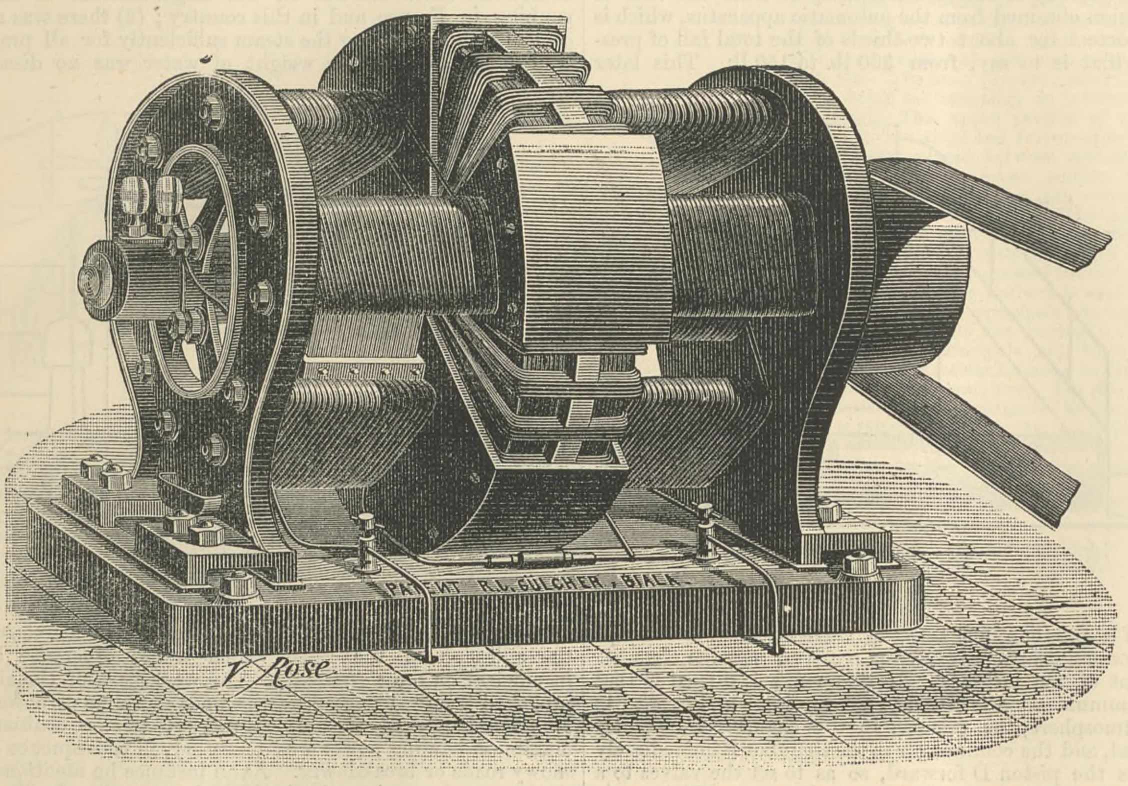
THE PARIS ELECTRICAL EXHIBITION.

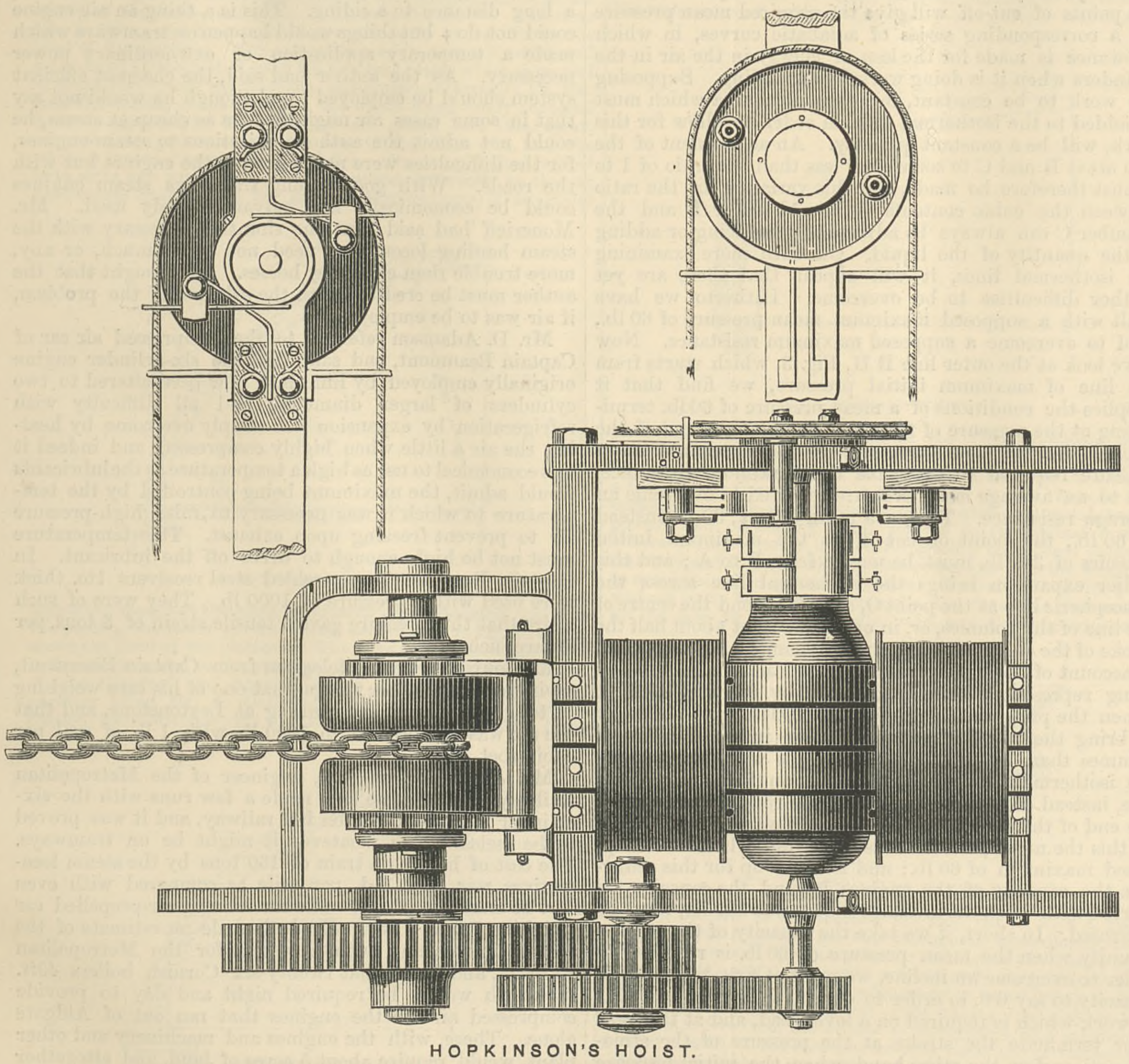
No. XIII.

The Gülcher machine in the Austrian section can hardly lay claim to originality in principle. Its armature is a Pacinotti or a Brush ring, but the arrangement of the



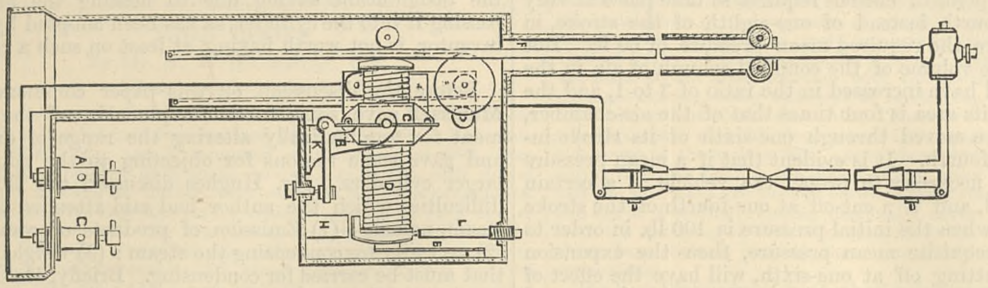
GULCHER'S DYNAMO MACHINE.

field magnets may be noticed. There are four pairs of these magnets so arranged that the opposed poles are of the same name, and are joined by massive ∏ shaped pole pieces. The armature revolving almost entirely within



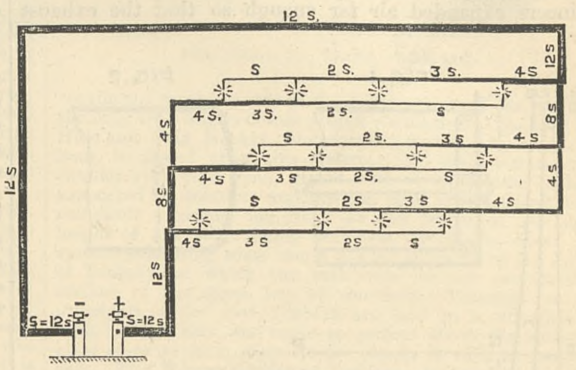
HOPKINSON'S HOIST.

these pole pieces, cuts nearly all the lines of force of the field magnets, and as the pole pieces and the form of armature both aid in keeping the coils cool, it ought to be a fairly economical machine. Two sets of brushes are used at the commutator, there being four reversals of the current during each revolution. Mr. Gulcher, like all those who have designed fairly good machines, makes his machines of low internal resistance, that at Paris having a resistance of only 0·12 ohm, while the field magnets are wound with insulated copper cord. Mr. Gülcher also exhibits an arc lamp, a section of which we give.



GULCHER'S LAMP.

The upper and lower carbons are connected by cords. D is an electro-magnet, in front of which, and partially as an armature, is the rod connected to the upper carbon-holder. The polar surfaces of D are rounded off as shown. Ordinarily D presses against the stop L by the action of a spring, the tension of which is regulated by the lever K. When a current passes through D one pole holds the rod, the other pole being drawn towards the block H, the magnet D moving about the axis C. As the carbons burn away D gradually resumes its normal position. The normal arc being thus made, the increase of the arc leads to a diminution of the current, and consequently the decrease of the action of the pole on the rod F, thereby allowing the carbon to fall. It may be interesting to notice in this place how Mr. Gülcher arranges his circuits. It is in reality equivalent to having a separate wire for every lamp. He calculates the section of wire required for any arrangement, and then calculates the diameter of the wire, of which say for twelve lamps,



GULCHER'S CIRCUITS.

twelve strands of wire arranged cable fashion will conduct the current. The twelve wires go from the + pole of the machine to No. 1 lamp, when one wire branches off through lamp to — pole of the machine, leaving eleven strands going to No. 2 lamp, where another wire branches off through the lamp, and so on. The illustration shows twelve lamps arranged in parallel columns, the numbers 12 *s*, 11 *s*, &c., showing the number of strands of wire in any given position.

Turning from electric light apparatus to notice new applications, we think that one of the most interesting is the adaptation to hoists or lifts. Dr. Hopkinson, F.R.S., has designed such an apparatus which is shown by Messrs. Clark, Muirhead, and Co The hoist is intended to be used instead of pulley blocks, the power used being obtained from an electric current instead of manual labour. The weight of the apparatus is about two hundredweights, and it can be easily and speedily hung overhead by a couple of chains, shown in our engravings. The motor is a small Siemens dynamo-electric machine, but of course it might consist of a Gramme, Brush, Bürgin, or any other similar machine. The machine, through gearing, drives a chain pulley, within which is a Weston clutch. Over the pulley hangs a chain with hooks at both ends. The whole system being completely reversible, a weight can be lifted by either hook. The reversal is effected by a movement of the commutator brushes controlled by a light rope. On pulling one end of the rope, motion of the chain takes place in one direction; on pulling the other end, the chain moves in the opposite direction The Weston clutch comes into operation where the attendant accidentally or intentionally lets go the rope, and the weight hangs safely suspended.

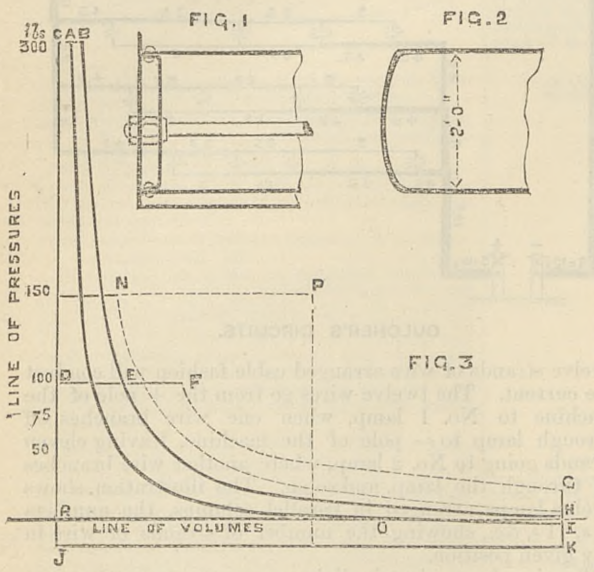
The hoist shown will lift about 5 cwt. held directly by one of the hooks, or 10 cwt. by the aid of a snatch block —the speed of lifting depending on the electromotive force of the producing machine. It is estimated that any of the ordinary electric light machines would be capable of causing the lift to hoist 5 cwt. 2ft. per second. It is hardly necessary to point out that a lift of this kind would in many instances be of the greatest convenience, and could be used when space or other considerations prevented the use of ropes or gearing. It also adds to the use to which a dynamo machine introduced into the works can be put, and so lowers the percentage of outlay incurred by such introduction.

THE INSTITUTION OF MECHANICAL ENGINEERS.

On the conclusion of the discussion on Mr. Copeland's paper reported in our last impression, Mr. Scott-Moncreiff read a paper on

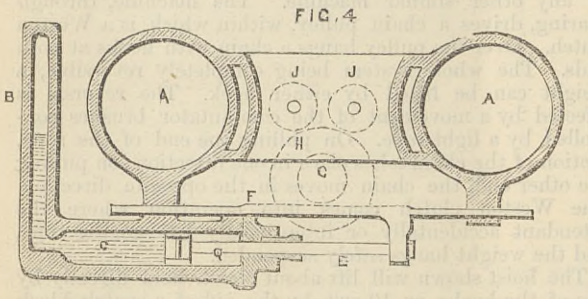
Compressed Air upon Tramways.

In this paper the author first recounted the various objections which have long been urged against the use of steam on tramways and the working of steam tramway engines. He next gave his reasons for thinking that in many cases compressed air tramway engines could be used with advantage, and even with economy. In his reasoning, however, there was nothing which has not been previously urged against steam engines and in favour of compressed air, though it was admitted that that motor should be adopted which was most cheaply and efficiently available, and that in some cases this would be the steam engine. He then described at great length the various circumstance, and conditions of the design of a tram-car with engines receivers, and other gear, as indicated in Figs. 5 and 6. The wheel base is 5ft. Three cylindrical receivers, each 2ft. in diameter, and of the overhanging space, or 8ft. in length, are used at each end. These were first made as shown in Fig. 1. By means of a process of welding by gas jets, receivers are now made as at Fig. 2. The working pressure is about 22 atmospheres, but the receiver was tested to 750 lb. on the square inch. In working an engine with compressed air from a receiver a tolerably uniform resistance has to be overcome by a constantly decreasing pressure of air. The disadvantage of working by reducing the pressure before the air passes into the cylinders is that it entails the loss of a great amount of energy. See Fig. 3. Starting with a reduced pressure of 100 lb. per square inch, as against the 300 lb. initial pressure, the loss of energy is represented at first by four times the area B C D E for every revolution of the wheels, in the case of a two-cylinder double-acting engine. This area will decrease with the decreasing pressure, and the gross loss is great. Again, where the pressure is reduced as low as one-third of the initial pressure, there is a great loss attending heavy work in consequence of late cut off and high pressure exhaust. Compressed air in receivers cannot be dealt with by reducing the pressure before using it without a great loss of power. In the diagram isothermal lines have been chosen to illustrate the meaning, on account of their simplicity. If adiabatic curves had been taken, allowing for the thermal equivalent of the work done in the cylinders, the same remarks would have applied to them at a higher point upon the scale of pressures. If engineers expanded air far enough so that the exhaust



took place at the pressure of the atmosphere, the loss of heat would be only the mechanical equivalent of the work done in the cylinders, without the additional loss of temperature at the end of the stroke, which occurs when a residual pressure is left to communicate momentum to the atoms composing the elastic medium. The writer found this to be the case by experiment, and thus showed that troubles from the formation of ice could only arise when the air escaped from the cylinders above the pressure of the atmosphere. Fig. 4 shows an apparatus devised for the purpose of automatically altering the range of expan-

FIG. 4



sion. A A are the engine cylinders. In chamber B is air at the pressure in the receivers. C is a chamber filled with a liquid so as to provide an hydraulic instead of a pneumatic connection with the piston D, which moves backwards or forwards as the pressure upon either side of it is increased or diminished. The piston rod E is attached to a toothed rack F, acting upon a pinion G, which revolves with the wheel H; and this in its turn gives a rotary motion to the pinions J J keyed to the valve spindles. These spindles, being turned to the right or left, give motion to cut-off valves placed upon the backs of the main valves, by altering their relative positions through the agency of right and left-hand screws. In this way the movements of

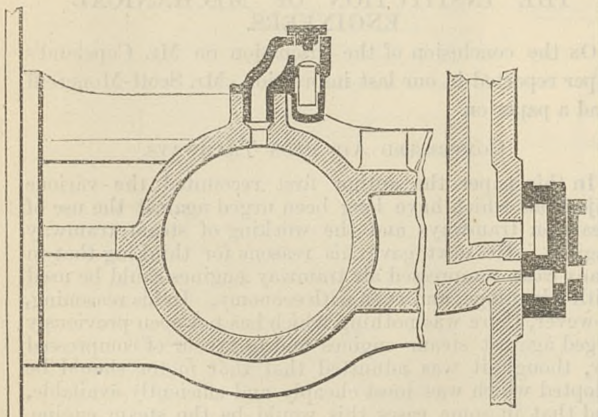


FIG. 7 FIG. 8

the piston D are conveyed directly to the valves, so as to vary the period of cut-off in accordance with the position of the toothed rack. Turn now to the diagram, Fig. 3. It will be seen that a mean pressure of 60 lb. will be given by the outer black line B H if the initial pressure is 300 lb. and exhaust at the pressure of the atmosphere. This mean pressure can only be obtained when the reservoir pressure has fallen to 100 lb., by cutting off at one-fourth instead of one-twentieth of the stroke. The pressure of the receivers, during the process of pumping, is admitted to the forward end of the piston D, Fig. 4, in the space Q, and therefore, as the pressure rises it forces back the piston until the motion is arrested by the confined air in the chamber B. Suppose the maximum pressure in the receiver and the piston D back so that the valves are adjusted to their earliest points of cut-off; and then, as the pressure in the receivers begins to diminish, the piston will be moved forward by the superior elasticity of the confined air in the chamber B, and the point of cut-off will be rendered correspondingly later. When the pressure has been reduced in the receivers by one-half, the pressure of the air confined in B being correspondingly diminished, its volume will have doubled. Hence the toothed rack would have moved through half its stroke, and would thus have moved the valves half-way towards their latest point of cut-off. When the pressure is reduced from 150 lb. to 100 lb., the point of cut-off requires to take place at very nearly one-fourth instead of one-eighth of the stroke, in order to give the required mean pressure of 60 lb. But at 100 lb. the volume of the confined column of air in the chamber will have increased in the ratio of 3 to 1, and the piston D, if its area is four times that of the air-chamber, will only have moved through one-sixth of its stroke instead of one fourth. It is evident that if a mean pressure of 60 lb. is necessary to propel the vehicle at a certain desired speed, and if a cut-off at one-fourth of the stroke is necessary when the initial pressure is 100 lb. in order to obtain the requisite mean pressure, then the expansion apparatus, cutting off at one-sixth, will have the effect of lessening the speed of the vehicle. Thus towards the end of the journey it becomes necessary to alter the rate of expansion obtained from the automatic apparatus, which is only correct for about two-thirds of the total fall of pressure—that is to say, from 300 lb. to 150 lb. This later

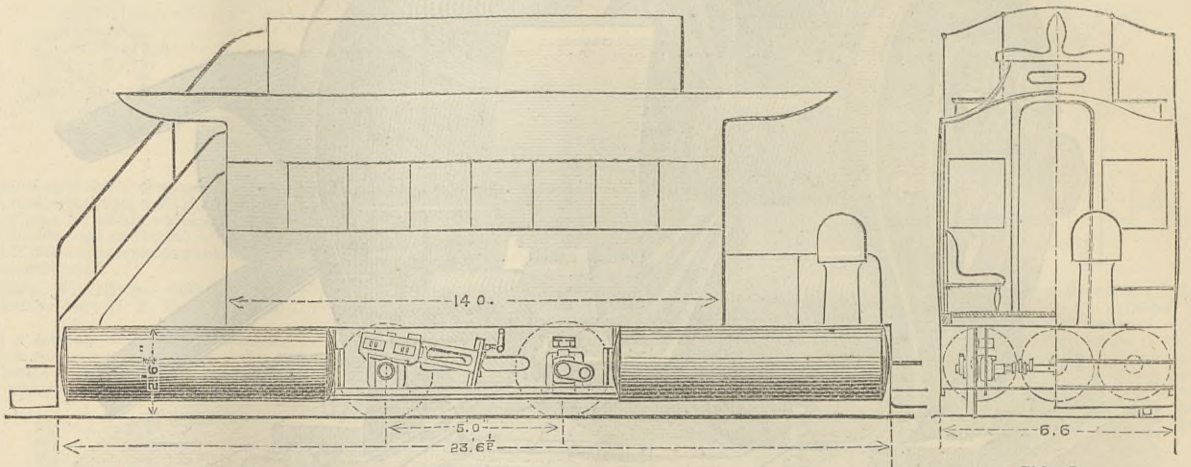


FIG. 5 FIG. 6

cut-off is obtained by a two-way valve attached to the pipe that communicates between the receivers and the chamber in front of the piston D. If this valve is turned so that the communication is closed to the receivers and opened to the atmosphere, the pressure in this chamber is instantly reduced, and the confined air in the chamber B immediately thrusts the piston D forward, so as to set the valves to a later point of cut-off. Turning to Fig. 3, it will be seen that many difficulties have still to be overcome. The ratio of the cubic contents of the two chambers B and C, when arranged as 1 to 4, is only right for the isothermal lines which we have already made use of for the purpose of explanation, besides being only correct for about two-thirds of the journey. The two areas must be adjusted so that the points of cut-off will give the required mean pressure for a corresponding series of adiabatic curves, in which allowance is made for the loss of energy in the air in the cylinders when it is doing work by expanding. Supposing the work to be constant, the dynamical area which must be added to the isothermal area, in order to allow for this work, will be a constant quantity. An adjustment of the two areas B and C to something less than the ratio of 1 to 4 must therefore be made, and this variation in the ratio between the cubic contents of the chamber B and the chamber C can always be adjusted by reducing or adding to the quantity of the liquid. On once more examining the isothermal lines, it will appear that there are yet further difficulties to be overcome. Hitherto we have dealt with a supposed maximum mean pressure of 60 lb., used to overcome a supposed maximum resistance. Now if we look at the outer line B H, Fig. 3, which starts from the line of maximum initial pressure, we find that it supplies the conditions of a mean pressure of 60 lb. terminating at the pressure of the atmosphere at the end of the stroke. Let us now turn, not to the maximum mean pressure required to overcome the maximum resistance, but to an average mean pressure required to overcome an average resistance. To use a mean of, say, 30 lb. instead of 60 lb., the point of cut-off at the maximum initial pressure of 300 lb. must be moved from B to A; and this earlier expansion brings the isothermal line across the atmospheric line at the point O, a little beyond the centre of the line of the volumes, or, in other words, at about half the stroke of the engine. In this way a dynamical loss will occur, on account of the back pressure of the atmosphere, this loss being represented on the diagram by the area H I O. When the pressure has dropped to 100 lb. it is necessary to bring the point of cut-off further in on the line of volumes than the point F, and in this way to terminate the isothermal line at the point H on the atmospheric line, instead of at G, so as to save the residual pressure at the end of the stroke represented by the height G H. To do this the mean pressure must be reduced below the supposed maximum of 60 lb.; and to make up for this reduction the capacity of the engines beyond the capacity we started with when the initial pressure was 300 lb., must be increased. In short, if we take the capacity of the engines as unity when the mean pressure of 60 lb. is required in order to overcome an incline, we must at first reduce their capacity to say 0·6, in order to obtain the normal amount of work which is required on a level road, and at the same time terminate the stroke at the pressure of the atmosphere; and on the other hand, when the initial pressure is reduced to 100 lb., we must have an earlier cut-off if we are to finish at atmospheric pressure, and must increase the capacity of the engines above unity in order to make up for it. Now the expense of the fuel for driving the writer's car is only about a half-penny per mile, when used on a large scale, and when furnace coals are to be obtained at 10s. per ton. The present car, as made for the writer by Messrs. Neilson and Co., Hyde Park Locomotive Works, Glasgow, travels seven miles with one charge of air at the moderate pressure of 26 atmospheres, and this with a load of forty passengers, and including about twenty-five stoppages and reversings of the engines. It is clear that the insignificant saving due to heating the air before passing it into the cylinder, as has been adopted by another inventor, is not worth having, at least on such a route.

Before the discussion on this paper commenced, Mr. Moncrieff gave some further explanation of the arrangement for automatically altering the range of expansion, and gave some reasons for objecting to the adoption of larger cylinders. Mr. Hughes discussed the three chief difficulties which the author had said attended the use of steam, namely—(1) Emission of products of combustion; (2) necessity for condensing the steam; (3) weight of water that must be carried for condensing. Briefly, Mr. Hughes's answer to these was—(1) The products of combustion caused no inconvenience on the large number of cars running in France and in this country; (2) there was no difficulty in condensing the steam sufficiently for all practical purposes; (3) the weight of water was no disadvantage, and often was of great advantage in increasing the adhesion on the rails, which would otherwise be insufficient on some gradients. The weak part of the air-propelled tramway engine was its want of range of power. It often happened that much more than the ordinary maximum hauling power was necessary, in consequence of snowy roads or breakdowns. As an instance he mentioned that, on one occasion, the brakes of an engine in Paris stuck fast, and the engine could not be got to move. Its stopping would have stopped the whole traffic for some time, if the engines had not a considerable range of power. This enabled the next engine that came up to raise steam in a few minutes to full pressure, and then push the disabled engine and its car, as well as hauling its own car, a long distance to a siding. This is a thing an air engine could not do; but things would happen on tramways which made a temporary application of extraordinary power necessary. As the author had said, the cheapest efficient system should be employed; and though he would not say that in some cases air might not be as cheap as steam, he could not admit the author's objections to steam engines, for the difficulties were not now with the engines but with the roads. With good strong tramways steam engines could be economically and advantageously used. Mr. Moncrieff had said that the shunting necessary with the steam hauling locomotive need not cause much, or any, more trouble than changing horses. He thought that the author must be credited with the solution of the problem, if air was to be employed.

Mr. D. Adamson referred to the compressed air car of Captain Beaumont, and said that the six-cylinder engine originally employed by him had now been altered to two cylinders of larger diameter, and all difficulty with refrigeration by expansion was simply overcome by heating the air a little when highly compressed, and indeed it was economical to use as high a temperature as the lubricants would admit, the maximum being controlled by the temperature to which it was necessary to raise high-pressure air to prevent freezing upon exhaust. This temperature must not be high enough to drive off the lubricant. In Captain Beaumont's car, welded steel receivers 1in. thick were used with a pressure of 1000 lb. They were of such a size that this pressure gave a tensile strain of 8 tons per square inch.

M. Bourgeron read a telegram from Captain Beaumont, saying, amongst other things, that one of his cars weighing 12 tons was successfully running at Leytonstone, and that the air was compressed to 1000 lb. with 1 lb. of coal per cubic foot.

Mr. J. Tomlinson, jun., engineer of the Metropolitan Railway, said that he had made a few runs with the six-cylinder Beaumont car on his railway, and it was proved to be useless there, whatever it might be on tramways. The cost of hauling a train of 150 tons by the steam locomotives was only $1\frac{1}{2}$d. per mile as compared with even Mr. Moncrieff's $\frac{1}{2}$d. per mile for his one air-propelled car weighing 7 tons 7 cwt. He had made an estimate of the cost of introducing such a system for the Metropolitan Railway, and found that twenty-six Cornish boilers 40ft. in length would be required night and day to provide compressed air for the engines that ran out of Aldgate alone. These, with the engines and machinery and other plant, would require about 5 acres of land, and altogether it would cost more than the whole of the engines on the line and their working for a long time. The air engine had no recuperative power, and for many reasons could not be successful for traffic such as that on the Metropolitan Railway.

Mr. Walker spoke of the very successful working of the tramway locomotives made by Messrs. Kitson and Co., on the Leeds tramways.

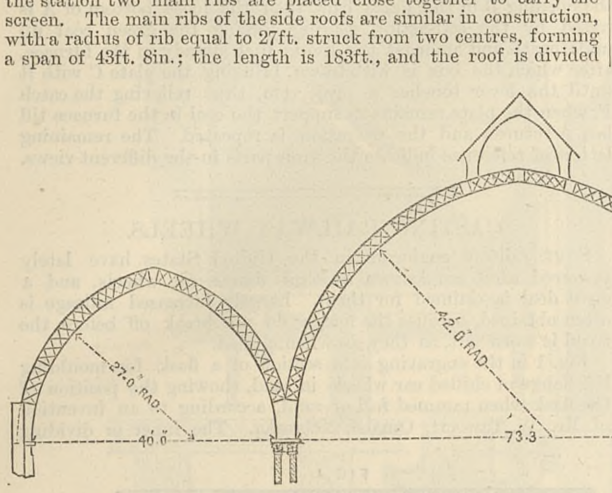
Mr. Scott Moncrieff then briefly replied to the discussion, and the business of the meeting concluded, the paper on water meters, by Mr. J. J. Tylor, being postponed.

IRON ROOFS.

By Mr. A. T. Walmisley, C.E.

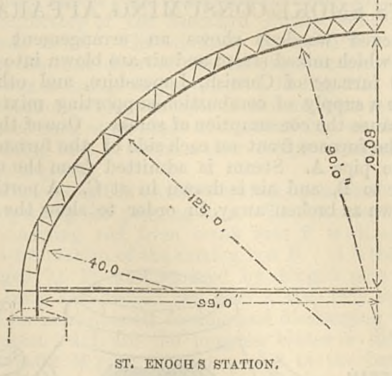
[*Continued from page 336.*]

The roof over the Middlesbrough Station of the North-Eastern Railway is divided into two spans of unequal lengths. The main roof is 309ft. long, and is composed of principals of 76ft. span formed in a pointed arch shape, having a radius to each side of 42ft. and meeting at the top, over which is fixed an ornamental ridge, fitted with side louvres for ventilation, and at each end of the station two main ribs are placed close together to carry the screen. The main ribs of the side roofs are similar in construction, with a radius of rib equal to 27ft. struck from two centres, forming a span of 43ft. 8in.; the length is 183ft., and the roof is divided



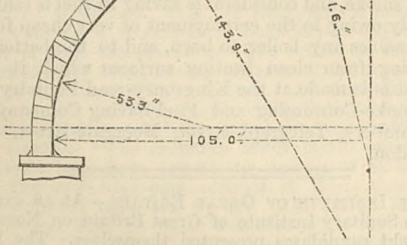
MIDDLESBROUGH STATION.

longitudinally between the end walls into nine spaces by eight double columns, over which the principals of the two roofs meet. The columns are connected by spandril girders carrying two intermediate ribs in each bay; the feet of the other end of the principals rest on side walls, which also carry the remaining ribs of the single roof, and are constructed to take the thrust of the outside ribs. The roof was designed in 1876 by Mr. W. Peachey. Each half of the main ribs of the St. Pancras station roof consists of two segments of circles with radii of 57ft. and 160ft. respectively, meeting in the centre, at a height of 96ft. above the level of the platform. The section of the rib varies to the same extent near the springing, the lower end of the rafter in a roof having to resist the maximum strain. The feet of the principals are each secured to an anchor plate built into the wall and strongly fastened down by four bolts 3in. in diameter, as well as connected below the level of the rail by a ⅝in. plate, which is rivetted on to the bottom flange of the wrought iron main floor girder of the platform. There are twenty-five of these main ribs in the roof, between which trussed purlins at every 18ft. 6in. carry intermediate ribs. The principals are placed 29ft. 4in. apart, and the roof is 690ft. long. The purlins help to stiffen the lower flanges of the main ribs longitudinally, and the whole is braced diagonally. The roof cost £31 10s. per square, and was designed by Mr. W. H. Barlow. The St. Enoch's Station, Glasgow, is covered with an arched roof of somewhat similar construction, but the main rib consists of a curve of five centres, struck with three radii, 40ft. at the springing, 125ft. at the middle of each side, and carried 90ft. over the centre. The clear span is 198ft., and the rise 80ft. from the soffit of the rib to the level of the platform. The principals are 5ft. deep all round, and are secured at the foot of each rib to a base plate, which is carried in about 13ft. under the platform, and projects externally 1ft. 9in. from the outside of the principal, the whole being firmly anchored down by 2¼in. bolts. The principals are placed 36ft. 10in. apart, connected by purlins supporting four intermediate ribs, and the whole is braced diagonally by wind ties. The end principal is filled in to serve as a wind screen, but is arranged differently to that at St. Pancras Station. In St. Enoch's Station there is no girder



ST. ENOCH'S STATION.

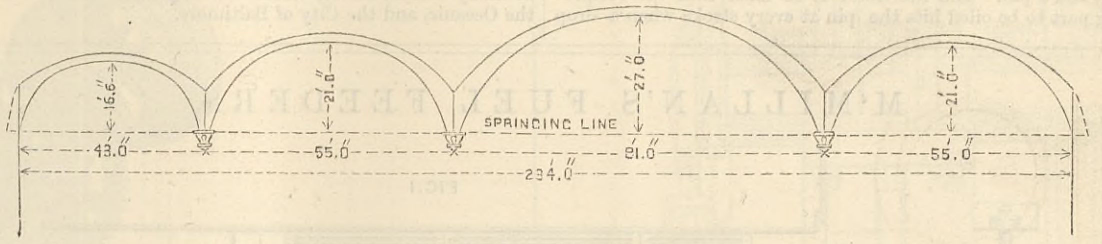
across the span, but the gable is trussed and bracketed firmly to the purlins, the lower portion being curved and rising 33ft. 9in. above the level of the platform. The wind pressure on the screen is thus transmitted to the purlins. The station forms the terminus of the Glasgow and South-Western Railway, the consulting engineer being Mr. A. Galloway. The roof over the Central Station, Manchester, is very similar to St. Enoch's, but wider, being



MANCHESTER CENTRAL STATION.

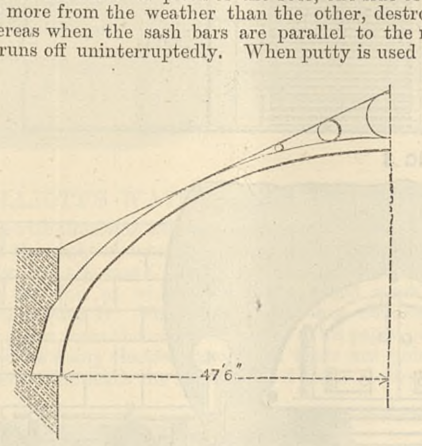
210ft. clear span, with a rise from springing level to the crown of 84ft. 10in. The principal is composed of five centres struck with three radii of 53ft. 3in., 91ft. 6in., and 143ft. 9in. respectively. The principals are 35ft. apart, dividing the roof into sixteen bays, and the feet of the principals are anchored down to masonry foundations. There are four intermediate ribs, except in the end bays, where an additional main rib is substituted for the last intermediate rib, and the gable screen is made more like St. Pancras Station than St. Enoch's Station. The principals are connected by purlins and diagonal bracing forming wind ties, and the whole work was designed and carried out by Mr. L. H. Moorsom to the satisfaction of the engineers of the Midland, Great Northern, and Manchester, Sheffield, and Lincolnshire railways. The Drill Hall at Derby is built on a similar principle without any direct tie, the form of the arch, together with the purlin connections and diagonal bracing, being sufficient to render the construction rigid and independent of the side walls. There are nine wrought iron ribs 75ft. span, each 2ft. deep placed 15ft. apart, and the level of the crown of the arch is 30ft. apart above the ground. The ribs spring from the ground, the lower portion being made of cast iron, and the side walls are built in between these standards. The wind ties are of T section, running diagonally under the roof covering from the springing of each alternate rib to the crown of the arch three bays distant, crossing the intermediate ribs at the purlin connections.

The York Station belonging to the North-Eastern Railway is 234ft. in width between side walls, and is divided into four spans consisting of two arches of 55ft. span having a rise of 21ft. above the springing level, one arch of 81ft. span with a rise of 27ft., and another of 43ft. span with a rise of 16ft. 6in. The main ribs are placed 10ft. apart, there being no secondary or intermediate ribs employed. The upper portion of the roof is glazed on the ridge and furrow system, carried on stiffeners placed between and attached to the principals, the lower portion being connected by purlins carrying the covering. The length of the roof is 795ft. The roof is built on a curve in plan, the centre line of the main roof of 81ft. span having a radius of 1131ft. 6in. The Sunderland Station belonging to the North-Eastern Railway is covered with a roof constructed of principals similar to those in York Station, but the glazing is differently arranged. The principals are arched ribs of 95ft. span, with a clear headway in the centre of 45ft. 6in. above the rail level. The ribs are placed 10ft. apart and are connected by purlins. The ridge is raised about 9ft. 6in. above the bottom flange of the arch at the crown to carry the rafters which run down on each side in a straight line to the gutters resting on the side walls, which are raised at the abutments to meet them. The upper portion is glazed, and curved glazing is thus avoided. The outside lower portion is slated, while the interior view shows curved boarding carried on the main ribs. The best method of glazing is much open to argument. The ridge-and-furrow system admits of



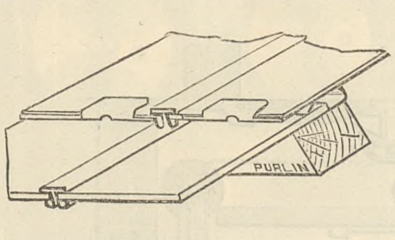
YORK STATION.

easy access for repairs, but it is evident that where the ridge-and-furrow follows the curve or pitch of the roof, one side of the sash bar suffers more from the weather than the other, destroying the putty, whereas when the sash bars are parallel to the main ribs the water runs off uninterruptedly. When putty is used it should



SUNDERLAND STATION.

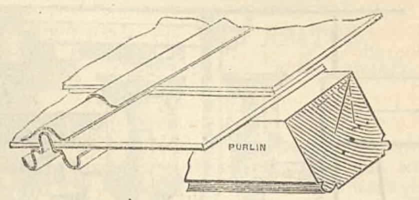
have tallow mixed with it, as in the "thermo-plastic putty" manufactured by Sir W. A. Rose and Co., of Upper Thames-street, which, with due care in preparation, is found to harden in a few hours after it is used; but, when exposed to solar heat, sufficient to cause the expansion of the glass and metal, becomes plastic, and on cooling again returns to its original firmness. Where ordinary putty is used for glazing in exposed situations, fractures and leakages are sure to occur, and it is the wisest plan to avoid the use of putty altogether. Several methods for glazing without putty have been proposed. The favourite plan patented by the late Mr. W. E. Rendle, who was the originator of the



RENDEL'S GLASS ROOFING.

system, consists in constructing the sash bar in such a manner that any water finding its way through is immediately carried along the inside of the bar on to the outside of the square below, and so off the roof. Thus with a moderately steep incline of roof there is no drip either from condensation or water driven in during violent gales of wind, and the glass having full play in every direction is free from the effects of contraction and expansion in the framework of the roof produced by variations of temperature. Patent metallic bars are employed which are more durable than ordinary sash bars, and curved roofs can be glazed by this method with straight glass. The system has been largely adopted in several roofs, both of small and great dimensions.

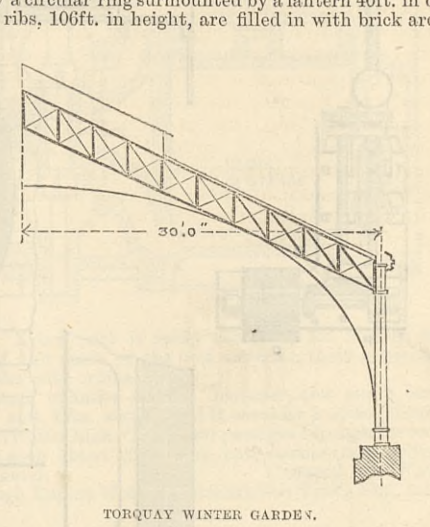
Another system of glazing without putty has been patented by Mr. T. W. Helliwell, of Brighouse, Yorkshire, which, though not so well known as other systems, possesses many advantages deserving our attention. The glass is made to fit close all round each square, so that there is no rattle in high wind, and the glass also receives sufficient support at the sides to be adapted to steep slopes. No air is admitted except such as is provided for by special



HELIWELL'S GLASS ROOFING

ventilating arrangements in the construction of the roof, which is the only true way to obtain proper ventilation. The roof over the Hide and Skin Market, Manchester, designed by Mr. F. H. Oldham, is glazed upon this system. The main rafters consist of circular ribs, 90ft. span, glazed with straight glass. The roof is supported on columns and girders, and is ventilated by louvre standards carrying the ridge at the crown of the arch, the height of the ridge being 66ft. 4in. above the floor. A third system possessing some merit is that patented by Mr. J. Watson, of Torquay, in which the sash bars do not project above the surface of the glass, but at convenient distances. or over the principals of the roof, timbers are laid in a direction parallel with the sash bars, and made to project above the surface of the glass so as to form supports for planks in case of necessary repair. The Winter Garden at Torquay, designed by Mr. Max-am-Ende, is glazed on this system. It was erected in 1880, and consists of a central pavilion 60ft. square, with two transepts serving as entrance halls to the pavilion and two wings, each 96ft. long, roofed over with principals of 60ft. span placed 12ft apart, and formed of lattice girders strengthened with elliptica wrought iron arches having cast ornamental spandrils, the whole being connected together to act as an arch. Each wing and transept terminates in a gable constructed of cast iron framework. The slope of the roof is 1 in 2, and Z-shaped purlins formed of angle irons are placed 3ft. apart in plan, to which are fixed wooden purlins grooved on top, the grooves containing small zinc gutters. The glass is laid without lap lengthways, a clear space of ⅛in. being left upon the sash bars, while crossways the usual lap over the purlins is allowed. The corner of the four panes meeting at the intersection of the zinc gutters with the laps are held down by a galvanised bolt and india-rubber washer.

Whatever system of glazing is adopted, a glazier's tool should never be used in the construction of a roof, as it is easy to ascertain the usual sizes manufactured, and work them in accordingly. In the erection of roofs, it is necessary to take care not to create an initial strain upon the various portions greater than they are calculated to bear, and this precaution is especially necessary to observe with purlins. It is also essential in all rivetted work to observe that the rivet holes are carefully marked and accurately punched or drilled, as in the narrow bars usually employed in roof constructions, the stability of the structure is likely to become endangered by errors of workmanship. The roof over the reading room at the British Museum consists of a dome 140ft. in diameter, formed of twenty iron ribs springing from the base and united at the top by a circular ring surmounted by a lantern 40ft. in diameter. The main ribs, 106ft. in height, are filled in with brick arches, and



TORQUAY WINTER GARDEN.

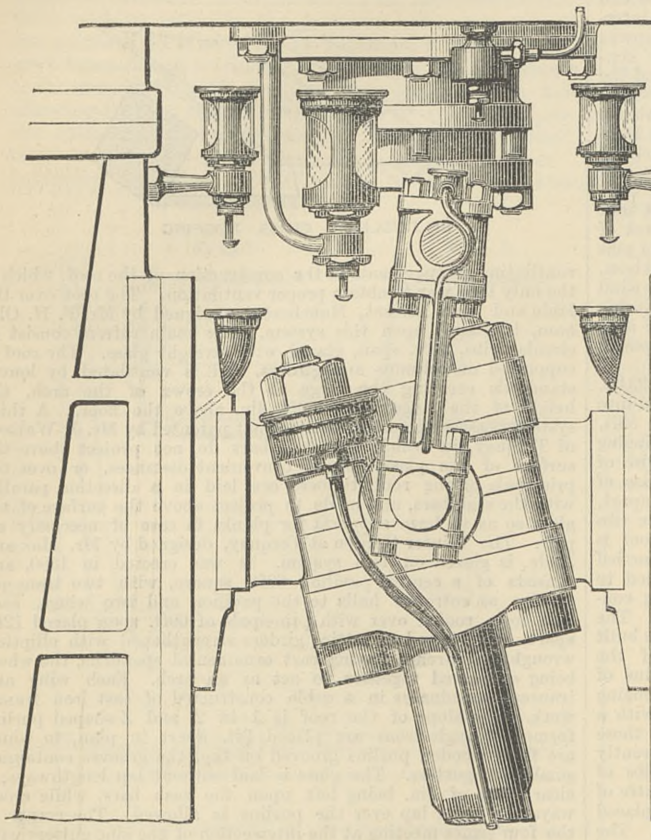
are supported upon twenty iron piers built into brickwork, each having a bearing surface of 10 square feet, including the casing, or 200ft. in all. The form of the roof was the original idea of Mr.—afterwards Sir—Anthony Panizzi, then principal librarian of the British Museum; the details being worked out by the late Mr. Sydney Smirke, the architect to the trustees, who was assisted in his design by the late Mr. Fielder. The excellent ventilating arrangements were carried out on Haydon's system, and the building was completed in 1857.

(*To be continued.*)

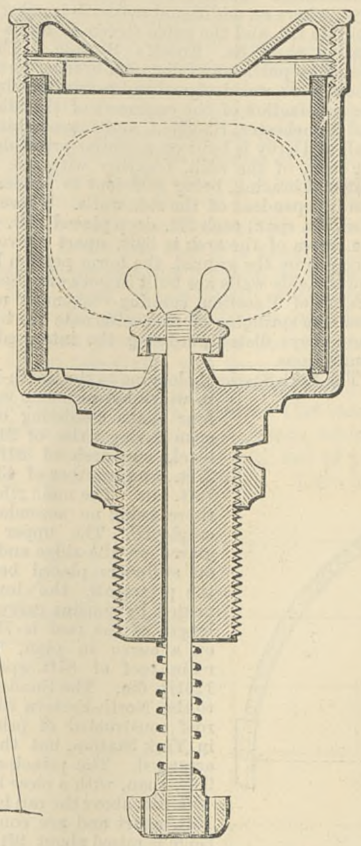
The Cunard Steamer Servia.—This magnificent screw steamship, the largest that has been built on the Clyde, after having had a new shaft fitted on board in place of the original one which was found to be faulty, proceeded down the Clyde on Tuesday, assisted by four powerful tugs as well as her own engine-power. She went to Gareloch to adjust compasses and was to run a short trial trip before proceeding to Liverpool, from which port she starts on her maiden voyage across the Atlantic on the 26th inst. The Servia was drawing 23ft. of water as she left the dock.

Market Harborough Sewerage.—The plans for the main sewerage of Market Harborough and the adjoining parishes of Great Bowden and Little Bowden, in the counties of Leicester and Northampton, these parishes forming a united district under one local board, having been approved by the Local Government Board, a contract amounting to £11,950 has been entered into with Mr. G. Stevenson, of Eckington, near Chesterfield, for carrying the plans into effect. The works are now being executed under the direction of Mr. J. B. Everard, of Leicester, the consulting engineer, with Mr. E. G. Mawbey, the surveyor to the board, acting as resident engineer and clerk of works.

CADMAN'S AUTOMATIC LUBRICATOR.



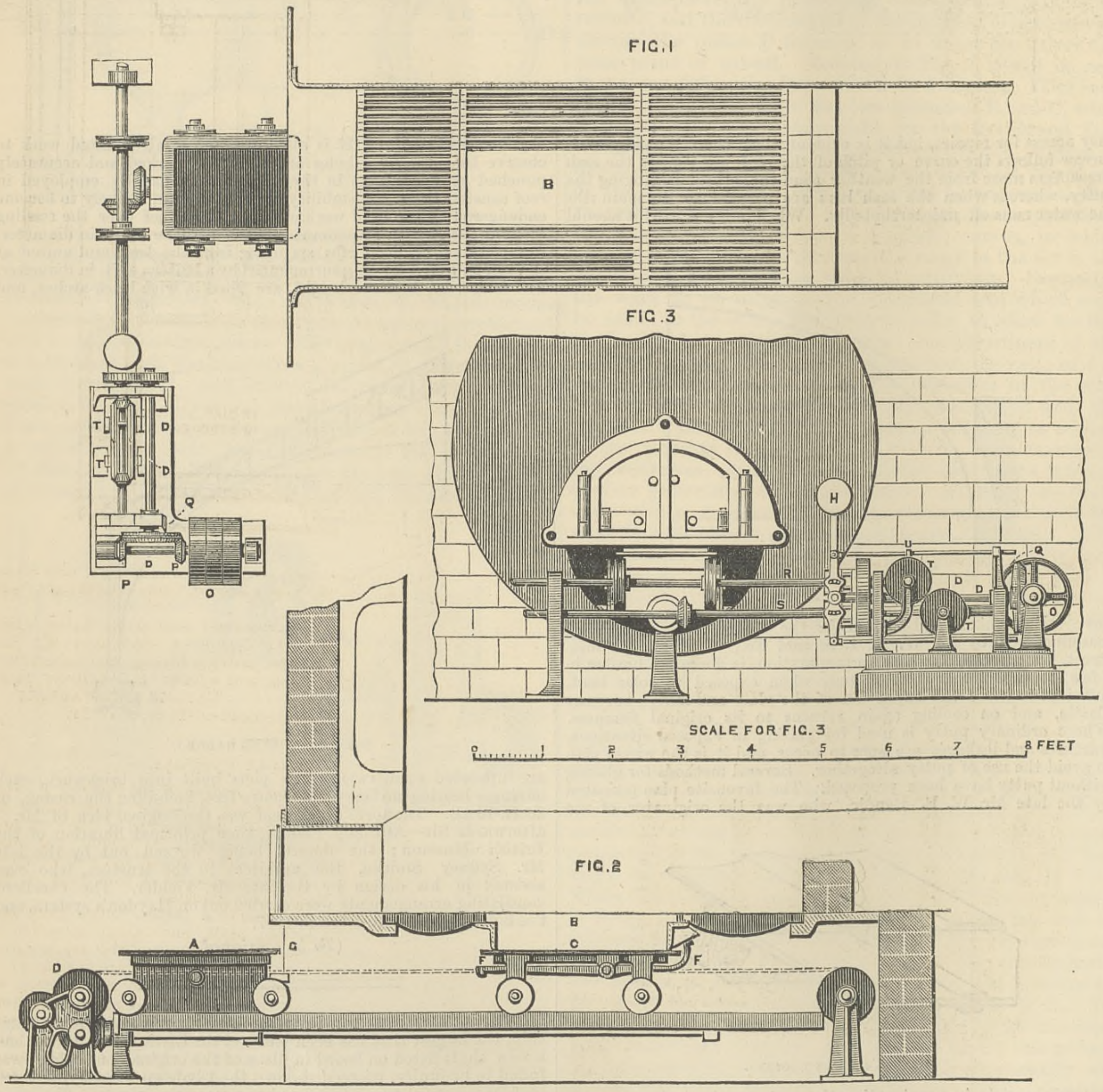
APPLICATION OF LUBRICATORS



SECTION

We illustrate above a very ingenious and successful form of lubricator invented and patented by Mr. Cadman, of Liverpool. Its construction will be readily understood. It will be seen that each lubricator is fitted with a small valve, provided with a spring and a pin. The lubricator is so fixed that the reciprocating part to be oiled hits the pin at every stroke when a drop of oil is discharged. When the engines are standing no oil escapes. Our engraving shows a lubricator, and the small end of a marine engine connecting rod and the crosshead, fitted with Cadman's lubricators. They have now been applied with perfect success in many vessels, among which we may name the Storm Cock, the Oceanic, and the City of Baltimore.

M'MILLAN'S FUEL FEEDERS.



The accompanying engraving illustrates a fuel feeder, patented by Messrs. J. and W. M'Millan, Port Dundas, Glasgow. Mr. M'Millan's patent fuel feeders are made either to be worked by means of a crank by the stoker or by self-acting gear. About two years ago two of the former kind were fitted up at the Port Dundas Distillery, and shortly thereafter the manager certified that they saved 25 per cent. in fuel, giving greater and more uniform heat, consumed the smoke, was easily worked, and gave no trouble. The apparatus was subsequently fitted in Greenock and at Dublin.

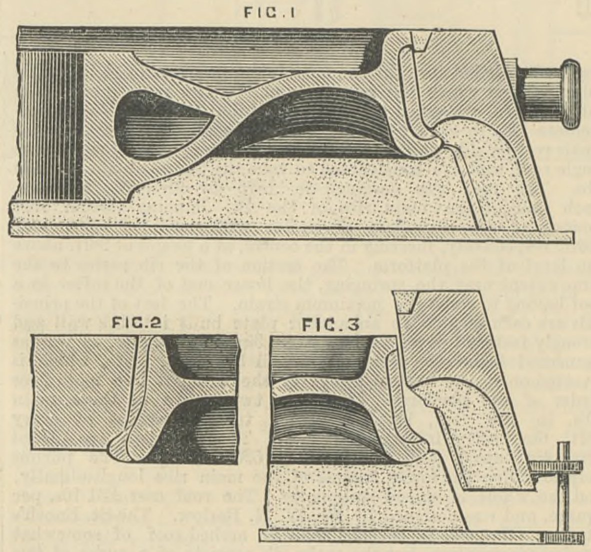
The Messrs. M'Millan are using the apparatus with self-acting gear, and it appears to give every satisfaction. They have it attached to one of the furnaces of a two-flued ordinary horizontal boiler of considerable size. The other furnace they prefer to leave in the meantime to be stoked in the usual way, so as to afford an opportunity to visitors to see by comparison the advantage of the feeder. But if the boilers were arranged in a line, one set of gear could be easily made to work a dozen at once, and each furnace could be supplied separately, if necessary, the gear being so arranged that either the whole or any part of it can be used. With their self-acting gear Messrs. M'Millan state that they get a regular saving of 20 to 25 per cent.; and there is no black smoke, except when the fires are being lighted in the morning. The coals being pressed up from beneath the furnace, the top of the fire is always clear, the combustion is thorough and regular, and altogether the apparatus promises well. It takes little power to work the apparatus. Messrs. M'Millan work it now with belts and shafting from their large engine; but it may of course be adapted for a small separate engine to work it.

Should any accident take place to the gear, the furnaces can be fired in the usual way, as no alteration is made upon their doors. In the accompanying engraving the feeder is shown, in Figs. 1 and 3, fitted to a Cornish boiler, and in Fig. 2 to an externally fired boiler. In plan and side elevation the box A, containing the green coal, is shown on the outside of boiler, ready to receive its charge, while the space provided, B, in the grate bars, is closed at the bottom by the plate C, thus preventing the fuel from falling down. The gearing for moving the box and plate is shown in Fig. 1. Connected with the plate C is a lever, having a projecting catch F, which enters into a slot G in the box A. The working of the apparatus is as follows:—After the box A has received its charge, the apparatus is put in motion and the box is moved in under the bars, the catch F entering into slot G, so that both the box and the plate go in until the box A comes exactly under the opening B in the grate bars, then the loose bottom of A is raised by the self-acting gearing, forcing the green coal up underneath and amongst the living fuel already in the furnace, after which the box is withdrawn, bringing the plate C with it until the lever touches a projection, thus relieving the catch F, when the plate remains to support the coal in the furnace till box A returns and the operation is repeated. The remaining letters of reference indicate the same parts in the different views.

CASTING RAILWAY WHEELS.

Some railway engineers in the United States have lately favoured what are known as sand flange car wheels, and a great deal is claimed for them. Largely increased mileage is often obtained, because the flanges do not break off before the tread is worn out, as they do when chilled.

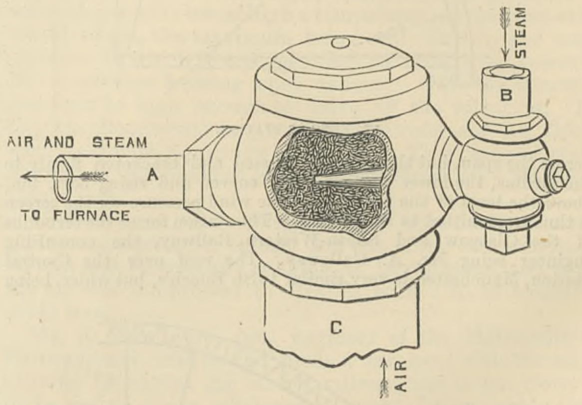
Fig. 1 in the engraving is a section of a flask for moulding the flange of chilled car wheels in sand, showing the position of the flask when rammed full of sand, according to an invention of Mr. W. Tawcett, Omaha, Nebraska. The inner or dividing



ring B is made conical, and serves as a parting line for separating the two bodies of sand, and allows all the sand under the pattern to remain in the usual manner on the bottom plate A, as shown in Fig. 3, and by its peculiar construction carries the sand that has been rammed on the upper side of the flange and holds the sand between the rings while the flask is being lifted off to allow removing the pattern and finishing the mould. Fig. 2 is a section of the ordinary chill, showing the chill in contact with the flange of wheel, and its effect on the rim of the wheel.

ORVIS'S SMOKE-CONSUMING APPARATUS.

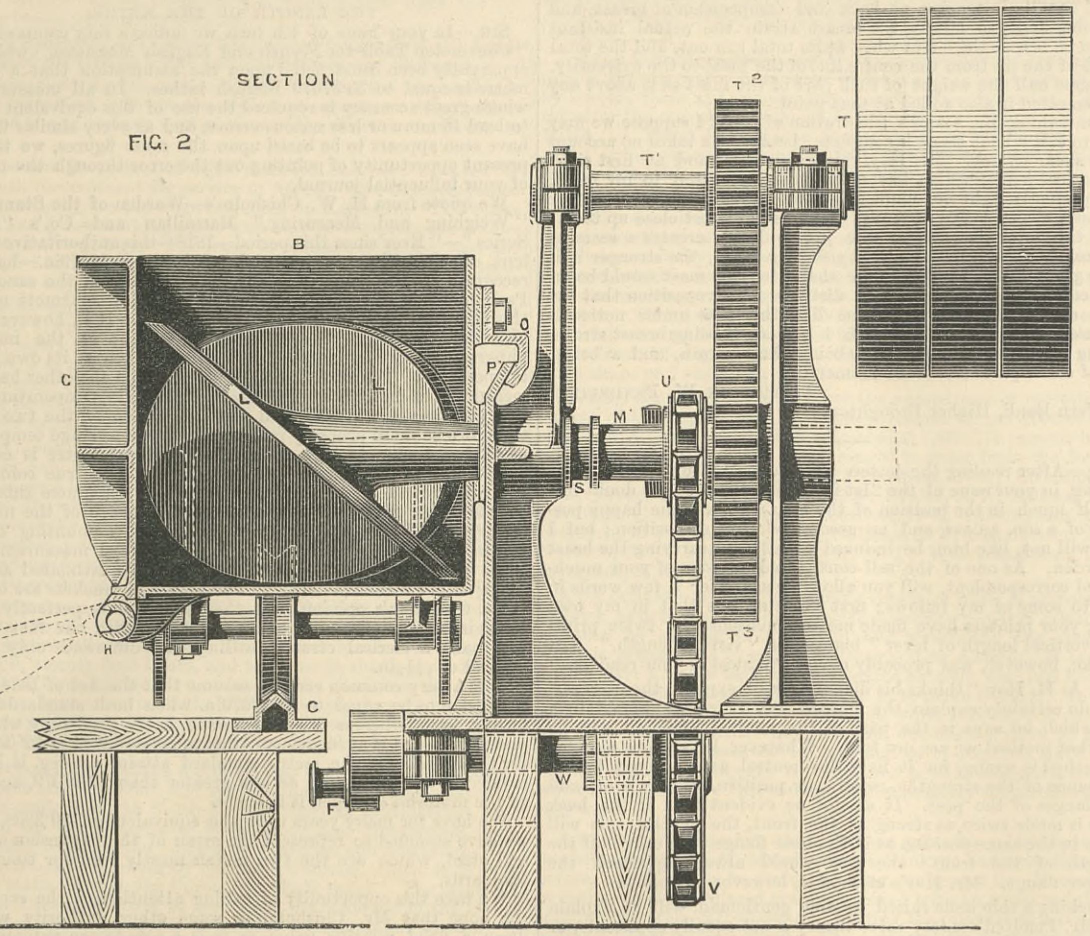
The annexed woodcut shows an arrangement of steam injector by which mixed steam and air are blown into the upper part of the furnace of Cornish, Lancashire, and other boilers so as to give a supply of combustion-supporting mixture where needed, to cause the consumption of smoke. One of these globes is fixed to the furnace front on each side of the furnace door by means of the pipe A. Steam is admitted from the upper part of the boiler to B, and air is drawn in at C. A portion of the globe is shown as broken away, in order to show the steam jet

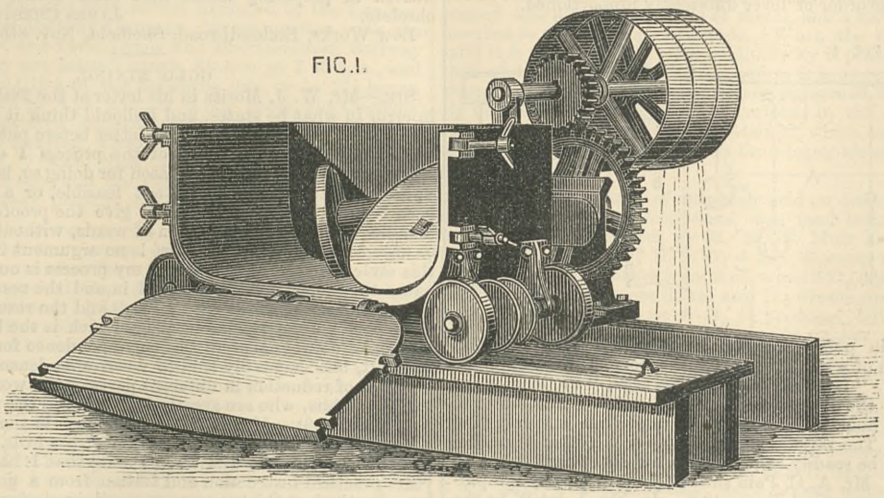


and air chamber. The apparatus is now in use at a considerable number of works in towns where it is necessary to prevent the emission of smoke, and considerable saving in fuel is said to be the result, partly owing to the employment of very cheap fuel, which its action enables any boiler to burn, and to the better evaporation resulting from clean heating surfaces which it preserves. The apparatus is made at the Kingsbury-road Foundry, Dalston, for the Smoke-Consuming and Fuel-Saving Company, St. Stephens' Chambers, Telegraph-street, Moorgate-street, and is in use in London.

Sanitary Institute of Great Britain.—At an examination held by the Sanitary Institute of Great Britain on November 3rd and 4th, eight candidates presented themselves. The Institute's certificate of competency as local surveyor was not awarded; but the institute's certificate of competency as inspectors of nuisances was awarded to Joseph Horrocks, W. Sortwell, and J. W. Witts.

GUBBINS' MORTAR MIXING MACHINE.





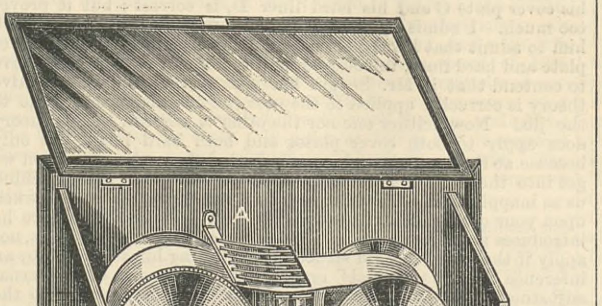
THE engravings herewith illustrate a new form of mixing or pugging machine for making mortar or any other similar material. It has been designed by Mr. R. R. Gubbins, more especially for mixing emery with agglutinating material for making emery wheels; and a machine is at work on this material in the manufactory of the Standard Emery Wheel Company, Greek-street, Soho. The machine is shown in perspective in Fig. 1 with the side door of the mixing box let down as it is when the box is being emptied; and in Fig. 2 it is shown in transverse section. The principle of the machine is the employment of discs fixed at an angle of about 45 deg. on shafts revolving in a mixing box, to which a slow reciprocating movement of short range is given.

In our illustrations C is a knife edge rail, upon which run grooved wheels supporting the pugging box. To the axle of one grooved wheel a connecting rod from crank arm F is attached to effect the to-and-fro motion of the mixing box B. G is the door of the box B hinged at H, and secured by hinged pins carrying fly nuts. A cover and hopper and also a trap may be supplied to the box B for continuously feeding and discharging the material operated upon. L L are the pugging blades or discs on shafts M. The shafts M pass through a slot in the box B, and the packing of these shafts is effected by the face plate sliding and bearing against the face on the standard of the machine. P is a guide piece on the standard, against which bears and slides the piece Q bolted on to box B to support and guide the box B in its movement. The forked ends of a yoke engage with the collars S on the shafts M, this yoke being set by a screw so that the shafts may be easily removed. The machine is driven from the pulleys and shaft T through gearing T_2 and T_3, and by the Ewart's chain on the wheel and pinion V and U.

THE SURVEY OF HEYWOOD.—In 1879 the local board of Heywood advertised for tenders from civil engineers for the survey of the borough, and for the correction of a book plan then existing. The district is about three and a-half by two and a-half miles, and the area 1450 statute acres. The work was entrusted to Mr. Alfred Hopkinson, C.E., of Bury, and is now completed, including a survey of the extended boundary of 630 statute acres, or a total of 2080 statute acres. The whole is shown on two plans, each 13ft. by 10ft., having an area of 260 square feet, and is drawn to a scale of 88ft. to an inch. All the buildings, roads, streets, footpaths, railway, canal, river, watercourses, &c., and also all sewers, drains, manholes, lampholes, and shafts with their sizes are marked. The ordnance bench marks are shown, and reduced levels have been cut at the corners of all the principal streets. The new book-plan consists of thirty-three sheets of paper on holland, each 3ft. by 2ft. The public buildings are coloured neutral tint, the other buildings pink. At a meeting of the Surveyor's Committee, held on the 17th October, the committee expressed their satisfaction with the manner in which Mr. Alfred Hopkinson, C.E., Bury, had carried out his contract for the new plan of the borough, and the town clerk was instructed to communicate the same to Mr. Hopkinson.

ELLIOTT'S WATCHMAN'S DETECTOR.

WE herewith illustrate an exceedingly simple form of detector, to show if the night watchmen perform their visits regularly and punctually. In the case C is a clockwork apparatus driving the axle S, at the end of which is a worm which gears into the wheel of the drum D. The rotation of D thus obtained unrolls a strip of paper from the other drum D. This paper passes over the poles of as many electro-magnets as there are points to be visited, and underneath the armatures of these electro-magnets.



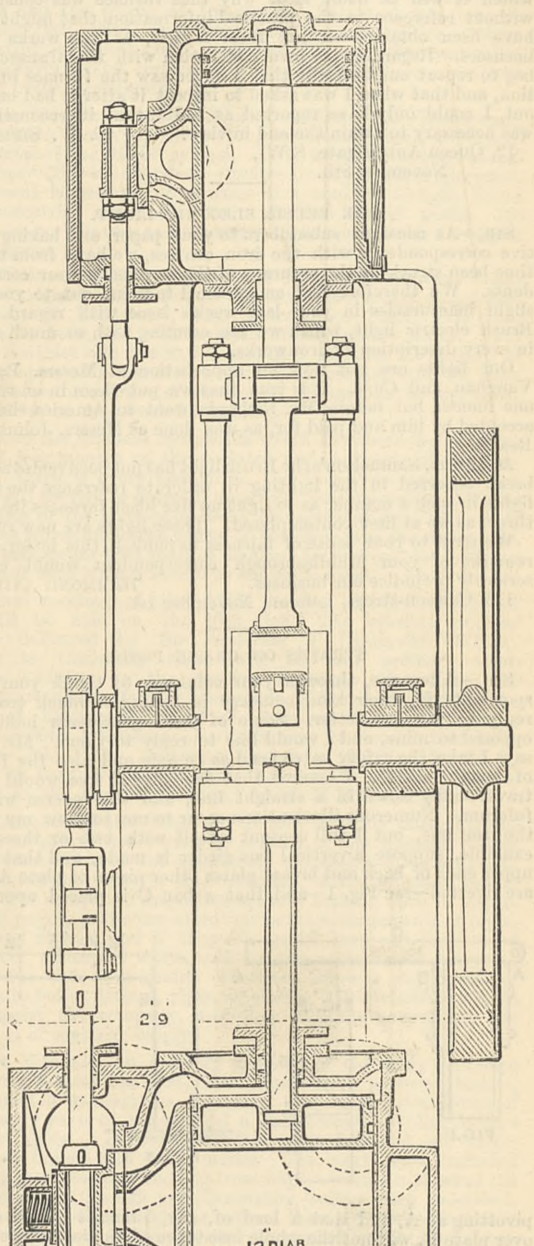
Each armature has a sharp point fixed on its under side, and when a current passing through the coils causes the attraction of the armature, this point perforates the paper. The places to be visited are connected electrically with the binding screws shown, and the watchman has merely to press a button to make the electric circuit complete. It has been found in practice that plain paper answers every purpose, as the clock giving an almost uniform motion enables the reader, after having seen the perforated slips once or twice, to determine fairly well the time which elapses between each pressure of the button.

LETTERS TO THE EDITOR.

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

PUMPS AT SEA.

SIR,—With this we beg to hand you tracing of the general arrangement of a steam pump which we make, and which, we think, goes a long way towards fulfilling the conditions you name—in your very sensible article this week on "Pumps at Sea"—as requisite for the kind of pump which every steamship ought to have as a stand by in case of a leak. We got it out specially as a ballast pump to lift 160 tons of water per hour, to give no trouble, and make no noise in working, and to be as nearly as possible incapable of being choked, save with hard substances; and in practice we find that waste, shavings, chips, and coal pass through



it freely. Every part is easily accessible for repairs, and when well fitted and made of the best material, there is nothing to get out of order with ordinary care.

The steam cylinder is 10in. diameter, and pump barrel 12in. diameter and 12in. stroke, and it occupies a space about 3ft. 9in. square by 7ft. 9in. high. The water passages through the valve to the pump are each about 22in. area, and suction and delivery pipes 6½in. diameter. CARRICK AND WARDALE.

Redheugh Engine Works, Gateshead-on-Tyne, Nov. 1st.

PRICE'S RETORT FURNACE.

SIR,—Although I noticed in your journal of the 21st ult. a letter from Mr. Wm. Price, finding fault with my observations on Colonel Maitland's paper, read at the last meeting of the Iron and Steel Institute, I did not think it necessary to trouble you with any reply, considering that Mr. Price is evidently not well informed on what I did say, and will before long be in possession of the paper, and of my observations upon the same.

In your issue of last week I observe a further letter from Mr. Price, written in the challenging style, and calling attention to the points of difference between his furnace and the regenerative gas furnace of usual construction, which I admit are very great.

When Mr. Price sees the complete account of the meeting, he will find that I did not criticise his furnace, but stated the difficulties I had found with the combined retort and grate gas producer, as patented by me in 1864—No. 3018—which patent Mr. Price seems to ignore, although it must have been extensively read, seeing that all printed copies of the specification have been sold and a second edition is being prepared at the Patent-office.

I asked two questions at the meeting, viz., in what respect the retort gas producer employed at Woolwich differed from mine, and what was the consumption of fuel per ton of steel produced? No answer was given at the meeting to these two practical questions, but Mr. Price now states, in reply to the first, six points of difference between his furnace and the regenerative gas furnace with reversible regenerators as usually constructed by me. These points of difference, however, do not remove the important points of similarity between the two apparatus in question, viz., that of both, being gas producers, consisting of a vertical retort placed above a common grate with admission of atmospheric aid, the retort portion being heated by spare sensible heat in order to pass the fuel through the first stages of distillation. In both cases the hydrocarbon evolved in the retort pass downward and through the fuel made incandescent by the air passing through the grate; and the waste heat of the furnace is also in both cases utilised to heat the air before entering into combustion, although Mr. Price's form of regenerator may differ from the non-reversible form of regenerator I have usually adopted where moderate degrees of heat are required.

The value of Mr. Price's construction should be tested by my second question having reference to the total amount of fuel consumed in both cases per ton of steel produced. If Mr. Price can answer this question satisfactorily, I should be the first to admit that he had made a valuable improvement; but if, on the contrary, as I suspect, the consumption in his furnace considerably exceeds that in the regenerative gas furnace of usual construction, in that case I can only regard it as an imperfect imitation of an existing arrangement of recognised value, But, in any case, I might have expected a graceful acknowledgment of my labours, both as regards the furnace and the steel process employed at the Arsenal, notwithstanding the immunity claimed by public departments from liability under letters patent.

I am pleased to observe that Mr. Price promises us an account of the circumstances surrounding the first application of the regenerative gas furnace at the Woolwich Gun Factory, from which it will be made clear why that furnace was constructed without reference to the practical information that might easily have been obtained—if not from myself, at the works of my licensees. Regarding my own connection with the transaction, I beg to repeat emphatically that I never saw the furnace in operation, and that when I was asked to inspect it after it had been put out, I could only have reported as I did, that its reconstruction was necessary to attain the end in view. C. W. SIEMENS.

12, Queen Anne's-gate, S.W.,
November 8th.

THE BRUSH ELECTRIC LIGHT.

SIR,—As constant subscribers to your paper, and having extensive correspondence with the iron centres, we have from time to time been struck by the accuracy of the reports by your correspondents. We therefore feel emboldened to point out to you some slight inaccuracies in your last week's issue with regard to the Brush electric light, which we are erecting with so much success in every description of ironworks.

Our lights are not now on approbation at Messrs. Bolckow, Vaughan, and Co.'s. It is true that we put them in on trial for one month, but before Mr. Richards went to America they were accepted by him and paid for, as was done at Messrs. Johnson and Reay's.

At Messrs. Samuelson's the Brush light has not been removed, but a break occurred in the lighting in order to rearrange the sixteen lights in such a manner as to light up five blast furnaces instead of three, as we at first contemplated. These lights are now running.

We trust to your sense of fairness to publish this letter, as the remarks of your Middlesbrough correspondent would tend to seriously prejudice our business. HAMMOND AND CO.

110, Cannon-street, London, November 1st.

STRAINS ON CRANE POSTS.

SIR,—Allow me, through your columns, to thank your correspondents for their kind courtesy in taking so much trouble to reply to my last letter. Some of these gentlemen hold views opposed to mine, and I would like to reply to them. Mr. Major says I take the safety valve head as an axis and also the fulcrum of lever; not so. I assume that the valve if free would simply travel bodily down in a straight line, and the reverse with the fulcrum. Numerous illustrations occur to me to show my view is the true one, but I will content myself with two or three. For example, suppose a vertical box girder is made, and that on the upper ends of back and breast plates other pieces of plate A and B are rivetted—see Fig. 1—and that a bar C is placed upon them

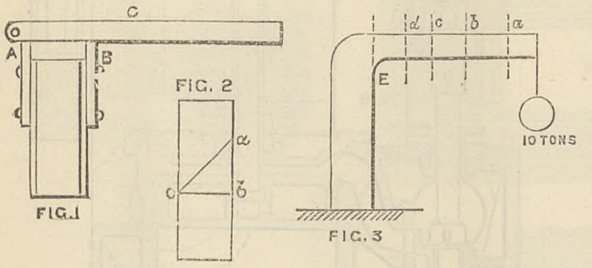


FIG. 1 FIG. 2 FIG. 3

pivotting at A, and that a load of, say, 5 tons is placed exactly over plate B, will not the whole insistance of the load be acting to shear B's rivets down, no strain at all reaching A's rivets? Now let the load be moved to point C. Here we have a tendency set up in C to either shear A's rivets up or B's rivets down; but with load over B direct a shear existed on its rivets while there was none on A's. How am I to believe that moving the load out to C alters conditions for A's rivets but not for B's? I cannot believe it, and if the bar C was rigidly united to A, I still maintain the load on B will be the greater; and this for one reason, namely, that in all probability a proportion of the tensile strain on the back would be counterbalanced by the transference to it of a portion of the downward or perpendicular load; or, in other words, while the breast, being nearest the load, would bear a certain absolute downward strain without any counterbalance to be deducted, the back would receive a less share of downward strain as being more remote from load; but this would have to be deducted from the upward or tensile strain, which my opponents say must be equal to the compression. This argument will apply also to Mr. Furrel, and to "H. W. G." The latter asks me where I would put the neutral axis if my crane mast were solid instead of being box form, *i.e.*, tubular. My reply is that I am of opinion that the neutral line would be located at the back surface of the solid column, like Fig. 2, where, if the sine $a\ b$ of angle θ equalled downward load, apex of angle θ would be the neutral axis.

I will ask my opponents: If I take a cast iron column, say 1ft. square, and any moderate height, say 8ft., and that I first place a load over its centre, and that I then place the load over one side—do they want me to admit that no difference is made in the strains in that column? Well, if they do not do so, I will in that case ask them what the nature of the difference will be. I repeat, that taking the rigid theory principle of Mr. Furrel and "H. W. G.," it, if it proves anything, proves that the tension of the back is reduced. I must, however, object to the soundness of the theory itself. The whole system of statical laws of strains on solids like this is that the given mass or body tends to rotate round the moment of compression strain.

Be the mast of a crane a solid column, I maintain that, other things being equal, it will tend to rotate on any selected point if free to move at all points, but on that one only; and no more can be said of the safety valve.

My own theory of the matter is simply this: In a crane there are two classes of strains in its jib, one class being those of what I may call leverage strains; and so far as these go, I readily admit the crane to be a bent lever with a uniform neutral axis; but the second class is pure shear, and equal to total weight of load, and of those parts of itself between load and any selected shear line. This shear is, so far as the mere load suspended goes, quite constant and uniform, and I believe it is transferred entirely to the ground through the breast plates, none reaching the back, simply because the web plates are not counted on as taking any compression strain downwards. They have no such function; their duty is to act as distance pieces, and to prevent the breast from buckling or bending, much as they do for the top boom or flange of the box girder of a bridge or of a plain web girder.

Reference to Fig. 3 will make clear what I say about shear strain lines. $a\ b\ c\ d$ are any selected shear lines, which shear finally goes to the ground through breast plate E.

My rule for calculating the strains on the mast of a crane of this or of the square head type is to take the mast as being loaded equally in tension at back and compression at breast, and this being done, to add to the breast strain the actual insistant load to be lifted, the chain when at its total run out, and the total weight of the jib from the centre line of the mast to the extremity. Of course half the weight of such part of the mast as is above any point selected is also added at that point.

I don't think Mr. Major's illustration of what I suppose we may agree to call a bent crane is complete, because he takes no account of the shear strains. Mr. Hoy raises a curious, and at first sight paradoxical point, which has often presented itself to my mind. He is perfectly right no doubt in saying that the compression due to what I above called leverage strains is greatest close up to the top of the mast just under the jib, and this creates a seeming paradox that the taller the mast *cæteris paribus*, the stronger it is at the ground, and that the true shape for the mast would be an inverted cone, but it in no way disturbs my proposition that the strain on the breast of a crane like this now under notice is expressed by the formula $S = L + y + x$; S being breast strain, L being leverage strain of load, y being shear strain, and x being load of crane parts above the moment.

HAMILTON W. PENDRED.

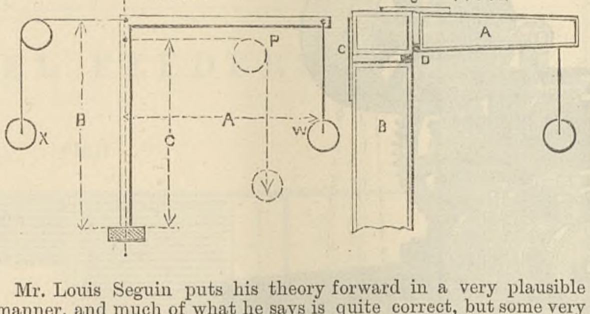
3, Fern Bank, Higher Broughton.

SIR,—After reading the letters which appeared under the above heading, in your issue of the 21st inst., Mr. Pendred no doubt felt himself much in the position of the man who was the happy possessor of a son, an ass, and an accommodating disposition; but I trust will not, like him, be induced to attempt carrying the beast of burden. As one of the self-constituted advisers of your much-advised correspondent, will you allow me space for a few words in reply to some of my fellows; first pointing out that in my own letter, your printers have made me talk nonsense, by twice printing "vertical length of lever" instead of "virtual length." The mistake, however, was probably obvious to most of your readers.

Mr. A. H. Hoy "thinks his diagrams will explain themselves." They do certainly explain the method Mr. Hoy uses to obtain a line, which he says is the path of the neutral axis, but why he uses that method we are not told. Whatever his reasons may be, his method is wrong, for it fixes the neutral axis without taking cognisance of the strengths, relative or positive, of the front and back flanges of the post. It should be evident that if the back flange is made twice as strong as the front, the neutral axis will not be in the same position as if the back flange were only half the strength of the front; the axis would always approach the stronger flange. Mr. Hoy's method is, however, inflexible.

Touching a side issue raised by this gentleman, will he explain why Mr. Pendred's safety valve theory is not equally applicable, or inapplicable, to either of the extreme cases assumed? I see in them only the same order of lever differently proportioned.

FIG. 1 FIG. 2



Mr. Louis Seguin puts his theory forward in a very plausible manner, and much of what he says is quite correct, but some very much the reverse. "In the crane post," he says, "the load is not at right angles to the neutral axis as it is in the girder, and the analogy will not hold." The fact here stated is correct; the inference not so. The vertical strain due to the load and parallel with the post may be readily resolved into an equivalent strain at right angles to it. Mr. A. C. Pain shows this very clearly, graphically—but here is a practical illustration. In Fig. 1, let W be the weight suspended from the end of the jib, setting up a tendency to break or overturn the post. This tendency may be counteracted by a weight X, with a cord passing over the pulley. The virtual leverage with which W acts to overturn, is the line A. Now if the weight W be removed, and another of equal amount V be attached to the post by a cord passing over a pulley P, and secured at such a height as will make C = A, and thus producing the strain at right angles to the post, which Mr. Seguin so much desires, it will be found that the same counteractive weight X suffices to maintain equilibrium as it did in the previous. But if the resisting strain is the same in both cases, the strains resisted must be identical, and the analogy will hold. All that Mr. Seguin says about his cover plate C and his hard liner D, is correct; but it proves too much. I admit all he says, and referring to Fig. 2, must ask him to admit that his remarks are equally true of my second cover plate and hard liner, introduced in the jib, and then I shall have to contend that if Mr. Seguin has proved that the safety valve theory is correctly applied to the post, he has also proved it so to the jib. Now neither one nor the other is correct. This theory does apply to both cover plates and both hard liners, but only because at these points we have eliminated the webs, and when we get into the solid jib and post proper, we leave the theory behind us as inapplicable. Something of this sort seems to have dawned upon your correspondent towards the end of his letter where he introduces a saving clause, admitting that his reasoning does not apply if the post is a rigid structure, sheltering himself again by an inference that "practical" cranes have an amount of "internal adjustment" which destroys the quality of rigidity, and also the applicability of the bent girder theory. If by "internal adjustment" is meant molecular movement under stress due to load, "rigidity" still remains, in the sense usually understood. If he means sliding of rivets in their holes, and of plates upon each other, his crane post would soon be in a bad way, and would not pay for discussion.

Shortly, Mr. Seguin removes the webs and argues behind their backs; what he does in practical, and if he will excuse me, workshop-like language, "Mr. Tozer" and "J. H. H." both do trigonometrically, and they all, starting with the same error, naturally arrive at similar results. Mr. Alfred Fyson's solution is simply delicious. After using his 40 tons load to produce strains of compression and tension in his crane post, he still finds 40 tons to stick upon the head of the post to produce more compression, and all out of the original 40 tons! The cruise of oil was nothing to it. Let us see where Mr. Fyson will land himself in an extreme case, bearing in mind that what will strain a secured post, will overturn an unsecured one. Take a post 2ft. wide, with a load of 40 tons suspended 1ft. horizontally from the face of the post. By the safety valve theory which Mr. Fyson adopts, the compression at the face of the post will be 60 tons, and the tension at the back 20 tons. Then, he says, the 40 tons load also sets up a compressional strain upon face and back, amounting to 20 tons each. The back is, therefore, suffering from 20 tons of compression and 20 tons of tension, and is consequently not strained at all in either direction—not even in tension, which is the uplifting or overturning strain; and yet, can it be? there are 40 tons hanging up 1ft. outside the base. After this, the comical gravity of the sentence, "Mr. Pendred's values for the same parts would be somewhat different," is truly refreshing. This gentleman, Sir, should be encouraged; another effort and he will probably attain to *perpetuum mobile*, or creative power; not to mention the more trivial matter of eating his cake, and having it.

34, Freke-road, Lavender-hill, S.W. C. G. MAJOR.
October 22nd.

THE LENGTH OF THE METRE.

SIR,—In your issue of 4th inst. we notice a very comprehensive "Conversion Table for French and English Measures," which has apparently been constructed upon the assumption that a French metre is equal to 39·37079 English inches. In all measurements where great accuracy is required the use of this equivalent is sure to lead to more or less serious errors, and as every similar table we have seen appears to be based upon the same figures, we take the present opportunity of pointing out the error through the medium of your influential journal.

We quote from H. W. Chisholm's—Warden of the Standards—"Weighing and Measuring," Macmillan and Co.'s "Nature Series"—"Ever since this period—1818—this authoritative equivalent of the metre in imperial measure—39·37079in.—has been recognised as the true equivalent, and it received the sanction of Parliament in the Act of 1864, for legalising contracts made in this country in terms of the metric system. It is, however, to be observed that it is the *scientific* equivalent of the metre in imperial measure, when each standard is taken at its own normal temperature. For all *commercial* purposes, on the other hand, the measure of a metre is always used at ordinary temperatures, just as a yard measure is used, and the comparison of the two should therefore be more properly made at the same average temperature of 62 deg. Fah. At such temperature a brass metre is equal to 39·382in., and this length is to be taken as the true commercial equivalent of the metre in British measure. Of course this difference between the equivalent in imperial measure of the metre at ite legal and at its ordinary temperature, amounting only to $\frac{3}{1000}$in., is perfectly immaterial in commercial measurements of small quantities, and the metre may safely be estimated as equal to 39$\frac{3}{8}$ of our inches (39·375)." The figures in brackets are ours.

Mr. Chisholm's opinion that the difference is perfectly immaterial in small measurements must be taken with the fact that he has made a clerical error in calling that difference only $\frac{3}{1000}$in. instead of $\frac{11}{1000}$in.

It is a very common error to assume that the Act of 1864 defines the metre to be equal to 39·37079in. when both standards are at 62 deg. Fah., whereas this comparison holds good only when the metre standard is at 32 deg. and the inches standard at 62 deg. Fah. By the time that the metre standard attains 62 deg. it has expanded to a length more or less greater than 39·37079, according to the material of which it is made.

We have for many years used the equivalent of 39·3808, which we have assumed to represent the mean of the expansion of brass and steel, which are the two metals mostly used for commercial standards.

We take this opportunity of calling attention to the error with the hope that Mr. Chisholm or some other authority will lay down a fixed relative value, as it is a pity to see valuable time wasted in preparing tables that must sooner or later become obsolete. JAMES CHESTERMAN AND CO.

Bow Works, Ecclesall-road, Sheffield, Nov. 8th.

GOLD MINING.

SIR,—Mr. W. J. Moritz in his letter of the 28th ult. is evidently in error in what he states, and I should think it would have been better if he had reconsidered his letter before publishing it, because his wholesale condemnation of the process I described, without advancing a single practical reason for doing so, is unreasonable and unjust. If he thought it was not feasible, or a process that has been brought out before, why not give the proofs instead of condemning the whole in a passion of words, without one single fact or date to justify them? There is no argument in a controversy of this style. If Mr. Moritz thinks my process is out of date, let him name the places it has been tried in and the results achieved, let him also describe the process he uses and the results, then compare them both and let the public judge which is the best. I may also say that I do not carry on this correspondence for my own benefit or profit, but that it my lead to a correspondence on the different methods of reduction in different parts of the world, so that in the end the public, who are greatly interested at the present time, may reap the benefit. Mr. Moritz further asserts that I am not practical and that I advance a process as old as the hills. Well in the first place it may surprise him when I state that I have had for many years practical instruction and tuition from a gentleman who has been for the last thirty years engaged in designing, erecting, and running machinery for the reduction of lead, tin, copper, silver, and gold ores; and as regards my process being as old as the hills, if Mr. Moritz will reperuse my letter he will see that I place a stone breaker as the first machine in my description, and I should say if the hills he alludes to are not older than the invention of that machine, I should say those hills must be of very recent date and quite a geological curiosity. Mr. Moritz further states that I had better wait until I could bring out a something nearer the mark, and yet in the same sentence threatens that if I do do so, that he knows all about. Now this is not very encouraging, especially as the latter part of the machinery I described for concentrating and classifying the ore so that there should be the least waste with a maximum of gain, only gave a verbal description of it, and I did not illustrate my remarks by drawings; and I may appear egotistical, but I honestly thought when I wrote that description that I had brought out a new process, and I still think so; and if this is so how Mr. Moritz can know it, and yet know a still better process, I do not understand. In fact as far as practical knowledge goes, the only display of it made by Mr. Moritz is that different ores require different treatment. This the veriest novice in mining knows, and it is amusing for him to taunt [me with not knowing this. GEO. T. EVANS.

EARLY STEAM NAVIGATION ON THE THAMES.

SIR,—In your very interesting account in THE ENGINEER of October 9th, of Messrs. Maudslay's workshops, you mention that the Regent, fitted by them, was the first Margate steamer. This is not correct. The Thames, formerly the Glasgow, purchased by Mr. George Dodd, and navigated by him under steam in June, 1815, from Glasgow to London, was the first steamer that ever performed a voyage on the high seas, as well as the first passenger steamer that ran from London to Margate. The Regent, a far superior steamer, came on the scene a year after, and soon drove off the poor old Thames, which was placed on the Gravesend line. The Richmond, of 10-horse power, was plying between London and Richmond some time before the advent of the Thames. She belonged to the enterprising company founded by Dodd, who may be really called the father of Thames steam navigation, but who, sad to say, came to an untimely end in 1828. George Dodd and his father, Ralph Dodd, who was the engineer of Vauxhall Bridge and other important works, were both largely interested in steam navigation. They were Newcastle men, and I think the spirited men of that town should in some way have done honour to their memory. In the British Museum may be seen a curious work by George Dodd, giving an account of the voyage from Glasgow to London, as well as a drawing of the Thames and other steamers, which should certainly be reprinted at the present day, as a very curious memento of a very ingenious and ill-fated man. May we hope to see such in THE ENGINEER. S. DARTON.

Alexandria, October 20th.

DEATH OF MR. PATERSON, C.E.—Mr. William Paterson, C.E., died at his residence, Craigie, on Saturday morning. Deceased, who was seventy-two years of age, was engineer at Perth Joint station. Mr. Paterson, during a long professional career, has been engaged by several of the principal railway companies of Scotland, and he acted as resident engineer during the construction of the Tay Bridge. He has been in delicate health for a considerable time.

RAILWAY MATTERS.

A TRAMWAY is to be laid between Newry and Bessbrook.

FOR economic reasons it has been decided not to light the St. Gothard tunnel with electric lights.

THE Government of Victoria has decided to complete the amalgamation of the Hobson's Bay and the Government Railways.

A COMPRESSED air locomotive is to be tried on the elevated railroads in New York. It has already made one or two trips with a train, and is said to have worked very well. Further trials are to be made.

THE Decauville system of light railways has been adopted by the French Government for service in Africa. It was employed to bring up supplies for the corps marching on Kairouan. The works at Petit Bourg are working night and day to complete the orders of the Minister of War. The track is ·60 metres gauge, and the rails weigh 7 kilogs. and 9 kilogs. per metre. A little 3-ton locomotive is to be employed to work the line.

THE following cases on the railways of the United Kingdom for six months to end of June last were reported, which involved no personal injury:—780 failures of tires, 3 of wheels, 1 of a brake apparatus, 5 of tunnels, bridges, viaducts, culverts, &c., and 381 of rails; 26 cases of trains running through gates at level crossings; 15 of the flooding of portions of the permanent way; 20 slips in cuttings or embankments; 1 fire in a train; and 2 other accidents.

AT the monthly meeting of the Leeds' Association of Foreman Engineers, held on the 27th ult., a paper on "Eames's" vacuum brake was read by Mr. Francis Campin, C.E. The author strongly advocated the superiority of the brake in question as a thoroughly reliable everyday brake, the subject exciting considerable interest. The discussion was adjourned until the next meeting to afford the members time to read and digest the paper before proceeding to criticise its contents.

ACCORDING to a *Daily News* telegram, the first locomotives for service on the St. Gothard Railway have arrived at Goeschenen. Express trains will run to Milan from Basel in eleven hours, to Florence in twenty-four hours, and to Rome in thirty-three hours. The Federal Council has given orders for the road over the pass to be kept free from snow until the line is opened throughout. The first journey through the tunnel without interruption was made last week by a train conveying sixty passengers.

IT is proposed to establish direct railway communication between Portsmouth and Aldershot and the Northern and Midland districts. It will, if made, join the South-Eastern Railway at Aldershot, and will open up the districts of West Meon and Hambledon, and, after passing between the villages of Waterloo and Purbrook, will reach Portsmouth Harbour by means of a tunnel which it is proposed to make through the Portsdown chalk range. The principal station at Portsmouth will be erected at the boundary of the Dockyard Extension Works, but it is also contemplated to carry a branch line into the fashionable watering-place of Southsea.

BY means of the rail and boat service arranged by the London, Chatham, and Dover Railway Company, in conjunction with the Northern of France, and Paris, Lyons, and Mediterranean Railway Companies, we may now leave Victoria Station at 7.40 a.m., and reach Marseilles at 11.15 a.m. the following day, or in 27½ hours. Nice will be reached at 4.29 p.m., or in 32¾ hours, the Customs' examination of registered luggage taking place at Marseilles and Nice respectively. Leaving Victoria at 8 p.m., passengers will reach Cannes at 7.17 a.m., Nice at 8.30 a.m., and Mentone at 9.59 a.m. the second day, and the Customs' examination of registered luggage will take place at the Gare de Lyon, Paris.

THE German railway regiment, in common with every other fraction of the German army, holds annually its autumn manœuvres. These exercises have been carried out this year at Klausdorf, and comprised the construction, within forty-eight hours, of a field railway 1½ kilometres in length and a viaduct 80 metres long and from 6ft. to 60ft. high—the centre arch of the viaduct having a span of over 30ft. The *Railway Gazette* says the task was completed well within the specified time, relays of men being employed to carry on the work night and day; and immediately the whole of a line was laid a locomotive was run over it to test the solidity and exactness of its construction. The railway regiment is a comparatively new formation in the German army, its first battalion having been organised only in May, 1871; and the perfection it has attained in the accomplishment of its special duties is largely owing to the interest taken in it by Count von Moltke himself. The organisation and training of the purely fighting element is not deemed by the German military authorities to be all that is necessary to insure success in war.

FROM the report of Major-General Hutchinson on the collision which occurred on the 26th August, at Doncaster station, on the Great Northern Railway—when the up express train from Newcastle and Scarborough overran the platform at Doncaster station, and ran into a siding where, 130 yards from the spot at which the engine ought to have stopped, it came into violent collision with a carriage-truck and two horse-boxes standing against the buffer-stops at the end of the siding—it appears that the collision can only be attributed to the driver having approached the station at an injudiciously high speed, and then having failed to properly apply the vacuum continuous brake with which the whole of the train was fitted, and which, had it been used sufficiently early, would no doubt have stopped the train in ample time to have avoided the collision. As the train approached Doncaster, the driver sent his fireman to the front of the engine to put oil in the lubricators, and he had not returned to the foot-plate before the engine had reached the south end of the platform, where he—the fireman—jumped off, and escaped without injury. In consequence of the absence of the fireman from the foot-plate, the driver had himself to apply the tender-brake on finding, as he says he thought, that the vacuum brake was not acting properly. The brake was apparently in good working order; so the lesson is one for drivers, namely, that their firemen should not be sent to do oiling just before entering a station; or if that is necessary, because oil cannot be got into the cylinders, except when steam is shut off, then other lubricators should be employed.

DURING the six months ending 30th June last there were 226 servants of our railway companies or contractors reported as having been killed and 1092 injured. Of these, 15 were killed and 186 injured whilst coupling or uncoupling vehicles; 3 were killed and 12 injured by coming in contact, whilst riding on vehicles during shunting, with other vehicles, &c., standing on adjacent lines; 22 were injured whilst passing over or standing upon buffers during shunting; 18 were killed and 131 injured in getting on or off, or by falling off, engines, wagons, &c., during shunting; 2 were killed and 75 were injured whilst breaking, spragging, or chocking wheels; 5 were killed and 20 injured whilst attending to ground points, marshalling trains, &c.; 2 were killed and 59 injured whilst moving vehicles by capstans, turntables, props, &c., during shunting, and 13 were killed and 107 injured by various other accidents during shunting operations; 5 were killed and 13 injured by falling off engines, &c., during the travelling of trains; 4 were killed and 7 injured by coming in contact with over-bridges or erections on the sides of the line during the travelling of trains; 15 were injured whilst getting on or off engines, vans, &c., during the travelling of trains; 4 were killed and 44 injured whilst attending to, or by the failure of, machinery, &c., of engines in steam; 60 were killed and 72 injured whilst working on the permanent way, sidings, &c.; 3 were killed and 4 injured whilst attending to gates at level crossings; 43 were killed and 106 injured whilst walking, crossing, or standing on the line on duty; 18 were killed and 104 injured by being caught between vehicles; 14 were killed and 67 injured by falling or being caught between trains and platforms; 15 were killed and 8 injured whilst walking, &c, on the line on the way home or to work; and 2 were killed and 40 injured from various other causes.

NOTES AND MEMORANDA.

THE Terek pass of the Caucasus reaches a height of 7877ft., or about 2000ft. above the St. Gothard, the Simplon, and the other Alpine carriage roads, the Stelvio excepted. Its length is 210¼ versts.

SIGNOR SUZANI, of Milan, some time ago suggested keeping the eggs of the silk worm in a state of lethargy for an indefinite time by keeping them at a temperature near the freezing-point. Apparatus for the purpose was shown in operation at the exhibition at Milan. A Pictet ice-machine is employed for the purpose. The value of the process lies in the fact, the *Génie Civil* says, that in years when the mulberry-trees are behind, the eggs may be held for a future more auspicious period.

SOME comparisons of the cost of the application of spirits, petroleum, and illuminating gas for heating operations in the laboratory have been made by Professor Wigner:—The most costly material is spirit, which costs three times as much as petroleum or gas. Petroleum and gas cost nearly the same, the former being a little cheaper. The tests were made by noting the time and heating material consumed in raising the temperature of a given amount of water from 12 deg. to 95 deg., the same vessel or vessels of the same shape and size being used in each case.

DURING the last week of October the annual rate of mortality in twenty of the largest English towns averaged 22 per 1000 of their aggregate population, which is estimated at 7,608,775 persons in the middle of this year. The rates, ranged in order from the lowest, were as follow:—Plymouth, 13·2; Sheffield, 16·8; Birmingham, 19·2; Leeds, 19·2; Portsmouth, 20·3; Bristol, 20·7; Salford, 20·8; Bradford, 21; Sunderland, 21; London, 21·6; Nottingham, 21·6; Brighton, 21·7; Leicester, 22·9; Oldham, 23·3; Manchester, 23·4; Norwich, 24·3; Newcastle-on-Tyne, 25·1; Wolverhampton, 25·4; Liverpool, 27·3; Hull, 33·3.

A COLOURLESS cement for joining sheets of mica is prepared as follows, as described by the *Scientific American*:—Clear gelatine is softened by soaking it in a little cold water, and the excess of water is pressed out by gently squeezing it in a cloth. It is then heated over a water bath until it begins to melt, and just enough hot proof spirit (not an excess) stirred in to make it fluid. To each pint of this solution is gradually added, while stirring, one-quarter ounce of gum-ammoniac and one and one-third ounces of gum-mastic previously dissolved in four ounces of rectified spirit. It must be warmed to liquefy it for use and kept in stoppered bottles when not required. This cement, when properly prepared, resists cold water.

A METHOD of preparing cheap carbon poles for voltaic batteries has been devised by M. Mauri, and we think we have mentioned it before, but as it may be useful to many, we repeat it. It consists in taking finely-powdered graphite mixed with an equal weight of sulphur free from carbonate, and heating the mixture in a crucible until all the sulphur is fused. The temperature, however, should not be raised over 200 deg. Cent. When the mass is fluid, it is poured into a suitable mould of metal, and a stout copper wire is inserted to serve for an electrode. When the mass is cool and solid it is ready for use. Its conductivity is practically as good as that of the best retort carbon, and as it is more electro-negative than simple carbon, the electro-motive force of the cell is higher. By increasing the proportion of sulphur in the mixture a highly resisting composition may be obtained, which can take the place of copper or platinum silver coils for telegraphic or electric lighting purposes.

A NOTE on the action of sulphuric acid on zinc and tin, which is of some interest to electricians, was read before the Chemical Society on the 3rd inst. by M. M. P. Muir and C. E. Robbs. Strong sulphuric acid $7\,H_2\,S\,O_4 + 2\,H_2\,O$ exerts no action on zinc until a high temperature is reached, when $S\,O_2$ is evolved and some sulphur separates; more dilute acid (7: 4) acts similarly with acid still more dilute 1: 1, no $S\,O_2$ is produced, but $H_2\,S$ is evolved with the separation of sulphur; with weaker acids the action begins at a lower temperature, and hydrogen is the chief product of the reaction. Traces of sulphutetted hydrogen also come off, but no $S\,O_2$ and no S^1. The action of strong sulphuric on tin at ordinary temperatures is very slight, $S\,O_2$ being evolved and a little sulphur; as the temperature rises the action increases and $H_2\,S^1$ begins to appear; with acid 1 : 1 (molecules) $H_2\,S$ is evolved at a lower temperature, and at 120 deg. H, $H_2\,S'$, and $S\,O_2$ and S are formed simultaneously, more dilute acids have but little action until the boiling point is reached, when H and $H_2\,S$ are evolved; with $H_2\,S\,O_4\,7\,H_2\,O$, H alone is formed.

ALTHOUGH England, Germany, France, and America are moving with great strides in electrical development, France had the honour of being the first to employ electricity for the transmission of power. The St. Claude shaft at Blanzy was sunk to the depth of 500 metres (1640ft.), for the purpose of searching for a faulted portion of the coal seams, and a heading was run from it across the strata. When this heading had reached a length of 400 metres (1312ft.) the ventilation became so poor that the temperature at the face rose to 95 deg. Fah., and the miners could work only for a few hours. After some ineffectual attempts to improve the ventilation by simple means, it was decided to put in a fan 2·63ft. in diameter, and run it by power transmitted by electricity. An 8-horse portable engine was put up above ground, and with it a Gramme dynamo-electric machine was run at a speed of 1200 revolutions per minute. The electric current thus generated was conducted by a cable, consisting of seven 0·044in. copper wires, to a second Gramme machine coupled directly with the fan, and placed in the heading near the shaft. Running at 700 to 800, it required 2½-horse power, the useful effect being about 60 per cent. The temperature at the face was only lowered 5 deg., but the men could work in eight hour shifts.

A JAPANESE physicist, Hanichi Muraoka, has ascertained the electrical properties of certain classes of carbon to be as follows. They have been given by a German contemporary:—(1) Siberian graphite, specific gravity 1·8 contains 98 per cent. of carbon, coefficient of expansion, ·0000038; temperatures, 26, 194, 251, and 302 deg., resistances in Siemens units ·0785, ·0693, ·0665, ·0646, specific resistance = 12·20. (2) Retort carbon, specific gravity 1·8, expansion coefficient ·0000015; temperatures 17·5 and 100 deg., resistances in Siemens units ·246 and ·240, specific resistance = 52·23. (3) Carbon prepared for electric lighting purposes, temperatures 17 and 100 deg., resistances in Siemens units ·360 and ·340, specific resistance = 48·44. (3) Other sorts of prepared carbon for electric lighting purposes, specific gravity 2·37, expansion coefficient, ·0000015, temperatures 26,165, 213 and 335 deg., resistances in Siemens units, ·228, ·219, ·217, 211, specific resistance = 42·90. (5) Prepared coke carbon for electric lighting purposes, made by Messrs. Heilmann and Co., of Mülhausen, specific gravity 1·90, contains of carbon 98·1 per cent., expansion coefficient ·00000032, temperatures 28, 165, 240, and 338 deg., resistances in Siemens units ·139, ·135, ·134, ·132, specific resistance = 39·10. (6) Faber's pencil leads, specific gravity 2·36, contains of carbon 52 per cent., expansion coefficient ·00000095, temperatures 120, 139, 159, 182, 210, 235, 261, and 287 deg., resistances in Siemens units, 10·50, 10·38, 10·25, 10·14, 10·01, 9·891, 9·770, 9·649, specific resistance = 952. (7) Prepared carbon No. 57, made by Messrs. Kaiser and Schmidt, of Berlin, specific gravity 1·63, contains of carbon 98 per cent., expansion coefficient ·00000205, temperatures 14·3 and 100 deg., resistances in Siemens units ·652 and ·638, specific resistance = 36·86. (8) Other sorts of carbon made by Messrs. Kaiser and Schmidt, temperatures 11·7 and 100 deg., resistance in Siemens units 1·224 and 1·186, specific resistance = 41·17. (9) Prepared carbon made by Gaudoin, specific gravity 1·55, contains of carbon 97·6 per cent., expansion coefficient ·0000030, temperatures 31, 169 229, and 322, deg., resistances in Siemens units ·0836, ·0797, ·0784, ·0765. Muraoka also observed that between different kinds of these carbons thermo-electric currents arise. The electro-motive forces are, though weak, distinctly evident.

MISCELLANEA.

A LIGHTHOUSE will be erected at once at Cranberry Island, Strait of Canso, to replace one recently destroyed by fire.

THE Chesterfield Corporation has signed a contract for a year for the entire lighting of the town by Messrs. Hammond and Co., on a combination of the Brush 2000-candle power lights and Fox-Lane incandescent lamps.

THE business and plant of Messrs. John H. Wilson and Co., Bankhall Engine Works, Sandhills, Liverpool, have been purchased by a new firm, of which Mr. Bradley is the acting partner, and Mr. F. F. Kennedy manager. The business will be carried on under the old style of firm.

THE proposal to hold a Universal Exhibition in Rome in 1885-86 is again cropping up. A committee has been formed in London for the purpose of securing the participation of British exhibitors. Other committees are being formed in Manchester, Birmingham, Leeds, and Liverpool.

MR. F. A. FAWKES, author of "Horticultural Buildings," has been appointed to give a course of three lectures to the students and the public at the Crystal Palace at five p.m. on November 16th, 23rd, and 30th, upon the construction, fitting, and heating of greenhouses, conservatories, and other horticultural structures. The lecture will be illustrated by numerous specially prepared diagrams, &c.

AT the Phœnix Bessemer Works, Ickles, near Rotherham, Messrs. Steel, Tozer, and Hampton, have commenced an experimental trial of the Brush system. It is intended to erect seventeen lamps—2000-candle power—twelve are at present in operation. The current is produced by means of a nominal 16-light Brush dynamo-electric machine, which at full speed makes 780 revolutions per minute, and is worked by one of Fowler's 16-horse power engines.

THE directors of Colonel Tomline's Felixstowe Railway Company have signed a contract for the construction of a deep-water tidal basin at Felixstowe, with an entrance 100ft. wide into Harwich Harbour, and with a depth of 23ft. at low water. It is said the contract sum is £80,000, and as it includes the making of a railway upon each side of the basin in connection with the main line, and also the erection of warehouses, things must be very cheap in Felixstowe or men work for nothing.

OWING to the frequent complaints which have been made during the past few months of the polluted and bad state of the river Thames, there is every possibility, the *City Press* says, that an inquiry will shortly be ordered, under the powers conferred by the 31st section of the Metropolis Local Management Act, 1858, as to the causes which affect the purity of the river near the metropolis, and the best means that shall be adopted to prevent the polluted condition if such a state should be shown to exist.

THE first meeting of the 128th session of the Society of Arts will be held on the 16th inst. The opening address will be delivered by Sir Frederick J. Bramwell, F.R.S.. Previous to Christmas there will be four ordinary meetings, in addition to the opening meeting. For these the following arrangements have been made:—November 23rd, "The Storage of Electricity," by Prof. Sylvanus Thompson, D.Sc., November 30th, Discussion on the Society of Arts' Patent Bill; December 7th, "The American System of Heating Towns by Steam," by Capt. Douglas Galton, F.R.S.; Dec. 14th, "Electric Lighting at the Paris Exhibition," by W. H Preece, F.R.S.

THE Lambeth Water Company is now actively enforcing the adoption of proper water fittings, instead of the wasteful things which are the cause of the apparently excessive consumption of water, and of the delay in the extension of the constant supply system. The company's inspectors are now making visits of inspection, and paying particular attention to the arrangements of pipes, closets, and fittings, and if they are awake they will find lots of instances of enormous waste, such as the necessity for emptying the cisterns into the drains whenever there is any need for attention to boiler fittings, pipes, or closets. Householders will do well to assist the company, and they will the earlier get the advantages of constant supply.

ON the 27th ult., an ordinary meeting of the King's College Engineering Society was held. Mr. Nunn read a paper on boilers, well illustrated by diagrams, beginning first with a description of the necessary parts of boilers, and a classification dividing boilers into five kinds. In the first class were included all externally fired boilers and their merits. The next class included internally fired boilers, resulting from improvements in those of the first class; and Cornish and Lancashire boilers were described. Under the head of multitubular boilers, those of locomotives and marine engines were explained and illustrated by means of drawings of the boilers of the s.s. Lord of the Isles and Assyrian Monarch and of a L. and N.W. engine. A model of a horizontal boiler, fitted with Galloway tubes, was shown, and its advantages mentioned. Vertical boilers were then described and their disadvantages shown; and, lastly, water-tube boilers.

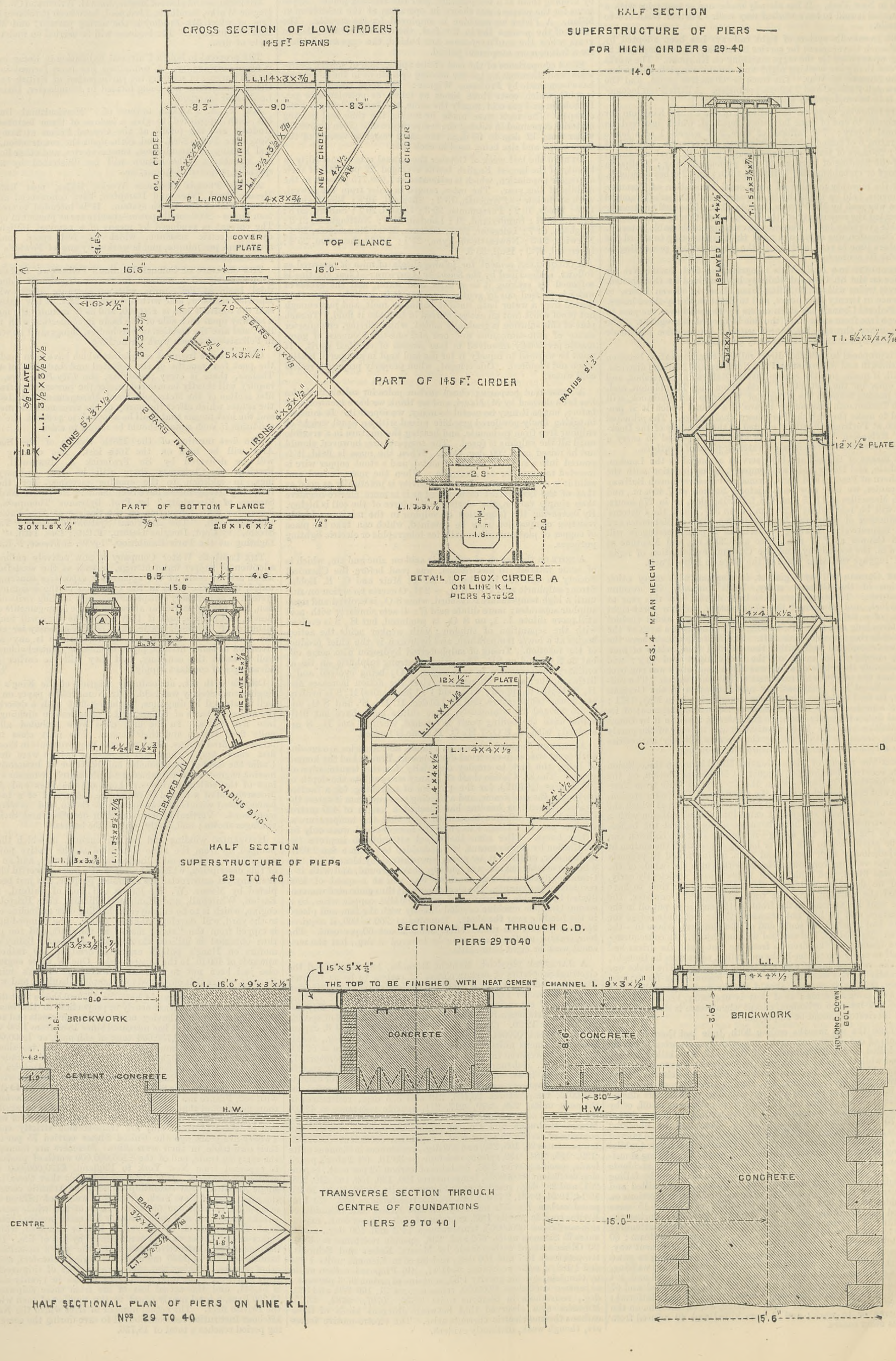
HYDRAULIC winding and hauling engines, in which the water pumped up from the mine is utilised as the motive power, are already in use at several collieries in this country, and an engine of this description, which is probably of a more powerful character than any yet constructed for a similar purpose, has just been completed by Messrs. W. H. Bailey and Co., of Salford, for the Easton, Whitehall, and Hanham Collieries, near Bristol. This engine, which is to be employed in hauling over an incline of 15in. in the yard, will develope 20-horse power. The pumped-up water is tapped from the "rising main" in the shaft, and the pressure thus obtained is utilised through one of Messrs. Bailey's water motors on Haag's patent under a head of 180 fathoms, or upwards of 460 lb. to the square inch. One of these engines has also just been put to work at Mr. Hussey Vivian's mines in Norway, where it is employed for pumping, hauling, and winding.

THE Wreck Register and Chart for 1879-80 shows that disasters at sea continue to increase nearly in proportion to the increase in shipping, 2519 wrecks having occurred on our coasts and seas last year. Our steam fleet has increased since 1850 from 1350 to 6690 vessels, representing 2,730,000 tons of shipping, or 1,000,000 tons more than all the steam fleets of the world put together. We thus hold the very highest position in the carrying trade of the world. In regard to large ocean sailing ships, America holds a very good position. England stands first on the list with 1276 ships, and America has 884. Norway stands very close to America with 882, France has only 57. When we turn to the ocean steam tonnage, we find that out of a total of 590 steamers engaged in the trans-oceanic trade, England counts for 447, America for only 46; and of these fourteen only are trans-oceanic strictly speaking. Twenty-five years ago the United States carried 75 per cent. of their own trade in their own ships. Steamers are monopolising the carrying trade, and of the £156,000,000 worth of produce that is exported from New York to England, £130,000,000 is now carried by steamers. It is a remarkable fact that there is not a single American iron steamship crossing the Atlantic ocean from the great port of New York. The 2519 wrecks of 1879-80 include every kind of maritime disaster. Thus of the whole number of wrecks, casualties, and collisions only 355 cases involved total loss, or about one in seven of the vessels lost or damaged, while only eighty-one of the cases were accompanied by loss of life. Deducting these 355 destructive cases from the year's casualties, the balance consists of 1130 more or less serious disasters, and 1035 other wrecks. Taking the aggregate number of shipwrecks it is truly startling. The total number of wrecks in twenty-six years is 51,841, and the actual loss of life from these shipwrecks of 18,550 lives, a total nearly equal to the number of men who man the British fleet. The actual number of lives which the National Lifeboat Institution has contributed to save during the corresponding period reaches a total of 18,736.

THE NEW TAY BRIDGE.

MR. W. H. BARLOW, F.R.S., ENGINEER.

(*For description see page* 353.)



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TO CORRESPONDENTS.

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

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ENGINEER.—*Multiply the square of the diameter of the piston in inches by the average effective pressure per square inch, by the speed of the piston in feet per minute, and by* ·0000238. *The result is the horse-power.*

THE REDENBACHER TURBINE.

(*To the Editor of The Engineer.*)

SIR,—I shall be much obliged to any of your readers who can tell me where I can get a drawing of the Redenbacher turbine. B. F.

November 10th.

JOINTING CEMENT FOR CAST IRON TANKS.

(*To the Editor of The Engineer.*)

SIR,—In reply to your correspondent's inquiry for a good jointing material for brewers' tanks, I should recommend him to use Scotch cement, which he will find answer the purpose better than any other material, without injuring the beer in any way. G. FREDK. RANSOME.

172, Scotland-road, Liverpool, November 7th.

BOOKS ON MILLING.

(*To the Editor of The Engineer.*)

SIR,—Supposing that "Novice," in THE ENGINEER of 14th inst. means grain milling, permit me to say—(1) I think there is not in English a really good book on the subject, that of Fairbairn (Longmans) being about 17 years old, that of Pallett (Baird, Philadelphia) about 12 years, that of Craik (Baird) 11 years old, and that of Abernethy (*American Miller*, Chicago), though through its recent date—1½ year old—having some of that needful new information which the others have not, being apparently partial. The prices of these American books are about $4, $5, and $4 respectively. Lockwood, 74, Duane, New York, has in press a $6 one by R. Grimshaw, M.E., which I think will be better, though not perfect. (2) In French, there is no book recent enough, but Roret, Paris, has in preparation a new edition of his "Manual." (3) In German, the best and most recent books are Kick's (1878), Pappenheim's (1878), Haase's (1879), Bergmann-Kögel's (1880), and Meissner's (1881). These are 18, 12, 11, 12, and 10 marks respectively. (4) Let him see last edition of Whitaker's "General Catalogue," Matheson's "Aid-book to Engineering Abroad," Leffel's "Dams," and consult the *Miller*, 69, Mark-lane. I wish him success, and offer to convenience him if I can. O'MADDEN.

24, St. Paul W., Jersey City, U.S.A., October 28th.

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MEETINGS NEXT WEEK.

THE INSTITUTION OF CIVIL ENGINEERS.—Tuesday, Nov. 15th, at 8 p.m.: Paper to be discussed, "Iron Permanent Way," by Mr. Charles Wood, M. Inst. C.E.

THE METEOROLOGICAL SOCIETY.—Wednesday, Nov. 16th, at 7 p.m.: "On the Gale which Passed Across the British Isles, October 13th-14th, 1881," by Mr. G. J. Symons, F.R.S., President. "On the Structural Damage Caused by the Gale as Indicative of Wind Force," by Mr. J. Wallace Peggs, Assoc. M. Inst. C.E., F.M.S. "On the Meteorology of Mozufferpore, Tirhoot, 1880," by Mr. C. N. Pearson, F.M.S.

THE ENGINEER.

NOVEMBER 11, 1881.

THE FORTH BRIDGE.

IN THE ENGINEER for May 20th we reviewed the history of the Forth Bridge from its inception in the year 1864 to its revival in the spring of the present year. Since the date of that article matters have progressed favourably; and the railway companies interested, namely, the North British, North-Eastern, Midland, and Great Northern Companies, are applying to Parliament for powers to construct a steel girder bridge in lieu of the suspension bridge for which an Act was obtained by the late Sir Thomas Bouch. We briefly indicated in the article referred to, the leading features of the design submitted by Mr. Fowler and Mr. Baker, and we understand that these features are adhered to in the design prepared, after five months' further investigation, by Messrs. Harrison, Barlow, and Fowler, for submission to Parliament next session. In a work of this magnitude and novelty the details of the design must necessarily vary almost from day to day as the elaboration of the plans proceed. We shall give on another occasion the design as first submitted by Mr. Fowler, and reserve for the time a consideration of the modifications already agreed to and of the details generally.

We may begin by stating that the future Forth Bridge will be a continuous girder bridge of varying depth. There are two spans of about 1700ft., two of about 600ft., and a viaduct approach of ordinary character on each side. The depth of the proposed girder is 330ft. over the piers and 55ft. at the centre. The extreme width of the lower member of the girder is about 112ft. at the piers and 30ft. at the centre, and of the upper member about 50ft. at the piers and 30ft. at the centre. In fact, the depth of bracing is roughly proportional both on elevation and plan to the stresses taking effect upon it. One result of this general characteristic of the design is that a large portion of the shearing stresses will be transmitted direct through the main members of the girder, and consequently the long struts and bracing generally will be eased to a corresponding extent in the same way that those members are relieved of stress in a bowstring girder by the arching of the top member. By making the bridge a continuous girder on plan as well as on elevation, it will be seen that the lateral wind bracing at the centre of the giant span of 1700ft., as regards length of struts and otherwise, is exactly similar to that of an ordinary double line railway bridge, instead of being 120ft. in width as in the original suspension bridge design. In the same way the central portion of the girder is of ordinary proportions, and thus the mass and weight furthest removed from the points of support and acting with the greatest leverage are enormously less than in an arch or suspension bridge of corresponding span and strength. It is due to this condition and to other consequences of the design that it has been found, after the most exhaustive and impartial investigation, possible to build a steel girder bridge of the unprecedented span of 1700ft. of vastly increased stiffness and freedom from risk during and after construction, and at an expenditure of about half-a-million less than that of a suspension bridge of the type originally contracted for. The estimated cost of the girder bridge is, it is true, considerably in excess of that of the original bridge, because the economy effected by the change of principle in the design is more than absorbed by the extra expenditure required to give that strength and stability which the Board of Trade justly insist upon after the disastrous experience of the Tay Bridge accident. Sir Thomas Bouch's bridge was designed for a rolling load of but 600 tons on each line, whilst the girder bridge is calculated for 1700 tons. Again, the wind pressure provided for was only 10 lb. per square foot in the former; and further, the strain upon the chains of the original bridge was 10 tons per square inch, whilst $6\frac{1}{2}$ tons has been adopted for the girder. The increased cost of the amended design thus needs no further justification.

Undoubtedly, after recent experience, the attention both of the public generally and of experts will be addressed in the first instance to the lateral rather than to the vertical stability of the Forth Bridge, and on this point it may be well to re-assure the public mind at once. We may state then, that it is intended to give such strength and stability to the structure that under the impossible wind pressure of twice 56 lb., or 112 lb. per square foot, no part of the bridge would be blown over, nor would any tie, strut, or any other member of the bridge, nor the structure as a whole, be even permanently injured, still less destroyed by the enormous lateral pressure due to that wind. All discussion as to what might be the actual maximum pressure of a hurricane in the Firth of Forth is thus anticipated by assuming a pressure which all the world will admit cannot possibly be approached on so large a surface as that of the Forth Bridge. It is hardly necessary to remark that with a pressure of 112 lb., which, as we have explained, would leave the bridge uninjured, locomotives, loaded coal wagons, and everything else about a railway would be sailing through the air like fallen leaves. The provision of such immense lateral stability involves, necessarily, the expenditure of an enormous amount of steel in the superstructure; but the cost is justified by the feeling of security which the public will subsequently enjoy in crossing the bridge during a storm. It is admitted on all hands that a wind pressure of 40 lb. would upset a railway carriage. Consequently it needs no demonstration to prove that no passengers could be in the neighbourhood of the bridge when what, having reference to the strength of the latter, might be termed the moderate gale of 40 lb. to 50 lb. per square foot was blowing. We have said that, under a wind pressure of 112 lb., no tie, strut, or other member of the bridge would be injured. The stress upon any member due to that pressure is necessarily a matter of calculation, whilst the stress which it could sustain without permanent injury is one of experiment. We understand it is intended to determine the proper sectional area of each member of the girder by direct experiment upon model members, and not to deduce it from indirect experiments upon the steel generally. This will involve a large expenditure of money and skilled supervision; but the results cannot fail to be of correspondingly great interest and value to the profession. As regards vertical strength little need be said. The rolling load provided for is four of the heaviest locomotives with an unlimited number of loaded coal wagons, which load on the 1700ft. girder would be equivalent in its bending action to a couple of tons per foot run moving load covering the entire length of the bridge. As the gradient approaching the bridge is 1 in 75, it would be practically impossible to work anything like that load, for the couplings would break if it were attempted. Under this load, however, the strain upon the steel would in all cases be less than $6\frac{1}{2}$ tons per square inch. This, it will probably be contended, is too low a strain, having reference to the unprecedented heaviness of the dead load; and it must be admitted that a strain of $6\frac{1}{2}$ tons per square inch on the Forth Bridge, where the dead load is about five times the live load, is certainly no more severe upon the metal than a strain of, say, 5 tons per square inch upon a steel bridge of moderate span where dead and live loads are equal. The Board of Trade do not at present recognise the vast difference in distructive effect on metallic structures of a live load as compared with a dead load, although the practice of drawing this distinction is universal in America and on the Continent. Whatever doubt may exist as to the legitimacy of the conclusions deduced by German writers from Wöhler's experiments on the fatigue of metals, it cannot be denied that a comparison of the practice of mechanical engineers as regards strains on iron subject to frequent alternations of stress, with that of architects and builders dealing with girders or brestumers carrying the dead load of a brick wall or house front, will show that practical men in the course of years have unconsciously been driven to Wöhler's conclusion, that a live load is at least twice as destructive as a dead load. With strains anything at all approaching those prevailing in ordinary railway bridges, the Forth Bridge must therefore, owing to the great dead weight, be regarded as an exceptionally strong structure. A wind pressure is, it is true, a wholly live load, but then the high pressures for which a bridge is calculated would not occur more, perhaps, than fifty times in a century. Taking the most unfavourable hypothesis, and assuming that a hurricane would blow alternately on opposite sides of the bridge, so that the strains would sometimes be tension and sometimes compression on each member of the wind bracing, then it follows from Wöhler's experiments that even if the strain were as high as 13 tons per square inch upon the steel, at least 100 million applications of alternating blows of the hurricane would be required to fracture the members of the wind bracing. The general practice in all countries of allowing a high unit strain upon wind bracing, although subject to alternating stress, is thus fully justified.

With reference to the important element of stiffness, it will be apparent at a glance that the girder design offers incalculable advantages over the suspension system. The great depth of girder over the piers and the enormous dead weight are sufficient guarantees that the deflection and vibration under a rolling load will be relatively less than in any existing metallic structure. The estimated deflection under a rolling load of 3400 tons on the 1700ft. span is but 9in., and the lateral deflection under a wind pressure of 56 lb. per square foot about 10in. In the suspension bridge the vertical and lateral deflections would be measured by feet and not inches. A stiffening girder may give a suspension bridge sufficient rigidity for ordinary loads, but the amount of tremor which invariably attaches to all suspension bridges, even under ordinary road traffic, is sufficient evidence of what might be expected if it were attempted to run a Scotch express over such a structure. In the girder bridge, on the other hand, we have a well-tested type of structure, across hundreds of which express trains are run daily without slackening speed.

Little need be said about erection, as the principle of the operations will be clear to all. The work will be commenced at the piers and carried on by adding successive portions to the projecting ends of the larger girder. The system is as old as the present century, and some of the largest existing bridges, such as the 520ft. span Douro and St. Louis arch bridges and the Minnehaha 320ft. span girder bridge, have been so erected. The form of the Forth Bridge girder is, as regards design, specially adapted for this mode, as the great rigidity of the girder over the pier entirely obviates such minor difficulties as have been found to arise when a comparatively flexible arched rib held up by wire back stays has had to be dealt with.

In conclusion, it may be remarked that the proposed Forth Bridge involves no untried element either in design or execution. It is merely a very large continuous girder bridge of economical proportions as regards depth and otherwise. In principle it resembles the Britannia Bridge, and in details of construction the Saltash Bridge—that is to say, the principle is that of a continuous girder, and the details are characterised by boldness of proportion as regards depth of girder and the adoption of tubular compression members. The struts in the 1700ft. girder are necessarily long, but they are not nearly so long as the top tube of the Saltash Bridge. That tube is in effect a column 460ft. long and 16ft. in diameter unsupported laterally, whilst the large raking struts in the Forth girders are about 340ft. long and 12ft. in diameter with a support in the middle, reducing the effective height to 170ft. Under the test load the 460ft. iron strut in the Saltash Bridge sustained as high a strain per square inch as will occur upon the relatively short steel struts of the Forth girders under their test load, so no suspicion can be entertained as to the satisfactory behaviour of the long struts. As to the tensional members, it is perhaps a matter for congratulation that the construction of this bridge has been deferred till the present time, when the nature of mild steel and the mode of treatment required to guard against occasional failures are thoroughly understood, which was not the case a few years back.

THE DESFORD RAILWAY ACCIDENT.

THE coroner's jury returned on Monday a verdict of manslaughter against Butler, the pointsman at Desford, where, about a three weeks ago, a collision took place by which five persons were killed. As is usually the case in railway accidents, the circumstances are exceedingly simple. Desford is a station on the Midland Railway. It is a small place, provided with sidings for shunting goods trains. On the day of the accident a mineral train was put into one of these sidings out of the way of an express train from Burton to Leicester. The siding is entered by facing points. These points were left closed, and the express, instead of keeping the main line, followed the coal train into the siding. The result was disastrous, the leading carriages being smashed into one another; five persons were killed, and many others wounded. The points were not opened after the mineral train had entered the siding, because Butler was talking to some one instead of minding his business, and forgot them. There were no signals to show whether they were open or shut, because the semaphore had been blown down in the great gale of the Friday before; and the semaphore was blown down because it had not been properly fixed in the ground; and it had not been refixed because, so far as we can make out, eighty semaphores had been blown down in various districts, and the Midland Railway Company had not sufficient hands to get them all put up again within a few days. Desford had to take its turn with other places, but being only an insignificant kind of station, its turn came late. It must be a very small station, however, that at which an accident cannot occur; and the Midland Company probably know by this time that no time ought to be lost in replacing signal apparatus which has been damaged by wind.

We see no reason to dispute the conclusion of the coroner's jury; nor do we doubt that Butler was one of the causes contributing to the accident, but he was certainly not alone to blame. His criminality is shared by the company. The utmost laxity of discipline was permitted to exist at Desford, the signal cabin appearing, indeed, from the evidence to have been used as an office by the shunters for making up their books, while to others it served as a convenient shelter in which to gossip on wet days. So long as the semaphore stood, and engine drivers —who have not much chance of gossiping on foot-plates— were vigilant, a neglect of duty such as that for which Butler stands committed for trial, could not have done much harm. The facing points and the signals being coupled, if the points were closed the signal would be against the driver. But this safeguard was missing. Lax discipline had full scope to do its worst, and it did it. The railway company was clearly to blame for not taking proper precautions to supply something which would be the equivalent of the interlocking arrangements which were absent. They supplied nothing. Here was one cause of the accident. The signalmen do not appear to have been specially warned to be careful. Things were left to go on in the ordinary way, although a very great protection for the travelling public had disappeared. Here was another cause.

This, however, is not all. It was not disputed by Mr. Loveday, Chief Traffic Inspector, that if the train had been fitted with continuous brakes there would probably have been no lives lost. Major Marindin told the jury the same thing. The train was running very fast when passing Desford, probably sixty miles an hour. The driver, if keeping a good look out—and drivers always do look out for facing points—could have seen at a distance of 50 yards whether they were open or shut. The mineral train stood some way in on the siding. Assuming—which it is quite within the range of possibility—that the driver realised the peril of his position 100 yards away from the coal train, it would still have been in his power with a Westinghouse automatic brake greatly to retard the train. About one second only would have been occupied in putting all the brakes hard on; during this the train would have traversed 88ft., leaving, say, 200ft. to be gone over. By the time the coal train had been reached the express would have lost so much of its speed that no telescoping would have taken place. In other words, the under frames of the carriages would have been able to stand up against the shock, and the passengers would have escaped, bruised and stunned indeed, but in all probability not a life would have been lost. If the company could argue that there is no continuous brake which will satisfy the ordinary conditions of railway work, then it would have a good defence. But this cannot be said. It has long been contended by the officers of the Midland Company, that the vacuum brake answers every purpose. If this be true, how is it that the express was not fitted with a vacuum brake? Again, it is well known that the Westinghouse brake has been worked for many years and given perfect satisfaction on—to name but one line out of many—the London, Brighton, and South Coast Railway, so that, take the facts in any way, the result is still the same. A continuous brake is ready for use, but the company will not use it. It is quite time that the true issues involved in this brake question should be made clear to the whole world. There are at this moment only two or three systems of continuous brakes, and two or three men in Great Britain who have any chance of being heard. Thus the field from which to select is not perplexingly large. There is no air pressure brake in the world which can compete with that of Westinghouse. To the adoption of this brake many English companies, the Midland, and London and North-Western in particular, manifest an invincible repugnance. They can allege no particular reason, bring forth no special argument for not using it; and the conclusion which forces itself on outsiders is that they will not adopt it because it has been invented by an American instead of an Englishman. The Midland Company has shown much favour to the vacuum brake, but as this brake did not comply with the conditions—obviously essential—laid down by the Board of Trade, the company has been compelled to abandon the simple vacuum—a very good brake in its way up to a certain point—and adopt an automatic vacuum brake designed by Mr. Clayton. This brake, however, does not comply with the required conditions; and while it is being tried and attempts are being made to improve it, nothing is being done to utilise inventions already perfected and ready for use. In the same way the London and North-Western Railway Company adhere to the use of a sectional chain brake, which is worse than useless, and seems to have been specially constructed to bring continuous brakes into disrepute. The returns to the Board of Trade made by the company about this brake contain statements which are not only in advance of the facts, but are a positive insult to the intelligence of Major Marindin and his brother officers. How much longer this condition of affairs is to last we cannot pretend to say. For the sake of the self-respect of the railway companies concerned, however, it seems that some kind of manifesto or authorised statement should be issued by the recalcitrant companies which would justify them in the eyes of the Government and the general public. General statements will not do. It will not suffice, for example, for the Midland Company to say, "We are doing all we can to fit our trains with continuous brakes." That would be an untruth. Nor will it do to say, "No continuous brake has been invented which will answer our purpose." The company will have to say categorically why the Westinghouse brake, for example, will not answer. If a company would honestly say that it is too poor to fit up its stock with continuous brakes in a hurry, but that it will do all it can, the excuse would be valid to a large extent. But companies do not speak honestly. They will not give in plain English the reasons for not adopting brakes which are proved to be satisfactory. Apparently plastic, they are really adamant, presenting a dull, unyielding, spherical kind of obstructiveness to every one, which it is impossible to overcome. They will do nothing, and they will not say why they will do nothing. Is it to be wondered at if under the circumstances very unpleasant stories begin to be circulated, and hints are freely exchanged concerning officials whose names ought to rank with those of the most honourable men who have ever lived? Is not such an accident as that at Desford one which disgraces a railway company? We think there can be but one answer to such a question. The *Times* in a powerful leader has recently called the attention of the public to the action of the railway companies in dealing with the continuous brake question. The time has at last arrived when the officials of our great railway lines are on their defence. "The verdict of the coroner's jury," in the Desford case, says our contemporary, "expresses a general sentiment," and with this statement we quite agree. Those who control the working of our railways will perhaps find that even the public opinion which they despise can assert itself to some purpose. The coroner's jury appended to their verdict in the Desford case the following rider:—"The jury also find that the semaphore signal displaced by the storm was 5ft. too short, and that it was improperly and insecurely erected. They also find that sufficient vigilance was not shown in re-erecting the semaphore. On both these points they consider the responsible officials are deserving of censure. The jury are also of opinion that if the express had been fitted with a continuous brake the accident would have been avoided, or much mitigated, and they consider that all trains should be fitted up with continuous brakes." Most of our readers will, we think, regard this as so closely resembling a verdict of manslaughter against the responsible offices of the company that the difference is nearly inappreciable. It is to be regretted that the shareholders, who are practically irresponsible, will alone have to pay the large charges for compensation which will no doubt have to be defrayed, the individuals really responsible escaping scot free.

THE CUMBERLAND COAL TRADE.

In the coal trade of Cumberland, owing to the difficulties amongst the workmen and other causes, the sliding scale system does not seem to have met with the favour that it has in others of the coal-yielding districts. One scale has been abandoned, and the agitation amongst the miners does not give much ground for hope that a second scale would be long adhered to. At a meeting of miners in one of the largest of the districts in the Cumberland coalfield, a resolution was passed unanimously to the effect that the meeting "deem it advisable to ask the coal-owners to advance the selling price of coals sufficiently to enable them to pay an advance of 15 per cent. on the wages of their workmen." It is the adoption of a spirit such as this that is most fatal to that improvement in trade from which all legitimate advances of wages spring. The argument at the meeting was chiefly this, that the demand for coal had increased, as was shown by the fact that last year "14 million tons of coal were wanted more than were ever wanted before," and that there was thus proved to have been an increased demand, which should have given higher wages. The fallacy of this is evident at a glance. The Cumbrian collier who buys his penny newspaper, pays with the penny for that paper, and out of it the printers receive their share of wage. But if the collier induces fourteen more men to buy the paper, is the printer to receive more wages?—that is to say, more than the same proportion? Suppose that the wages were a fourth of the total cost, it is plain that the more that were sold, the better for the workmen, if wages were at the old rate. So with the miner. Paid by the ton, he would receive his tonnage rate additional on all the 14 million tons, and so long as the cost of producing was the same, increased labour gives no cause for a higher rate of pay. When prices rose, under the operation of their sliding scale the wages of the miners rose 10 per cent. in Cumberland, and though prices have fallen, they retain still a fourth of this, whilst there are indications that another increase is approaching. To attempt to force up the price is to attempt to drive the coal trade into other districts, as was done in Cumberland once before to the benefit of the Scottish coal trade. The truest policy of the miners, now that the coal trade is apparently entering on an improved phase, is to fall to work so that that improvement may not be interfered with by artificial checks. To attempt to raise the basis of the scales so as to give an immediate advance of wages of "1s. per day," is a wild scheme, and in Cumberland it remains to be seen how far others of the men are prepared to kill the trade when it is apparently improving.

ENGINEERS IN THE NAVY.

The Lords of the Admiralty appear to be disposed to take the advice we have given, and reduce the number of engineers in the Navy. We have suggested that each ship should carry one chief engineer with a certain number of foremen to superintend the work done by artificers whose pay and position would be improved. A step has been made in this direction; a new order has just been issued for the engine-room department of all the ships in the Navy. A reduction will be made in the number of engineers and assistant engineers afloat, and an increase in the number of engine-room artificers. Thus, the Alexandra, which had originally an engine-room staff consisting of 1 chief, 8 engineers, 10 engine-room artificers, 14 leading stokers, and 60 stokers, has had it reduced to 1 chief, 5 engineers, with 12 artificers, and the same number of leading stokers and stokers. The staff of the Inflexible, which consists at present of 1 chief engineer, 10 engineers, 13 artificers, 16 leading stokers, and 90 stokers, will be changed to 1 chief engineers 6 engineers, 15 artificers, 2 leading stokers, and 90 stokers.

ROBERT MALLET.

No. I.

Our friend and colleague of many years, Robert Mallet, died on Saturday last, the 5th of November, and it is with the sincerest regret that we have to record this loss of one who for many years occupied a leading place in the foremost ranks of scientific men and engineers, and whose works will ever hold a high position, especially amongst the illustrious physicists and geologists. Robert Mallet was the only son of John Mallet, who married his cousin, Miss Mallet, of Dublin. He was a manufacturer, and twice High Sheriff of Dublin, taking an active part in the municipal affairs of that city. He went to Dublin at the invitation of his brother, Robert Mallet, who had established a business in sanitary fittings, small fire engines, water-closets, &c., including a number of things invented by William Mallet—another brother. They were Devonshire people, and John went to Dublin about the same time, or with, Manders, the founder of the celebrated brewery firm. He became intimately acquainted with Bramah, and in sanitary work adopted some of the inventions of that well-known mechanician.

The late Robert Mallet was born in Dublin on the 3rd of June, 1810, and was for some time thought to be of weak health. As he grew, however, strength grew with him, and he became a man of unusually strong constitution and powers of endurance. When the time arrived for a commencement to be made with his education, he was sent to Bective House, a well-known school in Dublin, of which Mr. Wright was the proprietor, or principal. He remained there until he was nearly sixteen years of age. He then went, in December, 1826, to Trinity College, Dublin, for a term of four years, at the end of which he took his B.A. degree. Between the time of his leaving school and his going to college he made his first tour on the Continent, in the company of the Rev. C. Barden, clergyman of the parish in which he lived, and his future brother-in-law, Mr. Watson, of Fitzwilliam Place. During the time he was at Trinity College he was also under the tutorship of Mr. Friedlezius, a Swedish professor of mathematics. In December, 1830, he took his degree of Master of Arts.

During all this time he paid particular attention to engineering matters, but he was especially fond of chemistry, in which he attained marked proficiency at a very early age. When only a little over twelve years old he used so much of his time in making all sorts of curious boyish experiments and chemical mixtures, often of anything but a pleasant character, that a small room was set apart as his "laboratory." Here he spent a great deal of his time when not in school, and he was fortunate in being able to secure everything he required for the construction of experimental apparatus from his father's factory. So much was this little room his favourite haunt that whenever it became the stern parent's duty to correct the boy for mischievous pranks, the punishment that was found most severe was to lock up his "laboratory" for from one to three days, according to the nature of the offence. This laboratory was afterwards provided with every requisite for chemical and metallurgical investigation, and good use was made of it long before its owner was twenty-five years of age.

After he left college he spent a good deal of time in his father's works, and visiting engineering establishments in England at every opportunity, taking at the same time practical outdoor lessons in surveying and levelling from one J. J. Byrne. The rapidity with which he acquired practical engineering knowledge was remarkable, and was probably largely due to the good training he had had between Trinity College, his father's works, and that of his relation, Dr. Burton, a man of great acquirements, and known also as a traveller.

In the year 1831 he made an extended tour on the Continent in the company of Mr. Purser, of Rathmines Castle, and Mr. Friedlizius, and in November he married Miss Cordelia Watson. He was then taken into partnership in his father's works. These works were first started by his grandfather, and the chief business was brass and copper founding, and plumbing of all kinds. A large trade was carried on, much of it consisting of brewery and distillery plant and apparatus. Nearly all the chief work of this kind required in Ireland was done in these shops, which were situated in Ryder's-row, and John Mallet became possessed of a considerable fortune. A large lead mill was added to the works, and a quay wall constructed on the Royal Canal, the mill being driven by a water-wheel fixed by Messrs. Fairbairn and Co., Manchester. In October, 1832, Robert was elected member of the Royal Irish Academy, and in a few years he had enriched the "Transactions" of that body by several important papers. To these we shall refer further on. Soon after Robert was taken into partnership he matured plans for and converted the manufactory into an engineering works with a considerable foundry, and here in a very few years nearly all the engineering work of any importance in Ireland was carried out. The modern engineering era had fairly commenced, and railways were being constructed. Railways were being talked of for Ireland, but before this the Dublin firm, under the name of John and Robert Mallet, had secured large contracts for railway plant and permanent way material. Mallet's father had constructed an enormous building near Dublin, intending it for a flour mill, to be driven by a water-wheel erected by Fairbairn, but after it was finished it was found that the water power could not be obtained, the water rights not having been secured. The great building thus stood empty for years. It is now a steam flour mill. Robert Mallet coverted this into a factory of railway material, with forty smith's fires, planing and screwing machines, large quantities of bolts and spikes being made there. One of Mallet's first engineering works exhibiting great engineering skill was the raising and sustaining of the roof of St. George's Church, Dublin, in 1834. This church was built in 1804 from designs by Francis Johnston, then Government architect, and the failure of the roof was the source of great trouble to its architect. The roof was covered in by a large flat ceiling, with massive cornice and other ornamental work. Its failure was attributed to inferior design and to the use of short lengths of timber then used in consequence of the scarcity of timber during the continental war. The massive side walls were being pushed out, and the whole was in such a dangerous state that it was almost decided to take the roof off and rebuild it. Mallet, however, stepped in and offered to raise and sustain the roof without damage to the ceiling, and his offer was accepted, with, however, full security should his plans fail. The roof was about 133 tons in weight, and was a large area to support and raise. He successfully lifted the whole roof off the wall plates by means of specially constructed screw-jacks resting upon a whole balk platform built within the church. When the whole of the principals were thus relieved of all weight, they were raised, and strong iron truss framing was attached to them, and the whole suspended therefrom. Elaborate arrangements were made for working all the screw jacks simultaneously; for measuring the rise of the roof at different parts as the work proceeded; and for measuring the deflection. The roof was originally covered with copper, but when the roof was reinstated and strengthened by Mallet, the copper was removed, and a new covering of ⅝in. sheet lead substituted for it. The task was most successfully completed, and the young engineer made a handsome sum by the work. The architect was again proud of his church, and presented to it a peal of eight bells, the first notes of which were strangely enough the announcement of his own death. A full description of this church work was presented to the Institution of Civil Engineers, vol. i., p. 92, and a Telford premium awarded for it in 1841. In the same year he constructed a "manumotive," as it was called, to run to Kingstown and back with mails. It was worked by eight men, and made the trip each way in twenty minutes. He also constructed what was then a large jib crane for the Kingstown wharf. It is a very fine 30-ton jib crane with 40ft. radius, but it is very seldom used. In the year after, 1835, he presented his first contribution to the British Association Reports. This was, somewhat curiously as it now seems, a description of an application of a series of magnets for the automatic separation of brass and iron borings and filings, the magnets being electro-magnets supplied with a current from a battery of four cells, each having a pair of plates over a foot square, the current being automatically made and broken by mechanism which lifted the wires of the soft iron magnets out of mercury cups and dropped them again when the iron had fallen from the magnets into proper receptacles. The paper described other applications of the magnetised and demagnetised magnets. "Brit. Assoc. Reports," 1835, part 2, p. 18. In the same volume is a short paper on a method of bleaching certain varieties of turf to make white fibre for paper making, and another paper on some singular phenomena of flames from coal gas. The paper on bleaching turf refers to a kind of peat found immediately under the vegetable surface of low land or flat bog in many parts of Ireland. Some of this material is capable of being converted into millboard without bleaching, and with very inexpensive preparation. At this time the celebrated firm of brewers, Messrs. Guinness and Co., began to consult him upon various matters, and amongst other things he did at this time was to give them a supply of water by boring a 4in. hole through the solid rock at the bottom of a well that had given out, and then firing a charge of powder therein, by which the rock was shattered, and a supply of water obtained which has never since failed. He also constructed a machine worked by steam for washing casks, and erected a very large sky cooler for the brewery, which was then rapidly increasing in fame. Steam engines of various sizes were made in the works from his designs. The barrel-washing machines were also made for Messrs. D'Arcy and Messrs. Manders and Co. Steam printing and other machinery was made for Messrs. Grierson, then King's printers, and for the Dublin *Freeman's Journal*, and the *Irish Times*.

In 1836 important works were being carried out by the Shannon Commissioners, Sir John Burgoyne being then the Government engineer, and owing to the skill of its junior member, which was becoming known throughout the country, Mallet's firm secured the contracts for the construction of a large number of bridges, including the swivel bridges over the Shannon at Limerick, Banagher, Portumna, Athlone, and Shannon Harbour. All the sluices and other apparatus for this work were also made by the firm from designs by Robert Mallet.

It gives some idea of the diversity of his studies amidst all the business of managing the Victoria Works, as those in Dublin were named, to mention that in this same year we find amongst his writings a paper on the seed-dispersing apparatus of the musk scented heron's bill—*Erodum Moschatum*—published in the magazine of natural history; and another paper on unobserved features in the structure of some of the trap rocks in the County Galway published in the "Transactions" of the Royal Irish Academy. In the same volume of this "Transactions," is a paper on the action of air and water on iron.

Beside the varied work which was being carried out under his care and from his designs in the Victoria Works in 1837, we find that he turned his attention to hydraulic rams, and produced a form of ram which was largely used in Ireland, and amongst other places was employed on the Kingstown Railway for forcing water to tanks for the locomotives. Amongst his literary work of that year are two papers in the British Association reports, the first on the formation of crystallised metallic copper in the shafts of the Cronebane copper mine, County Wicklow, and the other on the mechanism of the movement of glaciers. The object of this paper, which was the result of a visit to the Mer de Glace in 1831, was to show that "the great *primum mobile*, which causes these colossal masses to advance with such steady and irresistible force, is not to be sought in their weight alone, but it will be found in the hydrostatic pressure, acting between these masses of ice and the rocky bed on which they rest, and thus at intervals lifting them up and floating them, or as it were transferring them upon liquid rollers from a higher to a lower level," this theory being based on the fact that glaciers melt from their lower surface, a fact also previously noticed by Saussure and Playfair. This paper shows a most complete grasp of all that had been written on the subject by Merian, Simler, Höttinger, Schenchzer, Gruner, and Agazis. Another paper by him was published in the "Journal of the Royal Geological Society of Dublin" in the following year. Although in after years he modified some of the views put forth in these papers, most of them remain unquestioned. He had collected a large quantity of notes resulting from subsequent visits and more mature consideration, but owing to the loss of his sight these and his later views were never published, but were given to his son, Dr. J. W. Mallet, of the University of Virginia. The great and rapid increase in the application of iron to engineering structures at this time caused a good deal of discussion on the corrosion of iron under the influence of air and water, and in 1838 appeared his first report on a remarkably exhaustive series of experiments, carried out by him at the instigation of the British Association, on the action of pure and foul sea water and air on wrought and cast iron and steel. This and the succeeding reports in 1840 and 1843 are alone monuments of the skill and completeness with which he carried out any investigation entrusted to him. With the exception of the results of observations on modern mild steel, nothing out of all that has within the last few years been written on the subject, has added in the least to the knowledge of the subject as left in these reports; and the fact that mild steel plates do not corrode faster than iron when the magnetic oxide scale is completely removed, though looked upon as a recent discovery, was completely set forth in these reports, which mentioned that every metal is electro positive to its own oxides, the most direct inference from which would have been, if the reports had been examined by those who have in recent years had to study the subject, that the complete removal of these magnetic oxides would also have removed a great cause of corrosion of plates when placed in liquids as in boilers, and especially in sea water.

In May, 1839, he was elected associate of the Institution of Civil Engineers, proposed by Sir W. Cubitt, and seconded by Thos. Rhodes and Francis Bramah, and he was transferred to the class of member three years afterwards at the recommendation of Sir J. Burgoyne, Fairbairn, and Vignoles. During this year the business at the Victoria Works was increasing, but in spite of this and severe family troubles, he managed to find time for experimental and literary work. The handsome tower gate entrance to the Duke of Abercorn's castle grounds was designed and erected by him for the father of the present duke. The gate when first erected was opened and closed as a carriage approached and passed in by the lodge keeper, an aged woman, from within the lodge; but for some reason it is not so opened now, though we believe the gear is still in working order. A working model of this fine gate is still to be seen in the duke's castle. At this time also his scientific knowledge was called into play in devising extensive ventilating and heating apparatus for a large number of public buildings, upon the ventilation and heating of which he was called upon to report. Amongst the buildings ventilated and heated from his designs were Dublin Castle and chapel, the Records Office, Law Courts, and numerous prisons and poor houses. In all these the heating was effected by hot water, and the apparatus is all in working order to this day. In 1840 he turned his attention to the supply of water to Dublin, partly suggested by the supply he furnished to Lough Crew House, Co. Meath, by building a large circular catchment reservoir on the mountain side, and conveying water thence by pipes, the whole of which is in working order. He surveyed the whole of the river Dodder in 1841 at his own expense, and had plans made with a view to the supply of Dublin with pure water, and to supply the paper and other mills in summer time. All the paper mills were stopped in summer time for want of water, but this he proposed to prevent by constructing six large reservoirs at different levels along the Dodder, and by these store up and supply water which caused floods and ran to waste in the Liffey. It is noteworthy that Mallet's plans for supplying Dublin with water are now about to be utilised by the Commissioners for supplying Rathmines and Pembroke townships with water from the Dodder. In 1840 he began to make beam engines of considerable power, such as those erected at the Ringsend Dock Mills of Messrs. Hastings and Carter, but the Irish market for steam engines was not more extensive then than now, and Mallet turned his attention more to railway and civil engineering work, of which he presently did a great deal. In the year, however, of which we are speaking he spent some time in his old college, for which he designed, erected, and fitted out the new laboratory for Dr. Apjohn. His taste in designing ironwork of an architectural character was also well shown in the circular stairs erected on each side of the chancel in Trinity College Chapel, and in the much-admired palisading and railing bounding the College from Provost House in Grafton-street, through the whole length of Nassau-street, to Clare-street. The numerous illustrations of failure in the attempt to produce an iron palisading of pleasing design shows that though always looked upon as a small matter, it is not a task which can be satisfactorily discharged without some architectural taste.

It was in this year that he commenced some experiments with the buckled plates by which his name is well known to many who, not being interested in physical and geological sciences, know nothing of his works in these. An extensive series of experiments on the chemical and physical properties of a great variety of the atomic alloys of copper and zinc and of copper and tin, were made by him during this year, and the results presented to the Royal Irish Academy. Most of these results were embodied in two tables, and are now of great value. All the chemical, physical, and characteristic working properties of these alloys are given, as well as their relation to or effects upon cast iron when in presence of a solvent such as sea-water.

The buckled plate was one of the most successful of his inventions in a commercial sense, although in most other men's hands it would have been worth a hundredfold what it ever was to him. It was one of Mallet's faults that he had little commercial tact. As it was, however, the buckled plates were very extensively used in this country and abroad. They formed the very best floor ever made, combining the maximum of strength with the minimum of depth and weight. They were employed on the Westminster and other London bridges, one of which was floored at Mallet's cost owing to his own laxity in accepting verbal assurances from a contractor from whom the most stringent conditions should have been secured. It is anticipatory to deal with these buckled plates thus far, but it may now be mentioned that it did not occur to him until 1852, that this invention was worthy of being the subject of a patent, and that he received a grant of prolongation of the patent in 1866. He subsequently took out patents for buckled plate railway sleepers, and on the Bolivar railway sixty miles of these cross sleepers were laid by Messrs. Brunlees and McKerrow. Returning to 1841, it is perhaps worth remark that the three large 36-man power fire engines still used by the Dublin Corporation were made from his designs at the Victoria Foundry in that year, or forty years ago. In 1842-43, the shops were very full of the work to which the drainage operations then in progress and the railway then fairly commenced gave rise, and at the same time we find such work as the construction of the Limerick dock gates with 80ft. opening and 24ft. depth formed part of the operations carried out under him. Railway signals and numberless coke ovens for the production of coke for locomotives also employed his workmen. The atmospheric railway system also occupied much of his attention, and a very interesting report by him on the Kingstown and Dalkey line will be found in Weale's quarterly papers, Part II., 1844. In this he advocated the employment of large vacuum chambers to be exhausted by small engines running constantly, instead of the very large engines which were necessary under the system in use. The vacuum chambers thus proposed would have served the same purpose as the accumulator used for hydraulic machinery, and would have been very economical. The atmospheric system failed, however, owing to its want of flexibility and cost.

In 1845-6 he designed and erected the terminal station of the Dublin and Drogheda Railway; the large polygon engine-shed with a hydraulic turntable in the centre; the Kingsbridge passenger sheds, as they were called, and all the workshops and other buildings for the Great Southern and Western Railway; the engines and machinery for the Castlecomer Coal Mines, Co. Kilkenny; a 40ft. overshot water-wheel and machinery for Mr. McDonald's paper-mills in Sagart, Co. Dublin; while even a brief notice of the railway stations, roofs, and railway plant executed in 1848 would occupy more space than can be spared. Part of this work, however—the Nore Viaduct—should be mentioned, for the design for this, a wooden structure, though nominally prepared by Captain Moorsom, was re-designed by Mallet, as failure would certainly have been the result of following the original drawings. It was 200ft. span, the main girders or wood trusses being 22ft. in depth, constructed of Canadian hacmatac, a wood very similar to pitch pine, but not possessing the strength of that timber. Six hundred tons of timber were used in its construction, and during the erection a flood rise of 5ft. 9in. took place in one night, bringing down cots and hay which rested against the staging, and the whole structure only just missed being wrecked in consequence. The wood trusses were replaced in 1876 by an iron lattice girder, constructed by Messrs. Courtenay, Stephens, and Bailey, from designs by Mr. R. Galwey, C.E. Moorsom's whole design was considered by Mallet to be a mistake, as the situation was eminently well suited for a three-arch masonry bridge. In 1846 we find his first paper on "Earthquake Phenomena," in the *Philosophical Magazine*, giving an explanation of the vorticose motion then supposed to accompany earthquake shocks, and another in the Report of the British Association for 1847 on the facts of earthquake phenomena. The first paper systematically dealing with earthquakes, and setting forth his dynamic theory of earthquakes and reducing their observed phenomena to the known laws of wave motion in solids and fluids, was published in the Transactions of the Royal Irish Academy in 1848; and in the next year was published his elaborate report to the British Association on his experimental inquiry on railway bar corrosion. This showed, what has since been confirmed by long experience on the Cologne-Minden and other roads, that rails in use corrode much less rapidly than rails stacked. The report contains a mass of information on corrosion which has been overlooked in the modern investigations on the subject, which have gone over similar ground. In 1849-50 the Victoria Foundry was fully occupied with railway station roofs, plant, and bridges, but still he found time to devote himself to literary pursuits. Having now, however, briefly alluded to about half his active career, we must leave to another day the completion of our notice.

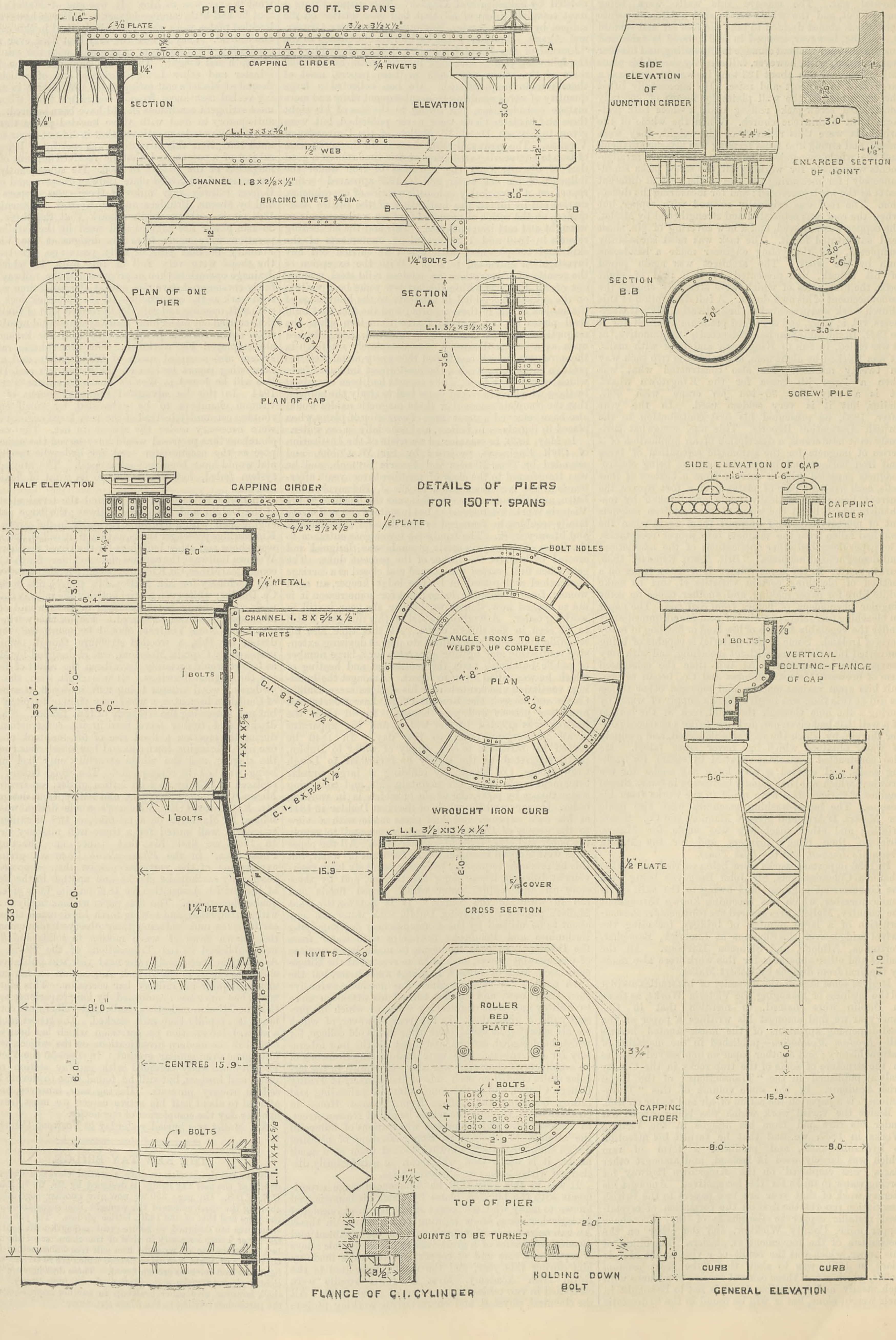
Mr. Mallet was buried yesterday in Norwood Cemetery.

THE NEW TAY BRIDGE.

In our last impression we gave a general elevation and some details of the new Tay Bridge as designed by Mr. W. H. Barlow, C.E., F.R.S. On page 350 we now give another page drawing showing the construction of the wrought iron superstructure of the piers and that of the 145ft. lattice girders. The pier superstructures are designed to secure great strength with lightness, the latter being necessary in view of the character of the river bed, while the use of wrought iron will free the structure from the results of slight transverse flexure which are so serious when light cast iron columns are employed. These drawings are sufficiently clear to make a description almost unnecessary. We shall, however, give other drawings in another impression with the particulars relating to the whole structure.

CONTRACTS OPEN—BRIDGE WORK FOR INDIAN STATE RAILWAYS.

(*For description see page 355.*)



PARKER'S PATENT PISTON.

THE principal improvements claimed for this piston are, first, the application of the inclined plane between the edges or joints of the rings as shown in the engraving, Figs. 1 and 2, complete. The spiral springs A, two, three, or four of which are used, according to the size of the piston, give the vertical pressure by forcing the rings in opposite directions and up the inclined planes against the piston flange and cover, preventing knocking and escape of steam at each end of the stroke. The

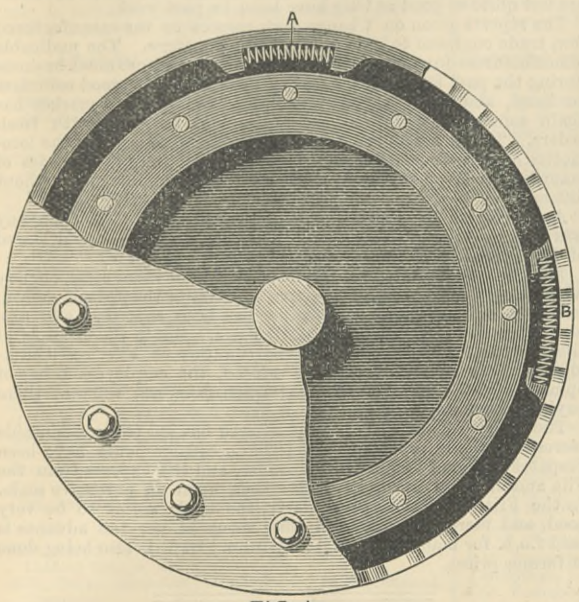


FIG. 1.

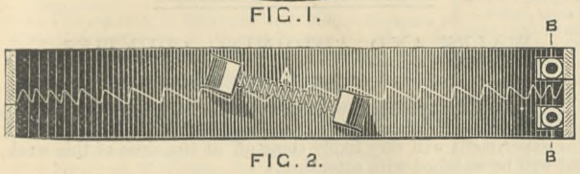


FIG. 2.

springs B B shown in Figs. 1 and 2 give the horizontal pressure. It is claimed that the rings being without flanges are more elastic and easily expanded, and do not require such a strong spring as is usually employed to press them against the cylinder sides, which is the means of the rings wearing a greater length of time, and also requiring a less amount of oil or tallow to keep the cylinder lubricated. It is manufactured by Messrs. Cole, Marchent, and Co., Bradford.

CONTRACTS OPEN.

INDIAN STATE RAILWAYS.—RANGOON AND SITTANG RAILWAY; METRE GAUGE.

CONTRACT FOR IRONWORK OF BRIDGES.

THE work required under this specification comprises the construction, supply, and delivery in England, at one or more of the ports named in the conditions and tender, of the cast and wrought ironwork for—Four piers for 150ft. spans, including all cast iron cylinders, caps, and tapered lengths, and all wrought iron curbs and bracings; five piers for 60ft. spans, including ten top lengths, seventy-five intermediate and ten screw lengths, and five sets of wrought iron bracing; one wrought iron capstan head for screw piles of piers for 60ft. spans; and all bolts, nuts, and washers, and all rivets required for completing the work in India, together with an allowance of 30 per cent. on the net quantity of each for waste. The piers are shown in the drawings, page 354.

The cast iron is to be of such quality that a bar of the same, 1in. wide, 2in. deep, and 3ft. 6in. long, placed on bearings 3ft. apart, shall not break with a less load than 30 cwt. applied in the middle. The wrought iron must be of such strength and quality as to be equal to the following tensional strains, and to indicate the following percentage of contraction of the tested area at the point of fracture:—Round and square bars, and flat bars under 6in. wide: Tensional strain, 24 tons per square inch; percentage of contraction, 20. Angle, channel, and flat bars, 6in. wide and upwards: Tensional strain, 22 tons per square inch; percentage of contraction, 15. Plates: Tensional strain, 21; percentage of contraction, 10. Ditto across grain: Tensional strain, 18; percentage of contraction, 5. The iron intended to be used for the rivets must, whilst cold, be capable of being bent double without showing signs of failure.

Each length of cylinder for both piers must be cast perfectly round, and all similar lengths carefully to the same diameter. The meeting ends are to be turned. The caps for the piers for the 150ft. spans are to be cast in halves, planed, or carefully hand-dressed at the joints. The bolt holes in the ends of the 3ft. cylinders are to be drilled, but they may be cast in the ends of those for the larger piers. They must in either case be so accurately spaced off that any one cylinder may fit any other cylinder in any position. All holes in the top lengths of the 3ft. cylinders are to be drilled in India to suit. The bolt holes for attaching the angle irons to the cylinders of the larger piers are to be drilled, and the bolts must be a good fit in the holes. The top lengths of the 3ft. cylinders are to be planed, or turned up flat, to take the junction girders; but the holes for attaching the girders will be drilled in India. All rivet holes to be filled in India are to be drilled; all other rivet holes are to be drilled or punched at the option of the contractor. The inner and outer angle irons in the curbs are to be each welded into a complete ring.

The whole of the ironwork, with the exception of the bolts and rivets, after being scraped perfectly free from rust, scale, and dust, is to be painted with one good coat of red lead. It is afterwards to be painted with two coats of good oil paint, of such colour as shall be approved by the Inspector General. The bolts are to be heated to the temperature of melted lead, and then dipped into boiled linseed oil. The cost of all templates, and of all oiling, painting, temporary erection, testing, marking, packing, and delivery is to be included in the price named in the tender.

The supposed quantities in one pier for the 150ft. spans are—Cast iron, 78 tons 16 cwt. 2 qr. 22 lb.; wrought iron in curbs, 2 tons 10 cwt. 2 qr. 8 lb.; wrought iron in bracing, 1 ton 18 cwt. 1 qr. 26 lb.; bolts, &c., 11 cwt. 2 qr. 13 lb.; total for one pier, 83 tons 17 cwt. 1 qr. 13 lb. Supposed quantities in a total of five piers for 60ft. spans:—Cast iron, 108 tons 10 cwt. 1 qr. 22 lb.; wrought iron in five sets of bracing, 4 tons 11 cwt. 0 qr. 3 lb.; forgings in five sets of bracing, 4 tons 1 cwt. 0 qr. 8 lb.; bolts, &c., 2 tons 3 cwt.; total in five piers, 119 tons 5 cwt. 2 qr. 5 lb.

Tenders are to be delivered at the Store Department in the India-office, Westminster, S.W., on Tuesday, November 22nd, 1881, before 2 p.m., after which hour no tender will be received. They are to be addressed to the Secretary of State for India in Council, with the words "Tender for Cast Iron Cylinders for Bridge Piers" on the left-hand corner of the envelope, and are to be placed in a box provided for that purpose in the Store Department.

THE INSTITUTION OF CIVIL ENGINEERS.

THE Council of the Institution of Civil Engineers have awarded the following premiums, Session 1880-81:—

FOR PAPERS READ AT THE ORDINARY MEETINGS.

1. George Stephenson Medals and Telford Premiums, to Thomas Forster Brown and George Frederick Adams, MM. Inst. C.E., for their Paper "On Deep Winning of Coal in South Wales."
2. A Watt Medal and a Telford Premium, to John Isaac Thornycroft, M. Inst. C.E., for his Paper "On Torpedo Boats and Light Yachts for High Speed Steam Navigation."
3. A Telford Medal and a Telford Premium, to Theophilus Seyrig, M. Inst. C.E., for his Paper "On the Different Modes of Erecting Iron Bridges."
4. A Telford Medal and a Telford Premium, to Max am Ende, Assoc. M. Inst. C.E., for his Paper "On the Weight and Limiting Dimensions of Girder Bridges."
5. A George Stephenson Medal, and a Telford Premium, to Benjamin Baker,* M. Inst. C.E., for his Paper on "The Actual Lateral Pressure of Earthwork."
6. A Telford Premium, to Richard Henry Brunton,† M. Inst. C.E., for his Paper on "The Production of Paraffine and Paraffine Oils."
7. A Telford Premium, to Charles Colson,† Assoc. M. Inst. C.E., for his Paper on "Portsmouth Dockyard Extension Works."
8. A Telford Premium, to Christian Hendrick Meyer, Assoc. M. Inst. C.E., for his Paper on the "Temporary Works and Plant at the Portsmouth Dockyard Extension."
9. A Telford Premium, to Benjamin Walker, M. Inst. C.E., for his Paper on "Machinery for Steel-making by the Bessemer and the Siemens Processes."
10. The Manby Premium, to Joseph Prime Maxwell, Assoc. M. Inst. C.E., for his Paper on New Zealand Government Railways.'

FOR PAPERS PRINTED IN THE PROCEEDINGS WITHOUT BEING DISCUSSED.

1. A Telford Medal and a Telford Premium, to Dr. J. Weyrauch, for his Paper "On the Calculation of Dimensions as Depending on the Ultimate Working Strength of Materials."
2. A Telford Premium, to James Richard Bell, M. Inst. C.E., for his Paper "On the Empress Bridge over the Sutlej."
3. A Telford Premium, to John Lewis Felix Target,† M. Inst. C.E., for his Paper "Experiments on a New Form of Module for Irrigation Purposes."
4. A Telford Premium, to William Thomas Henney Carrington, Assoc. Memb. Inst. C.E., for his Paper "On Three Systems of Wire Rope Transport."

FOR PAPERS READ AT THE SUPPLEMENTAL MEETINGS OF STUDENTS.

1. A Miller Prize, to James Bernard Hunter, Stud. Inst. C.E., for his Paper "On Wood-working Machinery as Applied to the Manufacture of Railway Carriages and Wagons."
2. A Miller Prize, to Mathew Buchan Jamieson, Stud. Inst. C.E., for his Paper "On the Internal Corrosion of Cast Iron Pipes."
3. A Miller Prize, to Thomas Stewart, Stud. Inst. C.E., for his Paper "On the Prevention of Waste of Water."
4. A Miller Prize, to William Henry Edinger, Stud. Inst. E.C., for his Paper on "Brick-and-Concrete and Concrete Gasholder Tanks."
5. A Miller Prize, to Daniel Macalister, Stud. Inst. C.E., for his Paper on "Caissons for Dock Entrances."
6. A Miller Prize, to Lindsay Burnet,‡ Stud. Inst. C.E., for his "Description of a Cargo-carrying Coasting Steamship, with Detailed Investigations as to its Efficiency."
7. A Miller Prize, to Edward Walter Nealor Wood, Stud. Inst. C.E., for his Paper on "The Improvement of the Old Harbour at Holyhead."
8. A Miller Prize, to Arthur Stuart Vowell, Stud. Inst. C.E., for his Paper on "Steel; its Chemical Constitution and Behaviour under Tensile Strain."
9. A Miller Prize, to William Marriott, Stud. Inst. C.E., for his Paper on "Boilers."

Of the nine Students' Papers last enumerated, the first six have been printed in the Minutes of Proceedings.

The Institution supplies the following subjects for papers:—

1. The adoption of a Standard Test-piece for bars and plates.
2. The Mechanical and other Properties of Iron and Steel; and the effect produced by tempering steel in oil and in water, with a description of the testing machinery.
3. The Behaviour of Iron and Steel under ordinary loads, and up to the limit of elasticity.
4. The methods of protecting Metal-work exposed to Corrosion, with examples.
5. The modern practice of Bridge-building in Germany, especially with reference to the details of construction and the substitution of bar and angle iron for wide flange plates.
6. The Action of High Winds on lofty and exposed structures, and the best methods for determining the force of the wind.
7. The Comparative Cost of Transport by land and by water.
8. The Works carried out on the Continent of Europe and North America for the Improvement of Rivers, and of Inland Navigation generally.
9. The methods used for determining the Discharge of Rivers, with a description of the Floats and Current-Meters employed for the purpose.
10. River Conservance;—Including a description of the physical conditions of the district, and the cause, effect, and means of prevention of Floods.
11. The Location and Construction of the most difficult portions of the several Pacific Railroads.
12. The Elevated Street Railroads of New York.
13. Continuous Railway Brakes.
14. Mechanical Power on Tramways, including steam, compressed air, electricity, &c.
15. A Review of Recent Hydraulic Experiments.
16. Investigation as to the Quantity of Water yielded by the Chalk Formation.
17. The Analysis of Water for potable purposes, having special reference to the method of estimating "Previous Sewage Contamination."
18. The Design and Construction of Covered Service-Reservoirs for Town Water Supply.
19. The Sewering of Towns on the separate system, by the exclusion of the surface waters.
20. The Utilisation of the Mechanical Power of the Tide and of the current of rivers.
21. The type of Steam Engine best adapted for ordinary factory purposes, in respect to economy in first cost, and in cost of maintenance as well as in the use of steam.
22. The best method of Testing Steam Engines—independent of their boilers—having regard to accuracy of the results, and ease with which the tests can be carried out.
23. The modern practice in the design and construction of Boilers.
24. On Magneto-electric and Dynamo-electric Machines, with their relative advantages.
25. The Generation, Storage, and Transmission of Electric Energy, the purposes to which it may be applied, and the sources of loss.
26. The methods and appliances for Storing, Weighing, and Delivering Grain in and from Granaries.
27. The various systems of Grinding Wheat, and the Machines used in Corn Mills.
28. The different systems of Refrigerating Machinery, and appliances for the preservation and transport of provisions.
29. The Utilisation of Waste Products in different manufacturing processes.
30. The Methods and Machinery employed for separating the impurities from coal as carried out in South Wales, in connection with the manufacture of coke for the iron and steel trades.
31. The application of Hydraulic Power to Machine Tools.
32. Drilling and Rivetting Machinery for Girder work.
33. The different systems of Lifts in use in Warehouses and in Dwellings.
34. The latest development of the Compound Marine Engine.
35. The special Construction of Vessels for the reception of Railway Trains on Deck, indicating the arrangements for the shipping of such trains on their own wheels at various states of the tide.
36. The Methods and Machinery employed in Sinking and in Working deep Coal Mines.
37. Coal Depôts for Ocean Steamers, the various points involved in their management, and the preservation of the coal from deterioration.
38. The Methods employed in securing large and irregular-shaped mineral workings, for example—the Almaden Mines, the Great Comstock Lode, &c.
39. The Manufacture of Lead and the Extraction of Silver.
40. Instruments for measuring the Velocities of Vehicles, of Prime Movers, and of Wind and Water Meters.
41. The Distribution of Heat over large areas from a central source of supply.
42. The Methods and Appliances for Blasting Rock under Water.
43. The Management of Underground Waters in mining districts, and the relative economy of distributed or trunk pumping engines, adits, &c., in particular cases.
44. On proportioning Mains for the distribution of Water and of Gas.
45. Forces and strains of Recoil considered with reference to the Elastic Field Gun Carriage.

* Has previously received a Telford Medal and a Telford Premium.
† Have previously received Telford Premiums.
‡ Has previously received a Miller prize.

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

(*From our own Correspondent.*)

TO-DAY—Thursday—there was a larger inquiry for lots of finished iron for shipment and for engineers' use in London than for the past three weeks. But the orders were held for lower prices than makers were generally prepared to accept. Yet the middlemen into whose hands the orders had been placed expressed themselves confident of being able to buy upon their own terms Of this expectation being realised there were, however, no very conspicuous indications up to the close of the market. A few bar firms who are known to be amongst those who accept the lowest rates were ready for small lots to take £6 5s. per ton for ordinary sections; but they could not be pressed below that figure with delivery at the works. The majority would not take less than between that price and £6 15s. Upon a similar basis the makers of slit rods quoted, and they announced that they were not in immediate need of new work. High-class marked bars were not to be got at anything under £7 10s. At that quotation a steady accession of business has this week come in. The cable and anchor firms are buying better. Cable rounds were inquired for to-day. The demand ran most upon the medium qualities, which could not be got in the brands in most favour at less than £6 10s. to £7.

Hoops and strips were scarcely so strong. The ruling quotation was more frequently £7 than £7 5s. No difficulty was found in securing a quotation at the rate of £7 10s., with delivery in London; and there were makers on 'Change in Wolverhampton yesterday who would have taken that price with delivery in London. There is less activity at the moment in the inquiry from the United States, but there is a better request upon the week for baling and cooperage hoops from Australia, and the gas and steam tube firms do not relax the pressure they have lately been putting upon the makers to deliver with more promptitude.

Plates were in dull request yesterday, but they were less neglected to-day.

Stamping sheets of iron are in gradually diminishing inquiry; though at present the firms keep well employed. Steel sheets are growing steadily in favour for the best work. Quotations for iron stamping sheets are upheld. For 20 w.g. £12 was the price asked to-day.

For galvanising singles it was sought to secure £8 10s.; for doubles, £9 10s.; and for latens, £11. It might have been possible to get 5s. off one or other of these rates, and with least difficulty off singles; but even when that was the case, the lots which would have been accepted ranged only from 25 to 50 tons. Most of the mills have still to deliver at under the foregoing figures.

Pig iron was easy to buy to-day. There were few brands made either at this district or beyond it which might not have been bought in small lots at 1s. 3d. to 2s. 6d. under rates stoutly demanded three weeks ago.

Coal showed a stiffening tendency.

A general meeting of the South Staffordshire and East Worcestershire Institute of Mining Engineers was held at Dudley on Monday. Professors Sopwith and Smith attended as a deputation from the Mason College, Birmingham, and spoke of the advantages likely to accrue to the Institute of Mining Engineers by the removal of its head quarters to the college. Professor Smith said that the removal to Birmingham would, he felt sure, result in good to both the college and to the institute. The district around them now was a purely mining one, but if they came to Birmingham they would find engineering pursuits, and those who followed them would be glad to meet engineers from the mining districts. No doubt, as they had mechanical engineers among them, a home in Birmingham would bring in an influx of mechanical engineers who would be able to give information on practical subjects, and would be glad to learn from mining engineers of Dudley and the district what was wanted to still further develope mining machinery. It was agreed that the deputation previously appointed should have power to treat with the trustees with a view to the removal.

The dispute between the employers and employed at Darlaston has come under the notice of certain nut and bolt manufacturers in America. It is stated that a communication has just been received from Alleghany, Pennsylvania, offering employment to as many men as like to go out.

The formation of a Nailers' Union, to which I have referred in previous reports, is now getting nearer accomplishment.

A strike in connection with the earthenware trades of the Staffordshire potteries now appears inevitable.

Some weeks ago it was reported that Lord Norton had given notice of his intention to proceed with his action on the injunction he had obtained against the Corporation of Birmingham with regard to the fouling of the river Tame by the sewage of the borough. In order, however, to await the result of the completion of improvements which the Corporation are now executing for the extension of the interception system, so as to prevent the pollution of the sewers, it has been arranged between Lord Norton and the Corporation that legal proceedings shall be suspended for a period of two years and a-half, the Corporation undertaking to pay the costs—about £600—already incurred by his lordship.

Some unknown philanthropist has promised £5000 towards the building of a public art gallery in Wolverhampton and industrial museum, provided that the town give a site, and that public subscriptions, amounting to £10,000, are also forthcoming. In addition to £500 given by Alderman John Jones, the ex-mayor, £500 is promised by his brother, Mr. Joseph Jones, towards the £10,000. Contributions of great value continue to be made towards the Birmingham Art Gallery. Mr. Richard Tangye, engineer, who has already promised £10,000, has now made known his intention to give another very large cheque, and he will also present his rare collection of Wedgwood ware, which is valued at £5000. Mr. Joseph Nettlefold, screw maker, had, before this, informed the Town Council that he should bequeath his collection of paintings, by David Cox, valued at from £25,000 to £30,000.

A site for a new school of art, it is this week made known, will be given by Mr. Colmore, and its value is estimated at between £10,000 and £15,000. Another benefactor, whose name is withheld, has promised £10,000.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—Notwithstanding a continued absence of any considerable demand for pig iron, the general condition of the iron trade of this district is satisfactory, and decidedly encouraging as regards the future. There is a steadily-growing activity in all the iron-using branches of trade, and if this for the present is not reflected in an increased demand for the raw material, it is chiefly because the heavy purchases made during last quarter when prices were low are still supplying the wants of consumers. Makers themselves show little or no concern with regard to the present lull in the pig iron market, as they are well sold for the present, and prices are steady at late rates. The only indication of concession is here and there a disposition, where prices had been put up to a figure considerably above the current range of values, to meet the market on a more reasonable basis, but there is no actual pressure to sell so far as makers are concerned.

Lancashire makers of pig iron are at present securing only a few small orders, but the deliveries they have to make on contracts in hand are more than sufficient to take away all their present production, and recently stocks have been reduced to a considerable extent. For delivery into the Manchester district prices remain firm at 48s. for No. 4 forge, and 49s. for No. 3 foundry, less 2½ per cent., and new orders are still only being booked for delivery over three months.

Sales to a moderately large amount are reported during the week in Lincolnshire and Derbyshire brands for delivery over the first three months of next year, and the prices realised have been equal to about 48s. 6d. and 49s. for forge, up to 50s. for foundry qualities, less 2½, delivered into the Manchester district. Middlesbrough iron has been nominally quoted at 49s. 10d. net cash delivered equal to Manchester, but business has not been done at this figure.

Hematites are in very good demand, and are quoted at 70s. less 2½ delivered equal to Manchester.

The finished iron trade continues very active, and the improvement has been so gradual and steady that it may be regarded as now established on a thoroughly sound basis. There has been an absence of that sudden and rapid advance in prices which would tempt speculators into the market, and the increased volume of business appears to have come through legitimate channels to meet actual requirements. The export demand has been very large, and though the chief pressure of the shipping season is now over, considerable transactions for shipment have taken place at Liverpool during the week, and any offers of bar iron delivered at that port at £6 10s. per ton are eagerly taken up. The demand for general home trade requirements is increasing steadily, and merchants, who are the chief distributors in this direction, are mostly busy. All the local makers continue well supplied with orders, and for delivery into the Manchester district prices are firm at £6 10s. to £6 15s. for bars, £7 5s. to £7 10s. for hoops, and £8 10s. to £8 15s. for sheets, which are in very brisk demand.

Brass founders are busy on marine engine and steam fittings generally, both for home and abroad, and the approach of the winter season is causing quite a pressure for the completion of orders for the Baltic ports.

Pipe founders are getting more orders both for gas and water purposes, and I hear that the Manchester Corporation are sending out preliminary inquiries with the view of placing out orders for a portion of the large-sized pipes which will be required for their Thirlmere water scheme, to complete which will require many thousand tons.

I continue to hear of a good deal of foreign work coming into the engineering shops of this district in various descriptions of tools and machines, and amongst the orders recently received was one for a number of the general class of tools, such as lathes, drills, &c., which, I have been informed on tolerably good authority, are being purchased on behalf of the Chinese Government.

Those branches of the engineering and iron trades which have any sort of direct relationship with the manufacture of munitions of war are generally busy, and tools for the equipment of arsenals are being made in considerable numbers, largely for foreign governments.

In the home trade engineers are also getting busier, and although I do not hear of much work of a special character in hand, or anything very new in construction so far as the general type of tools is concerned, I may mention that general attention is being paid in a special manner to every improvement of detail which can economise labour or lessen the cost of production. The competition with the longer hours of the continental workshops, in fact, renders imperative every possible improvement in machinery here, and as an illustration I may mention that one firm, Messrs. Hulse, the well-known tool makers of Manchester, have in hand special improvements in tools for marine engine work, railway work, large ordnance construction, and the manufacture of textile machinery. The general tendency of these improvements is in the direction of making the tools or machines automatic in their action to the fullest extent, with the view of economising labour. Another feature to which special attention is also now being paid by the manufacturers of machine tools is a greatly increased strength of construction, to enable them to deal with steel and the stiffer materials now so largely employed.

A dispute is at present going on in the wire rod department at Messrs. Pearson, Knowles, and Co.'s ironworks, Warrington, where the men claim an advance in wages equal to about 3d. per ton. This portion of the works has been stopped for about three weeks, but I hear that the matter is now in a fair way of settlement.

A meeting of the Manchester Trades Council was held last —Thursday—night, to make arrangements for the next trades congress which is to be held in Manchester.

In the coal trade there has been a decidedly less active tone during the past week. The milder weather following upon the advance in prices has brought about a considerable falling off in the demand for house-fire coals, and other descriptions of fuel for ironmaking and general trade purposes are not in more than fairly moderate request in proportion to the supplies. Deliveries which have still to be made on orders in hand are, however, keeping the pits going full time, and prices generally are firm at the advanced rates. The average prices at the pit mouth are about as under :— Best coal, 10s.; seconds, 8s. 6d.; common coal, 6s. 6d. to 7s.; good burgy, 5s.; and slack, 3s. to 4s. according to quality.

Shipping is moderate, with steam coal delivered at Garston on the high level, Liverpool, quoted at about 8s. 6d. per ton.

The wages question in the West Lancashire district, as I anticipated, has been settled by a compromise of 10 per cent., an advance of wages to this extent having been agreed upon by the colliery proprietors at a meeting held in Liverpool on Friday, and the men have resumed work. There is, however, talk of restricting the output, and this may be carried out to some extent.

Barrow.—I have nothing of any moment to chronicle as regards the position of the hematite pig iron market, which is in all respects satisfactory. The demand all round continues to be very good, and in some places shows an improvement. The work now in the hands of producers is very considerable, and likely to keep them in full activity for a length of time. Very large deliveries of metal are still being made, and although the shipping season is fast closing, it is understood that a large tonnage of metal yet remains to be delivered this year. The position of the pig iron trade is regarded as very satisfactory, and I think the prospects of a continuation of this must be admitted to be very good, as each day gives further proof of the soundness of the present increased activity in this industry, which has been a very gradual and sure one. Prices are practically as last quoted—No. 1 Bessemer, at 63s. 6d. per ton; and No. 3 forge, 60s. per ton at makers' works. In both these qualities makers are very fully sold forward. The steel department, as was to be expected from the orders booked, are busy, and the demand all round is good, particularly for rails and blooms. Iron shipbuilders are not so actively employed as they were a short time ago, the orders recently booked not being of any magnitude; negotiations are being made for a few large orders. Engineers, ironfounders, boilermakers, and others steadily employed. Iron ore in good demand at slightly higher rates. The demand for coal and coke well maintained. Shipping fairly busy.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

TRADE in the leading branches has not altered much during the last three weeks. The advance then secured in iron has been maintained, though with less animation than was anticipated. It was believed that the 5s. increase in value then obtained would have been followed ere this by a further rise of at least equal amount. No expectation is generally entertained of any decided improvement this side December, though makers stand out firmly against booking orders forward at current quotations.

In the coal trade "soft" or household sorts are in good demand, both in London and the metropolis. The first winter advance was secured this season fully a month before the usual time. A second advance was obtained on the date when the first has been announced in previous years. In hard or steam coal there is again a lull. The export trade to the Baltic ports closed last week, with the result that the whole of the supply is now thrown on the English market, which is somewhat glutted in consequence. Quotations are now about 6s. 6d. per ton. Gas coal keeps its price, and the collieries where it is principally obtained—Aldwarke Main, Car House, Thorncliffe, and other parts—are exceedingly well employed.

At the Birley Collieries, near Sheffield, the property of the Sheffield Coal Company, Limited, the principle of the sliding scale has been in operation for some time. A copy of the scale was shown to me on Tuesday. It practically fixes the wages of colliers and all underground workmen according to the average selling price of coal at the Birley pits. The "average selling price" at the 1st of January, 1881—6s. 1d. per ton—is taken as the standard average selling price, and the rate of wages at the same date was considered as the minimum rate of wages. When the average selling price for any six months ending June 30th or December 31st is under 6s. 5d. per ton, there will be no addition made to the pay-weeks of the following six months; but when the prices advance beyond 6s. 5d., wages are to be increased as follows :—6s. 5d. and under 6s. 9d., 2½ per cent.; 6s. 9d. and under 7s. 1d., 5 per cent.; 7s. 1d. and under 7s. 5d., 7½ per cent.; 7s. 5d. and under 7s. 9d., 10 per cent.; 7s. 9d. and under 8s. 1d., 15 per cent.; 8s. 1d. and under 8s. 5d., 17½ per cent., and so on, a further 2½ per cent. being allowed for each further 4d. in the "average selling price." In the 13th article of the agreement it is stated :—"Every workman at Birley will understand that, under this sliding scale agreement, each has a direct personal interest in increasing and keeping up the average sale prices of Birley coal and coke, and should always remember that this is done more than by anything else : (1) by increasing the quantity of 'branch' coal sent out; (2) by lessening the quantity of 'slack' and increasing the proportion of 'round' coal; and (3) by sending the coal out clean and in good shape. Any carelessness or neglect in these respects directly operates against increase of wages.

The Swinton Ironworks, which were closed for several years, are now in full swing. Fifteen furnaces are in daily use, and 160 men employed in puddling, rolling, shingling, &c. The manager for the company at the works is Mr. T. Teesdale. The telephone will shortly connect the Swinton establishment with Car House and Aldwarke Main Collieries. I hear, too, that the electric light will probably be introduced.

The Board of Trade statistics, as they affect Sheffield, are unusually interesting. Our cutlery trade with Russia and Germany is gradually declining; but in nearly every other country our trade is increasing. In October last we exported a total of hardware and cutlery—of course Birmingham and other parts send most of the hardware—to the value of £373,342, as compared with £332,126 in Oct., 1880, and £368,210 in Oct., 1879. British North America shows the greatest increase, having advanced from £13,523 in Oct., 1880, to £27,522 in Oct., 1881. France shows an increase of £2500, and the United States of nearly £10,000, the total to the States for last month being £57,776. The Argentine Republic has increased from £8954 to £11,138; and the British possessions in South Africa from £19,831 to £23,883.

At a meeting of delegates representing the miners of South Yorkshire, held at Barnsley on Wednesday evening, resolutions were passed declaring that the death of Mr. Macdonald, M.P., was a national loss to the mining community, and urging the erection of a memorial to commemorate his work.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

TOWARDS the close of last week the Glasgow iron market assumed a very sluggish condition; little business was done, and the prices had a downward tendency. On Monday, the market slightly improved, in consequence of an impression gaining ground that the ironmasters were resolved not to concede to the demands of the miners for an advance of wages. The improved tone in the market was still further enhanced on Tuesday by the publication of the Board of Trade returns, showing that the exports and imports of the country were steadily advancing. Together with this fact, there was the other, that the past week's exports of Scotch pig iron were, upon the whole, satisfactory, and these influences combined served to give an upward turn to the quotations. The position of the trade outside the warrant market has been very good for some weeks, and as the deliveries of pig iron into store have now materially decreased, and the reports from foreign markets continue to be encouraging, there is a prospect of a run of good business. Between 2000 and 3000 tons of pigs were placed in the course of the week in Mesers. Connal's stores, which, at time of writing, contain 612,000 tons. It is expected that the additions to stocks will continue to diminish week by week, but it is still regarded as doubtful whether they will cease altogether. On the whole, the pig iron trade appears in a highly promising state.

Business was done in the warrant market on Friday forenoon at 50s. 3d. to 50s. 1d. one month, also 50s. 1d. to 49s. 9d. cash, the afternoon quotations being 49s. 7½d. to 49s. 10d. cash, and 49s. 11d. to 50s. one month. On Monday morning transactions were effected at 49s. cash, and up to 50s. 1d. one month, whilst in the afternoon, the quotations improved to 50s. 2d. cash, and 50s. 5½d. one month. On Tuesday the market was steady, with business at 50s. 4½d. to 50s. 6½d. for cash, and 50s. 3d. to 50s. 10d. one month. The market was strong on Wednesday, with business up to 50s. 10d. cash and 51s. 1d. one month. There was a good business to-day —Thursday—up to 51s. 1d. cash and 51s. 3d. one month.

In sympathy with the improvement in the warrant market, the prices of makers' iron, which had declined at the close of the week, have since slightly advanced, the quotations being as follows :— Gartsherrie, f.o.b. at Glasgow, No. 1, per ton, 58s. 6d.; No. 3, 51s.; Langloan, 59s. 6d. and 52s. 6d.; Coltness, 59s. 6d. and 52s. 6d.; Summerlee, 58s. 6d. and 50s. 6d.; Calder, 58s. 6d. and 52s. 6d.; Carnbroe, 52s. 6d. and 50s. 6d.; Clyde, 50s. 6d. and 48s.; Monkland, 50s. 6d. and 48s.; Quarter, 50s. 6d. and 48s.; Govan, at Broomielaw, 50s. 6d. and 48s.; Shotts, at Leith, 60s. and 52s. 6d.; Carron, at Grangemouth, 52s. (specially selected, 55s. 6d.) and 51s.; Kinneil, at Bo'ness, 50s. and 48s.; Glengarnock, at Ardrossan, 52s. 6d. and 49s. 6d.; Eglinton, 50s. and 47s.; Dalmellington, 50s. 6d. and 47s.

It is noticeable that the consignments of pig iron to the United States have considerably improved. In the past week they amounted to no less than 3200 tons, but the exports to Canada and South America have almost ceased, while those to the Continent are not quite so good as they have been in past week.

The reports given on 'Change with respect to the manufactured iron trade continue to be of a satisfactory nature. The malleable manufacturers do not appear to have been doing quite so much business during the past fortnight; but they have as a rule good contracts on hand, and it is expected, now that the warrant market has again somewhat recovered, consumers will be ready with fresh orders. The founders are well employed, and so are also the locomotive and marine engineers. The recent advance in the price of manufactured iron will now, it is expected, be maintained without difficulty.

A meeting of the shareholders of the Armiston Coal Company was held in Edinburgh on Monday, when a dividend was declared of 10 per cent. with an additional bonus of 1¼ per cent.

The miners have only partially obtained the advance of 6d. per day which they expected to receive from the first of the present month. In the Hamilton district the advance has been conceded, and also at a number of collieries about Motherwell. But in the districts of Glasgow and Ayrshire, and in the counties of Fife and Clackmannan, the advance has been refused, the employers being of opinion that the state of the coal trade does not warrant them paying higher wages at present.

The improved weather of the past week has led to a considerable increase in the shipments of coals; large consignments have been despatched from Glasgow and Ayrshire, and the exports from the Fife and Lothian coasts have also been upon an extensive scale. In the Frith of Forth, particularly, the trade seems to be very good, and merchants reported that about 3d. per ton advance is paid f.o.b. for main coal. A steady inland trade is also being done at former prices.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

A PRACTICAL experiment with the electric light in mines is about to be made, and Maerdy Colliery, Ferndale, is the one selected. The experiment will very likely come off at the close of this week, and will be watched with attention.

I am glad to report another good week's work in the iron and steel works, and also in the collieries. A fair amount of Bessemer pig and steel rails is in hand, and orders are placed in a satisfactory manner.

The Rhymney improvements are going on well, and the Coppée range is in progress. The company is advertising for increased capital.

Prices in metals will be certain to rule until the turn of the year.

It is now stated that the management of the Rhymney line are contemplating joining Cyfarthfa, and thus no less than four railways are competing.

The settlement at Cyfarthfa still drags, but the difficulties are narrowed, and it now rests with Mr. W. T. Lewis on the one hand as agent, and Mr. Edward Williams, of Middlesbrough, as adviser of Messrs. Crawshay on the other, whether the question of a restart at Cyfartha shall be satisfactorily answered. The Messrs. Crawshay are prepared to convert into steel if they obtain the necessary conditions which Mr. Edward Williams suggests that they should have.

Mr. W. T. Lewis, as a Merthyr man, can have a very hearty wish for the prosperity of the town, a matter thoroughly dependent upon a restart; and he must also be credited with a thoroughly unbiassed and ingenuous mind. I am satisfied of a successful ending of the dispute, and hope it will soon come, for now labour is cheap and trade prospects good. I must notice here, as entirely in keeping with trade, a new literary venture, a national magazine for Wales. One of the leading features is industrial, and portraits and lives will be given of all leading men connected with the great lines of labour.

There is no falling off in demand for coal, and the exports from the leading ports last week reached over 150,000 tons. Prices, too, are firm, and despite sundry rumours in circulation of sales having been effected at a slight reduction, I believe the tendency is more to an advance. In all directions the condition of things is encouraging. At Swansea the patent fuel trade is good, as well as the coal trade. Of patent fuel 4000 tons left last week. I am surprised, however, at one thing—freights for France are low, and Cardiff is far better placed in respect of orders for that quarter.

Initiatory steps are being taken with regard to the railway connection between Rhondda and Swansea and law agents are busy in preparation. The colliers are beginning to agitate about the sliding scale; the question before them is to assimilate existing scales, and out of the three now in operation to form another. I see meetings are to be held, when the *pros* and *cons.* will be debated.

At a meeting of representatives held at Cardiff, on Tuesday, a motion of condolence was passed with regard to the late Mr. Macdonald, and it was suggested that a movement should be started in connection with the national executive to form a memorial.

LOUGHBOROUGH LOCAL BOARD.—Mr. F. Baker, A.M.I.C.E., of the Waterworks Office, Sheffield, has been appointed surveyor and waterworks manager. That gentleman, together with Mr. W. Matthews, assistant borough surveyor, Peterborough, and Mr. A. Brady, surveyor to the Dockwell Union and Hunstanton Local Board, were selected out of 136 candidates. Salary £200.

MARINE ENGINES IN EGYPT.—The steamship Behera has made a very sucessful trial trip at Alexandria. The Behera was built by Messrs. Samuda Brothers, of London, in 1865, and was engined by Messrs. John Penn and Son, of Greenwich; her total cost being £85,000. She had new boilers, and was completely refitted in London in 1872 by the same firms, and, till within the last twelve months, was continuously engaged in the postal service between Alexandria and Constantinople, as one of their fastest and best vessels. On one occasion, when engaged on special service, she made the run from Alexandria to the Dardanelles within forty-eight hours. The new engines have been constructed by Messrs. James Jack and Co., of Liverpool, and are of 300 nominal horse-power, working up to 1500 indicated horse-power; they are precisely similar to those in the Charkieh. The results of the run realised every expectation. The highest speed obtained was 13·4 knots with 67 revolution and 70 lb. of steam and 27in. vacuum, the indicated horse-power at this speed and pressure being over 1500; the consumption of coal was at the rate of nineteen tons per twenty-four hours. The consumption of coal required to attain a similar result with the old machinery was fifty-five tons per twenty-four hours. With the exception of the actual manufacture of the engines, the whole of the work of fitting them on board and completely refitting the vessel was executed by the factory of the Khediveh Administration, under the superintendence of Mr. Carpenter, the Superintendent Engineer of the Administration, where every preference is given to the employment of native labour. Mr. Beck, in conjunction with Messrs. Allen Alderson and Co., represented Messrs. James Jack and Co., the constructors of the engine, while they were being fitted on board in Alexandria.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

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

Applications for Letters Patent.

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

1st November, 1881.

4764. ROCK-DRILLING W. Morgan-Brown.—(*L. B. Stone, Massachusetts, U.S.*)
4765. MATTRESSES, J. T. Lockey, Northwich.
4766. AERATED BEVERAGES, T. Maughan, London.
4767. FURNACES, W. P. Thompson.—(*E. Prevost, Paris.*)
4768. ANTISEPTIC FLUIDS, J. Ascough, Handsworth.
4769. MANGLES, J. Deacon, Birmingham.
4770. GAME of CHANCE, C. A. Glazbrook, W. Taylor, and W. Trench, London.
4771. LIGHTING, C. Crastin, jun., London.
4772. OIL, &c., J. Darling, Glasgow.
4773. STEERING APPARATUS, A. W. Cooper, Dundee.
4774. SHAFT MACHINES, C. A. Barlow.—(*N. Anderson, Sweden.*)
4775. ELECTRIC LAMPS, H. Bonneville.—(*L. Daft, U.S.*)
4776. CARTRIDGE CASES, G. Kynoch, Birmingham.
4777. ELECTRIC LAMPS, E. R. Prentice, Stowmarket.
4778. ELECTRIC LAMPS, F. Wright, London.
4779. AUGERS, P. A. Gladwin, Boston, U.S.
4780. INSULATING CONDUCTORS, A. Woodward, New York.
4781. FRILLINGS, E. A. Cowper, Westminster.
4782. SEWING MATERIALS, E. H. Smith, New York.

2nd November, 1881.

4783. SHIPS, G. Hepburn, Liverpool, and W. Parker, Catford Bridge, Kent.
4784. SHIPS' RUDDERS, W. Cook and D. Mylchreest, Liverpool.
4785. COMPOSITION, E. Edwards.—(*H. Kolker, Germany.*)
4786. CAR-COUPLINGS, G. W. von Nawrocki.—(*G. Lippmann, Germany.*)
4787. STOVES, J. Dunnachie, Lanark.
4788. RING HOLDERS, H. Ziffer, London.
4789. HOLDING GUM, H. J. Haddan.—(*A. Rittmeyer, St. Gallen, Switzerland.*)
4790. VACCINATING, T. Smith.—(*V. Burg, Paris.*)
4797. SECURING TABS, G. C. Reddick, London.
4792. SWITCHES, W. Hubble.—(*J. Gérard-Lescuyer, Paris.*)
4793. MIRRORS, C. D. Cannon, Finnis-street, London.
4794. FURNACES, W. Malcolm, Lasswade, N.B.
4795. KILNS, G. von Nawrocki.—(*E. Arnold, Prussia.*)
4796. LAVATORIES, G. H. and S. Jennings, Stangate.
4797. TELEGRAPHIC CABLES, C. L. Gore, London.
4798. BOILERS, G. Kamensky.—(*O. Novikoff, Russia.*)
4799. GAS-BURNERS, J. B. Fenby, Sutton Coldfield.
4800. REMOVING SOIL from CESSPOOLS, A. M. Clark.—(*La Compagnie Générale de Salubrité, Paris.*)
4801. SIZING PAPER, W. Lake.—(*P. Minor, New York.*)
4802. WHITING, W. Brothers, Livesey, near Blackburn.

3rd November, 1881.

4803. KEELS, W. Cooke and D. Mylchreest, Liverpool.
4804. FILTERING PAPER, S. Johnson, Stratford, London.
4805. FLYERS for SPINNING, J. Murgatroyd, J. Croad, and S. Murgatroyd, Luddenden.
4806. HOLDERS for CRAYONS, A. P. Hansen, London.
4807. PROPULSION of SHIPS, W. Kinipple, Westminster.
4808. BREECH-LOADING FIRE-ARMS, H. Simon.—(*F. Vetterli, Paris.*)
4809. COMPOUND STEAM ENGINES, R. S. Boyer, Cardiff.
4810. NON-CONDUCTING COMPOSITION, L. Masche, Hamburgh.
4811. DISPLAYING CLOTHING in WINDOWS, F. M'Ilvenna, Manchester.
4812. APPARATUS for ELECTRIC LAMPS, H. J. Haddan.—(*Wauters de Busscher, Bruxelles.*)
4813. TIN ROLLERS, W. Gledhill, Mossley.
4814. STEAM ENGINES, N. Macbeth, Bolton.
4815. CARRIAGES used in BOBBIN-NET MACHINES, W. Spowage, Nottingham.
4816. CANDLES, L. Groth.—(*L. and C. Motard, Berlin.*)
4817. SPOOLING APPARATUS, L. A. Groth.—(*R. Steiner, Austria.*)
4818. DRIVING ROCK DRILLS, T. R. Jordan, London.
4819. MOTORS, W. L. Wise.—(*E. Bürgin, Switzerland.*)
4820. ELECTRIC LAMPS, W. L. Wise.—(*E. Bürgin, Switzerland.*)
4821. MEASURING WATER, &c., W. Jones, Manchester.
4822. CHRONOMETRIC OBTURATOR, E. G. Brewer.—(*P. Boca, Paris.*)
4823. PHOTOGRAPHIC CAMERAS, T. Bolas, Chiswick.
4824. ELECTRIC METERS, C. A. Carus-Wilson, London.
4825. REGULATING DYNAMO-ELECTRIC MACHINES, C. A. Carus-Wilson, Grenville-place, London.
4826. SPRING MATTRESSES, G. Lowry, Salford.
4827. BRACELETS, W. and W. J. Bancroft, Birmingham.
4828. LOCKS, W. S. Frost, Peckham, London.
4829. TRICYCLES, A. Archer, Birmingham.
4830. BOATS, W. R. Lake.—(*J. L. Lay, Paris.*)

4th November, 1881.

4831. SPRINGS, J. Tranfield, Sheffield.
4832. HEATING FEED-WATER, H. Dansey, London.
4833. LOCKS, H. J. Haddan.—(*O. Flagstad, Norway.*)
4834. ATTACHING HORSES, H. Dickinson, Huddersfield.
4835. SPRING HOOKS, J. Carter, Salford.
4836. PREVENTING FIRE, W. Fitzmaurice, Tipperary.
4837. CIGARETTE PAPER, J. Johnson.—(*E. d'Argy, Paris.*)
4838. LAUNCHES, W. R. Kinniple, London.
4839. NUT-LOCKING, S. Danischewsky, Paris.
4840. CONCRETE, J. B. Spence, London, and E. Ormerod, Belvedere, Kent.
4841. PIANOFORTE ACTIONS, G. Brockbank, London.
4842. ROLLING MILLS, P. Jensen.—(*Schmidt Brothers, Germany.*)
4843. LOOMS, T. Singleton, Darwen.
4844. CLEANSING FIBROUS SUBSTANCES, T. H. Cobley, Dunstable, and G. Tidcombe, jun., Watford.
4845. CLEANSING WATER-CLOSETS, J. H. Johnson.—(*T. Guinier, Paris.*)
4846. PLEATING MACHINES, O. Chamberlain, London.

5th November, 1881.

4847. PREPARING WOOL, G. Little, Oldham.
4848. LOCKS, H. Gibbons & A. Anthony, Hungerford.
4849. REDUCING FRICTION, W. J. Brewer, London.
4850. ELECTRIC LAMPS, C. J. Allport, London, and R. Punshon, Brighton.
4851. ELECTRO-MOTIVE ENGINE, D. T. Piot, London.
4852. STEAM PLOUGHS, R. Grimmer, Walsoken.
4853. SHAPING METALS, J. Whitehouse and S. Peacock, Birmingham.
4854. ELECTRICITY, J. B. Rogers, London.
4855. ELECTRIC LAMPS, J. B. Rogers, London.
4856. SHIPS' BERTHS, W. R. Lake.—(*J. H. Porter, U.S.*)
4857. DRYING MATERIALS, W. R. Lake.—(*P. Basquin, Paris, France.*)

7th November, 1881.

4858. FURNACES, F. Erskine, Manchester.
4859. FIRE-GRATES, J. Adams, Sheepbridge, and J. Bonehill, Rotherham.
4860. FASTENING TIRES, J. K. Starley, Coventry.
4861. PERMANENT WAY, J. Whiteford, Greenock.
4862. ASTRAGALS, J. Harley, Glasgow.
4863. BRACES, H. Allsop, Birmingham.
4864. STEAM GENERATORS, C. D. Abel.—(*H. Schulte, Austria.*)
4865. FORKS of BICYCLES, S. Armstrong, Birmingham.
4866. VOLTAIC BATTERIES, T. Coad, Finsbury, London.
4867. CABINET for VOLTAIC BATTERIES, T. Coad, London.
4868. SHIPS, J. Dickie, King William-street, London.
4869. PACKING, J. R. Williams and H. Dansey, London.
4870. FOLDING BEDS, H. Gardner.—(*D. C. Ottis and C. G. Clark, New York.*)
4871. TRAYS for FRUIT, W. H. E. Poulett, Crewkerne.
4872. "ACTIONS" of SMALL-ARMS, H. A. Silver and W. Fletcher, Sun-court, Cornhill, London.
4873. SMALL FIRE-ARMS, E. James, Birmingham.

Inventions Protected for Six Months on deposit of Complete Specifications.

4775. ELECTRIC LAMPS, H. A. Bonneville, Cannon-street, London.—A communication from L. Daft, New York.—*1st November*, 1881.
4779. AUGERS, P. A. Gladwin, Boston, U.S. — *1st November*, 1881.

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

4481. SHAPING METALS, T. Campbell, J. W. Campbell, and J. Hunter, Leeds.—*6th November*, 1878.
4798. DRIVING SHUTTLES, G. B. Woodruff, Cheapside, London.—*25th November*, 1878.
4417. OPERATING SLIDE VALVES, T. Lumley, Edgbaston, and T. Kavanagh, Birmingham.—*1st November*, 1878.
4438. PREPARING GUTTA-PERCHA, E. T. Truman, Old Burlington-street, London.—*2nd November*, 1878.
4446. COUPLINGS, A. B. Ibbotson and F. J. Talbot, Sheffield.—*2nd November*, 1878.
4465. SEWING MACHINES, A. M. Clark, Chancery-lane, London.—*5th November*, 1878.
4579. HYDRAULIC SHEARING MACHINES, G. Ratliffe, Liverpool.—*12th November*, 1878.
4455. OIL MILLS, E. R. Walker, Leeds.—*4th November*, 1878.
4459. SEPARATING FLUIDS, G. de Laval, Stockholm, Sweden.—*4th November*, 1878.
4474. DYEING HIDES, W. R. Lake, Southampton-buildings, London.—*5th November*, 1878.
4460. PRINTING MACHINES, W. L. Wise, Adelphi, London.—*4th November*, 1878.
4461. PIPES or TUBES, W. R. Lake, Southampton-buildings, London.—*5th November*, 1878.
4470. POTATO DIGGERS, L. A. Aspinwall, Chancery-lane, London.—*5th November*, 1878.
4477. FACILITATING REMOVAL of YEAST, S. Griffin and T. A. Pearce, Bath.—*5th November*, 1878.
4541. DRAWING WIRE, W. R. Lake, Southampton-buildings, London.—*8th November*, 1878.
4763. FORGING, &c., METALS, G. R. Postlethwaite, Aston, near Birmingham.—*22nd September*, 1878.
4484. SHUNTING GOODS, S. Chapman, Stratford.—*6th November*, 1878.
4490. NEW COLOURING MATTERS, J. C. Mewburn, Fleet-street, London.—*6th November*, 1878.
4491. NEW COLOURING MATTERS, J. C. Mewburn, Fleet-street, London.—*6th November*, 1878.
4494. CARRIAGE for ROCK-DRILLING MACHINES, J. McCulloch, Manchester.—*6th November*, 1878.
4523. WINDOW SASHES, T. H. Collins, Winchester.—*7th November*, 1878.
4526. AMMONIA, J. Young, jun., Kelly, N.B.—*8th November*, 1878.
4547. DOUGH MIXING MACHINES, T. Vicars, sen., T. Vicars, jun., and J. Smith, Liverpool.—*9th November*, 1878.
4595. GENERATING ELECTRIC CURRENTS, C. F. Heinrichs, London.—*13th November*, 1878.
4619. INDICATING SPEED, G. Westinghouse, jun, London.—*14th November*, 1878.
4860. COOKING STOVES, W. R. Lake, Southampton-buildings, London.—*28th November*, 1878.

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

3781. EXPLOSIVE COMPOUNDS, C. A. Faure, London, and G. Trench, Oare.—*2nd November*, 1874.
3834. TUYERES, F. H. Lloyd, Wednesbury—*6th November*, 1874.
3839. STEAM TRAM-CARS, E. Perrett, Abingdon-street, Westminster.—*6th November*, 1874.
3983. SEWING MACHINES, A. V. Newton, Chancery-lane, London.—*19th November*, 1874.
4074. KNITTING MACHINERY, J. W. Lamb and S. Lowe, Nottingham.—*27th November*, 1874.
3879. PYROPHONE, A. M. Clark, Chancery-lane, London.—*11th November*, 1874.
3791. HEATING CARRIAGES, &c., L. J. F. Lemeunier and C. A. Martin, Paris.—*3rd November*, 1874.
3916. ACTUATING RAILWAY SIGNALS, F. W. Webb, Crewe.—*13th Novenber*, 1874.
3799. DEODORISING MATERIALS, F. T. Bond, Gloucester.—*4th November*, 1874.
3830. BLOCKS for PAVING, B. Sheil, South Kensington, London.—*6th November*, 1874.

Notices of Intention to Proceed with Applications.

Last day for filing opposition, 25th November, 1881.

2582. TRICYCLES, H. J. Haddan, Westminster.—A communication from C. W. Oldreive.—*14th June*, 1881.
2586. SHIPS' PENS, H. J. Haddan, Westminster.—A communication from S. Shaw.—*14th June*, 1881.
2652. ROWING BOATS, W. J. Sage, Walworth, London.—*17th June*, 1881.
2873. LOCKING NUTS, H. Wedekind, London.—A communication from L. Imperatori.—*1st July*, 1881.
2892. CARDING MACHINERY, A. Barker, Leeds.—*2nd July*, 1881.
2894. CLASP KNIVES, C. Carter, Stamford-street, London.—*2nd July*, 1881.
2897. FASTENING for BRACELETS, A. B. Parkes and F. Westwood, Birmingham.—*2nd July*, 1881.
2901. CARD-SETTING MACHINES, J. Haley and J. Pinder, Cleckheaton.—*2nd July*, 1881.
2920. SCREW APPARATUS, W. W. Hewitt, Swanscombe.—*4th July*, 1881.
2964. BURNISHING SOLES of BOOTS, P. Justice, London.—A com. from W. F. Hutchinson.—*6th July*, 1881.
3046. SPINNING COTTON, T. Coulthard, Preston.—*12th July*, 1881.
3201. PRINTING CHARACTERS, W. P. Thompson, London. A com. from A. H. Rogers.—*22nd July*, 1881.
3232. DISTILLING BONES, W. L. Wise, Westminster.—A com. from MM. Pilon, Frères, et Cie.—*23rd July*, 1881.
3233. DOUBLING COTTON, T. Coulthard, Preston.—*23rd July*, 1881.
3615. BOTTLE-STOPPING MACHINES, C. M. Sombart, Germany.—Com. from O. Assmann.—*19th August*, 1881.
4038. EXPRESSION of JUICE from SUGAR-CANE, W. Thomson and J. Mylne, London, and J. B. Alliott, Nottingham.—*19th September*, 1881.
4071. LENO or GAUZE CLOTH, T. Bottomley, Buttershaw, near Bradford.—*21st September*, 1881.
4105. WINDING THREAD on COP-TUBES, R. Spöndlin, Zürich. — A com. from the Baumwollspinnerei and Zwirnerei, Niederuster.—*23rd September*, 1881.
4359. INDICATING SPEED of ROTATING SHAFTS, D. Young, Southampton-buildings, London.—*7th October*, 1881.
4729. RAISING SHIPS' BOATS, A. M. Clark, London.—A communication from R. H. Earle.—*28th October*, 1881.

Last day for filing opposition, 29th November, 1881.

2839. SCREW-NUTS, W. R. Lake, London.—A com. from C. H. Denison and E. F. Mead.—*28th June*, 1881.
2884. SHIPS' DAVITS, L. C. Niebour, Kingston.—*2nd July*, 1881.
2885. CRANES, &c., W. D. Bruce, Westminster.—*2nd July*, 1881.
2890. BLEACHING FIBRES, W. Barlow, London.—A com. from L. Naudin and J. Schneider.—*2nd July*, 1881.
2903. WHEELS, G. B. Lovedee, Birmingham.—*4th July*, 1881.
2907. CUT NAILS, B. J. B. Mills, London.—A com. from D., J., and S. Farmer.—*4th July*, 1881.
2910. CLIPPERS, J. Trickett, Newark-upon-Trent.—*4th July*, 1881.
2911. MECHANICAL STOKERS, T. B. Kay, Bolton-le-Moors, and R. Heywood, Salford.—*4th July*, 1881.
2935. SUPPORTING PERSONS OUTSIDE WINDOWS, J. Louis, London.—*5th July*, 1881.
2938. ATTACHMENTS to HARVESTING MACHINES, W. P. Thompson, Liverpool.—A communication from H. D. Blakemore—*5th July*, 1881.
2941. BOXES, C. R. E. Bell, London.—*5th July*, 1881.
2955. LAMPS, F. R. Baker, Birmingham. — *6th July*, 1881.
2958. LOOMS, E. and S. Tweedale, Accrington.—*6th July*, 1881.
2969. VENTILATING BUILDINGS, E. Aldous, Peckham, London.—*7th July*, 1881.
2977. GRINDING MILL, W. Hawley, jun., and F. Hawley, Duffield.—*7th July*, 1881.
2991. HAT-SHAPING MACHINE, J. R. Kelsey, Bristol.—*7th July*, 1881.
2992. STEAM ENGINES, J. E. Outridge, Egham.—*7th July*, 1881.
3052. WINDING ENGINES, D. Greig and R. H. Shaw, Leeds.—*12th July*, 1881.
3067. INDUCING OUTWARD DRAUGHT, J. Gilmore and W. R. Clark, London.—*13th July*, 1881.
3093. DRYING MACHINERY, W. A. Gibbs and D. H. Gibbs, Chingford.—*15th July*, 1881.
3103. STEAMSHIPS, R. F. Fairlie, Victoria-street, Westminster.—*16th July*, 1881.
3143. BREECH-LOADING SMALL-ARMS, J. S. Edge, jun., Yardley, & J. Deeley, Birmingham.—*19th July*, 1881.
3179. PREPARATION for HEALING WOUNDS, G. Lowe, Barnet.—*21st July*, 1881.
3218. REGISTERING the TRAVEL of VEHICLES, R. H. Brandon, Paris.—A communication from L. Pouget.—*23rd July*, 1881.
3238. ELECTRIC CONTACT for ELECTRIC CLOCKS, B. J. B. Mills, London. — A communication from G. Leclanché.—*25th July*, 1881.
3279. BRAKES, W. Mortimer, Sussex.—*26th July*, 1881.
3349. ELECTRIC LAMPS, A. W. L. Reddie, London.—A com. from D. A. Chertemps.—*2nd August*, 1881.
3551. WEIGHING MACHINES, C. Reuther, Hennef, Prussia.—*16th August*, 1881.
3568. CONCERTINAS, B. Berry, Newcastle-on-Tyne.—*17th August*, 1881.
3709. FLYERS used in SPINNING, T. A. Duncan, Otley.—*25th August*, 1881.
3829. DAMPING APPARATUS, W. Powrie, Camberwell, London.—*2nd September*, 1881.
3874. LOOMS for WEAVING, E. Smethurst, Manchester.—*7th September*, 1881.
3881. GELATINISATION of UNMALTED GRAIN, E. Luck, Stamford-street, London.—*7th September*, 1881.
3883. ACETIFYING ALCOHOLIC WASH, E. Luck, Stamford-street, London.—*7th September*, 1881.
3966. PORTABLE GAS APPARATUS, P. M. Justice, London.—A com. from A. J. Clavel.—*14th September*, 1881.
3984. PITCH CHAINS, A. H. Wallis, Basingstoke.—*15th September*, 1881.
4383. ELECTRIC BRIDGES for LAMPS, St. G. L. Fox, Westminster.—*8th October*, 1881.
4409. TELEGRAPH CONDUCTORS, W. O. Callender, Leadenhall-street, London.—*11th October*, 1881.
4671. RINGS for SPINNING FRAMES, W. R. Lake, London.—A communication from J. Y. Anthony and W. K. Evans.—*25th October*, 1881.

Patents Sealed.

(*List of Letters Patent which passed the Great Seal on the 4th November*, 1881.)

1952. FEEDING BOTTLES, J. Thomas, Brixton.—*5th May*, 1881.
1954. SLIDING WINDOWS, F. Attock, Manchester.—*5th May*, 1881.
1973. PRESSES, H. C. Gover, Hampstead.—*6th May*, 1881.
1979. FUR GARMENTS, W. H. Beck, London.—*6th May*, 1881.
1996. HOLDING HATS, &c., M. Conrath, London.—*7th May*, 1881.
2008. PREPARING BEVERAGES, B. Hunt, London.—*9th May*, 1881.
2020. BAROMETERS, B. J. B. Mills, London.—*9th May*, 1881.
2023. REGULATOR GAS-BURNERS, H. Zwanziger, Vienna.—*9th May*, 1881.
2028. WATERPROOF CANVAS, G. and W. H. Good, Yeovil.—*10th May*, 1881.
2062. STRETCHING FABRICS, S. Hallam, Manchester.—*12th May*, 1881.
2075. POWER HAMMERS, J. Patterson, London.—*12th May*, 1881.
2091. GAS, J. Keith, Edinburgh and Arbroath.—*13th May*, 1881.
2114. FILTERING, W. Spence, Chancery-lane, London.—*14th May*, 1881.
2120. THRASHING MACHINES, F. Wirth, Frankfort-on-the-Main.—*14th May*, 1881.
2124. HYDRAULIC CAPS, F. Wirth, Frankfort-on-the-Main.—*16th May*, 1881.
2148. COMPOUND STEAM-ENGINES, H. H. Lake, London.—*17th May*, 1881.
2160. ATTACHING KNOBS to LOCK SPINDLES, S. Harvey and J. Brodie, London.—*18th May*, 1881.
2173. RIDING SADDLES, R. Walters and J. Hewitt, Finsbury.—*18th May*, 1881.
2174. BRICKS, &c., J. Walker, Leeds.—*18th May*, 1881.
2202. BICYCLES, E. Marshall, Birmingham.—*19th May*, 1881.
2215. COUPLINGS for ELECTRICAL CONDUCTORS, P. R. Allen, Southwark.—*20th May*, 1881.
2224. SWEETMEATS, S. P. Wilding, London.—*21st May*, 1881.
2258. TRICYCLES, H. J. Haddan, Strand, London.—*24th May*, 1881.
2266. SPINNING, E. and L. J. Crossley and W. Sutcliffe, Halifax.—*24th May*, 1881.
2282. ARTISTIC HANGINGS, A. M. Clark, London.—*24th May*, 1881.
2304. EXHIBITING ELECTRIC LIGHT, W. Crookes, London.—*25th May*, 1881.
2317. PURIFYING GASES, R. Good and T. Dean, Croydon.—*26th May*, 1881.
2386. DISPLAYING ADVERTISEMENTS, H. J. Haddan, Strand, London.—*31st May*, 1881.
2410. QUARRYING SLATE, A. M. Clark, London.—*31st May*, 1881.
2517. WINDING TAPE, J. Imray, London.—*9th June*, 1881.
2546. SEWING MACHINE GEARING, H. J. Haddan, Strand, London.—*11th June*, 1881.
2558. CENTRIFUGAL MACHINES, W. Shears, Bankside.—*13th June*, 1881.
2612. ELECTRIC LAMPS, W. Crookes, London. — *15th June*, 1881.
2830. KNIFE and FORK, W. Wiley, Wolverhampton.—*28th June*, 1881.
3030. MAKING CIGARETTES, A. M. Clark, London.—*9th July*, 1881.
3122. ELECTRIC BRIDGES for LAMPS, St. G. L. Fox, London.—*18th July*, 1881.
3258. HORIZONTAL STEAM-ENGINES, D. Halpin, London.—*26th July*, 1881.
3280. FILMS for PRINTING, A. M. Clark, London.—*26th July*, 1881.
3394. GENERATING ELECTRIC CURRENTS, St. G. L. Fox, London.—*5th August*, 1881.
3590. EMBROIDERY, C. A. Barlow, Manchester.—*17th August*, 1881.
3637. SEWING MACHINES, W. Webster, Leeds.—*20th August*, 1881.
3707. WATER-CLOSET APPARATUS, W. R. Lake, London.—*25th August*, 1881.
3775. SELF-LEVELLING BERTHS, T. C. Dunn, Boston.—*30th August*, 1881.
3795. BRUSHES, B. J. B. Mills, London.—*31st August*, 1881.
3867. PENHOLDERS, J. G. Hester, Washington, U.S.—*6th September*, 1881.

(*List of Letters Patent which passed the Great Seal on the 8th November*, 1881.)

2000. WINDOW-FRAMES, E. Edwards, London.—*9th May*, 1881.
2005. PAPER CLOTH, W. T. Harvey, London.—*9th May*, 1881.
2027. RINK for SLIDING, H. Langsford, London.—*10th May*, 1881.
2033. SOLE-PLATES, M. and R. Slack, Bollington.—*10th May*, 1881.
2041. CONTROLLING ELECTRIC CURRENTS, L. M. de B. y O'Lawlor.—*10th May*, 1881.
2048. JOINTS, M. Benson, Chancery-lane, London.—*10th May*, 1881.
2054. BRAKES, H. H. Duke, Westbury, Wilts.—*11th May*, 1881.
2068. STEAM-ENGINE, J. H. McFerran and W. Rennie, Newry.—*12th May*, 1881.
2083. MOTIVE POWER ENGINES, J. Robson, Birmingham.—*12th May*, 1881.
2195. FIGURED CLOTH, J. Warburton, Bolton.—*19th May*, 1881.
2204. LATHES, H. J. Haddan, Strand London.—*20th May*, 1881.
2219. MAKING STEEL, J. Imray, London.—*20th May*, 1881.
2239. SHAVING SKINS, E. P. Alexander, London.—*23rd May*, 1881.
2247. CARPETS, &c., A. Webb, Worcester.—*23rd May*, 1881.
2388. EVAPORATING, W. R. Lake, London.—*31st May*, 1881.
2423. PRODUCING AMMONIA, W. L. Wise, London.—*1st June*, 1881.
2759. DOOR-LATCHES, S. L. Coales, Newport Pagnell.—*24th June*, 1881.
3048. COMBING MACHINES, C. A. Barlow, Manchester—*12th July*, 1881.
3318. FURNACES, W. H. Poole, Bolton.—*30th July*, 1881.
3425. CLOCKS, H. J. Haddan, Kensington.—*8th August*, 1881.
3801. MULES, J. Chisholm and J. Clegg, Oldham.—*1st September*, 1881.
3805. VELOCIPEDES, J. Humpage, London.—*1st September*, 1881.
3885. FIRE-EXTINGUISHING, W. R. Lake, London.—*7th September*, 1881.

List of Specifications published during the week ending November 5th, 1881.

533, 6d.; 1265, 2d.; 1327, 6d.; 1364, 10d.; 1399, 6d.; 1406, 6d.; 1407, 6d.; 1416, 6d.; 1423, 6d.; 1425, 10d.; 1432, 6d.; 1435, 10d.; 1447, 6d.; 1449, 6d.; 1456, 6d.; 1462, 10d.; 1463, 2d.; 1465, 6d.; 1466, 2d.; 1467, 2d.; 1468, 2d.; 1470, 4d.; 1471, 6d.; 1473, 6d.; 1474, 2d.; 1475, 4d.; 1479, 6d.; 1481, 6d.; 1482, 6d.; 1484, 2d.; 1485, 2d.; 1486, 6d.; 1487, 4d.; 1488, 6d.; 1490, 4d.; 1491, 2d.; 1493, 2d.; 1494, 6d.; 1495, 2d.; 1498, 6d.; 1499, 6d.; 1500, 6d.; 1501, 2d.; 1503, 6d.; 1505, 2d.; 1507, 2d.; 1508, 2d.; 1509, 6d.; 1510, 6d.; 1511, 6d.; 1516, 2d.; 1517, 6d.; 1518, 2d.; 1520, 2d.; 1523, 2d.; 1524, 4d.; 1526, 6d.; 1527, 6d.; 1528, 2d.; 1529, 4d.; 1531, 6d.; 1532, 2d.; 1533, 4d.; 1536, 6d.; 1538, 4d.; 1540, 8d., 1541, 2d.; 1542, 2d.; 1545, 2d.; 1546, 4d.; 1548, 1s.; 1549, 6d.; 1551, 6d.; 1552, 6d.; 1553, 2d.; 1554, 6d.; 1556, 2d.; 1557, 2d.; 1558, 2d.; 1561, 2d.; 1562, 4d.; 1574, 2d.; 1606, 6d.; 1265, 6d.; 1712, 6d.; 2670, 4d.; 3326, 4d.; 3342, 4d.; 3388, 8d.; 3396, 6d.

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

ABSTRACTS OF SPECIFICATIONS.

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

533. BICYCLES, &c., *W. Mickelwright and A. G. Gladwyn.*—*8th February*, 1881. *6d.*

This relates to the diminution of the jar caused by the trailing wheel, and consists in connecting this wheel to the forked end of the backbone, so that its bearing can move vertically in guides, a spring being interposed between the bearing and the fork.

1265. APPARATUS FOR UNCOUPLING, DETACHING, RELEASING, SLIPPING, &c., *C. F. C. Morris and F H. Bennett.*—*22nd March*, 1881.—(*Void.*) 2*d.*

This relates to improvements on patent No. 1389, A.D. 1879, and more particularly to the "slip," and it consists in substituting for two separate levers and cross pieces one member or part with an eye formed in the locking part, and taking into a spring locking and unlocking bolt or pin with ring-releasing attachment.

1327. MAGAZINE HEATING STOVE WITH FLUES FOR CIRCULATION OF AIR AND VENTILATION, *T. Morgan.*—*24th March*, 1881.—(*A communication from O. Elterich.*) 6*d.*

The fireplace is arranged so as to enable different kinds of fuel to be burnt. Two grates are used, one having a vibratory motion so as to widen or narrow the spaces between the bars. The fire-pot is made in two parts with inner projecting ribs. The outer shell can expand and contract freely. Flues, channels, and registers are arranged to enable the ventilation to be changed into circulation and *vice versâ.*

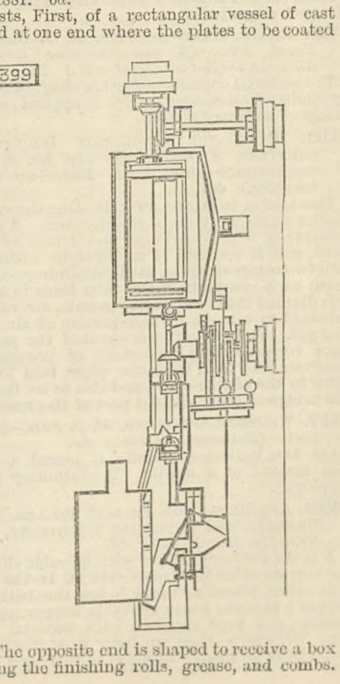
1364. SHIPS OR VESSELS, &c., *J. H. Johnson.*—*28th March*, 1881.—(*A communication from Baron C. A. H. C. de Winter.*) 10*d.*

This relates to an improved system of shipbuilding, by means of which vessels for carrying wood may be constructed with rapidity and economy, and it consists in forming such vessel from hard wood and soft compressed wood interposed, such materials being afterwards available for building or other purposes. An iron framework binds the whole together, and no caulking is necessary. The vessel is built up round the cargo.

1399. MACHINERY FOR COATING OR COVERING METALLIC PLATES WITH TIN, &c., *I. Matthews.*—*30th March*, 1881. 6*d.*

This consists, First, of a rectangular vessel of cast iron enlarged at one end where the plates to be coated

1399



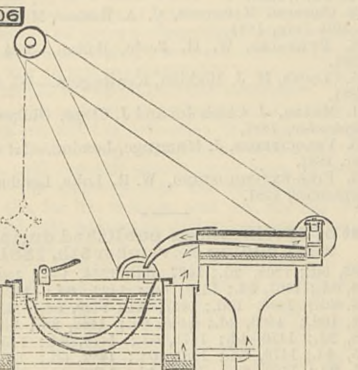
are fed in. The opposite end is shaped to receive a box for containing the finishing rolls, grease, and combs.

The vessel or tin pot is furnished with a movable platform suspended by rods from brackets, by which the platform can be adjusted to the required depth to suit the size of the plates operated on. There are fixed to the platform guides for guiding the plates from the end of the machine where the plates are fed in to the opposite or finishing end; there are also a corresponding pair of guides placed above the platform; Secondly, two pairs of reciprocating plates furnished with teeth on their inner edges, and so fixed that when one plate of each pair is advancing the corresponding plate are receding, the receding pair withdrawing their projecting teeth within the edge of the advancing pair; Thirdly, a series of pairs of rollers formed on the end of vertical spindles. The machinery for giving the requisite motion to the rollers and other parts is fixed on a cast iron bed-plate lying parallel to the tin pot.

1406. Means or Apparatus for Coating Sheets or Plates of Metal, *J. Lysaght.—30th March*, 1881. 6*d*.

A pair of rolls are employed to continuously feed forward the sheets which are to be coated over the top of a plate or frame which is heated by a furnace below it. The sheets are by the rolls caused to move forward between guides which conduct them over the heated plate or frame to a second pair of rolls situated above the top of one end of a vessel containing the melted coating metal. The second pair of rolls pass the

1406

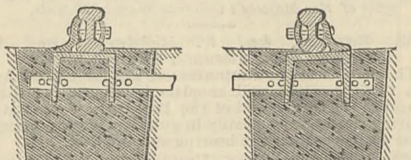


sheets between a second pair of guides. These guides are within the vessel containing the coating metal, and conduct the sheets through the coating metal from one end of the vessel to the other, and deliver them upwards and out of the metal at the other end of the vessel. The foremost ends of the sheets as they issue from the metal are, by means of tongs, attached to a rope or otherwise, connected to a pulley on a driving shaft which is above the vessel containing the coating metal, and are by the action of this pulley drawn up vertically out of the vessel at the same speed that the rollers feed it forward into the vessel.

1407. Permanent Way of Railways, *C. Bergerson.—30th March*, 1881. 6*d*.

The ballast is buried in two parallel trenches at 1½ft. in width formed below the two rails of an ordinary line of railway. These trenches are filled with sand. The sleepers are formed of inverted troughs, placed

1407



longitudinally under each of the rails. They are tied together in pairs by a transverse tie bar. Each sleeper is formed with three jaws standing up from it along its outer side, with a hole through each for a screw bolt to pass through. Holes are formed through the rails at distances apart corresponding to the holes in the jaws of the sleepers. The rail joints are each arranged to come over the centre of a sleeper, and the bolt of the central jaw of this sleeper passes through a somewhat oval hole formed half in the end of one rail and half in the end of the other.

1412. Carbons for Incandescent Electric Lamps, *J. Scott and W. H. Akester.—31st March*, 1881. 2*d*.

The inventors employ the fibre used by brush makers called kitool, and also coir or bass, surrounding it with sand or charcoal during carbonisation, which is separated afterwards.

1413. Sewage Works for Draining, *W. H. Denham.—31st March*, 1881. 4*d*.

This relates to the construction of sewage works, the utilising and disposing of sewage, house refuse, and scavenged matters, and the conversion of them into a fertilising natural manure; also the purifying and disposing of effluent.

1414. Lead or other Ductile Metal Pipes for Water Services, *J. S. Rigby and J. Mangnall.—31st March*, 1881. 2*d*.

This relates to the construction and adaptation of piping made of soft, ductile, malleable, or elastic metal or material for use as water services made transversely sectionally of such shapes as employ perimeters, which enclose areas not more than eleven-twelfths of the area of a circle employing a perimeter of equal magnitude.

1415. Manufacture of Hats, *B. J. Haddan.—31st March*, 1881.—*(A communication from Dr. A. Nietsche.)*—*(Not proceeded with.)* 2*d*.

The material consists of feather shag, plush, flannel, or similar fabrics, upon which is applied one or more sheets of ordinary muslin.

1416. Pneumatic Revolution Indicators and Counters, *A. Budenberg.—31st March*, 1881.—*(A communication from C. F. Budenberg and B. A. Schaeffer.)* 6*d*.

This relates to means for indicating the speed of the engine on steam vessels at a distance. A duplex air compressor is provided near and driven by the screw shaft, and it consists of an air-tight casing divided into two compartments, each containing a compressor. From each compartment a tube leads to a reservoir, also divided into two compartments, air valves being provided to allow a certain portion of air to be discharged. Variations in the speed of the engines produce corresponding variations of pressure in the reservoir, and from the latter pipes lead to the indicator in the engine-room, and also to an indicator on the bridge or other distant part of the vessel.

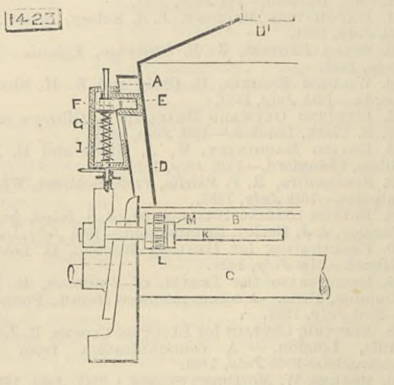
1417. Weighing Apparatus, *M. D. Pass.—31st March*, 1881.—*(Not proceeded with.)* 2*d*.

On the indicator spindle is placed a graduated dial instead of a needle. A stationary pointer is employed.

1423. Apparatus for Feeding Roller Mills and Dressing and Purifying Machinery, *J. H. Carter.—31st March*, 1881. 6*d*.

A is the ordinary hopper with movable slide B along the bottom of its discharge side; C is the revolving feed roller placed as usual below the bottom of the hopper; D is the inner movable hopper, open at the bottom, and kept supplied with material through a pipe D¹ which rises up from it at the top. The material is preferably supplied to this pipe through a flexible canvas tube. The material is discharged from the bottom of the hopper A by the feed roller C as it revolves, and is conducted to the rolls of the roller mills in the ordinary manner; E are projections standing out from the ends of the hopper D; these projections pass through slots in the ends of the fixed hopper A. The projections E rest upon nuts F screwed on to rods G. The rods pass through holes in the top and bottom of small casings, and surrounding the rods are spiral springs I; the nuts F rest upon the top

1423



of these springs, and thereby the springs serve to support the inner hopper; K is a spindle mounted in bearings upon the back of the slide B; L L are pinions fast upon the spindle K, one near each of its ends. The pinions L L gear into racks M fixed to the hopper A. At each end of the spindle K is an arm, the extremity of which rests against the lower end of the rod G, the weight of the slide B, which can rise and fall in guides, being sufficient to keep the arm against the end of the rod.

1425. Manufacture of Screws, &c., *J. Mackintire.—31st March*, 1881. 10*d*.

This relates to casting screws and other articles in a complete form, and as applied to the production of nuts for bolts it consists in forming a number of metal patterns with a print, and fitting them with the print upwards on a pattern plate furnished with pins, each to receive a pattern. The pattern plate has also lines of projections to produce "gates" in the sand mould, and it is then surrounded by a hinged flask, filled in with sand, and submitted to pressure. The pattern plate is then removed, leaving the patterns behind, which are then removed in the usual manner and screwed cores placed in each nut cavity. The patterns, before being placed in the mould, are cleaned and oiled and coated with a fine slip paste made from loam and kaolin, and china-clay and gelatine, glycerine and water.

1432. Deodorising Water-closets, &c., *W. Morgans.—1st April*, 1881. 6*d*.

This relates to the removal of the obnoxious gases from water-closets, commodes, &c., and as applied to a water-closet it consists in forming at the upper part of the pan a hollow ring perforated with small holes communicating with the pan, and connected to an ascending pipe, in which a gas-burner or oil lamp is placed, and causes an upward draught, so as to draw off the gas.

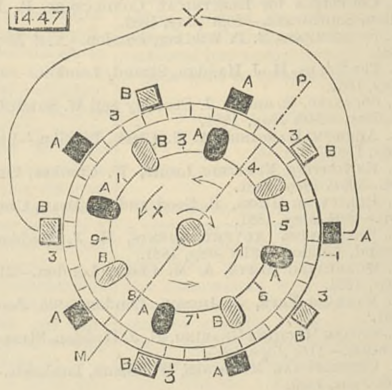
1435. Machinery for Enclosing Materials in a Covering of Cylindrical or Prismatic Form, &c., *W. A. G. Schonheyder.—1st April*, 1881. 10*d*.

The wrapping material, such as tape, webbing, paper, rubber, or other substance is coiled on a drum, from which it passes between guides, and below it, also between the guides, is a travelling chain with its upper surface grooved to the form of the covered article. The wrapping material is pressed into the groove and the substance inserted, and acted upon by a presser. The sides of the wrapper are then bent upwards into a U form, and one edge is bent down, the other first receiving a layer of paste and then being pressed down on the first side.

1447. Improvements in Dynamo-electric or Magneto-electric and Electro-dynamic Machines, *C. W. Siemens.—1st April*, 1881.—*(A communication from Siemens and Halske.)* 6*d*.

This invention refers to a machine in which separate electrical impulses are generated immediately after one another at different parts, and combined together in one continuous current. The diagram illustrates the action of the machine. The outer squares A B represent ten stationary fields of alternating polarity, and the inner ellipses A B represent the eight coils that revolve through them. The divided circle between these represents the commutator, having its forty plates arranged in five groups, each containing eight plates. The numbers between the ellipses indicate the wires that lead from the connecting wire of each pair of adjoining coils to the rings, and thence to the commutator plates. Thus, wire 1 is connected

1447



through its ring with all the five commutator plates marked 3, wire 2 with all five plates marked 8, and so on. Arrows + and − indicate the commutator brushes. All coils which are approaching fields marked with the same letters A to A, and B to B, have currents set up in them in one direction, indicated by arrows X, and all coils approaching fields marked by different letters A to B, or B to A, have currents set up in the opposite direction. There will always therefore be a diametrically dividing line, such as P M, towards one end of which there is an accumulation of positive and towards the other of negative electricity. This line always moves round in a direction opposite to that of the commutator, and with greater velocity.

1449. Firegrates, Stoves, &c., *A. MacPhail.—2nd April*, 1881. 6*d*.

This consists in means for preventing down draught in chimneys, and consists in substituting for the grate and box a corrugated bottom and backing of fire-clay, the corrugations being curved forwards and downwards towards a bottom ledge or plain surface placed within a short distance of the hearth. Behind and above the fire-box is a brick or metal partition, through which are holes communicating with a space behind, the lower end of which opens into a flue completely closed immediately over the fire, so that the smoke does not escape directly to the chimney. In front of the fire-box are fixed bars, which are arranged vertically and curved over towards the fire. Below the bottom of the bars is a screen with holes to admit air to the corrugated fire-box.

1456. Automatic Fire Extinguisher, *W. H. Beck.—2nd April*, 1881.—*(A communication from L. C. Blon and J. Kratzenstein.)* 6*d*.

The piercer stem is provided with an elastic joint, and is connected to a movable back-plate, by means of which the bottle containing the acid is broken open.

1462. Manufacturing and Arranging Types for Printing Purposes, *F. Wicks.—4th April*, 1881. 10*d*.

A wheel or disc has in it a series of moulds corresponding to the number of kinds of type to be made, the moulds radiating from the centre of the wheel. The matrices by which the types are formed are encased within the moulds so that they can slide therein. The periphery of the wheel being caused to revolve presents the orifices of the moulds in rapid succession before a reservoir of molten metal, so that each one as it passes is filled up, a vacuum being formed in each mould by suitable means. The matrices move outwards so as to eject the types, which are passed forwards by a wheel or band, so that those of the same kind are brought into line, or one upon or behind the other.

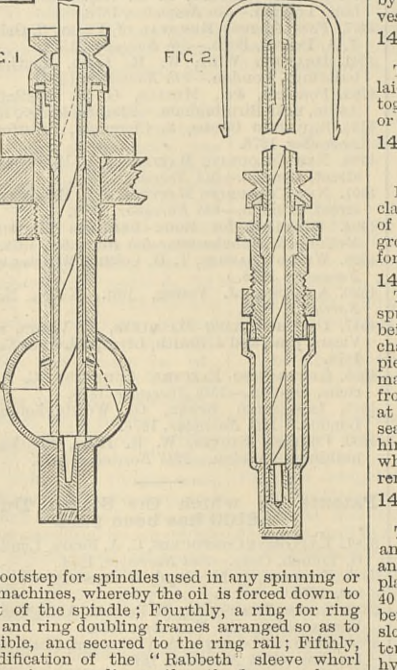
1463. Raising Sunken Vessels, *R. Hodgson.—4th April*, 1881.—*(Not proceeded with.)* 2*d*.

Air-tight vessels are filled with water and sunk into position near the vessel to be raised, to which they are then attached, and the water being pumped out, their buoyancy is utilised to raise the sunken vessel.

1465. Spinning and Doubling Cotton, &c., *G. Bodden.—4th April*, 1881. 6*d*.

This consists, First, in the combination of parts of a spindle in ring spinning and ring twisting machines, to ensure constant supply and circulation of oil over the bearings, facility for clearing and replenishing the oil reservoir, and for altering the height of the spindles without disturbing the position of the bolster carrier which is fastened to the ring rail; Secondly, in a loose bottom to the main oil cup to be used in some cases for the easier cleaning of same; Thirdly, in an arrange-

1465



ment of footstep for spindles used in any spinning or twisting machines, whereby the oil is forced down to the point of the spindle; Fourthly, a ring for ring spinning and ring doubling frames arranged so as to be reversible, and secured to the ring rail; Fifthly, in a modification of the "Rabbeth" sleeve whorl spindle carrying an ordinary throstle flyer as shown in Fig. 2.

1466. Lighting Fires, &c., *J. Sainty.—4th April*, 1881.—*(Not proceeded with.)* 2*d*.

The flame from a lamp is acted upon by a blast from a blowing apparatus so as to direct it upon the coal to be lighted. The apparatus may also be combined with a cooking vessel having flat sides, on to which the flame can be directed.

1467. Registering the Distance Travelled by Bicycles, &c., *S. C. Straker.—4th April*, 1881.—*(Not proceeded with.)* 2*d*.

The apparatus is fixed near the centre of the wheel with which it revolves, and consists of a weight, which drops twice and moves a ratchet wheel one tooth forward for each revolution, so as to set in motion a train of wheels, one of which carries a pointer moving over a dial.

1468. Flavouring and Colouring Beer, *A. B. Worthington.—4th April*, 1881.—*(Not proceeded with.)* 2*d*.

The preparation to be used in lieu of malt or sugar for flavouring and colouring beer consists of barley, either malted or unmalted, to which a solution of saccharine is added during the roasting process.

1470. Sugar, *A. M. Clark.—4th April*, 1881.—*(A communication from J. B. M. P. Closson.)* 4*d*.

This consists in the method of forming the saccharate of baryta by the employment of chloride of barium in lieu of caustic soda.

1471. Compressing Chaff in Sacks, &c., *G. Gilders.—5th April*, 1881. 6*d*.

The apparatus consists of a vertical cylinder arranged within a frame, so that it can be lowered into the sack, and is of suitable dimensions to contain the goods in a loose condition. A rammer passing through the cylinder and actuated by hydraulic or other power compresses the material into the sack.

1473. Pipes and Syphon Boxes or Traps for Drains, &c., *G. B. Jerram.—5th April*, 1881. 6*d*.

One part relates to jointing lengths of pipes, and consists in forming the sockets and spigots of tapered form, the spigot part being somewhat smaller than the socket, and the space between them being filled in with soft material to make a tight joint. The invention further relates to syphon-boxes or traps to prevent entrance of sewer gas into house drains, and consists in forming such boxes or traps with a depressed portion at or about the middle of the length of the bottom and adapting a loose cross partition to slide in guides formed in the box or trap, the lower end of such partition entering the depression in the bottom, so as to form a liquid lute when the depression contains water, sewage, or other liquid.

1474. Apparatus for Laying Underground Telegraphic, &c., Conductors, *J. C. Mewburn.—5th April*, 1881.—*(Not proceeded with.)*—*(A communication from J. Bourdin and General S. I. de Maltzoff.)* 2*d*.

This invention consists of a carriage carrying a reel on which the conductor is wound, and a kind of ploughshare, which makes a channel for the conductor, the latter running through a hole in the former as it advances, and coming out at the rear in the channel formed. A flattening roller is provided behind the share to replace the soil, and in front is a rotary coulter which prepares the furrow in which the share travels.

1475. Dwarf Window Blinds or Screens, *W. H. Dandy.—5th April*, 1881. 4*d*.

This relates to blinds or screens made of wood, and consists in making them of a number of vertical slats arranged side by side, being first cut to the desired size, and then ornamented by a fret saw or otherwise. The slats are secured to narrow strips of wood, placed along one or both sides of the blind and near the top and bottom.

1479. Wire Healds and Jacquard Harness, *H. B. Barlow.* 5th April, 1881. 6*d*.

This relates to a machine for making wire healds without cutting any wire to waste, which machine runs at a higher speed while twisting the wire than when discharging the heald and taking in fresh wire. A frame supports the shafts and the bridges, in which three loop-forming pinions revolve. The twisting nippers, which hold the wire, consist of pairs of nippers connected to the bridges, and opened and closed by cams on the main shaft. The warp eye and the other loops are formed by a peg fixed on a hollow cam, which slides at one side of and revolves with the pinion. The peg slides across the axis of the pinion in a hole between two teeth, and the warp eye is stretched by forcing the peg further through the hole beneath the twisting pinions. Each of the latter has two teeth longer than the others, and which rest on the periphery of the spur wheel with which it gears, and which has no teeth, so that the pinions remain stationary during the passage of the retracting rod for discharging the heald and taking in a fresh wire.

1481. Raising, Lowering, and Transporting Objects, *F. Behrns and G. Uarnh.—5th April*, 1881. 6*d*.

This consists mainly in the employment of an articulated framework on the principle of the "lazy tongs," one end of which is attached to a fixed point, while the other is free and carries pulleys over which pass travelling bands carrying buckets, the bands being kept stretched by a movable regulation pulley, so that the free end of the "lazy tongs" framing can be moved nearer to or farther from the fixed end, and so cause the bucket to take grain or other material from or deliver it at points varying in distance or position.

1482. Subaqueous Boring, *T. English.—5th April*, 1881. 6*d*.

A rotating boring tube has at its end suitable cutters, and is steadied in a vertical or inclined position by a frame resting on the bed of the river or sea, the tube extending above the surface of the water, its upper end being supported in a bearing and driven by bevel gearing from a shaft on a suitable ship or vessel.

1484. Expanding Fire-screen, *C. Haarburger.—5th April*, 1881.—*(Not proceeded with.)* 2*d*.

The screen consists of a number of strips or bars laid diagonally one over the other and articulated together, so that when expanded they form a trellis or lattice.

1485. Compound for Preventing Escape of Steam, Gas, Water, or Air from Joints of Machinery, &c., *G. Tall and J. Daddy.—5th April*, 1881. 2*d*.

12 lb. of ordinary brickyard clay and 2 lb. of pipe-clay are dried and mixed with 2 lb. of linseed oil, 2 lb. of blacklead, and 2 lb. of whiting, the whole being ground into a fine powder. Water is added so as to form a paste, which is then used to form the joint.

1486. Chairs, *C. H. Chadburn.—5th April*, 1881. 6*d*.

The object is to form a chair with the seat and back spring supported behind, and which is capable of being used as an upright, reclining, and a rocking chair at will. The seat and back are made in one piece separate from the legs or lower frame, which is made with an inclined upper surface with a raised front, below which are the legs, the highest part being at the front and the lower portion at the back. The seat and back are connected to the lower frame by hinges or springs, so that it can be made to rock when desired. By inserting wedges the seat is rendered rigid.

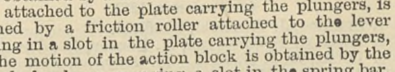
1487. Colouring Matters, *E. G. P. Thomas.—5th April*, 1881. 4*d*.

This relates to the production of a new induline, and consists of 100 lb. diazoamidobenzine, 130 lb. aniline hydrochloride, and 300 parts pure aniline, placed in an enamelled iron still and warmed to from 40 to 50 deg. C, so as to transform the diazoamidobenzine into amidoazobenzine. The temperature is slowly raised to 110 deg. C., and maintained at this temperature for four or five hours, when 65 lb. aniline hydrochloride is added, and the temperature raised to from 160 deg. to 170 deg. C., and maintained for from twenty to twenty-four hours. It is now allowed to cool, and then mixed with fifty gallons methylated spirits, and left to drain and filter. The insoluble portion is mixed with more spirit, and further drained until thoroughly washed, when it appears as glistening crystals of a yellowish bronze colour, which is the hydrochloride of the new induline.

1488. Machine Guns, *T. Nordenfelt.—5th April*, 1881. 6*d*.

This relates to improvements on patent 4991, 1880. Instead of the action block being in one piece, it is divided into two parts, the fore part remaining

1488



stationary whilst the rear part alone has the sideway motion. The motion of the plungers, instead of being obtained by a slotted lever engaging a friction roller attached to the plate carrying the plungers, is obtained by a friction roller attached to the lever working in a slot in the plate carrying the plungers, and the motion of the action block is obtained by the tail end of a lever engaging a slot in the spring bar. The drawing is a longitudinal section of the machine.

1490. Manufacture of Fibrous Material from a Vegetable Production, *W. R. Lake.—5th April*, 1881.—*(A communication from Corral, Tejado, and Corbera.)* 4*d*.

The plant from which the fibres are obtained grows wild in southern countries, being known in Spain as "Vivaz," and it grows beneath the soil without appearing above the surface. These plants have a silky covering, which is the part to be utilised, such part being repeatedly subjected to great and sudden changes of temperature, until it assumes the appearance of very fine cotton.

1491. Machinery for Dyeing Fabrics, *C. T. Smith, S. M. Milne, and J. H. Binns.—5th April*, 1881.—*(Not proceeded with.)* 2*d*.

This relates to machinery for rainbow or shaded dyeing, and consists of a vessel containing the dye liquor, and provided with a series of pairs of wheels, between which the piece is drawn or caused to traverse to and fro, the dye being supplied to the piece by means of the bottom or lower wheels of each series, which dip into the dye liquor. To insure regularity the piece is conducted through the machine as nearly as possible in a straight line, to insure which an endless spiked chain, temples, or other like devices, are used in combination with the wheels, and applied to each selvage of the piece.

1493. Fastenings for Boots and Shoes, *I. A. Wells.—5th April*, 1881.—*(Not proceeded with.)* 2*d*.

This consists in securing metallic blades to the edges of the opening to be closed, and when these blades are brought together they are connected by means of a clip or clips, thus avoiding the use of laces.

1494. Steam and Steam and Air Valves for Railway Brakes, *J. Gresham.—6th April*, 1881. 6*d*.

By one arrangement a spindle is made to slide in a casing in which two cone seatings are formed, which cones are at the opposite end of a cylindrical part. The spindle has two cone valves upon it, each cone with a length of cylinder attached of the size and to fit the cylindrical part between the said two cone seatings. When the spindle is moved in one direction and one cone is against its seating, the steam from the boiler is cut off, and the other cone valve on the

CONVERSION TABLES FOR FRENCH AND ENGLISH MEASURES.—No. II., AREA.

(*Square Metres and Square Feet; Square Centimetres and Square Inches; Hectares and Acres.*)

No.	Sq. M. = Sq. Ft.	Sq. Ft. = Sq. M.	Sq. Cm. = Sq. In.	Sq. In. = Sq. Cm.	Hectare = Acres.	Acres = Hectare
100	1076·	9·3	15·5	645·1	247·1	40·5
1	1087·	9·4	15·7	651·6	249·6	40·9
2	1098·	9·5	15·8	658·0	252·1	41·3
3	1109·	9·6	16·0	664·5	254·5	41·7
4	1119·	9·7	16·1	670·9	257·0	42·1
5	1130·	9·8	16·3	677·4	259·5	42·5
6	1141·	9·8	16·4	683·8	261·9	42·9
7	1152·	9·9	16·6	690·3	264·4	43·3
8	1163·	10·0	16·7	696·7	266·9	43·7
9	1173·	10·1	16·9	703·2	269·3	44·1
110	1184·	10·2	17·1	709·6	271·8	44·5
1	1195·	10·3	17·2	716·1	274·3	44·9
2	1206·	10·4	17·4	722·6	276·8	45·3
3	1216·	10·5	17·5	729·0	279·2	45·7
4	1227·	10·6	17·7	735·5	281·7	46·1
5	1238·	10·7	17·8	741·9	284·2	46·5
6	1249·	10·8	18·0	748·4	286·6	46·9
7	1259·	10·9	18·1	754·8	289·1	47·3
8	1270·	11·0	18·3	761·3	291·6	47·8
9	1281·	11·0	18·4	767·7	294·1	48·2
120	1292·	11·1	18·6	774·2	296·5	48·6
1	1302·	11·2	18·8	780·6	299·0	49·0
2	1313·	11·3	18·9	787·1	301·5	49·4
3	1324·	11·4	19·1	793·5	303·9	49·8
4	1335·	11·5	19·2	800·0	306·4	50·2
5	1346·	11·6	19·4	806·4	308·9	50·6
6	1356·	11·7	19·5	812·9	311·4	51·0
7	1367·	11·8	19·7	819·3	313·8	51·4
8	1378·	11·9	19·8	825·8	316·3	51·8
9	1389·	12·0	20·0	832·2	318·8	52·2
130	1399·	12·1	20·2	838·7	321·2	52·6
1	1410·	12·2	20·3	845·1	323·7	53·0
2	1421·	12·3	20·5	851·6	326·2	53·4
3	1432·	12·4	20·6	858·0	328·7	53·8
4	1442·	12·4	20·8	864·5	331·1	54·2
5	1453·	12·5	20·9	870·9	333·6	54·6
6	1464·	12·6	21·1	877·4	336·1	55·0
7	1475·	12·7	21·2	883·8	338·5	55·4
8	1485·	12·8	21·4	890·3	341·0	55·8
9	1496·	12·9	21·5	896·7	343·5	56·2
140	1507·	13·0	21·7	903·2	345·9	56·7
1	1518·	13·1	21·9	909·6	348·4	57·1
2	1529·	13·2	22·0	916·1	350·9	57·5
3	1539·	13·3	22·2	922·5	353·4	57·9
4	1550·	13·4	22·3	929·0	355·8	58·3
5	1561·	13·5	22·5	935·4	358·3	58·7
6	1572·	13·6	22·6	941·9	360·8	59·1
7	1582·	13·7	22·8	948·3	363·2	59·5
8	1593·	13·7	22·9	954·8	365·7	59·9
9	1604·	13·8	23·1	961·2	368·2	60·3
150	1615·	13·9	23·3	967·7	370·7	60·7
1	1625·	14·0	23·4	974·2	373·1	61·1
2	1636·	14·1	23·6	980·6	375·6	61·5
3	1647·	14·2	23·7	987·1	378·1	61·9
4	1658·	14·3	23·9	993·5	380·5	62·3
5	1668·	14·4	24·0	1000·	383·0	62·7
6	1679·	14·5	24·2	1006·	385·5	63·1
7	1690·	14·6	24·3	1013·	388·0	63·5
8	1701·	14·7	24·5	1019·	390·4	63·9
9	1712·	14·8	24·6	1026·	392·9	64·3
160	1722·	14·9	24·8	1032·	395·4	64·8
1	1733·	15·0	25·0	1039·	397·9	65·2
2	1744·	15·0	25·1	1045·	400·3	65·6
3	1755·	15·1	25·3	1052·	402·8	66·0
4	1765·	15·2	25·4	1058·	405·3	66·4
5	1776·	15·3	25·6	1064·	407·7	66·8
6	1787·	15·4	25·7	1071·	410·2	67·2
7	1798·	15·5	25·9	1077·	412·7	67·6
8	1808·	15·6	26·0	1084·	415·1	68·0
9	1819·	15·7	26·2	1090·	417·6	68·4
170	1830·	15·8	26·4	1097·	420·1	68·8
1	1841·	15·9	26·5	1103·	422·6	69·2
2	1851·	16·0	26·7	1110·	425·0	69·6
3	1862·	16·1	26·8	1116·	427·5	70·0
4	1873·	16·2	27·0	1123·	430·0	70·4
5	1884·	16·3	27·1	1129·	432·4	70·8
6	1895·	16·3	27·3	1135·	434·9	71·2
7	1905·	16·4	27·4	1142·	437·4	71·6
8	1916·	16·5	27·6	1148·	439·9	72·0
9	1927·	16·6	27·7	1155·	442·3	72·4
180	1938·	16·7	27·9	1161·	444·8	72·8
1	1948·	16·8	28·1	1168·	447·3	73·2
2	1959·	16·9	28·2	1174·	449·7	73·7
3	1970·	17·0	28·4	1181·	452·2	74·1
4	1981·	17·1	28·5	1187·	454·7	74·5
5	1991·	17·2	28·7	1193·	457·2	74·9
6	2002·	17·3	28·8	1200·	459·6	75·3
7	2013·	17·4	28·9	1206·	462·1	75·7
8	2024·	17·5	29·1	1213·	464·6	76·1
9	2034·	17·6	29·3	1219·	467·0	76·5
190	2045·	17·6	29·5	1226·	469·5	76·9
1	2056·	17·7	29·6	1232·	472·0	77·3
2	2067·	17·8	29·8	1239·	474·5	77·7
3	2078·	17·9	29·9	1245·	476·9	78·1
4	2088·	18·0	30·1	1252·	479·4	78·5
5	2099·	18·1	30·2	1258·	481·9	78·9
6	2110·	18·2	30·4	1264·	484·3	79·3
7	2121·	18·3	30·5	1271·	486·8	79·7
8	2131·	18·4	30·7	1277·	489·3	80·1
9	2142·	18·5	30·8	1284·	491·7	80·5
200	2153·	18·6	31·0	1290·	494·2	80·9
1	2164·	18·7	31·2	1297·	496·7	81·4
2	2174·	18·8	31·3	1303·	499·2	81·7
3	2185·	18·9	31·5	1310·	501·6	82·2
4	2196·	19·0	31·6	1316·	504·1	82·6
5	2207·	19·0	31·8	1323·	506·6	83·0
6	2217·	19·1	31·9	1329·	509·0	83·4
7	2228·	19·2	32·1	1335·	511·5	83·8
8	2239·	19·3	32·2	1342·	514·0	84·2
9	2250·	19·4	32·4	1348·	516·5	84·6
210	2261·	19·5	32·6	1355·	518·9	85·0
1	2271·	19·6	32·7	1361·	521·4	85·4
2	2282·	19·7	32·9	1368·	523·9	85·8

No.	Sq. M. = Sq. Ft.	Sq. Ft. = Sq. M.	Sq. Cm. = Sq. In.	Sq. In. = Sq. Cm.	Hectare = Acres.	Acres = Hectare
3	2293·	19·8	33·0	1374·	526·3	86·2
4	2304·	19·9	33·2	1381·	528·8	86·6
5	2314·	20·0	33·3	1387·	531·3	87·0
6	2325·	20·1	33·5	1393·	533·8	87·4
7	2336·	20·2	33·6	1400·	536·2	87·8
8	2347·	20·3	33·8	1406·	538·7	88·2
9	2357·	20·3	33·9	1413·	541·2	88·6
220	2368·	20·4	34·1	1419·	543·6	89·0
1	2379·	20·5	34·3	1426·	546·1	89·4
2	2390·	20·6	34·4	1432·	548·6	89·8
3	2400·	20·7	34·6	1439·	551·1	90·2
4	2411·	20·8	34·7	1445·	553·5	90·6
5	2422·	20·9	34·9	1452·	556·0	91·0
6	2433·	21·0	35·0	1458·	558·5	91·4
7	2443·	21·1	35·2	1464·	560·9	91·9
8	2454·	21·2	35·3	1471·	563·4	92·3
9	2465·	21·3	35·5	1477·	565·9	92·7
230	2476·	21·4	35·7	1484·	568·4	93·1
1	2487·	21·5	35·8	1490·	570·8	93·5
2	2497·	21·6	36·0	1497·	573·3	93·9
3	2508·	21·6	36·1	1503·	575·8	94·3
4	2519·	21·7	36·3	1510·	578·2	94·7
5	2530·	21·8	36·4	1516·	580·7	95·1
6	2540·	21·9	36·6	1523·	583·2	95·5
7	2551·	22·0	36·7	1529·	585·6	95·9
8	2562·	22·1	36·9	1535·	588·1	96·3
9	2573·	22·2	37·0	1542·	590·6	96·7
240	2583·	22·3	37·2	1548·	593·1	97·1
1	2594·	22·4	37·4	1555·	595·5	97·5
2	2605·	22·5	37·5	1561·	598·0	97·9
3	2616·	22·6	37·7	1568·	600·5	98·3
4	2626·	22·7	37·8	1574·	602·9	98·7
5	2637·	22·8	38·0	1581·	605·4	99·1
6	2648·	22·9	38·1	1587·	607·9	99·5
7	2659·	23·0	38·4	1593·	610·4	100·0
8	2670·	23·0	38·5	1600·	612·8	100·4
9	2680·	23·1	38·7	1606·	615·3	100·8
250	2691·	23·2	38·8	1613·	617·8	101·2
1	2702·	23·3	38·9	1619·	620·2	101·6
2	2713·	23·4	39·1	1626·	622·7	102·0
3	2723·	23·5	39·2	1632·	625·2	102·4
4	2734·	23·6	39·4	1639·	627·7	102·8
5	2745·	23·7	39·5	1645·	630·1	103·2
6	2756·	23·8	39·7	1652·	632·6	103·6
7	2766·	23·9	39·8	1658·	635·1	104·0
8	2777·	24·0	40·0	1664·	637·5	104·4
9	2788·	24·1	40·1	1671·	640·0	104·8
260	2799·	24·1	40·3	1677·	642·5	105·2
1	2809·	24·2	40·5	1684·	645·0	105·6
2	2820·	24·3	40·6	1690·	647·4	106·0
3	2831·	24·4	40·8	1697·	649·9	106·4
4	2842·	24·5	40·9	1703·	652·4	106·8
5	2853·	24·6	41·1	1710·	654·8	107·2
6	2863·	24·7	41·2	1716·	657·3	107·7
7	2874·	24·8	41·4	1723·	659·8	108·1
8	2885·	24·9	41·5	1729·	662·3	108·5
9	2896·	25·0	41·7	1735·	664·7	108·9
270	2906·	25·1	41·9	1742·	667·2	109·3
1	2917·	25·2	42·0	1748·	669·7	109·7
2	2928·	25·3	42·2	1755·	672·1	110·1
3	2939·	25·4	42·3	1761·	674·6	110·5
4	2949·	25·4	42·5	1768·	677·1	110·9
5	2960·	25·5	42·6	1774·	679·6	111·3
6	2971·	25·6	42·8	1781·	682·0	111·7
7	2982·	25·7	42·9	1787·	684·5	112·1
8	2992·	25·8	43·1	1793·	687·0	112·5
9	3003·	25·9	43·2	1800·	689·4	112·9
280	3014·	26·0	43·4	1806·	691·9	113·3
1	3025·	26·1	43·6	1813·	694·4	113·7
2	3036·	26·2	43·7	1819·	696·8	114·1
3	3046·	26·3	43·9	1826·	699·3	114·5
4	3057·	26·4	44·0	1832·	701·8	114·9
5	3068·	26·5	44·2	1839·	704·3	115·3
6	3079·	26·6	44·3	1845·	706·7	115·7
7	3089·	26·7	44·5	1852·	709·2	116·1
8	3100·	26·8	44·6	1858·	711·7	116·5
9	3111·	26·8	44·8	1864·	714·1	117·0
290	3122·	26·9	45·0	1871·	716·6	117·4
1	3132·	27·0	45·1	1877·	719·1	117·8
2	3143·	27·1	45·3	1884·	721·6	118·2
3	3154·	27·2	45·4	1890·	724·0	118·6
4	3165·	27·3	45·6	1897·	726·5	119·0
5	3175·	27·4	45·7	1903·	729·0	119·4
6	3186·	27·5	45·9	1910·	731·4	119·8
7	3197·	27·6	46·0	1916·	733·9	120·2
8	3208·	27·7	46·2	1922·	736·4	120·6
9	3219·	27·8	46·3	1929·	738·9	121·0
300	3229·	27·9	46·5	1935·	741·3	121·4
1	3240·	28·0	46·7	1942·	743·8	121·8
2	3251·	28·1	46·8	1948·	746·3	122·2
3	3262·	28·1	47·0	1955·	748·7	122·6
4	3272·	28·2	47·1	1961·	751·2	123·0
5	3283·	28.3	47·3	1968·	753·7	123·4
6	3294·	28·4	47·4	1974·	756·2	123·8
7	3305·	28·5	47·6	1981·	758·6	124·2
8	3315·	28·6	47·7	1987·	761·1	124·6
9	3326·	28·7	47·9	1993·	763·6	125·0
310	3337·	28·8	48·1	2000·	766·0	125·4
1	3348·	28·9	48·2	2006·	768·5	125·9
2	3358·	29·0	48·4	2013·	771·0	126·3
3	3369·	29·1	48·5	2019·	773·5	126·7
4	3380·	29·2	48·7	2026·	775·9	127·1
5	3391·	29·3	48·8	2032·	778·4	127·5
6	3402·	29·4	48·9	2039·	780·9	127·9
7	3412·	29·4	49·1	2045·	783·2	128·3
8	3423·	29·5	49·3	2052·	785·8	128·7
9	3434·	29·6	49·4	2058·	788·3	129·0
320	3445·	29·7	49·6	2064·	790·7	129·5
1	3455·	29·8	49·8	2071·	793·2	129·9
2	3466·	29·9	49·9	2077·	795·7	130·3
3	3477·	30·0	50·1	2084·	798·2	130·7
4	3488·	30·1	50·2	2090·	800·6	131·1
5	3498·	30·2	50·4	2097·	803·1	131·5

No.	Sq. M. = Sq. Ft.	Sq. Ft. = Sq. M.	Sq. Cm. = Sq. In.	Sq. In. = Sq. Cm.	Hectare = Acres.	Acres = Hectare
6	3509·	30·3	50·5	2103·	805·6	131·9
7	3520·	30·4	50·7	2110·	808·0	132·3
8	3531·	30·5	50·8	2116·	810·5	132·7
9	3541·	30·6	51·0	2122·	813·0	133·1
330	3552·	30·7	51·2	2129·	815·5	133·5
1	3563·	30·7	51·3	2135·	817·9	134·0
2	3574·	30·8	51·5	2142·	820·4	134·4
3	3585·	30·9	51·6	2148·	822·9	134·8
4	3595·	31·0	51·8	2155·	825·3	135·2
5	3606·	31·1	51·9	2161·	827·8	135·6
6	3617·	31·2	52·1	2168·	830·3	136·0
7	3628·	31·3	52·2	2174·	832·8	136·4
8	3638·	31·4	52·4	2181·	835·2	136·8
9	3649·	31·5	52·5	2187·	837·7	137·2
340	3660·	31·6	52·7	2193·	840·2	137·6
1	3671·	31·7	52·9	2200·	842·6	138·0
2	3681·	31·8	53·0	2206·	845·1	138·4
3	3692·	31·9	53·2	2213·	847·6	138·8
4	3703·	32·0	53·3	2219·	850·1	139·2
5	3714·	32·1	53·5	2226·	852·5	139·6
6	3724·	32·1	53·6	2232·	855·0	140·0
7	3735·	32·2	53·8	2239·	857·5	140·4
8	3746·	32·3	53·9	2245·	859·9	140·8
9	3757·	32·4	54·1	2252·	862·4	141·2
350	3768·	32·5	54·3	2258·	864·9	141·6
1	3778·	32·6	54·4	2264·	867·4	142·0
2	3789·	32·7	54·6	2271·	869·8	142·4
3	3800·	32·8	54·7	2277·	872·3	142·8
4	3811·	32·9	54·9	2284·	874·8	143·3
5	3821·	33·0	55·0	2290·	877·2	143·7
6	3832·	33·1	55·2	2297·	879·7	144·1
7	3843·	33·2	55·3	2303·	882·2	144·5
8	3854·	33·3	55·5	2310·	884·6	144·9
9	3864·	33·4	55·6	2316·	887·1	145·3
360	3875·	33·4	55·8	2322·	889·6	145·7
1	3886·	33·5	56·0	2329·	892·1	146·1
2	3897·	33·6	56·1	2335·	894·5	146·5
3	3907·	33·7	56·3	2342·	897·0	146·9
4	3918·	33·8	56·4	2348·	899·5	147·3
5	3929·	33·9	56·6	2355·	902·0	147·7
6	3940·	34·0	56·7	2361·	904·4	148·1
7	3950·	34·1	56·9	2368·	906·9	148·5
8	3961·	34·2	57·0	2374·	909·4	148·9
9	3972·	34·3	57·2	2381·	911·8	149·3
370	3983·	34·4	57·4	2387·	914·3	149·7
1	3994·	34·5	57·5	2393·	916·8	150·1
2	4004·	34·6	57·7	2400·	919·3	150·5
3	4015·	34·6	57·8	2406·	921·7	151·0
4	4026·	34·7	58·0	2413·	924·2	151·4
5	4037·	34·8	58·1	2419·	926·7	151·8
6	4047·	34·9	58·3	2426·	929·1	152·2
7	4058·	35·0	58·4	2432·	931·6	152·6
8	4069·	35·1	58·6	2439·	934·1	153·0
9	4080·	35·2	58·7	2445·	936·5	153·4
380	4090·	35·3	58·9	2452·	939·0	153·8
1	4101·	35·4	59·1	2458·	941·5	154·2
2	4112·	35·5	59·2	2464·	944·0	154·6
3	4123·	35·6	59·4	2471·	946·4	155·0
4	4133·	35·7	59·5	2477·	948·9	155·4
5	4144·	35·8	59·7	2484·	951·4	155·8
6	4155·	35·9	59·8	2490·	953·8	156·2
7	4166·	36·0	60·0	2497·	956·3	156·6
8	4177·	36·0	60·1	2503·	958·8	157·0
9	4187·	36·1	60·3	2510·	961·3	157·4
390	4198·	36·2	60·5	2516·	963·7	157·8
1	4209·	36·3	60·6	2522·	966·2	158·2
2	4220·	36·4	60·8	2529·	968·7	158·6
3	4230·	36·5	60·9	2535·	971·1	159·0
4	4241·	36·6	61·1	2542·	973·6	159·4
5	4252·	36·7	61·2	2548·	976·1	159·8
6	4263·	36·8	61·4	2555·	978·6	160·3
7	4273·	36·9	61·5	2561·	981·0	160·7
8	4284·	37·0	61·7	2568·	983·5	161·1
9	4295·	37·1	61·8	2574·	986·0	161·5
400	4306·	37·2	62·0	2581·	988·4	161·9
1	4316·	37·3	62·2	2587·	990·9	162·3
2	4327·	37·3	62·3	2593·	993·4	162·7
3	4338·	37·4	62·5	2600·	995·9	163·1
4	4349·	37·5	62·6	2606·	998·3	163·5
5	4360·	37·6	62·8	2613·	1001·	163·9
6	4370·	37·7	62·9	2619·	1003·	164·3
7	4381·	37·8	63·1	2626·	1006·	164·7
8	4392·	37·9	63·2	2632·	1008·	165·1
9	4403·	38·0	63·4	2639·	1011·	165·5
410	4413·	38·1	63·6	2645·	1013·	165·9
1	4424·	38·2	63·7	2652·	1016·	166·3
2	4435·	38·3	63·9	2658·	1018·	166·7
3	4446·	38·4	64·0	2664·	1021·	167·1
4	4456·	38·5	64·2	2671·	1023·	167·5
5	4467·	38·6	64·3	2677·	1026·	167·9
6	4478·	38·6	64·5	2684·	1028·	168·3
7	4489·	38·7	64·6	2690·	1030·	168·7
8	4499·	38·8	64·8	2697·	1033·	169·2
9	4510·	38·9	64·9	2703·	1035·	169·6
420	4521·	39·0	65·1	2710·	1038·	170·0
1	4532·	39·1	65·3	2716·	1040·	170·4
2	4543·	39·2	65·4	2722·	1043·	170·8
3	4553·	39·3	65·6	2729·	1045·	171·2
4	4564·	39·4	65·7	2735·	1048·	171·6
5	4575·	39·5	65·9	2742·	1050·	172·0
6	4586·	39·6	66·0	2748·	1053·	172·4
7	4596·	39·7	66·2	2755·	1055·	172·8
8	4607·	39·8	66·3	2761·	1058·	173·2
9	4618·	39·9	66·5	2768·	1060·	173·6
430	4629·	39·9	66·7	2774·	1063·	174·0
1	4639·	40·0	66·8	2781·	1065·	174·4
2	4650·	40·1	67·0	2787·	1068·	174·8
3	4661·	40·2	67·1	2793·	1070·	175·2
4	4672·	40·3	67·3	2800·	1072·	175·6
5	4682·	40·4	67·4	2806·	1075·	176·0
6	4693·	40·5	67·6	2813·	1077·	176·4
7	4704·	40·6	67·7	2819·	1080·	176·8
8	4715·	40·7	67·9	2826·	1082·	177·3

No.	Sq. M. = Sq. Ft.	Sq. Ft. = Sq. M.	Sq. Cm. = Sq. In.	Sq. In. = Sq. Cm.	Hectare = Acres.	Acres = Hectare
9	4726·	40·8	68·0	2832·	1085·	177·7
440	4736·	40·9	68·2	2839·	1087·	178·1
1	4747·	41·0	68·4	2845·	1090·	178·5
2	4758·	41·1	68·5	2852·	1092·	178·9
3	4769·	41·2	68·7	2858·	1095·	179·3
4	4779·	41·2	68·8	2864·	1097·	179·7
5	4790·	41·3	69·0	2871·	1100·	180·1
6	4801·	41·4	69·1	2877·	1102·	180·5
7	4812·	41·5	69·3	2884·	1105·	180·9
8	4822·	41·6	69·4	2890·	1107·	181·3
9	4833·	41·7	69·6	2897·	1110·	181·7
450	4844·	41·8	69·8	2903·	1112·	182·1
1	4855·	41·9	69·9	2910·	1114·	182·5
2	4865·	42·0	70·1	2916·	1117·	182·9
3	4876·	42·1	70·2	2922·	1119·	183·3
4	4887·	42·2	70·4	2929·	1122·	183·7
5	4898·	42·3	70·5	2935·	1124·	184·1
6	4909·	42·4	70·7	2942·	1127·	184·5
7	4919·	42·5	70·8	2948·	1129·	184·9
8	4930·	42·5	71·0	2955·	1132·	185·3
9	4941·	42·6	71·1	2961·	1134·	185·7
460	4952·	42·7	71·3	2968·	1137·	186·2
1	4962·	42·8	71·5	2974·	1139·	186·6
2	4973·	42·9	71·6	2981·	1142·	187·0
3	4984·	43·0	71·7	2987·	1144·	187·4
4	4995·	43·1	71·9	2993·	1147·	187·8
5	5005·	43·2	72·1	3000·	1149·	188·2
6	5016·	43·3	72·2	3006·	1152·	188·6
7	5027·	43·4	72·4	3013·	1154·	189·0
8	5038·	43·5	72·5	3019·	1156·	189·4
9	5048·	43·6	72·7	3026·	1159·	189·8
470	5059·	43·7	72·9	3032·	1161·	190·2
1	5070·	43·8	73·0	3039·	1164·	190·6
2	5081.	43·8	73·2	3045·	1166·	191·0
3	5092·	43·9	73·3	3051·	1169·	191·4
4	5102·	44·0	73·5	3058·	1171·	191·8
5	5113·	44·1	73·6	3064·	1174·	192·2
6	5124·	44·2	73·8	3071·	1176·	192·6
7	5135·	44·3	73·9	3077·	1179·	193·0
8	5145·	44·4	74·1	3084·	1181·	193·4
9	5156·	44·5	74·2	3090·	1184·	193·8
480	5167·	44·6	74·4	3097·	1186·	194·2
1	5178·	44·7	74·6	3103·	1189·	194·6
2	5188·	44·8	74·7	3110·	1191·	195·1
3	5199·	44·9	74·9	3116·	1194·	195·5
4	5210·	45·0	75·0	3122·	1196·	195·8
5	5221·	45·1	75·2	3129·	1198·	196·3
6	5231·	45·1	75·3	3135·	1201·	196·7
7	5242·	45·2	75·5	3142·	1203·	197·1
8	5253·	45·3	75·6	3148·	1206·	197·5
9	5264·	45·4	75·8	3155·	1209·	197·9
490	5275·	45·5	76·0	3161·	1211·	198·3
1	5285·	45·6	76·1	3168·	1213·	198·7
2	5296·	45·7	76·3	3174·	1216·	199·1
3	5307·	45·8	76·4	3181·	1218·	199·5
4	5318·	45·9	76·6	3187·	1221·	199·9
5	5328·	46·0	76·7	3193·	1223·	200·3
6	5339·	46·1	76·9	3200·	1226·	200·7
7	5350·	46·2	77·0	3206·	1228·	201·1
8	5361·	46·3	77·2	3213·	1231·	201·5
9	5371·	46·4	77·3	3219·	1233·	201·9
500	5382·	46·4	77·5	3226·	1236·	202·3
1	5393·	46·5	77·7	3232·	1238·	202·7
2	5404·	46·6	77·8	3239·	1240·	203·1
3	5414·	46·7	78·0	3245·	1243·	203·6
4	5425·	46·8	78·1	3251·	1245·	204·0
5	5436·	46·9	78·3	3258·	1248·	204·4
6	5447·	47·0	78·4	3264·	1250·	204·8
7	5458·	47·1	78·6	3271·	1253·	205·2
8	5468·	47·2	78·7	3277·	1255·	205·6
9	5479·	47·3	78·9	3284·	1258·	206·0
510	5490·	47·4	79·1	3290·	1260·	206·4
1	5501·	47·5	79·2	3297·	1263·	206·8
2	5511·	47·6	79·4	3303·	1265·	207·2
3	5522·	47·7	79·5	3310·	1268·	207·6
4	5533·	47·8	79·7	3316·	1270·	208·0
5	5544·	47·8	79·8	3322·	1273·	208·4
6	5554·	47·9	80·0	3329·	1275·	208·8
7	5565·	48·0	80·1	3335·	1278·	209·2
8	5576·	48·1	80·3	3342·	1280·	209·6
9	5587·	48·2	80·4	3348·	1282·	210·0
520	5597·	48·3	80·6	3355·	1285·	210·4
1	5608·	48·4	80·8	3361·	1287·	210·8
2	5619·	48·5	80·9	3368·	1290·	211·2
3	5630·	48·6	81·1	3374·	1292·	211·6
4	5640·	48·7	81·2	3381·	1295·	212·1
5	5651·	48·8	81·4	3387·	1297·	212·5
6	5662·	48·9	81·5	3393·	1300·	212·9
7	5673·	49·0	81·7	3400·	1302·	213·3
8	5684·	49·0	81·8	3406·	1305·	213·7
9	5694·	49·1	82·0	3413·	1307·	214·1
530	5705·	49·2	82·2	3419·	1310·	214·5
1	5716·	49·3	82·3	3426·	1312·	214·9
2	5727·	49·4	82·5	3432·	1315·	215·3
3	5737·	49·5	82·6	3439·	1317·	215·7
4	5748·	49·6	82·8	3445·	1320·	216·1
5	5759·	49·7	82·8	3451·	1322·	216·5
6	5770·	49·8	83·0	3458·	1325·	216·9
7	5780·	49·9	83·1	3464·	1327·	217·3
8	5791·	50·0	83·3	3471·	1329·	217·7
9	5802·	50·1	83·4	3477·	1332·	218·1
540	5813·	50·2	83·7	3484·	1334·	218·5
1	5823·	50·3	83·9	3490·	1337·	218·9
2	5834·	50·4	84·0	3497·	1339·	219·3
3	5845·	50·4	84·2	3503·	1342·	219·7
4	5856·	50·5	84·3	3510·	1344·	220·1
5	5867·	50·6	84·5	3516·	1347·	220·6
6	5877·	50·7	84·6	3522·	1349·	221·0
7	5888·	50·8	84·8	3529·	1352·	221·4
8	5899·	50·9	84·9	3535·	1354·	221·8
9	5910·	51·0	85·1	3542·	1357·	222·2
550	5920·	51·1	85·3	3548·	1359·	222·6
1	5931·	51·2	85·4	3555·	1362·	223·0

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2	5942·	51·3	85·6	3561·	1364·	223·4
3	5953·	51·4	85·7	3568·	1367·	223·8
4	5963·	51·5	85·9	3574·	1369·	224·2
5	5974·	51·6	86·0	3581·	1371·	224·6
6	5985·	51·7	86·2	3587·	1374·	225·0
7	5996·	51·7	86·3	3593·	1376·	225·4
8	6006·	51·8	86·5	3600·	1379·	225·8
9	6017·	51·9	86·6	3606·	1381·	226·2
560	6028·	52·0	86·8	3613·	1384·	226·6
1	6039·	52·1	87·0	3619·	1386·	227·0
2	6050·	52·2	87·1	3626·	1389·	227·4
3	6060·	52·3	87·3	3632·	1391·	227·8
4	6071·	52·4	87·4	3639·	1394·	228·2
5	6082·	52·5	87·6	3645·	1396·	228·6
6	6093·	52·6	87·7	3651·	1399·	229·0
7	6103·	52·7	87·9	3658·	1401·	229·5
8	6114·	52·8	88·0	3664·	1404·	229·9
9	6125·	52·9	88·2	3671·	1406·	230·3
570	6136·	53·0	88·4	3677·	1409·	230·7
1	6146·	53·0	88·5	3684·	1411·	231·1
2	6157·	53·1	88·7	3690·	1413·	231·5
3	6168·	53·2	88·8	3697·	1416·	231·9
4	6179·	53·3	89·0	3703·	1418·	232·3
5	6189·	53·4	89·1	3710·	1421·	232·7
6	6200·	53·5	89·3	3716·	1423·	233·1
7	6211·	53·6	89·4	3722·	1426·	233·5
8	6222·	53·7	89·6	3729·	1428·	233·9
9	6233·	53·8	89·7	3735·	1431·	234·3
580	6243·	53·9	89·9	3742·	1433·	234·7
1	6254·	54·0	90·1	3748·	1436·	235·1
2	6265·	54·1	90·2	3755·	1438·	235·5
3	6276·	54·2	90·4	3761·	1441·	235·9
4	6286·	54·3	90·5	3768·	1443·	236·3
5	6297·	54·3	90·7	3774·	1446·	236·7
6	6308·	54·4	90·8	3780·	1448·	237·1
7	6319·	54·5	91·0	3787·	1451·	237·6
8	6329·	54·6	91·1	3793·	1453·	238·0
9	6340·	54·7	91·3	3800·	1455·	238·4
590	6351·	54·8	91·5	3806·	1458·	238·8
1	6362·	54·9	91·6	3813·	1460·	239·2
2	6372·	55·0	91·8	3819·	1463·	239·6
3	6383·	55·1	91·9	3826·	1465·	240·0
4	6394·	55·2	92·1	3832·	1468·	240·4
5	6405·	55·3	92·2	3839·	1470·	240·8
6	6416·	55·4	92·4	3845·	1473·	241·2
7	6426·	55·5	92·5	3851·	1475·	241·6
8	6437·	55·6	92·7	3858·	1478·	242·0
9	6448·	55·6	92·8	3864·	1480·	242·4
600	6459·	55·7	93·0	3871·	1483·	242·8
1	6469·	55·8	93·2	3877·	1485·	243·2
2	6480·	55·9	93·3	3884·	1488·	243·6
3	6491·	56·0	93·5	3890·	1490·	244·0
4	6502·	56·1	93·6	3897·	1493·	244·4
5	6512·	56·2	93·8	3903·	1495·	244·8
6	6523·	56·3	93·9	3910·	1497·	245·2
7	6534·	56·4	94·1	3916·	1500·	245·6
8	6545·	56·5	94·2	3922·	1502·	246·0
9	6555·	56·6	94·4	3929·	1505·	246·4
610	6566·	56·7	94·6	3935·	1507·	246·9
1	6577·	56·8	94·7	3942·	1510·	247·3
2	6588·	56·9	94·9	3948·	1512·	247·7
3	6599·	56·9	95·0	3955·	1515·	248·1
4	6609·	57·0	95·2	3961·	1517·	248·5
5	6620·	57·1	95·3	3968·	1520·	248·9
6	6631·	57·2	95·5	3974·	1522·	249·3
7	6642·	57·3	95·6	3980·	1525·	249·7
8	6652·	57·4	95·8	3987·	1527·	250·1
9	6663·	57·5	95·9	3993·	1530·	250·5
620	6674·	57·6	96·1	4000·	1532·	250·9
1	6685·	57·7	96·3	4006·	1535·	251·3
2	6695·	57·8	96·4	4013·	1537·	251·7
3	6706·	57·9	96·6	4019·	1539·	252·1
4	6717·	58·0	96·7	4026·	1542·	252·5
5	6728·	58·1	96·9	4032·	1544·	252·9
6	6738·	58·2	97·0	4039·	1547·	253·3
7	6749·	58·2	97·2	4045·	1549·	253·7
8	6760·	58·3	97·3	4051·	1552·	254·1
9	6771·	58·4	97·5	4058·	1554·	254·5
630	6782·	58·5	97·7	4064·	1557·	255·0
1	6792·	58·6	97·8	4071·	1559·	255·4
2	6803·	58·7	98·0	4077·	1562·	255·8
3	6814·	58·8	98·1	4084·	1564·	256·2
4	6825·	58·9	98·3	4090·	1567·	256·6
5	6835·	59·0	98·4	4097·	1569·	257·0
6	6846·	59·1	98·6	4103·	1572·	257·4
7	6857·	59·2	98·7	4110·	1574·	257·8
8	6868·	59·3	98·9	4116·	1577·	258·2
9	6878·	59·4	99·0	4122·	1579·	258·6
640	6889·	59·5	99·2	4129·	1582·	259·0
1	6900·	59·5	99·4	4135·	1584·	259·4
2	6911·	59·6	99·5	4142·	1586·	259·8
3	6921·	59·7	99·7	4148·	1589·	260·2
4	6932·	59·8	99·8	4155·	1591·	260·6
5	6943·	59·9	100·0	4161·	1594·	261·0
6	6954·	60·0	100·1	4168·	1596·	261·4
7	6965·	60·1	100·3	4174·	1599·	261·8
8	6975·	60·2	100·4	4180·	1601·	262·2
9	6986·	60·3	100·6	4187·	1604·	262·6
650	6997·	60·4	100·8	4193·	1606·	263·0
1	7008·	60·5	100·9	4200·	1609·	263·5
2	7018·	60·6	101·1	4206·	1611·	263·9
3	7029·	60·7	101·2	4213·	1614·	264·3
4	7040·	60·8	101·4	4219·	1616·	264·7
5	7051·	60·9	101·5	4226·	1619·	265·1
6	7061·	60·9	101·7	4232·	1621·	265·5
7	7072·	61·0	101·8	4239·	1624·	265·9
8	7083·	61·1	102·0	4245·	1626·	266·3
9	7094·	61·2	102·1	4251·	1628·	266·7
660	7104·	61·3	102·3	4258·	1631·	267·1
1	7115·	61·4	102·5	4264·	1633·	267·5
2	7126·	61·5	102·6	4271·	1636·	267·9
3	7137·	61·6	102·8	4277·	1638·	268·3

No.	Sq. M. = Sq. Ft.	Sq. Ft. = Sq. M.	Sq. Cm. = Sq. In.	Sq. In. = Sq. Cm.	Hectare = Acres.	Acres = Hectare
4	7147·	61·7	102·9	4284·	1641·	268·7
5	7158·	61·8	103·1	4290·	1643·	269·1
6	7169·	61·9	103·2	4297·	1646·	269·5
7	7180·	62·0	103·4	4303·	1648·	269·9
8	7191·	62·0	103·5	4310·	1651·	270·3
9	7201·	62·1	103·7	4316·	1653·	270·7
670	7212·	62·2	103·9	4322·	1656·	271·1
1	7223·	62·3	104·0	4329·	1658·	271·5
2	7234·	62·4	104·2	4335·	1661·	271·9
3	7244·	62·5	104·3	4342·	1663·	272·3
4	7255·	62·6	104·5	4348·	1666·	272·8
5	7266·	62·7	104·6	4355·	1668·	273·2
6	7277·	62·8	104·8	4361·	1670·	273·6
7	7287·	62·9	104·9	4368·	1673·	274·0
8	7298·	63·0	105·1	4374·	1675·	274·4
9	7309·	63·1	105·2	4380·	1678·	274·8
680	7320·	63·2	105·4	4387·	1680·	275·2
1	7330·	63·3	105·6	4393·	1683·	275·6
2	7341·	63·4	105·7	4400·	1685·	276·0
3	7352·	63·4	105·9	4406·	1688·	276·4
4	7363·	63·5	106·0	4413·	1690·	276·8
5	7374·	63·6	106·2	4419·	1693·	277·2
6	7384·	63·7	106·3	4426·	1695·	277·6
7	7395·	63·8	106·5	4432·	1698·	278·0
8	7406·	63·9	106·6	4439·	1700·	278·4
9	7417·	64·0	106·8	4445·	1703·	278·8
690	7427·	64·1	107·0	4451·	1705·	279·2
1	7438·	64·2	107·1	4458·	1708·	279·6
2	7449·	64·3	107·3	4464·	1710·	280·0
3	7460·	64·4	107·4	4471·	1712·	280·4
4	7470·	64·5	107·6	4477·	1715·	280·8
5	7481·	64·6	107·7	4484·	1717·	281·3
6	7492·	64·7	107·9	4490·	1720·	281·7
7	7503·	64·8	108·0	4497·	1722·	282·1
8	7513·	64·8	108·2	4503·	1725·	282·5
9	7524·	64·9	108·3	4509·	1727·	282·9
700	7535·	65·0	108·5	4516·	1730·	283·3
1	7546·	65·1	108·6	4522·	1732·	283·7
2	7557·	65·2	108·8	4529·	1735·	284·1
3	7567·	65·3	109·0	4535·	1737·	284·5
4	7578·	65·4	109·1	4542·	1740·	284·9
5	7589·	65·5	109·3	4548·	1742·	285·3
6	7600·	65·6	109·4	4555·	1745·	285·7
7	7610·	65·7	109·6	4561·	1747·	286·1
8	7621·	65·8	109·7	4568·	1750·	286·5
9	7632·	65·9	109·9	4574·	1752·	286·9
710	7643·	66·0	110·1	4580·	1754·	287·3
1	7653·	66·1	110·2	4587·	1757·	287·7
2	7664·	66·1	110·4	4593·	1759·	288·1
3	7675·	66·2	110·5	4600·	1762·	288·5
4	7686·	66·3	110·7	4606·	1764·	288·9
5	7696·	66·4	110·8	4613·	1767·	289·4
6	7707·	66·5	111·0	4619·	1769·	289·8
7	7718·	66·6	111·1	4626·	1772·	290·2
8	7729·	66·7	111·3	4632·	1774·	290·6
9	7740·	66·8	111·4	4639·	1777·	291·0
720	7750·	66 9	111·6	4645·	1779·	291·4
1	7761·	67·0	111·8	4651·	1782·	291·8
2	7772·	67·1	111·9	4658·	1784·	292·2
3	7783·	67·2	112·1	4664·	1787·	292·6
4	7793·	67·3	112·2	4671·	1789·	293·0
5	7804·	67·4	112·4	4677·	1792·	293·4
6	7815·	67·4	112·5	4684·	1794·	293·8
7	7826·	67·5	112·7	4690·	1796·	294·2
8	7836·	67·6	112·8	4697·	1799·	294·6
9	7847·	67·7	113·0	4703·	1801·	295·0
730	7858·	67·8	113·2	4709·	1804·	295·4
1	7869·	67·9	113·3	4716·	1806·	295·8
2	7879·	68·0	113·5	4722·	1809·	296·2
3	7890·	68·1	113·6	4729·	1811·	296·6
4	7901·	68·2	113·8	4735·	1814·	297·0
5	7912·	68·3	113·9	4742·	1816·	297·4
6	7923·	68·4	114·1	4748·	1819·	297·8
7	7933·	68·5	114·2	4755·	1821·	298·3
8	7944·	68·6	114·4	4761·	1824·	298·7
9	7955·	68·7	114·5	4768·	1826·	299·1
740	7966·	68·7	114·7	4774·	1829·	299·5
1	7976·	68·8	114·9	4780·	1831·	299·9
2	7987·	68·9	115·0	4787·	1834·	300·3
3	7998·	69·0	115·2	4793·	1836·	300·7
4	8009·	69·1	115·3	4800·	1838·	301·1
5	8019·	69·2	115·5	4806·	1841·	301·5
6	8030·	69·3	115·6	4813·	1843·	301·9
7	8041·	69·4	115·8	4819·	1846·	302·3
8	8052·	69·5	115·9	4826·	1848·	302·7
9	8062·	69·6	116·1	4832·	1851·	303·1
750	8073·	69·7	116·3	4839·	1853·	303·5
1	8084·	69·8	116·4	4845·	1856·	303·9
2	8095·	69·9	116·6	4851·	1858·	304·3
3	8106·	70·0	116·7	4858·	1861·	304·7
4	8116·	70·0	116·8	4864·	1863·	305·1
5	8127·	70·1	117·0	4871·	1866·	305·5
6	8138·	70·2	117·2	4877·	1868·	305·9
7	8149·	70·3	117·3	4884·	1871·	306·3
8	8159·	70·4	117·5	4890·	1873·	306·7
9	8170·	70·5	117·6	4897·	1876·	307·1
760	8181·	70·6	117·8	4903·	1878·	307·6
1	8192·	70·7	118·0	4909·	1881·	308·0
2	8202·	70·8	118·1	4916·	1883·	308·4
3	8213·	70·9	118·3	4922·	1885·	308·8
4	8224·	71·0	118·4	4929·	1888·	309·2
5	8235·	71·1	118·6	4935·	1890·	309·6
6	8245·	71·2	118·7	4942·	1893·	310·0
7	8256·	71·2	118·9	4948·	1895·	310·4
8	8267·	71·3	119·0	4955·	1898·	310·8
9	8278·	71·4	119·2	4961·	1900·	311·2
770	8289·	71·5	119·4	4968·	1903·	311·6
1	8299·	71·6	119·5	4974·	1905·	312·0
2	8310·	71·7	119·7	4980·	1908·	312·4
3	8321·	71·8	119·8	4987·	1910·	312·8
4	8332·	71·9	120·0	4993·	1913·	313·2
5	8342·	72·0	120·1	5000·	1915·	313·6

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6	8353·	72·1	120·3	5006·	1918·	314·0
7	8364·	72·2	120·4	5013·	1920·	314·4
8	8375·	72·3	120·6	5019·	1923·	314·8
9	8385·	72·4	120·7	5026·	1925·	315·3
780	8396·	72·5	120·9	5032·	1927·	315·7
1	8407·	72·6	121·1	5039·	1930·	316·1
2	8418·	72·6	121·2	5045·	1932·	316·5
3	8428·	72·7	121·4	5051·	1935·	316·9
4	8439·	72·8	121·5	5058·	1937·	317·3
5	8450·	72·9	121·7	5064·	1940·	317·7
6	8461·	73·0	121·8	5071·	1942·	318·1
7	8471·	73·1	122·0	5077·	1945·	318·5
8	8482·	73·2	122·1	5084·	1947·	318·9
9	8493·	73·3	122·3	5090·	1950·	319·3
790	8504·	73·4	122·5	5097·	1952·	319·7
1	8515·	73·5	122·6	5103·	1955·	320·1
2	8525·	73·6	122·8	5109·	1957·	320·5
3	8536·	73·7	122·9	5116·	1960·	320·9
4	8547·	73·8	123·1	5122·	1962·	321·3
5	8558·	73·9	123·2	5129·	1965·	321·7
6	8568·	73·9	123·4	5135·	1967·	322·1
7	8579·	74·0	123·5	5142·	1969·	322·5
8	8590·	74·1	123·7	5148·	1972·	322·9
9	8601·	74·2	123·8	5155·	1974·	323·3
800	8611·	74·3	124·0	5161·	1977·	323·7
1	8622·	74·4	124·2	5168·	1979·	324·1
2	8633·	74·5	124·3	5174·	1982·	324·6
3	8644·	74·6	124·5	5180·	1984·	325·0
4	8654·	74·7	124·6	5187·	1987·	325·4
5	8665·	74·8	124·8	5193·	1989·	325·7
6	8676·	74·9	124·9	5200·	1992·	326·2
7	8687·	75·0	125·1	5206·	1994·	326·6
8	8698·	75·1	125·2	5213·	1997·	327·0
9	8708·	75·2	125·4	5219·	1999·	327·4
810	8719·	75·3	125·6	5226·	2002·	327·8
1	8730·	75·3	125·7	5232·	2004·	328·2
2	8731·	75·4	125·9	5239.	2007·	328·6
3	8741·	75·5	126·0	5245·	2009·	329·0
4	8752·	75·6	126·2	5251·	2011·	329·4
5	8773·	75·7	126·3	5258·	2014·	329·8
6	8784·	75·8	126·5	5264·	2016·	330·2
7	8794·	75·9	126·6	5271·	2019·	330·6
8	8805·	76·0	126·8	5277·	2021·	331·0
9	8816·	76·1	126·9	5284·	2024·	331·4
820	8827·	76·2	127·1	5290·	2026·	331·8
1	8837·	76·3	127·3	5297·	2029·	332·2
2	8848·	76·4	127·4	5303·	2031·	332·6
3	8859·	76·5	127·6	5309·	2034·	333·1
4	8870·	76·5	127·7	5316·	2036·	333·5
5	8881·	76·6	127·8	5322·	2039·	333·9
6	8891·	76·7	128·0	5329·	2041·	334·3
7	8902·	76·8	128·2	5335·	2044·	334·7
8	8913·	76·9	128·3	5342·	2046·	335·1
9	8924·	77·0	128·5	5348·	2049·	335·5
830	8934·	77·1	128·7	5355·	2051·	335·9
1	8945·	77·2	128·8	5361·	2053·	336·3
2	8956·	77·3	129·0	5368·	2056·	336·7
3	8967·	77·4	129·1	5374·	2058·	337·1
4	8977·	77·5	129·3	5380·	2061·	337·5
5	8988·	77·6	129·4	5387·	2063·	337·9
6	8999·	77·7	129·6	5393·	2066·	338·3
7	9010·	77·8	129·7	5400·	2068·	338·7
8	9020·	77·9	129·9	5406·	2071·	339·1
9	9031·	77·9	130·0	5413·	2073·	339·5
840	9042·	78·0	130·2	5419·	2076·	339·9
1	9053·	78·1	130·4	5426·	2078·	340·3
2	9064·	78·2	130·5	5432·	2081·	340·7
3	9074·	78·3	130·7	5439·	2083·	341·1
4	9085·	78·4	130·8	5445·	2086·	341·6
5	9096·	78·5	131·0	5451·	2088·	342·0
6	9107·	78·6	131·1	5458·	2091·	342·3
7	9117·	78·7	131·3	5464·	2093·	342·8
8	9128·	78·8	131·4	5471·	2095·	343·2
9	9139·	78·9	131·6	5477·	2098·	343·6
850	9150·	79·0	131·8	5484·	2100·	344·0
1	9160·	79·1	131·9	5490·	2103·	344·4
2	9171·	79·2	132·1	5497·	2105·	344·8
3	9182·	79·2	132·2	5503·	2108·	345·2
4	9193·	79·3	132·4	5509·	2110·	345·6
5	9203·	79·4	132·5	5516·	2113·	345·9
6	9214·	79·5	132·7	5522·	2115·	346·4
7	9225·	79·6	132·9	5529·	2118·	346·8
8	9236·	79·7	133·0	5535·	2120·	347·2
9	9247·	79·8	133·0	5542·	2123·	347·6
860	9257·	79·9	133·3	5548·	2125·	348·0
1	9268·	80·0	133·5	5555·	2128·	348·4
2	9279·	80·1	133·6	5561·	2130·	348·8
3	9290·	80·2	133·8	5568·	2133·	349·2
4	9300·	80·3	133·9	5574·	2135·	349·6
5	9311·	80·4	134·1	5580·	2138·	350·1
6	9322·	80·4	134·2	5587·	2140·	350·5
7	9333·	80·5	134·4	5593·	2142·	350·9
8	9343·	80·6	134·5	5600·	2145·	351·3
9	9354·	80·7	134·7	5606·	2147·	351·7
870	9365·	80·8	134·9	5613·	2150·	352·1
1	9376·	80·9	135·0	5619·	2152·	352·5
2	9386·	81·0	135·2	5626·	2155·	352·9
3	9397·	81·1	135·3	5632·	2157·	353·3
4	9408·	81·2	135·5	5638·	2160·	353·7
5	9419·	81·3	135·6	5645·	2162·	354·1
6	9430·	81·4	135·8	5651·	2165·	354·5
7	9440·	81·5	135·9	5658·	2167·	354·9
8	9451·	81·6	136·0	5664·	2170·	355·3
9	9462·	81·7	136·2	5671·	2172·	355·7
880	9473·	81·7	136·4	5677·	2175·	356·1
1	9483·	81·8	136·6	5684·	2177·	356·5
2	9494·	81·9	136·7	5691·	2180·	356·9
3	9505·	82·0	136·9	5697·	2182·	357·3
4	9516·	82·1	137·0	5703·	2184·	357·7
5	9526·	82·2	137·2	5709·	2187·	358·1
6	9537·	82·3	137·3	5716·	2189·	358·5
7	9548·	82·4	137·5	5722·	2192·	359·0

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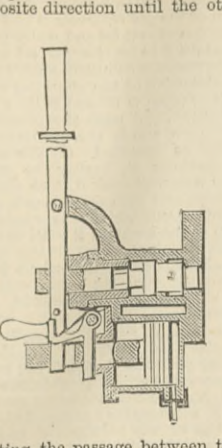
8	9559·	82·5	137·6	5729·	2194·	359·4
9	9569·	82·6	137·8	5735·	2197·	359·8
890	9580·	82·7	138·0	5742·	2199·	360·2
1	9591·	82·8	138·1	5748·	2202·	360·6
2	9602·	82·9	138·3	5755·	2204·	361·0
3	9613·	83·0	138·4	5761·	2207·	361·4
4	9623·	83·1	138·6	5768·	2209·	361·8
5	9634·	83·1	138·7	5774·	2212·	362·2
6	9645·	83·2	138·9	5780·	2214·	362·6
7	9656·	83·3	139·0	5787·	2217·	363·0
8	9666·	83·4	139·2	5793·	2219·	363·4
9	9677·	83·5	139·3	5800·	2222·	363·8
900	9688·	83·6	139·5	5806·	2224·	364·2
1	9699·	83·7	139·7	5813·	2226·	364·6
2	9709·	83·8	139·8	5819·	2229·	365·0
3	9720·	83·9	140·0	5826·	2231·	365·4
4	9731·	84·0	140·1	5832·	2234·	365·8
5	9742·	84·1	140·3	5838·	2236·	366·2
6	9752·	84·2	140·4	5845·	2239·	366·6
7	9763·	84·3	140·6	5851·	2241·	367·0
8	9774·	84·4	140·7	5858·	2244·	367·4
9	9785·	84·4	140·9	5864·	2246·	367·9
910	9796·	84·5	141·1	5871·	2249·	368·3
1	9806·	84·6	141·2	5877·	2251·	368·7
2	9817·	84·7	141·4	5884·	2254·	369·1
3	9828·	84·8	141·5	5890·	2256·	369·5
4	9839·	84·9	141·7	5897·	2259·	369·9
5	9849·	85·0	141·8	5903·	2261·	370·3
6	9860·	85·1	142·0	5909·	2264·	370·7
7	9871·	85·2	142·1	5916·	2266·	371·1
8	9882·	85·3	142·3	5922·	2268·	371·5
9	9892·	85·4	142·4	5929·	2272·	371·9
920	9903·	85·5	142·6	5935·	2273·	372·3
1	9914·	85·6	142·8	5942·	2276·	372·7
2	9925·	85·7	142·9	5948·	2278·	373·1
3	9935·	85·7	143·1	5955·	2281·	373·5
4	9946·	85·8	143·2	5961·	2283·	373·9
5	9957·	85·9	143·4	5968·	2286·	374·3
6	9968·	86·0	143·5	5974·	2288·	374·7
7	9979·	86·1	143·7	5980·	2291·	375·1
8	9989·	86·2	143·8	5987·	2293·	375·5
9	10000·	86·3	144·0	5993·	2296·	375·9
930	10011·	86·4	144·2	6000·	2298·	376·4
1	10022·	86·5	144·3	6006·	2301·	376·8
2	10032·	86·6	144·5	6013·	2303·	377·2
3	10043·	86·7	144·6	6019·	2306·	377·6
4	10054·	86·8	144·8	6026·	2308·	378·0
5	10065·	86·9	144·9	6032·	2310·	378·4
6	10075·	87·0	145·1	6038·	2313·	378·8
7	10086·	87·0	145·2	6045·	2315·	379·2
8	10097·	87·1	145·4	6051·	2318·	379·6
9	10108·	87·2	145·5	6058·	2320·	380·0
940	10118·	87·3	145·7	6064·	2323·	380·4
1	10129·	87·4	145·9	6071·	2325·	380·8
2	10140·	87·5	146·0	6077·	2328·	381·2
3	10151·	87·6	146·2	6084·	2330·	381·6
4	10161·	87·7	146·3	6090·	2333·	382·0
5	10172·	87·8	146·5	6097·	2335·	382·4
6	10183·	87·9	146·6	6103·	2338·	382·8
7	10194·	88·0	146·8	6109·	2340·	383·2
8	10205·	88·1	146·9	6116·	2343·	383·6
9	10215·	88·2	147·1	6122·	2345·	384·0
950	10226·	88·3	147·3	6129·	2348·	384·5
1	10237·	88·4	147·4	6135·	2350·	384·9
2	10248·	88·4	147·6	6142·	2352·	385·3
3	10258·	88·5	147·7	6148·	2355·	385·7
4	10269·	88·6	147·9	6155·	2357·	386·1
5	10280·	88·7	148·0	6161·	2360·	386·5
6	10291·	88·8	148·2	6167·	2363·	386·9
7	10301·	88·9	148·3	6174·	2365·	387·3
8	10312·	89·0	148·5	6180·	2367·	387·7
9	10323·	89·1	148·6	6187·	2370·	388·1
960	10334·	89·2	148·8	6193·	2372·	388·5
1	10344·	89·3	149·0	6200·	2375·	388·9
2	10355·	89·4	149·1	6206·	2377·	389·3
3	10366·	89·5	149·3	6213·	2380·	389·7
4	10377·	89·5	149·4	6219·	2382·	390·1
5	10388·	89·6	149·6	6226·	2385·	390·5
6	10398·	89·7	149·7	6232·	2387·	390·9
7	10409·	89·8	149·9	6238·	2390·	391·3
8	10420·	89·9	150·0	6245·	2392·	391·7
9	10431·	90·0	150·2	6251·	2394·	392·1
970	10441·	90·1	150·4	6258·	2397·	392·5
1	10452·	90·2	150·5	6264·	2399·	392·9
2	10463·	90·3	150·7	6271·	2402·	393·3
3	10474·	90·4	150·8	6277·	2404·	393·8
4	10484.	90·5	151·0	6284·	2407·	394·2
5	10495·	90·6	151·0	6290·	2409·	394·6
6	10506·	90·7	151·3	6297·	2412·	395·0
7	10517·	90·8	151·4	6303·	2414·	395·4
8	10527·	90·9	151·6	6309·	2417·	395·8
9	10538·	90·9	151·7	6316·	2419·	396·2
980	10549·	91·0	151·9	6322·	2422·	396·6
1	10560·	91·1	152·1	6329·	2424·	397·0
2	10571·	91·2	152·2	6335·	2427·	397·4
3	10581·	91·3	152·4	6342·	2429·	397·8
4	10592·	91·4	152·5	6348·	2432·	398·2
5	10603·	91·5	152·7	6355·	2434·	398·6
6	10614·	91·6	152·8	6361·	2437·	399·0
7	10624·	91·7	153·0	6367·	2439·	399·4
8	10635·	91·8	153·1	6374·	2441·	399·8
9	10646·	91·9	153·3	6380·	2444·	400·2
990	10657·	92·0	153·5	6387·	2446·	400·6
1	10667·	92·1	153·6	6393·	2449·	401·0
2	10678·	92·2	153·8	6400·	2451·	401·4
3	10689·	92·3	153·9	6406·	2454·	401·9
4	10700·	92·3	154·1	6413·	2456·	402·3
5	10710·	92·4	154·2	6419·	2459·	402·7
6	10721·	92·5	154·4	6426·	2461·	403·1
7	10732·	92·6	154·5	6432·	2464·	403·5
8	10743·	92·7	154·7	6438·	2466·	403·9
9	10754·	92·8	154·8	6445·	2469·	404·3
1000	10764·	92·9	155·0	6452·	2471·	404·7

pindle being then away from its seating, a passage is opened between the steam brake cylinder and the exhaust or atmosphere. But when the spindle is moved in the opposite direction until the other cone

1494



is against its seating, the passage between the steam brake cylinder and exhaust is closed, and the steam from the boiler can enter and act upon the piston of the brake cylinder.

1495. Sheep Shears, *J. Reaney.—6th April*, 1881.—(*Not proceeded with.*) 2*d.*

From a sheet of iron the form of a pair of shears, before being twisted and bent, is "punched" or "flyed" out, but the blades are made wider or have projections at the back edge, and this extended portion is bent over, thus making the back part double, and thicker than the front edge. A thin strip of steel is welded to the thin part of the blade, and the whole twisted, bent, and finished in the ordinary way.

1498. Cabinets for Containing Assortments of Thread, Spools, &c., *R. Kerr.—6th April*, 1881. 6*d.*

According to one modification the cabinet is in the form of a shallow box divided by partitions into compartments, which, when the cabinet is placed in position for use, are vertical, so that the articles in each compartment fall towards the bottom. Each compartment has a cover, by removing which the whole compartment is uncovered, and also a smaller cover for the purpose of opening the compartment sufficiently to allow of the removal of one of the articles only at a time.

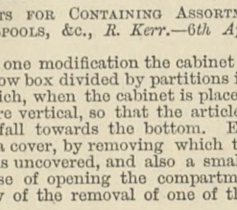
1499. Treatment of Tobacco, *J. Hopkinson and F. Wills.—6th April*, 1881. 6*d.*

This relates to the processes of heating or stoving and cooking tobacco, and consists in the use of a revolving hollow cylinder open at both ends, in the interior of which the tobacco is treated. A series of gas or oil burners are placed beneath the cylinder for the process of heating or stoving, and for cooling moisture is continually applied to the outer surface of the cylinder, and caused to evaporate rapidly by exhausting the air or by passing a rapid current of air round the cylinder.

1500. Rails for Tramways, &c., *E. Frère.—6th April*, 1881. 6*d.*

In the drawing A is the main portion of the rail; A1 A1 are the flanges; B B the longitudinal base

1500



plates, which are rivetted or otherwise secured to the flanges A1; and C is a dowel formed with tapered ends.

1501. Skates, *R. H. Bishop and H. F. Hailes.—6th April*, 1881.—(*Not proceeded with.*) 2*d.*

This relates to a gripping device for the heels, and consists of two plates actuated by a slotted cam-plate worked by a lever arm.

1503. Cupola Furnaces, *H. A. Dufrené.—6th April*, 1881. 6*d.*

The cupola is heated by gas produced in a separate gas generator (for solid fuel) formed of three movable parts. The blast arriving under the grate is divided into two parts; the one part serves for burning the

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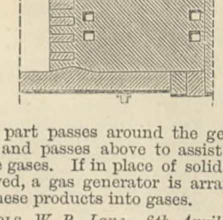


fuel, the other part passes around the generator, becomes heated, and passes above to assist in the combustion of the gases. If in place of solid fuel liquid fuel be employed, a gas generator is arranged which will convert these products into gases.

1505. Parasols, *W. P. Lane.—6th April*, 1881.—(*Not proceeded with.*) 2*d.*

This relates to a parasol capable of being readily converted into a fan or into a carriage sunshade.

1507. Cooking and Dishing up Meat, &c., *J. Hall.—6th April*, 1881.—(*Not proceeded with.*) 2*d.*

The meat to be boiled is placed in a tray and placed inside a kettle or saucepan containing a small quantity of water only, so that the meat is cooked by steam.

1508. Raising and Supporting Ladies' Dresses, *J. Fleurman.—6th April*, 1881.—(*Not proceeded with.*) 2*d.*

Cords pass through loops on the skirt and others on a waist belt, the cords being so arranged that by pulling either of them the skirt is raised symmetrically.

1510. Heels and Soles of Boots and Shoes, *F. Hocking.—6th April*, 1881. 6*d.*

This consists in applying conical or tapered metal plugs or rings to the under or outside leather of the heels and soles of boots and shoes.

1511. Receptacles or Racks for Bottles, *J. Heaps.—6th April*, 1881. 6*d.*

A series of loose and removable trays are capable of being pushed one over the other in a suitable box, or may be used as drawers to slide into recesses. These trays are divided by partitions on either side of a central bar arranged at an angle, so that the bottles lie horizontally, or nearly so, with their necks on one side under the bar and on the other side above the bar.

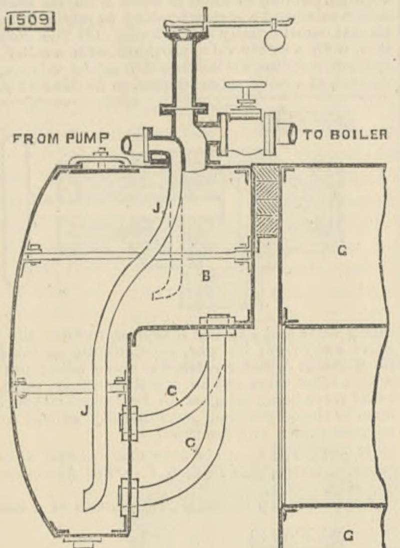
1516. Spindles for Looms, *R. H. B. Thompson.—7th April*, 1881.—(*Not proceeded with.*) 2*d.*

This consists in clipping the ends of the spindle firmly so that it cannot shake, and in arranging the clipping apparatus so that it can be adjusted vertically.

1509. Water Heaters and Fuel Economisers, *H. Schofield.—6th April*, 1881. 6*d.*

The waste heat from the boiler is utilised to heat the water before being forced into the boiler. The heater is constructed of boiler plate approximating to the cross sectional dimensions of the boiler G, and

1509



shaped so that two or more of its surfaces form a portion of the sides of the flue, and are subjected to the direct action of the furnace. The front of the top part B of the heater overhangs the lower part, and a number of circulating tubes C connect the two parts. On top of the heater is an inlet pipe J, leading the water to a position near the bottom of the heater, or to a position higher than the circulating tubes. An outlet to the boiler and a safety valve are also provided.

1517. Photographic Apparatus, &c., for Supporting the Head and Body, *E. Edwards.—7th April*, 1881. 6*d.*

A vertical frame supported on three feet has in front a vertical hollow column into which fits a bar, and at back is a hollow frame to receive a weight, which by a cord passing over pulleys is connected to the lower end of the bar, so as to counterbalance the same. The bar can be secured in a fixed position by set screws. The top of the bar is attached to a horizontal arm with a socket, in which a second bar can be adjustably secured, the latter carrying at its upper end the rod to which the head rest is secured.

1518. Gas Valves, *G. Waller.—7th April*, 1881.—(*Not proceeded with.*) 2*d.*

A cast iron case is closed at bottom and fitted with a gas-tight cover furnished with a stuffing box and gland, through which a cranked shaft passes, its upper part projecting and being fitted with a key or lever to turn it by, while its lower end works in a toe step. The crank is connected to the valve by an attachment free to slide between guides formed on the sides of the case.

1520. Decorating Bricks, Tiles, &c., by the use of Mica, *R. Applegarth.—7th April*, 1881.—(*A communication from E. A. L. Heureux.*—(*Not proceeded with.*) 2*d.*

Delicate enamel is dissolved in water and spread on the bricks, and over it a coating of gummed water is laid and powdered mica sprinkled thereon. The whole is then gently baked in a cover or muffle.

1523. Variable Expansion Valve Gear for Steam Engines, &c., *J. McFarlane and T. T. M. Lumsden.—7th April*, 1881.—(*Not proceeded with.*) 2*d.*

This relates principally to engines the speed of which is regulated by varying the cut-off, and it consists of improved gear to adjust more or less apart a pair of cut-off plates arranged to work on the back of an ordinary slide valve. A speed governor is used to determine the adjustments of the plates, but no power is derived from the governor for effecting the adjustments, and whenever the governor has acted its return to a normal position does not reverse the adjustment, but simply stops it on the speed being brought to its normal rate.

1524. Pickers, *M. Holt.—7th April*, 1881. 4*d.*

This relates to pickers made of buffalo hides the object being to strengthen and enable them to be used either end forwards. The hide for the body and foot is folded as usual for an ordinary "scoop" picker and having cut out the back part of the "scoop" so as to leave only a bar along the top to attach the picker band, two holes are pierced in the front ends near the top, and in them are inserted the ends of a solid bar of hide to correspond with the back bar. It is placed in the machine and pressed and finished in the usual manner, the bar becoming, as it were, rivetted into its place, and being perfectly firm and strong.

1526. Improvements in Electric Lamps and in Electro-magnets Applicable to these, &c., *J. D. F. Andrews.—7th April*, 1881. 6*d.*

This invention is an improvement on the inventor's patent, No. 2321, dated 11th June, 1879, for electric lamps in which plates or discs of carbon were used, and consists in the new method of forming the arc, in the case where two carbon plates are used, the one fixed and the other on a frame pivotted below, so that the upper edge of the movable carbon plate can approach or recede from the fixed plate. The arc is regulated as follows:—In the base of the lamp an electro-magnet is fixed, the core of which is divided lengthwise into two parts; one half is fixed and the other connected to the frame of the movable carbon. The coil surrounding these two half cores is in the circuit of the lamp. When no current passes, the weight of the frame and upper half core keeps the two half cores close together, the upper edges of the carbons being then in contact. But when a current passes through the coil and carbons, the one core repels the other, and the edges of the carbons are separated and the arc formed. Should the carbons be too far apart, the electro-magnet is weakened, and the carbons made to approach, and *vice versâ*. A full description and illustrations of these lamps will be found in our issue for the 9th September.

1527. Effecting Concentration and Crystallisation of Soda Solutions, *J. Imray.—7th April*, 1881.—(*A communication from J. Buffet.*) 6*d.*

This relates to the concentration of soda solutions by evaporating in vacuo in successive stages, so as to separate the carbonate from the caustic alkali, and to effect crystallisation of the former by means of apparatus arranged to operate continuously without requiring the calcination and second solution and concentration that are usually employed.

1528. Uniting Gas, Water, and other Pipes or Tubes, *W. T. Sugg.—7th April*, 1881.—(*Not proceeded with.*) 2*d.*

The ends of the pipes to be joined are gripped between an internal ring or thimble, and two external rings or sockets drawn together by screws or bolts and nuts. The external rings have an external flange, and are slightly conical internally. One of them is placed on each length, and they are secured together by screws passing through the flanges. The internal ring is of lead with a core of hard metal, and it is tapered off to correspond with the coned portions of the outside rings.

1529. Cord, Ropes, Cables, and Oakum, *A. T. Lawson.—7th April*, 1881.—(*A communication from J. Coulson.*) 4*d.*

To render cordage elastic and supple under all variations of climatic influence the yarn from which it is to be made is conducted through a bath composed of equal parts of fir tar and naphtha, or their equivalents, and heated to a temperature of about 100 deg. C.

1531. Breech-loading Fire-arms, *P. T. Godsal.—7th April*, 1881. 6*d.*

This relates to improvements on patent No. 979, A.D. 1880, and it consists in making the forked extension of the trigger guard lever act on the block through the central slot which is widened for the purpose, the hammer playing between the prongs of the fork. To prevent the block falling out of the gun one of the sides is extended downwards and has a vertical slot, with which the point of a screw passing through the side of the breech case engages and limits the extent of the play. The finger which bears against the hammer is formed without a tail-piece, and the form of the hammer tail is modified so that when the trigger guard lever is depressed to open the gun it will cock the hammer, but when the trigger guard lever is returned to its normal position to close the gun the finger will be retained in its raised position and lock the hammer.

1532. Agricultural and other Edge-tools, &c., *W. and M. G. Morgans.—7th April*, 1881.—(*Not proceeded with.*) 2*d.*

The blanks or moulds, instead of being acted upon by hammers, are passed through rolls, which reduce them to the desired form and weight. Instead of the rolls two long dies with convex faces may be used, having imparted to them a reciprocating rotary motion on adjustable centres. The invention further relates to hardening the blade, and consists in holding them firmly between two dies while cooling so that they do not lose their shape.

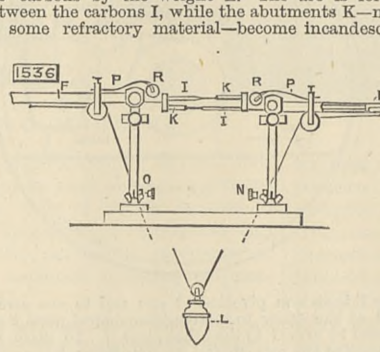
1533. Railway Brake Apparatus, *W. R. Lake.—7th April*, 1881.—(*A communication from E. Schrabetz.*)—(*Not proceeded with.*) 4*d.*

Gravity is employed to produce the requisite pressure by means of a weight applied to each vehicle, and which is counteracted when the brake is not in use by compressed air, the weight being raised by means of an ordinary cylinder with a piston, or by means of bellows or other suitable device.

1536. Electric Lamps *J. L. A. Dupont-Aubervillle.—8th April*, 1881.—(*A communication from V. Delaye.*) 6*d.*

In this lamp the carbon-holders F are placed in upright supports, and a horizontal motion is given to the carbons by the weight L. The arc is formed between the carbons I, while the abutments K—made of some refractory material—become incandescent,

1536



thus increasing the power of the light and causing it to resemble sunlight. The current enters by posts N and O, and is passed through the carbons by plates P provided with friction rollers R. Great steadiness is claimed for this light.

1538. Treatment of Paper for Photographic Purposes, *H. J. Haddan.—8th April*, 1881.—(*A communication from J. J. D. Hutinet and P. E. Lamy.*) 4*d.*

This relates to preparing photographic paper by means of gelatine containing argentic bromide, and consists in applying to such paper a second coating of a varnish or solution of gelatinous, gummy, albuminous, or similar substances being insoluble or made insoluble.

1540. Railway Points, *H. Whitehead and T. Dodd.—8th April*, 1881. 8*d.*

The object is to cause the points to work vertically instead of horizontally. B is the left-hand fixed rail, and B1 the corresponding movable rail; and C is the

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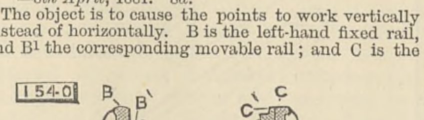

right-hand fixed rail, and C1 the corresponding movable rail, the two movable rails being actuated so that when one is raised the other is depressed.

1541. Gas Engines, *L. Bénier.—18th April*, 1881.—(*Not proceeded with.*) 2*d.*

The combustion of the gaseous mixture instead of taking place in the cylinder, and during the up-stroke takes place in a small chamber separated from the cylinder by a valve, the mixture being forced into such chamber by a pump.

1542. Roving Delivery Mechanism of Drawing Frames, Carding Engines, &c., *B. Hunt.—8th April*, 1881.—(*A communication from J. Pollit.*—(*Not proceeded with.*) 2*d.*

This consists in a device for so directing the slivers to the coilers, by which they are directed into the receiving cans, that the passage of the sliver from the rollers to the orifice of the coiler, and through the inclined passage of the same shall not be interrupted.

1545. Moistening, Cooling, and Purifying Air, *J. C. Mewburn.—8th April*, 1881.—(*A communication from A. J. Desmarest, P. Cosnard, and E. and P. Sée.*)—(*Not proceeded with.*) 2*d.*

A current of steam or compressed air is used to reduce spray or atomise water, which by mixing with the atmosphere either heats or cools and moistens and purifies the same.

1546. Menstrual Apparatus, *F. A. C. Græbert.—8th April*, 1881. 4*d.*

The pad is composed of a bag of pliable fabric to contain a sponge, and is connected by elastic tapes at back and front to a waist band.

1548. Sewing Machines, *J. W. Ramsden.—8th April*, 1881. 1*s.*

This relates to improvements on patents No. 1085, A.D. 1877, and No. 4430, A.D. 1880, and it consists of an improved means of imparting motion to the "whirl" or rotating looper in the nose of the horn of sole-sewing machines, whereby the whirl is rendered stationary while the waxed thread is being drawn through its eye. A rotating cam and adjustable stud are employed for transmitting motion from the inclined shaft of the horn-sewing machine to the looper. A hooked needle set excentrically in its bar receives an axial as well as a reciprocating motion and acts in combination with a rotary shuttle formed with a segment-shaped vertical projection, whereby the loop of the needle thread is so presented to and caught by the nose of the shuttle as to render the use of the "divider" unnecessary. A reciprocating needle bar is caused by a reciprocating feathered socket to turn in its bearings for the purpose of presenting the piercing edge of its needle at any desired inclination to the line of traverse of the work, and thereby producing "cast" stitches or stitches which lie parallel to one another. A reciprocating shuttle carrier is actuated by a cam on the cam shaft, and turned to advance the shuttle towards the needle when the loop is fully formed, thus avoiding the use of a divider.

1549. Raising a Nap on Woven Fabrics, &c., *J Worrall.—8th April*, 1881. 6*d.*

The object is to provide an arrangement of machinery, which by simply changing the carding rollers to brushes, or *vice versâ*, will enable the nap to be raised or finished in a more efficient manner, and it consists in the application to a pile-raising and finishing machine of a sliding frame capable of vertical adjustment for traversing the card rollers or brushes over the fabric, the latter at the same time receiving a rapid rotary motion.

1551. Speed Indicators for Engines, &c., *W. Stroudley.—9th April*, 1881. 6*d.*

This relates to improvements on patent No. 1211, A.D. 1879, and it consists of two cylindrical vessels A secured to casting B forming the casing of a centrifugal pump C, the bottom of one vessel communicating

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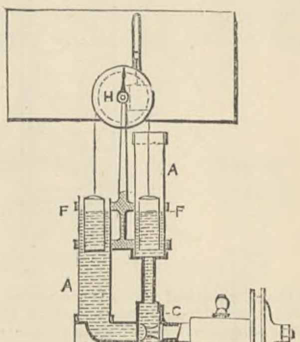


directly with the circumference of the pump casing, and the other with the centre of same. In each cylinder works a float F connected by cords with the opposite sides of a grooved pulley H, the axle of which carries a pinion gearing with a vertical rack moving in guides and carrying a pencil.

1552. Scraping Ships' Bottoms, *J. Westberg.—9th April*, 1881. 6*d.*

This relates to apparatus for scraping ships bottoms when afloat, and consists in means for pressing the scrapers against the sides and bottom of the ship as they are dragged to and fro. For this purpose boards or flaps are hinged to the back of the frame carrying the scrapers, and when the frame is pulled in either direction one of the flaps falls down, and by the resistance it offers in passing through the water, the scrapers are forcibly pressed against the sides of the vessel.

1553. Portable Rack Saw Bench, *J. Grills.—9th April*, 1881.—(*Not proceeded with.*) 2*d.*

This relates to a portable rack saw bench to enable timber to be cut up into planks, &c., on the spot where it is felled.

1554. Platen Printing Presses, *A. Godfrey.—9th April*, 1881. 6*d.*

The platen beam is actuated so as to give it an increased throw, and for this purpose the arms supporting it are formed with a second joint at a point between the primary axis and the beam, and in a line with the face of the platen. On the frame in the space of action covered by the supporting arms studs are placed, so that when the beam has moved a certain distance those portions of the arms below their second joints come into contact with the studs, and form stops to prevent the further movement in that direction of such portion of the arms, at which time the continued semi-rotation of the beam is taken up by the arms projecting from the second axis, which being nearer the centre of motion imparted by the cranks, causes the platen to open out to a position nearly at right angles to the face of the type. The invention further relates to a special arrangement of "frisket" fingers or springs; to the inking apparatus; and to the securing of the blanket to the face of the platen.

1556. Brakes for Wire Hawsers, &c., *W. H. Wise.—9th April*, 1881.—(*Not proceeded with.*) 2*d.*

Around a stout bar or cylinder a spring is wound, intervals being left between the coils to receive the hawser. The coil is attached at one point to the bar or barrel, and its ends are attached to cylindrical buffers capable of sliding on the bar, being guided by helical grooves, so that they may rotate and move towards each other and take up the slack of the coils. By causing the coils to close up (by means of a screw and hand wheel) the hawser is nipped.

1557. Winding, Roving, Doubling, and Twisting Fibrous Substances, *J. L. Lee.—9th April*, 1881.—(*Not proceeded with.*) 2*d.*

This relates to means for stopping the spindle when the yarn or thread breaks, and also stopping the action of the drawing or delivery rollers.

1558. Coupling Apparatus, &c., *J. O. O'Brien.—9th April*, 1881.—(*Not proceeded with.*) 2*d.*

This relates to improvements on patent No. 543, A.D. 1879, and it consists in constructing the fork in line with the shaft, but the prongs projecting at right angles to the plane in which the cranked bar or cap covering the link lies, and at an angle of 135 deg. with the stock; and the link lies against the stick, the fork merely serving to guide the link and prevent it slipping off. Two wedges are placed on each fork to prevent the link slipping. The invention also relates to mounting lamps so that they may be turned round in any direction.

1561. Metallic Road Gutters, *W. and J. Lawley.—9th April*, 1881.—(*Not proceeded with.*) 2*d.*

This relates to gutters to cross pathways and convey water from houses, &c., to the ordinary gutter, and it consists in making them with an open top to be fitted with a removable cover, so as to facilitate cleaning out.

1562. Soap, *H. H. Lake.—9th April*, 1881.—(*A communication from Benno, Jaffé, and Darmstaedter.*) 4*d.*

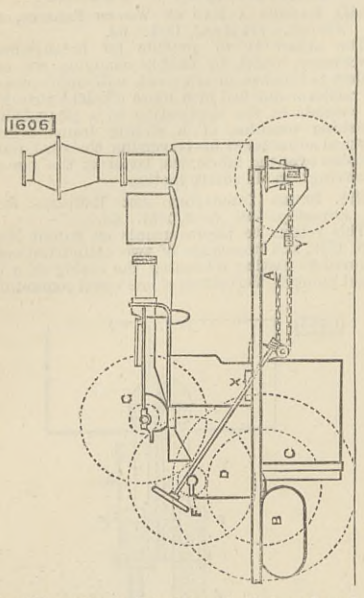
This relates to a process for the manufacture of soap, chiefly designed to recover glycerine from the residue, and it consists, First, in the employment for separating soap from the soap liquor, of sulphate of soda or other alkaline sulphate to facilitate the recovery of pure glycerine from the spent lye; and, Secondly, in the employment of hydric sodic sulphate for neutralising the lye (produced in separating the soap from the soap liquor by sulphate of soda) for the recovery of sulphate of soda as a bye-product.

1574. Medicinal Compound for Burns, &c., *J. Harris.—11th April*, 1881. 2*d.*

The compound to be applied to burns, scalds, &c., consists of 1 part camphor, 12 parts tincture of opium, 20 parts spirits of wine, and 128 parts linseed oil.

1606. Traction Engines, *A. M. Clark.—12th April*, 1881.—(*A communication from A. O. Frick.*) 6*d.*

This relates to the structure of the framework and means for hanging the boiler thereon to compensate for expansion; to connecting the engine and the frame so as to avoid working strain on the boiler sheets; to the construction and arrangement of the front truck; to the means for guiding the engine, and to the construction of the traction wheel. A pair of iron sills A extend from the front truck to a distance in rear of boiler, and form the main frame, the platform for driver being beyond the rear of engine and also the water tank B. These sills are connected at point X on each side to the boiler, and are further supported by strap C (which bears the weight of the boiler), and by an expansion joint on the front truck.



To the sills vertical plates D are bolted, and each has a slot to fit over and brace the axle of the hind wheel, and is connected to the engine frame G and the bearings for counter-shaft F. The steering chain is fitted with elastic links Y so as to relieve the gear from sudden strain.

1652. Propelling Ships or Vessels, *J. H. Johnson.—14th April, 1881.—(A communication from J. E. J. d'Arembecourt.)* 6d.

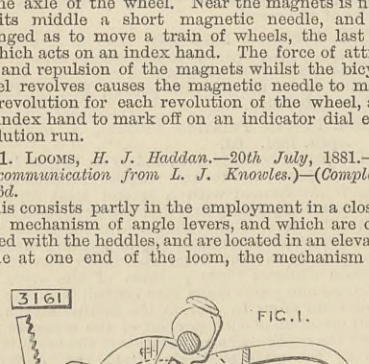
One or more pump barrels are arranged horizontally at the stern of the vessel below the water-line, the outer ends being open to the water. In the barrels are pistons worked from a suitable motor in the vessel.

1712. Improvement in Odometers, *E. S. Ritchie.—20th April, 1881.* 6d.

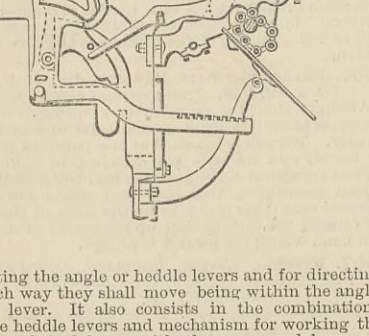
The object of this invention is to measure distances run with bicycles and similar vehicles, the apparatus in the former case being applied to the axle of the wheel, and revolving with it. The apparatus consists of a pair of magnets with their north poles in contact and their south poles also in contact; these are fixed inside a carrier, said carrier being attached to the axle of the wheel. Near the magnets is fixed by its middle a short magnetic needle, and so arranged as to move a train of wheels, the last one of which acts on an index hand. The force of attraction and repulsion of the magnets whilst the bicycle wheel revolves causes the magnetic needle to make one revolution for each revolution of the wheel, and the index hand to mark off on an indicator dial each revolution run.

3161. Looms, *H. J. Haddan.—20th July, 1881.—(A communication from L. J. Knowles.)—(Complete.)* 6d.

This consists partly in the employment in a closed-shed mechanism of angle levers, and which are connected with the heddles, and are located in an elevated frame at one end of the loom, the mechanism for



shifting the angle or heddle levers and for directing in which way they shall move being within the angle of said lever. It also consists in the combination of angle heddle levers and mechanism for working them in closed-shed looms with the compound levers of a drop shuttle-box motion, both the mechanism for operating the heddle lever and the mechanism for operating the compound levers, including the pattern



mechanism for both, being within the angle of the heddle levers. Fig. 1 is a sectional elevation, and Fig. 2 is a partial elevation, taken upon the back side of the loom, showing more especially the connection of the drop shuttle-box mechanism with the heddle mechanism.

3269. Circular Knitting Machines, *J. Bradley.—26th July, 1881.—(Complete.)* 10d.

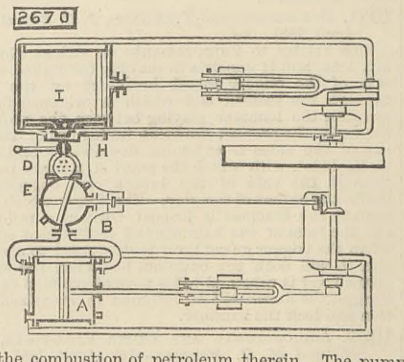
This relates to a knitting machine adapted to automatically manipulate two, three, four, or more colours so as to throw them successively into and out of action with the needles, and arrange the strips in any required order and make them of any desired width.

3278. Artificial Tooth Crowns, *S. Pitt.—26th July, 1881.—(A communication from C. M. Richmond.)—(Complete.)* 6d.

This relates to the application of an artificial tooth crown to the natural tooth roots while in the mouth. The crown is composed of a porcelain cutting face backed with metal, and having a metallic ring from which a pin projects and enters the root, so as to form a connection between it and the crown, being retained securely in a recess formed in the root by means of a suitable cement.

2670. Obtaining Motive Power, *B. J. B. Mills.—18th June, 1881.—(A communication from J. Lunant.)—(Complete.)* 4d.

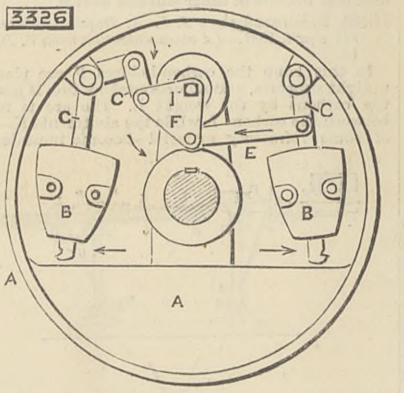
This relates to obtaining motive power by expanded air, and is based on the compression of air to a high pressure, and then heating and so expanding the same



by the combustion of petroleum therein. The pump A compresses air into reservoir B with two compartments alternately communicating with regenerator D by means of disc E, which is caused to rotate. The regenerator communicates with valve box H of cylinder I through a cock carrying a burner fed with petroleum from a reservoir in which the pressure is equal to that of the valve box.

3326. Operating Valves, *H. H. Lake.—30th July, 1881.—(A communication from F. B. Rice and S. A. Murphy.)—(Complete.)* 4d.

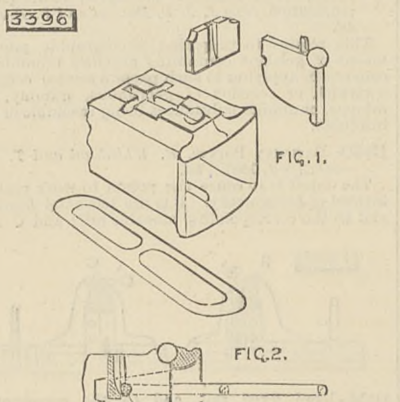
This relates to automatically operating the valve of an engine to adapt it to varying loads, and consists in a rock-shaft passing through the crank pin and having an excentric pin for connection with the valve rod in combination with a governor arranged within the crank disc. A is the crank disc of an engine; B, governor weights connected to arms C; pivotted to the



disc E is an arm pivotted at one end to one arm C, and at the other to a triangular-shaped plate F connected by arm G to the other plate C. To plate F is connected the rock-shaft I passing through the crank pin and connected to an arm fitted with an excentric pin to which the valve stem is connected.

3396. Car Couplings, *A. J. Boult.—5th August, 1881.—(A communication from J. H. Hunt and F. W. Jones.)—(Complete.)* 6d.

This consists principally in a draw head formed in two parts which are united upon a vertical central



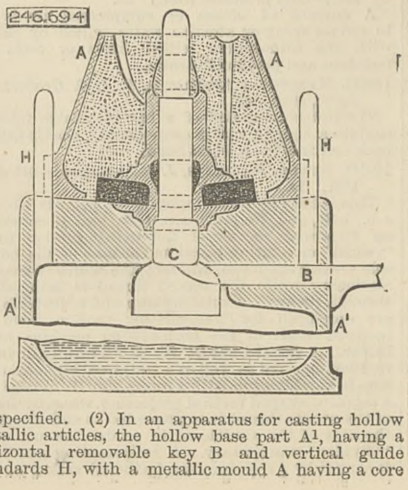
longitudinal line, and are adapted to yield to lateral pressure and release the link. Fig. 1 shows the different parts of the coupling detached; and Fig. 2 the whole coupling with the drawing link in its locked position.

SELECTED AMERICAN PATENTS.

From the United States Patent Office Official Gazette.

246,694. Apparatus for Casting Hollow Articles in Metallic Moulds, *Ferdinand Tellender, Wenersborg, Sweden.—Filed June 18th, 1881.*

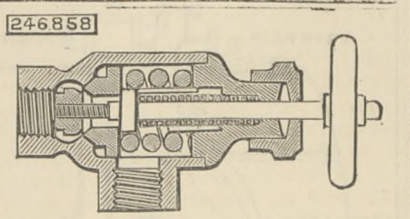
Claim.—(1) An apparatus for casting hollow metallic articles, consisting of a hollow base part having a removable key, and of a metallic mould supported thereon, said mould having a metallic core which is guided in a top opening of the base part, substantially



as specified. (2) In an apparatus for casting hollow metallic articles, the hollow base part A¹, having a horizontal removable key B and vertical guide standards H, with a metallic mould A having a core C, which is guided in an opening in the top of the base part and adapted to be dropped into the same, substantially as and for the purpose set forth.

246,858. Relief Valve for Steam Engines, *James Aitchison, Cleveland, Ohio.—Filed April 16th, 1881.*

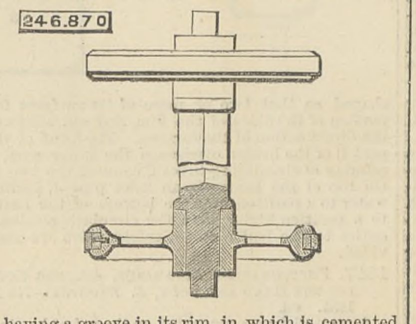
Claim.—(1) The combination, with a relief valve and a spring tending to force it away from its seat, of a safety valve and a spring tending to retain it against its seat, substantially as set forth. (2) The combination, with a safety valve provided with a relief valve seat and a spring for holding the safety valve against its seat, of a relief valve adapted to fit the seat on the



safety valve and a spring operating to force the relief valve away from its seat, substantially as set forth. (3) A steam cylinder valve, the same being provided with a relief valve and an auxiliary safety valve, said relief valve being adapted to be locked either in an open or closed position, substantially as and for the purpose shown and described.

246,870. Top Roll for Spinning Frames, *Alexander F. Crichton, New York, N.Y.—Filed November 26th, 1879.*

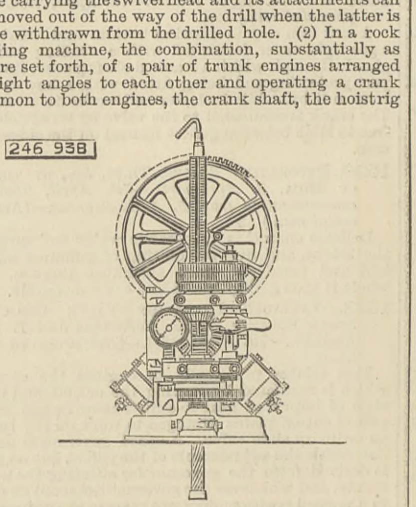
Brief.—The top drawing roll consists of a metallic



boss having a groove in its rim, in which is cemented two or more layers of leather, said roll being loosely mounted on a stationary spindle.

246,938. Rock Drilling Machines, *Milan C. Bullock, Chicago, Ill.—Filed January 27th, 1881.*

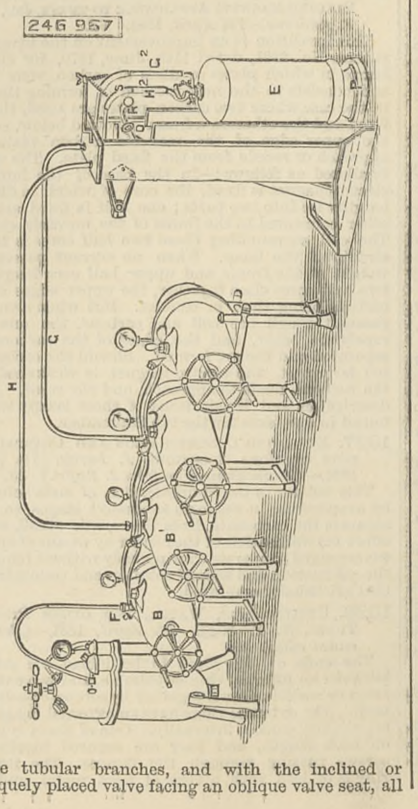
Claim.—(1) In a rock drilling machine, the combination, substantially as before set forth, of the front standard provided with a ring flange, the plate seated and adapted to be rotated on said flange, and the movable yoke, the parts being so arranged that the yoke carrying the swivel head and its attachments can be moved out of the way of the drill when the latter is to be withdrawn from the drilled hole. (2) In a rock drilling machine, the combination, substantially as before set forth, of a pair of trunk engines arranged at right angles to each other and operating a crank common to both engines, the crank shaft, the hoistrig



arranged above said shaft, and the feed screw for operating the drill. (3) In a rock drilling machine, the combination, substantially as before set forth, of the crank shaft, the hoist drum mounted to revolve on the drum shaft, motion transmitting mechanism, and the excentrics on the drum shaft. (4) In a rock drilling machine, the combination, substantially as before set forth, of the front standard provided with a ring flange, the swivel head, the hinged yoke, and the plate, to which the yoke is hinged, said plate being adapted to be turned so as to change the position of the hinge.

246,967. Apparatus for Charging Portable Fountains with Aerated Beverages, *John Matthews, New York, N.Y.—Filed July 6th, 1881.*

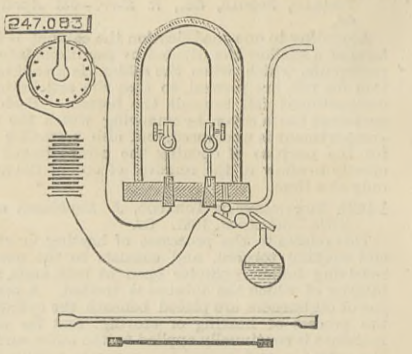
Claim.—(1) The cock F, constructed with three or



more tubular branches, and with the inclined or obliquely placed valve facing an oblique valve seat, all arranged so that by said valve communication with only one of said branches can be shut off or established, as described. (2) In a soda water apparatus, the combination of the gas reservoir B and water reservoir B¹ with the gas pipe G G² and water pipe H H², and with the fountain E to be charged, all arranged for operation substantially as herein shown and described. (3) The combination of the charging reservoir B B¹ and connecting pipes G G² and H H² with the fountain E to be charged, and with the pivotted weighted platform P, upon which the fountain E is placed, substantially as specified. (4) The combination of the tilting platform P, having the projection thereon, with the weighted lever R, rock shaft O, having lever and cranks, and with the valves L and N, all arranged for operation substantially as specified. (5) The combination of the fountain E with the tilting platform P and with the supply pipes G² and H², having valves L and N, all arranged so that when the fountain is full and weighted the said valves will be automatically closed, substantially as specified. (6) The combination of the elastic pipe G², which connects the pipe G and fountain E, with the metallic curved jacket S, substantially as described. (7) The combination of the tilting platform P, adapted to receive the fountain E, and provided with the projection T, for closing the valves L N, with the projecting graduated arm Y and weight Z, substantially as specified. (8) The combination of the tilting platform P and mechanism, substantially as described, for automatically closing the supply valves with the flexible connecting pipes G² H², curved metallic jackets S S, and suspension springs D², substantially as specified. (9) The platform P, provided with the cross bar L², formed into knife edge pivots L at its ends, in combination with the supporting brackets N and covering shield P, substantially as described.

247,083. Process of Manufacturing Carbons, *Hiram S. Maxim, Brooklyn, assignor to the United States Electric Lighting Company, New York, N.Y.—Filed 6th April, 1881.*

Claim.—(1) The process of manufacturing carbon conductors for electric lamps, which consists in cutting the blanks from fibrous material, carbonising the



same, bending the carbonised strips into the desired shape, and then electrically heating them for giving them a permanent set, as described. (2) The method herein described of fixing a carbon strip in any form to which it may have been bent, by subjecting the same while bent to the action of an electric current in an atmosphere of carbonaceous gas or vapour, substantially as set forth.

CONTENTS.

The Engineer, November 11th, 1881.