conducting fluid capable of dissolving the iron must give a current; this he has already demonstrated two years ago. The current in such an element as this flows across the fluid from the magnetised to the unmagnetised pole, and is independent of the nature of the magnetisation. The source of the electric current is in this case, according to the views of the speaker, to be sought for in the loss of specific magnetisation which the molecules of iron undergo as they pass from the solid to the fluid condition. Of the various solutions of salts of iron which were used in these experiments, only neutral salts of ferric oxide were found to yield a result, while the salts of ferrous oxide gave no current. The cause of this is, according to the speaker, that only the ferric salts lead to a solution of the magnets. *Nature* says: "Dr. Nichols has quite recently carried on some experiments on the heat of solution of magnetised iron, and has obtained the same experimental results, namely, that the heat of solution of magnetised iron is greater than that of unmagnetised, although he starts with theoretical views respecting the magnetic potential of solid iron and iron in solution which are diametrically opposed to those of Dr. Gross.

AT the last meeting of the Meteorological Society a paper was read on "Results of Thermometrical Observations made at 4ft., 170ft., and 260ft. above the Ground at Boston, Lincolnshire, 1882-86," by Mr. W. Marriott, F.R. Met. Soc. These observations were made on Boston Church tower, which rises quite free from any obstructions, in a very flat country, to the height of 273ft. A Stevenson screen with a full set of thermometers was placed 4ft. above the ground in the churchyard; a similar screen and thermometers was fixed above the belfry at 170ft. above the ground, while a Siemens electrical thermometer was placed near the top of the tower, the cable being brought down inside and attached to a galvanometer on the floor of the church, where the indications were read off. The results showed that the mean maximum temperature at 4ft. exceeds that at 170ft. in every month of the year, the difference in the summer months amounting to 3 deg.; while the mean minimum temperature at 4ft. differs but little from that at 170ft., the tendency, however, being for the former to be slightly higher in the winter and lower in the summer than the latter. As the electrical thermometer was read usually in the day time, the results naturally showed that the temperature at 4ft. during the day hours was considerably warmer than at 260ft. The author, however, detailed several sets of readings which had been made during the night as well as the day, the results from which were of a very interesting character.

MISCELLANEA.

THE new suspension-bridge at Hammersmith, which has been recently fully illustrated in our pages, will be opened on Saturday, the 18th inst., by Prince Albert Victor.

A PAPER on "Practical Ventilation in Mines" was read by Mr. W. H. Pickering, Assistant Government Inspector of Mines, at a meeting at Dudley on Monday of the South Staffordshire and East Worcestershire Institute of Mining Engineers.

OATMEAL manufacturers are paying a good deal of attention to the manufacture of rolled oatmeal, instead of cut meal. A large manufacturer in Canada says, "rolled oats have come to stay, like roller process flour: when once tried, they are generally preferred to the other."

BELGIAN Royal decrees of the 17th May, 1887, sanction the resolutions passed on 27th September, and 27th October, 1886, by the Société Anonymé—or "limited" company—for working the establishments of John Cockerill at Seraing, authorising the company to take a pecuniary interest in the Congo Commercial and Industrial Company of Brussels, and to join with the Praga Steelworks Company, of Warsaw, in erecting blast furnaces and ironworks in the South of Russia. It was this last resolution which caused the resignation of Baron Sadoine as administrator-director general of the Cockerill Company.

BOURNEMOUTH wishes to flush its sewers, and water its streets, and in the course of a recent enquiry with reference to the application of the Bournemouth Commissioners for a loan of £9000 for carrying out the necessary works for a sufficient supply of sea water for the purpose, one of the directors of the Bournemouth Water Company urged the rejection of the application because the water company were about to arrange to let the Commissioners have water at 1s. instead of 1s. 6d. per 1000 gallons. As the Bournemouth people can distribute sea water for 5d. per 1000, they do not show much gratitude to the company. 1s. per 1000. So kind.

ENGINEERS are sometimes employed on grim work. Dr. Hoffman, from the Home-office, Burials Department, has just inspected 18½ acres of land proposed to be added to the Bishopwearmouth Cemetery, making with the present burial ground 52 acres. The estimated cost for subsoil and surface drainage, road and boundary walls, with an additional entrance lodge, and inclusive of the land purchase, is £17,500, per plans prepared by Mr. D. Balfour, C.E. The subsoil drainage comprises 12in., 9in., 6in., and 4in. glazed fireclay socket pipes, laid with open joints in a stratum of gravel, the drains being 22ft. apart, regularly, or at one end of each grave, and at a depth of 10ft. to 11ft.

AN important move has been made by the promoters of the Manchester Ship Canal, who have issued a circular to the applicants for shares in which, after setting forth their conviction that the total amount of ordinary shares, of which upwards of £3,000,000 have already been allotted, that will be subscribed for in the distant future will not fall far short of £4,000,000, they state that they have decided to advise the issue of £4,000,000 in preference shares, bearing interest at 4 per cent. during the construction of the works, and afterwards 5 per cent. per annum in perpetuity; and a special Bill has already been read a first time in the House of Commons, under a suspension of the Standing Orders, to enable the company to raise this portion of their capital in preference shares.

THE *Chinese Times*, in an article on foreign competition in China, and the dishonest means adopted with a view to destroy each other's influence and opportunities, and in decrying each other's wares and characters, says that even well-informed English journals are exceedingly misleading on Chinese matters, and that underlying so many of the actions of foreigners who go there to do business, and of statements in European journals, there appears to be a fallacy—the assumption that the Chinese officials are children. No doubt in some things they are, but not in judging of characters which take so much trouble to resemble their own. And the general result of the detraction by foreigners of each other can only be to place all foreigners without distinction under the ban of Chinese contempt, and to retard the progress which the country might make by a reasonable and judicious employment of foreigners and foreign ways.

ON the 2nd inst. an inquest was held on the body of an unfortunate man of the name of Gilroy, who met his death on the 27th ult., at the works of Messrs. Wilson, Pease, and Co., owing to the bursting, from some unknown cause, of an ironstone kiln. The principal technical witness was Mr. Richard Howson, President of the Cleveland Institution of Engineers, who had officially examined the scene of the accident by order of the coroner. Mr. Howson considered that the failure of the casing of the kiln was due to internal corrosion of the plates of which it was composed. Inasmuch as this corrosion was entirely hidden from view, he was of opinion that the disaster could not have been foreseen or prevented. Nothing had previously happened which would lead to a suspicion that there might be a latent weakness. The jury returned a verdict of "accidental death." A request on the part of one of the jurymen that samples of the plates of which the kiln was composed should be officially retained, was not acceded to.

A REPORT to the health and drainage Committee of Windsor, on the "Iron Process," as seen at work at Chichester Barracks, by the chairman of the committee and Mr. Alderman Lundy, states that "The application of sulphate of iron is very simple, and the precipitate, occurring below the outfall, was perfectly free from offensive smell. A careful examination of the sewage resultant shows it to be a true chemical precipitate, which soon desiccates, when it may be handled with impunity. The effluent possesses a high degree of purity. The sewage discharge, which is weak, as thirty-four gallons of water are daily supplied per head, amounts to 15,000 gallons in twenty-four hours. Mr. Conder's scheme demands that the crushed dissolved sulphate of iron must be applied continuously; that the gentle flow and absence of light, such as occur in every sewer, render the chemical operations of sulphate of iron on sewage most effectual; that is, darkness and agitation are essential to make the experiment effectual. . . . It yields a deposit free from associated water; unlike lime and other reagents, which do not destroy sewage matters, but aggregate them into sludge—a resultant most difficult to get rid of and expensive to deal with."

A MEETING of the committee of the Birmingham and District Railway and Canal Freighters' Association was held at Birmingham on Thursday, the Hon. Philip Stanhope, M.P., presiding. The provisions of the Railway and Canal Traffic Bill were considered, more particularly Sections 17, 24, and 25. In the 17th section an alteration was suggested making the decision of the Commissioners' Court final and irrevocable. Clause 24 was considered unsatisfactory as a solution of the difficulty which existed in the revised classification of goods and in the schedule of rates. While admitting the principle of a charge for terminal services, the committee contended that such a charge should be included in the maximum rate. Instead of this clause they desired to support an amendment to be proposed by Mr. J. W. Barclay, M.P., providing that the Railway Commissioners, and not the Board of Trade, should settle the classification and schedule of rates, and that such rates shall include all charges except loading, unloading, and cartage, the classification and schedule of rates to be finally submitted to Parliament. Clause 25, dealing with preferential rates, was largely modified; and with regard to canals Mr. Stanhope was requested to endeavour to obtain the insertion of a clause authorising public bodies and local authorities to borrow money and form public trusts for the purpose of acquiring or constructing canals. It was resolved to communicate these views with the various public bodies with whom the committee desire to co-operate in obtaining a modification of the Bill.

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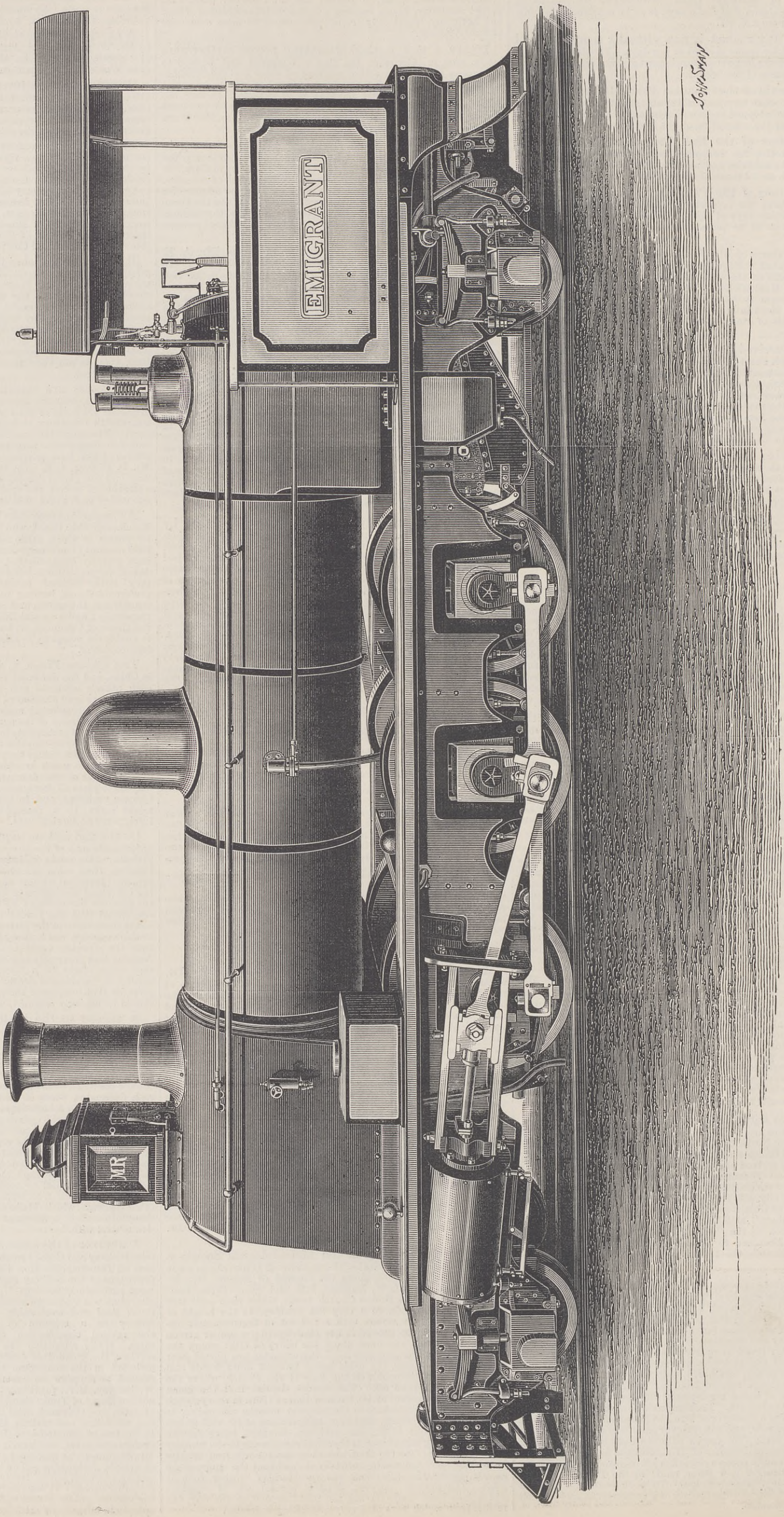

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H. H.—*The circumstances under which the engines ran were the same, in so far as each engine was assumed to be doing its best; but it must not be forgotten that it is very improbable that either engine could have continued to work for many minutes at the stated power. The article is not intended to convey that the power of a locomotive boiler is not dependent on the heating surface, but that it seems as if such was the case. There are so many factors to be taken into account—above all, the action of the blast pipe—that heating surface may be made to only play a secondary part in determining the power of a locomotive, especially for spurts.*

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MEETINGS NEXT WEEK.

SOCIETY OF ENGINEERS.—Arrangements have been made for the Members and Associates of the Society of Engineers and their friends, at the invitation of Messrs. Aveling and Porter, of Rochester, to visit their well-known steam roller and traction engine works, on Wednesday, June 15th. "Engaged" carriages will be attached to the train leaving Charing Cross at 11.42 a.m, and Cannon-street at 11.52 a.m., reaching Stroud at 1.22 p.m., where luncheon will kindly be provided by the firm.

CHEMICAL SOCIETY.—Thursday, June 16th, at 8 p.m. Ballot for the election of Fellows—important Papers to be read:—(1) "The Thermal Constants of a Liquid Mixture," by Professors W. Ramsay and S. Young. (2) "Derivatives of Hydrindonaphtene and Tetrahydronaphthalene," by Dr. W. H. Perkin," jun. (3) "The Formation of Closed Carbon Chains in the Aromatic Series," by F. S. Kipping, B.Sc., and W. H. Perkin, jun. (4) "The Action of Ethylene Bromide on Ethylic Sodacetoacitate," by P. C. Fraser, Ph.D., and W. H. Perkin, jun. (5) "Derivatives of Pentamethylene," by H. G. Colman, Ph.D., and W. H. Perkin, jun. (6) "Derivatives of Hexamethylene," by P. C. Freer, Ph.D., and W. H. Perkin, jun. (7) An Attempt to Synthesise a Carbon Ring containing Seven Carbon Atoms," by P. C. Freer, Ph.D., and W. H. Perkin, jun.

METEOROLOGICAL SOCIETY.—Wednesday, 15th instant, at 7 p.m., at the Institution of Civil Engineers, 25, Great George-street, Westminster: Ordinary meeting. Papers to be read:—"Amount and Distribution of Monsoon Rainfall in Ceylon generally, with Remarks upon the Rainfall in Dimbula," by Francis J. Waring, M. Inst. C.E. "Note on a Display of Globular Lightning at Ringstead Bay, Dorset, on August 17th, 1876," by H. S. Eaton, M.A., F.R. Met. Soc. "Ball Lightning seen during a Thunderstorm on July 11th, 1874," by John W. Tripe, M.D., F.R. Met. Soc. "Appearance of Air Bubbles at Remenham, Berkshire, January, 1871," by Professor T. G. Bonney, F.R.S.

ASSOCIATION OF MUNICIPAL AND SANITARY ENGINEERS AND SURVEYORS.—Saturday, June 11th, at Kidderminster: Midland Counties District Meeting. Business;—Appointment of hon. district secretary. Paper to be read and discussed, "On the Sanitary Works at Kidderminster," in which special reference will be made to the late typhoid epidemic. Visit the sewage pumping station, the waterworks and new and old reservoirs, the wooden infectious hospital, and the sewage farm at Stourport; and, if time permit, the carpet works of Messrs. Morton and Sons, also the carpet and spinning works of Messrs. J. Brinton and Co. Return to the Town Hall for discussion.

THE ENGINEER.

JUNE 10, 1887.

THE INAUGURATION OF CHINESE RAILWAYS.

WE use the word "inauguration" in this connection advisedly, because the short term of life accorded to the Woosung Railway hardly warrants that enterprise being considered to have demanded its employment. A telegram, but just received in Berlin from the Chinese Government to its ambassador in that city, announces that the short line of railway from Taku to Tientsin was formally opened by the Viceroy of that province on May 20th. It is this line which we may justifiably regard as inaugurating the commencement of a system of railways, the ultimate result of which it is impossible for even the most sanguine person at all clearly to foresee. It is evident that at length the obstinate conservatism of the Chinese Government has been broken down by the march of events. It is no concession, however, due to civil necessities, or to an appreciation of the benefits the extension of railways may be to the community. It is to the pressure of the Russian advance upon their northern frontier, and to the difficulty experienced in strengthening their forces at such outlying points, that the tardy yielding of the Chinese rulers to this innovation upon old prejudice is due. The difficulty referred to, and the fact of railways being the only means by which it could be overcome, was so strongly pointed out to the Central Government by a minute of the Chinese Board of Admiralty of March 15th, 1886, that no further resistance could be made to propositions which had previously been also strongly supported by the Marquis Tseng, the late Ambassador of the Imperial Government in London.

It will be well, and of interest, to consider, now that the start has been made, how far it is likely to be compatible with other schemes for tapping the inland trade of China which have for the last two years been strongly advocated in this country. The acquisition of Upper Burmah by this country led Messrs. Colquhoun and Hallett to survey the routes by which that acquisition might be availed of for the construction of a railway starting from Moulmein in British Burmah, which should reach the Chinese frontier on the borders of the very populous province of Yunnan. We so fully described the proposals put forward by the gentlemen above named in a former issue, that we need not now do more than refer to them as being an important factor in the general question of a Chinese railway system; but a paper recently read by Mr. Hallett before the Birmingham Chamber of Commerce seems to us to afford much additional information enabling us to realise the chief points which have to be studied by those with whom the development of a system of railways in China may rest. It is certain that in a country of such enormous area as China it will scarcely be possible to arrange a system which can be deemed arterial. It is not like Canada or the United States, a country reaching from sea to sea. Its frontiers touch upon those of nationalities, some of which have possibly aggressive tendencies towards the Celestial Empire. This fact will have to be considered, because the facilities afforded for trade may, unless carefully guarded, become facilities for hostile advance. We may be sure this contingency has not been overlooked by the advisers of the Pekin Government.

It is easy to realise from Mr. Hallett's paper before referred to that the main line of Chinese inland trade is up the river Yangtsze, which has a course of 2500 miles. It is exceedingly doubtful if for very many years to come any railway could successfully compete with the long-established trade on this river towards the upper and western provinces of the Empire. But for the last 700 miles of the course of that river navigation is exceedingly hazardous and fatal to even native boats, and is quite impracticable, owing to the strength of the current in the numerous rock-beset rapids, by any steamer. Steam power might indeed ascend those rapids, but no human skill could guide a steamer in their descent. As the consequence, for the distance referred to the river ceases to be a practicable highway over which can be carried the trade demands of the great and populous western provinces of China. Until, therefore, the enormous length of the present practicable navigation of the river Yang-tsze has been superseded by the gradual extension from the east coast towards the west of railways—a supercession which, as we have said, must prove to be of exceedingly slow development—it may be relied upon that the readiest way to tap the trade of these western provinces must be by railways communicating with the Burmese coast. We see therefore nothing in the inaugural steps now taken in China as to railways which should in the least diminish the interest attaching to proposals for railways through British Burmah.

In connection with what would be, strictly speaking, Chinese railways, it is satisfactory to learn that the Celestial Government has decided to place them in the hands of no syndicate, whatever nationality that may represent. We know that great pressure has been put upon the Chinese authorities to grant such a concession to a German association. We desire no such concession for ourselves, and would rather wish to see the construction of railways in China carried out upon the fullest principle of open competition. Such a system is, we learn, to be adopted. Even the rails required are to be tendered for in the open market, and no favour is to be shown to any nationality as to their purchase. That the demand for rails is likely to assume ere long very large proportions we can fully foresee, and we do not dread successful competition with ourselves in their supply. It is well known that it is difficult to move the Chinaman out of his conservatism, but that once moved he is disposed to even hurry forward. That knowledge inclines us to predict that the inaugural railway will be followed by a demand for very rapid extension. Even the short-lived Woosung Railway, during its abruptly cut-short career, earned very large profit. The railways in Burmah have had similar results, and we are confident those of China will experience equally favourable issues. Everything points thus to the rapid growth of railways from the eastern coast of China towards the west, where they may in course of time meet those we hope soon to see extend from our own possessions in Burmah to the Chinese frontier. The sooner our rail manufacturers take steps to secure the advantages this new prospect opens out the less likely are they to suffer from the rivalry of foreign competition.

CONTINUOUS BRAKES ON GOODS TRAINS.

FOR some time endeavours have been made in the United States to fit continuous brakes to goods trains. In order to test the merits of various inventions, arrangements have been made for an extended series of trials at Burlington, Iowa, and reports concerning these trials are now appearing in the American railway journals. These reports are, however, of a desultory and disjointed nature, and it is quite impossible to arrive at any just conclusions from them concerning the comparative merits of the brakes tested. Nothing, for example, like the carefully digested reports of the Trent trials, which appeared in this journal in June and July, 1875, has yet been made public. Possibly this has yet to come. Meanwhile it is of course out of the question to speak with any confidence concerning the results obtained. One or two prominent facts have, however, been demonstrated, which are of sufficient importance to be noted in our columns. Thus it has been proved that the difficulties encountered in devising a system of continuous brakes suitable for passenger trains are as nothing to that involved in similarly fitting up a goods train. The difficulty lies in the fact that goods trains are always slack coupled, and when the brake is applied from the engine it naturally goes on first on the vehicles nearest the engine, and then the rearward trucks run into these with terrific violence when the speeds are at all high. An instrument known as a "slidometer" has been employed to ascertain the relative amount of shock, but seeing that buffer and draw springs and couplers have been smashed up by the dozen, and cars more or less ruined, even when empty, the slidometer is hardly required to tell what takes place. To illustrate the state of the case, we may use definite figures. The stored-up energy in a ton of rolling stock, running at twenty miles an hour, or in round numbers 29ft. per second, is $\frac{29^2}{64{\cdot}4} = 13$ foot tons very nearly. That is to say, each ton of rolling stock would exert a push of 13 tons over a distance of one foot. Some of the long trains tested were composed of as many as fifty cars. At twenty miles an hour the leading cars in these trains were actually stopped dead, while the end cars were still running at twenty miles an hour. These smashed into the leading cars with a succession of violent collisions. Allowing a foot of play in the buffer springs, it will be seen that a car weighing 12 tons would exert a compressing force of 12 × 13, or 156 tons. The *Railroad Gazette* says:—"It is more than ever evident that the main difficulty in applying a continuous brake to a train of fifty cars is not to secure quick action, but to prevent violent shocks in the rear portion of the train. The trials so far have shown conclusively that even the quickest acting atmospheric brake will cause shocks quite inadmissible in ordinary working. The effect on trains of fifty empty freight cars is that drawheads are often broken, and the shocks are extremely violent. The effect on train hands may be imagined. A load of steel rails would probably slide through the end of the car, and indeed the effect on almost any class of freight would be destructive both to the freight and the cars. These results are of course obtained with emergency stops, and would be considerably modified by a milder application of the brake. As, however, no shock is felt on the engine, a thoughtless or unskilful engineer can at any time, by a full application of the brakes, inflict serious damage at the rear end of his train. It is questionable whether in many cases a mild collision, smashing the engine pilot, &c., and doing considerable local damage, would not be preferable to the widespread destruction to stock, valuable freight and cars caused by these shocks. Two methods of mitigating these shocks have been tried. One is by using tight in place of slack couplings. This appears to be but partially successful when the brake is applied with full force. The shock, as measured by personal sensations, is not quite so sudden, but the slidometer travels about the same distance."

The other method consists in the use of electricity, to apply all the brakes simultaneously, so that no car can run into its predecessor. To make this clear a few words of explanation are necessary.

The brake systems being tried are all with one exception air brakes, as made specially for goods trains by Westinghouse, Eames, and Carpenter. The general principle, so far as the fitting of the brakes is concerned, is the same in all. A continuous pipe or pipes runs the whole length of the train, and an alteration in the pressure or vacuum within this pipe puts on the brake. The alteration is effected by the driver opening a valve on the foot-plate. The pressure falls or rises by degrees throughout the length of the pipe. Some of the trains tested

were as much as 2000ft. long, and it will readily be understood that an easily appreciable time elapses before the pressure becomes the same at both ends of a pipe 2000ft. long. This is the reason why the brakes go on at the rear of the train last. To get over this difficulty, electricity is employed to open a valve in the train pipe on every vehicle. Thus, for example, to put the Westinghouse brake on, air must be let out of the train pipe. If now a valve is fitted to each vehicle, and all these valves, say fifty in number, are opened simultaneously, the required object is obtained. A more or less powerful electro-magnet fitted to each vehicle is used, and worked by a battery carried in the rear van or on the foot-plate. Up to a certain point this appliance works very well, but it will be seen at a glance that it introduces serious complications. The battery must be powerful, and two wires, each requiring an independent coupling, are necessary. One invention carries the insulated wires in the train pipe and couples them at the same time, and by the same act that couples the hose. This is all very well; but it remains to be seen whether, in the first place, the electrical part of the apparatus will be trustworthy; and in the second, whether railway companies will care to adopt an expensive and delicate device. We learn from the reports which have reached us that even in the hands of the inventor the electrical portion of the apparatus has failed more than once. Thus in one experiment with the Eames brake, the electricity failed to apply the blocks at the rear of the train, and a draw head was broken by the shock which ensued. No defect was discovered, and on a succeeding run the electricity worked perfectly without any apparent reason. One brake invented by a Mr. Card is worked entirely by electricity. This during an experiment went on of itself, without any apparent cause, breaking chains, &c., on six cars. All this is not very encouraging.

To us it appears that the simplest partial solution of the difficulty would be to apply the brakes from the rear end of the train first. To this end an insulated wire might be run along the train, which would open a valve at the rear end of the train pipe. Thus, in the case of a train of fifty cars it would be just fifty times simpler than the existing arrangement. The objection to it is that in the course of three or four seconds so many cars would be braked at the rear end of the train, that the tie bars coupling it to the leading portion would no longer stand the strain, and the train would part. Something to avoid this might be done by brakeing the engine and tender, and the evil could be wholly overcome by using only a small discharge valve at the rear, so that the train would be gradually retarded. This would, however, be fatal to the idea of stopping within a very short distance. The whole problem is, in short, beset with difficulties. That by the aid of electricity and compressed air or vacuum a goods train can be pulled up without shock in a short distance seems to be clear. But it remains to be seen if this can always be done in daily working; and it is also worth considering whether, if it can, the game would be worth the candle. On the whole, it seems that the best plan would be not to attempt to do too much. At present goods trains are deficient in brake power both in this country and elsewhere. Trains of fifty unloaded wagons tried at Burlington ran from a speed of twenty miles an hour, 1625ft. to 2463ft., when only the engine and tender brakes were used. Our contemporary already quoted, says the average results of the stops made by the driver and hand brakes by Carpenter, Westinghouse, and Eames is as follows:—On level, twenty miles per hour, 904ft.; forty miles per hour, 3029ft. On falling grade of 53ft., twenty miles per hour, 974ft.; forty miles per hour, 3918ft. These results can be compared with the following results attained by the same trains with continuous brakes. "With fifty empty car trains, the brake being put on by electricity, at twenty miles an hour, the Carpenter train stopped in 124ft., and at forty miles an hour in 507ft. The Westinghouse, at the same speeds, ran 155ft. and 578ft. The Eames brake, 291ft. and 690ft." Of course, little is to be learned from the results of so small a number of runs, but the figures are interesting as far as they go. They show that the train can be pulled up in almost one-eighth of the distance now necessary. It seems to us that an excellent result would be obtained if a stop could be made in half the present distance, and this we believe might easily be effected without danger by using brakes of less power, or less in number. It is very difficult to believe that any railway company would incur the risk of damage to freight incurred by putting in the hands of a driver the power of pulling up a tremendous goods train within one-tenth of its own length. Under the best conditions the effects must tell heavily on rolling stock. It appears to us that the competitors at Burlington are working on a false system. They seem to pin everything on making a quick stop. He who can pull up soonest regards himself as the winner. This idea was not out of place as regards passenger trains. It is a quite erroneous standard of excellence as applied to continuous brakes for goods trains. To be able to stop a goods train in 100 yards may be desirable, but there are other things yet more desirable; and we have no difficulty in saying that if one competitor has to use electricity to get a quick stop without piling up the bulk of the freight in a mountain on top of the unfortunate engine driver and fireman, while another can without electricity pull up a train safely and comfortably in 500 yards, that the last should, and doubtless will be preferred by the railway companies. To paraphrase a well-known saying, about what is being done at Burlington, "It is magnificent, but it is not good railway practice."

STEADY TRAINS.

The safety as well as the comfort of railway travelling is largely dependent upon the steadiness of the rolling stock, and it may also be said that this characteristic not only prolongs the lives of those who travel a great deal, but prolongs also the endurance of the rolling stock itself. Continuous vibration is destructive of all jointed structures in proportion to its extent, and depends in chief upon the state of the road over which the train runs, and upon the condition of the wheels, axles, boxes, and springs of the vehicles themselves. The former is matter for the permanent way staff; the latter comes into the locomotive and carriage department, and it is it which we now propose to notice. The steadiest running coach will be that which has its weights most evenly distributed. These weights are of two kinds, namely, those inherent in itself and capable of permanent arrangement, and the others being the loads, which may be subdivided into passengers and goods. The former of these is constantly varying; the latter is to a great extent under the control of those making up the loads. Obviously in aiming to secure a steady train the construction of the vehicles composing it is the first point of consideration. The frames and bodies being usually symmetrical, have their weight distributed with fair uniformity. They may be said to be, in a sense, self-adjusting. This cannot be said with equal accuracy of the wheels, springs, or axles. The mere dead-weight of the springs may be on the whole uniform, but their elasticity, comparing one with another, is probably not by any means uniform, or if so when new, does not remain so, and want of uniformity in these is one of the causes of unsteadiness. A moment's consideration will make this obvious. Take the case of a coach on four wheels. If one spring be more flexible than either the other three, it follows that even though by adjustment each spring bears its proportion while the coach is at rest on the level, this will cease to be the case either when the coach is put in motion, or when it is loaded uniformly with passengers or otherwise. The body of the coach will then be somewhat in the condition of a chair or table having one leg shorter than the other three, and like them will become like a balance beam supported on a fulcrum, whose bearings are the two strong springs respectively at right angles to the weak springs, and the body can rock on it in a direction diagonal to the track. The same condition may be present to some extent also in a six-wheeled coach. Here there is one inherent cause of unsteadiness. A far more powerful cause exists in the wheels; if these are not truly circular, truly balanced, and truly mounted on their axles, steady running is simply impossible. The greatest attention, therefore, given to these points is the greatest economy a railway company and its staff can practice in this department. It is to be feared, however, that all that can be effected in this matter is not always done. One point in particular is of the highest importance, and this is the true balancing of each pair of wheels. It by no means follows that a wheel uniform in dimensions will be also found uniform in weight; and if a wheel is not quite truly balanced, then its centre of gyration will not as a matter of course, be found in the centre of the axis, and if not here, then an element of unsteadiness is at once introduced. Not alone this, but inasmuch as a pair of railway wheels and their axle are and must be regarded in this connection as one structure, the centre of gyration will exist at some point between the wheels and the corresponding swinging stresses will be set up.

It may be convenient here to refer to what our French neighbours are doing in this matter. M. Bricogne, the Chief Inspector of the Northern Railway of France, deals with defects of wheels and axles under six heads; namely, (1) Inequality of diameter of two wheels on the same axle; (2) variations of profile of wheel tread from established standard, as well as uniformity of diameter at all points, and true centreing on axle; (3) the want of equilibrium of any pair of wheels; (4) the inequality of weight between each of a pair of wheels; (5) the incorrectness of the gauge, and if the wheels do not travel in the same line; (6) the centre of gravity of the wheels and axle being in some point other than in the centre of the length of the axle. Errors No. 1 are ascertained by gauging; No. 2, by hanging the axle in lathe centres and pressing spring gauges against the rims of the wheels and slowly rotating them, indexes on graduated scales showing errors; No. 3, by the ordinary method of mounting the axle loosely in lathe centres and seeing if the wheels remain in any position to which they are turned; No. 4, by weighing the pair of wheels simultaneously in separate scales; No. 5, a frame is made embracing the wheels, with fittings on each end carrying forms representing journal bearings, these fit the journals; two arms between the wheels carry strong spring indexes which press against the insides of the wheels and show any variations from their true plane of rotation; No. 6 is settled by simply suspending the wheels and axle. We confess we fail to see what evil can arise from one of a pair of wheels being heavier than its companion pair, so long as each is quite true in motion and balance to itself; the mere dead weight of the wheel has nothing to do with the steadiness of the coach it supports. The best shape for the tread of railway wheels is one about which some difference of opinion prevails. The superintendent of a leading French railway advocates and, to some extent, uses cylindrical wheels, to the exclusion of those with coned treads; following, in this case, a practice initiated by Mr. Crampton thirty years ago on the London, Chatham and Dover Railway. The theory of the cone is no doubt good so long as a particular set of conditions are pre-supposed. Thus, if a coach is mounted on wheels whose tread has a particular taper, all is well just so long as that coach is moving over either a straight road or else over a uniform curve of such a radius as will correspond with the radius of the curve which the pair of wheels would describe if they were reduced in thickness to mere discs, whose respective diameters equalled the largest and the smallest diameters of the cone tread. The required conditions are only incidentally met with in practice; curves of various radii are to be found everywhere. What use is the cone on these? The advocates of the cylindrical tire hold that evil and not good is caused by coning. It sets up a grinding action in two ways: First, rotative grinding from the absence of the necessary uniformity of curve radius to cone velocity; and, secondly, by resisting the horizontal change of direction of the motion of the coach owing to the conical treads acting somewhat like the V-guides of a planing machine. We believe that the gentleman to whom we refer can show that with cylindrical treads the resistance of his rolling stock is appreciably less than with cone treads. Another advantage claimed for the cylindrical tread is, that as it has a broader wearing face, it will keep in good order a longer time, and is safer, we venture to think, crossing switches than the other.

With regard to the function performed by springs, few will deny that as regards the springs of goods wagons they are far and away from being efficient, and their mortality, in spite of every effort to make them stand, is enormous. Every goods wagon repairing yard can show stacks of broken springs. They are usually so short and have so very little flexibility that they soon fail, and it is to be feared that the wheels and axle-boxes of these wagons are so little cared for, that the vibration stresses upon these springs must be of a most destructive nature. Thus we have not only the rapid destruction of the springs themselves, but also the bill for broken tires and axles, cracked and otherwise injured axle-boxes. Inventors are busy at automatic couplings, but there is a field ready for exploration in this wagon spring and axle-box question, which is entirely different from anything met with in passenger coach practice. The same objection prevails here as exists about some other railway details, namely, the expense of any alteration in existing methods, but it does not prevail to the same extent. The adoption and fitting up of a new lamp, a new footboard, or a new window is as a rule a game not worth the candle, but this railway wagon matter is different. Any scheme that would prove successful in materially reducing the destruction of springs, boxes, and axles, as well, shall we say, as wear and tear of permanent way, points, and crossings, would pay handsomely for itself. Really able inventors, not themselves railway men, are usually shy of touching railway affairs, partly because they know either by hearsay or by experience how difficult it is to get a company or its staff favourably to consider an invention. Directors and their technical advisers say very naturally, "We must know best ourselves what we require, and our executive staff, from long experience and training, must presumably be at least as well, if not better able to devise improvements than even the cleverest outsiders can be," and the inventor is bowed out. The reply to all this on the part of the inventor is, "that lookers-on see more than the players," that the nature of the railway man's work makes him "groovy," and presents little inducement to him to initiate changes, the trouble attending their introduction being certain to be considerable; while the beneficial results to himself, however great they may prove to the company, are, to say the least, doubtful. We do not think railway men can fairly be blamed for showing little countenance to inventors as a class. We are sure that every head of an engineering department has the unpleasant duty of receiving and listening to all sorts and conditions of "men with inventions," many of them alike ignorant and conceited, and disposed to lay down engineering law to those who have forgotten more than they themselves ever learned. Nevertheless, the whole question of what we may call the rolling gear of railways deserves the most exhaustive investigation and attention, because on its excellence or the reverse depends so large a share of the maintenance expenses of a railway system. Vibration is the most expensive thing about either rolling stock or road. The coaches and wagons badly hung and coupled, swing, roll, and their wheels hammer the rails and chairs; these latter soon return blow for blow. Permanent way, now that steel rails are in such general employment, and that the track beds have, from long use, become so soundly consolidated, could be kept in good order with little trouble or expense, even under the present locomotive loads imposed upon it, if some decided improvement could be effected in the fitting up of the mineral and other goods rolling stock. The present method, too, of coupling goods wagons, subjecting them to the most violent blows and concussions, cannot but be utterly destructive to them. Some more mechanical method could be devised. Besides the injury to the wagons and trucks themselves, there is the damage done to certain classes of goods also, to say nothing of that done to live stock. In these days of depression of railway business, as alleged by directors, attention to diminish wear and tear in common with other expenses is requisite.

HEMATITE IRON PRODUCTION IN THE NORTH.

The growth of the production, in the North of England, of crude iron from other ores than those of the locality is very marked just now. It is worth noticing that that production is in the face of some difficulties: the north-east of England has not hematite ore deposits like the north-west, and it has to import ore from Spain and other countries at some considerable cost. But the production has gone on increasing, until at the present time there are not fewer than 44 blast furnaces in the north-eastern district engaged in the production of hematite, spiegel, and basic iron. At the same time the output of iron from the furnaces producing from Cleveland ore does not increase, and at the present time only 50 furnaces are engaged in that production, so that numerically the difference is not great. But as the furnaces smelting the imported ores yield on the average more than do those which reduce the local ores, the tonnage statement is more remarkable in the comparison. Of Cleveland iron, the production for the last month was 110,148 tons, and that of "other kinds of iron" was 108,332 tons. As one of the furnaces smelting the latter kind was not at work the whole of the month, it may be fairly put that the production of the two classes is just about equal. The fact is remarkable—that in a district which yields ore so abundantly as does Cleveland, there should be only as much of that local ore smelted as of the imported kinds. Of course, the preference shown for the imported ores is chiefly due to the growing use of hematite iron, though it may be remembered that the makers of Cleveland iron have decided last year to make less than they could, simply in order to reduce the immense stocks they held. The difference thus made in the last month was slight, though in the last six months there has been a very great diminution in the tonnage of iron so held. But the figures point to the fact that there will need to be a larger use

of Cleveland iron in some of the methods of use which hematite iron fills if the former is to be increasingly produced in the Cleveland district. It is as yet only used in comparatively small quantities in the steel trade in this country, but that use seems likely to increase, and with any such hope fulfilled there would be a better prospect before the crude iron trade of the north-east of England. It is a fact to be borne in mind in this connection that we are likely to send more iron out to the great nations of the East, and that for the purposes of the extension of railways. Should such a demand arise, it will very largely reduce stocks held in some of the European countries; and in that eventuality there would probably be recourse to the immense deposits of Cleveland, because it is one of the chief of the reservoirs of iron on this side of the Atlantic.

THE ROYAL AGRICULTURAL SOCIETY'S TRIALS.

ELEVEN engines have been entered for the competitive trials of the Royal Agricultural Society, some makers entering a simple as well as a compound engine. The arrangements for the trials are receiving very careful elaboration, and will attract great attention all over the world. At the last meeting of the Implement Committee it was stated that Sir Frederick Bramwell had accepted the Society's invitation to act in conjunction with Mr. W. Anderson, M.I.C.E., as consulting engineers in connection with the trials of engines at Newcastle. Mr. Anderson had at some length explained the detailed arrangements in regard to the proposed trials of engines, and having suggested the desirability of chemical analysis of the gases, the Committee recommended that the escaping gases of the engines should be subjected to analysis. It was also recommended that seven acres of land should be prepared for the potato planters, one half to be ridged and the other half to be unridged. The Newcastle show will be remarkable for the largest stock entry since Kilburn, with a corresponding small implement entry. As regards the quantity of space allotted at Newcastle, it may be mentioned that the total number of feet reaches 8217, as compared with 10,812 at Norwich, and 12,000 at Preston. Some of the individual sections of the arrangement of the implement yard show an increase, as, for instance, the side sheds, which include models, &c., while showing a deficiency on the last show, are superior in size to those at Preston, Shrewsbury, Reading, Derby, and Carlisle. The Jubilee Exhibition at Newcastle may be cited as the greatest factor in the falling off in the grand total. Local firms, who generally take a large proportion of the space at each country meeting, have preferred quite naturally to patronise the local institution, rather than exhibit in the Royal yard, and this feeling of local pride has doubtless received an incentive in the consideration of the duration and length of time which each exhibition will remain open. The "hard times" and high rates charged by the Royal Agricultural Society for space, have also conduced to the cutting-down of the quantity of space taken by the regular exhibitors, and consequently the grand total suffers. The horse-shoeing competition has attracted forty-two candidates, whose skill will, if precedent at other societies' competitions is any criterion, attract a large number of interested and criticising visitors.

LITERATURE.

The Modern Practice of Shipbuilding in Iron and Steel. By SAMUEL J. P. THEARLE, N.A., &c. London and Glasgow: William Collins, Son, and Company. 1887.

THIS work is in two volumes, one a large octavo of 233 pages, containing the text; and the other a small thin quarto containing the plates, thirty-four in number. We may deal with the first at once. The plates are in every way excellent. They have obviously been prepared by an accomplished draughtsman who understands not only how to draw, but what to draw, and the lithographer has left little or nothing to be desired. These thirty-four plates supply an immense amount of information of a practical kind. They show in detail how all the various parts of a ship are put together. We have found only one which is incomplete, namely, Plate XI., which shows the stern frame, rudder, &c., of a screw steamer. Curiously enough, only the position of the stern tube is shown by a couple of straight lines. The mode of its attachment has been ignored. We should not object to this if the omission was supplied elsewhere, but it is not. In fact, nothing is said about the matter anywhere in either volume. Mr. Thearle has, perhaps, argued that the stern tube is not part of the ship, but of the engines. In this we do not agree with him, and whether it is or not in the strict sense, we think it a pity that his readers are left quite in the dark about the mode of attaching so important a detail. Something more, too, might have been said than has been said about engine and boiler bearers.

A considerable number of treatises in the English language on shipbuilding are in existence, but these all differ in method and scope from Mr. Thearle's book. They are concerned principally with questions of design, stability, and such like; and practical construction in them takes a secondary place if it takes a place at all. Mr. Thearle does not concern himself with such things. The work is from beginning to end a practical treatise on shipbuilding properly so-called. Thirteen years ago Mr. Thearle contributed a somewhat similar work to Collins's "Science Series;" but that book dealt with wood and composite ships. The present volumes concern only iron and steel vessels. Mr. Thearle begins at the very beginning, and tells how a ship is "laid off" or drawn. The plans are first prepared on paper to a small scale; then a model is made in wood from these, and on this the plates are marked. From this again the lines are deduced and laid off on the "scrive-board," or the floor of the mould-loft. Our author gives full particulars of the methods by which, under Lloyd's rules, the dimensions of the scantlings are obtained. Holding himself a position as Lloyd's surveyor at Gourock, he is, as a matter of course, thoroughly competent to speak with authority on such points. It may be of interest to explain to our readers not versed in shipbuilding what this system is. The dimensions of scantlings are based on what is known as the "first and second numbers." The first is the sum of the measurements in feet arising from the addition of the half moulded breadth of the ship amidships, the depth from the upper part of the keel to the top of the upper deck beams, and the girth of the half midship frame section measured from the centre line at the top of the keel to the upper deck stringer-plate. There are certain deductions and qualifications made, according to the way in which the ship is decked—that is to say, according to the number of decks, whether spar-decked or awning-decked. This first number settles the scantlings of frames, bulkheads, pillars, &c. The "second number" is obtained by multiplying the first number by the length of the vessel, and determines the scantlings of the keel, stern, and stern posts, the outside plating and decks, &c. The scantlings are obtained from tables published by Lloyd's with the rules of the society.

The design having been prepared, Mr. Thearle shows how materials should be ordered, gives specimen order forms, and then proceeds to describe the way in which a ship is built. He begins at the beginning, and leaves nothing to the imagination. He tells how the blocks should be laid, and the upright spars carrying the working stages are constructed; and he then goes right through the whole process, criticising to some extent as he goes different methods and forms of construction. He illustrates his text copiously with admirably drawn—and, we may add, printed—little engravings, which at once clear up all obscurity of text. In all this the book is perfect. Mr. Thearle's style, without being diffuse, is full; and he seems to possess the happy knack of saying just what ought to be said, and no more. Each description is complete in itself. Thus, for example, having taken the construction of keels in hand, he does not leave it to go to something else, and then return. He says all he has to say about keels once and for all.

It would be impossible, and at the same time useless, to follow Mr. Thearle step by step through his book. We have said enough, we believe, to make our readers fully acquainted with its scope and object. We may now proceed to examine a little more in detail certain points which demand attention.

Mr. Thearle being a Lloyd's surveyor, firmly believes in Lloyd's rules; and to this we have no objection to take. At the same time it is not to be denied, we think, that the book loses in originality; that is to say, there is very little expression of opinion in it. Certain scantlings or systems are in favour with Lloyd's Registry. Mr. Thearle does not say whether they are, in his opinion, good rules or bad. They exist and he accepts them. We do not say that the rules are in all respects perfect, or in any respect faulty; whether they are or not, it is quite beyond our present purpose or need to say; but we do say that the circumstances under which the book has been written substitute Lloyd's views for Mr. Thearle's; and this we regret, because we have no doubt that a man competent to write such a book as this must have opinions which we should like to hear. Nor would they be beyond the scope of his book. On the subject of bulkheads, for example, much might be written; they constitute a vexed—we had almost said a burning—question. They interfere with stowage, and their number is limited accordingly. We may grant that the arguments against their multiplication are sound. But if a bulkhead is to be used at all, it should be made sufficiently strong. Now, it is notorious that bulkheads are too weak. Whenever the safety of a ship depends on one, we hear that it has to be strengthened with balks of timber, and that it is well known that the lives of all on board are in peril. Why should this be? Why should not a collision bulkhead, for example, be made just as strong as the rest of the hull? By Lloyd's rules the bulkheads are allowed to be weak. Mr. Thearle tells us, "The thickness of bulkhead plating is regulated according to Lloyd's Rules by the first or frame number"—what this is we have already explained—"and varies between $\frac{4}{10}$in. and $\frac{7}{10}$in. in thickness. When the rules require $\frac{6}{10}$in., or thicker bulkhead plates, the upper half of the bulkhead is allowed to be $\frac{1}{10}$in. thinner than the lower half. The vertical and longitudinal stiffeners are to be angle bars of the same size as those of the frames; the vertical stiffeners are to be spaced not more than 30in. apart, and the horizontal stiffeners are to be not more than 4ft. apart below where the bulkheads are stiffened by a level deck." Now, it is obvious that the stresses to which a flat bulkhead may be subjected are greater than those borne by the shin of the hull. It follows, therefore, that the bulkhead should be at least as strong, but it never is. It is made light to save weight. Granted, for a moment, that lightness is necessary, then let the other bulkheads remain as they are, but let special scantlings be used in the collision bulkhead. Mr. Thearle expresses no opinion whatever on the subject, but he has not hesitated to say in other places whether he thinks a particular way of putting work together good, bad, or indifferent. We can quite understand that he has felt himself bound by Lloyd's rules. It is not improbable, indeed, that he is entirely satisfied with them. But as we have already said, this, in a certain measure, militates against the originality, and consequently the value of his work.

Before taking leave of Mr. Thearle's book, we would call attention to the fact that very interesting little bits of practical information having a bearing outside shipbuilding will be found in it in places. Who, for example, would *à priori* imagine the distance apart of rivets in an iron or steel ship affected the rate of her corrosion? Yet such is the case. "Experience," says Mr. Thearle, "with the older ships has shown that among other objections to the open spacing of shin rivets is the very serious one, of rapid and considerable oxidation between the surfaces, which are not in sufficiently intimate contact to prevent moisture from getting at and acting on them."

Men as well versed in the art of shipbuilding as is Mr. Thearle will find in this book nothing new perhaps. But we fancy that even under this disadvantage it will give them pleasure to find so much with which they are familiar so well expressed. But with younger men it will be different. To the student, for example, to the apprentice, to the man aspiring to be a foreman in the shipyard, we cannot too strongly recommend it. Its range is narrow; so much the better. Few men, however, will, we think, put it down after the last page has been read without feeling that his stock of information has been increased, and without acknowledging that, within the limits he selected, Mr. Thearle has managed to say a great deal to the purpose on a very important subject.

A Treatise on Belts and Pulleys. By J. HOWARD CROMWELL, Ph. B. London: Trubner and Co. 1886. 8vo.

THE complete title of this book describes it as "embracing full explanations of fundamental principles, proper disposition of pulleys, rules, formulas, and tables for determining widths of leather and vulcanised rubber belts, and belts running over covered pulleys; strength and proportions of pulleys, drums, &c., together with the principles of the necessary rules for rope gearing and transmission of power by means of metallic cables." As the book is what it pretends it to be, the reproduction of the above simplifies a notice of it. The author has not been content in dealing with belts, with a mere collection and editing of what has been written by men before him. He has found how very wide is the discrepancy between the results of the application of the rules and formulæ previously offered and how far they differ from usual practice, and has made experiments from which he has drawn his own deductions and made his own rules. With respect to belts he mentions that by the rules given by Haswell, Arnold, Unwin, Nystrom, and Reuleaux, the width of a belt to convey 25-horse power at 600ft. per minute is respectively 42in., 39·8in., 39·3in., 21·7in., and 18in. The three first are undoubtedly much too high, and the two lowest are, according to the author, too small for a double belt. He states that between the highest and lowest there would in America be, for the belt supposed to be double and 100ft. in length, a difference of over 600 dols., to say nothing of pulleys. Mr. Cromwell's rules would in this case give a width about midway between that of Unwin and Nystrom. The differences between the actual power of a belt, as affected by the relative sizes of the pulleys it embraces, the arc embraced, and the form of fastening, are, however, so great, that a difference of from 50 to 80 per cent. in width, apparently necessary, is made by them. Mr. Cromwell takes all these modifying conditions and others into consideration, and does not attempt to give one rule, but gives rules to suit the different conditions. He has, amongst other things, experimented upon the value of covering pulleys with leather, and shows that there is a marked and valuable economy resulting from this, but not so great as many people suppose. The book is valuable as dealing competently and in a clear practical manner with all that relates to pulleys, belts and ropes, and power transmission by them, and as showing the economies that may result from the use of belts in proper condition. He is a good deal indebted to Reuleaux, and entirely so for the part dealing with transmission by metallic cables. He does not follow Reuleaux concerning belts. In all instances the values given by Mr. Cromwell may be said to be safe values, but it may be questioned whether those for belts are not all too high. Reuleaux's values are higher than those commonly found in practice, and although Mr. Cromwell laments that the replies he got to questions he sent many belt makers and users "show almost no knowledge at all . . . . concerning the subject," we strongly suspect that they will continue to place a good deal of faith in their practical experience. Objection must be made to the author's statement that the velocity of belts is almost always taken in feet per second, so that formulas for the horse-power transmitted by a belt with the velocity in feet per minute are seldom needed in practice. He thus uses horse-power, which is foot-pounds per minute, and velocity in feet per second, and avoids muddle by using 550 instead of 33,000; but most people will use the velocity in feet per minute, the revolutions and engine powers always being taken in minutes.

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Dynamics for Beginners. By Rev. J. B. Lock, M.A. London: Macmillan and Co. 1887.

Units and Physical Constants. By J. D. Everett, M.A., F.R.S. Second edition. London: Macmillan and Co. 1886.

Theory and Practice of the Slide Rule; with a Short Explanation of the Properties of Logarithms. By Lieutenant-Colonel John R. Campbell, F.G.S. London: E. and F. N. Spon. 1886.

Analysis Tables for Chemical Students. By R. L. Taylor, F.C.S. London: Sampson Low and Co. 1886.

Osborn's Tables of Moments of Inertia and Squares of Radii of Gyration. By Frank C. Osborn, Cleveland, Ohio. Engineering Era Publishing Company. 1886.

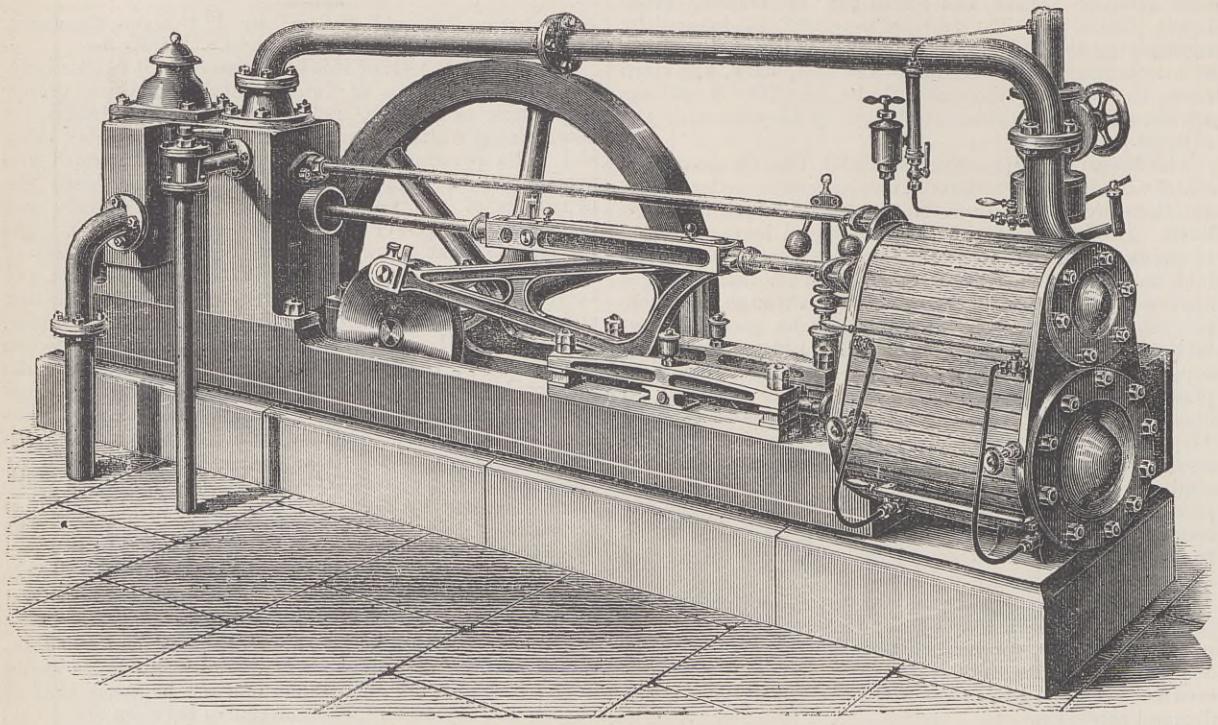
The Practical Engineer's Handbook; comprising a Treatise on Modern Engines and Boilers, a Large Collection of Rules, and Practical Data Relating to Recent Practice in Designing and Constructing all kinds of Engines and Boilers, and other Engineering Work. A Companion to the "Works' Managers' Handbook." By Walter S. Hutton. London: Crosby Lockwood and Co. 1887.

Practical Electric Lighting. By A. Bromley Holmes, Assoc. M. Inst. C.E. Third edition. London: E. and F. N. Spon.

ON the 31st May the Mayor and Corporation of Luton formally inaugurated the new sewage pumping engine designed and constructed by Messrs. Hayward Tyler and Co., of London and Luton. The pumping engines are of the horizontal type, the general dimensions of each of the two coupled engines being as follows:—Diameter of cylinders, 33in.; diameter of double-acting pumps for sewage water, 19¼in.; stroke of same, 36in. They are constructed to raise one and a-half million gallons per working day, and the maximum lift is 215ft. from surface to delivery. The working of the engines was entirely satisfactory, and practically noiseless.

COMPOUND ENGINE.

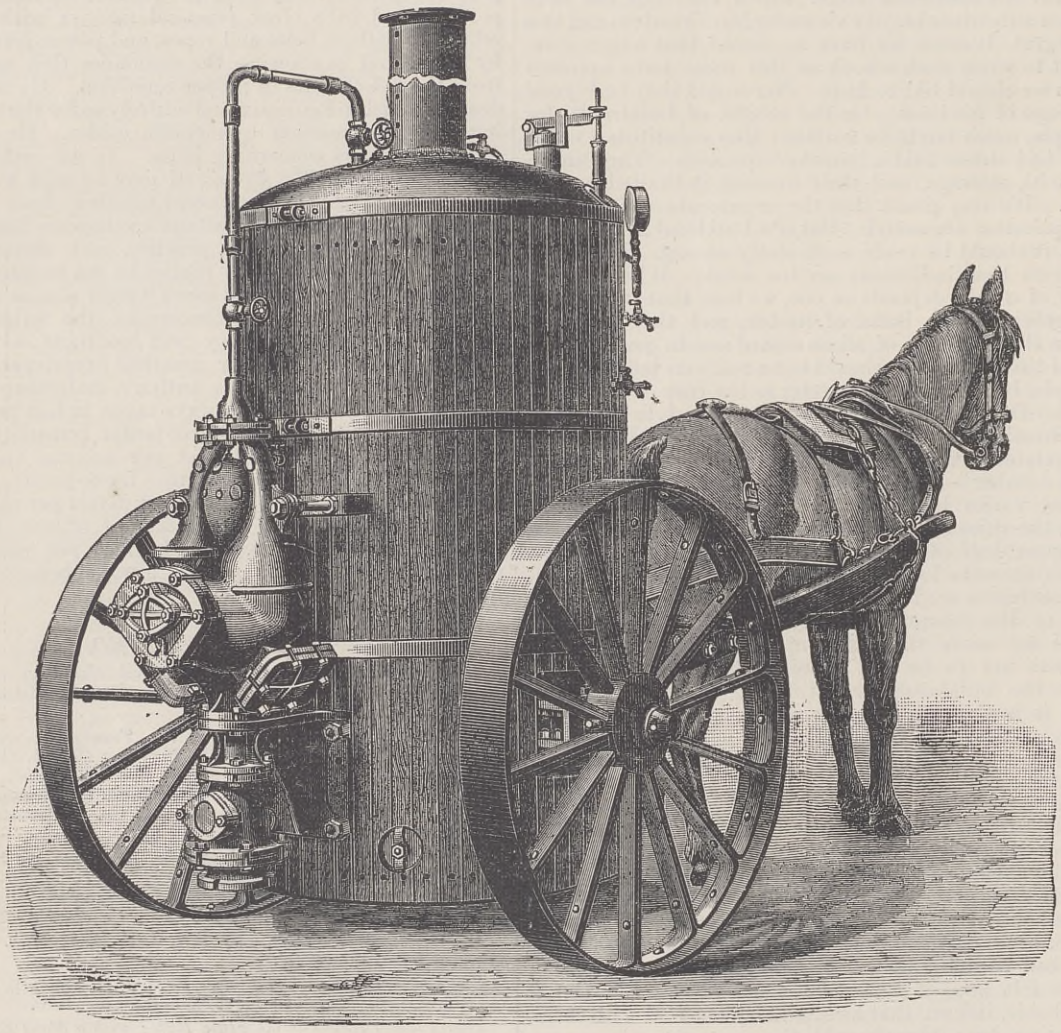
MR J H. KING, NEWMARKET, GLOUCESTERSHIRE, ENGINEER.



COMPOUND ENGINE.

WE illustrate above a curious compound engine, the action of which will be readily understood from the engraving. It will be seen that the connecting-rod is a frame forming an isosceles triangle. One corner of the base is pivotted to one piston-rod; the other corner is coupled by a link carried in a slotted frame to the high-pressure piston-rod; the apex of the triangle makes the usual head for the crank pin; a single excentric serves for the main valve of both cylinders. A grédiron expansion valve is worked on the back of the high-pressure valve automatically. We understand that several of these engines are at work in Gloucestershire, giving much satisfaction.

PORTABLE PULSOMETER AND BOILER.



PORTABLE PULSOMETER AND BOILER.

THE accompanying engraving illustrates a new arrangement of pulsometer and portable boiler made by the Pulsometer Engineering Company, more particularly for contractors' use. The pump illustrated is a No. 5, for lifting 10,000 gallons per hour to moderate height, or a lesser quantity to a higher level. The pump is quickly detached if wanted for working anywhere apart from the boiler.

THE GREAT NAVE OF THE MACHINERY COURT OF THE PARIS EXHIBITION OF 1889.

THE design for the machinery gallery of the Exhibition of 1889 has just been definitely approved and accepted. Two contracts have been entered into for the erection of the principal nave, the cost of which will be shortly published. The plan has been very carefully considered, and the details of its execution worked out under the direction of M. Alphand, M. Duterl, architect, and M. Contamin, chief engineer, who, with great experience in such matters, has calculated and fixed the dimensions of the different divisions. No hall of such large dimensions has ever before been constructed entirely of steel. It will show the progress which has been made in the art of metal working, and will demonstrate to the whole world the advantages and economy which are now gained by the use of steel. The conception is a bold one, and should be sufficient in itself to insure success to the Exhibition.

The gallery is rectangular in form, 422·70 m. long, by 150 m. broad, covering a surface of 63,418 square metres; adding to this the surface of the annexes, and that of the galleries of the first floor, the whole superficial area is 84,709·35 m.

The centre space measures 110·60 m. wide by 422 m. long. It is divided into nineteen bays: two at the extremities, measuring 25·29 m.; sixteen intermediate, each measuring 21·50 m.; and a central bay of 26·40 m.

The principals span the whole width of 110·60 m. (nearly 363ft.) without any intermediate support. The only example of the kind within our knowledge is that of the hall of St. Pancras Station, London, which measures 73 m. (240 ft.) across, and here the principals are tied by rods placed under the flooring.

The disposition of the principals is an especial feature, and extremely ingenious, as will be seen by the engravings which we give on page 469. These principals consist of two arches, resting at their base and at their centre on pivots, and the purlins which bind them together are placed vertically, and not as usual, normal to the flanges of the principal.

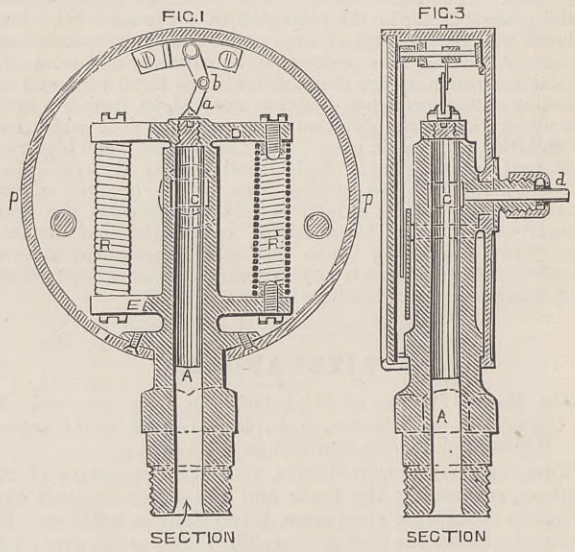
The maximum height, from the ground to the centre of the upper pivot, is 44·92 m. (147 ft.) To give an idea of this elevation, it may be compared with that of the Vendome Column, which is 44 m. high. The *Genie Civil*, from which we take our engravings, says:—"In spite of these exceptional dimensions, M. Contamin has succeeded, consistently with prudence and security, in reducing the weight of the principals, purlins bars, &c., to their utmost limit. The total weight does not exceed 110 kilogs. per square metre; the iron frame of the Exhibition of 1867 weighed 154 per square metre, and that of the Exhibition of 1878, 140. These weights are not absolutely comparable, the disposition of the galleries not being the same; but it is nevertheless evident that it is much more economical to employ steel in the place of iron, its price being no higher."

The Machinery Court is composed of the principal nave, of which we have spoken, and of the annexe galleries, 17·50 m. in width, with an upper storey, reached by broad staircases. It communicates with the galleries of the divers sections in the centre of the Champ de Mars by a central pavilion 30 by 30 metres. The lower parts are to be roofed with zinc, and the centre of the great nave glazed with streaked glass 6 mm. thick.

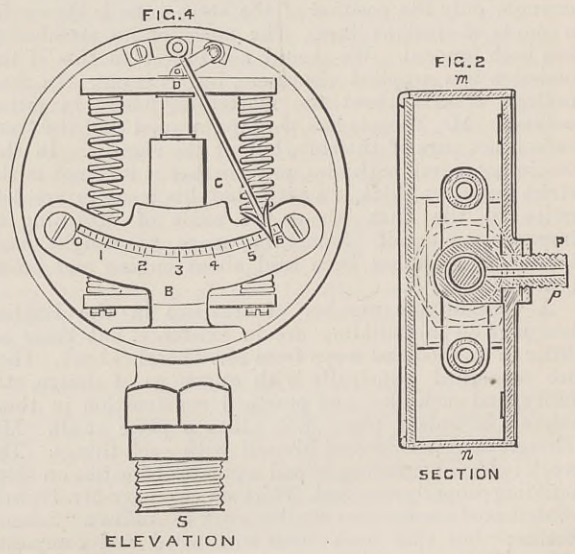
In spite of the difficulties of construction, and especially that of settling the foundations, the estimated expense amounts only to 6,496,228f. for 84,710 metres of available surface, being about 76·70f. per superficial metre. The decoration of the whole of the court will be very simple. As stated by M. Menard-Dorian in his report to the Commissioners, the architect has endeavoured to give a practical character to the building, not, however, at the sacrifice of artistic effect. It has been decided to light the Machinery Court by electricity, which will not be least among the attractions of the Exhibition of 1889. We shall give detail engravings of this great roof.

PRESSURE GAUGE ON THE TEUDLOFF-CORTHYM SYSTEM.

MM. TEUDLOFF AND CORTHYM, of Vienna, have produced a new pressure gauge, which is illustrated in the annexed engravings, and which, the *Annalles Industrielles* says, is likely to be much used in Austria and Hungary. According to information it has received, the directors of the Hungarian State Railways have resolved to replace the pressure gauges at present used for their locomotives by the new gauge, which is constructed as follows:—A piston, on the lower surface of which the steam



acts in the direction of the arrow, moves with slight friction in a vertical cylinder A. The upper part of this piston is attached to a horizontal transverse bar D, the extremities of which are fixed to two springs R and R. These springs are supported at the other end by a second transverse bar E, cast with the body of the cylinder A. The movements of the transverse bar D are transmitted to the indicating needle C, the point of which is moved over an index by means of the two cranks *a* and *b*. As will be seen, the lower surface only of the piston is in direct



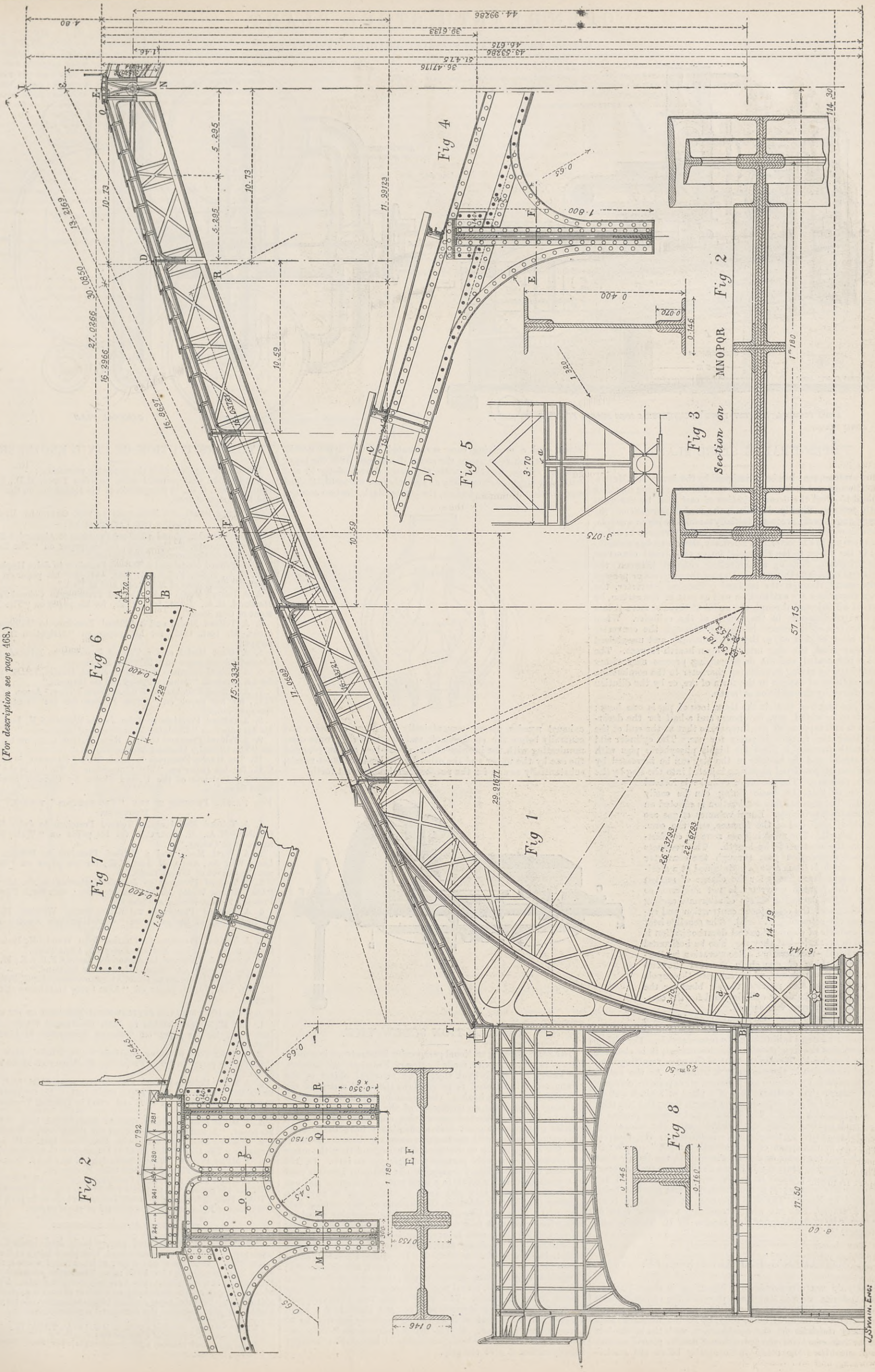
contact with the steam or condensed water, and deterioration of the apparatus is thus rendered impossible. The small quantity of steam and water which penetrates between the piston and the cylinder is collected in a small cavity, and ejected by means of a pipe *d*. From this description it will be seen that the gauge is a direct-acting gauge, which may be calibrated with ease and accuracy, the only element of uncertainty being the friction of the piston and the effect on this of clean or dirty steam

THE syllabus for the summer session of the Dundee Mechanical Society includes papers and excursions as follows:—July 7th, "Test Bars and Testing Machines," by Mr. Geo. C. Douglas; August 11th, "What is an Efficient Fly-wheel?" by Mr. Robert B. Clark; September 1st, Essay, by Mr. George Worral, jun. Excursions—July 2nd, Dundee Flour Mills, time will be duly advertised; July 9th, Dens Ironworks, Arbroath—Messrs. Shanks and Sons—time will be duly advertised; July 16th, Bullionfield Paper Works, time will be duly advertised; September 3rd, G. and P. Barrie, mineral water manufacturers, 3 p.m.; September 17th, Dundee Steam Laundry, 3 p.m.; September 24th, Dundee Gas-works, 3 p.m.

THE GREAT MACHINERY HALL, 375FT. SPAN.

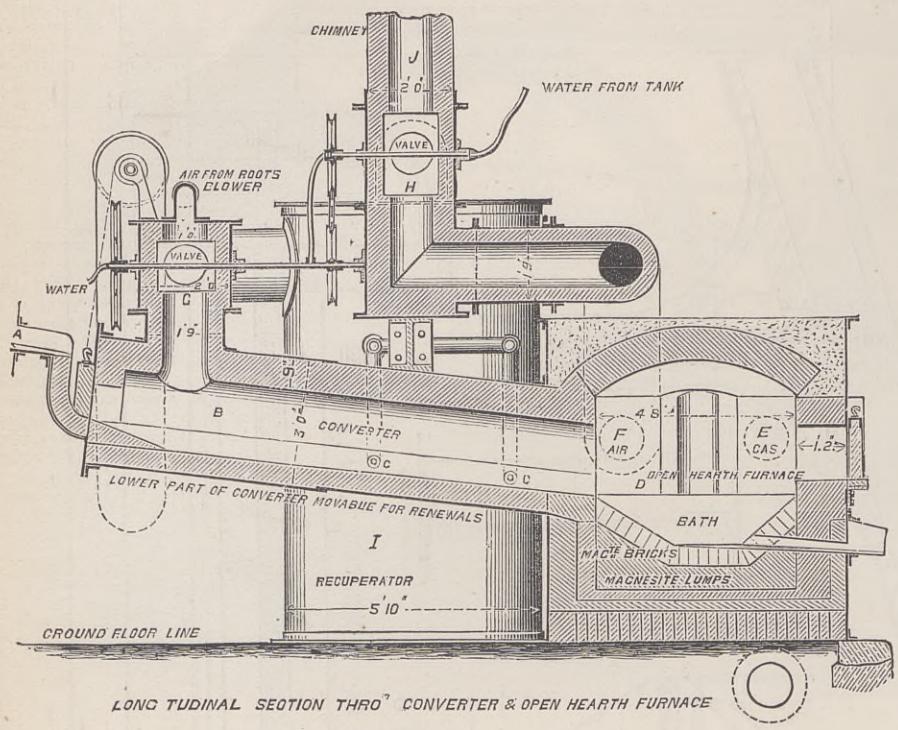
THE PARIS EXHIBITION, 1889.—ROOF OF THE

(For description see page 468.)

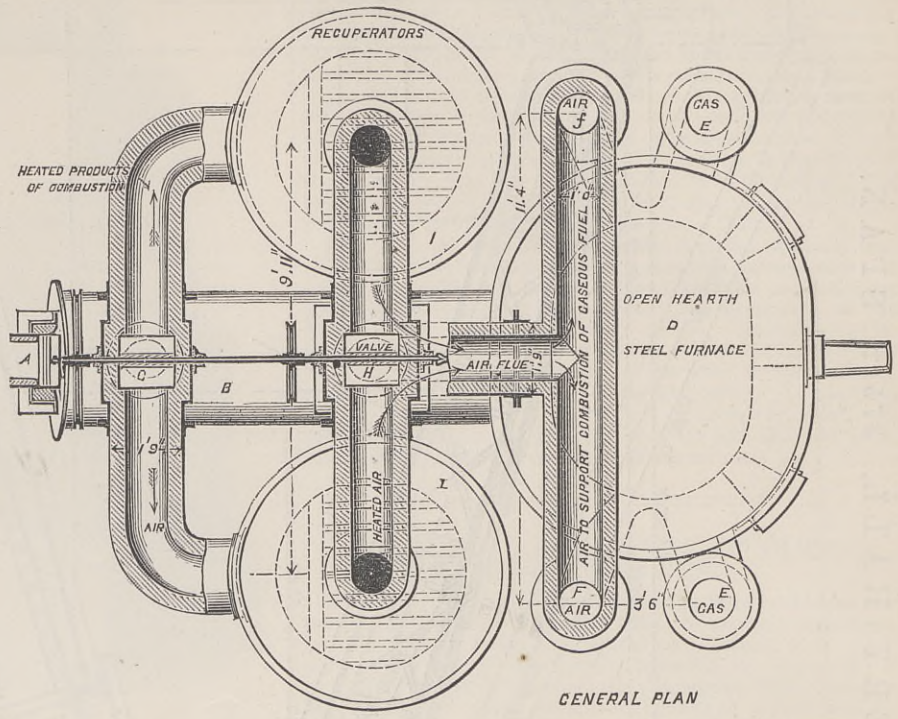


OPEN-HEARTH STEEL PLANT.

MESSRS. THWAITE AND STEWART, BRADFORD ENGINEERS.



LONGITUDINAL SECTION THRO' CONVERTER & OPEN HEARTH FURNACE



GENERAL PLAN

OPEN-HEARTH STEEL PLANT.

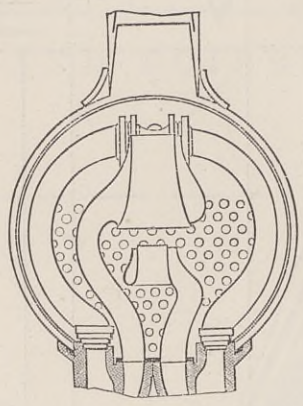
This arrangement has been designed by the inventors, Messrs. B. H. Thwaite and A. Stewart, with the aim of reducing the time required to effect the decarbonisation of cast iron by the open-hearth process. Simply described, the *modus operandi* of the Thwaite and Stewart process is initially to melt the pig in a cupola, preferably of the Stewart "rapid" type, and afterwards to collect the molten pig in a receiver, and when, say, three tons, has accumulated in the latter, to tap the metal into a cylindrical converter or decarboniser, forming a connecting channel between the cupola and open-hearth furnace. During the progress or passage of the metal through the inclined cylindrical converter, the foreign impurities are oxidised, as well as part of the carbon, by means of air injected through the metal at three or more points at graduated distances in the length of the cylinder. When three-quarters of the charge has passed through the converter the air blast is shut off, so that the remaining and unoxidised metal may wash the slag into the open-hearth furnace. The metal is now tested, and the decarbonising process may either be completed by giving an oxidising character to the combustion by the addition of oxygen in the form of ore, or by the dilution of the charge by the addition of scrap.

The time required to melt the three tons of pig is one hour; to this is to be added, say, two hours and a-half for the decarbonisation and tapping off the furnace, so that at the end of the fourth hour the furnace is ready for use. The cylinder and open-hearth furnace is lined for highly phosphoric pigs with basic material, and the basicity of the slag can be increased by the addition of powdered limestone injected into the slag by the air blast pressure. The converter cylinder is formed in halves, so that the basic lining can be easily renewed. The gaseous fuel combustion is effected on the forced blast principle. Equal volumes of gas are consumed at each end of the furnace, and the combustion is local. The most intense zone of combustion is in the centre of the hearth. The products of gaseous combustion pass through the converter cylinder, which is thus always maintained at a steel-melting temperature ready for the charge of molten pig, and the furnace converter is not subjected so severely to the damaging effects of alternate cooling and heating, and the consequent contraction and expansion of the refractory material. The sensible heat of the products of combustion and decarbonisation is collected in vertical—but they may also be horizontal and cylindrical—recuperators. Recuperation is alternate, the working of one chain reverses the two valves. The Roots blower, which supplies the cupola with its air blast, also provides the air blast for the converter or decarbonising cylinder, and for the combustion of the gaseous fuel as well.

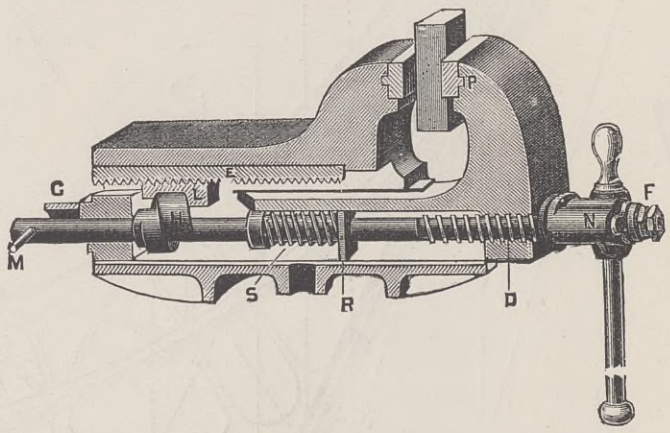
The gaseous fuel is produced by an improved Thwaite twin gas producer, or by a Thwaite's duplex gas producer—a form of producer we intend to illustrate in a future article. For highly phosphoric pigs the lime powder injection cannot, it is claimed, fail to be beneficial. The lowest heat of the gases resulting from the decarbonisation in the converter is utilised. As the action of combustion is by plenum air pressure, an expensive chimney is unnecessary. The estimate cost of a plant of a given output is less than that of the ordinary open-hearth type, and less than that of a Bessemer plant. The Thwaite and Stewart process is an approach to the rapidity of the latter, with the advantages of control possessed by the former. Referring to the illustrations:—A, is the spout of a Stewart's "rapid" cupola; B, is a cylindrical converter or decarboniser; C C, are the air blast tuyeres for decarbonisation; E E, are the gaseous fuel tuyeres; A A, the air tuyere; G and H, are the reversing valves; I I, are the recuperator vessels; J, is the chimney. The plant is being introduced by Messrs. Thwaites Brothers, of the Vulcan Iron-works, Bradford, who are also introducing a smaller type of Bessemer converter designed by Messrs. B. H. Thwaite and A. Stewart.

WOTAPEK'S EXHAUST NOZZLE.

Women do not often undertake inventions in steam engines, but in America one not long since patented the exhaust nozzle for a locomotive illustrated above. The number of the patent is 310,768, filed November 20th, 1884, by Bertha Wotapek, New York. Her claim is (1) the combination, with the smoke-box and the smoke-stack, of the two exhaust nozzles placed concentrically one above the other and centrally below the smoke-stack, and a receiving cone surrounded by the upper nozzle through which cone passes the steam discharged from the lower exhaust nozzle, together with the gases drawn along by and with that steam, substantially as hereinbefore set forth. (2) The combination of the smoke-box, the smoke-stack, the two annular



exhaust nozzles, placed concentrically one above the other and centrally below the smoke-stack, and two receiving cones communicating with the interior of the smoke-box, and surrounded the one by the upper and the other by the lower exhaust nozzle, substantially as and for the purpose hereinbefore set forth.



RAPID-ACTION SCREW VICE.

The accompanying sectional perspective illustrates an ingenious form of rapid-action vice, made by Messrs. Entwistle and Kenyon, and known as the Ewbank vice. The principal object of the arrangement illustrated is to combine the rapid action of the instantaneous or "lightning" vice, made by the same firm, with the range of screwing-up movement of the jaws which is common to the old-fashioned screw vice, and is necessary when articles which have a good deal of flexibility have to be held. This cannot be done with the instantaneous vice, because the movable jaw is pushed up to the work by hand, and then the range of screwing up is only perhaps a quarter of an inch. In the Ewbank vice the ordinary segmental nut and cam screw is used in conjunction with a screw in a solid nut. This screw and nut automatically come into play until a strong grip of anything between the jaws is obtained, the segmental nut coming into play first. This will be gathered from the engraving, in which E is a long steel rack fast to the jaw; L, a short steel rack; H, cam which raises rack L into gear with rack E; F, friction arrangement for revolving shaft and cam, sufficient to throw rack L in or out of gear with E; D, square-threaded screw which gives grip; N, square-threaded solid nut, carrying handle; S, spiral spring abutting against stop R, to keep shaft in position when unscrewing; P, round pegs on back of jaw plates, relieving screws from all strain. The view shows the work gripped. Turning the handle backwards revolves the shaft half a turn, dropping L out of gear with E, leaving the loose jaw free to be moved to any position. Half a turn forwards puts L into gear with E, thus fixing the loose jaw, screw D being then brought into operation to give the grip.

THE INSTITUTION OF CIVIL ENGINEERS.

The Council has awarded the following premiums:—

The Howard Quinquennial prize to John Percy, M.D., F.R.S., Hon. M. Inst. C.E., in recognition of his researches on the "Uses and Properties of Iron."

For Papers Read and Discussed at the Ordinary Meetings During the Past Session:—

1. A Telford Medal and a Telford Premium to Alexander Blackie William Kennedy, M. Inst. C.E., for his paper on "The Use and Equipment of Engineering Laboratories."
2. A Telford Medal and a Telford Premium to John Hopkinson, jun., M.A., D.Sc., F.R.S., M. Inst. C.E., for his paper on "The Electric Lighthouses of Macquarie and of Tino."
3. A Telford Medal and a Telford Premium to Colonel Eardley Maitland, R.A., Assoc. Inst. C.E., for his paper on "The Treatment of Gun Steel."
4. A Telford Medal and a Telford Premium to William Willcocks, M. Inst. C.E., for his paper on "Irrigation in Lower Egypt."
5. A Watt Medal and a Telford Premium to Edward Arnott Clowes, for his paper on "Printing Machinery."
6. A Telford Premium to William Joseph Dibdin, F.C.S., F.I.C., for his paper on "Sewage Sludge and its Disposal."
7. A Telford Premium to William Santo Crimp,[2] Assoc. M. Inst. C.E., for his paper on "Filter Presses for the Treatment of Sewage Sludge."
8. A Telford Premium to John James Webster,[1] M. Inst. C.E., for his paper on "Dredging Operations and Appliances."
9. A Telford Premium to John Kyle, M. Inst. C.E., for his paper on "The Colombo Harbour Works, Ceylon."
10. The Manby Premium to Louis Henry Ransome, Stud. Inst. C.E., for his paper on "The Conversion of Timber in the Pine-growing Districts of the United States by Circular Saws and Band Saws."

For Papers Printed in the "Proceedings" without being Discussed.

1. A Telford Medal and a Telford Premium to John George Gamble,[2] M.A., M. Inst. C.E., for his paper on "Water Supply in the Cape Colony."
2. A Watt Medal and a Telford Premium to William Isaac Last, Wh. Sc., Assoc. M. Inst. C.E., for his paper on "Setting out the Curves of Wheel Teeth."
3. A Telford Premium to Joseph Hetherington, for his paper "On Utilising Waste Air in Filter-Pressing; with Some Results of Pressing Sewage-Sludge at Chiswick."
4. A Telford Premium to Killingworth William Hedges, M. Inst. C.E., for his paper on "Central-Station Electric Lighting."
5. A Telford Premium to Charles John Wood,[2] M. Inst. C.E., for his paper on "The Molteno Reservoir, Cape Town."
6. A Telford Premium to Alexander Leslie,[1] F.R.S.E., M. Inst. C.E., for his paper on "Salmon-Ladders in Scotland."
7. A Telford Premium to David Alan Stevenson,[3] B.Sc., F.R.S.E., M. Inst. C.E., for his paper on "Ailsa Craig Lighthouse and Fog-Signals."

For Papers Read at the Supplemental Meetings of Students.

1. The Miller Scholarship to John Goodman,[4] Wh.Sc., Stud. Inst C.E., for his paper on "Recent Researches in Friction." Part II.
2. A Miller Prize to Sidney Herbert Wells, Wh.Sc., Stud. Inst. C.E., for his paper on "The Propelling Machinery of Modern War Ships."
3. A Miller Prize to Robert Francis Hayward, Stud. Inst. C.E., and a Miller Prize to John Platt, Stud. Inst. C.E., for their joint paper, "Experiments on Iron and Steel in Tension, Torsion, and Shear."
4. A Miller Prize to Ernest William Moir,[4] Stud. Inst. C.E., for his paper, "Hydraulic Appliances at the Forth Bridge Works."
5. A Miller Prize to Alfred John Hill, Stud. Inst. C.E., for his paper on "The Use of Cast Steel in Locomotive Construction."
6. A Miller Prize to Alfred Chatterton, B. Sc., Stud. Inst. C.E., for his paper on "Flour Mills and their Machinery."
7. A Miller Prize to Edward Carstensen de Segundo,[4] Stud. Inst. C.E., for his paper, "Experiments on Steam Engine Economy."

It has been determined to print, either in whole or in part, in the "Minutes of Proceedings," the first six of these papers.

An explosion of natural gas, which had leaked from pipes and mixed with the atmosphere, took place lately at Youngstown, Ohio. The result was a fire, which burned down a church and a large number of new buildings. The cause of ignition was the lantern of a watchman, who narrowly escaped death. The use of natural gas as an illuminant and fuel is attended by considerable danger, because, says *Nature*, being inodorous, it may leak without anyone noticing the fact until a disaster occurs.

[1] Has previously received a Telford Medal and a Telford Premium.
[2] Has previously received a Telford Premium.
[3] Has previously received a Manby Premium.
[4] Has previously received a Miller Prize.

ON COMPOUND ENGINES FOR ATLANTIC STEAMERS[1]

(*Concluded from p. 449.*)

IT seems to me a curious fact that while many engineers in setting their valves allow for the direct action of gravity on the moving parts, *i.e.*, their mere weight, which is constant at all speeds, no account is taken of the energy stored in these parts, although this varies with the weight and the square of the speed at which they move. There is another small point liable to be overlooked, viz., that while the weight of the pump connections—when levers are used—tends to counterbalance the weight of the pistons and main gear, it has the opposite effect as regards the momentum of these parts increasing instead of reducing it. These effects are only small, however, as the weight of the pump connections is small compared with the main gear, while the leverage and velocity is usually less than half. The resistance of the air pump due to the vacuum, however, acts as a counterbalance either to the dead weight or the momentum, and should be allowed for in making a diagram of twisting moments.

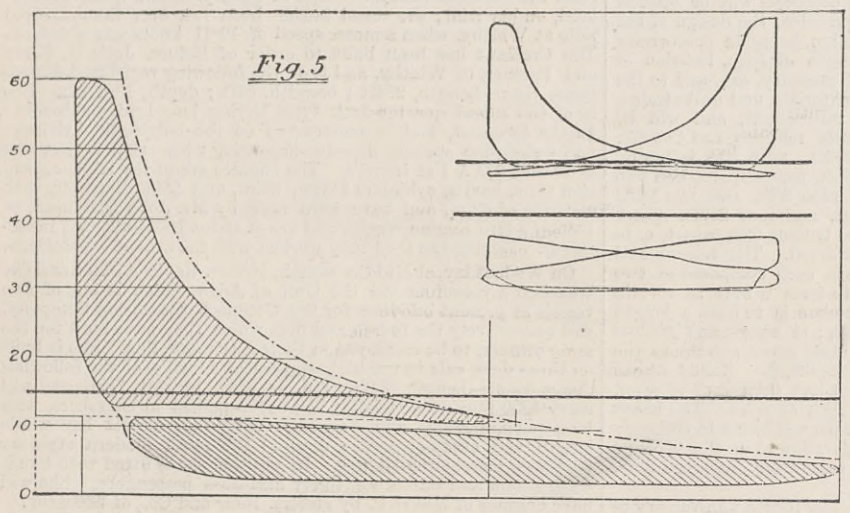
Fig. 5 shows some diagrams from the troopship Malabar, after her engines were compounded, and these were taken at about her usual steaming speed. These engines originally had two 94in. cylinders, with, I think, 4ft. stroke, and are of the horizontal return connecting-rod type. When compounded it was necessary to fit an 84in. high-pressure cylinder to take in the two piston-rods, and the largest low-pressure cylinder that could be got in was 110in., so that the cylinder ratio is only 1 : 1·72; and in arranging the cut-off in low-pressure cylinder for this power, it has been set at a mean of ⅝ stroke, which nearly represents the working capacity of the high-pressure cylinder; so that had there been no compression in that cylinder, and sufficient in the low-pressure to fill the clearance at the terminal pressure in high-pressure cylinder, there should have been no "drop" at the end of the high-pressure stroke; but as it is, the volume of steam admitted to the low-pressure cylinder is about 25 per cent. greater than that discharged at terminal pressure from the high-pressure. To equalise these volumes the cut-off in the low-pressure cylinder should take place not later than half-stroke, when the high-pressure diagram would have ended quite sharply, and there would only have been the "drop" due to the friction of the steam in passing from the one cylinder to the other, and the wire-drawing during admission to the low-pressure. The earlier cut-off in low-pressure cylinder would not only have reduced the "drop," but would have given more equal powers in the two cylinders. You will notice the peculiarity of the expansion curve, its greatest divergence from the hyperbolic curve being in the middle of its length.

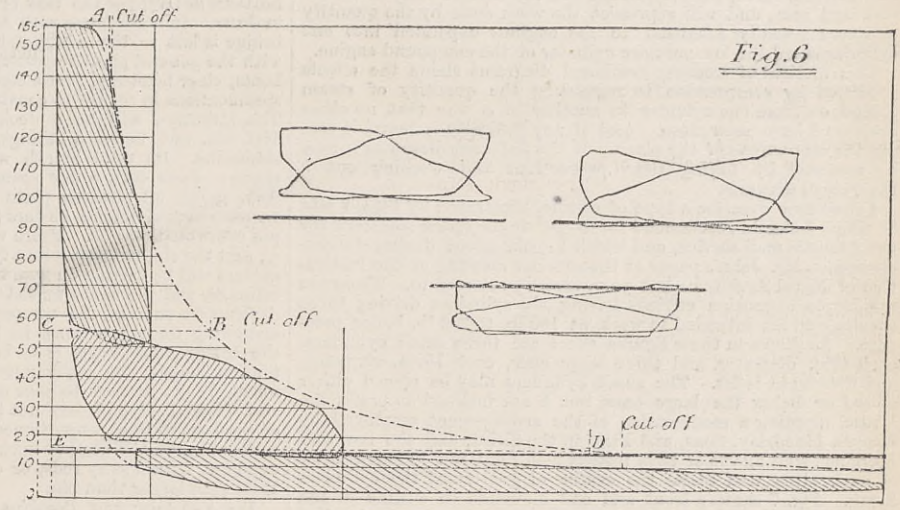
Fig. 6 shows the diagrams of the s.s. Westmoreland, by Messrs. David Rolls and Sons, who have kindly supplied me with the cards and the clearance capacities. In all the other cases I have had to approximate to the latter from careful measurements of the compression curves. These diagrams show considerable loss of pressure both between the high-pressure and intermediate and the intermediate and low-pressure cylinders, while the intermediate cylinder seems to have a great deal of loss by condensation, from the way in which the diagram falls back from the theoretical curves, which here again are hyperbolic. The steam, however, appears to be re-evaporated considerably in the low-pressure cylinder, as it approaches the theoretical curve pretty closely towards the end of the stroke in that cylinder. In a three-cylinder triple expansion engine with cranks at equal angles it is difficult to get rid of "drop" and at the same time maintain equality of powers in the several cylinders without very large high-pressure and intermediate-pressure cylinders, especially the latter, and without cutting off very early in the high-pressure. I am not sure that a better result on the whole might not be gained by sacrificing the advantages of cranks at equal angles and placing the high-pressure and intermediate-pressure cranks opposite to one another with the low-pressure at right angles to them, and then proportioning the cylinders and cut-offs so as to get unbroken expansion without "drop." Mr. Turner, of Birkenhead, has patented an engine of this type, the two first cylinders driving opposite cranks and working on the "Woolf" principle, one double-ended piston valve distributing the steam to both of them. This has the disadvantage common to all "Woolf" engines, that these two cylinders are in communication with each other during the whole stroke. This may, however, be avoided by the employment of an intermediate receiver and by cutting off early in the intermediate-pressure cylinder.

I shall now proceed to speak of the way in which I have combined these different diagrams, viz., that recommended by Mr. Schönheyder, and point out the defects in all the other methods I am acquainted with. Mr. Schönheyder's system is the only one that takes into account the effects of clearance and compression in all the cylinders, and gets the several cards into their proper places relatively to each other and the theroretical curves, and secures these curves, themselves being properly plotted. There are five different ways of combining indicator diagrams, all founded on the same general principle, and having certain points in common. They all have horizontal lines, which are zeros of pressure, and vertical ones, which are zeros of volume. The figures to be dealt with having been plotted to one scale of pressure and of lengths proportionate to the capacities of the several cylinders, are then placed in certain positions relatively to these horizontal and vertical zero lines, and the difference in the five methods lies in the horizontal placing of the figures. They all have also a theoretical curve or series of curves, to which the horizontal and vertical lines are assymptotes.

Now, the chief point to which I wish to draw your attention is that, in all the methods I shall describe, vertical ordinates or distances always represent pressure or density, and horizontal ordinates or distances always represent volumes or spaces. The products of these values are quantities or weights of steam or work done, and are represented as areas. One way of combining diagrams is to disregard clearance spaces and compression altogether, and to place all the figures up against one vertical line or zero of volume. For one purpose and under one condition of distribution this is right enough, but only then. The one purpose is the mere comparison of the collective areas of all the actual cards with a standard area representing the work which could theoretically be obtained from the quantity of steam used expanded into a cylinder the same capacity as the low-pressure cylinder. But it is only correct for this one purpose under one condition—viz., when the cushioning in the high-pressure cylinder is sufficient to fill the clearance at initial pressure. For comparing the actual pressure at any point in the expansion curves of the diagrams with the pressure which ought theoretically to exist at that point, this method is useless. And it does not give the correct theoretical expansion curves for the different cylinders, as these curves are due, not to the volume of steam admitted to the cylinders, but to the whole volume in the cylinder and clearance at the time of cut-off. A second method, and the one most generally used, is to place all the figures at such distances from one vertical line as shall represent the whole clearance spaces in the different cylinders. This is less correct than the first method, as it neither gives the correct standard area to compare the actual figures with nor the correct relative positions of these figures to compare the pressures with those of the theoretical curve, and it only gives the theoretical curve correctly for the high-pressure cylinder. It neither takes into account the effect produced by compression in, say, the high-pressure cylinder in upon the quantity of steam discharged from that cylinder, nor that due to the clearance and compression in varying the volume of steam admitted into the next cylinder. It gives one continuous curve for all the cylinders, which as a general rule will be incorrect except with special proportions of clearances and compression. A third method has been proposed and used by Mr. Mudd of Hartlepool. He takes one zero line of volumes for all the cylinders, as in the previously described methods, but places the separate figures at distances from it, proportionate only to that portion of the clearance unfilled by compression. That is to say, when the compression is sufficient to fill the clearance of any cylinder at half the initial pressure the distance = half the clearance, if the steam is compressed up to two-thirds the initial pressure the distance will = one-third the clearance, and so on. This plan is at least as incorrect as the last, as it neither gives the correct standard area for comparison, nor the correct positions of diagrams in relation to the theoretical curve, and it makes this curve itself wrong for the same reason as method No. 1. I have seen in one instance a fourth way of combining diagrams, and that was to place the high-pressure figure at a distance from a vertical line representing the clearance of that cylinder, and then to put the other figures at the same distance from the vertical as the high-pressure figure. After what I have said already, it is hardly necessary to criticise this method.

In the method described by Mr. Schönheyder neither the zero line of volume nor the theoretical expansion curve is necessarily the same for all the cylinders. He proceeds as follows:—Having placed the high-pressure figure at its proper height above the horizontal line or zero of pressure, draw at the admission end of it a vertical line at a distance representing the whole clearance of that cylinder, as in methods 2 and 4. This will be the zero of volume for that figure, and need not extend down to the vacuum line, but may stop at a pressure = initial pressure in the next cylinder. Having measured the quantity of steam shown at both ends of the expansion curve of the high-pressure figure, *i.e.*, just after cut-off and just before release, take the point in the curve where the product of pressure and volume is greatest, and through that point draw the theoretical expansion curve for the high-pressure diagram. This will rise to the initial pressure of the high-pressure cylinder and be carried down as low as the initial pressure of the next cylinder. At this pressure draw a horizontal line across the diagram meeting the high-pressure zero line of volume at one end and the expansion curve at the other. Now produce the high-pressure compression curve downwards to meet this line. The portion of this horizontal line between its intersection with the expansion and compression curves will represent the equivalent volume of steam at the initial pressure of second cylinder discharged from the high-pressure cylinder. If we had drawn a similar horizontal line at the terminal pressure of the high-pressure cylinder, *i.e.*, through the intersection of the expansion curve with a vertical line at the exhaust end of high-pressure diagram, the whole length of that line between the zero line of volume and the expansion curve would give the whole volume of steam contained in the cylinder and clearance at the end of the stroke, the portion cut off between the zero line and the compression curve would give the volume of steam shut up into the cylinder by compression at terminal pressure, and the portion between the compression and expansion curves will give the volume at terminal pressure actually discharged from that cylinder, and this volume will correspond with the increased volume at the initial pressure of the next cylinder already shown on the horizontal line at that pressure. This increased volume ought also to be the volume of steam admitted to the second cylinder—if no loss of steam take place between the cylinders—and is, at any rate, the maximum volume that can be admitted to it, and therefore the theoretical volume which will expand in it. Now, the volume of steam at this pressure admitted to the second cylinder equals the space swept by the piston before cut-off *plus* the portion of clearance unfilled by compression in that cylinder. Therefore, if we measure off from the intersection of the high-pressure compression curve with the horizontal line a distance = the unfilled clearance of the second cylinder, we get the commencement of the second diagram and the volume swept through by the piston before cut-off. (In order to get the unfilled clearance, it is only necessary to produce the compression line of second cylinder





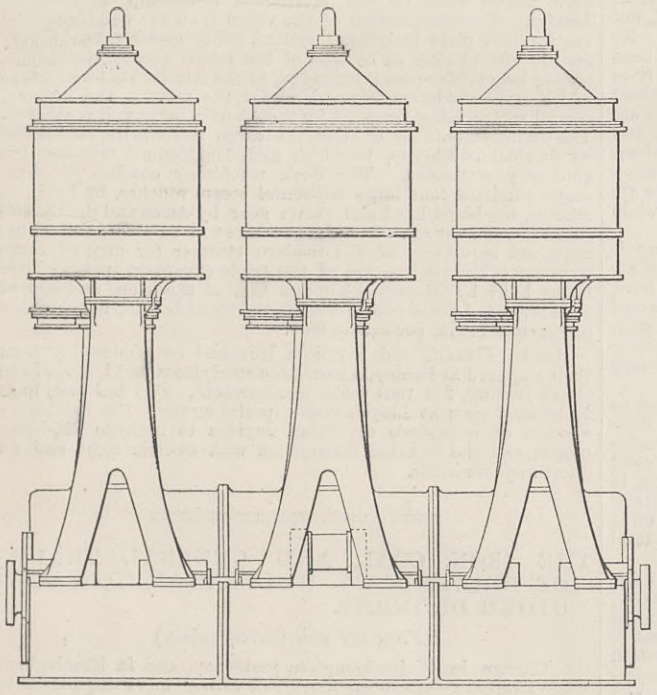


Fig. 7

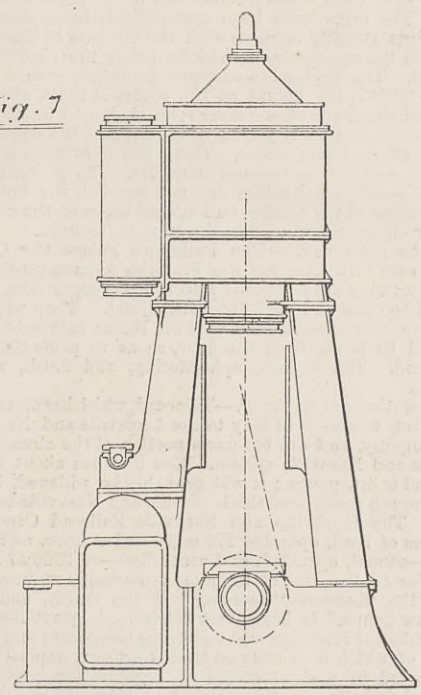
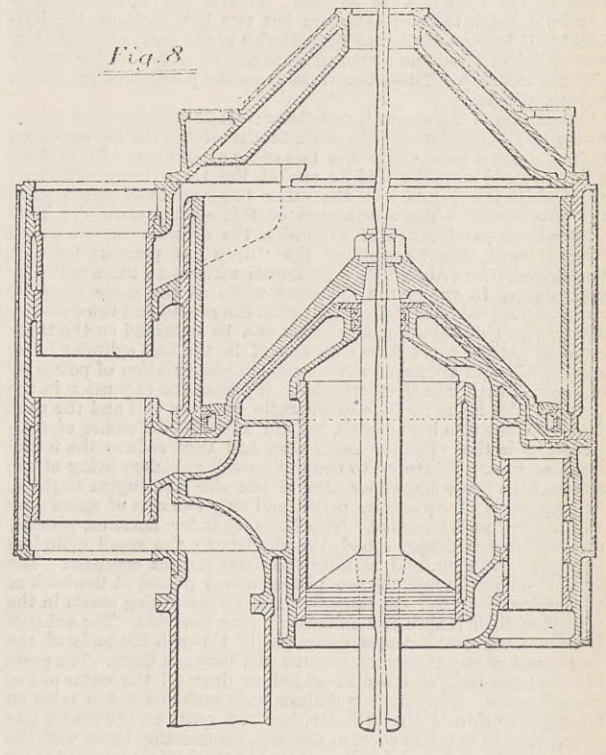


Fig. 8



COMPOUND ENGINES FOR ATLANTIC STEAMERS.

[1] Paper read by Mr. J. Jennings Campbell before the Liverpool Engineering Society.

up to the initial pressure.) Next, from the point marking the commencement of this second diagram, measure back towards the zero line a distance = the whole clearance in the second cylinder and drop a vertical line; this line will then evidently be the zero of volume for the second diagram. This will seldom be a continuation of the zero line of high-pressure diagram. The length of the horizontal line at initial pressure of second cylinder between this new zero of volume and the intersection with the high-pressure expansion curve, will be the volume we ought to have for expansion in the second cylinder, and the expansion curve for that cylinder will correspond with this volume, and will start from the point where the high-pressure curve stopped. This second curve will fall lower or rise higher than a continuation of the high-pressure curve, according as the new zero of volume is inside or outside the high-pressure zero line. If the engines whose diagrams are being combined are triple-expansion, the same process repeated will give the position, zero of volume, and theoretical expansion curve for the third cylinder.

The diagram thus obtained enables us to compare the pressure at any point in the expansion curve of any of the figures with the theoretical pressure which ought to exist at that point, and will enable us to detect the loss and the best way of remedying it. But it does not give us a standard area to compare with the actual areas of our cards. This should be an area representing the volume of steam at the initial pressure in high-pressure cylinder expanded into a cylinder the size of the low-pressure. To get this Mr. Schönheyder says:—Draw a perpendicular at the admission end of low-pressure figure, rising up to the initial pressure in the high-pressure cylinder, and mark off from it horizontally a distance equal the volume of steam at that pressure admitted to the high-pressure cylinder, *i.e.*, the distance between the high-pressure compression and expansion curves if produced up to that pressure. From the point thus obtained draw a theoretical curve extending out to the end of the low-pressure diagram. The area contained between this curve, the vertical line and the vacuum line will be the standard area, and will represent the work done by the quantity of steam actually admitted to the engines expanded into one cylinder equal the low-pressure cylinder of the compound engine.

This method of treating combined diagrams shows the effects produced by compression in regulating the quantity of steam passed on from one cylinder to another in a way that no other diagram I have seen does. And if any difficulty is found in seeing the correctness of the placing of the different diagrams it may be removed by taking fixed proportions and working out a theoretical diagram.

I shall now describe a type of engine, illustrated by Figs. 7 and 8, which I should recommend for large single screw steamers for the Atlantic mail service, and which I spoke about during the discussion on Mr. John's paper at the summer meeting of the Institution of Naval Architects last year, already referred to. These are quadruple expansion engines having six cylinders driving three cranks, and are intended to work at 180 lb. to 200 lb. boiler pressure. As shown in these figures there are three small cylinders, each 42in. diameter, and three large ones, each 100in. diameter, and the stroke is 5ft. The small cylinders may be placed either above or below the large ones, but I am inclined to prefer the latter, adopting a modification of the arrangement employed by Messrs. Maudslay, Sons, and Field in the Sirius, and the Iris, and Mercury, as it allows of both pistons being got out independently of each other, and keeps the centre of gravity of the cylinders lower. Fig. 7 shows a front and end elevation in outline of the general design of the engines, and Fig. 8 shows a more detailed view of the cylinders in section. This is not one continuous section through the two cylinders but two half sections, the left-hand half being a section at right angles to the centre line of ship, and the right-hand one a section more nearly in the centre line of engines and ship. These two views show the position of the piston valve seatings.

The action of the steam is as follows:—It is first admitted to one of the small cylinders for about six-tenths of the stroke, and from this cylinder it passes into the two other small ones. From these it is delivered into the middle one of the three large cylinders, from which it expands into the other two and then passes on to the condensers. The advantages of this system are:—(1) That with a large total range of expansion the cylinder ratio at each stage is small, thereby enabling the "drop" of pressure between the stages to be reduced to a minimum without an inconveniently early cut-off in any of the cylinders, while at the same time, by accepting a moderate "drop" between the second and third stages, a very equal distribution of powers can be obtained on the three cranks. At the same time, the cut-off in the first cylinder being moderately late allows of some considerable variation of power by cutting off earlier in that cylinder. (2) That the expansion in the first cylinder being small, and the ratio between this and the next two cylinders also being small, we can keep the difference of temperatures in this cylinder small also, and thus reduce the initial condensation. (3) Owing to the three small cylinders being of one size and the three large ones also of one size, the engine ought to be a tolerably cheap one to make, and only two sets of spare gear will require to be carried. The large cylinder bottoms, pistons, and covers are deeply coned, thereby letting the small cylinders partly within them and making the arrangement compact. The large cylinders have each two piston valves placed at the back of the engines over the condensers, these valves taking steam in the middle of their length and exhausting over the ends. The exhaust from the top ports passes down partly through the body of the valves and partly through a passage cast between them. The ports are of ample area, and are arranged to draw all the water out of the cylinders. The small cylinders have each one piston valve on the forward side of the cylinder, but not quite on the centre line of engines, in order to shorten the levers connecting them with the large cylinder valves. I have not made the bottom ports of these cylinders to drain out the water, as it necessitated such an inequality of clearances at the two ends of the cylinders, but this can be done if desired. I have not had time to arrange any particular form of valve gear, but it should be one of the radial or single-excentric types now becoming so common.

In two of the engines the small valves are simply driven from the large ones, but in the engine with the high-pressure cylinder means should be adopted for working the high-pressure valve separately so as to alter the expansion independently of the other cylinders. I think it best for the high-pressure cylinder to be tandem with one of the low-pressure cylinders, as it tends to more equality of power on the three cranks, and if it be the forward one it will give a more direct steam pipe. Fig. 7 is only intended as a general sketch of the design, and might be modified in many particulars when the engines came to be worked out in detail.

It will be seen from the above description that the cylinder ratios at the second and fourth stages of expansion are only 1 : 2, while at the third it is 1 : 3, each small cylinder being one-sixth the capacity of each large one, but two small cylinders delivering into one. It will be found that with a cut-off at about ·6 stroke in high-pressure cylinder and at from ·35 to ·4 in the others very equal powers will be obtained with moderate initial strains on the working parts, especially if the effects of inertia are taken into account. The rest of the engine needs no special description and any further information that may be required can be elicited by the discussion.

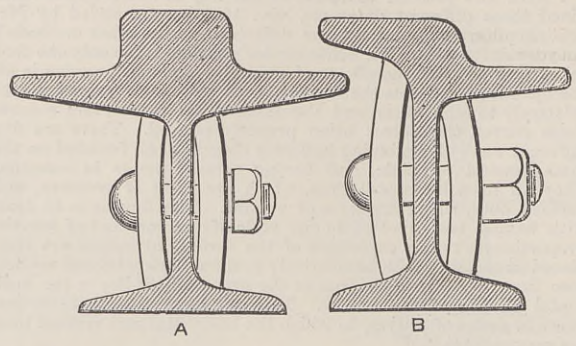
Having now strung together some of my ideas on the subject of compound marine engines especially as applied to the Atlantic mail service, I shall leave the matter in the hands of my hearers for discussion.

DUNDEE MECHANICAL SOCIETY.—This Society met on June 3rd, when Mr. Mair, ex-secretary, read his report for the past session, which was considered very satisfactory. Mr. D. J. Macdonald then read a paper on the "Conservation of Energy." On the motion of the president, Mr. George C. Douglas, a hearty vote of thanks was awarded the lecturer.

AMERICAN ENGINEERING NEWS.

(*From a Correspondent.*)

Girder rails for street railroads. — The Johnson girder rail for street railroads—tramways—is being very widely adopted, especially in the West. In the accompanying sections, A represents the form for a "centre-bearing" rail, and B for a "side-bearing" rail, these being the two rail head sections adopted in this country. A modification, known as the "slope back," has the outer side of the head inclined at an angle instead of being perpendicular.



The "slope back" is very strongly objected to by drivers of trucks and wagons. The girder rails are, of course, made of various sizes and weights.

New bridge across the Mississippi at St. Paul, Minn.—The specifications are out for the new bridge, and proposals will be opened in June. In accordance with American practice, the design of the bridge is left to the contractor; the design being in conformity with the general plans furnished as to length of span, location of bents, clear headway, grade elevations of masonry, &c., and to the specifications in regard to construction, materials, and unit strains. The structure will be a deck bridge throughout, and will be 41ft. 6in. wide between railings, having 24ft. roadway and two 8ft. sidewalks. Its total length will be 2770ft., with the following spans:—Four 40ft. tower spans, three 50ft. tower spans, and two 60ft. spans, all rivetted plate girders; nine 80ft. and five 90ft. spans, rivetted lattice girders; one 170ft. and four 250ft. spans, pin connected trusses. There will be two trusses 22ft. apart, c. to c., and the single intersection type is preferred. The trusses and girders will be carried on iron trestle bents, each composed of two columns, and the bents united in pairs to form towers at certain designated points. No compression member is to have a length exceeding forty-five times its least width; in beams and girders the compression flange is to be of the same gross section as the tension flange. No continuous girders admitted. Rolled beams for roadway stringers to have a depth not less than $\frac{1}{15}$th of span, and rivetted plate girders not less than $\frac{1}{12}$th of span. The heads of eye-bars to be so proportioned that the bar will break in the body rather than in the head or neck; no welds allowed in the body of eye-bars, lateral sway rods, or counters, except for loop-eyed bars. Hole $\frac{1}{50}$th larger than pin.

The New York and Brooklyn Bridge.—The fourth anniversary of this great structure was celebrated May 24th. Since its opening in 1883 the cable cars have carried 64,111,556 passengers, and 15,963,919 have walked across on the promenade, making a total of 80,075,475, from which number has been collected 2,435,789·23 dollars. The fares have been materially reduced since 1884, but the receipts steadily increase with the increase in the traffic. No returns, in the aggregate, of vehicles using the roadway has been published. The bridge is a suspension bridge, with a clear river span of 1595ft., the height at the centre is 135ft. above the East River, and the grade of the river span is about 1 in 30. There are four wire cables, each 15¾in. in diameter, and the suspensions and stays are all steel wire cables. There are four main trusses about 16ft. high, and two outer ones about 7ft. To prevent oscillation as far as possible, the cables are not parallel, the inner ones are close together at the saddles and spread apart at the centre, while the outer ones are arranged in the opposite manner.

Pullman cable cars. — The Pullman's Palace Car Company is building cars 33ft. long for the Franklin Avenue cable line at St. Louis, Mo.; they are combined grip and passenger cars. The front 13ft. will be open and the other 20ft. closed. They will be carried on a pair of trucks each, like cars on steam railroads. The platforms will be lower than the floor, so as to place the steps near the ground. The fittings, upholstering, and finish, will be very elaborate.

Mexican National Railroad.—This road, which has met with various vicissitudes, was sold in May to the Louisville and Nashville Railroad Company, and will become a portion of the already extensive Louisville and Nashville system. The line has about 950 miles of track, and is 3ft. gauge; it will probably be widened, however, to give a through route from the Louisville and Nashville to the City of Mexico. The Louisville and Nashville Railroad Company owns 1696 miles of road, operates 270 miles under lease, and has a total mileage—owned, operated, and controlled—of 3726·57 miles.

The New South.—One of the most remarkable movements of the time is the vigorous "booming" of the South, and the term, "the New South," is heard everywhere. A great deal is said of its vast mineral resources and numerous companies and syndicates, in many of which it is claimed that Northern capital is invested, are reported in various stages of organisation. Every possible trade and industry is "going to be" started immediately, and judging from all the flowery reports and newspaper articles, the New South will far outstrip the North in every department of commerce. On the other hand, it is asserted by men of experience that Birmingham, Ala., is the only place in and around which any practical and definite steps are being taken. There is a great probability that the South possesses many resources and advantages yet undeveloped; but they cannot be developed by mere "booms," and the whole business is likely to be overdone.

Pennsylvania Railroad.—New stock is to be issued to provide for the construction and equipment expenditures on the present system of main and leased lines and branches, and for the completion and extension of new lines. The total amount is estimated at 8,000,000 dols., made up as follows: Construction of third and fourth tracks, and additional facilities on the main line, branches, and leased lines, 4,000,000 dols.; real estate for same, 700,000 dols.; locomotives, and passenger rolling stock, 1,300,000 dols.; construction of new branches and auxiliary lines, 2,000,000 dols.

Two large bridges.—Work will shortly be commenced on the foundations for the piers of the Illinois Central Railroad bridge across the Ohio River at Cairo, Ill. C. C. Barr, of the firm of Anderson and Barr—who are constructing the foundations of the Hawkesbury bridge in Australia—is letting contracts for lumber and stone, and for the requisite machinery. The Union Bridge Company, of New York, have the contract for the superstructure. Work is progressing on the Kentucky approach, and will soon be begun on the Illinois approach.

The Lookout Mountain Railroad. -A cable railroad has recently been constructed up Lookout Mountain, near Chattanooga, Tenn. It is 4360ft. long, with an elevation of 1200ft. The track is laid with three rails, a double-track passing place being made at the middle of the line. The driving plant is at the foot of the mountain, and the cable is continuous. There are two cars, so operated that while one is at the top the other is at the bottom. At the top of the mountain a railroad a mile and a-quarter long runs round the brow of the bridge. The motor engine for this line was taken up in sections.

New Mexico Central Railroad Company.—This is a newly-incorporated company in the interest of the Atchison, Topeka, and Santa Fé. The charter includes 1680 miles of road, covered by four main routes and ten branches. The first route provides for a line from the eastern State line, on the Canadian river, to the Atchison line in San Miguel county, and thence to the same line in Bernahillo county, forming an air line through Santa Fé. The tide of great railroad projects is sweeping down towards the hitherto comparatively neglected South-west.

LAUNCHES AND TRIAL TRIPS.

MESSRS. JOHN JONES AND SONS, Brunswick Dock, recently launched the screw steamer Gwynfaen, built for Messrs. Kneeshaw, Lupton, and Co., of Liverpool. The dimensions of the vessel are 140ft. by 20ft. by 10ft. depth of hold, and she has topgallant forecastle and long raised quarterdeck. She is built to the highest class at Lloyd's, and is fitted with water ballast. She is rigged as a three-masted schooner, and has steam winches and other appliances for the rapid discharge of cargo, and will be fitted with compound engines made by the builders at their engine works, Cotton-street. Since our last visit to this building yard we observe that new ground has been rented from the Mersey Docks and Harbour Board, and very powerful machines for the heaviest class of shipbuilding have been put to work. On the adjoining slip the builders have a large steel screw steamer, 5500 tons displacement, built with cellular water bottom, and the highest class at Lloyd's. Since the reduction accepted by the workmen of the port early this year we are informed that all classes of steamers and ships may now be built on the Mersey at the same prices as paid to outside builders, and no doubt the local owners will endeavour to encourage the trade of the port by placing their orders with local firms.

On Monday afternoon the new steel steamer Crescent proceeded from the works of Messrs. Joseph L. Thompson and Sons, Sunderland, on her trial; the vessel having been run over the measured mile at Whitby, when a mean speed of 10·41 knots was obtained. The Crescent has been built to order of Messrs. John H. Barry and Partner, of Whitby, and is of the following registered dimensions, viz.:—Length, 284ft.; breadth, 38ft.; depth, 19ft. 3in. She is of the raised quarter-deck type, having long bridge extending to the foremast, and is constructed on the longitudinal stringer and web-frame system, thereby dispensing with orlop beams, and is classed 100 A 1 at Lloyd's. The engines are of the triple-expansion type, having cylinders 21½in., 35in., and 58in. diameter, with a stroke of 39in., and have been built by Mr. John Dickinson, of Palmer's Hill Engine Works, and are of about 1000 indicated horse-power. During the trial they worked with the utmost satisfaction.

On Wednesday, at Middlesbrough, Messrs. Raylton Dixon and Co. launched a vessel, named the Gulf of Aden, which is one of two vessels at present building for the Greenock Steamship Company, and respectively the fourth and fifth which they have built for the same owners, to be employed in their Australian line. She is built on three deck rule to the highest class of Lloyd's, of the following dimensions:—Length, 312ft. 6in. by 40ft. by 25ft. 2½in., and will carry 3500 tons dead weight; has water ballast in chambers, with long poop, bridge, and forecastle extending almost her whole length, and every convenience up to the most modern style for first-class merchant steamers. In addition she is fitted with hand some saloon and cabins for thirty first-class passengers. She will have engines of 300-H.P. by Messrs. Blair and Co., of Stockton.

On Tuesday Messrs. Joseph L. Thompson and Sons, Sunderland, launched a steel steamer, the Exe, of the following dimensions, viz.:—Length, 275ft.; breadth, 38ft.; depth of hold, 20ft. 6in.; built to the order of the Mercantile Steamship Company, of London. The construction of the vessel is on the web frame and longitudinal plate intercostal system, being under special survey for the 100 A1 class at Lloyd's, of the raised quarter-deck type, having long bridge-house, extending to the fore-part of foremast, in which accommodation is provided for the seamen and firemen, special means being arranged for these berths being well ventilated. The decks are entirely of steel, the cargo holds being subdivided by six steel bulkheads, to which each longitudinal intercostal is efficiently connected. The deck machinery consists of direct steam windlass, four large horizontal steam winches, by Lynn, of Pallion, combined hand and steam gear by Amos and Smith, and patent screw gear aft. Stockless anchors will be fitted, and all the improved appliances of the modern steamer for general cargo purposes. The engines are of the triple expansion type, and are being built by Messrs. Blair and Co., of Stockton, and are of 1000 indicated horse-power, having two steel boilers, working at a pressure of 160 lb. per square inch.

Messrs. Fleming and Ferguson launched on Wednesday from their shipyard at Paisley, a handsome steel steam yacht, named the Grace Darling, 240 tons yacht measurement. She has been built to highest class at Lloyd's under special survey. Her machinery consists of quadruple expansion engines to indicate 350-horse power, and she is fitted throughout with electric light and all latest improvements.

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

(*From our own Correspondent.*)

ON 'Change in Wolverhampton yesterday, and in Birmingham this—Thursday—afternoon there was rather more disposition to do business than a week ago. The holidays being out of the way and June being well started, there is some desire by ironmasters to do a brisk trade in the last month of the quarter. The extent of the business accepted has, however, to be limited by the prices attached. Makers cannot do all they would on this account. Works are more active this week than last, and some establishments which were closed all last week are now again briskly employed. Orders, however, continue to be individually small, except for shipment, and buyers confine themselves to covering early wants. Makers' books do not therefore present much business ahead.

More inquiries are to be found in the steel branch than any other, but the demand is not equal to the supply, and competition for the orders is therefore keen. Galvanisers are not so vigorous buyers as formerly, since they are not so well employed as a while back. South American and Australian orders for galvanised sheets are hardly up to the average, though great quantities are going out there. Indian business is less satisfactory than it might be if the rate of exchange were to improve. Prices of galvanised sheets in the Australian markets suffer from the heavy consignments that are still being made to Melbourne and Sydney. At home, galvanised doubles are £9 15s. to £10 per ton f.o.b. Liverpool, with the usual extras for 26 and 28 gauges. Black sheet prices remain at £5 17s. 6d. for galvanising purposes—singles—and £5 15s. for merchant uses. Doubles keep at £6, and lattens at £6 15s. to £7 a ton.

The quotations of Messrs. Morewood and Co. for galvanised iron at date are:—Galvanised crystallised corrugated sheets, "Red Star" brand, 18 and 20 B.G., £10 15s.; 24 B.G., £11; 26 B.G., £12 10s.; 28 B.G., £13 10s.; and 30 B.G., £15 10s. per ton. Galvanised tinned corrugated sheets, "Lion" brand or "Anchor" brand, £11 5s., £11 10s., £13, £14, and £16, for the respective gauges; best best close annealed and cold rolled galvanised tinned flat sheets, "Lion" brand, £20, £21, £23, and £24, for sizes up to 28 gauge; best close annealed and cold rolled galvanised tinned sheets, "Anchor" brand, £17, £18, £20, and £21; close annealed and cold rolled galvanised flat sheets, "Woodford Crown" brand, £13 10s., £14, £15, and £17; close annealed galvanised flat sheets

"Wheatsheaf" brand, £12, £12 10s., £14, and £15, for 18 and 20 B.G., 24 B.G., 26 B.G., and 28 B.G. respectively.

Stamping and working-up sheets rolled by the best houses keep in capital request, and makers speak cheerfully. Prices vary greatly, almost, indeed, with every specification, according as buyers wish the iron to be treated. The following may, however, be accepted as the basis quotations this week for singles of the best firms:—Working-up sheets, ordinary quality, £10; medium, £11; and best, £12; charcoal sheets, £15 to £17 per ton. Doubles for stamping purposes are £1 additional upon singles, and lattens a yet further 20s. per ton. Time was when the extra demanded was 20s. per ton, but the state of the market of late has altered this state of things.

In the bar trade shipping orders are arriving direct and through merchants from the Colonies, South America, and India. Home orders indicate reluctance by buyers to keep stock. Prices are firm at £7 nominal for marked bars, a figure which has now prevailed for thirteen months, with £7 12s. 6d. as the Earl of Dudley's quotation. Good medium branded sorts are £6 5s. to £6 7s. 6d.; merchant bars, £5 10s.; and common, £4 15s. to £5 per ton. North Staffordshire and Welsh ironmasters are sending bars at the exceptional figure of £4 10s. per ton, carriage paid.

Some hoop makers reported this—Thursday—afternoon inquiries for lines of 500 tons for export. Immediate execution was impressed. Certain classes of strip also show slightly more buoyancy. Common hoops and strips keep at £5 nominal, and occasionally £4 17s. 6d. per ton. Bedstead strip is £5 to £7 per ton.

Local steelmasters, in contrast to the ironmasters, give excellent accounts of the demand. Orders are increasing on every hand, and the works are full of business. Some orders have to be declined, makers being unable to fill them with the needed promptitude.

Basic steel never looked healthier than now, and local makers express the greatest satisfaction at the condition of the demand. The metal is getting into established favour for an increasing number of puoposes. Much of the local output of this material is going into bridgework for erection in India, China, and Japan, while plates and bars are also going out to Australia and China for machine boiler repairs, &c.

Admiralty and War-office orders for sheets and plates of basic steel are at present under execution at the works of the Staffordshire Steel and Ingot Iron Company, Wolverhampton. The company quotes its bridge plates at £6 10s. to £6 15s., and boiler plates £7 5s. to £7 10s. Steel bars are £6, and angles £6 5s. Sheets, singles, are £7 10s.; doubles, £8 5s.; and belting, £9 per ton. Blooms and billets are £4 15s. per ton.

Bessemer basic metal, the product of the Lilleshall Iron and Steel Company, Shropshire, is also in increasing sale, and the company is putting up another furnace. The quality of the metal is found to be its great recommendation. For blooms and billets the price is likewise £4 15s. per ton, and other products in proportion.

Engineers of experience hereabouts are urging that much of the soft steel now being employed for boiler and other similar purposes is, more correctly speaking, iron. They contend that the nature of the material is much more that of iron than of steel proper, and they dispute the claim of the steelmasters that iron is being superseded.

The railway carriage and wagon builders are at the present time securing their materials at very favourable prices. In steel they are particularly favoured. Railway tires are quoted £6 15s. to £7 per ton, delivered into the Birmingham district by Welsh producers. A fairly brisk demand is reported, and makers report that prospects are improving.

Iron plate makers report increased competition for steel, and orders at the local mills are not growing.

The pig iron trade is not brisk in the matter of new sales, but deliveries are being made with fair regularity. Some of the Midland firms are more anxious for new contracts than are local producers. Prices of local pigs are quoted by the Spring Vale Iron Company at: Hydrates, 47s. 6d.; B. F. M., 39s.; and common, 29s. J. Bradley and Co. quote: Best mine iron, 39s.; Darlaston, Northampton quality, 36s.; and cinder pigs, 30s. Shropshire all-mine pigs are selling at 50s. for hot blast sorts, and 75s. for cold blast. Staffordshire cinder pigs are changing hands in some quarters at less than 28s. 6d. per ton.

As to imported pigs, it must be noted that Welsh forge hematites are quoted at 51s. 6d. for No. 3 at stations and 54s. for No. 1. Lincolnshires are about 38s. to 38s. 6d., delivered to stations; Derbyshires, 36s. 9d. to 37s.; and Northamptons, 35s. 9d. per ton.

Shropshire rolled wire rod makers are meeting with a somewhat quickened demand at £5 15s. to £6 f.o.b., Liverpool, for the standard Nos. 5 and 6. German competition is, however, still severe, more especially in drawn rods.

To-day—Thursday—Mr. William Hipkins, of the Wengs, Wolverhampton, was showing the leading ironmasters and iron merchants in South Staffordshire a specimen of "fibrous steel," which has been made by the granulating and balling-up of Siemens-Martin steel under a process which he explained had been patented by Messrs. Dorman, Long, and Co. and Mr. Howson, of Middlesbrough-on-Tees. The specimen was a section of a ¾in. round bar, and the fracture showed undoubted fibre.

The makers hold that the new metal is well adapted also for armour plates—in the manufacture of which the pile has to return to the fire so often—since the silicious coating of each fibre protects it, it is claimed, from the action of the fire, where pure iron would perish. For the same reason it might be used, it is inferred, for the bilges of ships.

Considerable progress is noticeable throughout South Staffordshire in the extension of the galvanising business, mostly by ironmasters who have usually supplied sheets to the galvanisers, but occasionally also by galvanisers who have removed their works to the vicinity of the sheet mills.

The condition of the local iron, steel, and hardware trades is favourably reflected in the Board of Trade Returns for May just issued. No less an increase than 40 per cent. on the year appears in the total exports of railroad iron, the enlargement being mainly due to the East Indies. In pig iron the substantial increase of over 28 per cent. is shown, and this is attributable chiefly to the United States, Russia, and Italy. In bar and angle iron the bulk of the increase was with British North America. There was a decline in hoops and sheets, and a small decrease also in cast and wrought iron. The exports of unwrought steel have gone up very largely, mainly to the United States, the increase to which country alone during the past month amounts to 366 per cent.

The strike of rivet makers in the Blackheath district for an advance in their wages seems to have disconcerted the chainmakers, who fear that soon there may be too great a strain upon public support. Consequently, a suggestion has been made that the rivet makers, the nailers, the miners, and the chainmakers, should combine with a view to approach the employers. There is a distinct tendency towards conciliation, and at a meeting a few days ago of the representatives of these branches it was resolved to arrange an interview between the employers and a deputation from the meeting for the consideration of the present list.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—During the past week business both in the iron and the coal trades has been only settling down into its normal condition after the more or less general suspension of operations for the Whitsuntide holidays. Ironworks and engineering establishments had only got into full work again on the Tuesday, and some collieries in the Manchester district not until the Wednesday, whilst at the opening iron and coal markets at Manchester on Tuesday there was but a partial resumption of the customary business. It is consequently very difficult to form any really accurate estimate of the actual condition of trade, but it is sufficiently evident that business has not been resumed after the holidays with any improved prospects. A very quiet tone prevails all through, and with the exception that hematites and one or two brands of common pig iron are apparently firm, continued weakness characterises prices generally.

There was only a moderate attendance at Tuesday's iron market, and so little doing that prices were scarcely tested. In pig iron there was a steady tone so far as makers' quotations were concerned, but prices generally were little more than nominal, and if business of any weight had been offered, sellers could have been found at under the current quoted rates. For Lancashire pig iron, makers still quote about 38s. 6d. to 39s., less 2½, as their list rates for forge and foundry qualities delivered equal to Manchester, but they are open to entertain offers. In district brands the average prices quoted by makers for Lincolnshire iron are about 37s. to 38s., less 2½, for forge and foundry delivered here; there are, however, sellers in some instances at a little under these figures. Outside brands offering here are firm, so far as Middlesbrough iron is concerned. Good named foundry qualities are still quoted at 43s. 4d. net cash, delivered equal to Manchester, but Scotch iron remains without appreciable improvement.

Hematite makers are very firm in holding for the full rates they have recently been asking, and for good brands of No. 3 foundry it would be difficult to place out orders—except perhaps through some speculative merchant—at under 52s. 6d. to 53s. 6d., less 2½, delivered into the Manchester district.

A depressed tone prevails throughout the manufactured iron trade, with a downward tendency in prices, and makers are placed in the difficult position that they are unable to obtain the raw material except at prices which are considerably higher in proportion to those they have to take for the finished article. As the only way of meeting the difficulty the closing of works is being freely talked of, and certainly makers have only the prospect before them of a very slow trade for some time to come, which holds out no hope of improving their position. Just now works here and there are busy completing orders for shipment to Canada before the increased tariff is put into force, but the weight of actually new work coming forward either for home use or for shipment is decreasing. With regard to the new Canadian tariff, which will seriously cripple a considerable business that was previously being done, there is a very sore feeling that our colonies should take such hostile action against English trade; and there is further the new Russian tariff, which will also operate very injuriously upon the shipments of finished iron that have previously been made to that country. The quoted basis of prices remains nominally at £5 per ton for bars, £5 5s. for hoops, and about £6 5s. per ton for local made sheets delivered into the Manchester district; but where buyers have orders in anything like quantity for early delivery, they can place them at £4 17s. 6d. to £4 18s. 9d. for bars, and at about £5 3s. 9d. for hoops.

Messrs. Richard Johnson, Chapman, and Morris, of Manchester, have received a large order for their fire-proof wire lathing—Johnson's patent—of which an illustrated description was given some time back in THE ENGINEER, for the construction of a portion of the new starch works which are being erected at Paisley by Messrs. Brown and Polson.

The condition of the engineering trades remains without any really appreciable improvement. Here and there rather more inquiry is reported, and the leading boiler making firms in the districts are mostly well supplied with orders, whilst machine tool makers and stationary engine builders are generally fairly well supplied with work. Locomotive builders, however, continued very slack, and much the same may be said of the general engineering trades, whilst where there is new work being got it has still to be competed for at extremely low prices. With regard to the returns issued by the trades union societies, the recent interruption to the ordinary course of business and the stoppages of works for the Whitsuntide holidays deprive these for the past month of much of their value as an indication of the actual state of employment, and the Bolton strike is another disturbing element affecting the returns of unemployed. Apart from this strike, which has of course had the effect of increasing the number of out-of-work members on the books of the various societies, and making allowance for the recent holiday season, the condition of employment would seem to show very little material change.

With regard to the Bolton strike, a very determined feeling is being shown by the men generally to stand out until they get the return of the 2s. per week taken off wages at the commencement of last year, and in this they are encouraged by the liberal response which has up to the present been made to their appeals for assistance from fellow workmen in Bolton not connected with the strike, and in various other districts. The first balance-sheet which has been issued, and which covers a fortnight, shows that in voluntary contributions, which are, of course, independent of the strike allowances granted by the Amalgamated Society of Engineers, Steam Engine Makers, Metal Planers, and United Pattern Makers' Societies, the sum of £273 has been received in aid of the strike, and of this £154 has been expended in the support of non-society men, £18 in despatching imported non-society men from the town, and £17 in bringing out-workers home, whilst there is an item of £40, which is set down as "paid money advanced by a friend." In their appeal for further assistance, the Bolton Strike Committee state that they "look upon the issue as the defeat or victory for the whole of Lancashire;" and with reference to the recent fruitless negotiations for a settlement, they add that they have had a conference with their late employers, and they were recommended by them to return to work, and work as the employer wanted, and in three months hence they would submit their claims to a third party, but these proposals were unanimously rejected. Their next contention was for the Manchester rate of wages, consisting of a three miles radius from the Manchester Exchange, but the masters threw in a twelve or twenty mile radius, as they wanted to throw in all the low-paid districts to bring the average down. The committee conclude with the vague statement that they "may come to terms in the near future, or it may be otherwise." The employers so far have taken no further step with the view of bringing the dispute to an end, but a meeting is being held in London this week, and then no doubt the whole question will be fully discussed.

A portable electric lamp for mining purposes was submitted for inspection at a meeting of the Manchester Geological Society held on Tuesday. This lamp, which is being introduced by the Edison Electric Light Company may be briefly described as consisting of a small strong wooden case, suspended by a leather strap, and enclosing an accumulator and an incandescent lamp combined, the whole weighing about 7½ lb. The lamp will keep a light of 2½-candle power burning for about fourteen or fifteen hours, when it will require to be recharged by a dynamo; the light is carried in front of the accumulator, with a concave enamelled reflector behind it and a thick plate of glass in front to protect it, and the accumulator is provided with a switch to enable the light to be turned in or out as required, whilst it also enables the light to be turned higher as the accumulator becomes exhausted. The whole apparatus is kept within a sufficiently small compass, so that it is not too cumbersome to be readily carried about, and special provision has been made to prevent the possibility of the filament in the lamp becoming shattered by a fall or heavy blow it might be likely to receive while in use in a mine. During the discussion Mr. J. S. Burrows said he had tried one of the lamps at the Atherton Collieries with most satisfactory results; the lamp gave a better light than four Marsant lamps combined, and he did not find the weight any nuisance, as the lamp could be carried in any position as found most convenient. Mr. J. R. Williamson, who represented the Edison Company, in reply to questions, said the cost of working the lamp would be very small, as the dynamos for charging the accumulators could be driven by the colliery fan engines, and the lamps charged during the night-time ready for use the next day; he did not think, however, the lamps could be produced under 40s. each. The general opinion was that the cost of the lamp would be a serious drawback to its general adoption throughout a colliery; but it was suggested that stations might be fitted up with them in various parts of a colliery where they could be available, if needed, in case of accident.

In the coal trade there is only a dull demand for all descriptions of fuel, and although the reduction of prices in the Manchester district at the commencement of the month has not been followed by any general announced reduction in other districts, prices are weak and irregular, and at the pit mouth best coal does not average more than 8s. 3d. to 8s. 6d.; seconds, 6s. 9d. to 7s.; common coal, 5s. to 5s. 6d.; burgy, 4s. 6d. to 4s. 9d.; best slack, 3s. 6d. to 3s. 9d.; and common, 2s. 6d. per ton.

Shipping is quiet, with steam coal delivered at the high level, Liverpool, or the Garston Docks averaging 6s. 9d to 7s. per ton.

Last week the South-West Lancashire coalowners, at a special meeting, passed a resolution that a reduction in the wages of colliers was absolutely necessary, and a committee of masters was appointed to meet the men's representatives on the subject; but from what I hear it is scarcely likely that any united decisive action will be taken to carry the resolution into practical effect.

Barrow.—The most cheering news of the week is the assurance that the local shipbuilding trade is about to be revived by the placing of some important orders with local builders. The latter have been very indifferently employed for some months past, and the industry has therefore been very quiet. Numbers of both skilled and unskilled workmen have left the town because the hope of new work was not entertained, but now there is reason to believe that the chief yard at Barrow—that of the Barrow Shipbuilding Company—will soon be the scene of considerable activity. Of course orders are not actually booked, but prospects are better than they have been, and it is only a work of time to complete full arrangements. Much satisfaction is felt at Barrow at the fastest run on record, performed by the Pacific Steam Navigation Company's steamer Oroya, engaged in the Orient Line Service. She steamed from Adelaide to Plymouth in 32 days 10½ hours, although detained by dense fogs for 12 hours. It is confidently expected that the Orizala, also built by the Barrow Shipbuilding Company, will prove an equally fast steamer. I learn that the Barrow Shipbuilding Company has been asked if it will perform one of the greatest engineering feats ever attempted with steam marine in building a steamer for the Isle of Man Steam-packet Company guaranteed to travel 25 knots per hour, and that it has sent an affirmative reply. The great speed achieved by the new Manx Line steamers has doubtless led to this inquiry, but the engineering difficulties to be surmounted are very great owing to the tremendous displacement of water and the power required to propel a vessel at so high a rate of speed. However, the public generally will be interested to watch the progress of so important a step in Channel steaming. The Barrow Shipbuilding Company is, however, prepared to undertake the order. The same company has booked the order for building four triple-expansion engines, with boilers, of 1200-horse power each, for the Admiralty. The engines are intended for Government gunboats, which are being built elsewhere. There is little new to report in the iron and steel trades. Both branches of industry are busily employed, but there is not a brisk demand for pig iron. The variation between buyers' and sellers' prices is, however, very small. Makers are quoting 43s. 6d. to 45s. per ton, the latter quotation being for parcels of mixed numbers of Bessemer iron, prompt net f.o.b. The output of iron is still well maintained. There is still a good demand for steel rails, and prices this week for heavy sections are given at £4 1s. 6d. per ton net f.o.b. Blooms and billets are still in good demand, and the inquiry for steel shipbuilding material is again very brisk, with every prospect of good orders being booked. In the finished iron trade there is a quiet tone, and the price quoted remains very low. There is a poor trade in general engineering work, and boilermakers and ironfounders are still short of work. The iron ore trade remains quiet, and orders are being booked at from 8s. 6d. to 11s.—the rates which have been quoted for some weeks past. Large stocks of ore are held at the mines in the district. A fair amount of foreign ore has been imported lately, and at Barrow one of the thirteen furnaces in blast is engaged on spiegeleisen. There is no change to note in the steadiness in the coal trade. Shipping is well employed in exports of metals.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

THE recently issued ironmasters' returns show that the reduction in stocks which took place last month was considerably less than had been generally anticipated. Notwithstanding this a more cheerful tone prevails, and prices are quite as firm as at the beginning of last week. At the market held at the Exchange, Middlesbrough, on Tuesday last, buyers were freely offering 34s. per ton for immediate delivery of No. 3 g.m.b., and 34s. 3d. for delivery to the end of the month. Forge iron cannot now be had for less than 33s. per ton, and even a higher price has to be given for certain picked brands. Makers continue to quote not less than 35s. per ton, and are confident that they will be able to command that figure before long. The prospects of producers are certainly more encouraging than they have been for some time, and even finished iron makers talk more hopefully as to their future. The continued briskness in the steel trade has, without doubt, a good influence on the iron trade generally.

Stevenson, Jaques, and Co.'s current quotations:—"Acklam hematite," mixed Nos., 45s. per ton; "Acklam Yorkshire," (Cleveland), No. 3, 36s. per ton; "Acklam basic," 36s. per ton; refined iron, 48s. to 63s. per ton; net cash at furnaces.

Warrants are for some reason less firm than makers' iron, the price on Tuesday last having been 34s. 6d. per ton, as against 35s. the previous week.

The stock of pig iron in Messrs. Connal and Co.'s Middlesbrough store is increasing. The quantity held on Monday last was 332,671 tons, or 2470 tons more than on the 31st of May.

The official statistics for May show that during that month ninety-four furnaces were in blast, of which fifty were producing Cleveland, and forty-four hematite, spiegel, and basic iron. The make of Cleveland iron was 110,148 tons, and of the other kinds 108,332 tons. The total output for the month exceeded that for April by 11,353 tons. The stock of pig iron in the whole district amounted on the 31st to 619,082 tons, being a decrease of only 707 tons, as compared with what it stood at on the 1st.

The pig iron shipments for May amounted to 74,517 tons. Of this Scotland took 29,460 tons; Germany, 8415 tons; Russia, 6950 tons; Holland, 4948 tons; Italy, 4700 tons; Portugal, 3217 tons; and France, 1810. The manufactured iron and steel exported reached 57,032 tons, whereof India, the best customer, imported 22,361 tons.

It is often said that ironworkers have so severe a life that it never lasts long. There is, no doubt, a great deal of truth in this, and therefore it is with all the greater pleasure that notable and worthy exceptions are recorded. Mr. T. Siddell, one of the managers at the Consett Ironworks, and who in his youth was an ironworker, has just celebrated his golden wedding. Mr. Siddell has been forty years at the works in question, and seems as hale, hearty, and energetic as ever.

With regard to the commercial policy of Russia as regards the English iron trade, the following extract from a private letter from that country deserves to be made known. "It is almost hopeless that anything can be done here. The duties now imposed upon all imported machinery and iron and steel materials are simply prohibitive, and an increase in the taxes takes place almost monthly. I believe the object is to suppress all imports from abroad."

Merchants and manufacturers in the North of England are much exercised in their minds at the present moment with regard to the new Canadian tariff. It is of itself a serious matter, but taken in

conjunction with the prevalent tendency of foreign nations generally to do all in their power to cripple British trade, it is perplexing and disappointing indeed. It is argued that such a thing might have been expected from a nation like, say, the Russians, with whom we have little in common, and scarcely any sympathy, but coming from such warm and loyal friends as the Canadians have hitherto shown themselves to be, it is almost overwhelming. There is still a hope that the proposed measure may not be passed into law, as opposition has arisen from various parties in the Dominion, who expect to be worsened thereby. The representatives of the interests which will be adversely affected are now making their views known with no uncertain sound. If the Bill should be passed, and British imports of iron goods seriously impeded or totally prevented, there is a danger that some of our manufacturers may transfer their capital, energies, and experience to Canada itself. This has been done to a considerable extent as regards Italy, Russia, and other countries. But such a policy, though it may answer the purpose of the manufacturers who adopt it, is bad for their native land, and for their compatriots, and for the future generations which will grow up therein. It is to be hoped, therefore, that it will be discouraged as far as possible.

THE SHEFFIELD DISTRICT.

(From our own Correspondent.)

THE official return of coals brought to Hull from each colliery in Yorkshire has just been issued for May. It shows a total tonnage of 172,000, as compared with 123,704 for the corresponding month of 1886; from January to May, 1887, the quantity was 697,472 tons, against 490,392 tons for the first five months of 1886. The quantity sent by Denaby Main was 15,096 tons, against 13,160 tons for May, 1886; Allerton Main, 12,896, against 7888; Manvers Main came next with 11,880 tons, against 11,064 tons; and Peckfield, 10,496, against 3824. The export trade also shows a remarkable increase—316,526 tons for the five months ending May last, against 177,325 tons for the corresponding period of 1886. For the month the respective quantities were 80,855 and 74,515 tons. Germany, Russia, Sweden and Norway, and France are the principal increasing markets.

The Sheffield Coal Company has now placed on the market the briquettes, to which reference was made a few weeks ago. It is claimed by the company that they are the only compressed fuel in the country which is made from washed coal, and that they are in consequence exceptionally clean and free from ash, besides burning unusually well. They are made in 10½ lb. sized blocks and in smaller sizes, and the price is 7s. 11d. per ton at the pits. It will be interesting to watch the success of this experiment with what the public will soon accustom themselves to designate "coal bricks."

Sheffield is chiefly concerned at present with what is called the water campaign. Ward meetings have been held, at which the action of the Corporation in promoting a Bill for the acquisition of the Water Company's property has been endorsed, in some instances unanimously, and elsewhere with four or five dissentients. It is not expected that the Corporation will conduct the water affairs more efficiently than the company, but it is generally believed that the sanitary advantages of an abundant supply of water would outweigh all other considerations. Company and Corporation are fighting strenuously, but it would not surprise me to find, from private iuformation in my possession, that an arrangement was arrived at in the course of a week or two.

Messrs. Appleby and Co., of the Renishaw Ironworks, Derbyshire, have this week re-lighted one of their blast furnaces, which for the past six months has been standing for renovation. The managing partner of the firm, Mr. Martin Morrison, of Elton Hall, Stockton-on-Tees, performed the ceremony of lighting.

A local auctioneer, who had occasion to clear some premises the other day, came upon a mass of interesting papers in reference to foreign-made articles, chiefly scissors, brought to Sheffield to the order of Sheffield houses. These were mainly invoices of goods, and they proved—some two dozen of them shown to me—that the business in foreign scissors and other kinds of cutlery was very considerable indeed, and engaged in by merchants and manufacturers who were not supposed to encourage foreign work.

The Dore and Chinley Railway will go on. So much is settled. A private copy of the prospectus, which will be issued in a few days, has been shown to me. The capital is £1,070,000, in shares of £10 each; 10s. per share payable on application, £1 10s. on allotment, and the remainder in calls not exceeding £2 per share at intervals of not less than three months. The new line will form an important link in the Midland system, as it will become the main line of the Midland Railway between Sheffield and the South Yorkshire and Derbyshire coalfields and the port of Hull on the one hand, and Manchester, Liverpool, and other large towns in Lancashire and Cheshire on the other. The Midland has undertaken to work and use the line in perpetuity for 50 per cent. of the gross receipts, which it guarantees shall not be less than £65,520 annually, or equal to £60 per mile per week, of which sum the Dore and Chinley Company is to receive one-half, or £32,760, being sufficient to pay a minimum dividend of 3 per cent. per annum upon the authorised share capital. The company is authorised to pay interest out of capital during construction, to the extent of £70,000, which is estimated to yield 3 per cent. per annum upon the amount from time to time called up until the railway is opened for traffic. The Midland Company has subscribed £100,000, and nominated two of its directors to seats on the Board. Mr. G. E. Paget, deputy chairman of the Midland Railway, is to be the chairman of the new company. The contractors are prepared to commence at once, and to undertake to complete the works within four years.

The Nunnery Colliery Company took proceedings this week which have excited much interest in mining circles. A deputy in its service was summoned at its instance for neglecting, when he found part of the pit was unsafe, to take up two rails and cross them as a danger signal in the entrance to such place, and did not also personally warn the workpeople concerning the danger. On the 16th of May the defendant found a slight trace of gas in the workings of the pit, but omitted to place the signal, so that the colliers went past the perilous place. The defendant was fined £1 and costs.

The Sheffield Telephone Exchange makes rapid progress; the number of messages sent through during the week ending May 28th reached the unprecedented total of 41,206. This number is 19,200 messages in excess of the corresponding week last year.

Dr. C. B. Webster, who represented the United States here for many years prior to being superseded by Mr. Folsen, a cousin of President Cleveland's wife, left Sheffield this week for London. The doctor is a native of the New England States, and was American Consul in the Sheffield district for seventeen years. He was an able and conscientious officer, loyal to his own country, and thoroughly respected by all who came in contact with him. Before leaving he sent to the Weston Museum a clever and valuable statuette, entitled "The Last Shot," representing an incident of the great civil war. This will serve to remind the business men of Sheffield of a gentleman who was associated with their commercial life during the most profitable periods of American trading.

Some time ago I mentioned that a number of South Yorkshire ironworkers had made arrangements to accept employment with an Italian firm. These workmen—furnacemen and puddlers—have not made a long stay in foreign parts. They appear to have accepted employment without duly counting the cost. The arrangements in Italy with regard to wages were not what they anticipated, and they have returned to South Yorkshire. The men admit that the managers of the foreign works treated them with the utmost courtesy, and made no complaint against the Italian Company.

The Worksop Gas and Coke Company has decided to increase the storage capacity of its works by putting down a new circular tank. Eleven tenders were sent in for the work. That of Mr. A. T. Ripley, Rotherham, for £839, has been accepted, the contract for the tank being given to Messrs. Newton, Chambers, and Co., of Thorncliffe. This firm has had some very good work of this kind in hand of late, both for England and foreign countries.

NOTES FROM SCOTLAND.

(From our own Correspondent.)

THE Glasgow pig iron warrant market was dull but steady in the early part of the week. A scarcity of warrants had the effect of firming up prices whenever any orders came into the market. Later the tone gathered additional strength in consequence of reports that orders had been received for about 2500 tons of pig iron for the United States. The quality purchased was Scotch No. 1, and as the quantity was large to be ordered all at once, there was some advance in prices in the speculative market, warrants rising several pence a ton. The past week's pig iron shipments were small, amounting to only 6299 tons, as compared with 9597 in the corresponding week of 1886. Out of the total, the exports to Canada bulk largely; those to the United States being next in amount. Considerable additions continue to be made to the stocks in Messrs. Connal and Co.'s Glasgow stores. Since last report two furnaces have gone out of blast at Langloan, but an additional one has been lighted at the Clyde Ironworks.

The current values of makers' iron are as follow:—Gartsherrie, f.o.b. at Glasgow, per ton, No. 1, 48s.; No. 3, 44s.; Coltness, 53s. 6d. and 44s.; Langloan, 50s. and 45s. 6d.; Summerlee, 52s. and 42s. 6d.; Calder, 49s. 6d. and 41s. 6d.; Carnbroe, 43s. 6d. and 39s. 6d.; Clyde, 46s. and 41s.; Monkland, 43s. and 38s. 6d.; Govan, at Broomielaw, 43s. and 38s. 6d.; Shotts, at Leith, 48s. 6d. and 45s. 6d.; Carron, at Grangemouth, 52s. and 44s. 6d.; Glengarnock, at Ardrossan, 46s. 6d. and 40s. 6d.; Eglinton, 42s. 6d. and 38s. 6d.; Dalmellington, 43s. 6d. and 40s.

A very considerable amount of work of various kinds in iron and steel is being got ready with great dispatch in the West of Scotland at present, with the object of reaching Canada by the 30th current, so as to be admitted free of the additional import duty. The orders in question include one for 1000 tons of cast iron pipes placed through Messrs. William Jacks and Co., iron merchants, Glasgow, with Messrs. Thos. Edington and Sons, for the waterworks of New Glasgow, Nova Scotia.

Messrs. P. and W. M'Lellan, of the Clutha Ironworks, Glasgow, have obtained orders for wagon work for Indian railways that will keep them busily employed during at least the whole of the present year. At the close of last year, Messrs M'Lellan were obliged to discharge about a thousand workmen, owing to dull trade, and the orders now received will be of great benefit to the workpeople that reside in the vicinity of these works, many of whom have had to endure months of enforced idleness.

In the past week there was shipped at Glasgow five locomotive engines, valued at £6300, for Rangoon; machinery to the value of £12,307, of which £3965 was for a sugar mill sent to Demerara; and £6055 marine engines for Rangoon; sewing machines, £3374; steel goods, £8530; and general iron manufactures, £16,000; of which latter £4250 went to Calcutta, £2090 to Canada, and £2150 to Penang and Singapore.

There is considerable activity in the coal trade, and the week's shipments have been—Glasgow, 23,652 tons; Greenock, 1055; Ayr, 7629; Irvine, 2261; Troon, 5381; Burntisland, 14,230; Leith, 1946; Grangemouth, 17,275; Bo'ness, 11,153; Granton, 3490; and Port Glasgow, 860; total, 88,932 tons, as compared with 84,286 in the same week of 1886. For ell coal the demand is brisk, and the price for this quality as well as for steam coals is fairly well maintained, but other qualities have been less in request, and as the supplies are very abundant prices have been falling.

The Lanarkshire Miners' County Board has passed a resolution to the effect that the position of the coal trade makes it imperative to return at once to the system of ten days' work a fortnight. But in view of the approach of the summer holidays, it is not likely that the miners will carry this resolution into effect in the meantime.

Messrs. John Scott and Co., of Greenock, have received an order from the Admiralty to construct the machinery for the twin-screw gunboats Daphne and Nymph, now being built in one of her Majesty's dockyards. The engines are each to be of 2000-horse power.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

WITH reference to my remarks in this column last week on the objectionable clause in the new Mines Regulation Bill, I am glad to announce that, at an important committee meeting of coalowners and men, a well-worded amended clause was submitted to the Home Secretary, which, if adopted, will prevent the disastrous results foreshadowed by those practically conversant with South Wales mining—viz., through the stoppage of blasting operations.

In the midst of the political ferment about Home Rule in Wales it is surprising to note that the cry is principally about "tithes" and "church," while the subject of paramount consideration to all sections is omitted. This is the due representation in the home Government of men qualified to legislate for effectual government in all matters relating to mines. The coalowners have now before them three important suggestions—(1) electric lamps for mines—one coalowner has offered to take 1000 at £1 each; (2) the effectual watering of mines to prevent coal-dust from extending the effects of an explosion; and (3) Kirkhouse's "Underground Harbour of Refuge." It may be said that the Coalowners' Association are well able to select and support the best, but interests are too conflicting. In the South there are three sliding scales in operation, and unity seems afar off. The coal trade is still in a satisfactory state, and it is evident that the stream of trade diverted by the Tyne strike continues to flow in this direction. There was a large export last week from all parts, Cardiff especially, though in consequence of Whitsuntide holidays there were only four good working days. Prices remain the same for all kinds, and considering the time of the year house coal was never more active. In part this is accounted for by the weather, summer, except in a few isolated cases, having been postponed this year. Rhondda No. 3 is firm at 8s. 6d., and small steam, which occasionally shows variation, is selling freely from 4s. 6d. to 5s. Best steam commands 8s. 6d., and Monmouthshire 7s. 9d. to 8s.

Notice has been given by the men at the George Elliott Colliery, New Tredegar, to terminate contracts on June 30th. The subject of dispute has been before the Sliding-scale Committee, but they decided that it should be referred back again to the manager, Mr. Hann. The men ask for arbitration. There are questions—and probably this is one—which should be settled between the men and the management, and this appears to be the view taken by the Sliding-scale Committee.

I have to note the death of Mr. G. Martin, formerly mine agent at Dowlais, a descendant of Mr. Martin, of Swansea Valley, whose paper in the "Philosophical Transactions" of his day—something like a century ago—on the "Mineral Resources of Wales," has been the pabulum for most writers on the subject since.

Tin-plate makers in Swansea hold good orders from New York and Montreal, but the shipments this week have been fewer than usual, chiefly on account of festivities. About 2500 tons of plates were supplied this week for Baltimore and Philadelphia. The total quantity sent away from Swansea last week was 45,400 boxes. France continues a tolerable customer, and the American scare is, as I imagined, fading away. As regards prices, they are firm with, if anything, an upward tendency. Wasters are being eagerly bought up. Best brands of Siemens are in request. A number of tin-plate workers have left the district for America. The Monmouthshire works are going on regularly.

In the silver lead districts of Cardiganshire there is little doing. The price in the market is below the cost of production, and Spain is at present a successful competitor. Unless drastic changes take place in laws and arrangements, the native lead industry will go the way of the native iron mine industry. I note a large sale of properties in the Arenig district this week.

Pitwood appears to be rising in favour. The Messrs. Crawshay have sold their "pit timber woods," and the results are being utilised in every way but for pitwood. One thing is still unutilised, sawdust. There, and in other parts, mountains of sawdust are thrown away or burnt. A Builth merchant has suggested a plan of utilisation in combination with tar, but I do not know if it will prove a successful venture.

NOTES FROM GERMANY.

(From our own Correspondent.)

No important change has characterised the Rhenish-Westphalian iron market this week. Consumers continue to observe a waiting attitude, which would soon give way if indications of improvement were observable. Under the depressing circumstances, the reports from Silesia are favourable, and no furnaces have been blown out yet. The bar and plate mills have enough orders to carry them over a few weeks to come. Stocks of pig iron there are none, but as the production at present exceeds the domestic consumption of the mills and foundries, these must accumulate, and it will then remain to be seen whether new outlets can be found for this crude iron, and if not, a curtailment of production must ensue. The coal-mine owners have wisely resolved to restrict their output to the legitimate consumption. The steel works are mostly pretty well employed.

The neighbouring iron market of Austria is very firm and pretty brisk, and the prices have been constantly maintained since the beginning of this last spurt. Plates, girders, and building iron are in most request; wire rods, wire, agricultural implements, and machines in very active demand, and wrought iron tubes are soon to experience a considerable rise in price, which will be good for the Staffordshire works, though within the last year or two tubes are made at two native works. The constructive workshops are well employed, and the wagon works are about to receive some large orders for the State railways. It is gratifying to be able to record that where there is a chance, in spite of what is sometimes said about England losing its continental machinery trade, it still takes its lion's share of the work. The Ministerial report, just out, of machinery permitted to enter Austria-Hungary at half-duty for the first quarter of 1886, gives the number of machines thus admitted at 636, weighing 1762·6 t. The share for England is 1169·6 t. or 66·5 p.c.,; for Germany, 387 t., or 21·9 p,c.; Switzerland, 183·6 t., or 10·4 p.c.; France, 7 t.; Sweden, 13·4 t.; and Belgium, 2·0 t.; together, 1·2 p.c. The machines from England and Germany were principally for textile fabrics in cotton, hemp, and wool.

The Belgian iron market has continued firm through the period of strike, now for the moment ended, only to break out again when sufficient funds are subscribed, although the scarcity of coal, which had begun to be seriously felt in several industries, could not do otherwise than cause some disorganisation. The works have mostly sufficient orders in hand and new ones are being placed, and as for girders, so many are required that the mills can hardly roll them fast enough. As a rule, the Liége works are in a better position than those of the Charleroi district. Foundry pig is sold at 47f., iron plates at 130, steel ditto 165, and thin gauges up to 210 p.t. The coal trade is in a too abnormal condition to enable very trustworthy prices to be quoted, 10·50f. to 12·50f. are quoted for round coal and 11·50f. for cokes. In order to retain their old and large connection in Russia since the new tariff has upset all former arrangements, the Cockerill Company has decided, in conjunction with the Praga-Warsaw Works, to establish large ironworks in South Russia.

There appears no indication that the French iron trade is likely to improve much from its present feeble condition, yet hopes are entertained that the considerable works in progress or in prospect, amongst them extensive harbour works at Tunis, will cause a change for the better in some branches ere long, The ironmasters of the Nord have fixed the price for bars for Paris at 130f.; angles, 130; ordinary girders, 125; and extra strong ones, 135 p.t. This should oblige the Paris houses to sell bars at 140f., girders 135f., yet they do sell at 135 and 125 for the two sorts, and this just creates the damaging competition. With the exception of one or two rolling mills, the rest have nothing like regular work to go on with. Mild steel in the Haute Marne district is decidedly beginning to take the place of wrought iron, judging by the orders given out. The output of coal in the Nord department is increasing from week to week, and appears to be gradually ousting that from England, Belgium, and Germany from the market. In the Rhenish districts there is no perceptible change in iron ores to note, but as the stocks at the furnaces are all low, hopes of improvement in demand are shortly looked for with certainty, nevertheless prices are not expected to rise with it. Some kinds of pig iron have held their firmer prices, while others have become weaker. Spiegel has fallen a little for want of export opportunity, and best brands may be bought at M. 51 to 52 p.t., and a little less in some cases. Forge pig is maintained in price in Westphalia, and is very weak in the Siegerland. There is no change of moment in foundry, Bessemer, or basic pig. At the last meeting at Cologne the masters seem to have agreed about starting a common bureau for the sale of the production of pig iron. The rolling mills have still work enough in hand in general, but at non-paying prices, yet consumers hang back from placing fresh orders at the higher prices fixed, and will do so till the general coalition convention becomes an accomplished fact, the prospects for which appear good; consequently only such orders are given out as require immediate execution. No change has taken place as regards boiler plates, and since the fall in price last week, the same remark applies to thin gauge sheets; but as summer is the busy time for them, the hopes for better prospects are not given up yet. In wire rods there is nothing new. On account of the new tariff in Russia, one of the largest works here has been obliged to abandon its branch wire rod mill in Finland. In railway material there is little change to remark. On the 1st inst., at Elberfeld, 2213 t. of steel rails were awarded to the Dortmund Union Company at M. 112 p.t., Cockerill and Co. tendering at M. 113·03 and Krupp at M. 115·50 p.t. The orders for blooms and billets are becoming rare as the old ones are worked off. Some orders for wagons have been announced, namely, 160 covered goods vans, twenty-four coaches, and sixteen luggage vans. A few foreign orders have been placed at the machine shops; but the general situation of this branch is a sorry one, as nothing near enough orders come to keep them at moderately full work, and then at such exceedingly poor prices. It is noted with delight here—extracted from an English technical journal—that Japan will in future order all its mining machinery from Germany. That is a very roundabout way of getting what it requires, for all such machinery of any practical value is copied from England, except it may be some for coal-washing; and quality for quality, England would be the cheapest in the end. If the Japanese were better instructed they would apply to the fountain head. The brass foundries have been well employed last month, but at prices even lower than quoted the month before, which did not return a profit then; and the future prospects are anything but encouraging, besides the probability of the new Austrian tariff effecting the demand.

Furnace coal now costs M. 5·40 to 6, and slack down to as low as 2·60 to 3; briquettes, 6·60 to 8; cokes, according to quality, 6·80 to 8·60 p.t. The demand is good for this season of the year, the continued high Rhine assisting greatly to the result.

It appears the Gruson Company has at last fixed upon Washington as the place for establishing the branch works for making chilled projectiles and armoured forts.

NEW COMPANIES.

THE following companies have just been registered:—

Alexandra Arcade Company, Limited.

This company was registered on the 28th ult., with a capital of £8000, in £10 shares, to form an arcade between High-street and Alexandra-road, Swansea, in the county of Glamorgan, with lateral or any other communication into any contiguous street or place, and with such other communications as may from time to time be deemed necessary, and to erect a public hall or theatre in Alexandra-road aforesaid, and to form any other arcade or arcades in Swansea aforesaid, as the company may from time to time determine. The subscribers are:—

	Shares.
*T. Cory, Swansea, colliery proprietor	10
*R. Bird, Cardiff, merchant	10
E. R. Moxey, Cardiff, merchant	10
*A. Mason, Swansea, contractor	10
J. Beynon, Swansea, estate agent	10
S. Taylor, Swansea, chartered accountant	10
W. R. Collins, Swansea, solicitor	10

The subscribers denoted by an asterisk and Mr. T. Glasbrook, jun., of Norton House, Mumbles, are the first directors; qualification, 10 shares; remuneration, £100 per annum, or such larger sum as the company in general meeting may determine.

Automatic Electrical Apparatus Company, Limited.

This company was registered on the 25th ult., with a capital of £16,000, in £1 shares, to acquire the letters patent, which, when granted, will be dated 20th August, 1886, No. 10,680, for completing electric circuits, and for which provisional protection has already been granted to Mr. Percival Everitt. The subscribers are:—

	Shares.
G. Roddam Burn, 6, Bell-yard, Doctor's Commons, solicitor	1
H. D. Burn, Boyland's Oak, Streatham Hill	1
R. Bedford, South Ealing, clerk	1
A. J. Monshall, 24, Guildford-road, Greenwich, clerk	1
T. W. Vallis, 83, Lupus-street, S.W., accountant	1
R. W. Burn, Boyland's Oak, Streatham Hill	1
R. Edwards, C.E., Deal	1

The first directors are Messrs. Percival Everitt and G. R. Burn; qualification, £100 in shares; the number is not to be less than two, nor more than five. The company in general meeting will determine remuneration.

Crossgill Iron Ore Company, Limited.

This company was registered on the 28th ult., with a capital of £30,000, in £100 shares, to acquire from Messrs. J. Charters Brown, Wm. Burnyeat, jun., and Wm. Dalzell, the Crossgill Mines, situate at Frizington, parish of Arlecdon, Cumberland. The subscribers are:—

	Shares.
*J. Vivian, C.E., St. Bee's	1
*T. S. Douglas, Workington	1
*W. Burnyeat, jun., Whitehaven, merchant	1
*J. Hartley, Beckermet, merchant	1
*J. Moore, Egremont, merchant	1
*William Dalzell, Linethwaite, merchant	1
*W. Salmon, Mitside, merchant	1
*H. Kitchen, Whitehaven, dynamite agent	1
*G. W. Kenworthy, Whitehaven, merchant	1

(All in the county of Cumberland.)

The number of directors is not to be less than five, nor more than nine; the subscribers are the first. The company in general meeting will determine remuneration.

Domestic Battery Syndicate, Limited.

This company was registered on the 28th ult., with a capital of £20,000, in £10 shares, to acquire letters patent for improvements in galvanic and other batteries for all or any purposes in connection with the supply of light, heat, or motive power, by electricity. The subscribers are:—

	Shares.
J. W. Vickers, 5, Nicholas-lane, advertising contractor	20
Major W. F. Despard, 40, Hampstead-hill-gardens	10
J. Kirkwood, 9, Gracechurch-street	15
Vice-Admiral E. Howard, 16, Granville Park, Lewisham	5
B. Depledge, 3, Gracechurch-street, secretary to a company	10
J. C. Merryweather, 63, Long Acre, engineer	10
J. J. Shedlock, C.E., 9, Gracechurch-street	5

The number of directors is not to be less than three, nor more than seven; the subscribers are to appoint the first and act *ad interim;* qualification, 10 shares or £100 stock. The company in general meeting will determine remuneration.

Freshwater and Totland Bay Gas Company, Limited.

Registered on the 28th ult., with a capital of £5000, in £10 shares, to supply gas and gas products at Freshwater and Totland Bay, Isle of Wight. The subscribers are:—

	Shares.
H. C. Damant, West Cowes, solicitor	1
W. R. Parker, Penwith, contractor	1
W. R. Geere, Newport, contractor	1
J. Geere, Newport	1
T. Pedrette, Queen's-road, Finsbury Park, contractor	1
H. Marchant, 59 and 60, Tower-chambers, Moorgate-street, quarry proprietor	1
H. Harraden, 3, Hill's-place, W., East India agent	1

Registered without special articles.

Great George-street Chambers Company, Limited.

This company proposes to acquire certain buildings, the subject of a contract to be entered into with Richard Elisha Farrant. It was registered on the 1st inst., with a capital of £10,000, in £10 shares. The subscribers are:—

	Shares.
R. E. Farrant, 2, Park-square West, N.W., director of a company	1
Mrs. F. Farrant, 2, Park-square West, N.W.	1
F. T. Pilkington, 8, Russell-square, architect	1
E. C. Pilkington, 8, Russell-square, architect	1
W. Morris, jun., 6, Old Jewry, solicitor	1
W. T. Martin, 16 and 17, Cliffe, Lewes, chemist	1
J. T. Ford Bishop, 39, Market-street, Manchester, manager of fancy stores	1

The number of directors is not to exceed three, the articles also providing that the number "shall never be less than one;" qualification, £250 in shares. The company in general meeting will determine remuneration. Mr. Farrant is appointed life director, and so long as he may be willing to act alone will be the sole director.

San Cristobal Railway and Uribante Navigation Company, Limited.

This company was registered on the 1st inst., with a capital of £800,000, in £10 shares, to acquire a concession dated 19th April, 1886, granted by the President of Venezuela to M. Leon de Jaybert for the establishment of a railway from the town of San Cristobal, and for removing obstructions which may impede the navigation of the river Uribante for ordinary river craft, and for the navigation of that river and the river Apure to its junction with the Orinoco. The subscribers are:—

	Shares.
Dudley Raikes de le Chair, 11, Brewster-gardens, North Kensington	1
H. W. Paul, 32, Craven-terrace, Lancaster-gate, insurance broker	1
R. Papineau, C.E., 23, Warwick-road, Clapton	1
J. Eddowes, Leadenhall House, shipbroker	1
Albert Watkins, 4, Great St. Helen's, colliery agent	1
R. A. Hudson, 117, Leadenhall-street, secretary to a company	1
L. Beale Harvey, F.S.A., St. Margaret's, Herts, accountant	1

The number of directors is not to exceed seven; the subscribers are to appoint the first, and are to act *ad interim.* The company in general meeting will determine remuneration.

PHYSICAL SOCIETY.—At a meeting of this Society held on May 28th, Dr. S. P. Thompson read a "Note on Transformers for Electric Distribution." In the simple algebraic treatment of the dynamo several assumptions approximately true for well-made machines are made use of. The author finds that a similar set of assumptions for transformers greatly simplifies the algebraic theory. (1) The iron, copper, and insulation are assumed good. (2) The reaction of the secondary on the primary—other than that desired—is small. Thus if the primary be supposed to be supplied with constant mean current or constant mean potential difference, this is not to be altered by the current in the secondary. (3) No magnetic leakage, so that the coefficient of mutual induction is the geometric mean between their coefficients of self-induction. (4) The quantities of copper in the primary and secondary are to be equal. These assumptions are shown to be legitimate, and the ratios of resistances, E.M.F.'s, currents and coefficients of self-induction are expressed in terms of the ratio of the numbers of convolution, which ratio is represented by $p = \frac{S_1}{S_2}$. From analogy with the dynamo, it is shown that $E_2 = \frac{\omega M}{\sqrt{R_1^2 + \omega L_1^2}} E_1$, where $\omega = 2\pi n$, E_1 and E_2 the E.M.F.'s of the primary and secondary respectively, and R_1 and L_1 the resistance of self-induction of the primary coil. If R_1 be negligible, the above reduces to $E_2 = \frac{\omega M}{\sqrt{\omega^2 L_1^2}} = \frac{E_1}{p}$, since $\frac{L_1}{L_2} = p^2$ and $M = \sqrt{L_1 L_2}$. The latter part of the paper contains a general investigation of two neighbouring circuits, both having self-induction; and it is shown that the effective resistance of the primary is increased and the self-induction decreased by closing the secondary circuit. Mr. Gisbert Kapp said the coefficients of induction were not constants, as assumed, and the phases of current in primary and secondary were opposite; and asked what values were to be taken. Mr. Swinburne said the required data as to induction could be obtained much more accurately from Dr. Hopkinson's curves on magnetisation of iron.

SOCIETY OF ENGINEERS.—At a meeting of this Society, held on the 6th June at the Westminster Town Hall, Professor Henry Robinson, President, in the chair, a paper was read on the "Renewal of Roof over Departure Platform at King's-cross Terminus, G.N.R.," by Mr. R. M. Bancroft. A brief history and description was given of the construction of the old laminated timber roof, erected in 1851-2, according to the system introduced by Colonel Emy, a French military engineer. After pointing out the entire absence of ventilation in the old roof and other causes of decay, the author described the movable staging now being employed in the erection of the ribs for the new iron roof, the way in which it is moved from bay to bay as the work proceeds, and the means adopted for supporting the superstructure of staging so as to give a clear headway for locomotives, &c., and not to interfere with the departure passenger traffic. Reference was then made to a similar roof over the old G.N.R. passenger station at Bradford, its span, distance apart of main ribs, the weight per bay of 20ft. being given. The construction, hoisting, and fixing in place of the new wrought iron ribs were described, and it was pointed out that they have to be made to fit the existing cast iron spandrils and stanchions built into station walls. The construction and fixing of the lattice and trussed purlins, and the gangways adopted to give greater facilities for workmen in repairing and cleaning the glass covering, were also described. The author remarked on the absence of windbracing, and gave the reasons for not using it. He also described the method of glazing, both with putty for the roof generally and with Helliwell's patent puttyless glazing at the louvre. Diagrams were exhibited showing the general form of the roof and the movable staging, and the working drawings were also laid upon the table for reference, by the kind permission of Mr. Richard Johnson, M. Inst. C.E., chief engineer of the Great Northern Railway, under whose instructions the work is being carried out by Messrs. A. Handyside and Co., contractors, of Derby and London.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

Application for Letters Patent.

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

31st May, 1887.

7842. SIGNALLING by NIGHT at SEA, A. Taylor, Liverpool.
7843. AUTOMATICALLY INDICATING ANGLES of INCLINATION, T. M. Clarke, Manchester.
7844. GIG MILLS, E. Michaelis, A. Smethurst, and C. Wood, Manchester.
7845. FLAX-SPINNING MACHINERY, L. M. Laine, Shrigley.
7846. DOVETAILING MACHINES, J. Anderson, Newcastle-on-Tyne.
7847. PREPARING, &c., COTTON, T. R. Young, Manchester.
7848. WHEEL, T. R. Weston, Bristol.
7849. COPYING MACHINES, P. J. Cairns, London.
7850. THE WORLD'S EDUCATOR, W. S. Reed, London.
7851. KNIFE CLEANER, J. Smeeton and W. and E. Blackburn, Bradford.
7852. STOPPERING BOTTLES, S. Bunting, Dublin.
7853. AUTOMATIC PLATFORM WEIGHING MACHINES, J. K. Leather, Liverpool.
7854. RAISING or FORCING BEER, &c., R. Henderson and W. Fleming, Glasgow.
7855. COOKING RANGES, W. Dickson, Glasgow.
7856. AUTOMATIC CAR COUPLINGS, J. Coup, London.
7857. REGISTERING METRES for ELECTRIC CURRENTS, H. Tudor, Liverpool.
7858. BUTTON-HOLE STRIPS for BOOTS and SHOES, G. Valiant, London.
7859. CARBONATE of SODA, L. A. Staub, Liverpool.
7860. GRAIN SCOURING and CLEANING MACHINES, J. Yates, Liverpool.
7861. BOOTS and SHOES, G. Valiant, London.
7862. UNBURRING DEVICES for DEVILLING MACHINES, P. L. Klein, London.
7863. CARVING FORKS, H. J. H. Thomas, Sheffield.
7864. LOCKING and FRICTION-REDUCING DEVICES, H. C. Longsdon, Keighley.
7865. DYNAMO-ELECTRIC and ELECTRO-DYNAMIC MACHINES, F. George, Gloucestershire.
7866. PROPELLING and STEERING VESSELS, G. Chapman, Glasgow.
7867. PRIMARY DISTILLING APPARATUS, W. M. Fraser and J. Snodgrass, Glasgow.
7868. SWIVELLING CHAIRS, D. Cowan and A. Robertson, Glasgow.
7869. ARTIFICIAL FEATHERS, C. Brohl, London.
7870. NECKTIE HOLDER, F. Elton and J. Barber, London.
7871. ROTARY HAND KNIFE SHARPENER, G. H. Frearson, London.
7872. MACHINE for FELLING TREES, W. E. Rickard, London.
7873. RIFLE or GUN RACK, W. E. Bannett, London.
7874. LOCK-NUTS, J. J. Claret, London.
7875. AIR CUSHION HANDLES for BICYCLES, &c., J. T. Trench, London.
7876. SWITCH for ELECTRIC LIGHTING, J. H. Hawksworth, London.
7877. WEAVING TEXTILE FABRICS, S. C. Hooper, near Stroud.
7878. EXCAVATING MATERIALS from TRUCKS, &c., L. P. Nott, London.
7879. POCKET REEL NEEDLE-CASE, W. G. Wallis, London.
7880. CHECKING and INDICATING GATES or WICKETS, J. Smith, W. Johnson, and J. Knighton, London.
7881. LOCKING FISH-PLATES, E. W. Hughes, London.
7882. PORTABLE FROGS for RAILWAYS, W. O. Cooke, London.
7883. PREPARING RICE for BREWING, &c., A. W. Gillman and S. Spencer, London.
7884. SHEATHING, W. M. Ducker, London.
7885. GAS LAMPS and BURNERS, P. M. Justice.—(*E. Stein, United States.*)
7886. METAL WATER TANKS, A. E. Barthel, London.
7887. ELEVATED RAILWAY, &c., TANKS, A. E. Barthel, London.
7888. FLEXIBLE DRIVING GEAR, F. Y. Wolseley, London.
7889. BALL TURNING LATHE, T. Draper, London.
7890. LOCK for the BOLTS of PISTONS, J. Wormald and J. Wormald, jun., London.
7891. WATCHES, G. E. Hart, London.
7892. FORKS for CLEANSING WOOL, E. van der Hofstadt, London.
7893. SCREW PROPELLERS, W. Huett, London.
7894. HANDLES for VELOCIPEDES, &c., T. B. Jeffery, London.
7895. PORTABLE CANTEEN, J. F. Gillett, London.
7896. DISTILLATION, A. M. Coyle, E. F. Andrews, and E. C. Davidson, London.
7897. LEWIS, F. Hughes, London.
7898. ROLLING WHEEL TIRES, H. H. Lake.—(*J. Munton, United States.*)
7899. ROLLING MILLS, H. H. Lake.—(*A. and F. Schneiderlocker, United States.*)
7900. SHOVELS, J. Pfeifer, London.
7901. STEAM BOILERS or GENERATORS, I. M. Chase, London.
7902. ROLLING BLOOMS, H. H. Lake.—(*J. Munton, United States.*)
7903. RIVETTING MACHINES, J. L. Thomson and J. Hunter, London.
7904. BEER ENGINES, J. A. Bigelow, London.
7905. DENTAL PLATES, H. H. Lake.—(*C. McLean, United States.*)
7906. PRODUCING HYDRATE of BARYTA from SULPHATE of BARIUM, R. Schneider, London.

1st June, 1887.

7907. FLUID RESERVOIR, A. E. Barthel, London.
7908. GAZOMETER, A. E. Barthel, London.
7909. ADJUSTABLE WATCH KEYS, &c., J. G. Harris, Birmingham.
7910. HEATING SURFACE of BOILER FLUES, J. R. Robson, Leeds.
7911. AUTOMATIC VATS, W. Brierley.—(*R. Persina, Germany.*)
7912. RAILS, H. J. Morriss, London.
7913. HAT STAND, R. H. Bishop, Stroud.
7914. INSTANTANEOUS LOG, R. Rood, Portswood.
7915. SURGICAL TRUSS, R. Harrison, Dublin.
7916. WASHING MACHINES, W. Dewar and W. B. Mair, Glasgow.
7917. LOOMS, C. Hahlo, C. E. Liebreich, and T. Hanson, Halifax.
7918. PICKER PRESERVERS for LOOMS, J. W. Howard, Halifax.
7919. MOWING MACHINES, C. J. Bosanquet and W. A. Tomlinson, Lincoln.
7920. FASTENING CORDS for WINDOW BLINDS, T. B. Hinckesman, Bridgenorth.
7921. KNIFE-CLEANING MACHINES, J. Harrison, Stamford.
7922. SPINNING MACHINERY, J. Y. Johnson.—(*La Société A. Grandjeans et Cie., France.*)
7923. AUTOMATIC DISC BILLIARD SCORER, S. Long, London.
7924. SHIELD for MINERS' SAFETY LAMPS, W. G. Jackson, London.
7925. GAS ENGINES, R. Wallwork and T. Sturgeon, London.
7926. TESTING, &c., MANUAL SPEED, &c., J. C. Sellars, Liverpool.
7927. STRETCHING ROLLING PAPER, C. F. Thomson, Sunningdale.
7928. TRACTION ENGINE CHIMNEYS, W. Arnold, Skelmersdale.
7929. TENNIS and other BALLS, H. Swales, Manchester.
7930. EMERY CLOTH, &c., J. C. W. Stanley and W. D. Butler, London.
7931. DEMI-JOHN and CARBOY CASES, W. P. Thompson.—(*R. A. Marshall, United States.*)
7932. RHEA and other FIBRE, G. I. J. Wells and S. L. Howard, Liverpool.
7933. CUTTING TEXTILE FABRICS, &c., E. Law, Liverpool.
7934. SWITCH, A. B. Gill, Lewisham.
7935. LANDING STAGES, M. N. Ridley and G. F. Blackmore, London.
7936. PISTON VALVES, W. Payton, Richmond.
7937. MAGAZINE GUNS, F. Stock, London.
7938. STEAM BOILERS, T. Hipkins, London.
7939. MAKING COVERS for BOTTLES, &c., J. M. Baker, London.
7940. LOADING of HEAVY GUNS, J. T. Williamson, London.
7941. PUNCHING HOLES in METAL, E. T. Ash, London.
7942. STRINGED MUSICAL INSTRUMENTS, A. M. Clark.—(*J. S. Morgan, United States.*)
7943. DOOR SCRAPER, A. H. Williams, London.
7944. CANDLE-HOLDER and REFLECTOR, H. S. Sitwell, London.
7945. COMMUNICATING on RAILWAY TRAINS, P. Daley, London.
7946. SEWING MACHINE, W. S. Oliver, London.
7947. MOVABLE STERN DOCK for STEAMERS, A. C. Boothby, London.
7948. CLEANING the BOTTOMS of VESSELS, A. C. Boothby, London.
7949. CENTRIFUGAL BOLTING REELS, O. Imray.—(*Z. C. Eldred, United States.*)
7950. TELEPHONES, D. J. Smith and H. F. Jackson, London.
7951. POWER PRESSES, H. H. Lake.—(*N. C. Stiles, United States.*)
7952. ATTACHING ROPES, R. R. E. Drake-Brockman, London.
7953. ELECTRIC SIGNALLING, G. Conz, London.
7954. SEWER FLAPS, E. Anthony, Brentford.
7955. PNEUMATIC HOOK and SPRING CLIP, A. C. Morgan, London.
7956. PETROLEUM and other LAMPS, S. Siemang and A. Breden, London.

2nd June, 1887.

7957. REDUCING VIBRATION in the HANDLES of CYCLES, &c., G. Burgess, Coventry.
7958. COMBINED LANTERN and WALKING STICK, H. G. Forbes, Bitton, near Bristol.
7959. FLOOR COVERINGS, &c., G. H. Levis, London.
7960. LIFTER APPARATUS for SPINNING and other MACHINES, W. T. Garnett, Bradford.
7961. FIXING TAPS in BARRELS, &c., W. Cook, Redditch.
7962. STEAM HOISTING ENGINES, G. Donkin and B. G. Nichol, Newcastle-on-Tyne.
7963. STEAM STEERING APPARATUS, G. Donkin and B. G. Nichol, Newcastle-on-Tyne.
7964. SEWING MACHINES for CUTTING, &c., BUTTONHOLES in FABRICS, A. Anderson and R. A. F. Pollock, Glasgow.
7965. CUTTING and DRESSING STONE, J. Ogg, Glasgow.
7966. INLAID FLOORS, W. Boelling, London.
7967. CANNON, A. J. Boult.—(*E. J. Blood, United States.*)
7968. APPLYING COAT of ARMS to PANELS, &c., W. Gunningham, Liverpool.
7969. CASES for DISPLAYING PROVISIONS, &c., G. French, London.
7970. SASH FASTENERS for WINDOWS and CASEMENTS, A. Easthope, London.
7971. VELOCIPEDES, T. Humber, London.
7972. CARRYING a RIFLE and BAYONET on a BICYCLE, T. Humber, London.
7973. CASES for DISPLAYING PROVISIONS, &c., G. French, London.
7974. SIGNALLING from PIERS, &c., D. McGregor, Glasgow.
7975. SECONDARY BATTERIES or ACCUMULATORS, L. C. E. Lebiez, London.
7976. CHIMNEY POTS for the PREVENTION of DOWN DRAUGHTS, W. Haworth, London.
7977. POTS employed in COATING TIN and TERNE PLATES, R. Martin, London.
7978. MACHINE for CLEANING KNIVES and FORKS, J. F. C. Boyes.—(*H. Boyes, France.*)
7979. PLATES for PRINTING from, K. Klic, London.
7980. TREATMENT of PAPER for DRAWING PURPOSES, K. Klic, London.
7981. PORTABLE FENCE for GARDENS, &c., E. L. White and J. W. Stansfield, London.
7982. TELEPHONIC INSTRUMENTS, C. L. W. Fitzgerald, London.
7983. BRUSH STOCK, J. Root, London.
7984. PORTABLE and ORNAMENTAL COAL-BOXES, T. Robb, Glasgow.
7985. ADJUSTABLE SPANNER or SCREW-KEY, W. Wall, Bradford.
7986. SAFETY INDICATOR or ALARM, M. Bailey, London.
7987. CORSETS, J. Lakeman, London.
7988. LAMPS, W. Rowsell, London.
7989. OPENING, &c., the BREECH of GUNS, A. Noble, C. B., and R. T. Brankston, London.
7990. INCANDESCENCE GAS-BURNERS, J. Imray.—(*C. Clamond, France.*)
7991. MOTIVE POWER for TOYS, W. H. Hall, London.
7992. DELIVERY BOXES for NEWSPAPERS, &c., M. A. Katz, London.
7993. TACKS, &c., L. A. Denille, London.
7994. PENCIL-HOLDERS, &c., H. H. Lake.—(*L. H. Malzard, France.*)
7995. STENCIL COPYING APPARATUS, F. W. Zimer, London.

3rd June, 1887.

7996. MACHINERY for BOOTS and SHOES, W. Ross and J. Bilbie, London.
7997. FIGURED CLOTH for LADIES' MANTLES, &c., T. R. Ashenhurst, Bradford.
7998. WASHING ORES, M. Kennedy and G. Green, Glasgow.
7999. ASH-PANS, J. J. Green, Halifax.
8000. BRAKE MECHANISM for LOOMS, R. Whalley and W. Wells, Blackburn.
8001. SUSTAINING PEDAL for PIANOFORTES, &c., T. S. Ogilvy, Southsea.
8002. SIGNALLING, W. Grainger and C. Alvey, Birmingham.
8003. PLAQUES for TEAPOT STANDS, L. A. Holmes, Blackpool.
8004. CLEANING TIN, &c., PLATES, J. Williams, Bryn-y-Coed.
8005. COMBUSTION of OIL, H. Keevil, Bath.
8006. MARINE SOUNDING APPARATUS, R. Holdsworth, Hull.
8007. CAB WINDOWS, W. E. Carmont, Ardwick.
8008. PREPARING FARINACEOUS SUBSTANCES, T. A. Marshall, Glasgow.
8009. PLATE for SCREW, &c., CASTORS, G. Wakeman, Birmingham.
8010. TIME MEASURERS for COOKING PURPOSES, J. T. M. Burgess, Birmingham.
8011. CALL and other RINGING BELLS, A. Nicholas, Birmingham.
8012. CUTTING or DIVIDING CARD CLOTHING and FIXING the same on CARDING ENGINES, J. Heginbottom, Oldham.
8013. FEEDING-BOTTLES, E. de Pass.—(*P. Rougeot, France.*)
8014. RAILWAY SIGNALLING, H. Morris, Manchester.
8015. CAR DOOR FASTENER, E. B. Searles, London.
8016. IMPERISHABLE OPAL LETTER, A. H. Hull, London.
8017. SEWING MACHINES, H. Sommerfeld and F Hensel, London.
8018. TROUSER STRETCHERS, G. F. Avent and R. S. Wright, London.
8019. STOPPERS for BOTTLES, JARS, &c., H. Barrett, London.
8020. PUNCTURING the CLOSE ENDS of CIGARS, J. J. P. and E. P. Hides, Sheffield.
8021. LASTS for BOOTS, &c., E. and J. F. Atkinson Sheffield.

8022. Driving Mechanism of Tricycles, H. T. Pearce, London.
8023. Digging, &c., and other Ploughs, T. Corbett, London.
8024. Preservation of Woods, J. Stevenson.—(*J. Salvat, France.*)
8025. Tea and Coffee-pots, W. Robertson, Glasgow.
8026. Hauling Gear, E. Dutton, Glasgow.
8027. Drawing Appliances, A. Augsburg, London.
8028. Antiseptic Automatic Dry Closet, C. Webb, London.
8029. Top or Cover for Lamps, G. T. Wooldridge, London.
8030. Folding Carriage Chair, J. Priest, London.
8031. Distempering, R. Gould, London.
8032. Tools for Cutting Wire, &c., L. Vorpahl and H. Pohl, London.
8033. Lubricators, R. Wappler and A. Richter, London.
8034. Pincers, F. H. Schilbach, London.
8035. Lubricant-box and Runner, J. W. Stansfield, London.
8036. Indicating Names and Streets, J. W. Stansfield, London.
8037. Recreation by Sliding in all Seasons, J. W. Stansfield, London.
8038. Novel Sport or Pastime, J. W. Stansfield, London.
8039. Tell-tale for Registering Payment, J. W. Stansfield, London.
8040. Sardine Tin Opener, M. Wilson, London.
8041. Paper-making, W. B. Nation and J. J. Worswick, London.
8042. Wheels, H. E. Ludwig, London.
8043. Automatic Lathes, E. Davis.—(*G. and E. Heyne, Germany.*)
8044. Cocks or Faucets, H. H. Lake.—(*H. Ogden, United States.*)
8045. Determining the Percentages of Clean Wool, E. Jaegermayer, London.
8046. Meter, P. Jolin, Bristol.
8047. Fixings for Stop-nets or Fence Nets, J. Osmond, London.
8048. Steam Engine, G. A. de Pennings, London.
8049. Automatic Lathes, E. Davis.—(*G. and E. Heyne, Germany.*)
8050. Preventing Corrosion in Boilers, A. J. Marquand, London.
8051. Cushioning Valve for Pumps, J. S. Wyndham, London.
8052. Disappearing Gun Carriages, A. Noble, C.B., and C. H. Murray, London.
8053. Firing Mechanism, C. A. McEvoy, London.
8054. Pulverisers, G. Little, London.

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8055. Roofing, W. P. Thompson.—(*O. Poppe, Saxony.*)
8056. Separating Dust from Air, L. B. Fiechter.—(*C. M. Hardenbergh, Minnesota.*)
8057. Link Motion for Valves, J. McG. McCulloch, Liverpool.
8058. Fabrics, W. P. Thompson.—(*The Vereinigte Filz fabriken, Germany.*)
8059. Electric Arc Lamps, F. C. Phillips and H. E. Harrison, London.
8060. Revolving Shutter for Shafts, &c., F. H. Smith, Belfast.
8061. Releasing the Candle Tubes of Lamps, A. Jagger, Birmingham.
8062. Weaving of Long-pile Fabrics, J. Taylor, Manchester.
8063. Preserving Crustacea, J. C. Mewburn.—(*J. J. Bate, United States.*)
8064. Brushes, R. Condron, London.
8065. Circular Fleet of Sailing Ships, W. Jones, Birmingham.
8066. Gas Motor Engine, J. Middleton, Glasgow.
8067. Explosives, T. G. Hart, Bath.
8068. Socket for Incandescent Loop Lamps, H. Bayley, Walsall.
8069. Automatic Boxes, W. Sunderland, Birmingham.
8070. Carriages, W. D. Stephens, Newcastle-upon-Tyne.
8071. Carriages, W. D. Stephens, Newcastle-upon-Tyne.
8072. Coke Grape, T. Herron, Blaydon-on-Tyne.
8073. Stoppers for Boiler Tubes, J. Noble, Glasgow.
8074. Parlour or Indoor Football Game, C. B. Suffield, Leeds.
8075. Treatment of Stockinette Fabrics, O. Lupton, Bradford.
8076. Holders for Incandescent Lamps, R. T. Turnbull, London.
8077. Horseshoe, D. MacWhinnie, London.
8078. Bottling, &c., Beer, W. Paterson and R. Starke, Glasgow.
8079. Steam Regulating Contrivance, E. Klein, Berlin.
8080. Protection of Ships, J. J. Talman.—(*C. G. Blackburn, West Africa.*)
8081. Pack Saddles, H. R. Stewart, London.
8082. Production of Letters, &c., on Enamelled Surfaces, B. Baugh, London.
8083. Handle for Carrying Parcels, G. A. Nussbaum, London.
8084. Screws, F. S. Lees, London.
8085. Military Valise, E. S. Bulfin, London.
8086. Cable Sleeves, J. G. Lorrain, London.
8087. Locking Devices for Sportsmen's Knives, F. Weintraud, London.
8088. Electric Alarm Devices, A. Zettler, Manchester.
8089. Typographical Printing Machines, F. Moritz, Manchester.
8090. Distillation of Tar or Oil, F. Lennard, London.
8091. Revolvers, F. Praunegger, London.
8092. Tube Cutter, O. F. Martin and W. P. Dean, London.
8093. Hydatoid Motor, A. Fehlen, London.
8094. Wheels, R. Varty, London.
8095. Chalk-holder for Billiards, H. M. B. Beevor, London.
8096. Safety Apparatus for Elevators, A. Stigler, London.
8097. Slide-valve Mechanism, A. Tolhurst and H. Skinner, London.
8098. Toilet Papers, W. Wooton, London.

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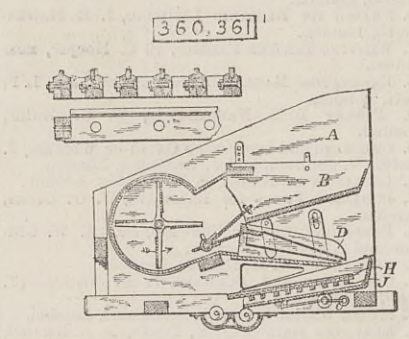
8099. Looms for Weaving, J. Ingham and W. Simpson, London.
8100. Hydatoid Motor, A. Fehlen, London.
8101. Steel Furnaces, J. Garvie, jun., London.
8102. Weaving Pile Fabrics, O. Drey, Manchester.
8103. Lockstitch Sewing Machines, G. T. Tugwell, Redhill.
8104. Retaining Tidal Waters, E. Lightowler, Liverpool.
8105. Spring Gun, W. Terry, Blackpool.
8106. Looms for Weaving, R. A. Whytlaw and J. Kincaid, Glasgow.
8107. Folding Boxes, E. H. Chesterton, Birmingham.
8108. Automatic Lubricator, A. M. Levy.—(*J. B. Fondu, Belgium.*)
8109. Loop for Hanging Coats, W. Fereday, Birmingham.
8110. Step Gratings, L. P. Cohen and E. Herrmann, London.
8111. Frames for Spinning, &c., W. R. Laing, Glasgow.
8112. Spring Fork for Tricycles, &c., J. J. Keating, Dublin.
8113. Pumping Engines, H. Davey, London.
8114. Portmanteaus, F. Bennett, London.
8115. Shaving Pots, &c., T. Lumb, F. Claughton, and W. Claughton, London.
8116. Fluid Pressure Engines, T. Moy, London.
8117. Shaft Disengaging Gear, &c., H. le B. Gunner, London.
8118. Disengaging Tow-ropes, &c., W. Balch and F. Hargrave, London.
8119. Indestructible Side-drum, W. H. Hanson, Portslade.
8120. Permanent Ways of Railways, &c., M. Archer, London.
8121. Ice Caves or Refrigerators, H. Y. Dickinson, Newbury.
8122. Cranes, S. S. Sugden, Woodford.
8123. Non-intoxicating Drinks, W. H. Symons and T. H. Williams, London.
8124 Anchors, H. P. Parkes and J. Hartness, London.
8125. Button Fasteners, A. J. Boult.—(*E. Kempshall, United States.*)
8126. Chlorine Batteries, P. A. Fichet and A. Nodon, London.
8127. Ice Cream Freezers, A. J. Boult.—(*W. Tunstill, United States.*)
8128. Shuttle Pickers for Looms for Weaving, A. J. Fabre, Liverpool.
8129. Carbonates of Soda, L. A. Staub, Liverpool.
8130. Railway Chair Keys or Wedges, R. M. Eastman, Liverpool.
8131. Lozenge Machines, A. J. Boult.—(*T. Robertson, Canada.*)
8132. Photographic Apparatus, E. de Pass.—(*M. Carquero, France.*)
8133. Drawing Wire, A. S. and T. Bolton, London.
8134. Bearding, Scouring, and Polishing Grain, G. S. Dowd, London.
8135. Plaiting Attachments for Sewing Machines, S. S. Bromhead.—(*C. W. Dudley, United States.*)
8136. Cover for Cooking Vessels, S. S. Bromhead.—(*A. C. Cary, United States.*)
8137. Seats for Outdoor Use, E. F. J. Callaghan, London.
8138. Cutting Hair of Horses' Tails, T. Everitt, London.
8139. Rollers for Agricultural Purposes, J. W. Lee, London.
8140. Stair Treads, &c., W. D. Bohm, London.
8141. Electric Arc Lamps, E. Domon, London.
8142. Hats or Bonnets, P. Haddan.—(*M. M. Jorsin frères, France.*)
8143. Umbrellas, H. J. Haddan.—(*W. Baumgarten, Germany.*)
8144. Bottle Holder or Clip, M. T. Hatchett, London.
8145. Galvanic Batteries, D. Skrivanow, London.
8146. Railway Couplings, A. M. Clark.—(*J. G. Clarkson, United States.*)
8147. Mirrors, P. Hufeland, London.
8148. Automatically Extinguishing Lamps, A. Breden, Vienna.
8149. Automatically Extinguishing Lamps, I. Kohn, London.

SELECTED AMERICAN PATENTS.

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

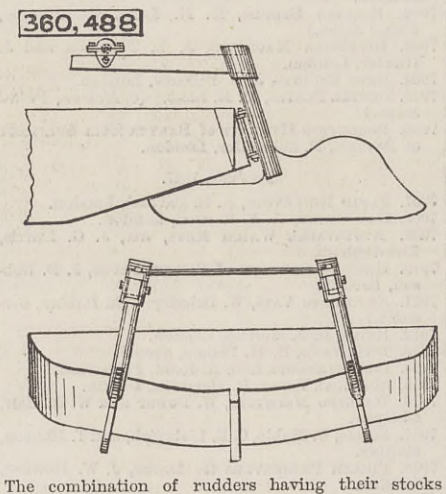
360,361. Grain Cleaner, *L. Prevost, Champoeg, Oreg.* —*Filed August 27th*, 1885.

Claim.—(1) A grain cleaner comprising the chute B, the inclined shoe D, the fan, the wind board, the reciprocating frame H, provided with a screen, and the stationary frame having a series of bars with wipers attached thereto, the parts being organised substantially as shown, and for the purpose set forth. (2) The combination, with a grain cleaner, of a reciprocating frame H, provided with a screen, and a stationary frame J, located in the main frame, and having a series of bars, each comprising two sections, between which are clamped flexible wipers, substantially as set forth.



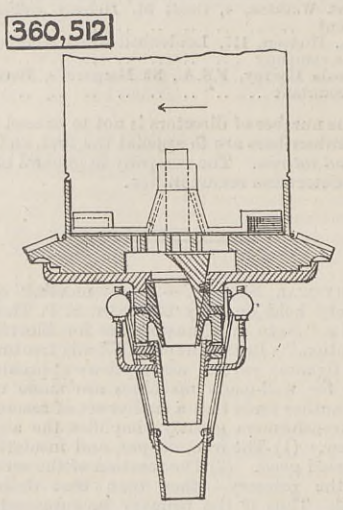
360,488. Rudder for Boats, *John M. Wheeling, W. Va.*—*Filed July 10th*, 1886.

Claim.—(1) The combination of a balanced rudder and a stock, the latter being hung to the stern of a boat in a line at right angles with the plane of rise thereof and arranged in the same plane with the rudder blade, substantially as and for the purposes described. (2) The combination of a balanced rudder and a stock, the latter being hung to the stern of a boat in a line at right angles with the plane of dead-rise and at right angles with the plane of the stern-rake thereof, and arranged in the same plane with the rudder blade, substantially as and for the purposes described. (3) The combination of rudders having their stocks inclined to each other and a shank or connecting-rod joining these rudders, and connected therewith by ball-and-socket joints, substantially as and for the purposes described. The combination, with the hull of a boat, of a balanced rudder, the forward part of the blade of which is contiguous, or nearly contiguous, with the hull, and arranged to afford a widening space from the contact point to the rudder stock, substantially as and for the purposes described.



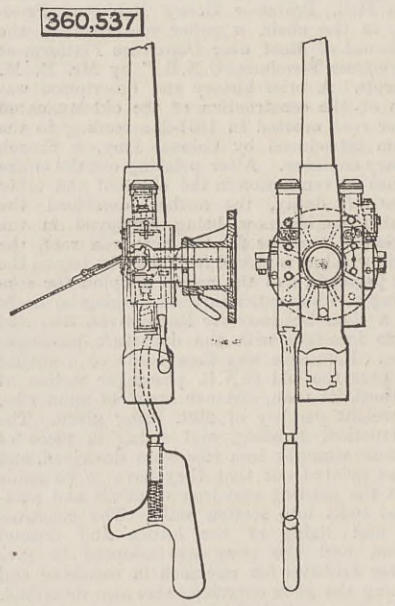
360,512. Feeding Mechanism for Automatic Weighing and Package-filling Machines, *Clement C. Clawson, Newark, N.J.*—*Filed October 8th*, 1886.

Claim.—(1) The rotary feeder provided with an annular slot or groove formed therein, in combination with the hopper arranged to supply the material to said slot or groove, the stationary scraper or cutter in the said slot or groove to remove the material therefrom, and the stationary plate or guard arranged to retain the material in the slot or groove until it reaches the delivery point, substantially as described. (2) The combination, with the hopper and a rotary feeder provided with an annular feeding slot or groove formed therein, of a packer to force the material in the hopper into said slot or groove, and a scraper or cutter placed at the point of delivery to remove the material from said slot or groove, substantially as described. (3) The feeding mechanism comprising, in combination, a hopper, rotary feeder and guard, and an adjustable scraper or cutter, said mechanism having an annular feeding slot or groove, in which said scraper or cutter is set, and the adjustment of said scraper or cutter enabling it to remove the material to a greater or less depth, as desired, substantially as described. (4) The combination, with the rotary feeding mechanism, comprising a hopper, feeder, and guard, and having an annular feeding slot or groove, of a stationary cutter or scraper projecting upward into said slot or groove, substantially as described. (5) The combination, with the rotary feeder in the form of a horizontal plate or disc provided with an annular feeding slot or groove, the hopper attached to and carried by the feeder, and the base plate, forming as well a support to said feeder as a guard to retain the material in said groove or slot till it reaches the point of delivery, and provided with a delivery opening, of a cutter or scraper projecting into said slot or groove through said delivery opening, substantially as described. (6) The combination, with the rotary feeding mechanism baving an annular feeding slot or groove, and comprising a hopper, a horizontal rotating feeder, and a guard, of a packer in said hopper to force the material into said slot or groove, and a scraper or cutter projecting upward into said slot or groove to remove the material, substantially as described. (7) The combination, with the horizontally rotating disc feeder provided with an annular slot or groove, the hopper carried by said feeder, the base plate supporting said feeder and hopper and forming a guard to said slot or groove, and provided with a delivery opening, of the stationary packer having inclined arms to act upon the material and force it into the annular slot or groove, and the scraper or cutter projecting through said delivery opening into said slot or groove, substantially as described. (8) The combination, with the delivery-controlling means of an automatic weighing machine, of a feeding mechanism comprising a hopper, a rotary feeder provided with an annular feeding slot or groove formed therein, a scraper or cutter set into said slot or groove, and a guard arranged to retain the material in the slot or groove until it reaches the point of delivery, substantially as described. (9) The combination, with the delivery-controlling means of an automatic weighing machine, of a feeding mechanism comprising a hopper, a rotary feeder, a guard, a scraper or cutter, and a packer, the said mechanism having an annular feeding slot or groove in which said cutter or scraper is set, and the said packer being placed in the hopper and serving to force the material into said slot or groove, substantially as described. (10) The combination, with the delivery-controlling means of an automatic weighing machine, of the rotary feeder in the form of a horizontal disc or plate provided with an annular slot or groove, the base plate provided with the delivering opening, the scraper or cutter projecting through said opening into said slot or groove, the hopper attached to and carried with said feeder, and the packer in said hopper for forcing the material into said groove, substantially as described.



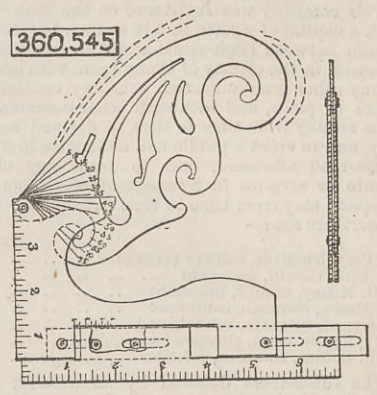
360,537. Gun-mounting, *T. Nordenfelt, Westminster.* —*Filed September 14th*, 1886.

Claim.—(1) The combination, substantially as set forth, of the trunnioned frame, its support, the gun movable longitudinally in the trunnioned frame, two hydraulic cylinders upon the trunnion frames, one on either side of the gun and in front of the trunnions of the frame, pistons in these cylinders with piston-rods connected with the gun, and springs upon the trunnioned frame on either side of the gun and behind the trunnions of the frame, for the purpose set forth. (2) A gun carriage comprising a trunnioned frame, within which the gun is supported and moves longitudinally, and the hydraulic cylinder or cylinders formed or fixed upon the trunnioned frame and containing pistons or equivalent parts having connection with the gun, and which during the recoil of the gun drive liquid through a passage or passages, which, as the recoil proceeds, are progressively contracted, substantially as set forth.



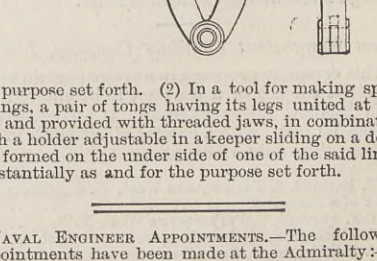
360,545. Draughtsman's Rule, *E. F. Wagner, Brooklyn, N.Y.*—*Filed September 4th*, 1886.

Claim.—A rule for use in drawing a number of uniformly spaced lines, and consisting of two parts, which intermatch so that the rule will have similar sides and can be reversed to present either side upward, substantially as specified. A rule for use in drawing a number of uniformly spaced lines, consisting of the part A, composed of two similar parallel sections and the section a^6, said parallel sections being provided with the notches a^1 a^2, and the part B, composed of two similar parallel sections provided with the notches b^1, said parts A B being adjustably secured together substantially as specified. The combination, with a right-line rule composed of two longitudinally adjustable parts, of a scroll pivotally connected to one of the parts, the one being provided with a scale for indicating the angle of adjustment of the scroll, substantially as specified.



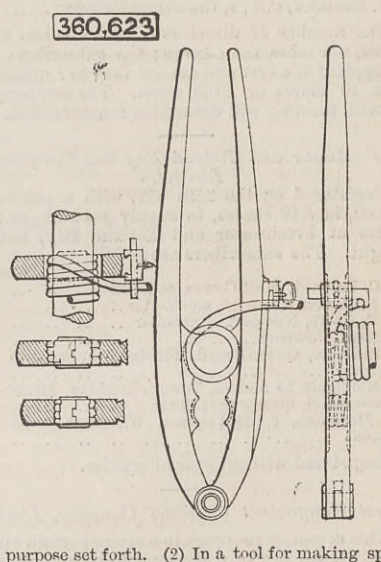
360,594. Steam Engine Valve, *A. L. Ide, Springfield, Ill.*—*Filed May 11th*, 1886.

Claim.—(1) The combination, with an engine cylinder, of a steam chest or valve-casing provided with a central annular steam space and cylindric valve seats at each side of said space, each of said valve seats being provided with two or more annular ports in communication with the cylinder, and a hollow piston valve having a reduced central part and provided with two or more annular cylindric surfaces separated by an annular opening or openings for steam, said annular surfaces being arranged to correspond in relative position with said annular ports and adapted to severally open and close the latter, substantially as described. (2) The combination, with an engine cylinder, of a valve chest having two cylindric valve seats, each provided with two steam ports communicating with a steam passage leading to each end of the cylinder, a hollow piston valve provided with two annular bearing surfaces, forming between them an annular port or passage c^2, located in position to communicate with one of said steam ports at the time the other steam port is uncovered by the valve, and a longitudinal passage c^1, in the wall of the valve, affording communication between the said passage c^2 and a central steam space of the steam chest, substantially as described. (3) The combination, with a steam chest having a cylindric recess provided with a broad annular passage b^3, of a removable bushing covering said passage b^3, and provided with two or more series of apertures arranged circumferentially and forming two or more separate steam ports, substantially as described. (4) The combination, with a steam chest having cylindric recesses, of removable bushings covering said recesses and forming passages b^3 and ribs b^4 in said passages, sustaining said bushings, substantially as described. (5) The combination, with a cylindric valve seat provided with two steam ports, of a hollow piston valve provided with annular bearing surfaces C^2 C^3, the surfaces C^3 being formed upon rings c^4, sustained from the body of the valve by ribs c^3, substantially as described. (6) The combination, with a cylindric valve and valve chest provided with cylindric seats having an annular steam passage b^3, of removable bushings provided with two or more series of apertures forming steam ports, said apertures being straight upon the inlet sides of the ports and curved upon the opposite or exhaust sides of said ports, substantially as described.



360,623. Tool for Making Spiral Springs, *J. T. B. Siden, Nybo, Walbo, Sweden.*—*Filed January 7th*, 1886

Claim.—(1) In a tool for making spiral springs, a pair of tongs having its legs united at one end and provided with threaded jaws, in combination with a holder adjustable in a keeper having a sliding connection with one of the legs, substantially as and for the purpose set forth. (2) In a tool for making spiral springs, a pair of tongs having its legs united at one end and provided with threaded jaws, in combination with a holder adjustable in a keeper sliding on a dovetail formed on the under side of one of the said links, substantially as and for the purpose set forth.



Naval Engineer Appointments.—The following appointments have been made at the Admiralty:—G. Rigler, staff engineer, to the Trafalgar; J. E. Chase, chief engineer, to the Seahorse, reappointed on promotion, to date May 21; P. Bingham, assistant engineer, to the Agincourt; J. Ward and G. Wheatley, assistant engineers, to the Minotaur; R. Ayers, assist. engineer, to the Monarch; P. Crichton, assistant engineer, to the Sultan.