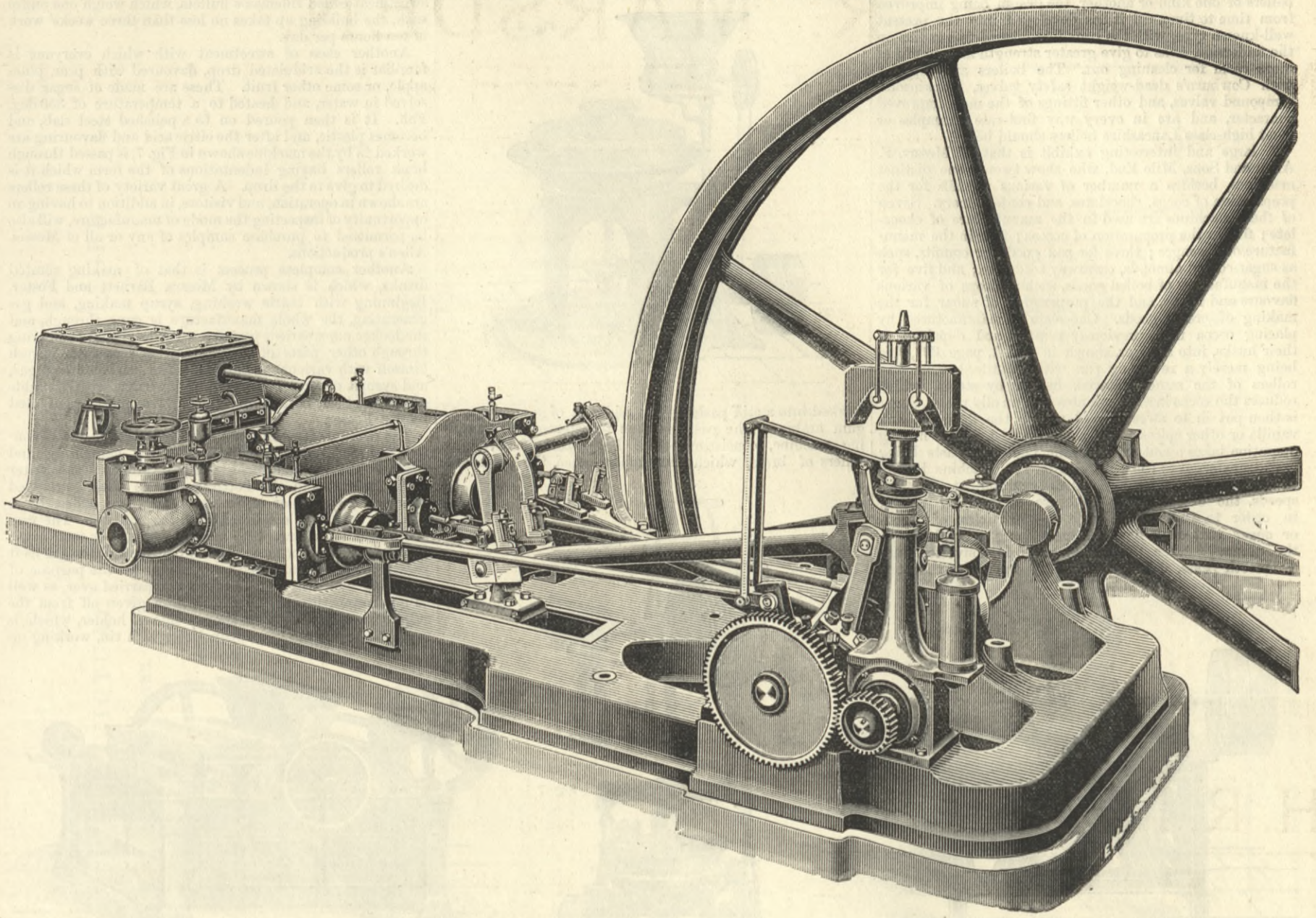
THE HEALTH EXHIBITION.—COMPOUND ENGINE.

MESSRS. GALLOWAY AND SONS, MANCHESTER, ENGINEERS.



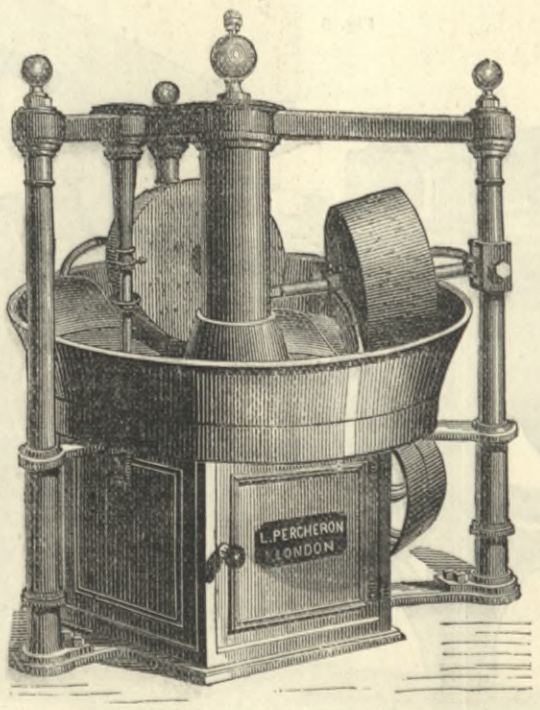
MACHINERY AND MECHANICAL APPLIANCES AT THE INTERNATIONAL HEALTH EXHIBITION.

No. I.

THOUGH at first it may appear that in an Exhibition devoted entirely to the subject of health there would be found little of any great interest to the engineer, we venture to think that in no previous Exhibition held in this country—or, for the matter of that, in any other country—has there been brought together so large and interesting a collection of machinery and mechanical appliances, which, if somewhat special in their application, yet embrace so varied a field, and are so intimately connected with the wants of the whole nation, as to render this portion of the Exhibition of great importance to those whose function it is to provide the means of producing the multifarious articles required in every-day life. A moment's consideration will show that under the single head of production of foods is comprised a sufficiency of machinery and appliances to interest the most varied tastes; and the same may be said in relation to other domestic matters, such as ventilation, water supply, coal combustion, furniture, and dress, all of which are, of course, most intimately connected with health. In some respects, also, it would appear that it has been attempted to make many of the exhibits representative types of their class, and we therefore find that considerable pains have been taken to show the manufacture of various articles of food, as well as several other processes, in as complete and comprehensive a manner as possible. We propose to describe each of these in its turn, but may perhaps just mention here that the process of making aërated drinks, of manufacturing mustard, soap, chocolate, cocoa, and sweetmeats, and of washing and drying by machinery, will be exhibited complete in every detail, while considerable space has been devoted to machinery and appliances for the preservation of perishable foods. In another part of the grounds are erected spacious buildings in which the principal dairy companies will show their machinery in full work, and a large octagon is specially devoted to the eight water companies, who exhibit models of their engines and pumping stations, full size sections of filter beds, and a number of specimens, maps, diagrams, and drawings relating to their various operations. Considerable space has also been allotted for the exhibition of bread-making appliances, and several mechanical bakeries will show how bread may be produced with the minimum employment of manual labour.

The great bulk of what may be called general machinery is comprised in the buildings known as the Western Gallery and Western Annexe, which may be approached from the grounds or from the west end of the large Central Gallery. The machinery in motion is all driven by one of Messrs. W. and J. Galloway and Sons' well-known horizontal twin compound engines, which occupies a central position in the Western Gallery. This engine we illustrate above. It is self-contained on a single bedplate, and has a 14in. high-pressure and 24in. low-pressure cylinder, each with 30in. stroke. These cylinders are placed side by side, and the cranks being at an angle of about 180 deg., no intermediate receiver is required, but the steam passes direct from the high to the low-pressure cylinder through short ports formed between them, the admission being controlled by a couple of flat slide plates. It is claimed that with this arrangement an equal balance of the working parts is obtained without the addition of counter-weights, while the valve gear is simplified and the

Fig. 1



length of the steam ports reduced. The admission of steam to the high-pressure cylinder is directly controlled by the governor which acts upon the slides through the medium of a link centred at one end. The governor is an almost isochronous one of novel design, and is shown in the engraving. The spindle, which runs in a footstep and bush in the usual manner, carries at the top a crosshead from which the weights are suspended by links. The weights are cylindrical rollers which roll in curved slots formed in the counterbalance, the outer face of the surface being a curve equidistant from a parabola by half the diameter of the weights, so that the curve described by the centre of the weights in rolling on their guiding surface is a parabola. The shape of the inner surface is immaterial, as the weights do not touch them. The counterweight consists of a rectangular block of iron turned on the ends, the bush being attached to it by screws, and it is driven by a feather on the spindle, in order that the joints of the links may be relieved of all twisting and binding action which would occur at a change of speed if the weight was merely revolved by the links. The friction caused by the feather is said to be less than that resulting from the twist in the joints, though both disappear when the spindle and rotating weights have assumed the same speed. The object of the arrangement has been to obtain a powerful governor of nearly isochronous action in a small space. We say nearly isochronous, for though perfection in this respect could be obtained by doing away with the links and permitting the weights to roll out on a horizontal crossbar, this is not considered desirable, but it is preferred to arrange the governor so that the speed slightly increases for its higher positions so as to ensure the rising of the counterbalance. Messrs. Galloway claim that the available power of this governor is about four times as great as that of a Porter governor with equal counterbalance, and that it is therefore specially adapted for comparatively heavy work, such as moving the expansion slides of large engines. All the details of the engine have been worked out in Messrs. Galloway's well-known style, and are extremely creditable to the drawing-office as well as to the workshop. The speed of the crank shaft is sixty revolutions per minute, and the power is given off direct from the fly-wheel, which is 15ft. diameter, an 18in. leather belt driving a countershaft placed below the ground, from each end of which the power is again transmitted by belting to lines of overhead shafting which extend to each end of the building, and revolve at a speed of 120 revolutions per minute. This shafting is 3½in. diameter, and is carried on cast iron A-frames about 9ft. high fixed in the centre of the gallery, the different lengths being jointed by muff couplings with internal cones. From this overhead shafting each exhibitor takes his power as is most convenient. In addition to supplying the engine and shafting, Messrs. Galloway have also erected in the annexe a couple of their cone tube boilers, made according to their 1875 patent, which supply steam at 70 lb. for the main engines, as well as for supplementary engines and other purposes. These boilers are made entirely of steel, and are each 26ft. long and 6ft. 6in. diameter. They are constructed on the most modern and improved system, the rivet holes being drilled after the plates are in their respective positions, and the edges are planed throughout, and fullered instead of caulked. The whole of the cone tubes are manufactured by machinery, as it is found that in this way the flanges can be got much

stronger than when they are produced by hand. It is, perhaps, worthy of remark that the first boiler constructed by Messrs. Galloway and Sons on their improved system was exhibited at the International Exhibition in 1851, since which time they have turned out nearly 5000 boilers of one kind or another, the design being improved from time to time, till it has developed into the present well-known type, with the back flue formed to a radius on the underside, so as to give greater strength and permit of more room for cleaning out. The boilers are supplied with Cowburn's dead-weight safety valves, Hopkinson's compound valves, and other fittings of the most improved character, and are in every way first-rate examples of what high-class Lancashire boilers should be.

A large and interesting exhibit is that of Messrs. F. Allen and Sons, Mile End, who show twenty-one distinct machines, besides a number of various utensils for the preparation of cocoa, chocolates, and confectionery. Seven of these machines are used in the manufacture of chocolate; five in the preparation of cocoas; four in the manufacture of lozenges; three for pan goods or comfits, such as sugar-coated almonds, carraway seeds, &c.; and five for the manufacture of boiled goods, such as drops of various flavours and forms, and the preparation of sugar for the making of cream goods. Chocolate is manufactured by placing cocoa nibs, previously roasted and deprived of their husks, into a mixer, shown in Fig. 1, page 337, this being merely a revolving pan with granite bottom and rollers of the same material, heated by steam, which reduces the cocoa in a few minutes into an oily paste. Sugar is then put in to sweeten and absorb the fluid oil, and vanilla or other spices added as flavouring. The mixing operation takes about an hour, the chocolate paste being then transferred to the refiner, Fig. 2, a machine having three horizontal granite rollers running at different speeds, the object being to cause a grinding action, in order to thoroughly crush any particles of cocoa or sugar that may have escaped being ground up in the mixer. After the whole mass is converted into a smooth paste, it is passed on to the air exhauster,

Fig. 3

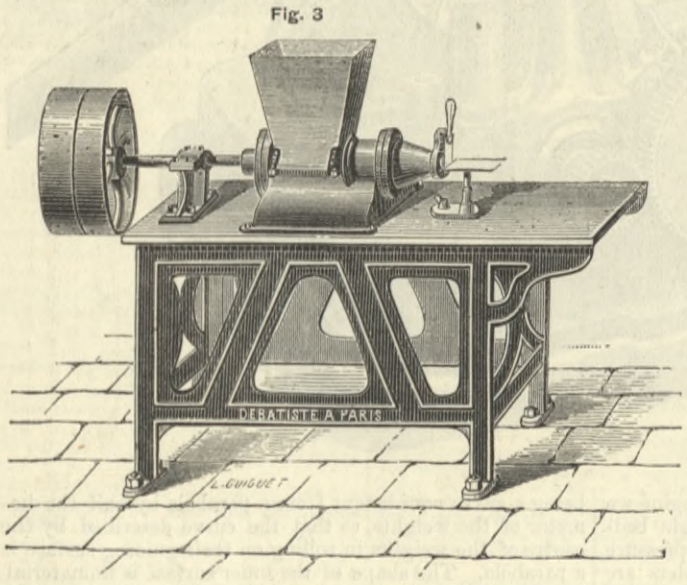
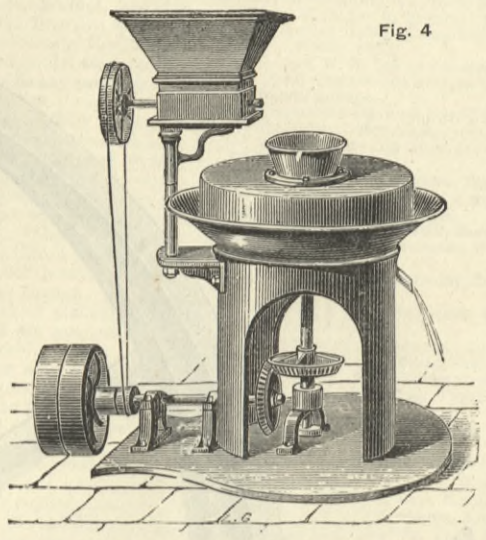


Fig. 3, in which a horizontal worm working in a hopper squeezes the chocolate up into a firm mass ready to be put in the moulds, which are generally made of tin, and are of an almost endless variety of forms. As chocolate concretes in a temperature below 80 deg. Fah. it is necessary to keep all the machinery and appliances used in its manufacture at that temperature or a little higher. In summer, when the outside air is above 80 deg., it is often very difficult to get the chocolate to harden before the fat separates from the solids, and frequently the manufacture has to be entirely discontinued in the hottest season of the year. To obviate this inconvenience, Messrs. Allen are erecting at their works one of Lightfoot's dry-air refrigerators, and by its means they will be enabled to maintain the temperature in an insulated chamber sufficiently low to cool without difficulty, no matter what the external heat may be. To carry on this part of the process at the Exhibition the Bell-Coleman Mechanical Refrigeration Company have erected at Messrs. Allen's stand one of their patent cold-air machines, which will be driven by a belt from the shafting. This machine has not been specially made for the Exhibition, but is one of the smallest sized gas-driven refrigerators made by the Bell-Coleman Company, which has been pressed into its present service at the last moment, the gas cylinder and large fly-wheel being removed in order to admit of its being driven by a belt. The machine is also larger than necessary for the purpose, being capable of delivering 3000 cubic feet of cold air per hour.

Cocoa may be divided into three chasses: (1) flake cocoa, which consists of the nibs roasted and deprived of the husks, and then partially ground or granulated; (2) ordinary cocoa, in which the nibs, after being ground to a fine powder in an ordinary mill with burr stones, Fig. 4, is mixed with arrowroot and powdered loaf sugar, in order to absorb the cocoa-butter; and (3) the essential extract of cocoa, a comparatively new form, which is produced by grinding the nibs into an extremely fine powder, placing this powder in strong linen bags, and subjecting it to hydraulic pressure till the larger portion of the cocoa-butter, which amounts to as much as 30 to 40 per cent. in good cocoas, is expressed. The pressed cocoa is then ground through a steel mill into a fine powder, and afterwards dressed in a silk bolting machine, the result being a pure cocoa, soluble in boiling water, and free from all fatty matter. To produce lozenges, powdered loaf sugar, with flavouring are put into a brass mixing machine, and

Fig. 4



worked into a stiff paste by the addition of a mucilage of gum arabic. The paste is then transferred to a kneading machine, consisting of a large pair of revolving rollers of brass, which thoroughly knead the paste and

Fig. 6

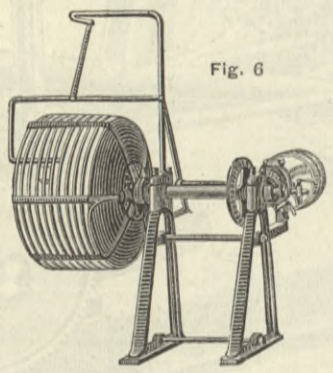
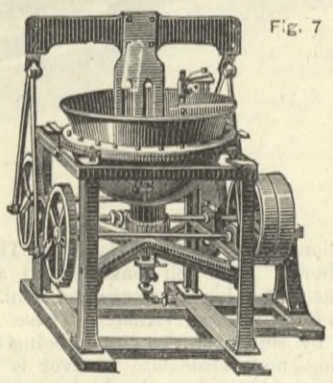
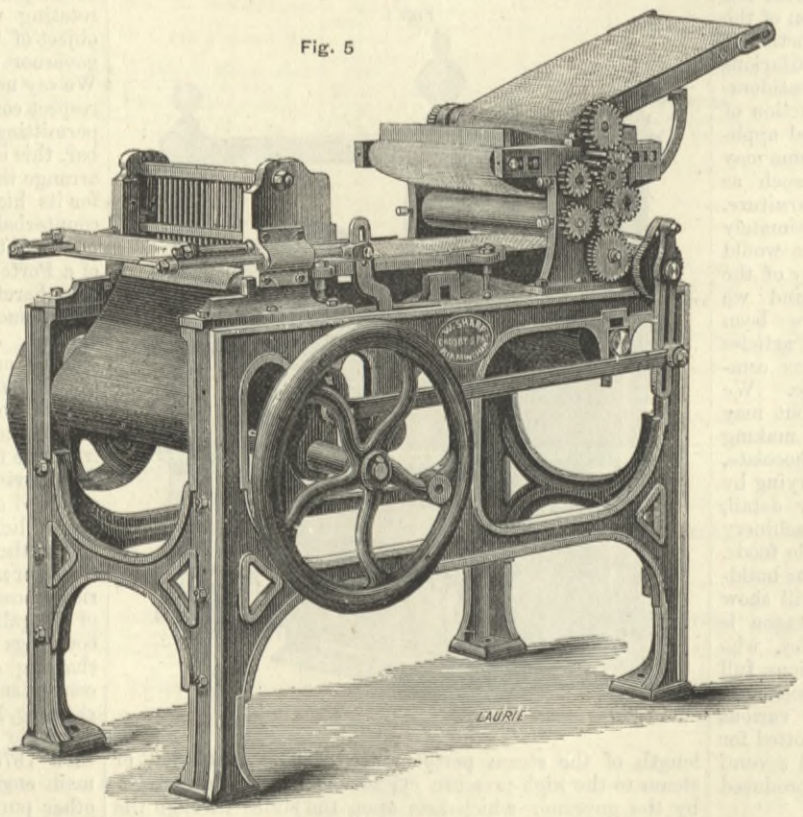


Fig. 7



make it ready for finishing. This last operation, or rather series of operations, is performed in a very ingenious machine, invented by Mr. Crosby, Fig. 5, which rolls the paste to the required thickness, stamps it in carmine, pink, or indented letters, and cuts it into the required shape.

Fig. 5



The lozenges are then spread out on trays and transferred to a drying room until they are sufficiently hard to pack.

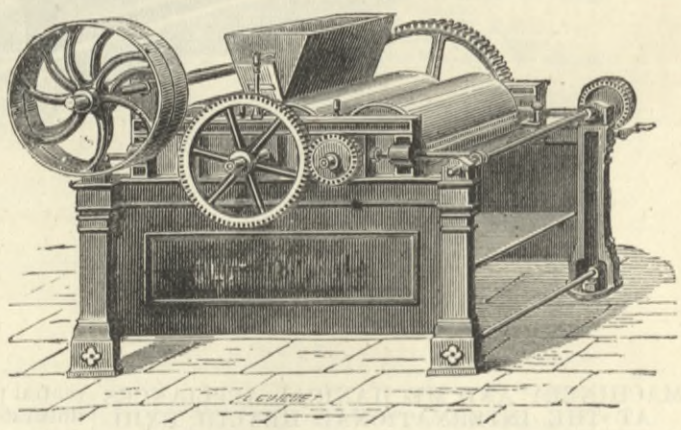
The process of making comfits consists in placing the objects that require coating, such, for instance, as Jordan or Valencia almonds, carraway seeds, or cinnamon, together with liquid sugar, into a copper pan, which is either rotated at an angle of 45 deg. or rocked backwards and forwards, Fig. 6. The motion of the pan works the sugar evenly over the goods to be coated, and the friction and heat dries it. This process requires to be repeated time after time, till the necessary thickness is built up, and in the case of the sweetmeat called rifleman's bullets, which weigh one ounce each, the building up takes no less than three weeks' work of ten hours per day.

Another class of sweetmeat with which everyone is familiar is the acidulated drop, flavoured with pear, pine-apple, or some other fruit. These are made of sugar dissolved in water, and heated to a temperature of 350 deg. Fah. It is then poured on to a polished steel slab, and becomes plastic, and after the citric acid and flavouring are worked in by the machine shown in Fig. 7, is passed through brass rollers having indentations of the form which it is desired to give to the drop. A great variety of these rollers are shown in operation, and visitors, in addition to having an opportunity of inspecting the mode of manufacture, will also be permitted to purchase samples of any or all of Messrs. Allen's productions.

Another complete process is that of making aërated drinks, which is shown by Messrs. Barnett and Foster. Beginning with bottle washing, syrup making, and gas generating, the whole manufacture is gone through, and the looker on, wearied, perhaps, with hours of wandering through other parts of the Exhibition, may here refresh himself with various mixtures of water, carbonic acid gas, and syrups, or may re-invigorate his frame with draughts of aërated beer, bottled on a new system recently patented by Mr. Foster.

The process of making unsweetened aërated waters consists of three distinct operations—the generating and washing the carbonic acid, the saturation of the water with the gas, and the bottling; while with sweetened waters the syrups or other flavourings are added by a separate operation combined with the bottling. The carbonic acid is generated by mixing whiting, or some other form of calcic carbonate, with sulphuric acid, the gas as it passes off being conveyed to a purifier for the purpose of removing any free acid that may be carried over, as well as any impurities that may have been given off from the sulphuric acid; and from thence into a holder, which is usually a bell made of copper, lined with tin, working up

Fig. 2

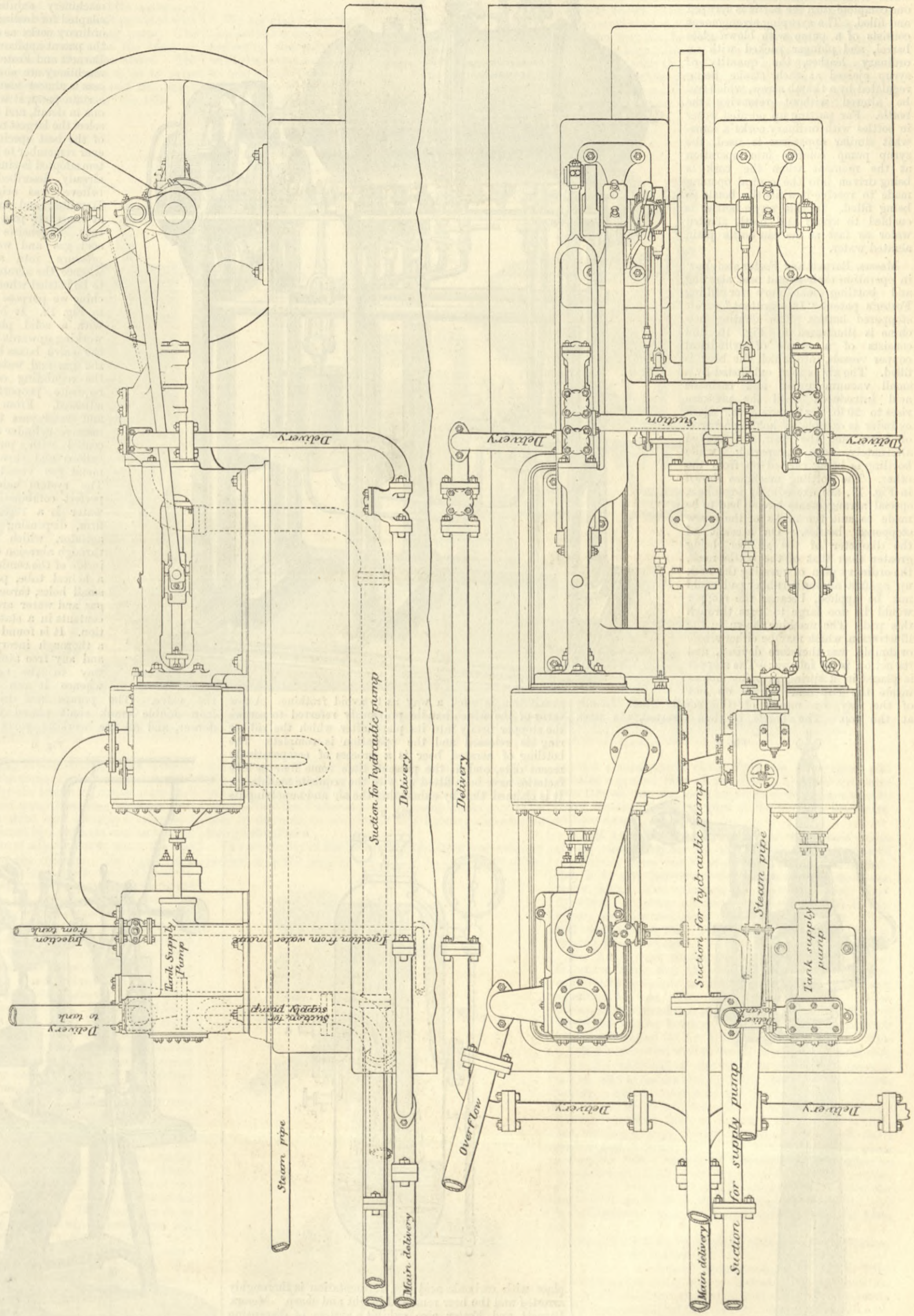


and down in an oak tub or cistern. The combination of the gas with the water is effected by pumping into a strong copper vessel, called the condenser, under a high pressure, the pump and condenser being combined together on one frame and bed-plate for compactness. The pump is an inverted plunger pump with valves at the top, gas being drawn in at one side and water at the other. The condensers hitherto made have generally consisted of a tin or silver-lined copper vessel within which is an agitator actuated by gearing from the outside, the spindle passing through a stuffing box in the usual manner, and samples of these are shown at the Exhibition. More recently, however, Messrs. Barnett and Foster have introduced what they term the "Niagara" condenser, illustrated in Fig. 8, in which mechanical agitation has been entirely dispensed with. The action of the apparatus is as follows:—Gas and water are pumped together into the annular compartment E, formed between the inner and outer casing, the liquid gradually rising and absorbing some of the gas which passes up through it. As soon as the level of the water thus partly charged with gas reaches the perforated plate D, placed at the top of the interior casing, it falls to the bottom of the vessel in the form of spray or rain, and in its descent becomes charged with a still further quantity of the compressed gas. It then accumulates in the lower part of the condenser in a state ready for conveying by pipes to the various bottling machines, a water gauge exhibiting the quantity of aërated water in store. The possibility of collapsing the gasholder bell by withdrawing all the gas by the pumps through inattention on the part of the attendant is provided against by fixing in one of the connections a diaphragm, so arranged as to break at a pressure below that at which the holder will collapse. In addition an electric bell is brought into action as soon as the supply of gas is deficient, and it can only be through the greatest carelessness that an accident of this kind can happen. Another improvement which makes the production of gas entirely automatic is to connect the holder itself by a cord or rods to the cock regulating the supply of acid to the generator. In this way the rise and fall of the bell decreases or increases the generation of gas. One of the latest forms of bottling machines, known as the

COMPOUND HYDRAULIC PUMPING ENGINES, H.M. VICTUALLING YARD, DEPTFORD.

MESSRS. FIELDING AND PLATT, ENGINEERS, GLOUCESTER.

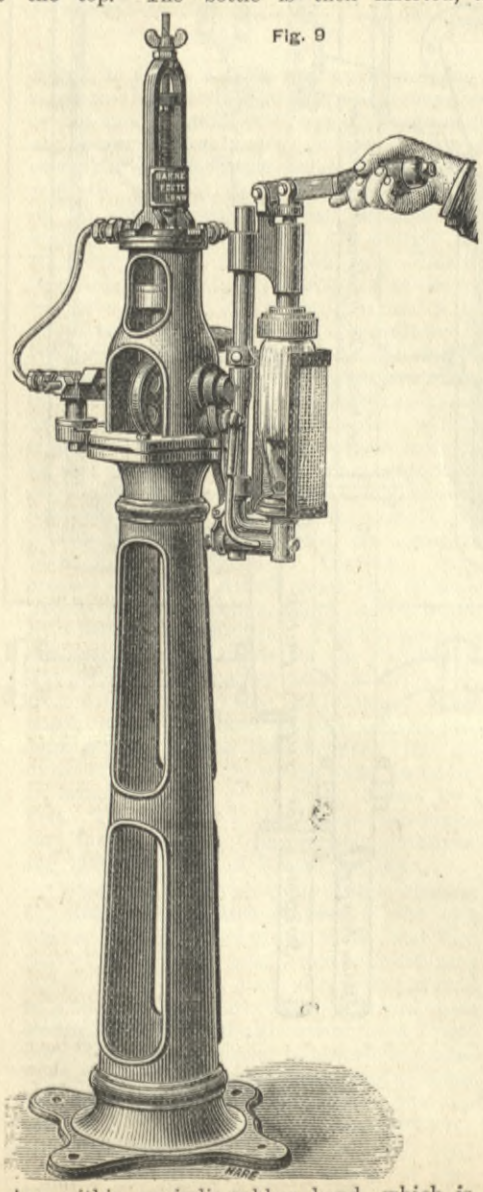
(For description see page 342.)



"Excelsior," is shown in Fig. 9, as arranged for use with Codd's patent bottles. The bottle being fixed in position by the handle shown at the top of the engraving, is revolved round a hollow horizontal axis, this motion first acting on the syrup pump by means of a cam, which causes the proper charge to be forced into the bottle, and then on the valve controlling the admission of aërated water from the condenser, so that in one complete turn the bottle is syruped and filled. The syruping arrangement consists of a pump with blown glass barrel, and plunger packed with an ordinary leather, the quantity of syrup ejected at each stroke being regulated by a thumb screw, which can be altered without removing the bottle. For putting up aërated water in bottles with ordinary corks a somewhat similar apparatus is used, the syrup pump coming into operation at the moment when the cork is being driven into the conical opening made to receive it while the bottle is being filled. In this way a bottler is enabled to syrup and bottle aërated water as fast as he can bottle plain aërated water.

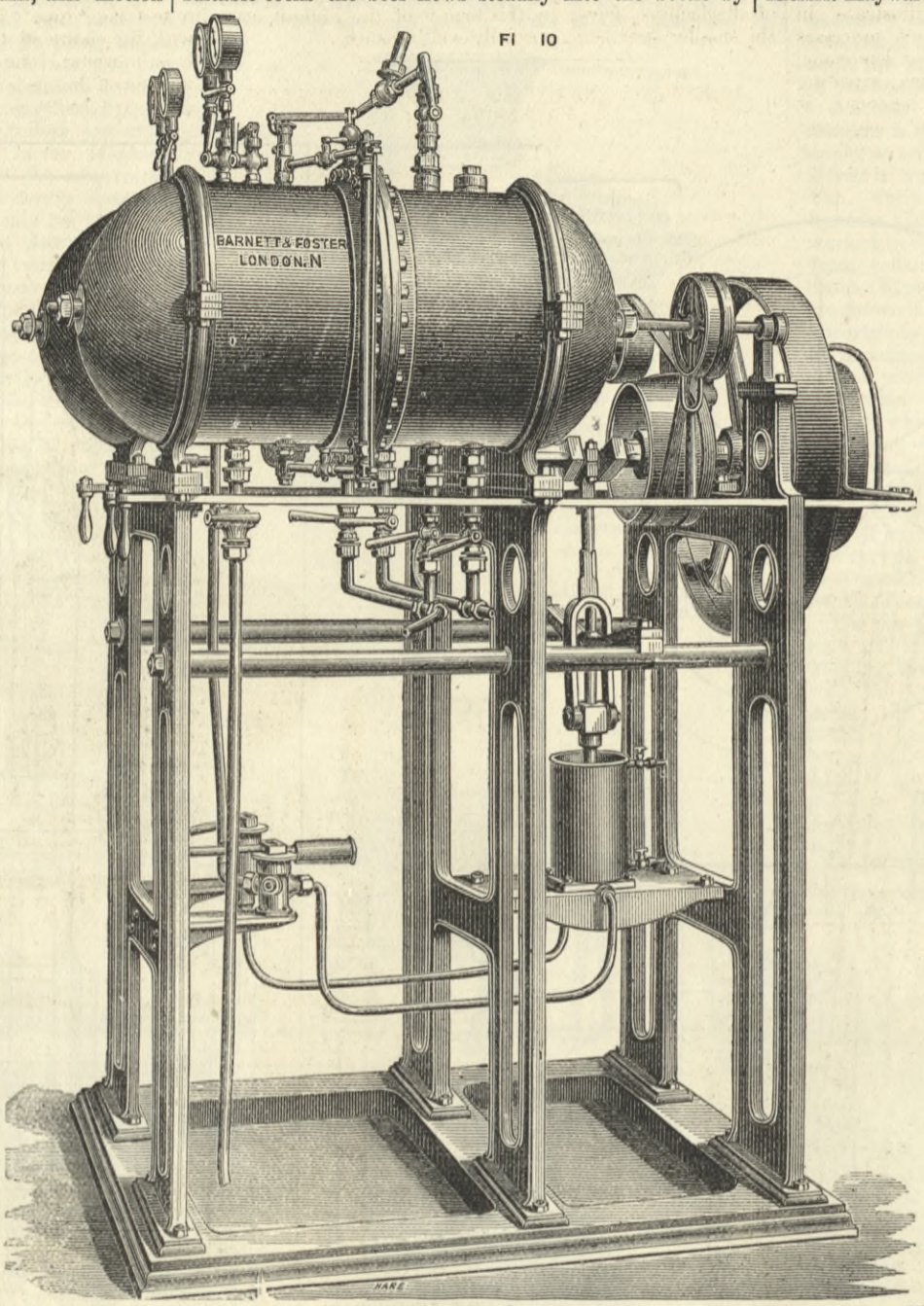
Messrs. Barnett and Foster also show in operation their patent beer aërating and bottling machinery for filling Foster's patent "Intermittent" screw stoppered bottles. The aërating machine is illustrated in Fig. 10, and consists of a couple of cylindrical copper vessels, into which the beer is filled. The air is then exhausted by a small vacuum pump and carbonic acid introduced until the pressure rises to 20 lb. per square inch. Each cylinder is capable of holding a barrel of beer, and the pair are worked alternately, one preparing while bottling is being carried on from the other. The bottling machines shown in Fig. 11, are exceedingly ingenious, special arrangements having had to be made to suit the necks of the screw stoppered bottles. On account of the diameter of the stopper being greater than that of the bottle neck, the ordinary plan of pressing the neck up against an india-rubber pad could not be applied, because the stopper would be too large to pass through this pad. The machine shown in the illustration, which may be either single or double, was therefore devised, and its action is as follows:—The stopper is placed in a spring gripping holder inside the cup and drawn up out of the way by means of the small winch handle at the top. The bottle is then inserted, the neck

Fig. 9



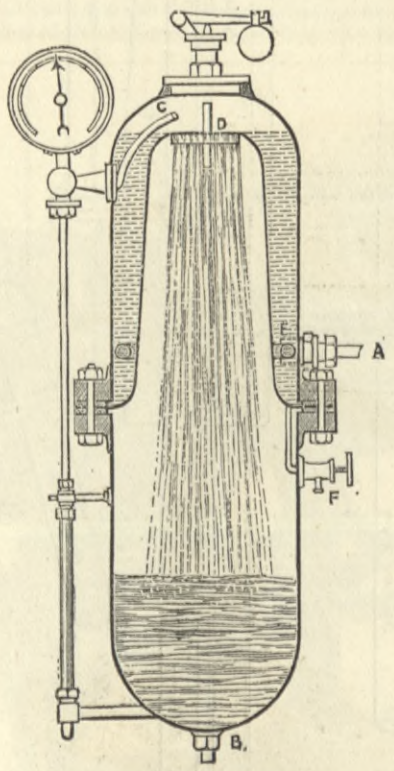
passing within an india-rubber band, which is capable of being pressed out from behind by water, pumped into the annular recess in which the rubber band is fixed by a single movement of a handle. The band thus closes and makes a tight joint, and on opening suitable cocks the beer flows steadily into the bottle by

Fig 10



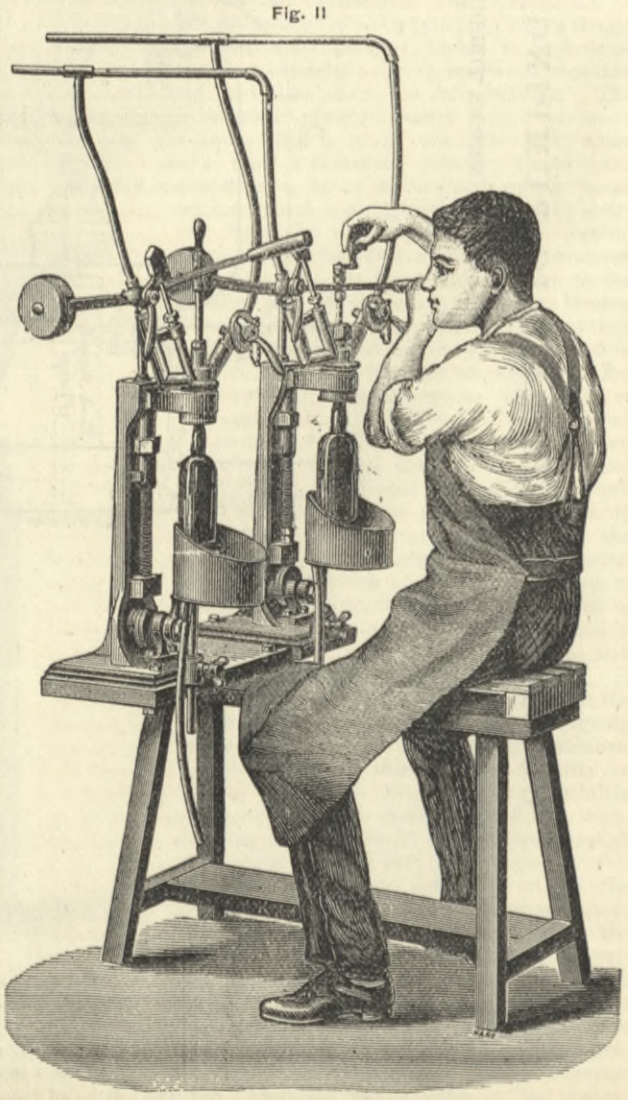
gravitation in such a way as to avoid frothing. A few turns of the winch handle previously referred to screws the stopper firmly into its place, after which the rubber ring is released and the operation is complete. The bottling of aërated beer is a process of comparatively recent date, and at the present time some four or five factories have been fitted up with the requisite machinery. It is claimed that by exhausting the air and supplying its

Fig. 8



place with carbonic acid gas, fermentation is thoroughly arrested and the beer rendered bright and sharp. Messrs. Barnett and Foster also exhibit a system of dispensing English beers in the manner adopted for Lager beer, but substituting carbonic acid gas for compressed air. This plan is said to be very suitable for private houses, where the daily draught is comparatively small, as the beer will keep sound and fresh for a much longer period than when air is allowed to enter from the outside. In the above sketch we do not profess to have given a description of all the machinery and appliances shown by Messrs. Barnett and Foster, and the visitor will find much to interest him in the supplemental apparatus, such as labelling and bottle washing machines, which our space will not permit us to notice. Messrs. Hayward Tyler and Co., Whitecross-street, E.C., though not occupying so much space as some of their competitors, show machinery of great interest and novelty. Their stand is devoted entirely to apparatus for producing and bottling aërated waters of various kinds; the machinery exhibited being chiefly adapted for dealing with bottles having ordinary corks as stoppers in place of the patent appliances used by Messrs. Barnett and Foster. Several plants of machinery are shown, but as the process is almost identical in all up to a certain point, it will suffice to describe one in detail, and for this purpose we select the largest machine, which is one of the best specimens of its class we ever remember to have seen. The system adopted is similar to what we have already described, and which, we believe, was originally invented by Hamilton and improved by Bramah at the early part of the present century. It consists in pumping carbonic acid gas and water at considerable pressure into a condenser, from whence the aërated water is drawn off to be bottled when required. The machine we purpose describing is shown in Fig. 12. It has two pumps, each with a solid plunger 3in. diameter working upwards through cup leathers, the valve boxes being at the top, and the gas and water are admitted by the regulating cocks by which the requisite proportions of each are adjusted. From the pumps the gas and water pass to the condenser, a massive cylinder of gun-metal thickly coated with pure tin, holding 28 gallons and surmounted by a gun-metal gas vessel with escape valve. The system adopted for securing perfect combination of the gas and water is a recent invention of the firm, dispensing with the revolving agitator, which often gave trouble through abrasion of the spindles. The inside of the condenser is provided with a helical tube, perforated with very small holes, through which the mixed gas and water are forced, keeping the contents in a state of complete agitation. It is found that by this means a thorough incorporation is effected, and any free atmospheric air finds its way to the vessel at top, from whence it can be discharged by the valve. The pumps are driven by a wrought iron double crank shaft placed just below the condenser, and all the working parts are extremely well

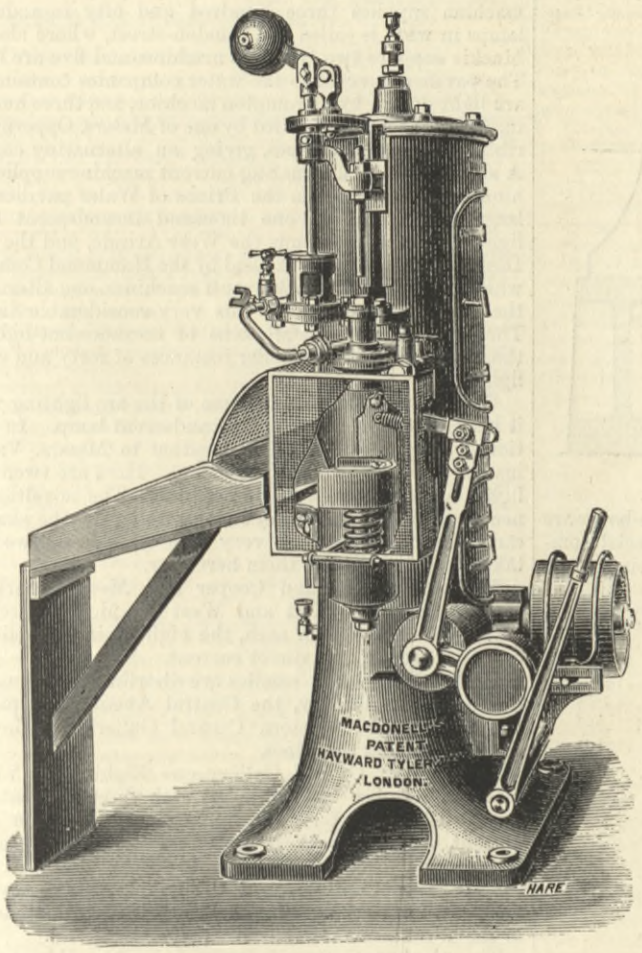
Fig. 11



designed and fitted. In small machines a single pump only is used, and in some cases it is convenient to place the pump separate from the condenser. The aërated water passes by pipes from the condenser to the

various bottling machines suited for filling "syphons," bottles with patent internal stoppers, bottles with Barrett's screw stoppers, &c. &c., each of which is interesting; but space will only admit of our minutely describing Macdonall's steam bottling machine, of which Messrs. Hayward Tyler are the sole makers, and which we illustrate in Fig. 13. In this apparatus all the different processes of injecting the various charges of syrup for lemonade, ginger ale, &c., the filling with aërated water, expelling the atmospheric air, corking the bottle, and delivering it to the wirer, are performed automatically, and with great precision, regularity, and speed. The machine consists of an outer casing and an inner revolving shaft provided with cams, which actuate the different working parts. The empty bottle is placed by the attendant on the block in front, and the cork is placed in the tube above. The bottle rest is then raised by the lower cam, so as to press the neck into a suitable water-tight collar, and the upper cam forces down the cork into the top of the tube, far bottler, so that the attendant has nothing to do but to place the bottles in the rest. Both these important inventions were specially mentioned in the award of the gold medal granted to Hayward Tyler and Co. for this class of machinery at the recent Calcutta Exhibition. The workmanship of all machines shown by this firm is of the highest class, the smaller sizes being specially well finished.

Fig. 13



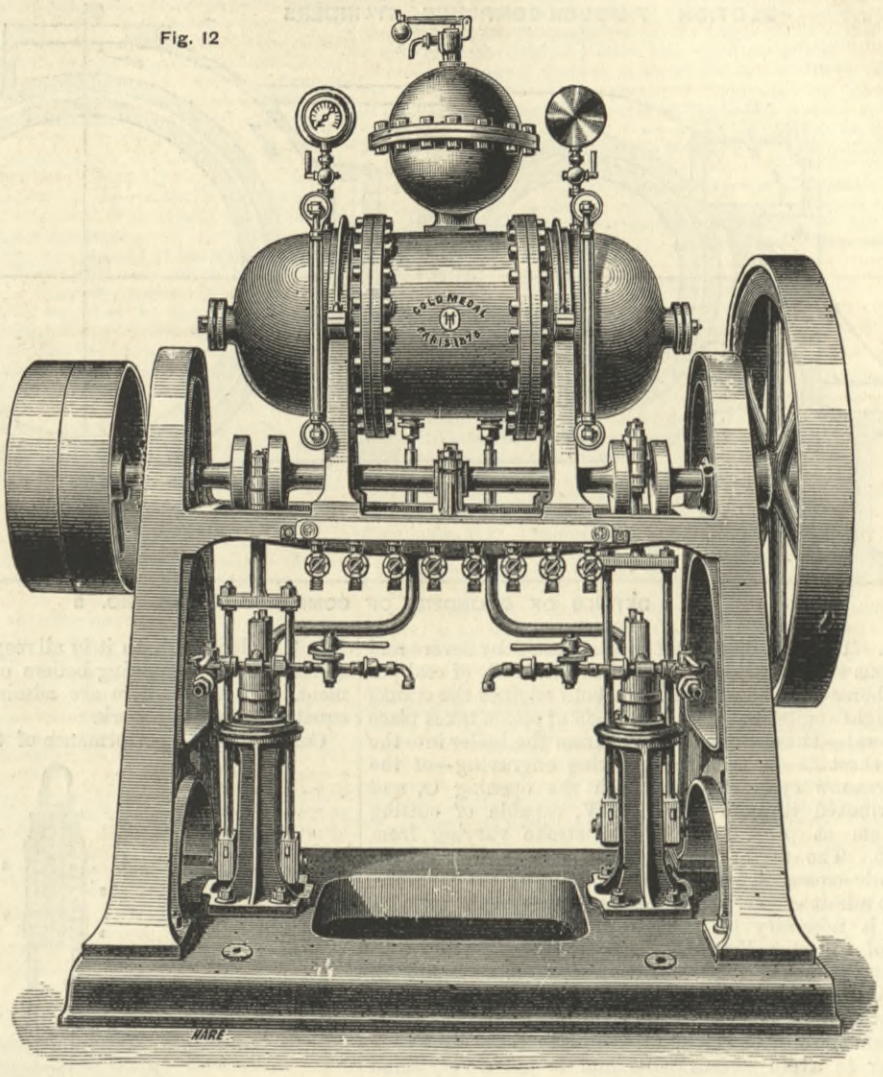
ELECTRIC LIGHTING AT THE HEALTH EXHIBITION.

No. I.

WE are glad to say that the authorities of the Exhibition are not going to commit the mistake of last year, of neglecting the arrangements for lighting the buildings until the season has greatly run by. The electric light is to bear almost the entire burden of the illumination, and takes it up at the commencement. The advantage of this to all concerned is very manifest. In the first place, noted. More especially should this opportunity not be lost of acquiring some useful and trustworthy statistics on the lives of lamps. If we take the duration of the Exhibition at 150 days, and give the burning time at four hours in the twenty-four, we have only 600 hours in which to test the lamps. Now this is a figure which, compared with the claims of the makers of lamps, is a very low one. It is, however, long enough to furnish—among the large number of lamps to be employed—a fair idea of the proportion of really poor lamps issued, and of the comparative merits of different varieties of lamp. These matters are no doubt known to the makers, but cannot be said to be firmly established as items of knowledge for even scientific men, who may not have had the opportunity of exactly observing a large installation during a considerable time.

In dealing with this subject we have first to consider the means by which power is provided. The electric light shed has been considerably enlarged, and a great deal more power has been provided. We publish with this impression a supplement, which illustrates the engines and contains a ground plan of the shed. Two bridges have been thrown over the main lay shaft, so that access may be freely obtained to every part of the shed by the public without danger.

Fig. 12



It will be seen from our supplement that there are in all six steam engines for the electric light, numbered respectively from one to six. No. 1 is a double engine; that is to say, there are two cylinders working on to one crank shaft. The cylinders are 19½in. diameter. Two fly-wheels, weighing collectively 8½ tons, and 12ft. in diameter, are mounted close together on the shaft. They will each take a 15in. belt. The engine is speeded at seventy-five revolutions.

No. 2 is a very similar coupled engine, the principal difference being that the cylinders are 18½in. diameter, and that there is only one fly-wheel 12ft. in diameter, and weighing 5¼ tons. This will take a 24in. strap. These two engines drive a lay shaft extending about four-fifths of the length of the building, and carried in high pedestal bearings supplied by Mr. Mumford, of Colchester. This l y shaft is provided with pulleys to drive various dynamos.

At the west end of the shed is No. 3, a compound engine with cylinders 15in. by 22½in. diameter. This engine stands, as will be seen from the plan, at right angles to Nos. 1 and 2. It will make 104 revolutions per minute. It has a fly-wheel 10ft. in diameter, which takes a 15in. belt, driving a large Ferranti dynamo. The crank shaft also carries a large pulley, the belt from which gives motion to a short length of countershaft, the pulley of which drives a large Brush dynamo with a Siemens exciter.

No. 4 is a compound semi-fixed engine—probably the largest ever made of the type—having cylinders 12½in. and 20in. diameter. It stands parallel with and not far from No. 3.

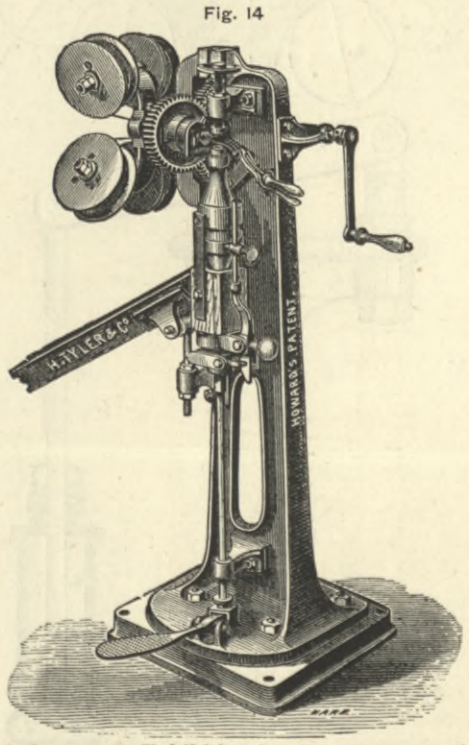
Engine No. 5 is a semi-portable, with two 10½in. cylinders, and runs at 140 revolutions.

No. 6 is a semi-fixed 25-horse engine, with two 12in. cylinders, and runs at 140 revolutions. The engines are fitted with Schonheyder's excellent sight-feed impermeators, which have already been illustrated in our pages.

The work to be done by these engines has hardly yet been settled by the electricians, but it can hardly be less than 1300-horse power; and we fear that, great as this is, it is not enough, the extent of space to be lighted being enormous. According to present arrangements, the main lay shaft driven by engines Nos. 1, 2, and 6, will supply power to the installations of Messrs. Siemens, Pilsen-Joel, Elphinstone-Vincent, Edison, and Hochhausen. No. 3 will, as

enough to close the opening at this end. At this moment the syrup is injected by the pump at the side, the quantity being exactly regulated by the length of stroke permitted to the pump. The aërated water from the condenser then enters by the action of a third cam opening a valve, and the atmospheric air is ejected by a separate cam and valve, each motion being capable of adjustmeut to meet the size of bottle and pressure in the cylinder. The upper cam then forces the cork into the bottle neck, the bottle rest descends, and an arm worked by a lower cam pushes the bottle away down a shoot to the wirer, the attendant then introducing another bottle, and the process re-commencing. The machine exhibited is one of the smallest size, and, attended only by a lad or girl, is capable of turning out fifty to sixty dozen bottles an hour. In the larger machines the process is almost identical, but the outer cylinder revolves round a central fixed cam shaft, the cylinder having three or six bottle rests, so that a number of bottles are being filled at one time. By these machines 150 dozen bottles can be filled in an hour with a single attendant. In the next process—that of wiring—a great novelty is exhibited, namely, Howard's patent wiring machine, Fig. 14. Hitherto the placing of the wires on aërated water bottles has always been the work of very skilled hands, the difficulty of making a machine to twist the wire into the proper shape, and secure it to the bottle, having been insuperable. The difficulty, however, has at last been overcome by the device of using four parallel wires, two of which pass over the top of the cork, and one along each side of the bottle neck, the four wires passing through a revolving die, which also carries the cutters which sever them at each operation in the middle of the twisted part, leaving a loop at the end of the twist for convenience in undoing by hand. The operation is as follows:—The wires, the ends of which have been left twisted, are drawn forward by a nipper moving in a spindle, the bottle being raised by the treadle, which pushes up the two wires, and causes them to pass over the work. The hand is then shifted to the crank handle at the side, and a single revolution of this handle communicated by multiplying wheels to the revolving die, twists the wires on the further side, drawing them tight over the neck and cork, and severs the twist as already mentioned. The treadle being released, the bottle descends, and an automatic catch delivers it down a shoot. The whole process is thus performed by two operations of the right hand, the left hand being free for putting in the bottles. Mr. Howard's patent also covers the carrying out of all these operations by mechanical means, analogous to those of the Macdonnell

Fig. 14

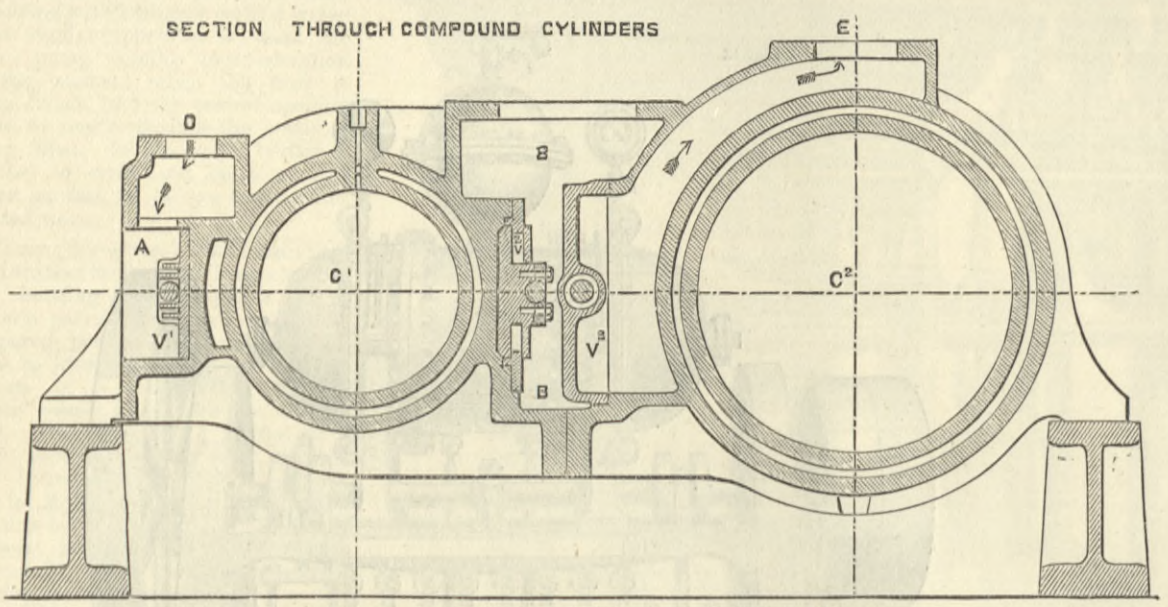


the promoters of the Exhibition will be able to keep the place open in the evening, and will we trust find considerable profit in doing so. It will be within the memories of our readers that the Fisheries were for many weeks only to be seen by daytime, on account of the lighting department being behindhand.

The popularity of the Fisheries Exhibition was certainly not less by night than by day, and if we may judge of the case of the present Exhibition by the former one in this matter, the public will certainly be satisfied at this fundamental difference between the two. But from the point of view of our readers, there is very much to be said as to the advantage of an extended trial of what are in many cases fairly extensive installations. We trust that statistics of failure and success in lighting up punctually and efficiently will be kept by impartial persons, and that variations in electrical pressure will be duly

we have already stated, drive a Ferranti and a Brush machine. Engine No. 4 drives a short length of lay shaft 4½in. diameter, from which power will be supplied to the Gulcher installation. No. 5 drives a cross shaft, from which power will be taken for five Gramme dynamos and exciters to supply current for the Jablochkoff installation.

About 320 out of the 1300 indicated horse-power will be supplied by the two compound engines Nos. 3 and 4; they are of different types. One—the "Colchester"—is a horizontal fixed engine, and the other is a semi-fixed engine. The stroke of both engines is 24in., and the piston speed about 400ft. per minute. In order to secure perfect regularity of speed and maximum of economy, both these engines are fitted with Paxman's patent automatic expansion gear controlled directly by patent high-speed governors. By means of this gear and governor the maximum variation of speed will be about 3 per cent. under the most unfavourable circumstances, and not more than 1½ per cent. under normal conditions. The consumption of fuel, as tested by severe and numerous trials, has always been less than 3 lb. of coal per brake horse-power per hour. In both engines the cranks are at right angles, and the distribution of steam takes place as follows:—The steam is admitted from the boiler into the steam chest A—in the accompanying engraving—of the high-pressure cylinder C, through the opening O, and is distributed through the valve V, capable of cutting off steam at percentages of the stroke varying from 0 to 75. The travel of this slide is regulated by the automatic expansion gear in combination with the governor, so as to admit exactly the quantity of steam to the cylinder which is necessary to do the work. The maximum travel of the slide V is 1¾in., and in altering the travel according to the various loads the lead remains unaltered, which is a great advantage this expansion gear has compared with many others. The travel being but very short, the steam is admitted through three ports at the same time in order to avoid wire-drawing, and to get a very small difference between the boiler pressure and the initial pressure in the cylinder. After the steam has done its work in the high-pressure cylinder C_1 it is exhausted at about 95 per cent. of the stroke through passages on the side of the cylinder opposite to those through which it was admitted into the steam chest B of the low-pressure cylinder C_2, which at the same time acts as a receiver. This exhaust is regulated by a separate exhaust valve V^2 with constant travel. The cranks being at right angles, the steam is compressed into the receiver B during about one half of a piston stroke, until the low-pressure slide V_3 opens the admission to the low-pressure cylinder C_2. The slide V_3, which also moves in the receiver B, is arranged to cut off steam at a little above half-stroke. The steam is finally exhausted through the opening E. The relative proportions of all the different parts of this improved valve system have been very carefully worked out and they are constructed so as to ensure the most economical results with a working pressure of 120 lb. per square inch. The cylinders of both engines are steam-jacketted, and, by means of a separate valve, high-pressure steam can be admitted into the low-pressure cylinder if desirable.



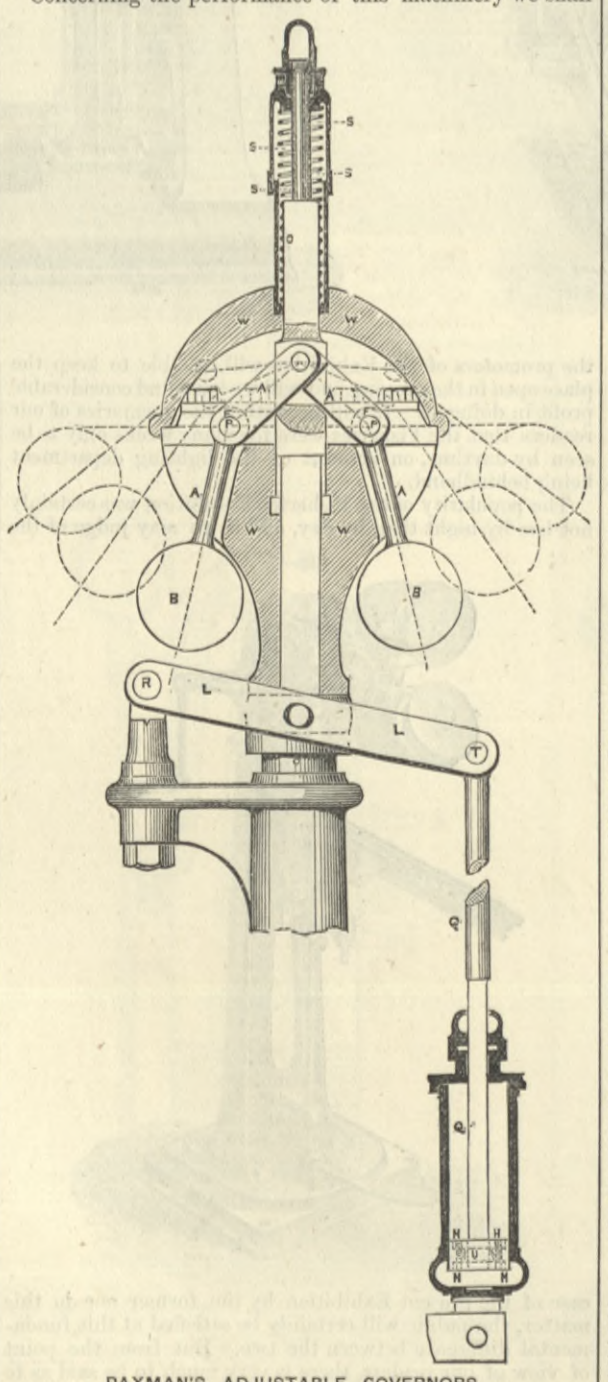
DETAILS OF CYLINDERS OF COMPOUND ENGINE, NO. 3

The two horizontal fixed engines, 1 and 2, and the two compound engines, 3 and 4, are fitted with patent governors, making two and a-half to three times the revolutions of the engines. These governors have been designed with the view of obtaining a minimum of friction, and a quick but gradual regulation of the engine speed, without the preliminary jumping which takes place with so many other governors before they get steady. The governor is of the dead-weight principle, and the counterweight W, in sliding up or down the spindle, moves the lever *l* round the fulcrum *r*, and transmits this movement at the point *t* to the link, or, in other words, to the automatic expansion gear. The arms *a*, carrying the balls *b*, are set out to a suitable angle, and their fulcrum is in the centre line of the spindle. The centrifugal force moving the arms *a* and balls *b* into positions, as shown by the dotted lines, lifts the counterweight W, by means of friction rollers F, placed on both sides of the pins P, and rolling in grooves formed in the counterweight. By compressing or slackening the spiral spring S, the engine can be adjusted whilst at work to run about 8 per cent. faster or slower. To further ensure, during frequent variations of load, a gradual working of these governors, they are provided with dash-pots. From the point *t* is suspended a rod *g* connected to a piston *u* moving in the dash-pot—which is filled with oil or glycerine. The piston *u* is provided with holes *h*, through which the liquid can pass; and these holes can be made smaller or larger, as may be desirable, by means of regulating screws.

Steam is supplied to the engines Nos. 1 and 2 by a group of six locomotive boilers, nominally of 40-horse power each. Each boiler has about 530 square feet of heating surface; the barrels are 4ft. 6in. diameter; the grates are 4ft. 8in. long by 4ft. wide. There are in each boiler 100 tubes, 2¼in. diameter and 9ft. 2in. long. The fire-boxes are of steel, with both bridge stays and sling stays. These boilers have been tested to 220 lb., and will work at 100 lb. They are clothed with Haacke's fossil meal composition. Each boiler is fed by a separate donkey pump, by Mumford, of Colchester, and draws its feed from a distinct tank set in floor. The fittings are all of a heavy type, and packed with asbestos.

Engine No. 3 is supplied with steam by one small and one large boiler. The former is 16-horse power, and was in the Fisheries Exhibition last year. The large boiler is entirely of steel and nominally 50-H.P. The barrel is 4ft. 6in. diameter, and the grate is 5ft. long and 4ft. wide. It has 100 tubes, 11ft. long. The boiler of the semi-fixed compound engine, No. 4, is identical with it in all respects; the fire-boxes are of steel. The remaining boilers call for no special comment. All the boilers are admirably made, being quite equal to locomotive work.

Concerning the performance of this machinery we shall have more to say after it has been fairly got to work. A start was made for the first time on Wednesday to get the bearings and guides clear of dust and grit, with which the building abounded. It is greatly to be hoped that the electricians will not demand more power than can be comfortably supplied, because no engine working expansively automatically can be expected to perform well if driven up to and beyond its full capacity. However, if 1300 or 1400-H.P. will suffice, it has been provided. It is a splendid installation, and will no doubt prove one of the great attractions of the Exhibition.



PAXMAN'S ADJUSTABLE GOVERNORS.

The entire Exhibition, with the single exception of the Queen's-gate annexe, is to be lighted by means of electricity. Various companies have undertaken different portions, the power to drive the electrical machinery being supplied to them. To divide the subject generally, we may state that there are 4450 incandescent lamps and 319 arc lamps, including among the last Jablochkoff candles. These lights are to be maintained by fifty-six machines, of which forty-two are direct-current machines, and fourteen supply an alternating current.

The Swan-Edison Electric Light Company undertake the Entrance Vestibule, the Art Gallery, and the two dining-rooms, and for this supply one thousand incandescent lamps and ten direct current machines. The South Gallery is lit by means of one thousand and eighty Swan lamps supplied by four Siemens machines, two giving direct and two alternating currents. Messrs. Gülcher and Crookes light the South Annexe with 300 lamps driven from their machines—direct current. One Elphinstone-Vincent machine supplies three hundred and fifty incandescent lamps in what is called Old London-street, where also Mr. Mackie supplies two Gramme machines and five arc lights. The pavilion devoted to the water companies contains one arc light driven by a Crompton machine, and three hundred incandescent lights supplied by one of Messrs. Oppermann's ribbon dynamo machines, giving an alternating current. A single Siemens alternating current machine supplies two hundred Swan lamps in the Prince of Wales' pavilion. A large installation of one thousand incandescent lamps lighting up the Aquarium, the West Arcade, and the West Dining-rooms, is taken in hand by the Hammond Company, which, by means of two Ferranti machines, one alternating the other direct, supports this very considerable display. These are the main installations of incandescent lighting; there are a few other smaller instances of forty and eighty lights.

We have noticed already some of the arc lighting where it has shared space with the incandescent lamp. In addition, we beg to call especial attention to Messrs. Varley's installation in the small corridor. Here are twenty arc lights supplied from a single machine. The novelties connected with Messrs. Varley's department in the shape of carbonised materials are very interesting, and we shall take occasion to notice them hereafter.

Messrs. Paterson and Cooper and Messrs. Clark and Bowman light the East and West Corridors respectively with eight arc lights in each, the eight being supplied by one machine giving a direct current.

Eighty Jablochkoff candles are distributed through the South Central Gallery, the Central Avenue, and parts of the Eastern and Western Central Galleries. They are supplied by four machines.

In the East Central Gallery one Elphinstone-Vincent machine supplies ten arc lights with direct currents, and one Brush keeps forty arc lights supplied with a direct current throughout West and East Quadrants, the East Arcade, and the third-class Dining-rooms.

The Pilsen Company and the Gülcher Company each maintain forty arc lights with two direct-current machines in the West and East Galleries respectively.

The Central Gallery is lighted by Mr. Edmunds by means of twenty-five arc lights derived from one machine.

The Central Fountain is illuminated by eight Sennett arc lamps.

It will thus be seen that there is still plenty of vitality in some of the best electric lighting companies, notwithstanding the depressing times that they have recently experienced, and some of the installations are quite large enough to furnish to those who are supplying the power very valuable information as to working expenses, if only proper measures are taken to collect it. We hope that those who have contributed so liberally towards supporting the Exhibition, as has been done by certain bodies, notably the City Companies, will see that their representatives upon the Council of the Exhibition do their duty in these and kindred points. The Exhibition, although in a very unfinished state, was opened with some little ceremony yesterday at noon, by the Duke of Cambridge. There was a very large number of visitors present, and there is no reason to doubt that the Exhibition will be extremely popular. Those under whose control it is have left nothing undone to make it attractive.

HYDRAULIC PUMPING ENGINES.

On page 339 we illustrate a pair of compound pumping engines recently constructed by Messrs. Fielding and Platt, of Gloucester, and erected at the Royal Victoria Victualling-yard, Deptford, for H.M. Government. The cylinders are 14in. and 26in. respectively, and 20in. stroke; they work pumps directly from the crossheads at a pressure of 700 lb. per square inch. The air pump is driven off the low-pressure piston-rod, and the high-pressure rod similarly works a tank supply pump. Both cylinders are steam-jacketted and fitted with separate liners of hard close-grained metal. The high-pressure valve is partly balanced. The hydraulic pumps are entirely of gun-metal, with loose seats of a harder mixture. It will be seen that the whole of the strains are met directly by the bed, which is of the modified girder type. A considerable number of this type of engine is now at work, giving great satisfaction.

On the property of the Penwyllt Dinas Firebrick Company, near Neath, South Wales, a bed of fine silica, 350ft. in thickness, has, we are informed, been found. Already the company possessed the largest area of the same material in South Wales, and the high quality of the bricks made from it has made the large extension of the works necessary.

Naval Engineer Appointments.—The following appointments have been made at the Admiralty:—Robert J. Barker, chief engineer, to the Asia, for the Cormorant; Martin Stewart, assistant engineer, to the Lord Warden; Stephen B. Williams, chief engineer, to the Defence; Charles A. Vogwell, chief engineer, to the Repulse.

LETTERS TO THE EDITOR.

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

H.M. TELEGRAPH SHIP MONARCH.

SIR,—I have only within the last two days seen the article in your issue of the 25th ult. regarding the new Post-office steamer Monarch, or should have written earlier to ask you to correct that part of it which relates to my connection with that vessel.

You say that I was called in to help the officers of the vessel to design her, which, of course, might mean that my duties were quite subordinate, whereas the fact is that I was appointed by the engineer-in-chief to design and take charge of the building of the vessel, Messrs. Lumsden and Cully giving me the outline plan of arrangements which they had prepared, and also affording me all information about their special requirements, quantity of cable, fuel, &c., required; arrangements for boats, stores, &c., which their great nautical and electrical experience so well enabled them to do. But as they are not naval architects, I had to take the whole charge and be responsible for the construction drawing, structural, sectional, and other drawings; specification, with all arrangements as to details of the construction of the vessel. I had also to make all the calculations as to displacement, &c., to estimate the weights and distribute them; in short, to do all the naval architect's duties. I think I may therefore fairly claim the first place in the designing of this vessel, and not a secondary one, such as your article suggests.

J. H. RITCHIE.
Mem. Inst. Naval Architects.

57, Fenchurch-street, London, May 5th.

PROFESSOR HUGHES' THEORY OF MAGNETISM.

SIR,—I have read with great interest in THE ENGINEER your remarks upon what has been designated Professor Hughes' theory of magnetism; and as I quite concur with you as to the importance of the subject, I trust you will give me space in THE ENGINEER to show that I had previously experimentally worked out and published in the *Electrician*,* in a series of papers entitled, "What is Electricity," a theory which in its outcome is almost identical. It is, moreover, interesting to observe, whilst it is in a measure confirmatory of the truth of the deductions, and not uncommon that two individuals, as in the present case, should arrive at the same general conclusions upon a subject, even when their investigations have been conducted by perfectly different methods and quite distinct from one another.

If I interpret Professor Hughes aright, he considers magnetism, like heat, a mode of a motion, and that when manifested the molecules or their polarities have all rotated. Professor Hughes states he has arrived at this conclusion from the curves of magnetic force which he has observed and examined in bars of iron and steel under different conditions; in fact, after describing the phenomena of the curve he says, "it would be difficult to explain these effects upon any hypothesis except that of molecular rotation, for if we regard it as simply a case of magnetic induction, the stronger re-acting upon the weaker, we fail to explain the perfect spiral, (helical?) form of the opposing waves;" and again, †"I regard the magnetic endowed qualities of all matter or ether to be inherent, and that they are rendered evident by rotation to a symmetrical arrangement in which their complete polar attractions are not satisfied."

The exact character of this motion Professor Hughes then describes as follows:—‡ "When magnetism becomes evident the molecules or their polarities have all rotated symmetrically, producing a north pole if rotated in a given direction and a south pole if rotated in the opposite direction." And he concludes his lecture at the Royal Institution in these significant words:—§ "Time will not allow me to show how completely this view explains all the phenomena of electro-magnetism, dia-magnetism, earth currents, in fact all the known effects of magnetism up to the original cause of the direction of the molecules of the earth. To explain the first cause of the direction of the molecules of the earth would rest altogether upon assumption as the first cause of the earth's rotation, and of all things done to the inherent qualities of the molecules themselves."

Now, if we are to consider magnetism as a mode of motion, there can be no manifestation of magnetic power without motion? and how does this accord with the views of Professor Hughes, "That when magnetism becomes evident, the molecules or their polarities have all rotated symmetrically, producing a north pole if rotated in a given direction, and a south pole if rotated in the opposite direction?" These words appear to mean that after the molecules or their polarities have rotated to a given point, they then become fixed in such position; and how, then, can magnetism be "a mode of motion?"

Now, I quite concur with Professor Hughes that magnetism is a mode of motion, and I hope to give a satisfactory solution of the above somewhat abstruse question when I call attention further on to the mode in which I have stated it is my conclusion that the earth obtains its magnetic charge. We will now turn to my investigations on the general subject.

My first published observations into the character of the magnetic force were contained in a paper read at the Royal Society in 1879,‖ the title of the paper being on "A New Method of Investigating the Magnetic Lines of Force in Magnets, Demonstrating the Obliquity of the Equator and Axis of Bar Magnets." The method consisted in suspending over every portion of the bar surface needle point test magnets varying from $\frac{1}{16}$in. to $\frac{1}{4}$in. in length. By such means I was enabled to show with great accuracy the curves of magnetic force, as the force was manifested over every portion of the magnets, together with the obliquity of the equator of bar magnets and other phenomena previously unknown. I continued these investigations by fixing two bar magnets lengthways in a groove, and by then placing one of the needle points on the end of the distant bar and pushing the other magnet towards it, I was enabled to define the character of the motion, and to ascertain that the force emanated from the bar in the form of right and left-hand helical directions, by which the *significance* of Faraday's lines of magnetic force became evident. I was thus also able to show that magnetic attraction depended upon two helices of similar denominations working into each other from opposite directions, and that magnetic repulsion was the result of dissimilar helices colliding as oblique forces against each other.

It is now well known that the magnetic pole is not situated at the end of the bar, but at some little distance removed from the end towards the equator. The cause of this phenomenon by means of my observations admitted of ready explanation, for upon placing two dissimilar poles together, which state of things is significant of magnetic attraction, the equator of each bar is removed from the centre, and is now situated at the line of junction, whereas, if two similar poles which are representative of magnetic repulsion are brought together, the two poles vanish from their position near the ends and are replaced by a single pole at the line of junction, thus demonstrating that the action which proceeds from the equator of a bar magnet in either direction towards the bar ends, is met by a corresponding reaction just as in the case of the two separate bars, and that the perpendicular position of the needle at the true pole is dependent upon its being supported on all sides equally at such point. The obliquity of the equatorial line and the curved lines which passed up the bars were significant of the resistance which the bar matter offered to the passage of the force, for although these lines might vary somewhat in different bars, I found from the many bars which I examined that the variation was too slight to set aside the existence of the law described. All these phenomena and others I exhibited at the *conversazione* of the Royal Society, held on April 30th, 1879. I also read a paper at the Physical Society of London on the same subject in 1879, and notices of these papers were published in the *Electrician*, *Nature*, &c., immediately afterwards. Subsequently I endeavoured to ascertain the cause of terrestrial magnetism, and inasmuch as all artificial magnetism is the outcome of impressed force, I was led to regard this as due to the earth's motion through the lines of force impressed upon it by the sun.

In the paper on this subject which I read at the meeting of the Physical Society on June 12th, 1880, printed copies of which paper I distributed at the time, I pointed out that the earth, as a mass of matter, is to be regarded also as a reservoir of energy, every form of matter entering into its composition being not only fully charged with the energy, but in direct communication with the sun by means of the continuity of the energy acting through space. In fact, the earth may be compared, as far as the energy is concerned, to a lake of water, the running level of which is maintained by the streams of supply and outfall. Every vibration, therefore, which is emitted by the sun which comes in contact with the earth tends to eject a like amount of energy from the earth, a new direction and impetus having been imparted by its passage through the earth. I further pointed out that the solar energy which impinges on the earth, and developes heat more especially in the line of the ecliptic, assumes right and left-hand helical directions as it traverses the earth towards the north and south poles, where, after undergoing many changes of state in its passage through the crust of the earth, it makes its exit again. Now, this latent energy, or *vis viva* of the earth is brought to a point at each of the magnetic poles of the earth, where it is met by a vortex of force of the opposite direction, the point of which is directed towards the magnetic pole of the earth, just as occurs in artificial magnetism. I next showed that if this be so, then the earth's rotation cannot be said to be maintained by inertia alone, unless this be the basis upon which inertia rests, but that it is partly the effect of resistance, an example of which is given in the rotation of Hiero's steam engine, and partly, also, of refraction, which light energy undergoes when it reaches the mass of the earth.

The late Professor Clerk-Maxwell arrived at the conclusion that matter was endowed with different properties owing to the mode in which the particles of a common matter—the ether—were primarily combined. It will be seen that the theory which I have evolved from the study of magnetism entirely supports this view, and shows that the axial inclination of the earth, and every planet, is the outcome of the mode in which the particular description of matter of which each is composed refracts the energy of the sun; and as the *vis viva*, or display of natural phenomena, which a planet exhibits is the outcome, other things being equal, of its particular description of motion owing to its axial inclination to the sun, so the particular manner in which the particles of matter are combined, and act as force directors, is the mechanism by which the work is effected. We can thus perceive that even when the molecules "have been rotated," as Professor Hughes has described, it is very possible for them to continue rotating upon the same axis without any apparent motion, for the first moving of the bar under the action of the impressed magnetic force would place the mass, and every molecule of the mass, in such a line as to permit the force being transmitted with the least resistance. This having been accomplished, it is evident that molecular rotation could continue in the artificial steel magnet without any visible motion, the only essential to the motion being the continued action of the impressed force; or, on the other hand, the molecules may be rigidly fixed in one position and simply act as directors of the force.

After the foregoing remarks I do not think it is difficult to perceive the mode in which magnetism is a mode of motion, and yet that such motion is not recognisable, for we are bound to admit:—(1) That the earth's mass is rotating upon its axis, whilst the energy of the sun is constantly impinging upon it with enormous force from, as it were, a fixed point. (2) That this force or kinetic energy, owing to the motion of the earth, is constantly pervading the earth's crust in right and left-hand helical directions. (3) That every form of matter, according to its molecular composition, has a certain power of diverting this force from a right line, and this constitutes the polarity of any description of matter. (4) That the greater the angle to which the force is diverted by any form of matter, the greater must be the resistance of the matter and the force of re-action from the opposite direction; consequently any local manifestations of polarity, apart from the terrestrial magnetic poles, are to be regarded as evidences of the existence of matter at these points which diverts the kinetic energy of the earth; but the rate of motion being equal, there is no apparent motion, upon exactly the same principle as there is no visible motion of matter whilst all is in rapid motion. Upon the same principle, I think it will be found that all natural phenomena are the outcome of the mode in which different forms of matter divert the kinetic energy of the earth.

Upon referring to some papers which were published in the *Electrician* in 1881 and 1882, under the title of "What is Electricity?" I find I used these words:—"I do not claim that the methods which I have adopted in my investigations are essentially new, but that the very minute test magnets I have employed to trace out the manifestations of this force in its form of magnetism over every portion of the surfaces of magnets—magnets under separate and combined action—have enabled me to divest this branch of science of all theory and to reduce it to a system of applied mechanics."* And, further, I show that all electric and magnetic phenomena are only different manifestations of that energy which exists in matter, as an element of its constitution under the influence of a compressing force, without which it would again pass into the form of ether. Although there is thus seen to be great similarity in the words which I used about three years since and those of Professor Hughes' so recently expressed, it will be perceived that our views differ also with regard to the identity of the electric and magnetic forms of force. I have adduced evidence showing that they are only modifications of one and the same force, and that the axes of power are in similar planes. And this, indeed, becomes evident when we regard, as we are bound to do, the locus of the points at which the needle stands at right angles to the bar as the plane of force, for at these points are the resultants of all the curved lines of force on either surface of the bar; moreover, all these curved lines vary in their co-ordinates according to their situation on the bar. We, therefore, perceive that the plane of magnetic force is at right angles to the axis of the bar, and that the motion of the galvanometer needle is due to an effort to place the force emanating from the bar parallel with the force moving in the wire.

For the further consideration of this subject, and the mode in which the energy of the sun is utilised by the earth in the maintenance of natural phenomena, not excepting animal and vegetable life, I must beg to refer to *The Electrician*, vol. viii., pages 197, 233, 267, 353, and 410, and vol. ix., pages 85, 110, 181, 326, 393, and 512. In addition, I cannot perceive in what way Professor Hughes accounts for the phenomena of magnetic attraction and repulsion, by means of his curves of magnetic force, unless it be in the mode which I had previously pointed out. Neither can I understand upon any other principle than that which I have advanced, why the pole of a magnet is situated at some distance short of the bar end; or why, when two similar poles are placed together, the polar manifestations are removed from their usual situation and occupy the line of junction, unless the phenomenon be the outcome of that action and reaction or motion to which I have attributed all magnetic phenomena. R. C. SHETTLE, M.D.

73, London-street, Reading, April 28th.

GERMAN TORPEDO BOATS.

SIR,—My attention has been drawn to a letter from a St. Petersburg correspondent in your issue of the 25th ult., which is so full of inaccuracies as regards matter of fact that it ought not to pass without comment. He speaks of torpedo boats supplied to the Russian Government, built in England in the year 1878. Allow me to state that there were only three constructed in this country for Russia in that year, of which two built at Poplar were never allowed to leave the country, and subsequently were purchased by the British Government. The third boat, built by another firm, was delivered after the war, and was never adopted by the Russian Admiralty as a type to be followed. Consequently, what your correspondent states about the boats built in England for the Russian Government at this date falls to the ground.

Having drawn attention to one important inaccuracy, I leave your readers to form their own conclusions as to the value of the remainder of your correspondent's remarks. Having had to do with the boats referred to as above, I speak positively of the facts.

The first torpedo boat ordered in this country by the Russian Government after the war was the Batoum, the first of its type. This order was given in 1879. G. ALLIMAN.

18, Great St. Helens, E.C., London,
May 7th.

RAILWAY SIGNALLING.

SIR,—The letter of Mr. Wm. Marriott, which appears on page 325, has very much surprised engine-drivers. From his letters one would gather that railway signalling is nearly perfect, whereas I can assure you, Sir, that it is very defective on many lines. I and fellow-drivers have often reported defective signals, and our locomotive chiefs say the matter is in the hands of the signal department. Mr. Marriott says there is a standard system in vogue; I can only only say if there is, it is a pity it is not strictly followed. As to good inspectors taking pains as to the position of signals, all I can say is I wish this was the case on the line on which I work. In conclusion, I can inform you of a portion of main line on which at least half the signals are in wrong positions or badly placed. The engine-drivers therefore heartily thank Mr. Clement E. Stretton—who is an honorary member of our society—for the public service rendered to us by calling attention to this matter in your valuable columns, and we sincerely trust that improvements will be the result. A MIDLAND ENGINE-DRIVER.

May 7th.

THE INSTITUTION OF CIVIL ENGINEERS' STUDENTS.

THE ninth annual dinner of the students of the Institution of Civil Engineers was held at the Holborn Restaurant on Wednesday evening last, May 7th, Sir Frederick Bramwell, F.R.S., senior vice-president, being in the chair. The gathering was large, over 140 students and guests being present. Amongst the guests present were Sir John Hawkshaw, F.R.S., past president; Mr. Thomas Hawksley, F.R.S., past president; Mr. John F. Bateman, F.R.SS. L. and E., past president; Sir Robert Rawlinson, C.B., member of Council; Mr. William Henry Preece, F.R.S., member of Council; Mr. J. Wolfe Barry, member of Council; Mr. Benjamin Baker, member of Council; Mr. William Shelford, M.I.C.E.; Mr. Chatterton, M.I.C.E.; and Mr. James Forrest, secretary of the Institution. The dinner was well served in what is known as the Venetian Salon, which is lighted throughout by the Edison incandescent electric light. It may be well to mention that the whole of the wines drunk at the dinner were the graceful gift of an anonymous donor, said during the evening to be Sir Wilfrid Lawson. The general arrangements reflected great credit on the members of the managing committee. The toasts were:—"The Queen," proposed by Sir Frederick Bramwell; "The Institution of Civil Engineers," proposed by Mr. Sidney Lowcock, chairman of the Students' Representative Committee, responded to by Sir Frederick Bramwell; "The Guests," proposed by Mr. E. W. Cowan, responded to by Sir John Hawkshaw; "The Secretaries of the Institution," proposed by Mr. F. W. Stokes, honorary secretary of the Students' Representative Committee, responded to by Mr. James Forrest, secretary to the Institution; "The Old Students," by Mr. Thomas Hawksley, replied to by Mr. F. Pettegrew; "The Students of the Institution," proposed by Sir Frederick Bramwell, replied to by Mr. F. J. Appleby; "The Students' Representative Committee," by Mr. A. Lovegrove, replied to by Mr. Sidney Lowcock; "The Generous Anonymous Donor of the Wine," proposed by Mr. F. W. Stokes. In his usual happy manner Sir Frederick Bramwell addressed the students, and with an amusing combination of the serious and witty, gained more than usual applause. Sir John Hawkshaw, in replying for "The Guests," expressed his great interest in the students' class and young men of the profession, and the pleasure which he had derived from being present that night at such a large gathering. Mr. Thomas Hawksley made some well-timed remarks in proposing the health of "The Old Students," and confessed his liking for old ways and customs generally, referring to his early experience and schoolday life in an amusing manner. Mr. Forrest also contributed not a little to the interest of the evening, while replying to the toast of "The Secretaries." Referring to students as a body, he assured them that in his capacity of secretary to the Institution no one could be more anxious than he was for their prosperity and well-being. He urged them to co-operate in the movement now on foot, and gave his hearty good wishes to the success of the organisation of the Representative Committee of Students. Mr. Sidney Lowcock referred to the question of examination before young men were admitted as students of the Institution. He considered this a most advisable step, as it would give the student a status which he did not at present possess. As chairman of the Student's Committee he was glad to be able to report that the work undertaken by the Committee was in a most promising condition. The question of a lending library was at present in abeyance, but five visits to interesting works had already been arranged for through the kindness of Sir Joseph Bazalgette, Messrs. Bateman, and Messrs. Appleby, and that many more visits were in prospect. Out of three applications for employment received, already one had been provided with a berth, while another was in a fair way to obtain one at once. He urged students to communicate with the honorary secretary, Mr. Stokes, as soon as they heard of vacancies, as this was one of the Committee's most useful capacities. There were abroad promises of eleven papers for next session, which he hoped the students would make a point of attending. He regretted that Sir Joseph Bazalgette was, from ill-health, unable to be present, but was glad that his place had been so ably filled.

Mr. Cowan and Mr. Stokes also made some very pertinent remarks on the several toasts they had to propose.

ARMOUR PLATE EXPERIMENTS AT COPENHAGEN.—In our number of March 28th we published an account of some important testing of steel and compound armour at Amager, near Copenhagen, and immediately afterwards our attention was drawn to the fact that there were certain inaccuracies in the report which Messrs. J. Brown and Co. considered were prejudicial to them. We delayed further comments on the matter until we had seen the official photographs. From these we feel bound, in justice to Messrs. Brown, to correct our former statement. Our sketch of the first shot on Brown's plate shows a crack to the top edge; but, judging by the photographs, no such crack was then formed, nor was it mentioned in our verbal description of effects. Indeed, although this crack was again shown in our sketch of the effect of the second shot, as well as a long crack to the right lower corner, the drawing is in this respect incorrect, as neither of them were formed until the third round. We hope to discuss this experiment in its general bearing on steel and compound plates in a future number, and we may add that while making this correction with reference to Messrs. Brown's plate, it appears to us that the photographs—which are excellent—suggest that minor corrections of a similar character should be made with regard to the plates of other makers.

* The *Electrician*, 1884, vol. xii., page 420.
† The *Electrician*, vol. xii., p. 394. ‡ Idem, p. 391. § Idem, p. 3[illegible]4
‖ *Vide* "Proceedings" of Royal Society, 1879.

* The *Electrician*, vol. viii., page 197.

SERAINE'S GAS ENGINE.

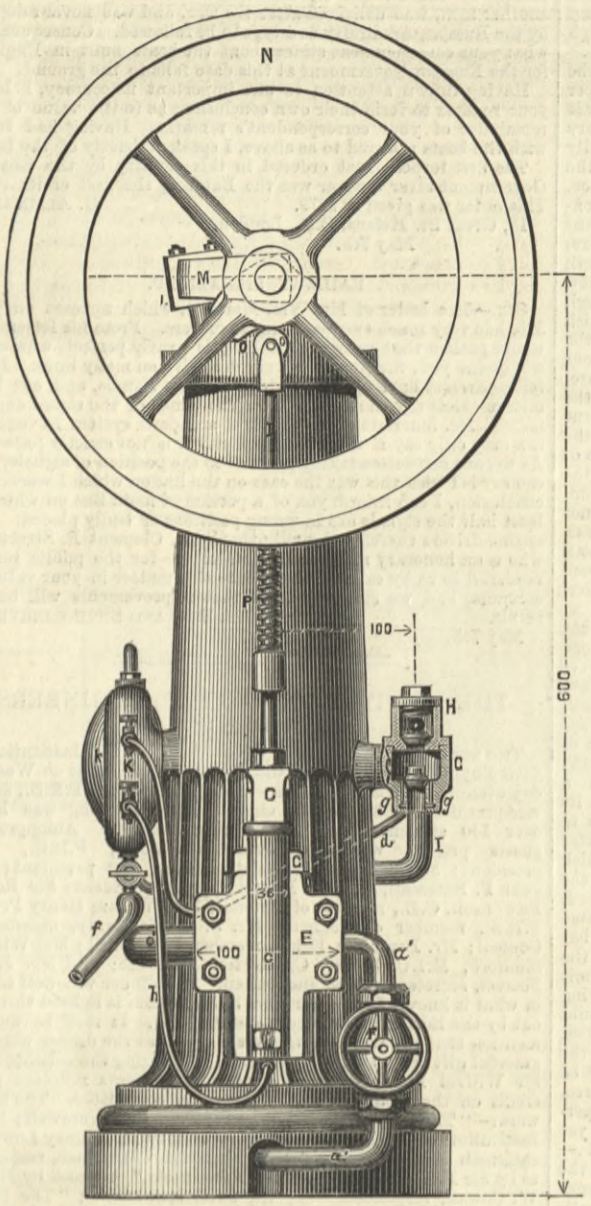


FIG. 2

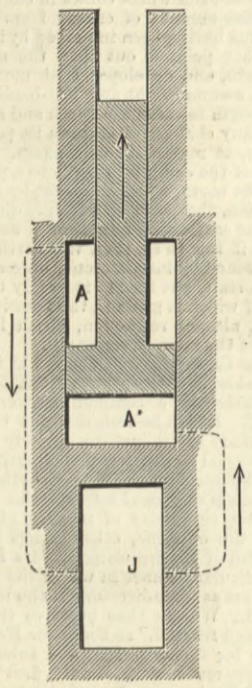


FIG. 1

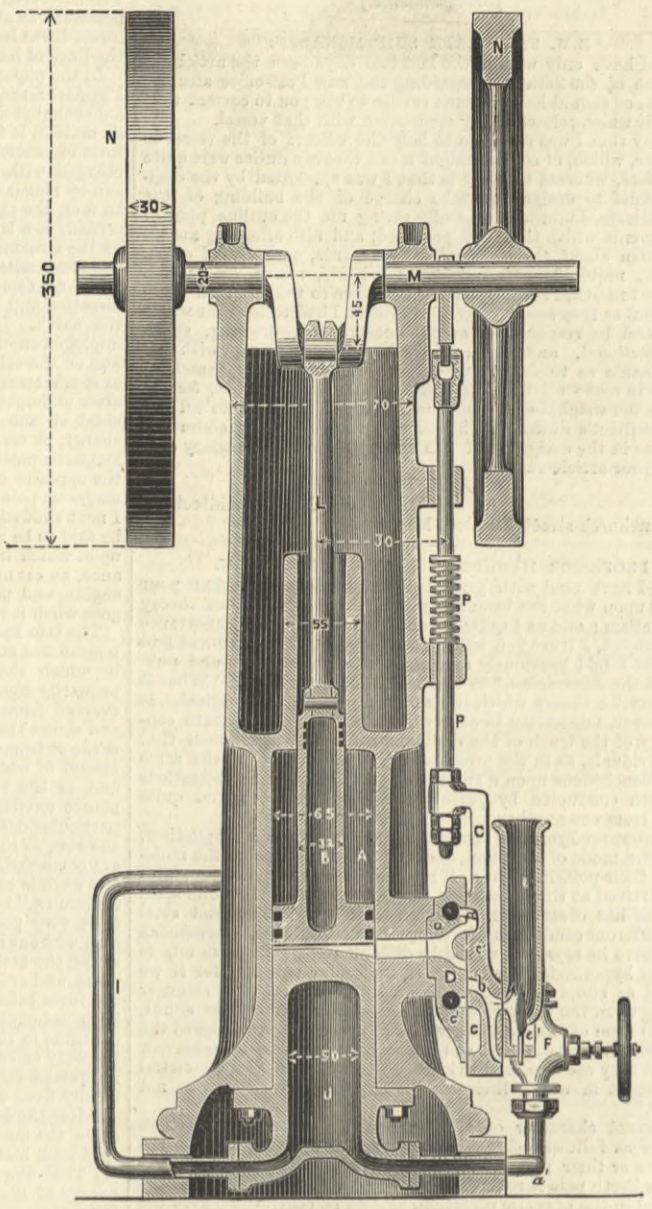
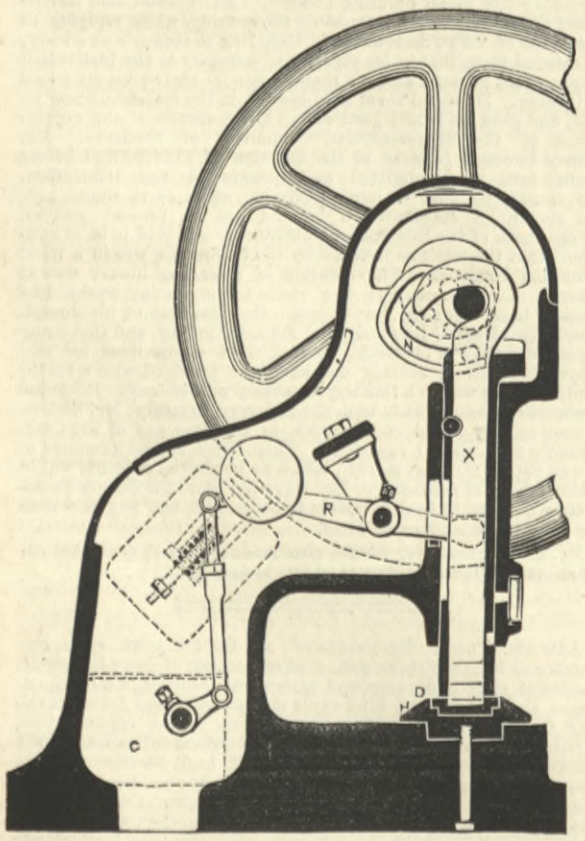


FIG 3

The gas engine illustrated above has been designed by M. J. Seraine, Paris, with a view to obtaining a higher efficiency by exhausting at a lower pressure, or in other words, by carrying the expansion of the heated gases through a greater range. The theoretical efficiency of a gas engine, such as the Otto, cannot under present designs be more than 0·33, and M. Seraine attributes much of this to the high pressure at which exhaust takes place. He says, for instance, that if the exhaust pressure could be by expansion reduced to one atmosphere that the theoretical efficiency would be increased to 0·63, and that taking the actual duty of an Otto gas engine as 0·106, the efficiency is but 0·321 of the theoretically possible efficiency.



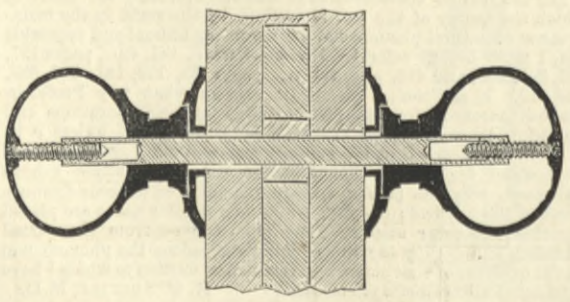
JAMES'S EMBOSSING PRESS.

To improve things, M. Seraine points out that increases of stroke and range of expansion will not secure the result, because the greater stroke will be accompanied by a greater quantity of gases, and the wasted heat in a high temperature exhaust will remain the same. He has, therefore, designed an engine in which the compression of the charge is rendered independent of the volume swept through by the motor piston, and yet to use this piston for compression, so as not to complicate the engine with a special compressing cylinder.

Fig. 1 illustrates the principle on which is based the construction of the engine. The part A of the cylinder of which the section is reduced by the piston-rod, serves for the compression and forcing of the mixture of gas and air into the space J below the motor cylinder. The compressed mixture passes thence to the bottom of the piston at A^1, and is there ignited by the burner in the position shown. Figs. 1 and 2, which we reproduce from the *Annales Industrielles*, show a vertical gas engine in elevation and section, of 6 kilogrammetres power, or 4329 foot-pounds per minute, equivalent to 0·131, or a little over one-eighth horse-power. A is the cylinder, the upper part of which is used for compressing; B, the piston; C, the distributing valve for the inflammable mixture through the port *a*; *b*, the igniting port; *c*, port by which the burnt gases escape; D is a slide face, carrying the admission port a^1 and escape port c^1; E is the plate by which the valve and the slide face casting D are kept in position; F, inlet cock; G, suction valve admitting air for the compression, admitting the air by the central part and the gas by a series of holes *g g*; H is the valve through which the mixture passes into the compressor; I, pipe conducting the mixture from the valve H to the reservoir J; R, reservoir for the compressed mixture; K, clarinette receiving the gas from the meter by the pipe *f*, passing it to the burner by the pipe *i*, and to the suction valve by the pipe *j* and the india-rubber bag *k*; O, cam commanding the distributing valve. The consumption of the gas is given by our authority as 600 litres of gas per horse-power per hour, or 21·2 cubic feet. Whether this is indicated horse-power or actual is not stated, but it is very low.

DENNIS'S DOOR FURNITURE.

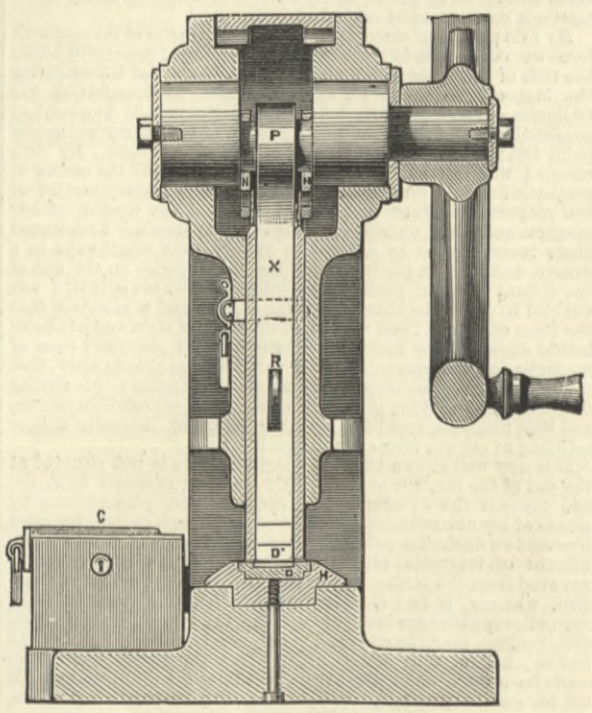
The accompanying engraving represents a new form of lock furniture, brought out by Mr. T. H. P. Dennis, of Chelmsford. The spindle of the lock is tapped with a screw thread at each end in the direction of its length. The knobs are also tapped in the centre of their outer end with the same screw thread as the spindle; when put in place they are secured to the spindle by a uniting screw which passes through the knob and engages into the screw thread of the spindle, as seen in the illustration.



The pull of course comes upon the thread of the central screw, but the advantage is that the knobs may be placed upon the spindle exactly where required, so that there shall be no end play between door plate and knob, and yet the spindle may turn freely. The play need not be more than one-fourth of the pitch of the screw thread as, if when on one way or square the knob gives a whole thread pitch of play, the knob may be turned through a quarter, half, or three-quarter revolution, and put on another square, and thus from one-fourth to three-fourths of a thread taken up. The screw cannot very well come out, for as soon as it moves out a little way it must be felt, and need not be lost like the very small screws used in most forms of lock furniture.

EMBOSSING AND RECORDING PRESSES.

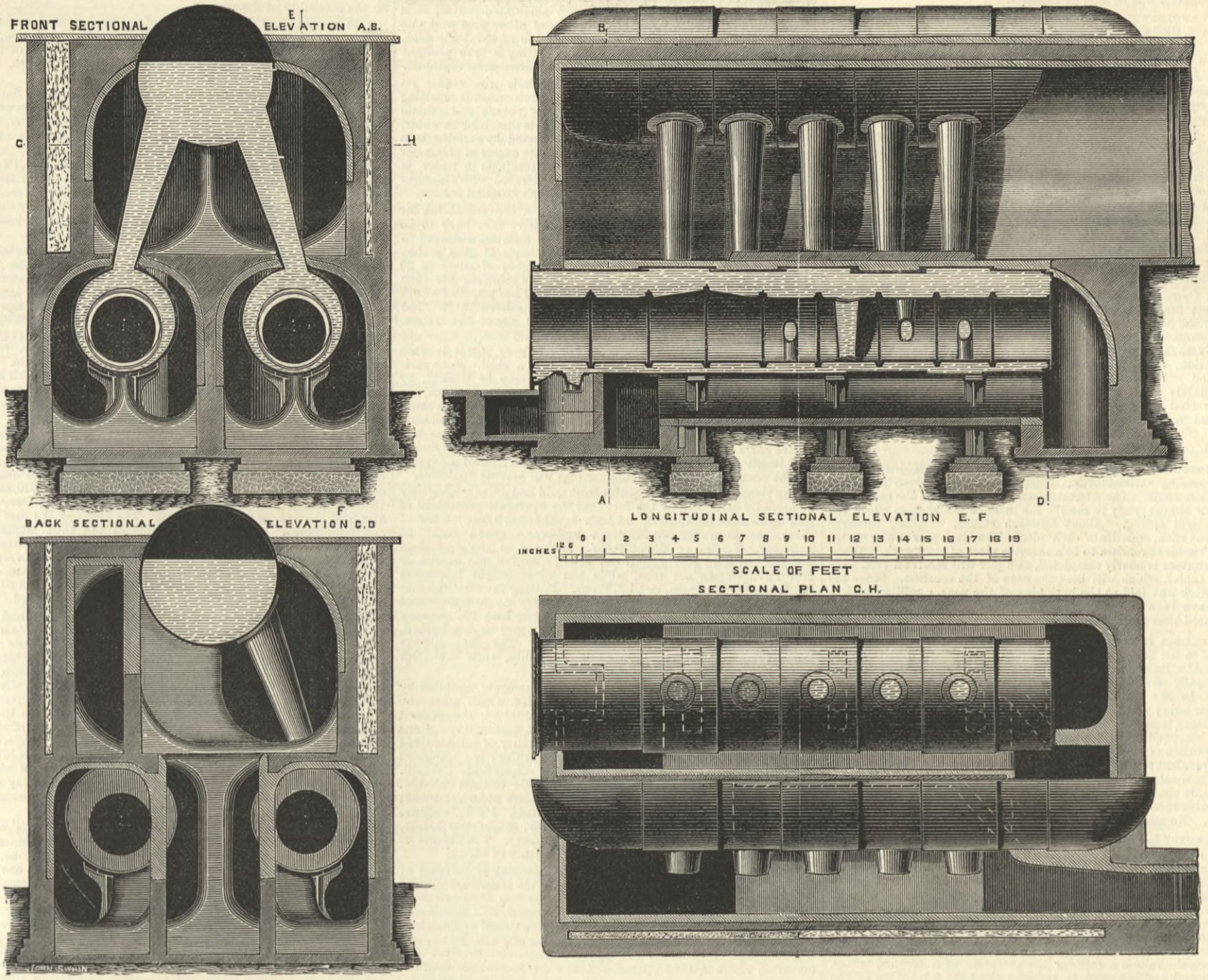
The accompanying engravings represent a recording and embossing press, made by Mr. Robert James, successor to Mr. Jabez James, of Princes-street, Commercial-road, S.E. The press is worked by the hand applied to a winch handle on the wheel moving it through part of a revolution forwards and backwards. A crank pin on the shaft of this wheel acts in a hook P on the rod X, which it throws up and down and actuates the plunger and the lever R. A pair of cams N N on the shaft give relative but similar motion to the tube which encloses the



JAMES'S EMBOSSING PRESS.

plunger and the die slide. By the back movement of the wheel the plunger levers R are raised, but it is not until the plunger has risen a certain distance away from the die slide that the latter is raised by the hook, so as to lift the die off the matrix or bolster D. When again the plunger descends the lever R is moved also, and through it the mechanism in the box C by which the impressions made by the die are registered. The pin near the letter X is a locking pin to prevent the use of the machine except by the proper persons. These presses have been made for various Government departments.

LIVET'S ELEPHANT BOILER AND SETTING.

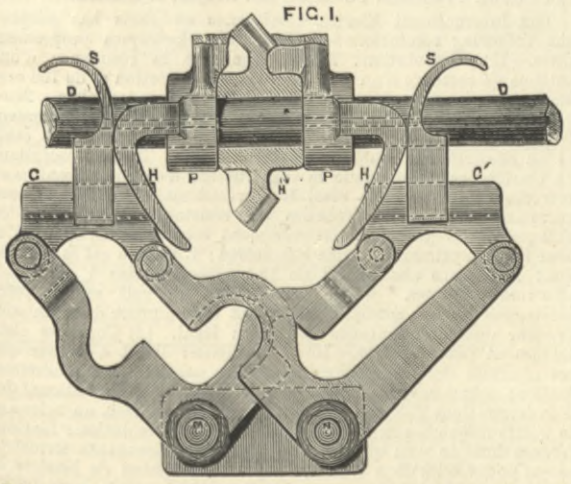


THE elephant boiler which we illustrate above is made by Messrs. Livet and Co., and set according to Mr. Livet's plans, a special feature of which is the arrangement of the flues so that they have a constantly increasing sectional area, the result of which is that velocity of the hot products of combustion decreases as their temperature becomes less. As the difference in the temperature between the gases and the boiler thus lessens, and with it the rate at which heat is taken up by the water, the gases move more slowly, and have thus time allowed them to part with their heat. All Messrs. Livet and Company's boilers are set in this way as well as that we illustrate. In the latter there is about 8ft. of water above the furnace flue, so that this is not likely to be injured by shortness of water. There is a large steam space in the upper cylinder, so that priming is unlikely, though the steam generated at the lower parts has to pass up through a high column of water. It will be observed the crown of the furnace flue is raised above the position of the bridge, so as to give extra room for the passage of the gases where combustion is very rapid. The boiler is carried on iron supports and is fitted with cross tubes. The advantages of the elephant form of boiler are so well known that it is unnecessary to give any description which the engraving does not convey.

WALKER AND SHOULER'S SHAFT SUPPORT.

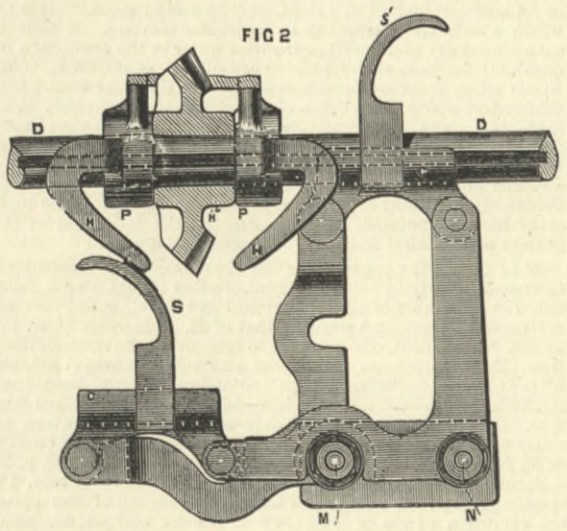
THE accompanying engravings relate to shaft supports as applicable to cranes, lathes, and other machinery, and description is scarcely necessary; the one view, Fig. 1, showing the mechanism in mid position, and moving in either direction, as the case may be; the other view, Fig. 2, illustrating the trough

FIG. 1.



C in solid contact with the shaft D, the bevel wheel and carrier marked P_1 P and H^1 receding from the trough C. It will be noticed that either of the troughs or bearings C and C^1 rises and falls to and from the shaft in a perfectly parallel line to it, and that the elasticity of the snail pieces S and S^1 when being pressed down by either of the horns H_1 H_1 ensure a perfect bearing with an entire absence of any falling movement or metallic percussion, which is not usually the case. With other apparatus hitherto in use, and from its perfectly noiseless action in consequence, wear and tear on any of the parts is reduced to a minimum. Six pin joints are all that is required, and it will readily be seen upon reference to the engravings that

FIG 2

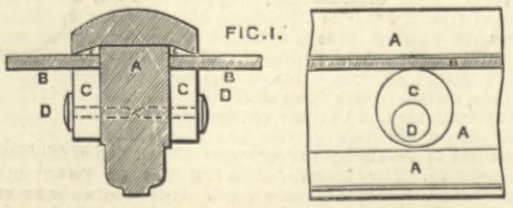


the lower stud pins M_1 N_1 not only act as pivots, but determine the precise or exact angles of the L-shape levers, and preclude the possibility of any angular inaccuracy whatever. The levers and troughs or bearings are made of malleable iron, and all the parts are interchangeable. These bearings are the invention of Messrs. Walker and Shouler, Nursling-street, Leicester.

DENNISS SYSTEMS OF GLAZING.

THE systems of glazing illustrated by the engravings given below have been brought out by Mr. T. H. P. Dennis, of Chelmsford. Fig. 1 shows the form intended for use with wood

FIG. 1.



sash bars and putty, the glass B being held up against the putty E by cork excentrics C and copper nail or pin D. Fig. 2 shows the form proposed for the roofs of weaving sheds, warehouses, and horticultural buildings, the excentric wedges C being held by screw pins and nuts G. Fig. 3 shows an arrangement of metal sash-bar with metallic fittings, dispensing with putty, and the part I being the movable part of the sash bar which holds the gas and conveys away any water. This form is proposed for railway and other roofs. The whole of the glazing is done from the inside of the building, and in all cases the glass can be taken in and out without climbing on the roof. The glass cannot be removed from the outside, thus affording security from

FIG.2

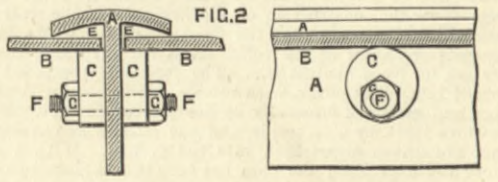
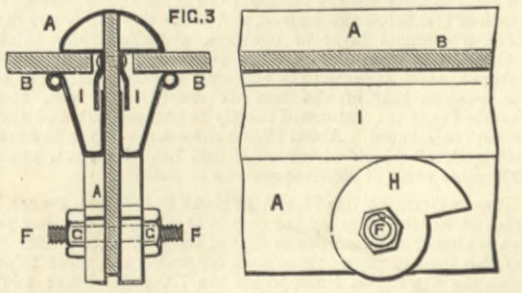


FIG.3



external entry. In the system employed for horticultural buildings, putty is employed on one side of the glass only; the roofs are rendered water-tight, and loss of internal heat, as far as this can be effected by exclusion of air from without, or by preventing leakage round the glass, is effectually prevented. The putty, where used, is protected, and we are told that roofs of horticultural buildings can be glazed under this system at the same cost as ordinary putty glazing, and more rapidly.

SEWAGE SCHEME: PORT OF GOOLE, YORKSHIRE.—On Friday, the 2nd inst., an inquiry was held by Mr. J. T. Harrison, C.E., one of the inspectors of the Local Government Board, with reference to the Local Board borrowing £6000 for works of sewage and street-making. The scheme was prepared by Mr. E. C. Buchanan Tudor, C.E., P.A., S.I., surveyor to the Board, who explained the plans in detail. There was no opposition, and the scheme was favourably considered. Mr. Tudor has also prepared and carried out a scheme for the south side of the town in Old Goole, which was visited by Mr. Harrison for the purpose of seeing the flushing arrangements, designed by Mr. Tudor, by pumping water from a deep bore hole with one of Bailey's hot-air engines, raising water 30ft. high to a tank holding 21 tons. For 4d. the whole contents of the tank are discharged down either line of 15in. pipe in 120 seconds.

RAILWAY MATTERS.

On the occasion of the celebration of the fiftieth anniversary of the commencement of the Belgian railways an International Industrial Congress will be held at Brussels.

M. Vandensweep, Administrator-President of the Belgian State Railways, died at Brussels on Saturday. During his long official career he contributed much towards the development of the Belgian railways.

The *Exchange Gazette* states that engineers have been sent from the Caucasus to Teheran to obtain permission to unite Baku with Resht by a new railway running for 350 miles along the shore of the Caspian.

Mr. Leon Francq has sent us a copy of an official statement of the cost of working the Lille and Roubaix tramway by means of the fireless locomotive. The total cost is given as 0·363f. per train kilometre, equal to 0·182f. per car kilometre, to 0·017f. per ton per kilometre, and to 0·004 per passenger kilometre.

"There was a dense fog at the time." This line is always in type. During a fog at Chicago a few days ago a goods train on the Grand Trunk Railway ran into the rear of a passenger train on the same line which was standing at a station in the suburbs. The coaches were telescoped, two passengers being killed and fifteen more injured.

The Council of Ministers at Athens on the Eastern Railways Question has made some important modifications in the proposed convention with Baron Hirsch. The Council insists that, should past accounts, which are of great importance, not be settled in a friendly manner within three months, they must be submitted to arbitration, that all future differences are to be settled by the Ottoman tribunals, and that the Baron Hirsch Company shall immediately become an Ottoman Association. A further condition is that all army transports, soldiers, provisions, and war material are only to pay at the rate of one-fourth of the general tariff. These counter proposals have not yet been ratified by the Sultan.

The rebuilding of the Hoo Brook Viaduct, near Kidderminster, is proceeding satisfactorily. There are to be nineteen piers and two abutments. The abutment and three piers at the south end are now almost ready to receive the massive stones from which the arches will spring. About fourteen stones, weighing upwards of 5 tons each, constitute each pier. The block pier at the centre of the viaduct promises to be a massive piece of brickwork. When the structure is nearly completed, this pier will receive a 10ft. wide stone tablet, which will bear the date of the erection. Since the first brick was laid at the beginning of the year, a million and a-half have been bedded, and if the supply can be maintained, it is estimated that upwards of 200,000 bricks will be used every week.

An extract from the official report of the Minister of Public Works to the President of the Council of Ministers with reference to the Alcudia bridge disaster, based upon the engineers' report, is textually as follows:—"The occurrence was almost certainly caused by the train leaving the line at the first pillar on the Badajoz side; and the engineer assures me that he has found indications that the rail on the side upon which the train fell was either removed from its place, or was without spikes, which might be the origin of the train leaving the line." Such, says a Madrid correspondent of the *Times*, is the evidence so far published—that a criminal act was the direct cause of the catastrophe. The engineer adds that the telegraph wires were cut in two places, and attributes this, as well as the cutting of two posts, to criminal action. No trace of the criminals, however, has yet been found.

A project has been formed, writes a *Times* correspondent, "and will, in all probability, shortly be executed for uniting the Hôtel des Alpes, at Territet Chillon, and the Hotel de Mont Fleury, which is situated on the steep mountain side immediately above Chillon, by an electric railway. The difference of altitude between the two hotels is 180 metres, and a few days ago the system which t is proposed to adopt was put to an experimental test. Rails of a gauge of 50 centimetres were laid on a part of the mountain for a length of 50 metres, and with a gradient of 30 to the 100. Between the rails is a rack for the reception of a toothed wheel, and at each end is a curve in order to show the advantage of the proposed system over the funicular system, which does not admit of the slightest curve. The wagon carries a dynamo-electric machine, which actuates by special gearing a toothed wheel on the axle in connection with the rack between the rails. An electric and an ordinary brake enable the conductor to modify the rapidity of descent at pleasure. The electricity was produced for the occasion, and in the first instance, by a dynamo-electric machine of five-horse power, actuated by a portable engine. This engine it is intended to replace eventually by a turbine, for which there is an ample supply of water."

A Board of Trade report has been published on the works in progress for the construction of the bridge over the river Forth, from which it appears that the most important works at South Queensferry consist of the coffer dams for the south cantilever pier and for No. 7 viaduct pier. The former is composed of two rows of 12in. sheet piling, with outside struts bearing against the piles, and sustained internally by heavy cross timbers. The dam measures 115ft. by 65ft. inside, and the piles, which average 47ft. long, are driven about 21ft. into the ground. With a view to safety and expedition the dam has been divided into two halves; the eastern half is completed, the water pumped out, and a trial pit sunk in the centre to ascertain the depth of the hard clay; at a depth of 9ft. below the surface, and 12ft. below low-water of spring tides, a compact layer of boulders, averaging 18in. thick, was reached, and immediately below this the hard boulder clay was entered, which appears to be very stiff and compact. The piles of the western half of the dam are nearly all driven, and it is expected that the water will shortly be pumped out and the excavation commenced. About 96,000 cubic feet of granite have been delivered, of which 64,000 cubic feet have been set, and about 8000 cubic yards of concrete are now in position.

While Germany has 21,865, England 18,685, and France 18,050 miles of railway, Turkey has only 1015 miles, though her population is almost as numerous as that of these three countries. There are four lines of railway now open for traffic, the most important being the Roumelian lines, which are 730 miles long; and upon which, in 1881—the last year for which statistics have been given—the receipts were £587 a mile. The Smyrna, Cassaba and Alachur Company has 295 miles of railway, which in 1881 carried 395,000 passengers and 470 tons of goods; its receipts being £1125 to the mile. The Aidin Company has 120 miles of railway, and carried 190,000 passengers and 500,000 tons of goods; its receipts being £1088 to the mile. The Haidar Pasha line is 58 miles long, and its receipts in 1881 were £573 per mile. There is also a short line, 26 miles long, from Mondavia to Broussa, which was opened a few years ago. But it has been allowed to fall into disuse, and the inhabitants of the district through which it passes are using the sleepers as firewood, and the rails themselves to brace up their houses. Four new lines are now in course of construction:—First, the junction with Western Europe, from Vrania to Salonica (56 miles), and from Bellara to Sofia (30 miles); secondly, the secondary line from Aidin (40 miles); thirdly, the line from Messina to Adana (44 miles); fourthly, the line from St. Jean d'Acre to the Jordan (36 miles). The following lines, though no concession for them has yet been granted, have been declared "of public utility": —First, the line from Ismidt to Bagdad, by way of Angora, Cesarea, and Diarbeher (1500 miles); secondly, from Esaicheir, Cornia, and Aintab to Diarbeher (750 miles); thirdly, from Afioun-Kora-Hissar to Alachier (125 miles); fourthly, from Samson to Siras (250 miles); fifthly, from Siras to Erzeroum (312 miles); sixthly, from Broussa to Yenitini (62 miles); seventhly, the Syrian lines (310 miles). Thus when all these lines have been constructed the total mileage of the Turkish railways will be only 4600 miles.

NOTES AND MEMORANDA.

When brass castings are of too complicated a form to be ground, filed, or machined, they may be finished by the action of acid, either alone or combined with a varnish. After cleaning the casting by heating it and plunging it into acidulated water, it is immersed in a bath composed of two parts of nitric acid and one part of water, or one part of sal-ammoniac, one of sulphuric acid, one of nitric acid, and one of water. The casting is then plunged into pure water, then into hot soap ley, and dried in hot sawdust.

The insolubility and infusibility of chromic iron render its analysis one of the most tedious. Schwarz recommends smelting the finely pulverised mineral with chlorate of potash and caustic potash, in a silver crucible. The fused mass is dissolved in water, and the quantity of potassic chromate estimated by running in a solution of ferrous sulphate, then titrating the excess of the latter with permanganate solution. The residue, insoluble in water, is dissolved in hydrochloric acid, and the iron titrated with stannous chloride. A good silver crucible will stand one hundred fusions.

The following formula has been given for a convenient ink for marking, by means of a stamp, textile articles that have to be washed:—Twenty-two parts of carbonate of soda are dissolved in 85 parts of glycerine, and triturated with 20 parts of gum arabic. In a small flask are dissolved 11 parts of nitrate of silver in 20 parts of officinal water of ammonia. The two solutions are then mixed, and heated to boiling. After the liquid has acquired a dark colour, 10 parts of Venetian turpentine are stirred in it. The quantity of glycerine may be varied to suit the size of the letters. After stamping, expose to the sun or apply a hot iron.

When a casting is very thin, even if of soft grey pig, it is often as hard, even though run in sand, as if cast in a chill. Such castings may be annealed, so that the surface may be worked, by putting them in boxes and raising the temperature to redness. In the case of grey iron the castings are surrounded with coarse sand, and heated for forty-eight hours; but in that of white iron they are surrounded by a mixture of one part of sal-ammoniac and twelve parts of hammer scales, and heated for twenty-four hours. This length of time is sufficient to soften the skin; but if the operation be continued for a week the castings will become malleable.

The riches of the United States from gold and silver mining may be partially estimated by the fact that the aggregate production of gold up to June 30th, 1883, has been 1,632,364,670 dols. That of silver has been 598,083,217 dols., making a grand total of 2,230,447,887 dols., or £446,089,577. Reduced to the equivalent weights, the total gold output has been 78,965,572 troy ounces, or 2707·4 avoirdupois net tons, while the silver weight represents 462,590,469 troy ounces, or 15,860 tons. Putting the statistics into another form, the gold produced in the country up to the present time, if brought together, would be sufficient to load 271 ordinary freight cars; the silver, supposed to be collected as fine bullion, would require 1586 cars for its transportation. The gold would tax the carrying capacity of a large ocean steamship, while the silver would form cargoes for a considerable fleet.

The water of the old sulphur well at Harrogate, analysed by Professor Thorpe, at a temperature of 9 deg. Cent., gave the following:—Specific gravity at 16·8 deg. was 1011·04; it contained in each gallon 1047·561 grains of solid matter, besides 3·772 grains of free sulphuretted hydrogen. The total quantity of sulphuretted hydrogen, free and combined, was 6·935 grains; the combined being reckoned as 5·215 grains of sodium sulphydrate (NaHS). Other constituents are barium chloride, 6·566; calcium chloride, 43·635; magnesium chloride, 48·281; potassium chloride, 9·592; lithium chloride, 0·753; ammonium chloride, 1·031; sodium, chloride, 893·670; magnesium bromide, 2·283; magnesium iodide, 0·113; besides other constituents of less moment. The absence of sulphates is, of course, explained by the presence of barium.

From a paper recently presented to the Academy of Sciences of Berlin, by Herr Quincke, it appears that the compressibility of liquids may be shown under pressures of even less than one additional atmosphere. Herr Quincke experimented with liquids contained in glass bulbs, with a capillary tube attached to them vertically; the bulbs were placed in the chamber of an air pump, and the decrease of volume resulting from increased pressure was observed, which method promised more exact indications than the opposite one of watching the expansion under diminished pressure. Water carefully freed from air by continuous boiling was compressed by 49 millionths of its original volume under a total pressure of two atmospheres. The following figures express the compressions of some liquids resulting from one millimetre additional pressure, also in millionths of the respective volumes:—Glycerine, 0·03; olive oil, 0·07; alcohol, 0·12.

In a paper on "The Theory of Cement Hardening," Herr E. Landrin calls the silica which has been precipitated from a silicate by an acid and ignited at a red heat "hydraulic silica." It is this which effects the hardening of hydraulic mortars. It abstracts such a quantity of lime from the lime water in the course of a few days that the mass corresponds to the silicate $4CaO,3SiO_2$. Gelatinous silica obtained by decomposing soluble glass with hydrochloric acid and soluble silica obtained by analysis behave in the same way. The above compound of hydraulic silica with lime is named by Landrin "Puzzo-Portland." This is the main constituent of all hydraulic mortars, not the silicate $2CaO,SiO_2$, as assumed by Le Chatelier. The theory of Le Chatelier, that the hardening of cement depends, as in the case of gypsum, on supersaturation phenomena, is, according to the "Journal of the Society of Chemical Industry," disputed by Landrin.

In an interesting paper, "On the Employment of Electricity in Chemical Industries," by Herr Ferd. Fischer (Dingl. Polyt. Journ. 251, 418,) a number of electro-chemical and metallurgical processes are employed, amongst which is that of R. P. Herman (Ger. Pat. 24,682, April, 1883), who proposes to precipitate zinc electrolytically from dilute solutions of sulphate of zinc with the help of sulphate of the alkalis or alkaline earths—potassium, sodium, ammonium, strontium, magnesium, aluminium—added, singly or mixed together. These additions appear only advantageous when one has solely to deal with dilute solutions of sulphate of zinc. According to M. Kiliani—*Berg. und Hüttenmännische Zeitung*, 1883, p. 251—during the electrolysis of a solution of sulphate of zinc, 1·33 specific gravity, the anodes and cathodes consisting of zinc plates, the evolution of gas is greatest with a weak current, diminishes with an increasing current, and ceases when 1 square centimetre pole surface 3 milligrammes zinc are precipitated per minute, as the following table shows:—

Intensity current in mg. zinc per minute and 1 sq. cm.	Gas evolved in c.c. on 1·5 grm. zinc precipitated.
0·0145	2·40
0·0361	2·27
0·0755	0·56
0·3196	0·43
0·6392	0·33
3·7274	—
38·7750	—

The precipitate obtained with a strong current was very firm. From a 10 per cent. solution the precipitate was best with a current of from 0·4 to 0·2 milligramme zinc. From very dilute solutions the zinc was always obtained as a sponge, accompanied by energetic evolution of hydrogen. With a weak current and from a 1 per cent. solution oxide of zinc was also precipitated, even with an electro-motive force of 17 volts, when only 0·0755 mgrms. zinc per minute and 1 square centimetre cathode was precipitated. The size of the pole surface has consequently to be adjusted according to the strength of the current and the concentration of the solution. The process of Blas and Miest for the extraction of metals from their ores appears good. It is based on the fact that the natural sulphur compounds conduct electricity when they are heated and pressed into plates. Such plates are used as anodes and cathodes.

MISCELLANEA.

It has been decided to hold an international exhibition in Bombay during the cold season of 1885-86, if possible, and a sub-committee has been appointed to prepare a report to the Government on the feasibility of the scheme.

The last course of Cantor lectures of the Society of Arts for the present session will be "On Fermentation and Distillation," by Professor Noel Hartley, F.C.S. The course will consist of three lectures, and will be given on Monday evenings, the 12th, 19th, and 26th instant.

At the Siloh Chapel, Landore, on the 1st inst., Lady Siemens presented photographs of the late Sir W. Siemens to 768 of the workmen employed by the Landore Siemens Steel Company, who, it will be remembered, some time ago subscribed towards a testimonial for presentation to the late knight.

A new engineering establishment, to be known as the Central Dock Engine Works, has been built at West Hartlepool for Messrs. W. Gray and Co., and is now almost completed. It contains excellent plant, and is an establishment provided in every respect with the arrangements necessary for carrying on a large business under the most favourable conditions.

It is stated that there are now idle in the ports of the north-east coast from want of employment no fewer than 137 ocean-going steamers of 150,000 tons gross, valued at over a million sterling, and employing 1800 men when voyaging. This shows an increase of thirteen vessels on the total number idle two months ago. A largely-attended meeting of shipowners of England and Scotland was held on the 30th ult., at Newcastle, to consider the proposal to lay up one-fourth of the steam tonnage for four months, with a view of forcing up freights, which at present are declared to be unremunerative. The proposal was carried, only three hands being held up against it, and arrangements are being made for carrying it into operation on May 20th, provided the owners of 1500 steamers have then entered the association.

The annual meeting of the Birmingham gun trade took place on Tuesday. The annual report showed that the number of barrels dealt with in the Proof House during 1883 was 681,439, as compared with 771,597 during 1882, and 730,364 during 1881. The amount of cash received for barrels had been £8647, against £10,157 in 1882, and £9261 in 1881. Including accrued profits since December 31st last, the reserve fund was £5000. The profit on the past year had been £1804. New ramming machines had been introduced during the year for the protection of the workmen, and they had worked most satisfactorily. In moving the adoption of the report, the chairman—Mr. J. F. Swinburne—congratulated the meeting upon the fact that a firm at Liége had obtained permission to take measurements of their machinery. The report was adopted.

The South Staffordshire Institute of Mining Engineers had read to them at Dudley on Monday a paper by the President "On the Beaumont Rock Drill." The author was of opinion that the apparatus was unsuitable to the Black Country district, but he believed that Cannock Chase might derive some benefit from its use. In the discussion which followed, it was urged that in working ordinary collieries there was but little chance of the invention being used, that under the most favourable circumstances the air locomotive attached to the apparatus could only approximate to the cost of rope haulage, and would probably be more expensive. In the case of gob roads, the locomotive as a substitute for horses, where the roads were good and easily kept in order, would be favourable as a matter of economy. It was decided to lay these views before Colonel Beaumont, and a vote of thanks was accorded to the author of the paper.

A pamphlet has been published having for its object the recommendation of a new scheme for the construction of a ship canal from Manchester to Liverpool on wholly different lines from that which is now before Parliament. The scheme in question has been under consideration for some considerable time, and has supporters in both cities. The distinctive feature of the scheme is that it shall be cut directly through the land, in no place touching the river Mersey along its route. The projectors say that a canal, which would begin at Garston and take a direct course overland to Manchester, leaving the estuary altogether out of sight and not touching it, would answer even a better purpose than a scheme for putting down training walls and otherwise interfering with the natural flow of the river could ever do. They further allege that the great opposition which the present Bill will meet will be on the matter of the estuary works, which are of a highly radical character. As the scheme proposes to begin at Garston, it has already obtained the assent of certain Liverpool people.

A test of the electric light for fishing purposes was made during the trial trip of the steamship Tilly, on the 28th ult., on the Clyde. The Tilly was built by the Abercorn Shipbuilding Company, and engined by Messrs. Hanna, Donald, and Wilson, of Paisley. She is an iron steamer, 105ft. long by 18ft. beam, built under special survey, and classed 100 A1 at Lloyd's, and is intended for fishing operations in the Java seas. The engines are of the ordinary high-pressure, compound, condensing class, with cylinders 16in. and 32in. diameter respectively, by 24in. stroke, with one boiler working at 80 lb. per square inch, the speed attained on trial being 10½ knots. She carries a powerful submarine electric arc lamp enclosed in a water-tight casing of glass, as a mode of attracting fish, and catching the same by means of nets—this being the first application on a practical scale in this country of the electric light to such purposes, the lamp being 15,000-candle power. For the purpose of testing the submarine lamp it was lowered into the sea some few feet below the surface of the waves, and subjected to a four hours' continuous working trial—this being the test imposed by Mr. Hayes, the inspecting engineer—the engine and dynamo making a speed of 700 revolutions per minute, the result being a perfect illumination of the sea for a considerable distance around the lamp, which, as the darkness of night came on, had a very novel and striking effect. The trial was completed at 10 p.m., when the lamp, still burning brilliantly, was hoisted up from the deep, and found to be working in perfect order. The electric light machinery, driven by one of Gwynne's "Invincible" high-speed engines coupled up direct to a Lumley dynamo and placed in a convenient corner of the engine-room, was supplied and fitted into the steamer by Messrs. Patterson and Cooper, of London.

The International Electric Conference at Paris has adopted the following resolutions:—"(1) Unités électriques proprement dites.—1ère Résolution: L'ohm légal est la résistance d'une colonne de mercure d'un millimètre carré de section et de 106 centimètres de longueur à la température de la glace fondante. 2ème Résolution: La Conférence émet le vœu que le Gouvernement français veuille bien transmettre cette résolution aux divers états et en recommande l'adoption internationale. 3ème Résolution: La Conférence recommande la construction d'étalons primaires en mercure conformes à la résolution précédemment adoptée et concurremment l'emploi d'échelles de résistances secondaires en alliages solides qui seront fréquemment comparées entre elles et avec l'étalon primaire. 4ème Résolution: L'ampère est le courant dont la mesure absolue est de 10 exposant moins 1 en unités électromagnétiques. 5ème Résolution: Le volt est la force électromotrice qui soutient le courant d'un ampère dans un conducteur dont la résistance est l'ohm légal. (2) Courants électriques et paratonnerres.—1ère Résolution: Il est à désirer que les résultats des observations recueillies par les diverses administrations soient envoyés chaque année au Bureau International des Administrations Télégraphiques à Berne qui en fera un relevé et le communiquera aux Gouvernments. 2ème Resolution: La Conférence émet le vœu que les observations des courants terrestres soient poursuivies dans tous les pays. (3) Étalon de lumière.—Résolution: L'unité de chaque lumière simple est la quantité de lumière de même espèce émise en direction normale par un centimètre carré de surface de platine fondu à la température de solidification. L'unité pratique de lumière blanche est la quantité de lumière émise normalement par la même source."

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

Y. R.—*Two-and-a-half per cent. appears to meet the case.*

J. R.—*If you consult Chambers' book "On Logarithms," you will find the means of obtaining any power of any number.*

A. B. AND CO.—*Messrs. Bailey, of Salford, can supply you with a pressure recorder which will no doubt suit your purpose.*

J. W.—(1) *No.* (2) *Unless we know to what use your boiler was to be put we could not tell which of those you name is best for your purpose. For example, if you want to get up steam quickly, the boiler with the smallest quantity of water would be the best.* (3) *Only that part of the tubes under water is to be called heating surface; the remainder is superheating surface, and serves a good purpose in drying the steam.* (4) *There are several books on valve gear, of various sizes and prices. You can see most of these at Spon's, Charing Cross, and select what suits you.*

J. D.—*Your great difficulty will be in getting sound castings. At a pressure of four tons on the inch water will ooze through cast iron. The coefficient of friction of ram leathers is a very variable quantity. It often reaches, it is said, one-tenth, but the available trustworthy information concerning it is very small. It has recently been ascertained that if a ram is made to rotate a little while moving longitudinally in cup leathers, the frictional resistance is very much decreased. We have some doubts as to whether it will be possible to make a cast iron cylinder quite tight and sound of the great size you require.*

TRAMWAY ENGINES.

(*To the Editor of The Engineer.*)

SIR,—I should esteem it a great favour if any reader could give me the address of the makers of first-class steam tramway engines and cars.

Hastings, May 7th. W. B. J.

PULLEY LATHES.

(*To the Editor of The Engineer.*)

SIR,—Can any of your readers give me the names and addresses of English makers of lathes for turning pulleys, &c., in which the mandril is vertical and the work laid upon the face plate? X. Y. Z.

London, April 30th.

WATER SUPPLY FITTINGS.

(*To the Editor of The Engineer.*)

SIR,—Will any reader answer the following questions:—(1) With a pressure of 30 lb. to the square inch, what quantity of water would ½in. service from water main supply per hour? (2) With a pressure of 30 lb. to the inch, would ½in. service from the main supply ¾in. or 1in. fittings in a house, and would it be to the company's advantage in preventing waste and strain on fittings? E. C.

Littlehampton, May 7th.

LOCOMOTIVES WITHOUT WATER.

(*To the Editor of The Engineer.*)

SIR,—If any of your readers can assist me in the following matter, and will kindly do so, I shall esteem it a favour:—There is no water available for steam power at our works; I, however, find it absolutely necessary to have a locomotive of from 10 to 12-horse power. Are there any locomotives made worked by other than steam power; if so, where can I see one at work, and who are the makers? We may say that we have a stationary hot-air engine at work. R. B.

Buxton, May 5th.

[Possibly a condensing locomotive would answer your purpose.—ED. E.]

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MEETINGS NEXT WEEK.

THE INSTITUTION OF CIVIL ENGINEERS.—Tuesday, May 13th, at 8 p.m.: Adjourned discussion upon the paper by Mr. S. B. Boulton, "On the Antiseptic Treatment of Timber." Paper to be read, "On the Progress of Upland Water through a Tidal Estuary," by Mr. R. W. Peregrine Birch, M. Inst. C.E.

CHEMICAL SOCIETY.—Thursday, May 15th, at 8 p.m.: "On the Indices of Refraction of Organic Substances," by Dr. J. H. Gladstone, F.R.S. "On Fluorene Derivatives," by Mr. W. R. E. Hodgkinson. "Some Minor Researches on the Action of Ferrous Sulphate on Plant Life," by Mr. A. B. Griffiths.

SOCIETY OF ARTS.—Monday, May 12th, at 8 p.m.: Cantor Lectures.—Lecture I., "Fermentation and Distillation," by Professor W. Noel Hartley, F.C.S. Wednesday, May 14th, at 8 p.m.: Twenty-first ordinary meeting.—"Telpherage," by Professor Fleeming Jenkin, F.R.S. Sir Frederick Abel, C.B., D.C.L., F.R.S, Chairman of the Council, will preside.

THE ENGINEER.

MAY 9, 1884.

THE PROTECTION OF OUR COALING STATIONS.

LORD HARTINGTON'S recent declaration, in reply to a question addressed to him respecting contributions by our colonies towards military expenditure within them, to the effect that such contribution was not asked for in regard to protection afforded to coaling stations used for Imperial purposes, involved what may fitly be termed a pleasant fallacy. We should naturally conclude from the terms in which Lord Hartington expressed himself that efficient protection was afforded to all the places at which the steamers of our great mercantile marine call to replenish their supply of fuel. The question may be asked, perhaps,—In what category did the Minister for War intend to class ports used for such a purpose? Did he imply a distinction between such as are only, or mainly, used by ships of the Imperial Navy, and those which are the resort of mercantile vessels chiefly? If he did—although we cannot consider such a distinction to be justifiable in the application of the term Imperial—there is, doubtless, some ground for the statement made; but it is manifestly improper, we hold, that any such distinction should be drawn. All and every port at which stocks of coal are accumulated for the purpose of supplying ships should be held included within the scope of Imperial service, and should, consequently, receive full and proper protection from Imperial funds. But it is a fact that with the exception of those places more especially looked upon as the resort of our ships of war, there is a lamentable want of the means necessary to repel hostile attack. Starting from our home ports eastward, we find Gibraltar, Malta, Cyprus, and Aden, all, as coaling stations used by our Government ships, well provided with the means of defence. At Suez, of course, our stores are situated within the jurisdiction of a foreign Power, and it is only under the shelter of possible neutrality that the stocks of coal there can be considered safe. But continuing our pictured journey to the eastward of Aden, we come to Ceylon, in which island there are three great coaling ports—Colombo, Galle, and Trincomalee. The latter is the great rendezvous of our ships of war composing the Pacific squadron, and large stores of coal are kept here for the supply almost exclusively of the Navy. Yet it is very certain that Ceylon pays for the troops kept for its defence, and it is the only coaling station in Ceylon which is in a condition to repel an enemy. The newly-formed harbour of Colombo is now one of the chief coaling ports of the world, and the stores of fuel accumulated there are exceedingly large, this being a necessity to provide for the supply of the numerous steamer lines which make it their place of call. Yet it is not too much to say that Colombo is absolutely defenceless against an attack in force from the sea. Some twelve or fourteen years ago the old Dutch fortifications were almost entirely demolished, on the plea that they were no longer efficient in these days of heavy artillery and exact vertical fire, and that they obstructed the free ventilation of the large and populous area included within them, and occupied much valuable space; so their moats were filled in and their sites levelled, but nothing, comparatively speaking, has since been done to furnish modern substitutes for them, and Colombo remains now, as it has done since the demolition referred to took place, practically defenceless. We have heard much of the Royal Commission on Colonial Defence and of its recommendations, but nothing has yet been taken in hand at this, our chief Eastern coaling port, to give effect to them. It was only the other day that the General in command at Ceylon opposed the reduction of the force maintained under his orders, on the ground that if below its present strength there was no means of ensuring the protection of the port, its vast stores of coal, and large influx of vessels. Can it be said that Colombo is less wanting Imperial protection than Trincomalee, which latter port is scarcely visited save by a few ships of war?

As regards the other coaling station of the island, Galle, which, although in its decadence since the formation of the harbour at Colombo, still supplies the wants of many vessels the masters of which do not care to make the dêtour involved by a call at the last named place, it is a well-known fact that although a few heavy guns are mounted upon its old fortifications, these can in no way be looked upon as likely to prove efficient in repelling an attack in any force from the sea, and the coal stored at Galle is, therefore, as unprotected in the event of war with any naval Power as is that at Colombo. Bombay and Calcutta are doubtless sufficiently supplied with the means of defence, but these ports come within the presumed meaning of Lord Hartington when he referred to coaling stations maintained for Imperial purposes. Kurrachee is, we believe, better furnished with the appliances of modern warfare than the ports of Ceylon that we have referred to; but then it is the resort of the Persian Gulf Squadron, and as such may well be included in Lord Hartington's general designation. Proceeding further eastward, we find many coaling ports practically without means of defence, among them being the recently formed coal depôt of Diego Garcia. In the Malay Peninsula there are several places, notably Singapore and Penang, where heavy supplies of coal are kept. The first-named is the rendezvous of the naval squadron, and may be assumed to be well protected, but Penang has no such assurance; while the island of Labuan, in which are situated considerable coal mines, is left to the guardianship of a few local police.

In our Western possessions, if we except Bermuda and Halifax, we shall find but few of the ports of call of our mercantile steamers supplied with fortifications of a modern character. In fact, we understand the Commission on Colonial Defences has unequivocally condemned such as do exist, but we have not learned that steps have been taken to fulfil its recommendations for the West any more than they have been for those relating to the East. It is not pleasant to contemplate what might ensue should war break out between Great Britain and any great naval Power. A few heavily-armed cruisers, eluding the vigilance of our own ships, might in a month completely cripple, by the destruction of the coal accumulated at the ports we have named, the whole of the movements of British vessels, both of the Navy and the mercantile marine, and we cannot therefore but consider that the delay in giving effect to the recommendations of the Royal Commission we have cited is most dangerous and unjustifiable. Apart from the immediate question we have considered, that of the present system of storing coal at our colonial ports demands, we hold, considerable revision. It can scarcely be a wise policy to store this valuable and highly inflammable material, as it is in nearly every case at present, in wooden coal sheds on wharves quite open to an enemy's fire. One shell successfully planted would at nearly every port within our knowledge set the whole stock in a blaze, and the contiguity of the sheds to the shipping would render it extremely probable in such an event that the flames would irresistibly spread to all the vessels in harbour. Granted that for convenience it is desirable that the stores should be handy to the shipping, it still seems to us that, for the reasons we have above named, some measure of precaution should be taken against such a contingency as we have referred to. It may be urged that earthwork ramparts and bomb-proof roofs could not for lack of space in many instances be constructed in the positions now occupied by such stores. Why not, then, remove them further inland? All coal must be transferred from them either by boat or truck, and it would not entail prohibitory expense to extend the necessary rail or canal communication to a position of safety. At Colombo, we understand, the ground reclaimed from the harbour is being utilised for the erection of further needed coal stores, a site most open to fire from the sea. So long as peace is maintained such a locality for them has undoubted advantages; but it is a question as to whether these may not be too dearly purchased by the liability to a catastrophe in case of war which we cannot contemplate without serious alarm. Lord Hartington has referred to defence given to coaling stations. He and his fellow Ministers may well be asked to consider what that defence consists of, and the serious responsibility which must rest on those who delay, year after year, giving effect to the recommendations of the Commission, the appointment of which was sufficient proof of the gravity of the matters it was appointed to report upon, and to which we have endeavoured thus briefly to call attention.

THE LONDON CENTRAL ELECTRIC RAILWAY.

IT is, we think, much to be regretted that the Select Committee of the House of Commons has thrown out the London Central Electric Railway Bill. In another place we give an abstract of the evidence of Mr. Henry Law and Mr. Siemens. It will be seen that the picture drawn by the former gentleman is one of perfect Metropolitan locomotion. Brunel, it is said, proposed that after he had laid his rails on the Great Western Railway, on the tops of piles driven into the ground, a car fitted with a couple of enormous grindstones should be run over it to remove every inequality and asperity from the surface of the rails. Of course he did not carry out this scheme. The inequalities in his permanent way were of a kind beyond the power of grindstones to rectify. Mr. Law describes a line, however, as near perfection as that which Brunel imagined. The rails, Mr. Law told his hearers, were to be carried on longitudinal timbers supported on beams on the invert of the tunnel, with a layer of felt between the wood and the bricks. The surface would be dead level "like glass"—that is to say, there would be no inequalities. On such a track the resistance of the very light cars which it was proposed to run on it would be very small indeed. As a scientific experiment, the working of such a line would be extremely interesting. It is not to be supposed that Mr. Law built castles in the air. We have no doubt whatever that he could make and maintain such a permanent way as he described; but he could only maintain it by reason of the light weights running on it. A locomotive with 16 tons on a single pair of wheels finds out the weak places in permanent way with perfect precision. It is impossible to make a road anything like that described by Mr. Law for use under heavy locomotives. Mr. Law's line would be successful only because the rolling stock would be so light. The Metropolitan Company knows to its cost what the use of needlessly heavy rolling stock means. Mr. Law promised—and as we think truly and reasonably—that the public would find the electric railway cars comfortable. One of the most noteworthy features of the enterprise would be the remarkable smoothness of the motion. We are inclined to think that a trip on the electric railway would have supplied an entirely novel sensation—novel, at least, as regards railway locomotion.

The electrical details of the scheme are very simple. As the line would be protected from atmospheric influences, few difficulties would be met with in the matter of insulation. A single conducting rail would be laid down between the termini; at one of these latter would be an engine indicating 750-horse power, and driving a dynamo or dynamos; on this point the information available is not very precise. The rails would provide the return circuit. In each car would be a motor; and it is calculated that each motor would have an efficiency of 50 per cent., and that 4-horse power would suffice to propel a loaded car at ten miles an hour. This is probably much more than would really be needed on a track so perfect. The error is on the right side, however, as it should be. It is contemplated that as many as ninety cars might be at work at one time. At 8-horse power per car, this gives 720 indicated horse power for the engines driving the dynamos. As much as 750-horse power would be provided, an ample margin being allowed by the circumstance that all the cars could not be running at the same time. Into certain details neither

Mr. Law nor Mr. Siemens, nor the Committee, entered. Information on the subject is, however, desirable. It will be seen that each motor would act as a bridge, coupling the positive current flowing along the central conductor with the negative or return current flowing along the rails. Thus the motors would be in multiple arc; they would be in very much the condition of arc lamps worked under the same conditions; and certain precautions would have to be taken to prevent the serious injury or even burning of the motors. Thus, let it be supposed that there were six or eight cars all running at one time, and that for some reason all the cars save one was stopped—this might happen without difficulty—then the whole of the current would be transferred to the car which was running, with the probable result of instantly destroying the insulation of its wires. The car would then be brought to a standstill, and would have to be pushed home by the next succeeding car. Of course, the danger to which we allude can be avoided, but it is worth while to mention it. Certain other points present themselves for consideration, such as the probable cost of working, which ought to be very small, seeing that the repairs of engines and permanent way would be infinitesimal. It is, indeed, possible that this would be found the cheapest mode of locomotion ever devised; it is not a necessary consequence that the shareholders would get a good dividend, because the cost of constructing the tunnel would be very high.

The scheme was rejected, not because the Committee expressed any doubt concerning the degree of success to be achieved, but because the Metropolitan Board of Works claimed that the ground to be occupied was already taken up with their sewers. It is not quite easy to see what will happen if London grows much larger; already the existing lines, both of street and railway, are overcrowded. For more underground lines we are told there is no room; overhead or "elevated" railways will not be tolerated; it is to be supposed that the difficulty will settle itself somehow. It is certain, meanwhile, that the authorities give the least possible encouragement to schemes for more Metropolitan railways.

CURRENT METERS.

In dealing last week with the discharge of rivers, we referred at some length to the float meter. The current meter—the conception of which is due to Woltmann—is a very different instrument. It has many forms, but the principle in all is the same. A small shaft carrying inclined blades is set in the direction of the current at the place where the velocity is to be taken. The current impinging on the blades causes the shaft to rotate with a velocity which is obviously some function of that of the current itself. Some simple form of counting gear enables the number of revolutions to be recorded. In the older arrangements the instrument was simply fitted with an apparatus for stopping and starting it as required from the surface of the water. It was lowered down upon a rod or by cords until the proper depth was reached, and then started. It was suffered to run for a given time—say one minute—and was then stopped and lifted to the surface. The number of revolutions taken in that time were noted, and from these the velocity of the current during this minute was deduced. As to the mode of making this deduction, the theorist's plan would be to determine the function of the velocity which represents the meter's speed of rotation, and then to make a calculation in each case in order to deduce the latter from the former. But this would be a very dangerous method in practice. Fortunately we are not compelled to have recourse to it. The meter has not the same disadvantage as the float; it may be tested independently. For this purpose we need only take advantage of the fact that the action will be precisely the same whether the meter moves through the water at a given speed or whether the water moves past the meter at the same speed. Therefore, to test a meter we have only to attach it to some apparatus which can be moved through the water at a known speed by a rope from the bank, or other means. Having done this for, say, a minute, we compare the number of revolutions recorded with the actual velocity. By doing this for a considerable range of velocities we obtain what is called the rate of the meter in a way which is thoroughly satisfactory, being independent of the form of blades, the friction, and all the other circumstances which tend to modify the results of theory.

Several improved meters have been brought out during the last few years. Their inventors have specially aimed at doing away with the mechanical arrangement, always more or less uncertain, for starting and stopping the meter from the surface, and at recording the velocity by some method which shall be continuous and automatic. One of the best examples of this kind is the electric meter devised by Mr. G. S. Deacon, and described in vol. 69 of the "Proceedings" of the Institution of Civil Engineers. Three of these meters, with all the most recent improvements, were sent in 1882 to Mr. Robert Gordon, to assist in the researches which he has been carrying out for so many years, and with such rare energy and perseverance, upon the discharge of the Irrawaddy; and Mr. Gordon's first report upon the results of its use is now before us.

This document is both interesting and important, and should be read by all engineers concerned in the subject. We can do no more here than indicate a few salient points. In the first place Mr. Gordon has had opportunities perhaps never before enjoyed of testing the correctness of the meters themselves. Before sending them out they were carefully rated by runs at known speeds in the celebrated tank at Torquay, where Mr. R. E. Froude and his lamented father have carried out so many experiments for the Admiralty and others. Two of the instruments, after being in use for some months, have been returned to the same establishment, and tested over again. One of these appeared to have altered its rate in the interval by about 6 per cent., possibly owing to some slight damage to the blades of the screw. In the other no serious alterations were visible, and even in the first the difference observed would be of no moment as long as comparative observations only are desired. As the velocities at which the meters were run varied from 6in. to 15ft. per second, and as the variations at the extreme speeds in the reading of the instrument were not more than 2 per cent., it will be seen that its reliability has been fairly established.

In the second place, Mr. Gordon has now, we believe for the first time, been enabled to institute a direct comparison between the velocities given by the double float and velocities given by the meter; both sets of experiments being conducted in the same river, at the same time, by the same observers, and under the same conditions in every respect. The result is completely to overthrow any confidence previously felt in the double float method for great depths, at any rate for such as exceed, say, 25ft. On comparing the results with the meter and with the float at such depths, it is found that the velocities given by the meter are higher, and by a percentage which greatly increases as the depth is greater —varying, for instance, in one experiment from 9 per cent. at about 30ft. depth to 33 per cent. at about 60ft. depth. This is not the case with a single experiment only, but is practically found to exist wherever the two were tried together. In some cases, indeed, the difference was far greater, but here the meter had probably suffered by being clogged by fine vegetable filaments. All cases where any doubt of this kind existed were carefully eliminated from the results, and Mr. Gordon himself with a rare candour admits that, as a general conclusion, the double float in such cases gives results which are very much in excess of the truth, and are altogether untrustworthy.

As we have said, at depths up to about 25ft. the float and meter give results fairly accordant, although those of the meter are generally slightly the lower. Mr. Gordon therefore adheres to the float as a sound system where the depth is not great. It may be questioned, however, whether the proper mode of putting this statement should not be that the float is a good system where the *variations of velocity* are not great. It does not seem possible that the depth itself can have much influence upon the result, except indirectly through its influence on the velocity; and it is quite clear that it is the difference in velocity that brings out the cardinal weakness of the double float, viz., that it consists of two bodies tending to move at different speeds. If the difference between these speeds is small, it may be granted that the joint velocity will be governed by the larger size of the lower float, but if the difference of velocity is large, and that at the surface is the greater of the two, it may reasonably be suspected —and appears now to be established beyond question— that it is the surface and not the lower velocity which governs the joint result. Hence we would not advise any engineer to take Mr. Gordon's statement too literally, and trust implicitly to double float observations in a river whose depth is, say, from 25ft. to 30ft. Here he would find, we believe, that the velocity near the bottom is but a fraction of that near the top, and that the double float would fail to record anything approaching to the actual difference. Mr. Gordon's statement only applies to very deep rivers, where the velocity for the first 25ft. or 30ft. varies but little. This, in fact, is evident in the case of the Irrawaddy, to anyone who consults the elaborate chart of velocity curves which is annexed to Mr. Gordon's report. It will be remembered that the maximum velocity is never exactly at the surface. It is generally at a short distance, say 5ft. to 10ft. below, but occasionally it is as much as 15ft. to 20ft. below, and then the velocity at 30ft. is about equal to that at the surface. In other cases, although the maximum velocity is near the surface, the rate at which it subsequently falls off is so slow that the surface velocity and that at 30ft. still differ very little from each other.

It is satisfactory to find that these valuable experiments have thus disposed of what has for some time been an unexplained anomaly in questions of river velocity. It was expressed in a discussion on the subject a few years back by saying that in the largest rivers the bottom velocity may be taken as the same as the surface velocity, varying within small limits only. "In such cases the whole mass of water appears to move almost like a solid body, independently of the resistances of the sides and bottom." This view was even at that time out of accord with the experiments of Mr. Revy on the great rivers of South America, which were made with a current meter; but the authority attaching to the double float system was then so great that Mr. Revy's results were not accepted. It is evident now that this was a mistake, and that in large rivers, as in small, the velocity falls very rapidly after a certain depth has been reached, and near the bottom has but a fraction of the value it has at the top.

Finally, Mr. Gordon's experiments seem to have disposed of the view strongly held by some hydraulicians that the curve representing the velocity from the top to the bottom of a section must somehow or other be a parabola, with its apex at or near the surface. On looking at the chart previously referred to it will be found that very few of the curves conform even approximately to such a condition, and that those which most nearly resemble a parabola are those in which the maximum velocity is at a comparatively great depth below the surface, and which therefore seem to indicate some abnormal condition. In most of them the curve, at starting from the surface, is inclined forwards at a sharp angle for 2ft. or 3ft. in depth. It then makes a very sharp bend, and slopes gently backwards as it descends, keeping for some distance in what, for practical purposes, may be taken as a straight line. As it approaches the bottom it curves more and more, and in some cases, when close to the bottom, takes a form not very far from the horizontal. It is clear there is nothing in such a curve which can possibly be forced into accord with the parabolic theory.

THE NEW SIBERIAN RAILWAY.

A question not only of commercial importance, but of great technical and engineering interest, is that of how Europe may best be connected with Siberia by a line of railway. It is a question which was decided in principle many years ago by the Russian Government; the problem now awaiting merely formal solution to-day is simply what direction the promised railroad shall take. To be strictly correct, it may be said that there are three rival schemes in the field. The first proposes that the communication shall take place by means of a line connecting Nishni Novgorod with Kazan, and ending in a temporary terminus at Ekaterinburg; the second plan is to start from Samara and carry the rails to Ekaterinburg through Ufa; the third scheme is a proposal to reach Ekaterinburg, passing through Tetushka, from some point of the Morshan Sizyran Railway. This last project may be dismissed from consideration altogether. The only competition, if there be any at all, is between the two schemes first-named. And of these the Nishni Novgorod one has the immense advantage over its rival that it has been twice adopted in principle by imperial ukase. The scheme was drawn up so far back as 1875 by the Council of the Empire, and the same year saw its confirmation by a decree of the Czar. This was virtually a triumph over the project then entertained of starting the railway at Rybinsk. Eight years, however, passed without any attempt being made to give effect to the imperial rescript. In the meantime the Minister of Ways and Communications came forward with a proposal. It originated with the *zemstvos*, or district board of Samara and Ufa, who, in conjunction with Rybinsk merchants, had discussed the question of a line to Ekaterinburg from Samara, their aim being that of putting themselves into closer communication with the rich districts of Southern Siberia. Permission was, indeed, actually given by the committee of ministers of certain preliminary works in connection with the Samara project, and those preliminary works were carried out. Further than this, however, Government sanction did not go. In fact, the previous decision of the Council of the Empire in favour of the Nishni Novgorod scheme was reaffirmed by a second imperial ukase of date 27th April, 1881; yet, in spite of this significant state of things, the controversy between the two projects is still vigorously kept up. The technical issues are very simple. The distance between Nishni Novgorod and Ekaterinburg, through Kazan, is 1252 versts; the distance between Samara and Ekaterinburg, through Ufa and Zlatust, 940 versts. The Nishni Novgorod line would involve the building of bridges across the rivers Oka, Volga, Kama, and Viatka; the alternative route would be complete with a single bridge over the Bielaya. The Government scheme would render necessary the construction of 1252 versts of line; the Samara-Ekaterinburg project would involve the making of a new railroad for a distance of 940 versts. So far, therefore, as cost is concerned, the latter scheme has a manifest advantage. A Nishni Novgorod line, it has been calculated, would cause an expenditure of from thirty-six to fifty millions of roubles more than the highest cost of a railroad between Ekaterinburg and Samara. The real problem, however, begins neither at Nishni Novgorod nor at Samara. It commences, as practically the proposed line of railway must commence, at Moscow. The question, in its larger and national bearings, is not now to construct a line of railway at the smallest possible cost, nor even how to direct its course so as to benefit local interests eager for development *en route*, but rather how to connect European with Asiatic Russia by the shortest and most direct line. This way of looking at the matter—and it is the way which beyond all doubt has influenced the decisions of the Russian Government—at once relegates the Samara-Ekaterinburg scheme to the background. The line distance from Moscow to Ekaterinburg through Riazan, Riazhsk, Samara, and Cheliabinsk, would be 2006 verst; that from Moscow to Ekaterinburg through Nishni Novgorod and Kazan would not exceed 1662. There is thus on broad, national, strategic, and to some extent even commercial grounds, an advantage of 344 versts in favour of the Nishni Novgorod scheme; and it is this scheme for the practical realisation of which there is every reason to believe the Russians will in a few days issue its final authorisation.

EFFECT OF RESTRICTION IN THE IRON TRADE.

The returns of the Cleveland Ironmasters' Association for the month of April show that the policy of restriction adopted in March is beginning to take effect. The wisdom of that policy was very seriously questioned at the time, but no other remedy for the results of over-production could be suggested. There are in the Cleveland district 166 furnaces. Of this number 101 were in blast on the 30th of April last, and fifty-five were cold. The production of the 101 furnaces is divided over Cleveland iron, hematite, and spiegel. During last month 129,764 tons of Cleveland iron were produced, and 74,557 tons of hematite, &c. This was a reduction of 12,240 tons as compared with the previous month. At the end of April the total stocks of pig iron held in makers' stocks, makers' stores, railway stores, and warrant stores, were 283,433 tons, as compared with 291,733 tons on the 31st March. In other words, the district produced 12,240 tons less than in the previous month, but only reduced stock by 8300 tons. It, therefore, appears that but for the restriction introduced stocks would have been increased by 16,000 tons, and that in a month when increased shipments usually begin to operate towards a reduction of stocks. Curiously enough, however—and this may be taken as a striking proof of the depressed condition of the trade—the shipments of Cleveland iron were about 2500 tons less in April than in March. Since a policy of restriction was last adopted in 1879 owners of blast furnaces have, by the employment of improved methods of heating, and greater care in mixing, procured from their furnaces very much greater yields than were ever before known. A blast furnace of ordinary capacity is now in some instances able to keep up an average output of 100 tons per day. In 1879 the maximum was 500 tons per week. It follows, therefore, that a smaller number of furnaces is required to keep the make up to its average position. If the Cleveland ironmasters can retain sufficient cohesion to maintain the policy of restriction for twelve months, they will to a very large extent have grappled with the difficulty. It is true it is a painful process for the interest of capital and labour alike. But to continue making iron at a dead loss would only lead to ultimate ruin, while restriction may be expected to produce a beneficial effect, and so enable Cleveland ironmasters to again compete successfully in the market.

FALLING OFF IN SHIPBUILDING.

Although the statistics are only procurable for a third of the year, and for one centre of the shipbuilding trade only, there is evidence that there will be a very serious falling off in the tonnage of the vessels that will be built in the present year. It may be remembered that last year the Clyde built 417,000 tons of shipping, and, roundly stated, about one-fourth of this was built in the first four months of the past year. This year the tonnage of the vessels that have been launched in the first four months on that river is stated at less than 90,000 tons, or, roughly, 20,000 tons less than in the corresponding period. It is believed, from the number of the vessels that are now in course of construction, that the falling off in the tonnage launched in the next few months of the present year will be still greater than that in the months of the year that are gone; and it is well known that in some other centres of the shipbuilding trade the collapse of the industry in the present year has been much more serious and complete than that of the

Clyde, so that it is evident that the tonnage of new vessels for the present year will be very much less than that of the past year. So far as the industry itself is concerned, the loss is one that is regrettable for the present, but it has also the aspect of a great relief to the shipping trade, and one that will allow of a more speedy recovery than would have otherwise been possible. There are also some contingencies that might affect the trade—the decision of the American Congress as to the "free ship" question, but as the decision on this cannot be far off, it is idle to speculate upon it now.

LITERATURE.

Die Schiffsmachine ihre Construction, Wirkungsweise und Bedienung. Bearbeitet von CARL BUSLEY, Kaiserlicher Marine Ingenieur, &c. Kiel: Lipsius and Tischer. 1883. 507 pp.

THE aim of the author of this book has been to provide marine engineers, students, and all concerned with marine engine and boiler construction, with a book which shall contain a practical digest of the theory upon which design and construction should be based, and with numerous examples of the practice of marine engineers of Germany and other countries. For this he is unusually advantageously circumstanced, as he is at the same time an engineer in the Imperial German Navy and professor in the Royal Academy at Kiel. Commencing with heat and the thermodynamics of marine engineering, the author proceeds with a discussion of the laws relating to the application of heat in the generation of steam, and follows with the laws and phenomena of steam expansion. Combustion is next dealt with, and the steam-producing powers of coals from all parts of the world are set forth, with observations on the essential conditions for proper combustion in boilers. Economy in coal consumption as affected by the performance of boilers and engines of different kinds, is dwelt upon at great length. Proceeding next to the practical applications of the theory and experimental information which has so far occupied his pages, the author describes the design, construction, and management of various kinds of boilers in use in German and other war and merchant vessels, the names and particulars of many of which are given. The illustrations of the boilers, as of the machinery, are especially worthy of remark. They are published as separate lithographs; and though on a small scale, they are so well done that every detail of construction is very clearly shown. They are all coloured in the sectional parts; and whether we speak of the boilers, boiler fittings, or engines and machinery, we may say that no book of its kind in English is illustrated with any approach to its completeness or finish. Having thus dealt fully with all that relates to the generation of steam, and with the heat problems concerned in its use, the engines and machines used in war and merchant ships are next and equally well described. The machinery referred to includes every mechanical appliance used in steamships of every kind, large and small; and no detail is too small for the author's notice. There is certainly no book published giving anything which will compare with this collection of the smaller machinery in use at sea. The information is brought down to very near the end of last year, and in the form of tables an immense amount of statistical and other matter relating to German, French, and English ships and their machinery is given. The dimensions of boilers thus given are more numerous and complete than can elsewhere be found; and in this and other respects the author shows a very wide acquaintance with the work of engineers in foreign countries. The book is one which combines in a remarkable way the practical and the theoretical. For its completeness in both, and because of its value for reference, it will no doubt find very numerous purchasers; and we shall be glad to see an English translation of it. The book has a good table of contents, but it lacks an index.

Absolute Measures in Electricity and Magnetism. By ANDREW GRAY, M.A., F.R.S.E. London: Macmillan and Co. 1884. 207 pp.

THIS little book is an amplification of some articles contributed to *Nature* on "The Measurement of Electric Currents and Potentials in Absolute Measures" about a year ago. It is not pretended that it is a complete treatise on this subject, but it gives a clear account of the absolute units system of measurement, and of the methods and instruments for theoretical and practical work. It is a little book, but there is much in it. It commences with an explanation of Gaus's method of determining that mystic quantity, H, which a contributor to an eastern county paper in describing Messrs. Crompton and Co.'s works so hopelessly mixed up with the strength of concrete. He makes this easy by showing how to make a simple instrument for the purpose, and then showing how to use it. An explanation of absolute units and derivations of practical units naturally follows, with a description of the tangent galvanometer. Sir W. Thomson's potential and current galvanometers are then described, and potentials and currents in derived circuits dealt with. The comparison of resistances by various forms of bridges is next explained, followed by the measurement of energy in electric circuits, including everything that may be in any such circuit and such effects as may be brought about in efficiency by variation in the speed of dynamo machines; the efficiency of a secondary battery, use of electro dynamometers, and the measurements of intense magnetic fields. Some useful, and to some extent original tables, complete the book.

The Art of Soapmaking: a Practical Hand-book of the Manufacture of Hard and Soft Soaps, Toilet Soaps, &c. By ALEXANDER WATT. London: Crosby Lockwood and Co. 1884, 260 pp.

EXCEPT in works on applied chemistry and a few encyclopædic articles, and in such works as Ure's "Dictionary," soapmaking, one of the oldest manufactures, has no readily accessible literature. Mr. Watt's work is therefore a very acceptable hand-book, especially as he is practically acquainted with its subject. In an introductory chapter a brief notice of the history of soapmaking is given. The first chapter of the book explains the work of Chevreul, and the hinge upon which all soapmaking turns, namely, saponification. Processes of saponification and soapmaking apparatus are then described generally, and the rest of the book is taken up with descriptions in particular of the methods by which the numerous kinds of soap now sold are produced from an almost limitless variety of materials. The part played by modern chemistry in reducing the cost of production is shown in almost every page. The formula for every kind of soap is given; but large as is the soap industry, it is to be regretted that it can be carried on with but comparatively little help from the engineer; at least, one would gather this from the author's book, but fortunately there is a good deal of machinery used of which the author has not thought it necessary to give any full description.

PRIVATE BILLS IN PARLIAMENT.

Group 1.—We give this week an abstract of the important evidence submitted by Messrs. Law and Siemens, before the Select Committee of the House of Commons, on the London Central Electric Railway Bill. Although, as stated in our last issue, the Committee did not think it advisable to allow the scheme to proceed, the evidence of the two gentlemen in question cannot fail to be of interest.

Mr. Henry Law—of the firm of Law and Chatterton, engineers—who planned the engineering details of the railway, was the first to give evidence. In answer to Mr. Moulton, he said the railway would be entirely underground, the maximum depth being 36ft., and the minimum depth at Farringdon-street, at the Fleet Valley, 17ft. to the rails. The main station would be at Charing Cross, the second at Cranbourne-street for Leicester-square and Long Acre; the third at Dudley-street. At that point the branch from Piccadilly Circus joined the two, then proceeded together to New Oxford-street, where there was another station to Little Queen-street, where was a station serving for Lincoln's-inn-fields; a station at Brownlow-street which served for Bedford-row and that district; a station at Gray's Inn-road; a station at Holborn Circus, where the stationary engine would be for making the electric power; a station at Farringdon-street for the new meat market, the fish market, and the fruit market; a station at the Old Bailey and at the new Post-office. It would not interfere in any way with the main drainage of the metropolis. The estimates of cost were extravagant. There would not be any openings in the streets at any time during the progress of the work. Shafts would be sunk at the sites of the stations, and the earth would be removed from those points at night. There would be no disturbance of the surface of the road or of the adjoining property. They proposed to work the line entirely by electricity. There would be a stationary engine placed on vacant land near Holborn Circus. It would be a compound engine, condensing and working up to 750 indicated horse-power. The electricity would be conducted along the line, and the rolling stock would take it up by motors. Every carriage would carry its own motive power. The principle of the Electric Railway was exceedingly simple. If a dynamo was caused to revolve by some power that they applied to it, and that current was carried to some other dynamo properly connected, the second dynamo would be made to revolve in sympathy with the first. If the first dynamo was very large they might move a very large number of small dynamos by the current, and that was the whole principle upon which the line would be worked. Each of the cars would have a small dynamo underneath, and the contact would be made with the central rail conductor, and that would cause the dynamo under the car to revolve and be the motive power of the car. Each car would be self-propelled by its own motive power. The force to propel arose from a small contact brush with the conducting rail. The moment the brush was lifted from the rail the power ceased; and by shifting what was called the commutator, the carriage could be made as it would do on the return journey to go in the opposite direction. The carriages would be self-propelled, but entirely under the control of the person on them regulating them. The carriage is more sensitive to the wishes of a driver than a horse is, because the carriage must obey; the mere shifting of it reversed the motion, and the wheels were stopped at once, and travelling at the low speed which they would do, not exceeding ten miles an hour, and the carriage being excessively light, there is no momentum, and it would be brought up just as an omnibus was stopped in the road. The lightness of the cars, and their being self-propelled, would prevent vibration. When an omnibus passed along a comparatively rough road there was some amount of vibration. The cars would be lighter than an ordinary omnibus. They would run on smooth steel rails, which would be unusually smooth, because they would have no locomotives run over them to disturb them. There would be no ballast as in an ordinary railway, where the excessive loads caused settlement; but here the longitudinal timbers would be laid directly on the invert of the tunnel, and perhaps a little felt introduced to give the requisite elasticity, and the steel rail would be laid upon that. It would be a road as smooth as glass, and without any vibration. The power developed in the car was a definite percentage of the power taken from the engine. With the first installation proposed the power required under the most disadvantageous circumstances to work the line would be 80-horse power applied to the rails and 750-horse power to furnish it. The carriages could run separately or connected. They would run two or three carriages together; the platforms would allow of five carriages being drawn up, and if they ran at intervals of a minute they would be able to carry considerably more passengers than could be carried at the present moment upon the District Railway. They proposed to limit the speed to ten miles an hour, because a quicker speed would really be impracticable. On the District Railway the average speed was only twelve miles per hour; and he had the authority of Mr. John Fowler, the engineer of the line, for saying that in consequence of their working up to that speed, they wasted 60 per cent. of the power developed by the locomotives in grinding the brakes. Out of the 30 lb. of coal consumed per train mile, 18 lb. was wasted in propelling the train. Then, again, the locomotives weighed 42 tons, and all the carriages on the District Railway weighed about 9 tons—those upon the Metropolitan about 14 tons; and they therefore carried so much weight that there was a useless weight of about 6 cwt. for every passenger; whereas in the light carriages intended to be used on the Electric Railway the weight per passenger would be about ½ cwt.—though in their calculation of power they had taken 2 cwt. There was this great difference in a railway: they must have a locomotive sufficiently powerful to carry the heaviest train when loaded up the steepest incline at the highest speed. When they were going down-hill and had to put the brakes on to prevent the carriage from its own weight running down too fast, they had still that powerful locomotive carrying round with them. They must have a locomotive sufficiently powerful to get them over their greatest difficulty, and allow them to work with a momentum over the line. The peculiar feature of the Electric Railway was this:—They had a conductor on the line, to use a figure of speech, which he might say was a store of power, and also if the engine was properly arranged up to the limits of the power of that engine, that conductor would give out to them whatever power they demanded from it, and the power taken at any moment would be the power required by every one of the carriages added together, started in different parts of the line. The consequence was that you did then get, without any mechanical arrangement, an absolute average of the power at any given moment. No more power was required over the whole of the railway than what was demanded by each particular train; and there was no other system in the world that could satisfy that condition. This was one of the things which would make the future of electricity as a motive power for railways. He had no doubt that the most economical method of working must be by electricity. Electric railways, too, had special advantages in the case of underground working. The electric railway which had already been made, such as the Eberfeld, in Berlin, and the Portrush, had been on the surface, and accordingly exposed to all the vicissitudes of the weather. When rain fell, and the conductors became wet, insulation was not so perfect, but the power of the electricity—called by electricians the "difference of potential"—was so low that electricity might be conveyed thirty miles and lose not above 5 per cent., and the effort to escape was so slight that there was very little leakage. The potential was so slight that even a child might take a shock when the power was sufficient to work the line; and in fact the Irish children amused themselves in this way. The fact that the proposed railway would be underground would enable them to have a higher potential, and consequently increased economy. With regard to ventilators, there was a great advantage in the use of ventilation, for there was none of the products of combustion present as in the case of a line worked in the ordinary way, and the only source of pollution to the atmosphere was the breath exhaled in the tunnel. If, in any unusual length of line, artificial ventilation should be required, it would only be necessary to put dynamos at intervals. In this case all that would be required would be to take a small part of the current from the conductor passing along the tunnel at any point desired in order to work a small dynamo with the fan or some shaft to extract the air. The lighting and ventilating would be done by exactly the same source of power that worked the railway. In his opinion, from an engineering point of view, there was nothing defective or insufficient in the works of the railway, and he had been through it very carefully. He had no doubt that the railway would be a very great public benefit if it were constructed.

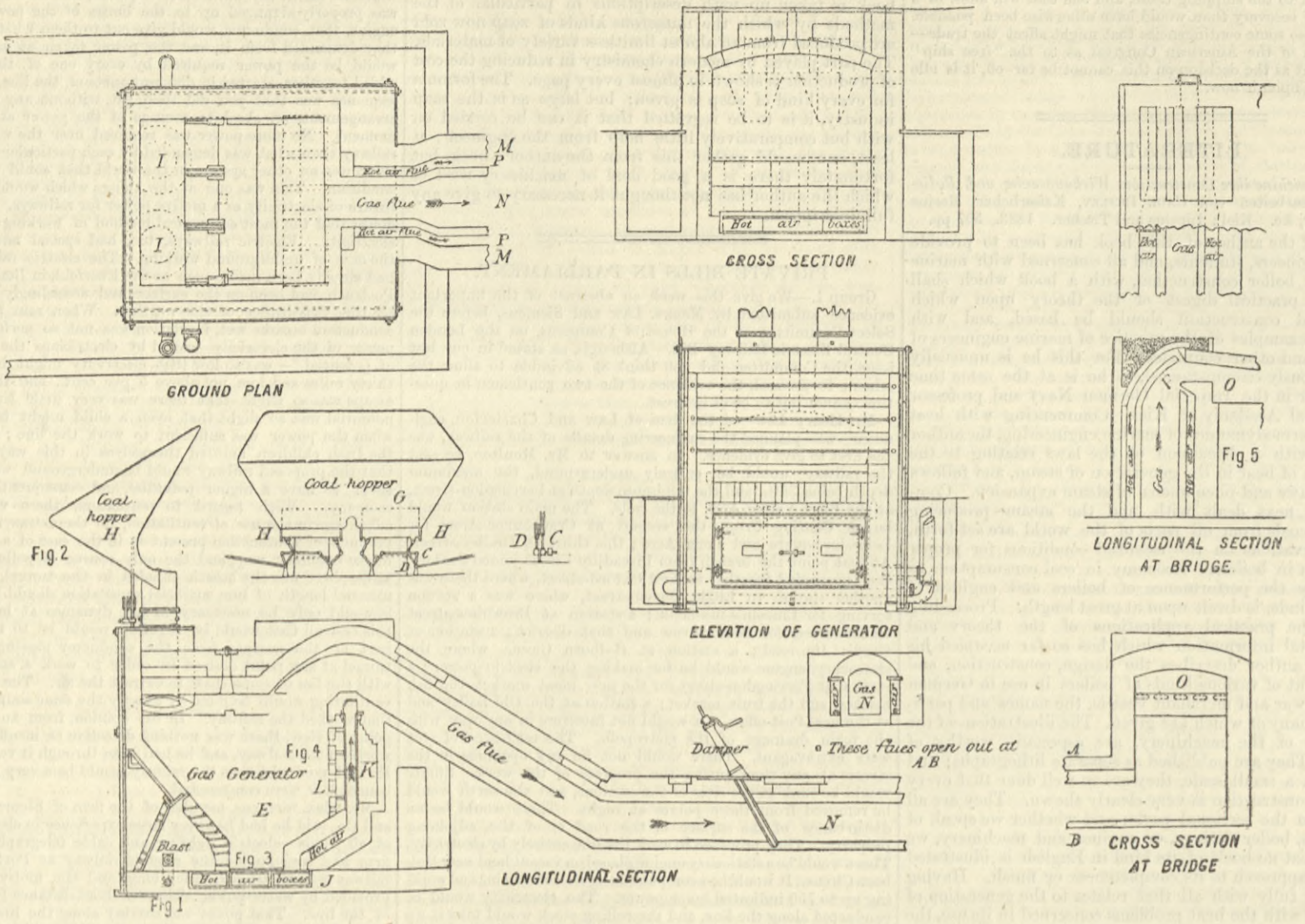
Mr. Alex. Siemens, member of the firm of Siemens Brothers and Co., said he had had very large experience in electric matters of all kinds—electric lighting and cable telegraph work. His firm had constructed the electric railway at Portrush. That railway was about six miles long, and the motive power was provided by water-power situate a short distance from one end of the line. That power was carried along the line to the carriages by a separate conductor put about 18in. above the ground, and the rails served as a return conductor. The railway ran along the surface of the ground and that certainly rendered it somewhat more difficult to insulate the conductors; but he did not think there was very much to choose as to whether the railway was above or underground. He agreed with Mr. Law as to the engineering features of the scheme. With regard to the self-propelling cars, it was perfectly easy not only to stop the continued progression, but also to increase its effect upon the car, if necessary. Experience on the Portrush Railway, where the gradients were more severe than on the proposed railway, had shown that there was no difficulty in getting a carriage to run at any speed up to its maximum, and to stop it in its own length in the worst gradient. He saw no difficulty whatever in running in a rapid succession trams or carriages such as had been described by Mr. Law, and working them with complete safety. On a car such as was proposed for this line to be worked at a speed of fourteen miles an hour, which was more than the proposed speed, and therefore on the safe side, about 4-horse power would be required. Counting on about ninety cars, which would represent about four trains at each station either way, about 360-horse power would be necessary on the carriages, and they could get 50 per cent. power expended with generators back again on the motors, so that they should want 720-horse power for the maximum traffic. It was intended to provide 750, but 730 represented the maximum horse-power if all the carriages were running at the same time on the level. But, of course, some of them would be standing; some would be shunted at the terminal station, and therefore it was not likely that the maximum power would be wanted all the time. If further power were needed, nothing would be easier than to increase it at the generating engine.

Mr. Wm. Shelford, Dr. John Hopkinson, Dr. Edmund Hopkinson, Mr. R. E. Crompton, Mr. James Shepherd, Mr. C. T. D. Crews, Mr. Lewis Hy. Isaacs, and Mr. Robert Vigers were also called in support of the scheme.

Having heard the evidence on behalf of the Metropolitan Board of Works, who urged that the scheme would affect their sewers, the Committee threw out the Bill.

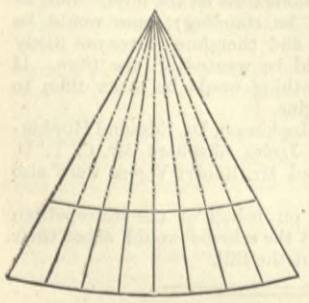
AN EMINENT HOROLOGIST.—"In the person of George Auguste Leshot, who died a short time ago at Geneva," writes a correspondent of the *Times*, "horological science has lost one of its most distinguished devotees and Switzerland one of her most original inventors. George Leshot was born at Geneva in the early part of the century, and for well nigh sixty years he hardly ceased work for a day, and during that time was nearly always engaged either in improving old inventions or bringing out new improvements. His first important discovery related to a modification of watch escapements, and it was he who first introduced watch making by machinery, and conceived and carried out the idea of making watch movements and their various parts identical and interchangeable. This invention, for which Americans have justly claimed the credit, has effected a complete revolution in the art of horology. It was Leshot, too, who first proposed the utilisation of the black diamonds of Brazil for the boring of rocks. At the time in question, 1862, it struck him that these diamonds, which were of little or no value as ornaments, might be turned to some useful purpose, and in company with another eminent Genevan mechanician, M. Charles Sechehaye, he made the first diamond-pointed drill. The tool more than answered the expectations of its inventors. In an hour and twenty minutes it pierced a hole five centimetres in diameter and thirty-seven centimetres long through a block of granite. Yet although diamond-pointed drills are now used all over the world, Leshot gained by his discovery no money and little fame. It was almost the same with his other inventions. Absorbed in his work and detesting disputes and litigation, he generally left to others the exploitation of his patents, and neglected to acquire the large fortune which he might have so easily gained. A short notice of the life and labours of Leshot, by M. Daniel Colladin, has been published in the *Comptes-Rendus* of the Paris Academy of Science.

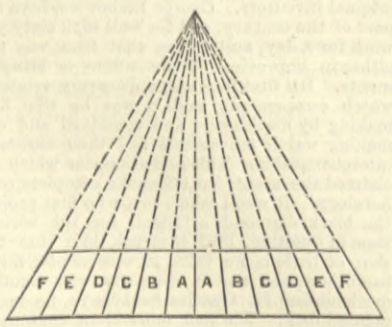
MR. SMITH-CASSON'S GAS FURNACE.



THE IRON AND STEEL INSTITUTE.

In continuing the discussion on Mr. Bell's paper, published last week, Mr. Charles Cochrane referred to the paper recently sent to the Iron and Steel Institute by Mr. J. M. Hartmann, of Philadelphia, pointing out the untractable character of anthracite and the mode of dealing with it. Since the paper was read further experience had been gained, the result of which was to reduce the diameter of the bosh, to enlarge that of the hearth, and to compensate for reduced capacity by increasing the height to 90ft. The object was to prevent as far as possible the formation of those accumulations of anthracite dust at the angles and sides of the bosh which so harass the managers of furnaces using anthracite fuel; and, if only circumstances would permit, the wish evidently exists to get rid of the sloping side of the bosh altogether and to make the furnace walls ventrical from throat to base. In the enlargement of the hearth the risk of the bricks floating, if vertical joints were employed, was obviously greatly increased. To meet this Mr. Hartmann had adopted a very ingenious arrangement of joints and hearth. Instead of adhering to the customary method—the old standing practice of constructing the hearth with a flat bottom—he had boldly departed from this form, and was introducing one with a concave surface, thus making the hearth a segment, either of a hollow sphere, or that of a hollow cylinder, in either of which cases every brick can be made exactly alike, and the stability of the hearth bottom secured against upward floating of the bricks should iron find its way beneath. A modification of the latter system was adopted with success at Ormsby Ironworks, the radial lines being introduced, but the bricks were cut off in horizontal lines. This involved a distinct form of brick for every line of bricks in the half section, thus:—Some such precaution would be absolutely necessary in future blast furnace practice in our own country, where considerable enlargements of hearths was in contemplation, and he had much pleasure in bearing that testimony to the careful thought which Mr. Hartmann gave to the design of the details of a blast furnace. On the subject of the employment of coal in lieu of coke in blast furnaces, it was quite true that coal gas did neither good nor harm in its escape at the tunnel head of a blast furnace, whether the latter were closed or open, whether it were unburnt or burnt, and he quite concurred with the author of the paper that the low temperature of escaping gases was mainly due to absorption of heat in that evolution. In the example of the Scotch furnace using coal given in the paper, the Scotch furnace, although 75ft. high nominally, was only working at a height of 63ft. practically. Its capacity was thus greatly reduced, and, like English furnaces of small capacity, the carbonic acid he believed to be removed by absorption of carbon, in consequence of its evolution from reduction of the ore and disengagement from limestone being performed in the presence of red-hot coke. The limit of 2 volumes of CO to 1 of CO_2—beyond which any further excess of CO_2 prevented reduction of ore — need not affect the consideration of this matter at all; for as a matter of fact, in furnaces of 34,000 cubic feet capacity this limit was not yet reached, although producing pig iron with about 19 cwt. of Durham coke and Cleveland ironstone. There were still 2⅓ volumes of CO to 1 of CO_2, whilst in furnaces of 20,600 cubic feet capacity this proportion rose to 3½ volumes of CO to 1 of CO_2. To be more precise, the following were two average analyses of escaping gases:—





	17 months' average; furnace of 34,000 cub. feet capacity.	13 months' average; furnace of 20,100 cub. feet capacity.
Nitrogen	60·32	60·55
Carbonic acid	11·65	8·76
Carbonic oxide	26·92	29·55
Hydrogen	1·11	1·14
	100·00	100·00

The large furnace consuming about 19 cwt. of coke, the lesser about 22 cwt. per ton of pig iron. Nor was it necessary to suggest the interposition of hydrogen in the Scotch furnace to explain the non-appearance of a larger proportion of carbonic acid than actually appeared, for considering the behaviour of moisture entering the furnace with the blast. It was all decomposed, the hydrogen being set free, and carbonic acid generated by contact with the hot coke; and as hydrogen in precisely the same quantity it made its exit from the tunnel head, so that, however they might speculate as to its change in the upward passages, it emerged unaltered from the furnace, and must be accounted for as a heat absorbent. It would therefore appear improbable that any hydrogen introduced at the tunnel head will escape otherwise than as hydrogen, and would simply add its volume to that due to the decomposition of moisture in the blast. That appeared to be actually the case in the Scotch furnace, where the escaping hydrogen amounted to 6·83 per cent. by volume of the total, a quantity five or six times as large as that usually found when coke was employed, furnishing no hydrogen. Furthermore, in actual experience of the use of coal at Woodside Ironworks, changes were sometimes made from coke to coal and from coals to coke, and the practice was invariably to substitute unit for unit of fixed carbon in the two to regulate the weight of the one fuel to replace the other.

Mr. Heath said when he first commenced to take off the tar he found some difficulty; but now he lined them with bricks and had no trouble at all. With reference to taking off the furnace, with a coal furnace which he tried some years ago he found that he could not manage with any considerable pressure upon the furnace, and now he had a tube both back and front, and had doubled the capacity for taking off the gas, and since then he had had no trouble.

Mr. Snelus said he believed that the limit fixed by Mr. Bell of two of carbonic oxide to one of carbonic acid was approximated to the Cleveland district, where they were using the calcined stone with coke, and therefore Mr. Bell had got a higher temperature than at the top of the furnace, and the conditions were more favourable for the reducing action of carbonic oxide which was going on. He had found in the West Cumberland district that they could not reach that figure at all; in fact, he was sorry to say that they rather approximated to those figures given in the paper to the raw coal in the Scotch district. He had made an analysis at one of their furnaces for the past twelve months, and he could not get up to the proportions of carbonic acid that Mr. Bell had indicated, and it puzzled him for a long time. He had however come to the conclusion that they could not reach those limits when they were using iron ore which contained a great deal of moisture in their furnaces. He was using the raw stone of the district, containing from 12 to 15 per cent. of moisture, and he believed it was the lowering of the temperature on the top of the blast furnace that prevented their being able to employ the carbonic oxide. Therefore they found that they were not able to decrease the proportion beyond 7 or 8 per cent. of carbonic acid to over 28 to 29 per cent. of carbonic oxide, being, in fact, from nearly the figures that Mr. Bell had given for the Scotch furnaces. The furnaces using raw coal were exactly in the same position, even though using calcined stone; the difference being, where the coal was used they lowered the volatile qualities of the coal.

Mr. Edward Williams did not see how it could matter whether the furnace was opened or closed, so long as there was free egress of the gases. If there were not retardation of these gases it must affect all the work of the furnace; but supposing all the passages were sufficient, it did not matter whether the ultimate products of combustion were discharged. He had known furnaces worked year after year with raw coal and ore with 10 per cent. of water on the average. He thought that they had worked nothing but Northampton ore, but not to so large an extent, and he failed to see how the work of the furnace was to be prejudicially interfered with by closing the top, it being quite understood that the passages were sufficient. He had tried to use burnt lime in furnaces of all heights, from 90ft. to 50ft., and he was sorry to say without success. He found that there was no advantage in the furnace by the use of calcined lime, and they went back to limestone as the more economical way of carrying on their business. At Dowlais they had a very great amount of pressure of the furnace in using raw coal, and Mr. Menelaus put a large exhausting fan, 30ft. in diameter, to exhaust the gases. This effectually got rid of the pressure from the valves, but it simply overwhelmed them with tar. All the culverts and tubes became full of it, and they had to stop it altogether. That took off the gas and they had tar and a little more temperature, and by this they got rid of the tar. He held it to be an entire fallacy that the closing of the throat of a blast furnace need interfere with the working of that furnace however it was charged.

Mr. Fisher Smith did not think that weak coal would do in a tall furnace, but for a strong coal the high furnace would very much improve the yield.

The President referred to the very important improve-

ments in the anthracite furnaces of Pennsylvania. Mr. Bell mentioned in his paper that some 40 or 45 per cent. of the iron of the United States was still produced by anthracite coal, but he, the President, thought that until lately, the iron made with anthracite coal in the United States had been constantly diminishing. Bituminous coal of Western Pennsylvania was used in preference to the anthracite coal. If this should cease to be the case, it might afford some hope that we might also be able to utilise the enormous deposits of anthracite coal which existed in the western portion of the principality of Wales, and which hitherto were only utilised for their trifling purposes, such as malting and matters of that sort.

Most of those who took part in the discussion rejoiced in getting rid of the tar; but Mr. Bell had pointed out that it was worth from 1s. to 2s. per ton of coal consumed. Volatilising the tar was thus not to be recommended.

Mr. I. L. Bell replied fully upon the whole discussion. According to the accounts given him by Mr. Cane, of Gartsherrie, there were 224 lb. of tar given off every ton of coal, which, in point of fact, using 2 tons of coal to 1 ton of iron, was 448 lb. of tar. Now, tar was highly inflammable, and when ignited gave out a great quantity of heat. The whole of that tar Mr. Smith burned under his heating stoves, and had a large increase of temperature of the blast. Mr. Markham had said that he thought with regard to the furnace, no furnace using close tops had been successful in using raw coal.

The next paper read was by Mr. R. Smith-Casson,

On Gas Puddling and Heating Furnaces.

The author said:—"We are indebted to the Messrs. Siemens for a practical gas furnace giving such satisfactory results as to warrant its adoption wherever sufficient capital is at command. There are, however, many firms with much capital tied up in plant, or who have neither the capital nor the inclination to spend large sums; and it is more especially to these that my system may be of value. Briefly described, it is as follows:—(1) Each furnace has attached to it a separate gas-producer E, which may be placed at any reasonable distance from the back of the furnace itself. The gas evolved is either exhausted by draught or forced out by blast F, according to the nature of the coal. (2) The producer is fed from a large hopper G, communicating by valves H with the ordinary coal-feeders I, thus dispensing with any hand-shovelling. (3) The air is heated by passing first into a cast iron box J, forming the base of the gas-producer E, thence into iron or clay pipes K built in the producer, and protected by a pigeon-holed fire-brick wall L, then along the side walls M of the gas flue N, until it reaches the under side and crown of the fire bridge O, where it passes in streams, mixing with the gas sufficiently early to produce any degree of heat that may be required. (4) In Staffordshire and Yorkshire, where this system has been at work for several years, it has been found necessary, owing to the nature of the coal, to apply blast both for gas F and air P. (5) It will be seen that regenerators are not employed in heating the air, and that the waste gases used for heating these can be utilised for generating steam or other purposes, as in the case of ordinary puddling furnaces fired by coal. (6) For the same reason existing furnaces need not be interfered with beyond making gas connections; consequently, the cost of applying gas to old furnaces becomes a matter of very small outlay. (7) Each furnace has attached to it two levers communicating with the blast valves, whereby the furnaceman can control to a nicety the quantity of gas or hot air he may require. (8) Owing to the mechanical feeding arrangements, one stoker is sufficient for three or four mill-heating furnaces. (9) Except when necessary to obtain a reducing flame, no smoke whatever can be seen from the tops of the chimneys, the dampers of which are never more than about 6in. high. The puddling furnace as constructed on my system differs from the heating furnace:—(1) In having the producer fixed immediately behind the fire bridge without any intermediate gas flue—see Fig. 1. (2) In the different method of heating the air, *i.e.*, in passing it under the neck and bottom of the furnace—see Fig. 2. The gas and air are worked under pressure, and the stoking arrangements are similar to those in the heating furnace. Owing to the close proximity of the producers to the furnace, the gases are liable to ignite; consequently, the saving in fuel is not so great as with the heating furnace arrangement, where the producer is at a greater distance from the furnace; but the furnaces work very economically and well. At the Round Oak Ironworks all the heating furnaces of the 22in., 16in., and 12in. trains are constructed on this system, as well as the ball furnace and the single and double puddling furnaces of one forge, the largest heating furnace being 13ft. 3in. by 11ft. by 2ft. 5in. The only fuel used is slack, as it comes from the pit, if of good quality." The author gave tabular statements showing how small was the consumption of fuel by his furnace. At the Hornbury Junction Ironworks, Wakefield, Casson-Bicheroux gas generators with reheating furnaces gave an average of 5 cwt. 3 qrs. 13½ lb. per ton of coal on iron produced. Under the old system about 9 cwt. of coal at 7s., against 5 cwt. 3 qrs. 13½ lb. at 5s. 9d., were used. It was also said that the yield of iron was better, quality more uniform, and repairs much less.

The following paper was then read by Mr. W. S. Sutherland on

The Use of Gaseous Fuel.

In this paper the author said:—"Messrs. William Baird and Co., of Gartsherrie Ironworks, have for several years devoted part of their attention to the recovery of bye-products from their blast furnace gases. At Gartsherrie and at their Eglinton Ironworks in Ayrshire, Messrs. William Baird and Co. have now erected and at work plant for the recovery of the tar and ammonia from the gases of sixteen of their blast furnaces consuming about 1000 tons of coal daily. They manufacture the ammonia into sulphate, and they distill the tar into oils and pitch. The gases at their different works contain ammonia equal to from 20 lb. to 30 lb. of sulphate, and 200 lb. to 225 lb. of tar per ton of coal consumed—the yields varying with the qualities of the coals and also with the working of the furnaces. The ammonia and the tar are perfectly taken from the gas, but hitherto various sources of loss have crept in, and the actual yield attained varies from 18 lb. to 25 lb. of sulphate of ammonia and 180 lb. to 200 lb. of tar per ton of coal consumed. The gas after being treated is perfectly clean, is very free from moisture, and as it deposits practically no dust, it is found to be better adapted than before for all purposes of the works—for raising steam, heating the furnace blast, distilling the tar, &c. This plant has now been at work for about six months, and part of it equal to two furnaces for eighteen months, and Messrs. William Baird and Co. are extending their Gartsherrie plant to take in the whole of their blast furnaces there. The plant for dealing with the gas has been erected under patents granted to Mr. Alexander and Mr. M'Cosh, both partners in the firm of William Baird and Co., with whom the author is associated in the problem of purifying blast furnace and producer gases and obtaining bye-products therefrom. Those who have practical experience in working producers, of whatever type they may be, will recognise how important a point it is to be able to break up easily the mass of fuel contained in them, to keep them open and of the right degree of porosity, and yet to avoid their breaking through into large holes. They know how much the attainment of such results adds to the labour cost, while they are essential to the uniform and successful production of good gas. Regenerators have such a remarkable steadying action that this sort of thing may go on to a considerable extent, alternating with the production of good gas, without, in many applications, interfering with any other result than the economy of fuel; and in blast furnaces, which are gas producers of a very highly efficient type indeed, this compensating action is obtained by the enormous depth of fuel, which practically gives the combining surface absolutely required, even though there be large holes in the fuel, and allows, in addition, plenty of time to coke the coal and prepare the fuel, although at the expense of enormous driving power. This driving power is allowed for and submitted to in blast furnaces, where good iron is the chief thing to be made, and not gas or gas products; but in gas producers a driving pressure of some 4 lb. or 5 lb. per square inch would be out of all question. Since the main object of a gas producer is to expose a sufficient surface of incandescent fuel to the current of air passing through it, and thus to convert the whole of the oxygen in that air into carbonic oxide before passing up through the upper layers of fuel, it follows that all producers should be so arranged that if the fuel be sodden down in a lump or broken through into holes, the parts that are out of order can be instantly attacked and restored to their normal condition. When coal is put into a retort gas of a certain quality can infallibly be produced from the coal if only the fire can be kept up under the retort. The same thing ought to obtain in the making of regenerator gas. Now, the measure of the quality of producer gas is the amounts of carbonic acid and pure oxygen present in the gas, and the temperature at which the gas escapes from the producer, and as well of the quantities and qualities of the tar and ammoniacal products. In general the quantity of CO_2 will vary from 4 per cent. to 7 or even 9 per cent. in some producers, whilst the temperature of the escaping gases varies from 1200 deg. Fah. to 2000 deg. Fah., and the tar, owing to the coal not having been thoroughly coked before the formation of CO_2 has ceased, will be found to be charred and of little value, while the ammonia will be partly destroyed, and any that remains will be found to be in the form of fixed salts or sulphites. The common plan of working producers by hand labour is inefficient, it leaves the quality of the gas produced a matter of chance and dependent upon whether the teazer can hit upon the sore place in the producer, and to obviate this, mechanical stirring should be resorted to. To do this the author makes the producers of cylindrical form, and through the centre a vertical revolving spindle passes, carrying on the end a stirrer to plough up the fuel. This is made perfectly diamond-pointed, to enter and loosen the fuel, and carries two arms, like propeller blades, which screw their way into the fuel, and at the same time loosen it and break it up effectually. The spindle is worked up and down by gearing. The whole is driven by a small engine. As only one producer needs stirring up at a time, very little power is required to do the work, and as the labour on the top of the producer is thus limited to putting in the coal and working the levers—if, as is generally the case, the coal be brought up in suitable trucks—it will be found that the economy realised will be considerable. The author found that, with high speed, in gas producers about 4ft. in diameter, up to 5 cwt. per hour of coal can be worked through, and that if the stirring be properly done no carbonic acid may appear in the gas, whilst 2 or 3 per cent., and no free oxygen, should be looked for at most. At present, the maximum quantity of ammonia sulphate obtained per ton of coal is about 20 lb., but more may be got by sacrificing the gas, because it appears that if steam comes in contact with hot fuel in such a way that carbonic acid is produced instead of carbonic oxide, the nitrogen in the fuel is eliminated in the form of ammonia, and at first glance, since each atom of CO formed in this way into CO_2 liberates its equivalent of hydrogen, there would appear to be no loss of heat, but the carbonic acid formed is equivalent to so much additional nitrogen. The quantity of tar got varies with the nature of the coal, perhaps more so than that of the ammonia, but about twelve gallons appears to be about the normal quantity. There are several vital points to be attended to in getting the triple products—generator gas, tar, and ammonia; but it it now being found that this gas, of high quality, can be got with certainty with up to 20 lb. of sulphate of ammonia per ton of coal, and from 10 to 20 gallons of good tar. The labour upon the producers and plant can be reduced to about from 4d. to 6d. per ton of coal passed through, and thus a net saving of about 2s. 6d. to 4s. per ton of coal may be effected. The tar is not of the same quality as the gasworks tar. The aromatic series is not formed, but the whole of the tar above referred to is being put into the market, and that it is all disposed of. Benzol and the aromatic series are in part being prepared from this class of tar in considerable quantities. In Scotch oilworks, if the value of the residual tar produced goes down to four times the value of the fuel used to heat the retorts, it is found advantageous to use it as fuel under the retort instead of the coal generally employed. Reasoning from this fact, it would appear that the time is not far distant when tar or tar and paraffin oil will be the fuel used on steamships, whereby only about one-half the present space, or even less, will be taken from cargo room. There will also obviously be an enormous saving in the labour of stoking, and an absence of smoke."

Mr. Head opened the discussion on these papers.

Mr. Kitson said, with reference to the 18½ cwt. of coal given as the amount per ton, it occurred to him that that economy may have been effected by the use of double puddling furnaces. In double puddling furnaces from 15 to 16 cwt. of coal per ton was commonly obtained, so that as regards the quantity of coal used, he did not see anything remarkable in the returns of Messrs. Morewood and Co.

Mr. Riley said Mr. Sutherland had almost made him believe that instead of its being the fact that tar and ammonia were to be the bye-products, that the making of steel was to be the bye-product. But the more he had looked into the matter, and the more experiments he had made with regard to this point, the further away was the realisation that these economies appeared to get. In the first place, from the common producer—and this was the essential point—they could not obtain from the gas more than from 4 lb. to 11 lb. of sulphate of ammonia. It was a very doubtful quantity, and the point which they ought to direct themselves to was the best form of producer. He was wavering between two points—of distilling the coal in the retort or a blast furnace producer. Which of the two would be the outcome he did not know. It was an extremely important point to them, and he looked to this gigantic scrubber and condenser for dealing with the blast furnace producer with some amount of terror, whereas in dealing with a small quantity by the process carried on at the gasworks in Glasgow, they felt that it was not a formidable thing to undertake.

The President read an extract from a letter from Mr. Andrew Carnegie, in Pittsburg, in order to show what was being done with gaseous fuel in America:—"I wish you would come and see our works running by natural gas nine miles, and to our works in the city, nineteen miles, and not a pound of coal, either for puddling, or heating, or under boilers. The same thing in steel rail works. A small jet laid under boilers at blast furnaces ignites the other gas, and we are using not one pound of coal at the place now. Is not this the rich land—rivers of oil and lakes of gas?" The Bicheroux furnace is a practical furnace, for so far back as 1877 a paper was read on the use of that furnace at the Ongrée Works in Belgium, and in a letter from M. Trasenster, of Bicheroux, the engineer of those works, it was stated that those furnaces were at work at the present day. Twenty thousand tons of iron were produced annually, and the results obtained are even better than those mentioned by Mr. Smith-Casson. The average consumption of coal per ton of iron puddled is 11 cwt., and the waste is considerably less than in the ordinary bath furnace, and instead of there being from 13 to 15 per cent. of waste, there is only from 9 to 10 per cent. The cost of the furnace is said not to exceed £80.

Mr. Smith-Casson replied to the discussion.

Mr. Sutherland, speaking of the works referred to in his paper, said:—"The quantity of coal now being dealt with amounts to somewhere about 1000 tons of coal per day, and the quantity of ammonia put into the market is something near 3000 tons per year, and the quantity of tar 20,000 gallons per day. The thing was still in its infancy, and was going on. He had lately been called into works where 2500 tons of coal were used per week, and there the idea that the owners had was to make the gas somewhere about half-a-mile from the works on account of cleanliness, and to take it in mains and divide it, and split it up, as in gas works, and to take the gas into different furnaces and to burn it there, and do away with all dirt and smoke and all nuisance in the works. That is what we are doing practically. The licenses granted represent over a million tons of coal per year."

It was then announced that the first paper for the next day's meeting would be Mr. Walter R. Browne's paper on "Steel Sleepers," and the second paper by Captain Orde-Browne on "Armour Plates."

South Kensington Museum.—Visitors during the week ending May 3rd, 1884:—On Monday, Tuesday, and Saturday, free, from 10 a.m. to 10 p.m., Museum, 13,052; mercantile marine, Indian section, and other collections, 4113. On Wednesday, Thursday, and Friday, admission 6d., from 10 a.m. to 6 p.m., Museum, 1965; mercantile marine, Indian section, and other collections, 271. Total, 19,401. Average of corresponding week in former years, 16,604. Total from the opening of the Museum, 21,002,173.

The Civil and Mechanical Engineers' Society.—The annual dinner of the Civil and Mechanical Engineers' Association was held at the Holborn Restaurant on Wednesday week, when a large gathering of the members sat down under the chairmanship of Mr. R. Harkness Twigg, the president. Among the members and others present were the secretary, Mr. F. Cuxton; Mr. Fung, of the Chinese Legation; Mr. Vanderburgh, of the Netherlands Embassy; Mr. Haughton, Mr. Street, Mr. Valpy, Mr. Walmsley, Mr. Statham (of the *Builder*), Mr. Sandall, Mr. Burbridge, Mr. Cole (the president elect), Mr. Knowles, Mr. Myall, &c. In responding to the toast of the society, the chairman remarked that the finances of the society, which was established in 1859, were in a flourishing condition, and that the society was growing. From four years ago, if they took the figure 1 as representing the membership, they had increased so that in the next year after that period it was 1·1; in the second year, 1·27; and last year, 1·77. One cause of their prosperity was that the society was one which was distinguished from any other institution, and it did not interfere with any other society connected with engineering. Mr. Fung and Mr. Vanderburgh responded, respectively, to the toasts of the "East" and "West," the former expressing a belief that there was nothing more widespread in its influence upon civilisation than engineering. Diplomacy was the great communication between Government and Government, but engineering was the link between people and people. Other toasts followed.

THE INSTITUTION OF MECHANICAL ENGINEERS.

A general meeting of the Institution of Mechanical Engineers was held on Thursday evening, the 1st inst., at the Institution of Civil Engineers. The first paper read was by Mr. Georges Marié, engineer of the Paris and Lyons Railway. The paper we give on this page, as it contains a good deal of information interesting to many of our readers. The discussion on the paper was opened by Mr. J. Tomlinson, who directed his attention mainly to the compound locomotive, and to what he considered the main cause of economy by those engines where any had been achieved. He was of opinion that the fact that all, or nearly all, of the compound locomotives had been put upon high speed long journey passenger work afforded sufficient explanation of the high duty. Most well-constructed locomotives would show good results under such circumstances. Such engines would, however, fail on the Metropolitan Railway, because of the frequent stoppages and short distances run. With so many stoppages there would be frequent stopping on centres with the engine, and steam would be used in this way, and with slow speeds the compound engine would lose its advantages. With higher pressures no doubt greater economy could be obtained; but no packing that he had yet tried would stand much higher pressures than are now used in locomotives. Mr. Tomlinson does not seem to have tried metallic packings of the best form.

Mr. Tomlinson admitted the value of Mr. Webb's arrangement of engine as a means of dispensing with coupling rods, which he seemed to consider the bane of a locomotive engineer's life. He considered that the compound engine had given the economic result which had been claimed for it only under the careful driving of picked men. The engines had been placed in the best hands, and under the same conditions he believed simple engines would give equally good results on long run service and better on short distance stopping trains. Some of the best men on the Metropolitan Railway ran their trains with from 26 lb. to 27 lb. of coal per mile, while some could not do with less than 36 to 37. The former would take from 9s. to 11s. per month bonus on the economy.

Mr. Druitt Halpin discussed the paper at some length, and favourably criticised much of the information given by M. Marié. He much questioned some of the estimates of locomotive horse-power by which the coal consumption was brought down below from 3·5 to 4·5 lb. On some of the Indian State Railways as little as 27 lb. of water per indicated horse-power was used, and the quantity of fuel necessary to do this was very well known. Mr. Halpin spoke at length upon the necessity for very great care in the arrangement of indicator gear, and in the selection of indicators suitable for high speeds for use in locomotives. He was much in favour of the indicator gear lately brought out, by which continuous diagrams were taken, and a mean performance more accurately pictured. After making some remarks on the friction of engines under different conditions, Mr. Halpin described the useful table which we give herewith relating to boiler performance.

No.	Description of boiler.	Lbs. water evaporated. Per sq. ft. of heating surface per hour.	Lbs. water evaporated. Per lb. of fuel from and at 212 deg.	Thermal units. In fuel.	Thermal units. transmitted per hour per sq. ft. heating surface per hour.	Thermal units. Per lb. fuel.	Efficiency.	G figure of merit = units per sq. ft. per hour, × efficiency.
1	Field	4·57	8·83	—	4,414	8,529	—	—
2	Field	2·28	10·83	—	2,202	10,461	—	—
3	Field	2·57	10·93	—	2,482	10,558	—	—
4	Portable (Cardiff.)	1·52	10·23	14,718	1,468	9,882	67	98,356
5	Portable (Cardiff.)	2·26	10·49	14,718	2,183	10,133	68	148,444
6	Portable (Cardiff.)	1·76	11·81	14,718	1,700	11,408	77	130,900
7	Portable (Cardiff.)	3·56	9·93	—	3,438	9,592	—	118,248
8	Lancashire	1·57	12·83	15,715	1,516	12,393	78	108,248
9	Lancashire	2·83	9·89	13,833	2,733	9,553	68	185,844
10	Lancashire	1·88	12·25	15,715	1,816	11,833	75	136,200
11	Jacketted	4·70	7·7	14,805	4,595	7,500	50	229,750
12	Lancashire	2·57	10·9	15,715	2,482	10,529	67	166,294
13	Compound	1·43	11·51	14,296	1,381	11,125	78	107,718
14	Loco. (Webb)	9·83	10·28	14,004	9,495	9,930	70	664,650
15	Loco. (Marie)	4·62	10·65	14,600	4,462	10,287	70	312,340
16	Loco. (Coke)	12·57	8·22	13,550	12,142	7,940	58	704,236
17	Loco. (Coke)	13·73	8·94	13,550	13,263	8,636	63	835,569
18	Loco. (Coke)	6·76	10·01	13,550	6,530	9,669	71	463,630
19	Loco. (Coke)	7·39	11·2	13,550	7,138	10,819	77	549,626
20	Torpedo	12·54	8·37	14,727	12,113	8,085	54	654,102
21	Torpedo	14·86	7·78	14,727	14,354	7,523	51	732,054
22	Torpedo	17·90	7·49	14,727	17,291	7,235	49	847,259
23	Torpedo	20·74	7·04	14,727	20,034	6,800	46	921,564
24		*a*	*b*	*c*	*d*	*e*	*f*	*g*

From this it will be seen that the boiler of a locomotive engine when used as a locomotive, gives far higher results than the same boiler fixed, or than any other class of boiler. This Mr. Halpin attributes to the disintegrated or open condition of the fire maintained by the shaking of the engine, and also to the liberation of the steam bubbles from all heating surfaces as fast as made by the same shaking. He objected to the general statement of M. Marié as to the necessity for large heating surface and large cylinders. Referring to Mr. Webb's compound locomotive, he said he had ridden upon it, and certainly saw nothing of "jockeying," but only careful stoking, and the engine travelled with remarkable ease and steadiness.

Mr. Longridge took occasion to repeat his views as to the economy of compound engines, namely, that it was due to the use of greater pressures and not to compounding. Mr. W. Rich referred to the high results obtained with the locomotive form of boilers by portable engine builders as long ago as the Cardiff Show. Mr. McDonnell replied to the remarks that had been made as to nursing, and said that good drivers may be said to nurse their engines always. Mr. Bell thought it was questionable whether sufficient attention had been paid to the quantity of air which passed into the furnace and to the quantity of heat lost up the chimney. In reply, however, to this, it may be remarked that drivers who have, as mentioned by Mr. Tomlinson, brought their consumption down to 26 lb. have not much to learn as to whether they are letting too much or too little air into their fire.

The next paper read was by M. Decauville on "Portable Railways." In this paper the author described the system now so well known all over the world that he turns out about 80 tons of it per day. It is indeed so well known that we need not reproduce the paper here.

ON THE CONSUMPTION OF FUEL IN LOCOMOTIVES.*

By M. Georges Marie, Engineer of the Paris and Lyons Railway.

During the past twenty years a great advance has been made in regard to economy of fuel in steam engines. In marine engines remarkable results have followed from the general use of compound cylinders and surface condensers; for whereas their consumption was formerly from 3½ lb. to 4½ lb. per indicated horse-power per hour, it has now been reduced to about 2 lb., and sometimes even less.† Equally good results are obtained with Corliss engines. This progress in economy of fuel has led to the endeavour to effect a corresponding reduction in locomotives. But, before the ordinary build of locomotives so long in vogue is abandoned, their exact consumption ought to be ascertained. Generally it is measured in pounds per mile; but that mode is not a convenient one for comparison, because it takes no account of gradients, weight of train, speed, and train resistance, all of which are so variable that the bare statement of consumption per mile is of scarcely any value. The only proper way of reckoning the consumption, so as to admit of comparison under different circumstances, is in pounds per horse-power per hour; and this is accordingly the new methods described in the present paper, as applied to locomotives under ordinary working conditions. There is a general impression that locomotives consume as much as from 4½ lb. to 5½ lb. of fuel per horse-power per hour. With a view to dispel this very prevalent error, the author can quote experiments made by him during the last few years, which show an average consumption in good locomotives of 3·35 lb., when the horse-power is measured by the work done at the circumference of the driving wheels, and of 2·91 lb. when it is measured by the indicator diagrams; the fuel being of good quality and the firing done with care. Comparing this with the marine engine consumption of 2 lb. per indicated horse-power, it is seen that locomotives are much more economical than is usually supposed, considering that they work non-condensing while marine engines enjoy the great advantage of condensation. The author's first experiments on this subject, made in 1877 on the line between Rive-de-Gier and St. Etienne in the department of the Loire, gave a consumption of 2·90 lb. to 3·24 lb. per indicated horse-power per hour;‡ other experiments confirming this consumption were also made on a longer length between Alais and Langeac on the Nîmes and Clermont line. These results, which were widely criticised, led M. Hirsch, Professor of Steam and Engineering at the Ecole des Ponts et Chaussées, to request that the experiments might be repeated in his presence. Fresh trials, which may be considered official, were accordingly made with him on 18th, 20th, and 21st of July, 1882, on the Mont Cenis line between St. Jean de Maurienne and Modane, with the ordinary trains. The average consumption was again found to be 2·90 lb. per indicated horse-power per hour. In these experiments neither indicator nor dynamometer of any kind was used, such delicate instruments being liable to give rise to errors. Indicators especially occasion considerable errors through the oscillations of the piston-rod and spring, and in general give accurate results only from stationary engines working at slow speeds. The following are the particulars of the three days' trials, which it is hoped will successfully clear the locomotive from the imputation of wastefulness in consumption of fuel.

Choice of line.—For experiments of this kind the writer generally chooses a steep rising gradient, because the work performed by the engine can then be easily and accurately calculated. It then consists of two portions; first, the work due to the train resistance on a level; and secondly, that due to gravity on the incline. On a steep rising gradient this latter portion becomes much the more important, while it can always be determined with accuracy, being the product of the total weight of train and engine, multiplied by the difference in level between the two ends of the incline; whereas the calculation of train resistance on a level is always subject to slight errors, arising from variations in the circumstances of wind and weather. Hence the steeper the incline up which the engine takes the train, the greater is the accuracy with which the work done can be calculated. In this way the engine duty can practically be determined without the use of either indicator or dynamometer of any kind. The portion of line selected for the trials was the length of 17⅛ miles between St. Jean de Maurienne and Modane stations on the Mont Cenis line; the gradients are 1 in 100 to 1 in 35, rising towards Modane, which is 1709ft. above the lower station; the average gradient is 1 in 53½.

Choice of train.—The train chosen was a passenger train starting from St. Jean de Maurienne at 12.21 noon, stopping only once on the way, at St. Michel, for three minutes, and reaching Modane at 1.25 p.m.; the average speed being accordingly 17·40 miles per hour. The engine, built from the designs of the writer's father, the late Ernest Marié, had eight wheels coupled, and its principal dimensions were as follows:—

Cylinders	Diameter	21⅛in.
	Stroke	26in.
Wheels, diameter		4ft. 1⅝in.
Heating surface	Fire-box 104·52	2149·70 sq. ft.
	Tubes 2045·18	
Fire-grate area		22·39 sq. ft.
Boiler pressure		128 lb. per sq. in.

The weight of the train, ascertained with the greatest care, was 163·58 tons, the particulars of which are given in the tabular summary appended; engine, tender, and carriages were all weighed accurately on weighing machines.

Calculation of work done.—If calculated at the circumference of the driving wheels, not in the cylinders, the work done is exclusive of the engine friction, and is given by the following formula:—Work done $= W \times l \times r + W \times h$. Here W = total weight of train, including engine and tender = 163·58 tons = 366,419 lb.; l = distance run = 17,334 miles = 91,536ft.; r = coefficient of resistance = $\frac{1}{232{\cdot}5}$ in the present case, or 9⅝ lb. per ton; h = height of train's ascent = 1709ft. The choice of the coefficient $\frac{1}{232{\cdot}5}$ will be explained further on. Substituting the foregoing values—

$$\text{Work done} = 366{,}400 \times (91{,}536 \times \frac{1}{232{\cdot}5} + 1709)$$
$$= 366{,}400 \times (394 + 1709) = 770{,}600{,}000 \text{ foot-pounds.}$$

Of this work the portion due to the resistance on a level amounts to only $\frac{394}{394 + 1709}$ or barely one-fifth, while gravity absorbs the remaining four fifths. Hence an error of as much as 10 per cent. in the coefficient of resistance occasions only 2 per cent. error in the calculation of the work; while even 20 per cent. error in the coefficient causes only 4 per cent. error in the result. Although, therefore, the coefficient here taken of $\frac{1}{232{\cdot}5}$ may be open to criticism, it is clear that it may be considerably modified without sensibly affecting the calculation of the work done. This constitutes the principle on which the author's trials have been based; whereby he has been enabled to arrive at an accurate determination of the work done, without the use of either indicator or dynamometer of any kind. The only objection to the method is that it applies only to moderate speeds, inasmuch as high speeds would be dangerous on the curves of a mountain line.

Consumption of fuel.—To ascertain correctly the consumption of fuel the author employed a different method from that ordinarily followed in locomotive trials. The general plan is, after lighting the fire and getting up steam, to note the pressure shown by the gauge, and the height of the water-level, and to estimate the quantity of coal then on the grate. The trial is then made, and is so arranged as to end with the same pressure and water-level as at starting, and the coal remaining on the grate is again estimated. The correct consumption is arrived at by measuring the quantity consumed on the journey, adding what was on the grate at starting, and subtracting what remains at the end. Unfortunately it is impossible to determine correctly the quantity of burning fuel on the grate; and in consequence the calculated consumption almost always involves a serious error. This is one cause of the discrepancies met with in statements of fuel-consumption. In the author's trials the above source of error has been completely avoided by the following mode of procedure. The engine tried had already made one journey that morning, so that it was in steam, with a pressure of 46 lb. per square inch, before lighting the fire for the experimental trip. The water-level was 5·16in. above the mean line. The fire-grate was cleared of every particle of fuel from the previous journey. The tender was loaded with one ton, or 2205 lb., of Anzin patent fuel in bricks, and 119 lb. of wood was served out for lighting the fire. The wood was included as fuel in reckoning the actual consumption, and was taken as equivalent to not more than 44 lb. of coal; the total supply of coal would therefore be 2249 lb. Steam was quickly got up, and shortly afterwards the engine was coupled to the train in St. Jean de Maurienne station, and proceeded thence up the incline to Modane. The trip was made with the engine working in the ordinary way, with 128 lb. of steam, cut off at 19 per cent. of the stroke. Professor Hirsch, and M. Bazire, of the locomotive department, accompanied the author on the engine. The firing was so managed as to have no coal at all left on the grate on reaching Modane. The steam-pressure was then found to be 20 lb. per square inch, and the water-level 4·49in. below the mean; the datum level in the locomotives of the Lyons Railway being not the actual low-water line, but a mean level below which the water may fall without danger. The water-gauge was of course observed while the engine was on the level portion of the line in the station, the line running level through every station on this railway. The coal remaining in the tender weighed 1133 lb., which would show a consumption of 2249 – 1133 = 1116 lb., if the boiler had been in exactly the same state after the trip as before; but no skill could succeed in securing the same steam pressure and the same water-level as on lighting the fire. A slight correction has therefore to be made in the coal consumption, to allow for the difference in quantity of heat contained in the boiler before and after the trip.

Correction for difference of heat in boiler.—Calculating first the quantity of heat contained in the boiler on lighting the fire, and secondly the heat remaining in it after the trip, the difference converted into pounds of coal will be the correction to be made in the weighed consumption of 1116 lb., to give the true consumption. Firstly, at the time of lighting the fire, when the water-gauge stood at 5·16in. above datum, the quantity of water in the boiler would be 1571 gallons, or 251 cubic feet, as ascertained from the dimensions given in the tabular summary appended. The temperature corresponding with the steam pressure of 46 lb. is 293 deg. Fah. The weight of water, therefore, allowing for its expansion, would be 14,506 lb.; and this, at the temperature of 293 deg. Fah., would contain 3,436,000 heat units, reckoning from the temperature of the air at the time, which was 59 deg. Fah. The metal of the boiler, weighing about 20 tons, would contain about 1,175,000 heat units. The heat in the steam may be neglected. Hence the total quantity of heat contained in the boiler at the time of lighting the fire, above the air temperature of 59 deg. Fah., would be 4,611,000 units. Secondly, the heat remaining in the boiler after the trip, estimated in the same manner, would amount to 3,143,000 units. The difference, or 1,468,000 units, is therefore the additional heat expended during the trip. As the weight of dry steam generated per pound of coal consumed was found to be 8·08 lb., and as each pound of steam at the pressure of 128 lb. per square inch contains 1169 heat units above the feed-water temperature of 59 deg. Fah., the boiler would produce, in practice, 8·08 × 1169 = 9445 heat units per pound of coal. The additional expenditure of 1,468,000 heat units during the trip is therefore equivalent to 155 lb. of coal, which, added to the weighed consumption, gives 1271 lb. as the true consumption of coal for the trip.

Consumption of fuel per effective horse-power per hour.—The work done, corresponding with the above consumption of 1271 lb. was 770,600,000 foot-pounds. Hence the coal consumption per horse-power per hour was $\frac{33{,}000 \times 60 \times 1271}{770{,}600{,}000} = 3{\cdot}27$ lb., the work being the effective work, *i.e.*, that measured at the circumference of the driving wheels. Throughout the foregoing calculation, the only coefficient open to dispute is that of the train-resistance, which has been taken at $\frac{1}{232{\cdot}5}$; but it has been seen that even a considerable percentage of error in this coefficient would involve no appreciable error in the final result of 3·27 lb. consumption per effective horse-power per hour. To get at the consumption per indicated horse-power, it is only necessary to deduct the proper allowance for the engine friction; which has been found, in careful experiments made by the writer's father, to absorb at least 12 per cent. of the indicated power, when the engine is in perfect working order. Hence the corresponding consumption per indicated horse-power per hour would be $3{\cdot}27 \times \frac{100-12}{100} = 2{\cdot}88$ lb. as a maximum.

Consumption of water and production of dry steam.—The consumption of water on the trip, from the tender and from the boiler, was measured with the greatest care, allowing for expansion of the water in the boiler. It was found to amount to 11,290 lb., or 8·88 lb. per lb. of fuel. Deducting 9 per cent. for priming, the weight of dry steam produced would be 8·08 lb. per lb. of fuel.

Nature of fuel.—Samples carefully analysed of the Anzin patent fuel, which was used in the trip, showed 6·9 per cent. of ash, and 1 per cent. of moisture. The heating power was found to be 14,600 units per lb. It was ascertained by means of apparatus specially made for the purpose, similar to that used by Ebelman, Fabre, Silbermann, and Berthelot, in their experiments on the heating power of fuel. It consists of a glass phial, within which a powdered sample of the fuel, placed in a crucible, is burnt in a current of oxygen; the phial is immersed in a measured quantity of water, and the rise of temperature in the water indicates the heat developed by the combustion of the sample. Cardiff coal was tried in the same way by the author, and gave the same heating power; a direct comparison can therefore be made between this experimental trip and any English trials with Cardiff coal. The Anzin patent fuel is in fact composed of 91 per cent. of slack, of the same quality as Cardiff coal, and 9 per cent. of coal pitch, the heating power of which has been found by the writer to be equal to that of ordinary coal.

Remarks.—During the experiment, the admission of steam to the cylinders was for 19 per cent. of the stroke, the steam in the waste spaces being included. The valve gear was tested by Professor Hirsch himself. The locomotive had not been repaired for a long time. It may be objected that the driver probably looked after the fire much more closely than usual, being stimulated by the presence of the engineers. This may be, but, on the other side, the following circumstances were unfavourable to economy of fuel:—(1) During the firing up, the locomotive gave out some heat to the atmosphere as usual; this loss of heat was equivalent to about 29 lb. of fuel, according to an experiment made for that special purpose. (2) In the last few minutes of the trial, the engine was

* Read before Institution of Civil Engineers.
† See Paper by Mr. F. C. Marshall, Proceedings 1881, p. 452.
‡ See "Revue des Chemins de fer," July, 1881, p. 17.

running with a very low pressure, which was necessary in order to arrive at Modane without any fuel on the fire-grate; hence the engine was working during these minutes in unfavourable circumstances.

(*To be continued.*)

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

(*From our own Correspondent.*)

THE claim of the ironmasters for a reduction of 6d. per ton in puddlers' wages and 5 per cent. in those of mill and forgemen has resulted in an award by Mr. Avery, dropping puddlers' wages 3d. and millmen's in proportion from May 19th to August 23rd certain, and after then subject to a month's notice upon either side. Puddlers' wages are now, therefore, 7s. 3d. a ton. But this is still 6d. higher than in the Middlesbrough district. The contents of this award were known in time for the meetings of the trade yesterday in Wolverhampton and to-day—Thursday—in Birmingham, and the document was much discussed. Some masters expressed a little disappointment that the reduction was so small, but the more cautious members of the trade pointed out that they could scarcely have looked for more in the face of the very limited drop which has been awarded in the North of England. The alteration will affect wages, not only in Staffordshire, but to a similar extent in most of the other iron-making districts of England also outside Cleveland and South Wales.

Prices of iron are not quotably influenced by the reduction. Masters declare it to be too small to allow of any further concessions. In truth, the drop has already been discounted in the prices which regulated previous contracts with buyers of iron.

The amount of work doing at the mills and forges does not, upon the whole, show any perceptible augmentation upon the week, yet here and there a few establishments are rather better off.

The sheet and hoop mills are chiefly to the front in this temporary improvement. Alike yesterday and to-day ironmasters, however, spoke of the great difficulty which exists in inducing customers to give out specifications under orders placed some time ago. Consequent upon this holding back by buyers, works' proprietors have still to be content with running only part of their mills.

The prices of sheets continue as varied as ever, but there is more determination on the part of certain of the manufacturers to refuse prices at which they cannot see a profit than is generally supposed. Numerous instances were mentioned this afternoon in which, on this account, masters had refused inquiries.

It is somewhat questionable whether all the inquiries which are coming out through merchants are genuine. Certain makers are beginning to suspect that some of them are merely "feelers," to ascertain the lowest prices. Common merchant sheets—singles—are £7 per ton upwards; galvanising doubles, £7 10s. to £7 15s.; and lattens, £8 10s. to £8 15s. Thin sheets are in large call upon the basis of £10 to £11 for working-up doubles, and £13 to £14 for stamping lattens.

Galvanisers are unusually reticent concerning the prices now ruling, but corrugated sheets of 24 gauge, in bundles, delivered Liverpool, may be quoted about £12 to £12 5s.

Bars, hoops, and strips are not in much increased sale. Yet for gas strip there is a little better demand, consequent upon the tube makers being busier. Nail strip for Russia and Canada is selling more freely. The orders from the latter market are unusually late in arriving, but their advent has now imparted a little more work to certain mills.

The merchant orders for hoops are much below the average, and the United States' requirements are conspicuous by their absence.

Best bars range from £7 10s. to £7; second-class qualities are £6 10s.; and common are £6. Export hoops vary from £6 5s. to £6 10s. Gas strip is a minimum of about £5 15s., but the general quotation is £6. Nail strip is about £6 to £6 2s. 6d. easy.

The pig iron trade lacks animation. The business doing is mostly in the hands of foreign makers, whose prices and brands are more to the mind of some customers than native makes. Among the Staffordshire producers, those who turn out part-mine and cinder pigs are doing more than those who confine their output to best qualities. Hot blast all-mines vary from 62s. 6d. to 57s. 6d. per ton; part-mines from 55s. to 45s.; and cinder pigs from 40s. to 37s. 6d. In actual business not much above 56s. 6d. can be obtained for good forge hematites, though higher prices are asked

The coal trade rules dull, and there is considerable competition for the ironworkers' trade with consequent underselling. The following are approximately the official prices, but they are not maintained:—Furnace and house coal, 9s. 6d. to 10s. per ton; steam or locomotive coal, 8s.; cobbles, 7s. 6d. and 8s.; slack, 4s. 6d. to 5s. 6d. Miners' wages are at present 3s. 8d. per day for thick coal men, and 2s. 10d. for thin coal men. The colliers are only working short time, and prospects do not encourage the belief that they will have much more to do yet awhile.

The iron roofing, girder, and bridge building works continue fairly employed.

The Patent Shaft and Axletree Company, Limited, of Wednesbury, has recently secured several good orders for wheels and axles from the Indian States Railways. The company does not, however, consider the orders of unusual magnitude, since it frequently books lots of 2000 to 3000 pairs for the Government lines. Nevertheless, the orders just received are welcome, as helping to find the men employment.

In reply to deputations from their men who are out on strike for an advance of wages, several of the chainmakers in the Old Hill and Cradley Heath districts have intimated that they have not sufficient orders in hand to warrant them giving the advanced rate, and have even advised the men to remain out some time longer. The men have held a meeting to consider their position, and they have decided to pursue the policy recommended.

Operations at the hardware factories are not very vigorous. At some of the establishments the hands are employed upon Admiralty and War-office contracts lately distributed. This class of business, however, does not bring in any large profits. It is satisfactory only as affording work for operatives who might otherwise be altogether idle, consequent upon a lack of open buying by the open market. Reports from New South Wales are more cheery. In the class of hardwares that are inquired for for India, plantation and other edge tools are still conspicuous.

The Employers' Liability Insurance Company, of Birmingham, is in a prosperous condition. The premium income, which between April 1st, 1881, and March 31st, 1882, was £3524, amounted in the following year to £6004, and in the year ending March 31st last, to £6833. During the past twelvemonths 308 policy holders have given notices of accidents, reporting 864 accidents to workpeople, and in 750 cases payments had been made. Only seven cases have involved legal proceedings. The income of the company during the year has been £7061, which, after paying expenses, leaves a balance in hand of £2615. The directors resolved to pay a dividend of 10 per cent., and to add £1927 to reserve, making it £2208, and at the annual meeting on Thursday last this proposal was adopted.

The manufacture of gas by the Corporation of Walsall continues to be a remunerative undertaking. It is estimated that the profits for the ensuing year will amount to £8000, and in order to dispense with a borough rate of 1s. 10d. in the pound to meet a small deficiency on the estimates for the year, it has been determined to appropriate a surplus of gas profits together with the estimated profits for this year.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—The iron trade of this district continues in a depressed condition, which shows but little change from week to week. The actual requirements of consumers are only small, and in many cases they are more than covered by deliveries which have to come in on account of iron already bought, and the persistent weakening tendency shown by prices naturally operates as a check upon anything like speculative purchases, as buyers prefer to take the probable chance of the market being still more in their favour when they have actual requirements to cover. Business, consequently, drags on from hand to mouth, with makers, as their order books get bare, showing more disposition to entertain offers at under their quoted rates. By some of the makers a tolerably firm tone is still maintained, but there is very little business done except where sellers are prepared to come in at low prices.

There was again a very dull iron market at Manchester on Tuesday, with little or no business of any weight reported in pig iron. Local makers are able to secure a few small orders in the immediate neighbourhood of their own works, where they have the advantage of low rates of carriage, but on the basis of the quoted prices of 43s. 6d. to 44s., less 2½ for forge and foundry delivered equal to Manchester, they are unable to get orders. At under the above rates there is a considerable amount of business pending, but makers are not at all anxious to push sales at anything much below these quoted rates, and buyers seem to be equally indifferent about giving out their orders. The transactions reported in district brands continue very limited in extent, and the average basis of prices is about 43s. 4d. to 44s. 4d. less 2½ for forge and foundry Linconshire, and about 1s. per ton more for Derbyshire brands, but there are sellers who would take under these figures to secure orders. Outside brands, such as Scotch and Middlesbrough, continue to ease down in value, with merchants offering at under makers' prices.

The hematite trade continues extremely dull, with good foundry brands to be bought readily at about 45s. 6d. to 46s., less 2½ delivered into this district.

In the finished iron trade there have been some moderate orders giving out in connection with bridge work, and some of the large forges in this district are doing a very fair trade for shipment; but as regards business generally, there is a continued want of animation. For good Lancashire and North Staffordshire bars delivered into this district, £5 15s. remains about the average prics. There are, however, inferior brands to be got for about 2s. 6d. less, and north-country bars are offered freely at about £5 12s. 6d. Local made hoops are quoted at about £6 5s. to £6 7s. 6d., and sheets at about £7 10s. per ton.

Ironfounders still report trade as very dull, and for some descriptions of castings extremely low prices are being taken. Cast iron columns are being delivered into the Manchester district at £5 per ton, ordinary pipe castings at £4 7s. 6d., and bored, turned, and lined pipes at £4 10s. per ton.

In the engineering trades the complete collapse of shipbuilding is naturally making itself felt amongst marine engineers who, in this district, are simply kept going completing orders chiefly on account of Government work. With this exception, a moderate amount of activity is still maintained, and the complaints are not so much of actual scarcity of work, but of the extremely low prices at which it has to be taken. Boiler makers report that more orders have been stirring recently; special tool makers are tolerably well off for orders, and machines are moderately busy.

The strike in the Warrington wire trade seems now to be practically at an end, and I understand that the men are seeking to make some arrangement whereby they can return to work. The stocks which makers have had on hand have been amply sufficient to meet the requirements of the present depressed state of trade, and practically the only effect of the strike has been to clear away some of these stocks.

The question of underground haulage in collieries, which with the large areas now worked in the Lancashire coal-field, is a matter of considerable importance to mining engineers, was discussed at the meeting of the Manchester Geological Society, on Tuesday, when Mr. G. H. Peace described the system of underground haulage which had been adopted at the Ashley and Tyldesley Collieries, near Manchester. At the older and shallower pits of the company the various systems of haulage comprised self-acting planes, single down brow ropes, main and tail and endless ropes, the engines in each case being placed underground and supplied with steam through pipes in the upcast shafts. At the deeper pits the objection to taking steam down from the surface was increased, and the other alternatives had been very fully considered. Whilst admitting the convenience in working of compressed air, the much smaller first cost and economy in the working of engines on the surface led to the adoption of the latter system with endless ropes. In the discussion which followed a unanimous opinion was expressed in favour of the adoption of endless ropes, both on the score of efficiency and economy; some difference of opinion existed as to the comparative results obtained by the use of compressed air engines, but generally the system was condemned for its waste of power. Mr. Dickinson, her Majesty's Chief-Inspector of Mines, observed that he had made experiments and he had found a great loss of power with compressed air. There was, however, no doubt that in other respects compressed air possessed important advantages over steam for use in collieries.

That the working places in coal mines are occasionally penetrated by the electric current generated during thunder-storms is a pretty well established fact, although doubts on the matter are still entertained in some quarters. At the meeting of the Manchester Geological Society, on Tuesday, this question was also discussed, and Mr. John Knowles read a paper describing the descent of an electric current into a pit near Bolton, owned by Messrs. Andrew Knowles and Sons, on the 21st February last. The pit is 97 yards deep, and the electric current seemed to have struck the top of the upcast chimney, displacing a large quantity of brickwork, then descending outside the chimney, it struck the ground close to it, making a large hole. It then went along the ground to the cast plates at the top of the downcast pit, and it was presumed went down the steam pipes in the shaft and so into the workings on the east and west. From the effects experienced by the men in the workings it was evident that there must have been a very strong current of electricity passing down the pit. The manager, who was on the west side and 300 yards from the shaft, received so severe a shock that he was completely prostrated from work for six days, and had it not been that the current found ample means for distribution the effects might have been much more serious. Mr. Dickinson, who has investigated the matter, said it had occurred to him that the flash had gone down both shafts, and he added that the descent of an electric current had been given as the cause of the Risca colliery explosion, which occurred when a violent thunderstorm was in progress. As a further illustration of the effect of electric currents descending into the workings of a coal mine, Mr. Burrows described a similar incident at one of their collieries, which produced the impression that the pit had "fired," and was the cause of intense alarm both to those above and below ground.

In the coal trade a generally steady tone is being maintained. As I intimated last week, there has been a giving way upon the top quotations of last month, but, except that for quantities special prices are quoted, there is no material reduction upon the minimum rates which were previously being taken, and as there is indisposition to attempt any general reduction in wages, colliery proprietors can scarcely come much lower on their parts. The general demand for coal remains much the same, pits being kept running about four, and in a few cases five, days a week, with the bulk of the output going away, the chief accumulation of stocks being in the common classes of round coal. At the pit mouth prices average about 9s. for best coals, 7s. for seconds, 5s. 6d. to 6s. for common house fire coals, 5s. to 5s. 6d. for steam and forge coals, 4s. 6d. to 5s. for burgy, 3s. 9d. to 4s. 3d. for best slack, and 3s. to 3s. 6d. for ordinary qualities.

With regard to the railway contracts for locomotive fuel, to which I referred last week, I understand that one company has placed about 200,000 tons in the Lancashire district, at an average price of 5s. 6d. per ton at the pit.

Shipping, so far as the demand for steamers' use is concerned, is only quiet, owing to so many vessels being laid aside, but the low freights now obtainable have tended rather to stimulate activity in the shipment of cargoes, and there is a moderately good trade doing. There is, however, so much coal offering in the market that orders are competed for at very low figures, and for delivery at the high level, Liverpool, or the Garston Docks, Lancashire steam coal can be got readily at 7s. to 7s. 3d., and seconds house coal at 8s. 3d. to 8s. 6d. per ton.

Barrow.—I have no improvement to report in the condition of the hematite pig iron trade of the district. The market remains practically unchanged. Business is very dull, and the orders coming to hand from all quarters are inconsiderable and inextensive. Consumers, although prices are so very low, are restricting all their orders, and no speculation is noticeable in transactions; but they seem to be holding back in order to still further reduce prices. Prices are unaltered, last week's quotations ruling. Mixed prices of Bessemer qualities are selling at 47s. 6d. per ton net at works. The quantity of metal now stocked at warehouses is considerable, and it is gradually increasing, as the deliveries do not by any means represent the production of the district. Unless an improvement occurs before long, makers will be obliged to further reduce the output. Steel makers are but indifferently employed, as few orders are coming to their hands. In the merchant department little activity is displayed, whilst rails are in slow request at from £4 10s. to £5 per ton net at works, prompt delivery. Shipbuilders are almost at a standstill, and no new orders have been received. The minor departments of the steel and iron trades are remarkably quiet. Iron ore is in demand at from 8s. 6d. to 9s. per ton net at mines. Stocks are heavy. Coal and coke quiet. Shipping freights low.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

IT seems increasingly difficult for Sheffield firms to secure orders for railway material of all kinds. No one expects that the rail trade will ever become what it was; but there ought to be less difficulty in retaining rolling stock work. It is impossible to shut one's eyes to the fact, however, that even in wheels and tires, and similar goods, Sheffield cuts but an indifferent figure in the way of securing contracts. The latest cases in point are certain orders for the Indian States Railways, amounting in all to 4000 pairs of wheels and axles, and 460 pairs of a smaller size. Lancaster—Lancaster Wagon Company—and Wednesbury—Patent Shaft Company—have had the 4000 order divided between them, and the Patent Shaft Company has also obtained the order for the 460 pairs. A portion of the tires will, of course, come to Sheffield; but this seems a sorry slice for a place which ought to be the home of railway material production. Is this another case of carriage charges? It may be so as regards Lancaster, but what of Wednesbury?

Iron is very sluggish, and quotations are stated to be lower than at any previous period. Nos. 1, 2, and 3—hematite iron—are now quoted at 54s. per ton; common forge and foundry is at 44s. to 45s. per ton. In the latter quality a fair business is doing; in the former holders press sales even at the low quotations named, and their eagerness to sell has the effect of making buyers hold off in the hope of still lower values being current. There is not much prospect, I think, of the wages question in the coal trade being re-opened this summer. Though all the coalowners agree that the present prices of coal do not warrant a continuance of the 10 per cent. obtained by the miners in 1882, an influential minority is opposed to any agitation about wages this summer. The first proposal was to have the reduction till October only; it could not, even if unresisted, come into operation before June, and there is no doubt that a stubborn fight would take place, and probably cause more loss than could possibly be gained.

Is the grinder to wake up some morning and find his occupation gone? There really seems some fear of this result. Many minds have turned to this subject, particularly at times when other workmen have had to stand because sufficient blades could not be got from the men of the wheelswarf who did the grinding. One machine, of a primitive construction, is going now, and is said to make very good work. Mr. F. Marsden, of Pond Hill, Sheffield, has invented and patented an idea which has been satisfactorily tested for twelve months, and appears to be of a most promising character. The drawings were shown to me this week. Mr. Marsden is himself positive as to its power of work, and the adaptability of his contrivance to all the varied kinds of grinding here and elsewhere.

The City of the Crooked Spire at the present moment may fairly claim to be the best lighted town in England. The corporation have just entered into a new contract with the gas company, while that with the Electric Lighting Company has not quite expired, so that for a few nights longer the streets will be illuminated with gas and electricity. The gas company having been put upon their mettle by the electric light, have erected several powerful lamps in the Market-place and other open spaces, and these with the electric arc lamps previously there, cause these parts to be brilliantly lit. In the less important streets a gas lamp and an incandescent lamp are burning side by side.

At Swinton forge, belonging to Messrs. John Brown and Co., business appears to be very depressed. For a fortnight only five days' work had been given; and since the 2nd inst. the men have been idle, owing to the scarcity of orders. At Parkgate Ironworks, on the other hand, the men are working full time, though, of course, the 2½ per cent. reduction has now come into force.

The Fair-Trade agitation appears to be gaining ground here. At one time it was impossible to get anything like a fairly-attended meeting even to discuss the subject; now there are several meetings a week, and resolutions in favour of an inquiry into the present working of free trade and tariffs, generally, are regularly worked. At one of the meetings this week, a resolution was passed in our principal working district, "That this meeting has no confidence in any Government, Conservative or Liberal, that is not in favour of an inquiry into our present system of trading with foreign nations, and that a copy of this resolution be sent to the Parliamentary representatives of Sheffield."

The Manchester, Sheffield, and Lincolnshire Railway Company, giving effect to the opposition raised by the shareholders at the Wharncliffe meeting, and having in view the depressed state of traffic at the present time, has come to the conclusion to withdraw its "Additional Powers—Lincolnshire Lines—Railways Nos. 2 and 3," for the present session. This decision has caused much disappointment in the Isle of Ancholme, where it was intended to construct tramway lines to help in "tapping" the district. The Dore and Clunley Railway has now complied with the Standing Orders, the additional provision in the form of an agreement between the Midland and the Dore and Clunley Companies having been passed by the examiners unopposed; though, of course, it will now go before the Committee.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

ALTHOUGH the ironmasters' returns for April are considered satisfactory from a producer's point of view, showing, as they do, a reduction of 8300 tons in stocks, and shipments heavier than were expected, still the condition of the pig iron trade does not improve. The market held at Middlesbrough on Tuesday last was but thinly attended; the tone was decidedly one of depression, and the amount of business transacted was very small. Buyers would not give more than 36s. 9d. per ton for No. 3 g.m.b., delivered f.o.b. Merchants and some makers sold at that figure, but the principal producers quoted 37s., and for less they would not sell at all. The usual quotation for No. 4 forge was 35s. 3d. per ton, but one or two lots changed hands at 35s.

The stock of Cleveland pig iron in Messrs. Connal's store at Middlesbrough remains at 60,427 tons. It has not varied during the

last four or five weeks. Their stock at Glasgow has decreased about 300 tons during the week.

Shipments from the Tees have been so far but moderate this month. During April the total quantity exported was 78,287 tons, or about 2000 tons less than during March. The principal items in last month's shipment returns are as follows:—Scotland, 19,027 tons; Germany, 15,195 tons; Wales, 7525 tons; Holland, 6590 tons; France, 6035 tons; Russia, 5850 tons; and Belgium, 4260 tons. Of manufactured iron and steel 32,411 tons were sent away.

The Cleveland ironmasters' statistics for April show that 101 blast furnaces were at work, of which 66 were producing Cleveland iron. The total make of iron of all kinds was 204,321 tons, being 12,240 tons less than in March. The iron in stocks at makers' works and in stores amounted to 283,433 tons, being a reduction of 8300 tons for the month.

Nothing new is to be said with respect to the finished iron trade. Most of the works are upon short time, notwithstanding the willingness of their owners to undertake orders at exceedingly low prices. Quotations on Tuesday were as follows:—Ship plates, £5 to £5 2s. 6d.; angles, £4 15s. to £4 17s. 6d.; and common bars, £5 2s. 6d. to £5 5s. per ton, all free on trucks at manufacturers' works, cash 10th, less 2½ per cent.

The depression of trade is now being keenly felt at Spennymoor. The Tudhoe Ironworks, belonging to the Weardale Iron and Coal Company, were closed last week, and about fifty mechanics received their notices on Saturday. It is said that their new steelworks will not be started until trade revives.

Messrs. Armstrong, Mitchell, and Co.'s new steelworks at Elswick are almost finished, and will shortly be put into operation.

Messrs. W. Gray and Co., shipbuilders, of West Hartlepool, have nearly completed their new marine engine works. About 6 acres of land will be occupied, and employment will be given to from 1000 to 1500 hands. Marine engines and boilers of all kinds will be undertaken. The machinery and appliances are of the very best description and most modern patterns.

The shipbuilding trade seems to be passing from bad to worse, and there is no present prospect of any revival. The shipyards in Stockton and Middlesbrough are now, to a large extent, idle. The shipyard at Whitby is likely to be closed when a vessel at present on the stocks is finished. On the 30th April there were 137 steamers lying idle at the four chief northern ports. These represent a gross tonnage of 150,000 tons, and employ 1800 men when in use. Eighty-two of them are at anchor in the Tyne, twenty-eight in the Wear, twenty-six at Hartlepool, and one in the Tees.

Great satisfaction is felt, locally, at the evidence just given before a Select Committee of the House of Commons, by Mr. A. Rendell, upon the subject of harbours of refuge. Mr. Rendell is decidedly of opinion that the Tees' mouth is by far the best place on the north-east coast for the purpose. The cost he estimates at £1,400,000, against £1,250,000 estimated by Sir Jno. Coode for a harbour at Filey. But the area of safe anchorage in the Tees would be 400 acres, against 73 acres for Filey. The depth would be from seven to nine fathoms, and the depth at the entrance bar of the river from three to five fathoms. Filey would be of no use for commercial, repairing, or manufacturing purposes; whereas the Tees would have the benefit of being an exporting and importing river second to few. It is also a shipbuilding river, and has wet, dry, and graving docks, and slipways, any of which would be available for detained ships in case of need. In case of war, and an attack by torpedo boats or heavy ordnance, ships could retreat up river to Middlesbrough or Stockton. For steamers there is abundant opportunity for coaling at a cheap rate. The enormous quantity of material which would be required for making the necessary banks, walls, and concrete blocks is on the Tees always obtainable gratis, in the shape of slag, which is produced by the blast furnaces. About six millions of tons were made last year only, and was got rid of in various ways at considerable cost. The absorption thereof in the immediate future by useful public works would be a twofold boon, namely, to the givers as well as to the receivers. It is earnestly hoped by all in Cleveland that this important evidence will have with the authorities the full weight which it deserves.

NOTES FROM SCOTLAND.

(From our own Correspondent.)

There is no improvement in the warrant market since last report; indeed, a further decline in prices has taken place, and the rates are now lower than at any former time in the history of the trade during recent years. There is scarcely any inducement for speculation, and so it happens that when holders are obliged to sell, they must do so at prices tending downwards.

The shipments of Scotch pigs in the course of the week are larger than was anticipated, amounting to 15,233 tons, as compared with 13,198 in the corresponding week of 1883. The figures are swelled by large exports to Russia; it is doubtful if anything like the same quantity will go there in succeeding weeks. To Germany and Italy fair quantities are being sent, but the purchases on behalf of Canada and the United States are quite disappointing. The stock in Messrs. Connal and Co.'s Glasgow stores shows a decrease for the week of 140 tons, which is less than has been usual of late. Two more furnaces have been put in blast—one at the Clyde Ironworks and one at Glengarnock—which brings up the number blowing to ninety-seven.

Business was done in the warrant market on Friday at 42s. to 41s. 10½d. and 41s. 11d. cash, and 42s. 1d. one month. Monday being a Scotch bank holiday, the market was closed. On Tuesday forenoon business took place at 42s. to 41s. 10½d. cash, and 42s. 1½d. to 42s. 2d. one month, the afternoon quotations being 41s. 10d. to 41s. 9d. cash, and 41s. 11½d. to 41s. 11d. one month. Business was done on Wednesday at 41s. 9d. to 41s. 8½d. cash. To-day—Thursday—the quotations were 41s. 9d. to 41s. 10d., and again at 41s. 9½d. cash.

The values of makers' iron have been getting slightly easier for a few weeks, without much actual change in figures. Some reductions have now, however, been made, and the quotations are:—Gartsherrie, f.o.b. at Glasgow, per ton, No. 1, 52s.; No. 3, 50s. 6d.; Coltness, No. 1, 57s. and 50s.; Langloan, 53s. 6d. and 51s.; Summerlee, 51s. 6d. and 47s. 6d.; Calder, 52s. 6d. and 47s.; Carnbroe, 51s. 6d. and 47s. 6d.; Clyde, 47s. 6d. and 45s. 6d.; Monkland, 44s. and 41s.; Quarter, 43s. 3d. and 41s.; Govan, at Broomielaw, 43s. 6d. and 41s.; Shotts, at Leith, 52s. 6d. and 51s. 6d.; Carron, at Grangemouth, 48s. (specially selected, 54s.) and 47s. 6d.; Kinneil, at Bo'ness, 45s. and 44s. 6d.; Glengarnock, at Ardrossan, 51s. 6d. and 45s. 6d.; Eglinton, 45s. 3d. and 42s.; Dalmellington, 48s. and 44s.

There has been less doing at some of the steel works, in consequence of the material slackening in the shipbuilding trade. The Steel Company of Scotland has in hand the steel for the new Forth Bridge, which helps to keep them fairly well engaged; but the other steel making firms are now slightly feeling the pinch of dull time.

Although there is in reality no improvement in the manufactured iron trade, the past week's shipments of iron goods from the Clyde were fairly good as to bulk. They embraced £45,500 worth of machinery, of which £14,390 represented locomotives for Calcutta, and £2950 engines for the same place; £1428 engines and £15,111 locomotives for Bombay, £5415 sugar mills for Brisbane, £4875 for Canada, £4550 sewing machines; £4700 steel goods; and £32,710 iron manufactures.

The coal trade in the western districts of Scotland is quiet; but the volume of business has within the last week exhibited a slight change for the better—the result mainly of a larger demand for shipping qualities, together with the improved inland consumption caused by the unseasonable weather. The quantities of coals despatched from Glasgow in the past week make up a good total; but the traffic this week has been a shade quieter. At Ayr 9164 tons of coals were shipped, and 4772 at Troon; while the week's shipments at Grangemouth amounted to 5104 tons. The prices of coals per ton f.o.b. at Glasgow are as follows:—Main coal, 6s. 3d. to 7s.; ell, 7s. to 7s. 9d.; splint, 6s. 9d. to 7s. 3d.; steam, 8s. to 8s. 6d. There is an expectation of an improved trade being presently done at Leith and other Firth of Forth ports, in connection with the continental trade, there being especially a fair inquiry at present for the Black Sea ports.

The miners still hold meetings with the object of promoting the movement for an increase of pay; but in the present condition of the coal trade there is not much chance of their being successful. It appears that in some districts the colliers are earning about 6s. a day.

WALES & ADJOINING COUNTIES.

(From our own Correspondent.)

It is unfortunate for the promoters of the Barry Dock Bill that all through the late enormous coal traffic despatch has gone off without a hitch. When one hears of a quarter of a million tons of coal going off in one week, and tips often idle, congestion at docks and on railway unknown, the natural exclamation of an outsider is, "Then what in the world is the need of further railways and docks?" An important witness for the Bill, Mr. Moxey, of the firm of Cory and Co., admitted that while the arrangements were good enough for ordinary traffic, they were insufficient for the exceptionally large. This was a grave admission. Is it not a fact that the history of the Welsh coal trade has always been one of ups and downs. Who can depend upon even the continuance of the present prosperity? Who is sanguine enough to anticipate more?

It is rather hard upon Mr. W. T. Lewis that he, who has laboured so unremittingly to bring about peaceful relations between master and man and to develope the great coal-field for the general benefit, should have now to contend against coal-owners as arduously to maintain the integral condition of the Welsh coal industry. The success of Barry means dismemberment of Cardiff. Barry, in the face of the Bute Dock extensions, Newport new railway, and Swansea Bay, would be a grave misfortune even for the promoters.

The coal trade has been very good this week again. In a journey over the busiest routes, I was much pleased at the excellence of arrangements from the collieries to the tips at the docks. The Taff Vale, in particular, have done good work, and the spectacle for miles out from Cardiff, in the direction of the great collieries, is one to impress a stranger. Cardiff and Swansea have had the lion's share of the coal trade of late. Newport has not been quite so brisk as one cared much to see. This, however, will change shortly. The new line connecting the Rhondda coalfield with Newport is ready, and will certainly be a great outlet; Davies, of Ocean fame, notwithstanding.

I am glad to see sidings being arranged for the new colliery sinking near Pontypridd. It will be well to avoid the mishap of Ferndale, and of Merthyr Vale, and not sink too near the river. A valley means, geologically, a watercourse, up to the margin of historic times covered to the hill tops with water, which gradually subsided, leaving "ystrads" or lakes at various points, and marshy ground to a great extent along the margin of the river. Any part of the Taff Valley will disclose the roller stones of an ancient watercourse, but the nearer the river bed the more uncertain and shifty the ground.

I am glad to hear that Basil Jayne and Co. have taken a large area in addition to the Milfraen Colliery, and will at once sink to the lower seams. This will give employment to 500 men.

The colliers after all do not seem so desirous of furthering the farthing a ton scheme by which it was proposed to establish scholarships in connection with the Welsh University. At the last meeting of the Rhondda men it was postponed.

The condition of the iron trade begins to look serious. It is useless to attempt to buoy up when there is not a particle of hopeful news to be obtained. Here is an incident which will show the depreciation of the trade. At Ebbw Vale lately a builder obtained steel rails for girders to his house, finding them at £4 10s. cheaper than timber!

With pig at £2 10s., spiegel and labour, the wonder is that this price was ever accepted. Now since the combination prices are up and—buyers keep aloof!

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

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

Applications for Letters Patent.

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

29th April, 1884.

6925. Candle Lamp, R. Hartshorne, Birmingham.
6926. Thrashing Machines, W. Hornsby, R. Edwards, and C. James, Grantham.
6927. Surfacing Slate, E. E. Emmerson and J. H. Broscomb, Leeds.
6928. Axles, C. Clay, Manchester.
6929. Music Stands, T. W. Bennett, St. Neots.
6930. Tuyeres, W. Morgan, New Swindon.
6931. Drying Sugar, &c., D. Stewart, Glasgow.
6932. Cleaning, &c., Wool, E. Kempe and G. Forsyth, Leeds.
6933. Driving Centrifugal Machines, A. Watt, Liverpool.
6934. Velocipedes, J. Lindley, Birmingham.
6935. Attaching India-rubber Tires to Wheels, W. C. Perrins, Birmingham.
6936. Preserving &c., Steam Boilers, E. Metcalf, Accrington.
6937. Locking Nuts upon Bolts, F. T. Baker, and W. S. Glenister, London.
6938. Working Sections of Hydraulic Press Packing Stillage, T. Garner, Manchester.
6939. Pulleys, W. R. Watson, Glasgow.
6940. Submarine Boats, &c., J. H. L. Tuck, San Francisco, U.S.
6941. Nailing Machines, R. H. Brandon.—(*S. W. Robinson, Columbus, U.S.*)
6942. Brakes, R. Thompson, Sheffield.
6943. Securing Spindles in Looms, R. Illingworth, Leyland.
6944. Making Nails, T. Stanford and H. Payne, Birmingham.
6945. Books for Protecting Flies for Fishing, S. Allcock, Redditch.
6946. Engines, W. Tyrer, Birkdale, and B. Boothroyd, Southport.
6947. Metallic Packing, S. Perkins, Manchester.
6948. Adjusting Lawn Tennis Poles, T. Eastman, Fareham.
6949. Preventing Retardation in Electric Cables, S. F. Shelbourne, New York, U.S.
6950. Apparatus for Distributing Water, B. and W. P. Gibbons, Dudley.
6951. Apparatus for Operating on the Atmosphere of Apartments, W. W. Nightingale, Southport.
6952. Middlings Purifiers, J. M. Case, Columbus.
6953. Manufacturing Flour, J. M. Case, Ohio, U.S.
6954. Reduction Machines for Flour, J. M. Case, Ohio, U.S.
6955. Puzzle or Game of Numbers, A. Foley, Salisbury.
6956. Portable Tables, J. H. Teale, Chapeltown.
6957. Oil for use in Railway Lamps, W. P. Thompson. —(*J. Schrafton, India.*)
6958. Petroleum Cooking Apparatus, A. Steenberg. —(*J. P. Goverts and P. H. Petersen, Denmark.*)
6959. Clutch for Cords of Venetian Blinds, W. Johnson, Plumstead.
6960. Door Locks, &c., A. Overfield, Leek.
6961. Making Fences, G. Sargent, Ditton.
6962. Rabbit, &c., Trap, J. McCririck, jun., Ayr, and H. Thomson, Dalmellington.
6963. Fixing Handles to Cast-metal Utensils, R. Clayton, Deepfields, and E. Green, Coseley.
6964. Machine Vices, G. B. Taylor, Birmingham.
6965. Recording Performance of a Steam Engine, J. B. Moscrop, Urmston.
6966. Draining Land, &c., W. Smart, Chigwell.
6967. Lubricating Journals, &c., W. Robinson, Stockton-on-Tees.
6968. Furnaces for Burning Green Sugar Cane, A. W. L. Reddie.—(*M. Agrela, Paris.*)
6969. Studs, &c., J. Nadal, London.
6970. Hay Knives, P. M. Justice.—(*W. H. Carter and J. R. Bodwell, Manse, U.S.*)
6971. Brick-making Machinery, C. Chambers, jun., Philadelphia, U.S.
6972. Barbed Fence Wire, P. M. Justice.—(*The Washburn and Moen Manufacturing Company, Incorporated, Worcester, U.S.*)
6973. Ferment for use in Indigo Vats, &c., F. W. Renault.—(*C. Collin and E. Benoist, Paris.*)
6974. Ferment for use in Indigo Vats, &c, F. W. Renault.—(*C. Collin and L. Benoist, Paris.*)
6975. Flanging Boiler, &c., Plates, G. and W. Rhodes, Wakefield.
6976. Cranes, &c., P. Everitt, London.
6977. Metal Open Work, W. R. Lake.—(*J. F. Golding, Chicago, U.S.*)
6978. Emptying Cesspools, &c., W. R. Lake.—(*A. Dubout-Morson, France.*)
6979. Device for Paring Apples, &c., W. R. Lake.— (*W. E. Brook, Dunellin, U.S.*)
6980. Cutting, &c., Stone, W. R. Lake. —(*Messrs. Crump and Brereton, U.S.*)
6981. Heating Mineral Waters, A. M. Clark.— (*B. D. Newton, New York.*)
6982. Purifying Gases, A. M. Clark.—(*W. Maynard, New York.*)
6983. Purifying Coal Gas, A. P. Price, London.
6984. Electric Regulator of Prime Movers, O. Weiss, Woolwich.
6985. Drilling Machines, W. R. Lake.—(*E. F. Gordon and H. Hobbs, Concord, U.S.*)
6986. Preventing Friction in Bearings, W. A. Barlow.—(*C. D. de St. Sauvier, Paris.*)
6987. Registering Tickets Issued in Theatres, &c., P. E. Cashin, London.
6988. Lubricators, M. S. Cabell, Quincy, U.S.
6989. Injectors, W. R. Park, Taunton, U.S.
6990. Grinding Mills, J. Wetter.—(*J. C. Wedekind, Germany.*)
6991. Drive Chain Links, T. F. Hall, Ohio.
6992. Rein Controllers, A. Warth, Stapleton, U.S.
6993. Construction of Portable Buildings, E. E. Allen, London.
6994. Levelling Instruments, B. J. B. Mills.—(*J. MacDonald, New York.*)
6995. Carbonising Bones, &c., B. J. B. Mills.—(*A. Zwillinger, Vienna.*)
6996. Telephone Receivers, A. M. Clark.—(*D. G. Barnard, Winslow, U.S.*)

30th April, 1884.

6997. Box for Fractures of the Leg, J. J. Foley, Cork.
6998. Driving Gear for Velocipedes, &c., C. V. Boys, London.
6999. Holders for Ever-pointed Pencils, J. Appleby, Birmingham.
7000. Screw or Brace Auger, T. Newry, jun., Birmingham.
7001. Holding the Barrels of Shot Guns, &c., C. A. Barlow, Manchester.
7002. New Puzzle, M. A. Wright, Cheetham.
7003. Ring Spinning Machinery, &c., J. H. Bower, London.
7004. Steam Generators, J. H. Harrison, Chester.
7005. Washing Clothes, &c., T. Bradford, Salford.
7006. Tires, S. Huffam, Walsall.
7007. Wire Fencing, G. Taylor, Liverpool.
7008. Earth Plate for Fencing Standards, T. Mailer, Liverpool.
7009. Curtain or Cornice Poles, J. T. Armstrong, Newcastle-under-Lyme.
7010. Shuttles used in Textile Manufactures, G. M. Wilson, Hawick.
7011. Button-hooks, F. Sunderland and J. Finnemore, Birmingham.
7012. Holders, &c., for Cigarettes, &c., J. Morris, Edgbaston.
7013. Raspberry Treacle, C. Cade, Stamford.
7014. Stair Rods, &c., J. Gamlin and J. B. O'Neill, Birkenhead.
7015. Securing Sheets of Zinc for Roofing Purposes, T. W. Helliwell, Brighouse.
7016. Turning up the Edges of Zinc, T. W. Helliwell, Brighouse.
7017. End Frames for Washing Machines, &c., H. L. Wilson and J. Clegg, Clayton-le-Moors.
7018. Securing the Ends of Belts, &c., W. B. Styring, Sheffield.
7019. Barm, A. Maitland, Pollockshields.
7020. Supporting Door Alarm Bells, T. Hughes, Aston.
7021. Bags for Holding Wool, St. J. V. Day.—(*P. S. Swan, Calcutta.*)
7022. Clamp for Candle-moulding Machines, A. E. Ware, Hounslow.
7023. Gas Engines, W. H. Watkinson, Haworth.
7024. Paper Tubes for the Manufacture of Textile Materials, &c., W. J. Lyon, Tutbury, and R. Riley, Habergham.
7025. Bassinette Stands, E. R. Wethered, Woolwich.
7026. Locks and Latches, E. R. Wethered, Woolwich.
7027. Propagating Seeds and Plants, H. T. Dobson London.
7028. Chimney Top, J. G. Clements, London.
7029. Water-jacket Cupola Blast Furnaces, C James, Swansea.
7030. Automatic Weighing Machines, A. M. Clark.— (*M. F. Koch, New York.*)
7031. Carpet-beating Machines, S. Simmons, London.
7032. Dynamo-electric Machines, W. E. Gedge.—(*C. J. Van Depoele, Chicago.*)
7033. Pavements, S. W. Cragg, Baltimore, U.S.
7034. Boxes for Containing Materials Separately, A. McDonald, Langside.
7035. Doubling Winding Machines, A. M. Clark.—(*La Société Ryo, France.*)
7036. Drawing Corks, R. W. Bradnock, Birmingham.
7037. Automatic Fire Extinguisher, J. E. Walsh.— (*A. Guilleaume, Belgium.*)
7038. Horn Buttons, &c., G. Downing.—(*E. Mayer, Saxony.*)
7039. Spindles for Spinning Cotton, B. Travis, Dukinfield, and W. Travis, Ashton-under-Lyne.
7040. Grinding Mills, A. F. Link.—(*J. Karasek, Austria.*)
7041. Furnaces, &c., A. F. Link.—(*C. Martin, Paris.*)
7042. Gas Brackets, &c., W. H. Goldsmith, Hull.
7043. Illustrating the Alteration of Day and Night, &c., W. Rice, London.
7044. Illustrating the Phases of the Moon, &c., W. Rice, London.
7045. Stoppering Ink Bottles, E. G. Colton.—(*M. Rubin, Philadelphia, U.S.*)
7046. Packing for Piston Rods, E. G. Colton.—(*M. Jones, Oystermouth.*)
7047. House Sanitation, H. C. Smith, Richmond.
7048. Galvanic Batteries, P. R. De Faucheux d'Humy, London.
7049. Carbons for Galvanic Batteries, P. R. De Faucheux d'Humy, London.
7050. Steam Boiler Furnaces, E. Honychurch, London.
7051. Call Bells or Gongs, G. W. Betjemann, London.
7052. Pegging-out Courts for Playing Lawn Tennis, &c., F. Proctor, Stevenage.
7053. Indicating the Fermentation of Dough, &c., W. R. Lake.—(*E. Kölitz, Denmark.*)
7054. Lucifer Matches, J. N. Söderholm, London.
7055. Pneumatic Flushing Apparatus, M. Syer, London.
7056. Treating Sulphides, Sir F. C. Knowles, Ryde. —*3rd January*, 1884.
7057. Valves, E. B. Donkin, London.
7058. Lowering Persons, E. Robert, Paris.
7059. Treatment of Slag, A. Frank, Berlin.
7060. Presses, E. G. Jahncke and H. W. Herbst, London.

1st May, 1884.

7061. Stench or Drain Traps, J. L. Cartwright, Birmingham.
7062. Piano Stool Movement, H. P. Trueman and J. G. New, Birmingham.
7063. Pen-holders, J. Appleby, Birmingham.
7064. Horse-rakes, T. H. Ramsden, Bramhope, near Leeds.
7065. Cricket Net Expanders, &c., T. P. Palmer, Bristol.
7066. Combined Reaping and Sheaf-binding Machines, H. J. H. King, Newmarket.
7067. Earth and Rock Drill Rotator, C. Chapman, Salford.
7068. Hoists or Compound Pulley Blocks, W. Box, Liverpool.
7069. Continuous Brake Apparatus, R. Robinson, Liverpool.
7070. Weighing Machines, J. Needham, Manchester.
7071. Marking or Printing Sacks, &c., J. A. Stewart, Dundee.
7072. Shafts, &c., H. Bramall, Oughtibridge, near Sheffield.
7073. Looms for Weaving, W. Shaw, Breabury.
7074. Expansion Gear of Steam Engines, H. Kühne. —(*R. Proell, Dresden.*)
7075. Miners' Safety Lamps, E. Bainbridge, Sheffield.
7076. Combination Splash Brush with Metal Scraper, S. Musgrave, London.
7077. Beaters, P. Parkinson, Bolton.
7078. Flexible Spokes, H. J. Allison.—(*J. Davidge, France.*)
7079. Heating the Rims of Velocipede and other Wheels, S. Lee, London.
7080. Velocipedes, H. Usher, London.
7081. Steno-telegraphy, W. H. Beck.—(*G. A. Cassagnes, Paris.*)
7082. Scarf Fastenings, R. B. Blackhurst, Birmingham.
7083. Glove Fastenings, J. Hinks, Birmingham.
7084. Rose Support, H. Foster, Ashford.
7085. Ships, E. J. Walford, London.
7086. Extinguishing Fires, W. Smethurst, Wigan.
7087. Key Blanks, J. W. Phillips, Willenhall.
7088. Adjustable Mould for Bricks, &c., G. H. Couch, London.
7089. Urinals and Water-closets, W. Moyes, sen., J. Moyes, and W. Moyes, jun., Pollokshields.
7090. Hand Tool, S. Clokey, Glasgow.
7091. Breech-loading Fire-arms, G. Jeffries, Norwich.
7092. Pulleys, O. L. Olsen, U.S.
7093. Spinning Fibrous Substances, J. W. Smith, Bradford.
7094. Shirt or Collar Studs, J. E. Wilmot, Birmingham.
7095. Cutting Tools, J. P. Brookes, Bridge Town, J. and T. Norris, Stourbridge.
7096. Boilers, W. Evans, West Bromwich.
7097. Betanaphtol-disulpho-acids, J. Wetter.—(*The Leipziger Anilinfabrik, Bayer and Kegel, Saxony.*)
7098. Separating Betanaphtol-monosulpho-acids, &c., J. Wetter.—(*The Leipziger Anilinfabrik, Beyer and Kegel, Saxony.*)
7099. Festooning Attachment for Sewing Machines, J. Wetter.—(*R. Otto, Saxony.*)
7100. Shawl Straps, I. and H. Scheuer, New York.
7101. Holders for Elastic Types, &c., G. C. Dixon, London.
7102. Clasps for Neckties and Scarves, H. W. Aberlin, London.
7103. Cutting Cloths, &c., A. Rothery, Rugeley, J Rothery and J. Warburton, Conisburgh.

7104. PICKS, &c., TOOLS, A. E. Stayner, Sheffield.
7105. SHOVELS, A. E. Stayner, Sheffield.
7106. DRILLING MACHINES, R. Cunliffe and J. Croom, Manchester.
7107. SODA, J. Imray.—(*La Société Anonyme des Produits-Chemiques du Sud-Ouest, Paris.*)
7108. COMPRESSING GUNPOWDER, H. H. Lake.—(*H. Gruson, Germany.*)
7109. BRINGING DOWN COAL, G. A. and W. H. Crow, Newcastle-upon-Tyne.—*24th March*, 1884.
7110. MEDICINAL COMPOUNDS, J. N. Beach.—(*J. Carnick, New York.*)
7111. KILNS, J. Watson and J. L. Spoor, Gateshead-on-Tyne.
7112. STOPPING and STARTING TRAM-CARS, &c., C. A. Bowman, London.
7113. ELECTRIC STAMP, N. Frère, London.
7114. COMBINED WATCH-CHAIN and PEN or PENCIL HOLDER, N. Frère, London.
7115. MECHANICAL MUSICAL INSTRUMENTS, H. J. Haddan.—(*J. M. Grol, Saxony.*)

2nd May, 1884.

7116 INJECTORS, J. Gresham, Salford.
7117. LOOSE BOXES and STALLS for STABLES, A. Adams and H. T. Hassall, Birmingham.
7118. CHANNEL ROOFING and AWNING, E. P. Gribbon, Dublin.
7119. CONCRETE BUILDING, J. S. and W. Thompson, Wexford.
7120. BEDS for SURGICAL PURPOSES, &c., G. Woodburn, Liverpool.
7121. GAS BURNERS for HEATING and BOILING PURPOSES, S. Siddaway, West Bromwich.
7122. BOLTS for DOORS, R. Whiston, Wolverhampton.
7123. FAN for VENTILATING MINES, &c., F. L. Jeyes, London.
7124. CLEARING YARN or THREAD, L. Haslam and C. Marshall, Bolton.
7125. STOVE GRATES or FIREPLACES, F. Brown, Luton.
7126. BREECH-LOADING SMALL FIRE-ARMS, E. C. Green, Cheltenham.
7127. RETURNING WASTE STEAM to the BOILER, T. B. Sharp, Smethwick.
7128. RETURNING WASTE STEAM to the BOILER, T. B. Sharp, Smethwick.
7129. INJECTOR for FEEDING STEAM BOILERS, T. B. Sharp, Smethwick.
7130. AQUARELLE PAN, S. Clift, Addiscombe.
7131. PROPELLING LIFEBOATS by STEAM POWER, F. J. P. Cheesbrough and E. R. Royston, Liverpool.
7132. APPLYING FILTERING CLOTHS to FILTER PRESSES, J. J. Musto, London.
7133. FISHING-FLY HOOKS, A. James.—(*T. B. Mills, Brooklyn, U.S.*)
7134. PROPELLING SHIPS W. Balch, Greenwich.
7135. BUSKS for STAYS, G. Wrencher, London.
7136. ADJUSTING FILTERING CLOTHS, &c., J. J. Musto, London.
7137. JUTE and HEMP CARPETS, &c., W. Longair and T. Couper, Dundee.
7138. PROPELLING TRICYCLES, J. T. Medcraft, London.
7139. INCANDESCENT ELECTRIC LAMPS, E. L. Roussy, Switzerland.
7140. STEAM JOINT, F. Goizet, France.
7141. REGISTER GRATES, A. V. Brooks, Glastonbury.
7142. TRICYCLES, G. Schadler, London.
7143. PROMOTING COMBUSTION in DOMESTIC FIRE-GRATES, W. Stobbs, London.
7144. STOVE GRATES or FIREPLACES, G. Wright, London.
7145. DECORATING SURFACES, J. H. Johnson.—(*A. Semal, Belgium.*)
7146. SHUTTLE GUARDS for WEAVING LOOMS, J. Derome, Preston.
7147. OPENING, &c., WINDOW SASHES, E. Patterson, Liverpool.
7148. INTERMITTENT DELIVERY of WATER, W. Bartholomew, London.
7149. ADJUSTABLE CHAIRS, &c., A. V. D. Sahl and M. O. Hund.—(*E. Calic-Toussaint, Zurich.*)
7150. LUBRICATORS, J. Kitson, Thornhill, S. Berkett and J. Robinson, Northgate.
7151. UMBRELLAS and PARASOLS, J. Wetter.—(*Knauth and Co., and R. Geisler, Leipzig, and W. Jaedicke, Berlin, Germany.*)
7152. FOUNTAIN PENHOLDER, J. Wetter.—(*R. Grumbach, Pforzheim, Germany.*)
7153. BRIDGES, J. R. Shearer, London.
7154. BRAKE SHOES and HEADS, J. Wilson, J. H. McLean, and W. Jackson, St. Louis, U.S.
7155. FIRE-LIGHTERS, T. T. Onslow, London.
7156. INJECTING FUEL and HOT AIR into FURNACES, D. Tildesley, London.
7157. COMBINED MATCH-BOX and TOBACCO POUCH, J. Caffarey, Streatham, and J. J. Perry, London.
7158. BURNING PYRITES, A. Grothe, London.

3rd May, 1884.

7159. BUTTONS, C. I. Bell and H. Dolman, Greenwich.
7160. FACSIMILE COPIES of WRITINGS, &c., F. Friend, Lancaster.
7161. DELIVERING MANURE, H. Lander, Mere.
7162. CONCUSSION PAD for HORSES' FEET, T. A. Veale, Plymouth.
7163. ROTARY PRINTING MACHINES, H. Bond, Latchford.
7164. HAMMERLESS GUNS, J. W. Smallman, Nuneaton.
7165. BOOTS and SHOES, E. Wilden, jun., London.
7166. FOLDING SEATS, &c., J. H. Stone, Birmingham, and C. T. Powell, Handsworth.
7167. VENTILATING WATERPROOF GARMENTS, R. Coulter and J. Brown, Manchester.
7168. CUTTING PILE FABRICS, J. Platt, Walton.
7169. CONSUMING SMOKE, J. Cornforth, Aston.
7170. STOPPING DESCENT of CAGES in MINES, &c., J. W. Stables, Batley.
7171. SECURING BOBBINS, G. B. Talbot and C. Shaw, Batley.
7172. DISINFECTANTS, A. Campbell, Millbrook.
7173. ATTACHING AXLES, J. Shaw, Manchester.
7174. SHUNTING CARCASES, A. W. Shaw, Limerick.
7175. RETORTS, A. Neilson, Inkermann.
7176. DRYING COAL, &c., J. A. Yeadon, Leeds.
7177. SHOOTING GALLERIES, F. Moore.—(*E. C. S. Moore, Gibralter.*)
7178. REMOVING FLUFF, &c., from CLEARERS, R. T. Gillibrand, Darwen.
7179. AUTOMATICALLY STOPPING MACHINES, J. W. Gaunt, Bramley.
7180. CIRCULAR PLAYING CARDS, T. Morris, London.
7181. CULINARY UTENSILS, G. B. Richards, London.
7182. SCALES, E. Morgenroth, Berlin.
7183. DRAW-BAR ENDS, A. Macqueen, Birmingham.
7184. LOCKING GUNS, S. Warren, Edgbaston.
7185. DYNAMO-ELECTRIC MACHINES, E. Jones, Leeds.
7186. BEARINGS for LOCOMOTIVES, J. Willis, Sheffield.—*5th March*, 1884.
7187. SHOEMAKERS' COMBINATION IMPLEMENT, L. A. Groth.—(*E. Nagy, Austria.*)
7188. LIGHTING APPARATUS, H. Delmas-Azema, France.
7189. OPERATING TRAMWAY POINTS, &c., E. Patterson, Liverpool.
7190. COLOURED ENGRAVINGS, &c., J. Wetter.—(*L. Forquignon, Bordeaux.*)
7191. RINGS, A. J. Boult.—(*E. Diamant, Hungary.*)
7192. CENTRIFUGAL PUMPS, W. H. Allen and R. Wright, London.
7193. DOUBLE CURRYCOMB, T. H. Wyatt, Wooton-under-Edge.
7194. SPEED GEARING, J., R., and M. Rowan, Belfast.
7195. DYEING the SEAMS of KID GLOVES, E. G. Brewer.—(*J. B. Jacobs, Belgium.*)
7196. LOCKS, D. N. Sacker.—(*S. E. Weisblat, Russia.*)
7197. LONGITUDINALLY CORRUGATED STEEL and IRON BARS, &c., J. F. Fairley and A. Fairley, Birmingham.
7198. TREATMENT of SEWAGE, S. K. Page, Aylesbury, C. E. Robinson, Scarborough, and W. Stevens, London.
7199. ELASTIC COMPOUNDS, J. Jeyes, Plaistow.
7200. SURFACE CONDENSERS and HEATERS, J. Kirkaldy, London.
7201. PHOTOGRAPHIC CAMERAS, T. Samuels, London.
7202. CHIMNEY GEAR, F. A. Sharpe and W. Woollason, Lincoln
7203. EXPANDING and CONTRACTING GRATE, W. J. Hopkins, Worcester.
7204. SHAPING FLY-CUTTERS, W. T. Hamilton, Dublin.
7205. BALL-TAPS, W. W. Fyfe, Aberdeen.
7206. TREATING ORES, J. Hargreaves, Widnes, and T. Bobinson, Farnworth.
7207. SHIPS, &c., E. J. Walford, London.
7208. SHIPS, &c., E. J. Walford, London.
7209. DRYING TEA, J. Greig, jun., Edinburgh.
7210. FEEDING WOOL, &c., to CARDING ENGINES, C. F. Roberts, Delph.
7211. STEAM and other PRESSURE GAUGES, J. Burden, Birmingham.
7212. ELECTRICAL INDICATOR, &c., P. Jolin, Bristol.
7213. COMBINED MILK BUCKET and STRAINER, T. B. Burns, Camelford.
7214. SPRINGS for WASHING MACHINES, J. Barnes and R. W. Kenyon, Accrington.
7215. NOVELTY for GRAIN-CLEANING MACHINERY, G. Kiefer, Germany.
7216. "SLIDE" FANLIGHT STAY, C. W. Osmaston, London.
7217. BOTTLE-STOPPERS, E. Capitaine.—(*H. Grauel, Berlin.*)
7218. PISTON, G. Dieckmann, New York.
7219. SHIPS, &c., J. F. Batchelor, Baltimore, U.S.
7220. BUSKS, L. T. Genty, London.
7221. SEA-WORKS, C. Van der Elst, Paris.
7222. OBTAINING MOTIVE-POWER, J. C. Martin, Richmond.
7223. BLOWING, &c., AIR, &c., R. C. Jay, London.
7224. HEMMERS, F. N. Cookson, Wolverhampton.
7225. MEASURING the RIGHTING COUPLES of STABILITY of VESSELS, P. P. S. y Chico, London.
7226. HAULING NETS, G. Souter, Elgin.
7227. TEA or COFFEE-POT, S. M. Smith, Steventon.
7228. BOTTLES and JARS, J. N. Pickin, Cromwell, near Newark.
7229. PRESERVATION of HEALTH, J. P. Norris, London.
7230. HYDRAULIC CEMENT, J. E. Billups, Cardiff.
7231. COVERING CYLINDERS with an ELASTIC CORK COMPOSITION, E. Greenfield, Bromley.
7232. SIGNALLING APPARATUS, J. Riedel, Berlin.
7233. STAPLES, &c., J. Holding, Farnworth.
7234. HORSESHOES, W. W. Box, Crayford, and F. J. Beadle, Erith.
7235. EXTRACTION of SUGAR from MOLASSES, V. Daix, St. Quentin, and A. L. Possoz, Paris.
7236. FASTENINGS for RETORT LIDS, G. King, Essex.
7237. IRON, J. Beasley, Handsworth.
7238. CLIPPING AIR, H. H. Lake.—(*C. Carleton and G. H. Noble, U.S.*)
7239. MAKING PLUMBERS' TRAPS, W. H. Dorman, Stafford.
7240. PLATE or SHEET-METAL HOLLOW-WARE, H. H. Lake.—(*C. Kind, New Zealand.*)
7241. OPENING or CLOSING the LIDS of INKSTANDS, &c., H. H. Lake.—(*L. Hardtmuth and C. Hardtmuth, Vienna.*)
7242. FRILLING, E. S. B. Tombs, London.
7243. ENVELOPE or WRAPPER for OIL-CAKE PRESSES, J. F. Gaskell and W. Roberts, Hull.
7244. ARRANGING ELECTRIC LIGHT APPLIANCES with PORTABLE, &c., FURNITURE, A. Gray, London.
7245. HAND BAGS, R. Weintraud, Germany.
7246. TENSION MECHANISMS for LOOMS, J. Shew, Newcastle, U.S.
7247. FILTERING LIQUIDS, J. P. Jackson, Liverpool.
7248. DUST-BINS, &c., F. L. G. Gunn, Dublin.
7249. COMBUSTION of LIQUID HYDROCARBONS, E. C. Burgess, London.
7250. BALL GEARING, C. Kleyer, Germany.
7251. LOOMS for WEAVING, F. E. Schlesinger and J. Horrocks, Germany.
7252. ARRANGEMENT, &c., of ROWING VELOCIPEDES, W. H. Thompson, London.
7253. TRAMWAYS, &c., G. J. Chapman, London.
7254. VOLTAIC CELL or ELEMENT, J. Imray.—(*W. Wenzel, Vienna.*)
7255. PREPARING LIME, M. Williams, Lancashire.
7256. TYPE-WRITING MACHINES, A. M. Clark.—(*D. W. Dodson, Pennsylvania, U.S.*)
7257. HOSE COUPLINGS, A. M. Clark.—(*G. M. van Riper and J. O. St. Clair, Michigan, U.S.*)

ABSTRACTS OF SPECIFICATIONS.

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

4221. MANUFACTURE of FLAVOURED or SCENTED CIGARS and CIGARETTES, *J. McGovern, Liverpool.*—*1st September*, 1883. 6*d.*

The cigar or cigarette is made with a core of other material, such as a string, or strip, or roll of paper running through it impregnated with flavourings, and with or without a highly oxygenated body to assist combustion.

4371. APPARATUS for and PROCESS of MANUFACTURING CELLULOSE, &c., *E. A. Brydges, London.*—(*A communication from A. Mitscherlich, Hannöversch, Munden.*) 6*d.*

The principal part of the apparatus is the boiler or cooking vessel, consisting of an iron cylinder which is provided with a novel protective arrangement or device against the attacks of the solution on the iron of the said apparatus.

4389. MACHINES for MANUFACTURING CONFECTIONERY, *W. R. Lake, London.*—*13th September*, 1883.—(*A communication from J. Lutted, Buffalo, U.S.*)—(*Not proceeded with.*) 4*d.*

Relates to the general construction of a machine for moulding confectionery.

4395. APPARATUS for PREVENTING the RADIATION of HEAT in VESSELS CONTAINING HOT WATER, &c., *W. E. Williamson and E. V. New, London.*—*14th September*, 1883.—(*Not proceeded with.*) 2*d.*

Consists in an outer and inner vessel, the inner one containing the liquid. The space between the two is filled with hair or hair felt.

4397. ARRANGEMENTS of APPLIANCES FORMING A COMBINED BROOCH and FLOWER-HOLDER, *H. J. Davis, London.*—*14th September*, 1883.—(*Not proceeded with.*) 2*d.*

Relates to the attachment of a spring to the brooch so as to hold a flower.

4398. MACHINERY for FILLING and STOPPERING BOTTLES, &c., *J. Phillips, London.*—*14th September*, 1883.—(*Not proceeded with.*) 2*d.*

Relates to improvements in machinery described in patent No. 5619, dated 27th November, 1882, and has for its object to render such machinery applicable for filling and stoppering bottles with screw stoppers or corks.

4402. APPARATUS for JOINING LEAD PIPES, *J. Jakens, Bury.*—*14th September*, 1883.—(*Not proceeded with.*) 2*d.*

Consists of apparatus composed of an asbestos or analogous fibrous sleeve or wrapper, held in position by means of clamps or otherwise, for the purpose of joining lead pipes by fusing the same with or without molten lead or by means of solder.

4423. CLOSING, SECURING, and RELEASING RAILWAY or other CARRIAGE DOORS, *F. Pontifex, W. J. Rosser, and F. E. Pontifex, London.*—*15th September*, 1883.—(*Not proceeded with.*) 2*d.*

Relates to the arrangement of a bolt which securely fastens the door upon the starting of the carriage.

4427. IGNITING and DISCHARGING CARTRIDGES, &c., by ELECTRICITY, *T. P. Wood, Bristol.*—*15th September*, 1883.—(*Not proceeded with.*) 2*d.*

Relates to means for igniting the charges of sporting guns or rifles.

4435. MANUFACTURE of TABLE CUTLERY, &c., with BOLSTERS, *J. Ball, Sheffield.*—*17th September*, 1883. (*Not proceeded with.*) 2*d*

The entire bolster is cast of any suitable metal, having a hole through it to receive the tang of the blade to which it corresponds in size, and an open-ended slot or groove across the top to receive the shoulder of the blade.

4433. LOOMS for WEAVING, *D. Whittaker, Blackburn.*—*17th September*, 1883.—(*Not proceeded with.*) 2*d.*

Relates to improvements in shuttles and in mechanism for "taking-up" the cloth as woven.

4436. MACHINERY for LASTING BOOTS and SHOES, *C. F. Gardner, London.*—*17th September*, 1883.—(*A communication from G. McKay, Boston, U.S.*) 10*d.*

Relates to improvements on patent No. 2987, dated 20th July, 1880, and comprises apparatus for forming notches in the uppers of boots and shoes, apparatus for driving tacks, and apparatus for driving wood pegs into boots or shoes.

4437. SAILS for VESSELS and their RUNNING GEAR, *I. A. Storer, Newport.*—*17th September*, 1883.—(*Not proceeded with.*) 2*d.*

Consists in the addition of certain lines called purchase buntlings, whereby a portion of the sail may be hauled up to render the clewing up of the remainder an easy matter, and in certain strengthening ropes on the forward part of the sail.

4440. ELECTRICAL SIGNALLING and INDICATING APPARATUS, *G. Porter, London.*—*17th September*, 1883.—(*Not proceeded with*) 2*d.*

Relates to that class of apparatus usually employed to indicate from what part of a building the signal is given, and consists in causing the current firstly to operate the bell and then the indicator.

4441. MANUFACTURE of MATS and MATTING from SOLE LEATHER SCRAPS, *W. Cooper, Nantwich.*—*17th September*, 1883.—(*Not proceeded with.*) 2*d.*

The scraps are strung or fastened together by copper wire.

4443. APPARATUS for MEASURING and REGISTERING RADIANT, LUMINOUS, and CALORIFIC ENERGY, *W. Siemens, London.*—*17th September*, 1883.—(*Not proceeded with.*) 2*d.*

Relates to a method and apparatus to determine separately the luminous and other forms of radiant energy emanating from a radiating source, according to their relative magnitudes, and to express them in Watts or other unit rates of energy.

4455. GAS and PETROLEUM ENGINES, *H. J. Haddan, London.*—*18th September*, 1883.—(*A communication from Dr. M. V. Schiltz, Cologne.*)—(*Complete.*) 6*d.*

Relates partly to the method of utilising the heat derived from the combustion of a combustible mixture in a petroleum engine, for the rapid vaporisation of the petroleum required to produce the charge of combustible mixture for the next stroke, which method consists in establishing in each combustion chamber one or more suitably formed metallic vaporising surfaces, standing on detached supports of non-conducting material, so as to vaporise the petroleum injected on these heated surfaces, and thus form a fresh charge mixed with air pumped in, and which charge will in its turn be ignited and exploded for producing the next stroke of the piston. Other improvements are described and claimed.

4460. ELECTRIC CABLES and APPARATUS or DEVICES CONNECTED THEREWITH, *A. J. Boult, London.*—*18th September*, 1883.—(*A communication from J. B. Hyde, Brooklyn, U.S.*) 8*d.*

This relates to the machinery used in the construction of a cable, the equilateral configuration of which, in cross section, approaches a triangle having two of its angles rounded and the other left sharp. An insulated wire is carried in each angle and one in the centre. The "armar," of lead, is compressed about the wires and is afterwards covered with insulating material. The invention also includes a testing chamber of peculiar construction.

4461. MACHINES and MOULDS for MAKING HEEL COUNTERS or STIFFENERS for BOOTS and SHOES, *W. P. Thompson, Liverpool.*—*18th September*, 1883.—(*A communication from M. Hynes, W. G. Cruickshank, and B. F. Lamb, Montreal.*)—(*Not proceeded with.*) 2*d.*

Relates to the general arrangement of the parts and to the construction of the moulds.

4466. LETTER-BOXES and BAGS for EMPTYING THE SAME, *F. Wirth, Frankfort-on-the-Main.*—*18th September*, 1883.—(*A communication from T. Maynz and C. O. Weber, Offenbach-on the-Main.*)—(*Not proceeded with.*) 2*d.*

Relates to the mode of suspending the letter bag and to the means of emptying the contents of the box into the same.

4469. PREVENTING the SPREAD of FIRE from one PART of A BUILDING to ANOTHER, *A. M. Clark, London* —*18th September*, 1883.—(*A communication from W. H. Dolman, St. Helen's, U.S.*)—(*Not proceeded with.*) 2*d.*

Relates to the application of sheet iron and ashes to the joists, rafters, and other timbers of the structure.

4472. INDIA-RUBBER TIRES, &c., OF WHEELS, *T. Clarke, Manchester.*—*19th September*, 1883.—(*Not proceeded with.*) 2*d.*

Relates to the formation of a groove in the metal rim, and to cementing the india-rubber tire therein.

4477. SPANNERS, &c., *H. J. Haddan, London.*—*19th September*, 1883.—(*A communication from H. Port, Vincennes, France.*)—(*Not proceeded with.*) 2*d.*

The strains produced on the cheeks by turning the spanner are taken up by a pair of spindles, which also serve as guides, while the screw is only used for altering the distance between the cheeks.

4478. HOLDERS for PICTURES, &c., *H. J. Haddan, London.*—*19th September*, 1883.—(*A communication from C. Marot, Troyes, France.*)—(*Not proceeded with.*) 2*d.*

Relates to the construction of a frame for carrying and handling pictures.

4479. COMPOUNDS for DETONATING RAILWAY SIGNALS, *W. P. Thompson, Liverpool.*—*19th September*, 1883.—(*A communication from J. F. A. Mumm, Dayton, U.S.*)—(*Not proceeded with.*) 2*d.*

The ingredients are chlorate of potash, gumtragacanth, alcohol, antimony, sulphur auratum antimonii or golden sulphuret, sublimed sulphur or flowers of sulphur, French chalk, and broken glass or gravel.

4481. GEARING, *F. Jenkin, Edinburgh.*—*19th September*, 1883.—(*Not proceeded with.*) 2*d.*

The object is to provide an improved mode of producing and maintaining the pressure between the different parts of the nest gearing described in patent No. 1913, A.D. 1883, and it consists in the use of a roller coned at both ends and a spring tending to force the cones asunder and between two reverse cones in a rigid roller.

4482. INDIA-RUBBER PUMPS, *E. Edwards, London.*—*19th September*, 1883.—(*A communication from J. Ruffel, Paris.*—(*Not proceeded with.*) 2*d.*

This relates to improvements in pumps consisting of a curved tube of india-rubber which is compressed by a series of rollers made to pass along it, and the object is to reduce the wear of the tube and rollers by covering the tube with a flexible sheath, such as leather, and making the rollers with grooves.

4483. RAILWAY CHAIRS, *W. R. Lake, London.*—*19th September*, 1883.—(*A communication from C. E. Mark, Michigan, U.S.*)—(*Not proceeded with.*) 2*d.*

A plate of metal forms the base of the chair, and upon it are two lips diagonally opposite to each other. The plate is secured by spikes or screws to the sleepers, and the edges of the lips are curved to fit against and hold the rail.

4487. MACHINES for REELING or WINDING YARNS or THREADS, *J. Dyson, Farnworth, and J. H. Stott, Rochdale.*—*20th September*, 1883.—(*Not proceeded with.*) 2*d.*

The object is to give increased and more regular tension to the yarn as it unwinds from the cone of the cop, bobbin, or spool, and it consists in applying a staple or ring loosely to the bobbin or spool at the small end of the cone of the thread, through which staple or ring the thread as it unwinds passes in going to the surface upon which it is to be unwound.

4485. CARRIAGES for COMMON ROADS, *M. M. Benoliel, London.*—*19th September*, 1883.—(*Not proceeded with.*) 2*d.*

The object is to provide an improved two-wheeled vehicle of the Hansom cab class, which can be used either open or closed, is provided with a movable seat for a third person, and with a more convenient arrangement for conveying luggage.

4489. STAYS and CORSETS, *W. Rosenthal, London.*—*20th September*, 1883.—(*Not proceeded with.*) 2*d.*

This relates to the method of introducing and securing busks in proper position in stays or corsets, and it consists in making a fold in the fabric and providing eyelets, through which a lace passes so as to form a sheath for each busk.

4491. CONSTRUCTION of TRAMWAYS or RAILWAYS, *R. L. Urquhart, Edinburgh.*—*20th September*, 1883. 8*d.*

The objects are to provide a level roadway which will not be liable to rut or groove on both sides of the line of rails, and to generally simplify the construction of tramways and railways. Blocks of steel are secured to the sides of the rails. An improved chair, cast with transverse sleepers, is described, and also a method of forming the groove for the flange of tramway wheels by means of two rails secured side by side.

4492. CONSTRUCTION of DRIVING DRUMS and PULLEYS, *R. Woodhouse and S. Mitchell, Brighouse.*—*20th September*, 1883.—(*Not proceeded with.*) 2*d.*

The boss is cast or forged, and is in form of a bobbin with a flange at each end, and intermediate flange if required. The arms are of wrought iron or steel and of flat or oval section, the ends being secured to the flanges of the boss and the middle to the rim of the drum.

4493. RAISING, SUPPORTING, and LOWERING the HOOD or COVERING of CARRIAGES, *R. W. Palmer and R. Randell, Manchester, and W. Hely, Bath.*—*20th September*, 1883. 6*d.*

The jointed struts to raise and lower the hood are placed inside the hood, and are pivotted at their lower ends to the carriage body, and extensions of the struts are connected by links to the front rib of the hood. The struts are also hinged to the second rib of the hood, the two ribs being pivotted on a common centre.

4500. PENCIL CASES, *O. Bussler, London.*—*20th September*, 1883.—(*Not proceeded with.*) 2*d.*

A spring, preferably consisting of a caoutchouc tube, is arranged to cause a conical split upper to grasp the lead when the head of the pencil case is relieved from pressure. A screw adjustment regulates the amount of lead protruding from the case.

4501. PROPELLING CARS, &c., BY MEANS OF ELECTRICITY, *P. R. Allen, London.*—*20th September*, 1883.—(*Not proceeded with.*) 4*d.*

To vary the speed of the car and maintain that of the motor constant, the driving and car axle pulley are so constructed that their relative diameters may be varied. The armature of the motor is wound with independent coils, which are brought into circuit as required when ascending an incline by a mercury level. The invention also relates to a starting and stopping arrangement, to a "three-wheel motion," and to a method of switching in fresh accumulators as required.

4511. SELF-ACTING ROTARY SCRUBBER and SCRAPER for CLEANING and SCRAPING SHIPS' BOTTOMS WHILE IN MOTION, *T. de Grucby, Leytonstone.*—*21st September*, 1883.—(*Not proceeded with.*) 2*d.*

A hollow drum is mounted in adjustable bearings in a frame and carries scrapers, the drum being caused to revolve by the passage of water through it when the ship is in motion.

4514. BOATS, &c., *F. Byrnes, Liverpool.*—*21st September*, 1883.—(*Not proceeded with.*) 2*d.*

The boat is in the form of an inverted pyramid, and is preferably made of wood lined with gutta-percha. Outside the sides form a series of inverted steps, to prevent the sides sinking in the water when struck by a sea. The bottom has a deck and a pump well below. Longitudinal and transverse stays point outward to strengthen the boat, and a cover similar to the sides with the steps pointing outward is formed in several parts, capable of sliding over each other.

4515. MANUFACTURE of ANCHORS, *J. Imray, London.*—*21st September*, 1883.—(*A communication from J. A. Lannes, Comte de Montebello, Paris.*)—(*Not proceeded with.*) 4*d.*

This relates to the manufacture of anchors of cast steel or wrought iron or steel without welds; and when of cast steel, the blank is formed with excess of metal to allow for forging, and with arms projecting at right angles to the shanks, so as to give facility for forging the flukes, which are afterwards bent up.

4517. PRODUCING and MAINTAINING A VACUUM TO FACILITATE THE EMPLOYMENT OF ATMOSPHERIC PRESSURE FOR THE PROPULSION OF MACHINERY, &c., *S. B. Robertson, London.*—*21st September*, 1883. —(*Not proceeded with.*) 2*d.*

A water-supply pipe connected with a head of water is introduced into an air-tight chamber, and is provided with contracted outlets or nozzles in close juxtaposition, and in line with which is a discharge or exhaust pipe diverging or flaring towards the point of discharge, and which passes out of the chamber, the water passing through and carrying with it the air.

4523. MACHINERY for TURNING BAGS or SACKS AFTER STITCHING, &c., *W. R. Lake, London.*—*21st September*, 1883.—(*A communication from S. T. Lockwood, Chicago, U.S.*) 8*d.*

This relates to machinery for turning bags or sacks so that the seams will be inside, and also for pressing them and placing them in piles when turned.

4526. TRAMWAY or other ROAD ENGINES, *R. Peacock and H. L. Lange, Gorton, Lancashire.*—*21st September*, 1883. 6*d.*

The objects are, First, to dispose of the exhaust and waste steam, and at the same time to deaden the beat of the engine; and Secondly, to provide an automatic speed regulator stop and brake valve. A vessel is placed on top of the boiler over the vertical flue, and to which the exhaust and waste steam is conducted, such vessel being heated by the gases in the flue. The steam then passes to a second superheater in the fire-box, on its way to the chimney. The speed regulator valve is placed between the cylinders and the steam regulator, and shuts off steam when a certain speed is exceeded.

4527. FURNACES, STOVES, and GRATES, &c., *R. E. Cox, London.*—*21st September*, 1883.—(*Not proceeded with.*) 2*d.*

Relates to the construction of the air spaces.

4534. PULLEYS and WHEELS, *C. L. Watchurst, Lee, Kent.*—*22nd September*, 1883.—(*Not proceeded with.*) 2*d.*

The rim is of wrought iron and the boss of cast iron, the two parts being connected together by a series of rings. The rim may be convex outside.

4547. APPARATUS USED IN CONNECTION WITH THE DISTILLATION OF TAR OR OIL, &c., *F. Lennard, Shoreham.*—*24th September*, 1883. 6*d.*

A covered wrought iron tank, of preferably rectangular form, has an arched top and a bottom sloping to one side. At the lower part of the tank valves are arranged to draw off the contents. In the tank a number of pipes are arranged, the different rows being connected together alternately at opposite ends. The pipes are connected to the stills or other apparatus, and cold tar or oil caused to pass through them, while the pipes themselves are surrounded with hot pitch, resulting from distillation.

4548. SIMULTANEOUSLY MAKING UP and SECURING TOGETHER THE BODIES and LININGS FOR THE BODIES OF TROUSERS, *J. Baxter and W. Gould, Bristol.*—*24th September*, 1883. 4*d.*

The materials to form the bodies are placed below the materials to form the linings of the bodies, and

the two secured together in one seam at the desired places in the garments.

4550. APPARATUS FOR MAKING ILLUMINATING GAS, *M. Schwab, Manchester.*—*24th September*, 1883.—(*A communication from J. Overhoff, Prussia.*) 6*d.*

The generator is placed centrally of the retort setting, and provided with a grate, horizontal in the centre, and with inclined sides. The side walls of the generator are connected by a solid arch on the top, separating the generator completely from the interior retort setting. The side walls are closer together at the back than in front, and the bottom in the narrow part inclines upwards. At the far end of the generator is an aperture, through which gases enter a distributing chamber, running the length of the bench. In this chamber small particles of coal, coke, or dust are retained, and prevented from passing into the furnace. The gases enter the furnace through apertures in the sides of the distributing chamber, and mix at once with the highly-heated air, and rise to the top. The walls and arch support the middle retort, which is protected from the direct action of the fire.

4554. SAFETY CATCH FOR BROOCHES, &c., *D. MacGregor, Perth.*—*24th September*, 1883. 6*d.*

The point of the pin is inserted in a slot in a head, to which a spindle is secured, and surrounded by a spring tending to force a cylindrical case on to the head, and so prevent the pin leaving the head of the catch.

4559. STEAM BOILERS, *F. H. F. Engel, Germany.*—*24th September*, 1883.—(*A communication from A. Donneley, Germany.*) 6*d.*

The furnace may be arranged either outside or in front of the boiler, and is composed of two or more rows of upright tubes, the top and bottom of which are in communication with the water of the boiler. The upright furnace tubes form a basket to receive the fuel, which is fed into it from the upper end, and burns from below, the gases passing between the rear tubes into the flues or fire tubes.

4560. MACHINES FOR BREAKING PIG-IRON, *W. R. Lake, London.*—*24th September*, 1883.—(*A communication from T. A. Blake, New Haven, U.S.*) 6*d.*

The object is to adapt the "Blake" ore crucher for the purpose of breaking pig-iron, the jaws of the crusher converging, one being stationary while the other has a vibratory movement to and from the other, and one armed with two vertical bearing points and the other with an intermediate bearing point, the two points being less distance apart than the length of the pig.

4561. MANUFACTURE OF KNITTED FABRICS, &c., *W. R. Lake, London.*—*24th September*, 1883.—(*A communication from L. E. Salisbury, Providence, U.S.*)—(*Not proceeded with.*) 6*d.*

The needles are actuated vertically with great rapidity by cams arranged upon a revolving shaft. A further object is to provide for the employment of a number of knitting or loop threads at the same time upon a straight bar, each following the other in close succession, constituting numerous points or sections simultaneously and continuously in operation, thereby greatly increasing the capacity of the machine for producing fabric; and a third object is to introduce a warp into the fabric by a novel arrangement; and, lastly, the formation of a new fabric.

4564. CHARGING GAS RETORTS, *F. C. Glaser, Germany.*—*25th September*, 1883.—(*A communication from R. W. Grice, Germany.*)—(*Not proceeded with.*) 2*d.*

The scoops containing the coals are carried by an endless band into the retorts and then drawn back very rapidly, leaving the coals behind.

4565. APPARATUS FOR PREVENTING WATCHES, &c., BEING LOST OR STOLEN FROM THE POCKET, *W. Wain, Skegness.*—*25th September*, 1883.—(*Not proceeded with.*) 2*d.*

This consists of a plate provided with a pivotted bell-crank lever with a slot at one end and a handle at the other, and against which rests a pin on which the watch is placed.

4566. DRILLS, *R. Stephens, Cornwall.*—*25th September*, 1883.—(*Not proceeded with.*) 2*d.*

This relates to drills driven by air or other expansive vapour or gas, and it consists of a special cam for actuating the valve to admit the gas and allow it to escape and to retard the same.

4568. APPARATUS FOR HANGING, CLEANING, AND STRETCHING COATS, &c., *A. Elliot, London.*—*25th September*, 1883.—(*Not proceeded with.*) 2*d.*

A pair of arms are hinged to a block and provided with springs to throw them upward, so as to enable the arms to be inserted in the sleeves of a coat, which will then be supported and stretched as when being worn.

4569. PAPER-FOLDING MACHINERY, *R. Cundall, near Bradford.*—*25th September*, 1883. 8*d.*

The invention consists, First, in constructing and arranging paper-folding machines with two sets of self-acting deliveries, either of which can be employed while the other set is at rest, so that one or other of such deliveries may be in use when required, and consequently a four-fold machine can be used as a three-fold machine. To prevent necessity of counting the folded sheets mechanism is provided for placing the papers on the table in tiers of equal numbers, one above the other, but with their edges not in the same vertical line. The invention further relates to adjustable stops or gauges employed in folding machines, and consists in adjusting them by screws and bevel wheels; and lastly, to means for preventing the vibration of the tapes on which the paper travels by placing bars or bears under each length of tape.

4570. MACHINES FOR SIFTING OR STRAINING PAINTS OR COLOURS, *J. C. Mewburn, London.*—*25th September*, 1883.—(*A communication from J. C. Matter, Paris.*) 6*d.*

A brush is made to rest with adjustable pressure on a sieve of wire gauze, the brush and gauze being caused to revolve in opposite directions, the effect being to sift or strain the colours efficiently.

4571. APPARATUS FOR SEPARATING SOLID AND LIQUID MATTER IN SEWAGE, &c., *J. Young and P. Fyfe, Glasgow.*—*25th September*, 1883. 2*d.*

This consists in the use of a series of settling tanks, from which the liquid matter is drained off.

4572. LOOM-SHUTTLE, *W. Youngjohns, Kidderminster.*—*25th September*, 1883. 4*d.*

The body of the shuttle is made of iron, and a strip of wood or other material which will not injure the weft is secured in its underside.

4577. GAUGE-GLASS FITTINGS, *A. J. Boult, London.*—*25th September*, 1883.—(*A communication from V. Agnès, Paris.*)—(*Not proceeded with.*) 2*d.*

A scale of enamelled metal is fixed behind the gauge-glass, and an indicator on the scale may serve to show the normal water level. The sockets supporting the gauge-glass are of special construction.

4578. DYNAMO-ELECTRIC MACHINES, *W. P. Thompson, Liverpool.*—*25th September*, 1883.—(*A communication from R. J. Sheehy, New York, U.S.*) 6*d.*

This generator has a number of field magnet pole pieces arranged alternately, and is provided with intermediate armatures between the adjacent pole pieces and exterior armatures between the outer faces of the exterior pole pieces, the latter serving to maintain the magnetic fields. The dividing power is communicated through friction gearing. The length of the conductors in any of the armature bobbins may be automatically increased or diminished when the normal strength of current is disturbed.

4579. ENGINE DIRECTION INDICATORS, &c., *C. Stout, Liverpool.*—*26th September*, 1883. 6*d.*

Relates to mechanism and a dial indicating the direction, the same being controlled by an electric current.

4580. PACKING FRILLING, FRINGES, &c., *J. MacCullum, Manchester.*—*26th September*, 1883. 6*d.*

Relates to a reel for packing and displaying frilling, fringes, and other similar goods, provided or formed with an internal receptacle, chamber, cavity, or space, adapted for the reception and protection of a portion of the goods disposed therein in the form of coils or otherwise, whilst presenting a surface between the wings of the wheel for the reception of outside lappings of the same goods.

4581. WASHING MACHINES, *E. A. Brydges, Berlin.*—*26th September*, 1883.—(*A communication from J. Szczesny, Germany.*)—(*Not proceeded with.*) 2*d.*

Relates to the employment of a revolving drum, constructed with laths or staves of wood provided with projections.

4585. GALVANIC BATTERIES, &c., *A. W. Warden, London.*—*26th September*, 1883. 6*d.*

A constant flow of the exciting liquid is maintained by an arrangement of reservoirs and receivers, pumps being used to raise the liquid from the latter to the reservoirs.

4586. BRACKET FOR SEATS, SHELVES, &c., *A. Barker, London.*—*26th September*, 1883. 6*d.*

The bracket consists of two portions or members, one of which is arranged to slide telescopically within or over the other.

4588. STEAM BOILERS, *J. and H. Layfield, Burnley.*—*26th September*, 1883.—(*Not proceeded with.*) 2*d.*

Relates to improvements in three-flued boilers. The bottom or third flue, after passing inside the shell of the boiler in the usual way for the distance of the fire-box, dips down and the flame and products of combustion are thrown under the boiler bottom and pass along that for the remainder of its length. The products of combustion from the three flues meet in a chamber at the back end of the boiler, and from thence pass along two flues under the boiler to the front, and back again along two side flues, after which they escape up the chimney.

4590. CARRIER MECHANISM, &c., OF MACHINES FOR KNITTING CARPET OR STAIR PADS, &c., *J. Burdon and C. Till, Leicester.*—*26th September*, 1883. 2*d.*

Relates to improvements in the carrier mechanism of knitting looms for knitting carpet and stair pads, and other like fabrics in which a series of parallel fillings passed between the loops of the fabric are knitted together and held in place by interlacing threads.

4591. EQUILIBRIUM EXPANSION VALVE FOR STEAM ENGINES, *J. Brooks, Manchester.*—*26th September*, 1883.—(*Not proceeded with.*) 2*d.*

The object is to reduce the friction that takes place during the working of an ordinary slide valve between the face of such valve and the corresponding surface of the engine cylinder.

4593. MANUFACTURE OF GLYCERINE, *J. Imray, London.*—*26th September*, 1883.—(*A communication from I. A. F. Bang, Paris.*) 4*d.*

The inventor claims, First, the use of chemically pure lime and limestone with distilled water, so as to obtain glycerine liquor free from lime salts soluble in mineral acid; Secondly, the addition of stearic acid or its analogues under heat to decompose lime salts and absorb colouring matters; Thirdly, the addition of zinc powder or equivalent hydro-generating substance to bleach the glycerine.

4597. DISENGAGING HOOKS, *L. E. Liardet, London.*—*27th September*, 1883. 8*d.*

Consists in the construction of disengaging hooks in in such manner that the upper part is separated from the two side arms of the lower part of the hook, and is so coupled at one end by a pin joint to the upper end of one of these arms and made to catch under a pin or projection at the upper end of the other arm; and also in such manner that when the lower part is upheld, the upper part can not only drop, but also, in addition, move sidewise, so that if it is again turned upwards its end shall pass clear of the pin or projection at the top of the side arm of the lower part of the hook.

4599. VALVE FOR DETERMINING INTERMITTENT FLOW OF FLUIDS, *J. Imray, London.*—*27th September*, 1883.—(*A communication from A. Kaiser, Switzerland.*) 8*d.*

In one form the seating of the valve is arranged on a flexible diaphragm of larger area than the valve orifice through its centre. The valve stem is attached to a lever on which is a tumbling weight, so shaped that when the valve is closed the centre of gravity of the weight is on the same side of the fulcrum as the valve is, but when the valve is open the centre of gravity is on the opposite side of the fulcrum, a stop preventing the weight going too far.

4605. APPARATUS FOR RETARDING AND STOPPING SHIPS, &c., TO PREVENT COLLISIONS OR OTHER ACCIDENTS, *J. Love, Finchley.*—*27th September*, 1883. 6*d.*

This consists in an arrangement of hydraulic cylinders which are so connected with plates secured to the vessel as to swing outwards when the pistons are caused to travel in the cylinders, and thus stop or retard the advance of the vessel when required.

4606. BULWARKS OF SHIPS OR VESSELS, *C. Grey, Glasgow.*—*27th September*, 1883. 6*d.*

This relates to the application of storm netting to the bulwarks of ships to prevent heavy seas breaking on board.

4614. APPARATUS FOR CUTTING HAIR OR WOOL, &c., *W. E. Bennett, Condover, Salop.*—*28th September*, 1883. 6*d.*

The apparatus can be operated by one hand, as the cutting part is combined in one instrument with the comb. A comb has a row of teeth mounted on one side, on which it can slide to and fro; the edges of such teeth, as well as those of the comb, being sharpened so as to cut any hair which may be between them. The sliding teeth are actuated by a coiled spring, and suitable gearing and connections forming part of the instrument.

4620. FLUES OF STEAM BOILERS, *G. Rowland, Stalybridge.*—*28th September*, 1883. 6*d.*

The flues are constructed of a series of flanged rings or sections rivetted together, such sections or rings being arched or bulged, the object being to strengthen the flues.

4621. MANUFACTURE OF YELLOW AND ORANGE COLOURING MATTERS, *J. Imray, London.*—*28th September*, 1883.—(*A communication from La Société Anonyme des Matières Colorantes et Produits Chimiques and Messrs. L. Roussin and A. Rosenstiehl, Paris.*) 2*d.*

This relates to the manufacture of colouring matters by the action of parabenzoic or metabenzoic acids on secondary amines, such as diphenylamine or monobenzylaniline.

4623. HOES, SPADES, &c., *D. Smith, Wolverhampton.*—*28th September*, 1883. 6*d.*

This relates to the production of blanks by rolling which have the blades of the finished dimensions intended for the hoes, spades, or other tools, and lumps or thickened parts thereon, from which the eyes may be formed, or with shanks, to which the sockets or straps are afterwards welded, and also with any ribs thereon which are required for the finished tool.

4624. APPARATUS FOR PURIFYING SMOKE FROM STEAM BOILER FURNACES, &c., *J. Griffiths, Weobley.*—*28th September*, 1883. 6*d.*

The smoke is caused to pass through water ejected from one or more perforated pipes arranged in the chimney tubes or flues of a furnace.

4628. APPARATUS FOR OPERATING AND REGULATING THE FEED OF STEAM BOILERS, &c., *F. H. F. Engel, Germany.*—(*A communication from W. Ritter, Altona, Germany.*)—(*Not proceeded with.*) 2*d.*

A closed hollow vessel communicates by one or more flexible bent pipes with the water of a boiler or a condensing vessel, as long as the level of water is above the low-water mark, whilst as soon as it falls beneath this mark one or more of these pipes communicate with the steam of the boiler or the condenser.

4639. THIMBLES, *M. Demme, Germany.*—*29th September*, 1883. 2*d.*

This consists in lining thimbles with an elastic material so as to fit more perfectly and prevent discoloration of or injury to the finger.

4655. OPTICAL INSTRUMENTS, *D. R. Cameron, Sheerness.* *29th September*, 1883. 6*d.*

The object is to enable points or objects at different focal distances to be seen simultaneously and with precise definition. The object glass is separated or subdivided without actual separation into two or more adjustable parts, so that each of them is capable of separate focussing with the eye piece to adapt them simultaneously to objects at different distances.

4663. HOT BLAST STOVES FOR BLAST FURNACES, *A. M. Clark, London.*—*1st October*, 1883.—(*A communication from C. Alger, Hudson, U.S.*) 6*d.*

This relates to the construction of air heating pipes for heating air blasts for blast furnaces, and it consists in forming such pipes of metal of U-shape faced inside and out with fire-bricks, and arranged in a heating chamber communicating with a combustion chamber beneath, to which gas from a gas culvert or furnace is introduced, and also air to support combustion, the heating chamber being provided with outlet chimneys for the incombustible products, all being under the control of suitable valves. The bricks lining the pipes are of different width, so as to form a rough surface to cause the intermingling and an even heating of the air passing through the pipes.

4671. ALARM BELLS FOR BICYCLES, &c., *H. Serrell, Plainfield, U.S.*—*2nd October*, 1883. 6*d.*

The duration of the alarm is brought under the control of the rider by causing it to be actuated by a coiled spring, which has to be first wound up, when, by pressure on a suitable thumb piece, the alarm will be sounded, but will cease sounding on removal of such pressure therefrom.

4682. LEVELS, THEODOLITES, &c., *H. Darwin, Cambridge.*—*2nd October*, 1883. 6*d.*

The object is to ensure the accuracy of the shifting parts of levels, theodolites, and similar instruments, and it consists in applying to such parts a method of fitting and bearing, which consists in effecting the fit by contact of four points on a truly cylindrical or turned surface.

4698. PRESERVING FOOD, &c., *J. Y. Johnson, London.*—*2nd October*, 1883.—(*A communication from La Société Anonyme de Conservation Alimentaire, Paris.*) 4*d.*

This relates to the preservation of animal and vegetable substances by the employment of "petreoline," vaseline, or soft paraffin.

4699. APPARATUS FOR DRYING AND COOLING SUGAR, &c., *C. A. Day, London.*—*3rd October*, 1883.—(*A communication from G. M. Newhall, Philadelphia.*) 8*d.*

Relates to the mode of effecting the drying of sugar and the like substances, said mode consisting in subjecting the said substances to heat and agitation in one machine to effect a partial drying of the same, and then transferring the partially dried substances to a second machine and subjecting them to further heat and agitation to complete the drying operation. The drying machine is provided with a drum, the entire circumference of which consists of a heated jacket, and which is combined with mechanism for working said drum.

4713. CONCENTRATING AND VANNING APPARATUS, *P. M. Justice, London.*—*4th October*, 1884.—(*A communication from The Frue Vanning Machine Company, Detroit.*)

Relates to that class of apparatus employed in treating crushed or fine materials or ores in which the lighter particles are washed away and carried off in the tailings, while the metallic particles are collected or concentrated for subsequent amalgamation or other suitable treatment.

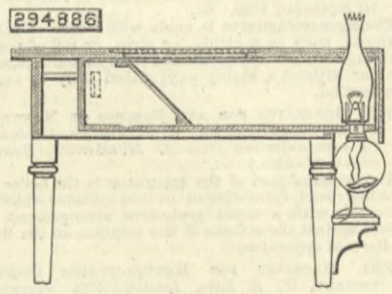
SELECTED AMERICAN PATENTS.

From the United States' Patent Office Official Gazette.

294,886. WRITING TABLE, *Marshal E. Lenril, Homestead, Pa.*—*Filed October 4th*, 1883.

Claim.—(1) A writing table provided with a transparent glass plate in its leaf and a drawer underneath containing a mirror, for the purpose substantially as set forth. (2) A writing table provided with a transparent glass plate in its leaf and a drawer underneath containing a mirror that, when the drawer is drawn out to its full capacity, stands at an angle of 45 deg. under the glass plate, substantially as described.

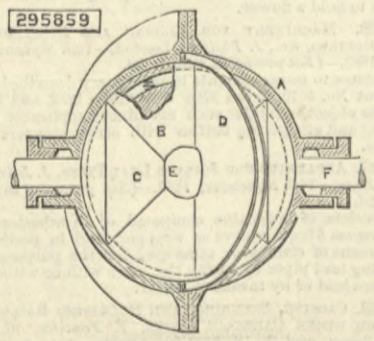
294,886



295,859. ROTARY ENGINE, *John T. Davis, New York, N.Y.*—*Filed November 28th*, 1882.

Claim.—(1) The combination of the sphere A, cones C C, the piston B, and the shafts F F, all acting upon a common axis through the centre of the sphere, and revolving upon a common centre with the disc D, having a larger diameter than the internal diameter of the sphere, a slot of the exact diameter of the piston B, and a circular central aperture fitting the globe E of the piston B, and provided with packing *f*, which piston is set at an angle from a perpendicular, and the inlet and outlet passages *l m*, all of said parts being arranged substantially as shown, and for the purposes set forth. (2) The disc with a slot through its centre and a circular aperture fitting the globe on the piston, through which the piston works in its revolutions around its axis, supported and kept in position by an outside ring or flange working in a groove turned in the case of the sphere at the point where the flanges come together.

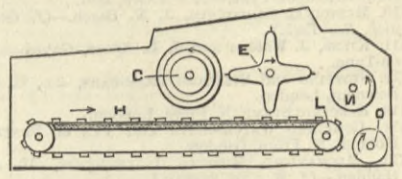
295859



296,109. SELF-FEEDING AND BAND CUTTING ATTACHMENT FOR THRASHING MACHINES, *Samuel Samuels Barr, Waukon, Iowa.*—*Filed July 11th*, 1882.

Claim.—(1) The bell H and spreader E, having double pulley e^1 e^2, and belt *r*, in combination with rollers L N O, the roller L having double pulley l^1 l^2, and gearing l^2, *n*, *s*, and *o*, by which the relative speed of the parts and feeding of grain are regulated, all as and for the purpose set forth. (2) The band-cutter shaft C having cutter discs *d*, and spreader E, having ribs *f* and teeth *g*, in combination with rotating carrier apron H, and rollers L N O, double pulleys, bands, and gears, substantially as set forth, whereby the relative speed of the parts and the feeding of grain are regulated, as set forth.

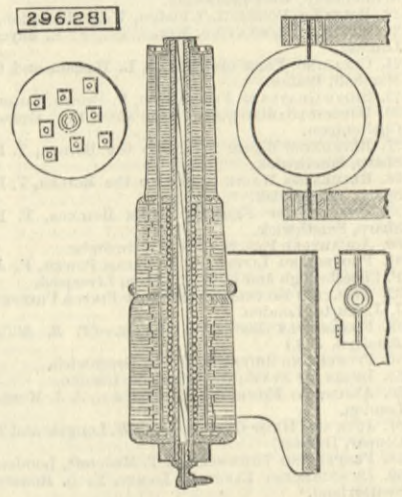
296,109



296,281. BREECH-LOADING ORDNANCE, *Henry Durell, West Morrisania, N.Y.*—*Filed April 4th*, 1882.

Claim.—(1) The combination of the inner barrel or bore, a muzzle plate secured to the front end of the barrel, a series of discs, and a series of draw bolts with a metallic plate placed at the beginning of the reenforcement, and a second series of discs and draw-bolts, the second set of draw-bolts being passed from the metallic plate through the rear series of discs, a breech plate, and a nut which is passed over the rear end of the barrel, substantially as set forth. (2) A trunnion composed of two pieces of iron, which are bent so as to conform to the shape of a gun, and which have their ends turned outward, so as to receive a screw collar or sleeve, substantially as described.

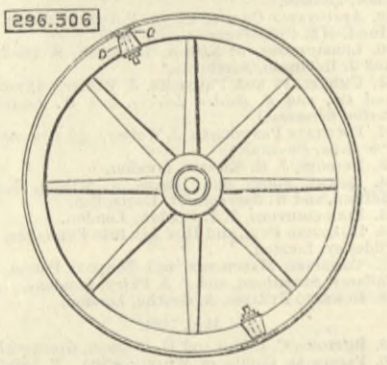
296,281



296,306. TIRE-TIGHTENER, *Henry C. Bates, Miles.*—*Filed January 10th*, 1884.

Claim.—The combination, with the tapered block D, having its sides *a a* depressed to fit the felly ends *b b*, of the elastic packing *c*, inserted in the space between the end of the fellies, and between the end of the block and the tire, substantially as and for the purposes described.

296,306

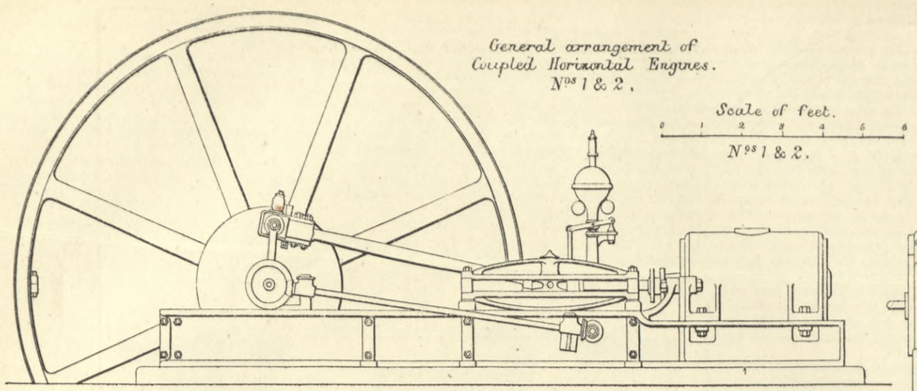


CONTENTS.

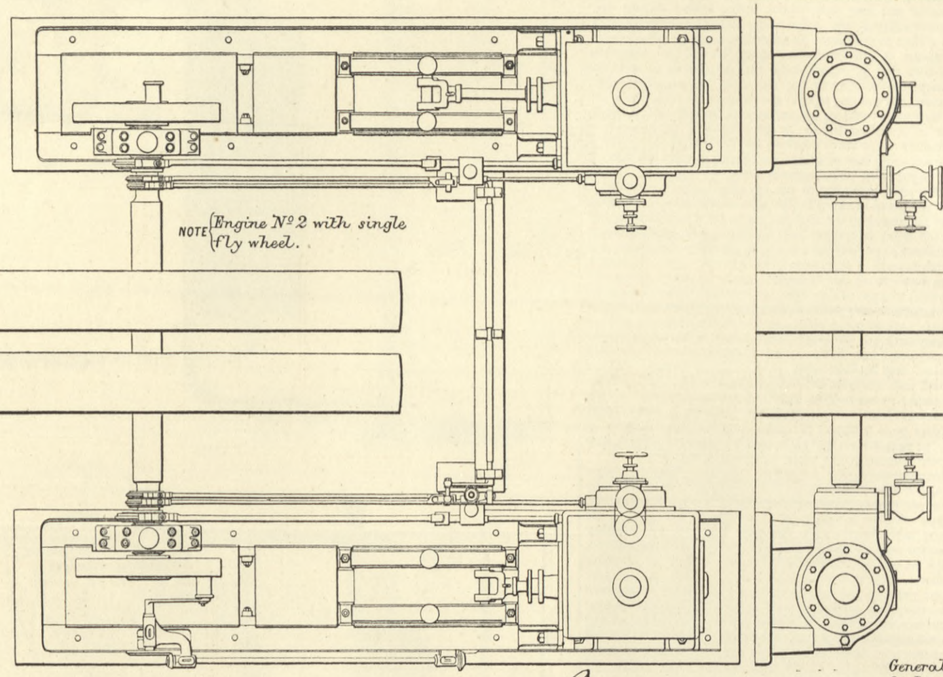
THE HEALTH EXHIBITION.—ENGINES AND BOILERS IN THE ELECTRIC LIGHT SHED.

MESSRS. DAVEY PAXMAN & CO., ENGINEERS
COLCHESTER.
(For description see page 341.)

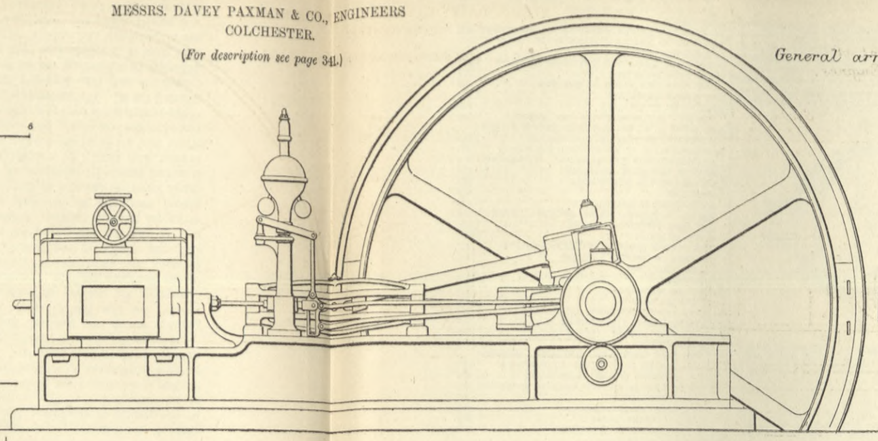
General arrangement of Coupled Horizontal Engines. Nos 1 & 2.

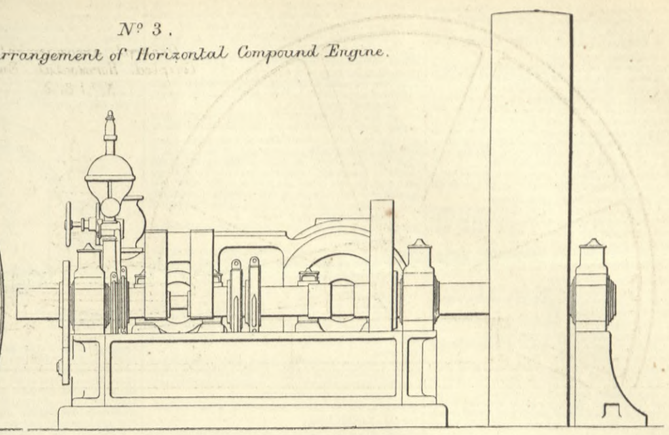


Scale of feet.
0 1 2 3 4 5 6
Nos 1 & 2.

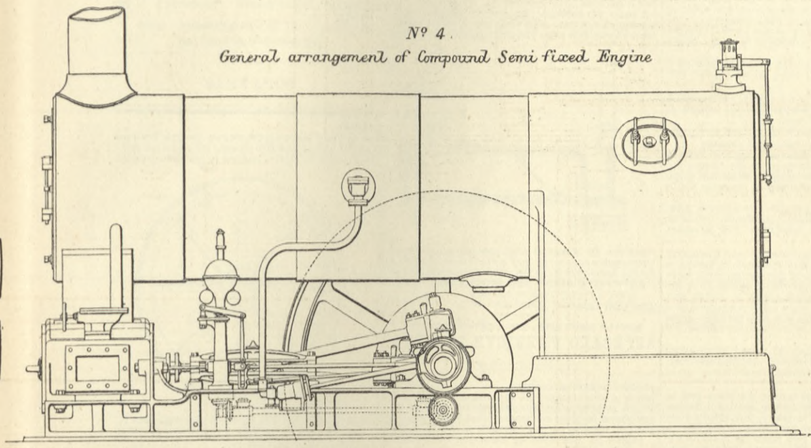


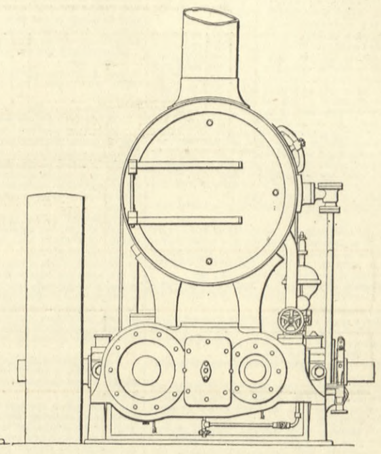
No 3.
General arrangement of Horizontal Compound Engine.





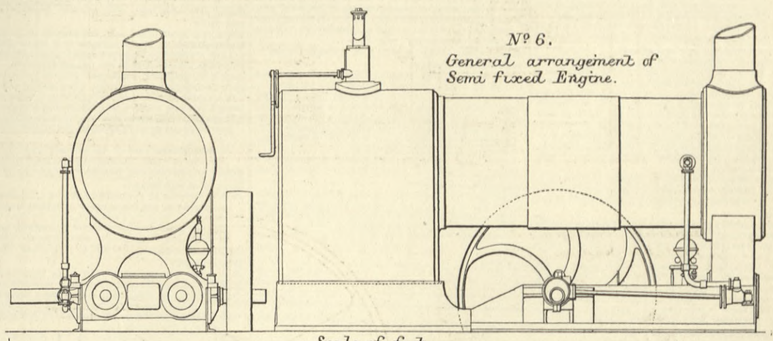
No 4.
General arrangement of Compound Semi fixed Engine





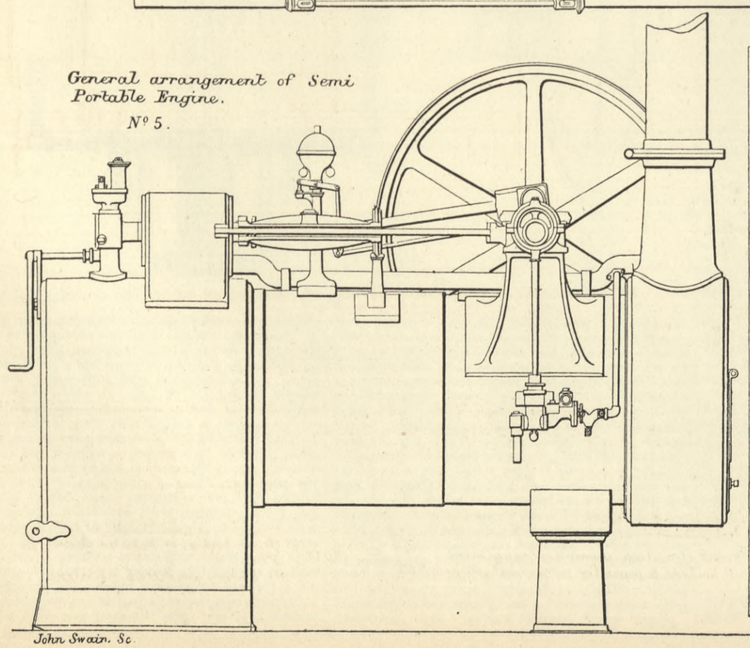
Scale of feet. No 3.
0 1 2 3 4 5 6
Scale of feet No 4.
0 1 2 3 4 5 6 7 8
Scale of feet No 5.
0 1 2 3 4 5 6

No 6.
General arrangement of Semi fixed Engine.



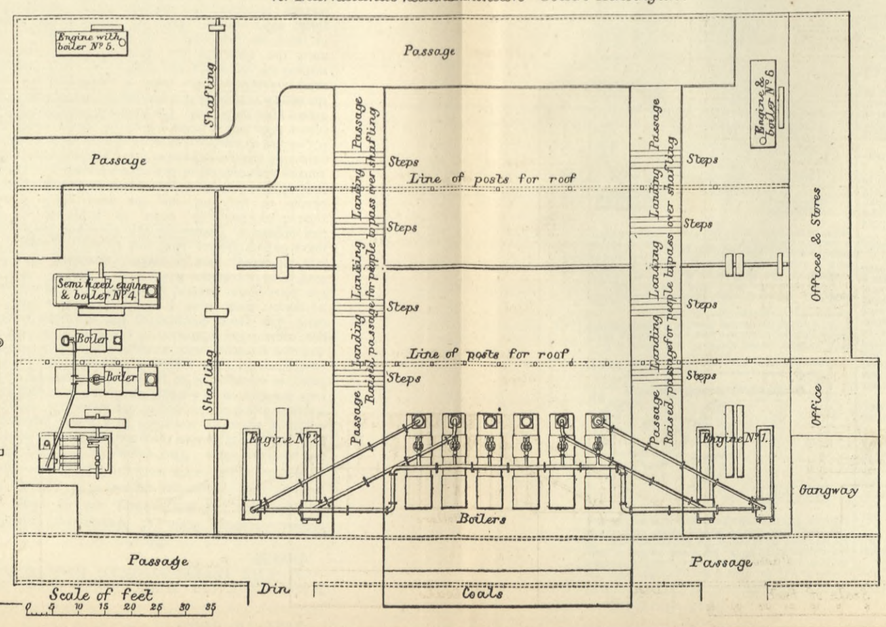
Scale of feet
0 1 2 3 4 5 6 7 8 9 10

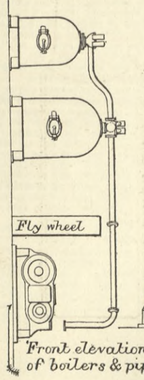
General arrangement of Semi Portable Engine.
No 5.



John Swain. Sc.

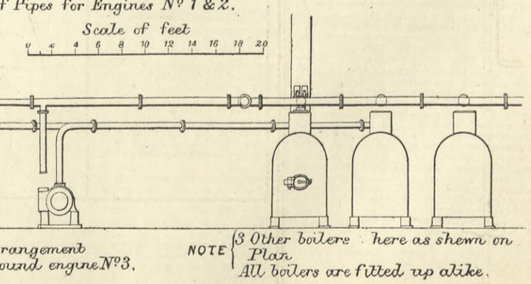
General plan of engines boilers &c in the Electric Light shed for International health Exhibition South Kensington.





Front elevation shewing arrangement of boilers & pipes for compound engine No 3.

Front elevation of Boilers shewing arrangement of Pipes for Engines No 1 & 2.



NOTE { 3 Other boilers here as shewn on Plan
All boilers are fitted up alike.