

LITERATURE.

Magnetic Surveying and Angular Surveying, with records of the Peculiarities of Needle Disturbances. By WILLIAM LINTERN. Crosby Lockwood and Co. 1881.

EVERY practical man who troubles himself to think at all, must necessarily gain valuable experience in the course of years; but, as a rule, it is exceedingly difficult to get such men to speak, much more to get them to write, about their conclusions. Mr. Lintern, however, writes in this little book of his own experience, and hence demands attention. In the first place he takes a rapid survey of the whole question of mining surveying, referring at times for particulars to a previous work, the "Mineral Surveyor's and Valuer's Guide." He reviews the subjects—surface surveying and underground surveying—separately and in combination. The connection of surface lines with lines at the bottom of a shaft is thus treated:—"Different ways of connecting a surface line with lines at the bottom of the shaft have been proposed, such as extending one of the surface lines across the top of the shaft, and then dropping two plummets laid accurately in its direction, from the surface to the bottom of the shaft, and as far apart as the diameter of the shaft admits of, from which plummets at the bottom of the shaft the same surface line may be reproduced in direction, and from it a series of lines and angles extended into the workings of the mine in the operation of the survey. Another plan that has been advocated is to fix the instrument over the shaft in such a position that the direction of a surface line can be observed, and with the instrument so fixed in that alignment turn the telescope down so that two lights may be observed and adjusted in the same direction as the shaft bottom. Another plan has been suggested, that of fixing the instrument in the bottom of the shaft, and turning it into alignment with two objects fixed at the surface of the shaft, and seen in the vertical hair of the telescope, and so arrange a parallelism between a surface and a subterranean line." The author's description is rather hard to understand, but his conclusion is emphatic, "Only the first of these deserves a moment's notice." Continuing, he speaks of the angular and magnetic systems, and pointedly calls attention to the inaccuracy of the most costly instruments supplied by even the best makers. The results, he says, obtained with these instruments instead of agreeing oftentimes differ considerably. Mr. Lintern's experience leads him to the sources of error well known to scientific men, liable to be made in using the magnetic needle. He describes his amazement at noticing the "marked variation between the parallelism of the needle and the zero of the instrument," coming then to the conclusion "that an error in manipulating the instrument must have been committed." The lines were re-observed, and a constant oscillatory motion of the needle noticed. We cannot pay much regard to the casual remarks made on the changes undergone by steel when it is magnetised, and it would not be difficult to point out numerous accidental causes influencing a magnet in subterranean workings, besides the greater or less conductivity of strata, though there is no doubt this does play its part in the phenomenal results.

We must confess to a little surprise that no mention is made of a simple system of obtaining angular measures with great exactitude by means of reflected light, whilst the ordinary system is carefully described, and what is more important, illustrated by tables giving examples of how the readings, &c., should be entered by the surveyor.

Many of the remarks referring to "magnetic surveys" ought to be carefully noted, such for example as the following caution:—"In taking an angular survey it will not be sufficient, in order to be able to fix the magnetic meridian to the plotted lines, to take the magnetic bearing of the first or any intermediate line, and assume that the meridian is thus determined for the whole if the several angles are 'reduced' into this magnetic angle as a base."

The portion of this little work relating directly to surveying concludes on page 44; but two short chapters, entitled respectively "Notes on Colliery Property" and "Notes on Rating," are added. We think the question of subterranean surveying is of sufficient importance to be dealt with exhaustively with diagrams, and whilst there can be no objection to the information given in these two chapters, they can hardly be said to come within the subject indicated by the title of this work.

LEGAL INTELLIGENCE.

HIGH COURT OF JUSTICE—CHANCERY DIVISION.

(Before VICE-CHANCELLOR SIR JAMES BACON.)

March 23rd—30th.

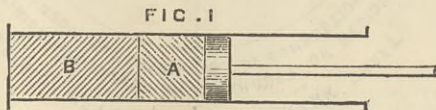
OTTO v. LINFORD.

THIS action was commenced on the 26th July, 1880, by Mr. Nicolaus August Otto to restrain alleged infringements by the defendants, Messrs. Charles Linford and Company, of Leicester, of letters patent dated the 17th May, 1876, No. 2081, and granted to Mr. C. D. Abel, the agent of the plaintiff. The defendants, besides denying that they had infringed, gave notice by their particulars of objections, that they disputed the validity of the plaintiff's patent on the following, amongst other grounds, namely, that the first and second claims in the plaintiff's specifications were claims for a principle, and that the mechanical appliances for carrying the principle into effect were not particularly described in the specification; that the invention had been anticipated by the following prior letters patent, viz.:—J. H. Johnson, 14th January, 1861, No. 107, and 8th February, 1860, No. 335; G. B. Babacci, 29th April, 1868, No. 1393; E. P. Alexander, 15th December, 1875, No. 434; C. D. Abel, 12th February, 1866, No. 434; Barsanti and Martteucci, 12th June, 1857, No. 1655; R. Gottheil, 2nd January, 1874, No. 25; W. Barnett, 1838, No. 7615; M. P. W. Boulton, 10th March, 1866, No. 7381, and 8th July, 1867, No. 2000, and 19th June, 1868, No. 1988. The plaintiff's case shortly was, first, that they were the first to introduce a cushion of non-combustible gas between the piston and the explosive; secondly, that they were the first to draw in behind a piston first air, and then air and gas mixed; thirdly, that they were the first to utilise the heat generated by the explosion in expanding the cushion of air before named; and fourthly, that they were the first to compress a charge by the working piston in the working cylinder, and so render possible the combustion of comparatively dilute mixtures of gas and air. The plaintiff administered interrogatories to the defendant Lind-

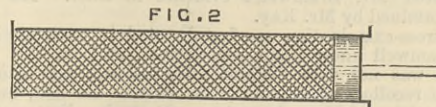
ford, who stated by his answer that it was not correct to say that in the gas motor made by him a charge of combustible and incombustible fluid was compressed by one instroke of the piston or otherwise, or that any such charge of combustible and incombustible fluid had been drawn into the cylinder by the previous outstroke of the piston or otherwise. It was the fact that in his engines the compressed charge when ignited propelled the piston during the next outstroke, and that the products of combustion were partly expelled from the cylinder by the next instroke. He admitted that his motor performed all the operations and effected all the purposes mentioned in the second claim of the plaintiff's specification, except as regarded the action of the slide, which in the plaintiff's patent admitted air alone during the first portion of the piston's stroke, and air and gas during the remaining portion, whereas in Lindford's engine the slide valve only admitted a combustible charge of air and gas during the whole of such stroke. In such motors the piston was propelled by the explosion of the charge, and the products of combustion were expelled from the cylinder partly by the next instroke of the piston. A scavenger charge of air was afterwards drawn in to expel the remaining products of combustion. He referred to the specification of his patent of 24th January, 1880, No. 330, for a description of the manner in which his engine was constructed and worked.

Mr. Aston, Q.C., Mr. Hemming, Q.C., and Mr. Lawson were counsel for the plaintiff; and Mr. Kay, Q.C., Mr. Brett, and Mr. H. H. Cunningham were for the defendant.

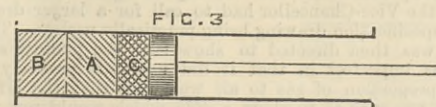
Mr. Aston, Q.C., in opening the plaintiff's case, stated that although the gas motor engine was not a new thing at the date of the plaintiff's patent, yet the invention of the plaintiff enabled a very new engine to be employed much more generally and successfully than such machines ever were before. Mr. Aston then proceeded to explain at some length the principle of the first gas engine, in which a mixture of gas and air was exploded behind a piston in a cylinder. It was necessary to have a mixture of ordinary atmospheric air, so as to cause the gas, the carburetted hydrogen, to explode by giving the particles of oxygen and hydrogen sufficient oxygen for them to form an explosive mixture. The proportions might be three to one of carburetted hydrogen, to six or seven or eight or ten of atmospheric air. If, into the charge chamber of an ordinary cylinder working an ordinary piston, there were introduced a combustible mixture consisting of eight parts atmospheric air and one of carburetted hydrogen, and if this charge were ignited by a small flame outside, an explosion would ensue, which would drive the piston violently back from one end of the cylinder. If we had a similar chamber at the other end of the cylinder, we might repeat the process there, and drive the piston back again, and that would be the best form of an ordinary gas engine. Again, instead of using a second charge to blow the piston back, we might trust to the gradual cooling down of the remains of the exploded charge, when a partial vacuum would be made, and the piston released, and this had also been done; and these were the only two systems in use at the time when the Otto engine was invented. The defects of the existing gas engines were that the explosion produced a violent shock, almost sufficient to dislocate the strongest engine, and so much heat was generated and wasted in order to keep the cylinder cool as practically to nullify the advantages to be derived from the use of gas. Mr. Aston next proceeded to consider the advantages of gas engines, such as that they could be put down anywhere, and wasted no fuel when they were not at work, &c. Several attempts were made to get rid of the defects of the gas engine by Lenoir, Hugon, Boulton, and others, but unsuccessfully until 1876. He then went on to speak of Mr. Otto's earlier efforts to produce a good gas engine, and of his good fortune in meeting with Messrs. Crossley, of Manchester. He then proceeded to say that in 1876, or some time previous to that period, it occurred to Mr. Otto that if instead of causing a charge of the combustible fluid only, to explode in the gas chamber of a cylinder, he could introduce between the explosive mixture and the surface of the piston something that would act as a cushion and take off the shock, something that would also utilise the heat generated instead of wasting it, he could very easily, and by a very simple remedy, obviate the previously existing defects, and what Mr. Otto did was to provide for the introduction into the charge chamber first of all of a certain charge of atmospheric air A (Fig. 1).



Secondly, he put behind that a charge of the combustible mixture of gas and air B (Fig. 1), and then by communicating as before the light of a gas jet to the combustible mixture he would allow the mixture to be fired, causing the heat generated to be absorbed in a very large degree by the cushion of atmospheric air, among which the particles of the combustible mixture would insinuate and disseminate themselves, and the operation instead of being sudden so as to cause violent shocks would be gradual, and economy would be effected by the cushion of air absorbing the heat, and expanding and doing work. This, in its simple form, may be said to be a description of the important steps in advance made by Mr. Otto, and communicated to Mr. Abel in 1876. Mr. Aston then went on to describe what took place in the engine after the explosion of the charge and the making of a stroke. The cylinder would then be full of the products of combustion—Fig. 2. There would be carbonic anhy-



dride and the residue of unconsumed atmospheric air. By the action of the fly-wheel the piston would be brought back again, and as it came back it would expel a certain portion of the products of combustion. When, by the continued revolution of the fly-wheel, the piston was again moved away from the closed end of the cylinder, the residue was carried back as room was left for it, and communication was opened to a supply, as provided by the patentee, of, first, atmospheric air, and then, behind, that combustible mixture; but the patentee provided for their being introduced in such proportions, and there was so much time given during the operation of the stroke of the piston, that instead of the three layers remaining divided and separate—as in Fig. 3—where A is air,



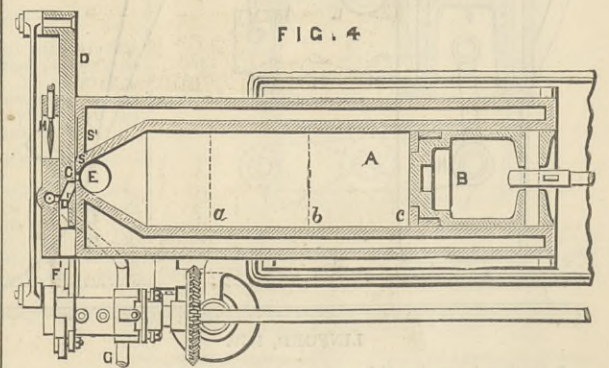
B combustible mixture, and C residual products of combustion—they became mixed together. The air and the residue of the charge commingled, the combustible mixture which was introduced last did the same, and the particles of the combustible mixture were dispersed through the entire charge; but they lay relatively more isolated, more dispersed, and more disseminated at the end next to the piston, less isolated, less dispersed, and less disseminated at the end next to the point of ignition. By the action of the fly-wheel the piston now returned and compressed the charge, and in that compressed state it was fired, and in that compressed state the same relative conditions of mixture remained unaltered, and as the combustible mixture had its particles nearest together close to the point of ignition, there was gradual combustion and development

* The learned counsel illustrated this for the Court, by first putting into the cylinder of a model, white, and afterwards red wool.

of heat and of force. Such, Mr. Aston explained, was the general principle of the action of the plaintiff's engine, but before going further he thought it would be well to say that the method of dealing with and introducing a charge, and of allowing that charge to be compressed, was one that had been proposed to be used in some specification prior to 1876; but, as far as was known, no gas engine was ever made and used which worked upon that principle. Mr. Aston then read the specification of the plaintiff, commenting on it as he went. The first portion of the specification, apart from the drawings, we print, because on it turned a large part of the case. The drawings round which most interest concentrated, we give in full size from the specification further on.

"In gas motor engines as at present constructed an explosive mixture of combustible gas and air is introduced into the engine cylinder where it is ignited, resulting in a sudden expansion of the gases and development of heat, a great portion of which is lost by absorption unless special provisions are made for allowing the gases to expand very rapidly. According to the present invention combustible mixture of gas or vapour and air is introduced into the cylinder together with air or other gas that may or may not support combustion in such a manner that the particles of the combustible mixture are more or less dispersed in an isolated condition in the air or other gas, so that on ignition, instead of an explosion ensuing, the flame will be communicated gradually from one combustible particle to another, thereby effecting a gradual development of heat and a corresponding gradual expansion of the gases, which will enable the motive power so produced to be utilised in the most effective manner. The mode of using the gases and the arrangement of the engine may be variously modified in carrying out this invention. Thus, according to one arrangement the gases are introduced into the engine cylinder at atmospheric pressure. The cylinder is for this purpose provided with a slide having suitable ports for the admission of air and of an intimate mixture of combustible gas or vapour and air, and the movement of the slide is so regulated by means of a cam or eccentric on the engine shaft that during the first part of the stroke of the piston air alone enters the cylinder, while during a succeeding portion of the stroke the mixture of gas or petroleum vapour and air is introduced behind the air. This mixture in entering the cylinder will become more or less dispersed in the air previously introduced, the particles of the mixture being situated nearest together at the point where they enter the cylinder, and becoming gradually more dispersed as they mix with the air in front. A communication being now established by the slide between a small external gas flame and the contents of the cylinder at the point where the combustible mixture is most dense, this ignites, and the combustion of the whole charge takes place gradually, the mixture burning with gradually decreasing rapidity as the flame extends to those particles that are more dispersed among the air. The gradual expansion of the gases thus produced causes the piston to complete its stroke, and on the return stroke, which may be effected either by the momentum of the fly-wheel or by the introduction of a similar charge at the other end of the cylinder, the products of combustion are expelled through a valve, after which the above-described operation is repeated for the next stroke. According to another arrangement, the combustible gas and air or other gas are employed in a compressed state in the engine. For this purpose the engine may operate either as above described, the gas and air being simply compressed to the requisite degree before being introduced into the cylinder, or, by preference, the compression is effected in the cylinder itself in the following manner:—The cylinder is constructed of greater length than the stroke of the piston, so that there is a space beyond the latter when it is at end stroke. Assuming this space to be filled with a portion of the gaseous products of combustion resulting from the last stroke at atmospheric pressure, the piston in performing one part of its stroke draws in atmospheric air, after which it will draw in the combustible mixture during the remainder of its stroke. The cylinder will then be filled with three strata of different gases, more or less intermingled at their junction, namely, a stratum of products of combustion next the piston, then a stratum of air, and lastly the combustible mixture. The piston then performs its return stroke, whereby the gaseous charge is compressed into the before-mentioned space at the end of the cylinder. The gases will in this condition still retain their stratified position, the particles of combustible mixture being diffused to a certain extent through the other strata. The charge is now ignited and burns gradually and with the same effect as described with reference to the first arrangement. On the return stroke the products of combustion are expelled with the exception of the quantity contained in the space at the end of the cylinder. The regulation of the power of the engines operating according to the above-described invention is effected simply by admitting more or less of the combustible gas for each charge, this being done by regulating the time of opening and closing of an admission valve on the gas supply pipe. The motion of this valve is regulated by a rotating cam capable of being adjusted longitudinally on its shaft by any suitable known arrangement of governor."

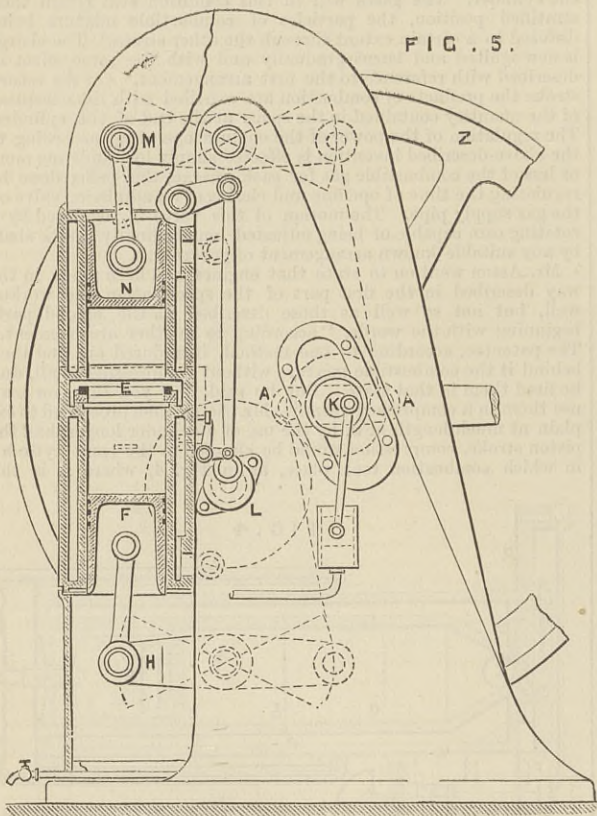
Mr. Aston went on to state that engines had been made in the way described in the first part of the specification and worked well, but not so well as those described in the second part, beginning with the words, "according to another arrangement." The patentee, according to one method, introduced air, and then behind it the combustible mixture without compressing at all, and he fired them in that state. But he said, "If you like you may use them in a compressed form." Mr. Aston then proceeded to explain at much length how, by the use of a cylinder longer than the piston stroke, compression would be effected in the same cylinder in which combustion took place, as in Fig. 4, where A is the



ABEL (OTTO), 1876.

cylinder, B the piston, D the slide, E an exhaust port closed by a valve, not shown. When the piston is at the inner end of its stroke its face is at a; the slide D is in such a position that as the piston begins to move out, air entering by the aperture D¹ and port C until the piston reaches the point b, when the slide reached such a point that gas is drawn in mixed with air until the piston reached the end of its outstroke; when the instroke was complete, and the compression effected, the slide moves so as to admit the gas flame H, igniting the charge. Mr. Aston laid much stress on the plaintiff's statement that the contents of the cylinder would be stratified. The work of compression was a very important function of the engine, for the proportions that constituted an explosive mixture were, say, 1 of gas to 8 of air at atmospheric pressure; but if we had a mixture in a compressed form, we might have a mixture in as high a proportion as 15 or 16 of air to 1 of gas. Mr. Aston then, by means of a model, explained in detail to the Court the whole action of the Otto gas engine; and as, this is no doubt fully understood by our readers who have

followed us so far, it is unnecessary to say more on this point. Resuming, he called the attention of the Court to the statement in the specification, which runs—"It will be evident that if the space *a*, or a separate chamber, such as an air vessel," &c., what the patent then said was, "you need not always draw in when you make your first out-stroke, a charge consisting partly of air and partly of combustible mixture, provided that you have your chamber—which may be called the residuum chamber—sufficiently large to contain a charge of incombustible fluid, such as is left after the last charge has been fired, to act as a cushion in the way described." Mr. Aston then defined the invention in the following words, as "consisting in introducing or admitting into the working cylinder a charge of a combustible mixture and an incombustible fluid in such a manner that the combustible mixture was dispersed in a gradually disseminated condition among the incombustible fluid, more dispersed at parts distant from, and less dispersed at parts near to, the place of ignition; thereby effecting when the charge was fired gradual combustion, gradual development of heat, and gradual expansion of the gases, and so utilising most effectively the motive power, and avoiding shocks and waste of heat." The claiming clauses, he submitted, entirely coincided with the definition which he had given as constituting a fair summary of the invention. The first claim was virtually "having in your cylinder a charge properly admitted, and firing it so as to produce these new results," namely, the avoiding of shocks and loss of heat. The second claim was "compressing by one in-stroke of the piston a charge of combustible and incombustible fluid drawn into the cylinder during its previous out-stroke, so that the compressed charge when ignited propelled the piston during the next out-stroke, and the products of combustion were expelled by the next in-stroke." These covered the whole cycle of operations. The third claim was for "regulating the admission of the combustible gas or vapour to the cylinder by means of a separate slide controlled by a governor;" and the fourth claim was for "the construction of a gas engine substantially as herein described in reference to drawings Figs. 2 to 13." Mr. Crossley had found that Messrs. Linford and Co. were making gas engines practically the same as those patented by Mr. Otto, differing in form, as might be imagined, but constructed on practically the same principles; that upon this the action was brought. Mr. Aston then proceeded to state various particulars of breaches, and to give the names of persons who had purchased engines from the defendant, and dealt with the defence. "The defence is a denial that Abel was the true or first importer or inventor—denial that the invention was entirely new, that the invention is entirely useful, and denial that the letters patent are valid." This was practically a denial that Mr. Charles Denton Abel was the true and first inventor; that the invention was new, and that it was useful, and that the specification was sufficient. Furthermore, the defendants relied in some measure on certain prior specifications—Johnson, 1860 and 1861; Barbacci, 1868; Abel, 1866; Barrett, 1838; Boulton, 1866, 1867, and 1868. Mr. Aston then went on to say that none of these affected his client's position. It was possible that some persons had proposed to introduce small quantities of atmospheric air into the cylinder of gas engines to nullify the evil effects of carbonic acid produced in the cylinder, but he should like to see the engine in which this was done. He did not believe it could be done. There was, of course, variety of form and appliances, but these the Court would remember constituted no part of the invention claimed. The patentee said, "you may vary the appliances and the form, but I will tell you the way you may do it best," and he gave three modifications. The defendant varied the number of his out-strokes and in-strokes, and the engine he made was different in shape, but in the long run he produced the same results as the plaintiff in the same manner. The defendant had two pistons working in one cylinder. These pistons, instead of receding from and approaching the residuum chamber which is at the end of the cylinder, approached one contained between them and in the middle of the cylinder, and that was the only difference; all the rest as to change of form followed naturally as a consequence. He then described the action of the defendant's engine at length, claiming that this action was in all essential respects identical with that of the plaintiff's engines.



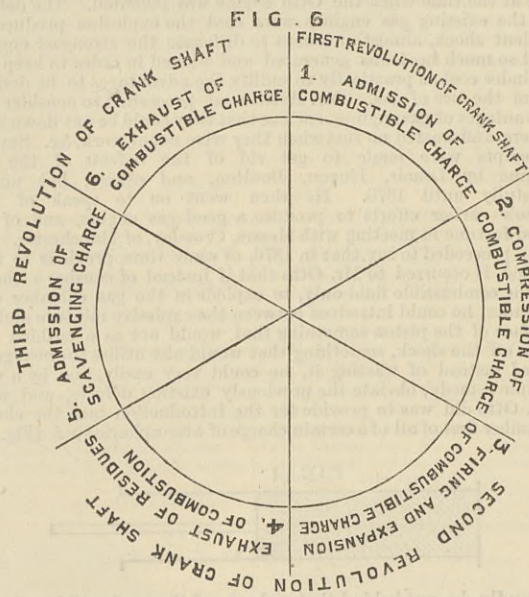
LINFORD, 1870.

In order to make this portion of the trial intelligible to our readers we give in Fig. 5 a diagram of one of the forms of engines patented in 1870 by Mr. Linford. This is a part sectional elevation. In this construction there are two pistons, F and N. E is a portion which is made movable so as to slide to and fro under the action of a lever not shown, operated by a cam. F has ports through it to form a single chamber between the two pistons F and N, when the pistons approach each other to compress the charge, also while the charge is ignited and when the residues are being expelled by the exhaust, the partition only being closed while the charges of air into one portion of the cylinder, and air and gas into the other portion of the cylinder, are being drawn into it. The two pistons have the same amount of travel by the arrangement of the beams M H, and links, and cranks A A on the fly-wheel shaft K. According to Mr. Linford's specification the object of the invention is a special construction of gas engines by which a charge can be admitted into, compressed and ignited, within the cylinder during one revolution of the crank. The object of the second part of the invention is the construction of gas engines to admit separate charges of air and air and gas, compress the same and ignite it, said

engine having beams working separate pistons specially arranged, and made to balance each other to produce perfect equilibrium.

Mr. Aston traced the action of this engine through all its stages, claiming that that action was in all respects identical with that of Otto's engine.

The first witness he called was Mr. F. J. Bramwell. The learned counsel examined him at great length as to the defects of the older forms of engine, and as to the similarity of the plaintiff's and defendant's engines. The now comparatively well-known difficulty met with in reading the wretched drawings published by the Patent-office authorities arose as a matter of course. Magnifying glasses had to be used to make out letters of reference, and the time of all concerned was wasted, and finally reference had to be made to enlarged drawings specially prepared. Mr. Bramwell's evidence really threw little light on the subject, and added not at all to the opening statement of Mr. Aston. Generally he held that the two inventions were practically identical. He illustrated his observations by the aid of the models in Court, and commented on and explained the meaning which it appeared to him should be attached to the plaintiff's specification. A great deal of his evidence was concerning the dissemination of the combustible charge through the other fluid contents of the cylinder. An example given verbatim will fully illustrate the line of evidence. Thus, asked by Mr. Aston to explain what a passage in the plaintiff's specification meant, he said:—"I have already said that the cycle of operation involves four single or two double strokes of the engine—the first out-stroke propelled by the ignition, the first in-stroke driving out the products of combustion; the second out-stroke drawing in the air and then the mixture, the second in-stroke compressing. Then one gets to the third out-stroke, which is again the ignition. That being so, it follows that if the slide were worked off the crank shaft, it would repeat its functions at every revolution, but by working it off a shaft which goes at half the velocity, it repeats its functions at only every second revolution. That is the object of that gearing.—The Vice-Chancellor: Two to one?—Yes, my lord." Asked as to anticipation, he said that he had read the claiming clauses in the plaintiff's specification, and that he had also read the specifications referred to by the defendant in his particulars of objections, and that in none of these did he find described what is claimed in Otto's specification. As to the defendant's engine, he said that the two pistons working in one cylinder acted like a similar arrangement of steam engine known many years ago; and that the effect produced was precisely as though there were two cylinders put end to end, each having its own piston, only that if there were only two pistons put end to end there could be a partition between the spaces occupied by the pistons, but here there was no partition at all; and he went on in reply to Mr. Aston to trace the course of a cycle, holding that it was identical with that of the plaintiff's engine. It may here serve to elucidate matters if we give a diagram taken from Linford's second specification, 1880, of the cycle in his engine, the "scavenging" charge being regarded as an important feature by Mr. Linford.



It will be seen that there are here three double operations in a cycle. Mr. Bramwell was asked by Mr. Aston, "Now in order to produce that cycle of the double operations, is there any difference as regards the arrangement of the defendant's apparatus?" To which Mr. Bramwell replied, "Yes, the defendant has to work his slide by gearing, which is geared 3 to 1 to the revolution of the engine, while the plaintiff works his slide by gearing as I have explained to his Lordship, that is geared 2 to 1." "In order to produce the triple instead of the double operation?" "Yes." "In your opinion does that make any substantial difference with regard to the improvements described and claimed by the plaintiff?" "It does not." "I think that it makes a worse engine, in the sense that you do not get as much work out of the same sized cylinder, because it only operates once in six times instead of once in four." This terminated Mr. Bramwell's evidence in chief. He was then cross-examined by Mr. Kay.

The cross-examination was first directed to ascertain how much Mr. Bramwell knew about gas engines, and on this point the witness was not very definite. He had seen gas engines, but he did not recollect clearly when or where. He had, he believed, seen Lenoir's and Hugon's engines. He took a diagram from one; but virtually he admitted that he had paid little or no attention to the subject until he was consulted in this case. Asked if a mixture of gas and air separate from a charge of air had ever been admitted to a cylinder until Mr. Otto had done it, he replied that he could not say that he did not know that it ever was done. "If you put the question 'proposed,' I have very great doubts if it ever was done." But my question is, can you say it never was done till the date of this patent? "I cannot." On this point he was cross-examined very closely without much result. Next ensued a long discussion on whether there was or was not a draughtsman's error in a drawing put in, Mr. Bramwell maintaining that there was an error, which would be so obvious to a workman that it would not prevent him from making an engine which would work. At last the Vice-Chancellor had to call for a larger drawing, the patent specification drawing being practically useless. The examination was then directed to show that the plaintiff's specification was imperfect in that it did not state precisely what the proper proportion of gas to air was, and that the error in the drawing was such as to show a slide which would not admit the proper mixture. A great deal of discussion followed as to the flow of gas through ordinary gas burners. Much confusion was caused by the imperfection of the drawings. That most discussed we reproduce in *fac-simile* in Fig. 8; in one case Mr. Kay had a drawing in his hand in which a certain orifice for the discharge of gas was shown, while Mr. Bramwell stoutly denied there was any such orifice. A larger drawing had to be produced to clear up the point. Then the Vice-Chancellor found in his drawing two G's, while Mr. Kay could only find one. This portion of the examination, as we have said, turned altogether on the sufficiency of the plaintiff's specification, and, of course, on the way in which the drawings were to be read, and it would be impossible to give even an intelligible synopsis of it in the absence of the whole of the actual drawings, on the accuracy of which so much depended. Mr. Bramwell to the end maintained that an intelligent man could work from them, and that they were therefore sufficient.

Mr. John Inray was next called. Being asked to explain the state of knowledge on gas engines at the time of the plaintiff's patent, 1876, he said that many attempts to use the combustion of gas had been made prior to 1861 and 1865, but it was not until that time that practically useful engines had been made, and even then the engines worked by the explosion of gaseous mixtures had serious defects, and the expenditure of gas was very great. In 1866 Langen and Otto contrived an engine in which, instead of using the explosion of the gas, they used the partial vacuum produced by the contraction of the products of combustion, and thus, by using atmospheric pressure, relieved the engine of the shock otherwise due to explosion. He then explained the Langen and Otto vertical engine, in which a heavy piston was blown up by the force of the gas explosion, the piston-rod in its upward ascent not affecting the other parts of the engine, but by means of a clutch causing the engine shaft to rotate by the downward descent of the piston under the action of its own weight and atmospheric pressure. He then explained that by reason of the shocks due to the explosion of the explosive mixture, and that effective pressures of only about 7 lb. could be obtained on the piston, high powers could not be obtained with this form of engine. He then said that the next step of any practical value was the 1876 patent, the subject of this action, and he concurred in Mr. Bramwell's description of Otto's engine and of the mode of its operation. Asked to explain the main defects that had to be got rid of in 1876 in order to get a perfect gas motor engine, he said that in all engines worked by pressure produced by combustion there was an enormous loss of heat. Gas and air mixed in the proper proportions and ignited produced a very intense heat, and if not allowed to expand that heat was all lost, or a large portion of it, in heating the containing vessel—the cylinder, for instance. If the products of combustion were allowed to expand and perform work, the heat was utilised in the shape of mechanical work. In the Otto and Langen engine the piston was free, and expansion could take place rapidly; but when the piston was connected to the crank it was controlled by the revolution of the fly-wheel, expansion took place without sufficient rapidity and heat was lost through the walls of the cylinder. Mr. Inray was next asked if instead of merely an iron cylinder next to the exploded gas there was a mass of gas, whether the heat would go into the gas; and said that the heat would readily go into the gas and increase its pressure and be thus utilised, and that this was the principle on which the old defect of loss of heat was overcome. The suddenness of shock of the old engines was, he said, avoided, the combustion instead of being sudden like an explosion, being gradual from the ignition end through the mass, or from the cylinder bottom towards the piston. Ignition across the cylinder would not have the same effect, he said, because the combustion should follow up the piston. Mr. Inray next explained the points in Otto's specification 1876, which he considered to be the essence of the invention, and which were not found in any of the previous specifications. They were, he said, effecting the combustion of the combustible mixture in the presence of a considerable body of elastic fluid, amongst which the combustible particles were dispersed in a regulated graduation—that is to say, the combustible mixture strongest next the point of ignition and gradually weaker towards the piston, this graduation being produced either by providing so much space behind the piston in the cylinder that the elastic fluid existed as the residue of a previous combustion, the fresh combustible mixture being introduced at the end of that; or to introduce a quantity of air before the combustible mixture was introduced. He considered the plaintiff's specification gave sufficient information to enable a workman to make an engine that would work. He, however, admitted the clerical error in Fig. 1 (see Fig. 8) of the drawings, a serpentine passage in the slide D being made with its mouth rather too narrow, and marked D instead of D1. If a slide were made in accordance with the drawing as it stood, a workman would readily find the error that the mouth was too narrow, and would rectify it by taking a chisel and cutting it open. After stating that he had seen engines made according to the plaintiff's specification, and according to the modification in which the gas and air are supplied under greater than ordinary pressure, the witness gave evidence as to his inspecting one of defendant's engines, in company with Mr. Bramwell, at a shop in Queen Victoria-street, London, on the 15th February, 1881; he saw the engine at work, saw as much as could be seen from the outside, saw duplicates of the slide valves, and took rubbings of the slides. He considered the principle upon which the defendant's engine and the plaintiff's engine acted to be the same; that the same result was obtained by substantially the same means; that this result and these means were the utilisation of "a large portion of the heat of combustion to give pressure and expansion to an elastic fluid in the cylinder in the same way as the plaintiff did; he thereby got greater efficiency, and the means that he adopted was to admit the combustible fluid after the incombustible fluid in a similar manner to the plaintiff, to compress it in a similar manner and to ignite it in a similar manner." He explained that by incombustible fluid here he meant incombustible in the sense that it did not burn in the cylinder.

Cross-examined by Mr. Cunningham, he said that the defendant obtained the same result as the plaintiff by admitting the admixture of gas after the air and the residual products of combustion. Mr. Cunningham: "Then I suppose that same result would be obtained if the air was drawn in before the combustible mixture for the purpose of neutralising the carbonic acid gas, the previous residuum." Mr. Cunningham was using the words of Johnson's specification of Lenoir's engine of 1860, which describes drawing in a portion of air for the purpose of neutralising the carbonic acid gas, which was the residuum of the previous charge, which might otherwise prevent the ignition of the inflammable gases, and he went on to ask whether Mr. Inray had not said that it made no difference for what purpose the air was admitted at first into the cylinder, that on the combustion of the explosive, or a combustible mixture, the air would be heated and expand, and tend to utilise that heat which Mr. Inray had said was formerly lost in the walls of the cylinder. Mr. Inray said that was so if the air was admitted and combustion effected in the manner of the plaintiff, but that if it was attempted to admit it in the way described in Lenoir's specification it could not be done, the charge would not ignite unless the contents of the cylinder were arranged as the plaintiff described. Mr. Inray considered that the arrangement of gases in Lenoir's cylinder, according to the description of the engine and its slides, would be next the piston a film of air, then a body of combustible mixture, then next the bottom of the cylinder a quantity of air again. This he said was not the condition of things in the plaintiff's cylinder; that leaving out the question of quantities, the arrangement was not the same, because there was not the same sort of dispersion looking to the way the gas and air entered the cylinder. In Lenoir's arrangement he said the only thing that governed the supply of gas and of air was the movement of a slide valve, while in the plaintiff's a slide valve governed the admission of air while a separate valve governed the admission of gas. Mr. Cunningham remarked that Mr. Inray had not accounted for the absence of stratification. Mr. Inray explained that considerable thickness or volume of air was necessary for the dispersion; that the thin film next the piston did not afford room for dispersion; and that the axial or centre opening in the plaintiff's cylinder admitted a jet of gas into the elastic fluid already in the cylinder, and that dispersion was thus much better effected than by the side entrance of the gas, as in Lenoir's engine. He considered that the time occupied in a stroke in the plaintiff's cylinder would be by no means sufficient for complete diffusion. The rapidity with which diffusion would take place and the extent to which stratification would take place, and the length of time it would continue to exist formed the subject of many more questions than answers; Mr. Inray not admitting that a high speed of piston would tend to more complete mixing of the gases because there would be less time for diffusion. He considered that ignition would not take place in Lenoir's cylinder as described, because the gas was not sufficiently diffused in the air.

In answer to the question, "In your opinion does not the proposal of Lenoir to stratify anticipate the specification?"—plaintiff's 1876—Mr. Inray said Lenoir proposed the crude idea of what he would like to do, but he did not show efficient means of doing it. That he was evidently wrong in his whole idea, and he never made an engine that worked according to that, and never could; and that he found the difficulty, and in the following year took out another patent, in which he corrected that and introduced gas and air at the same time through separate channels and obtained explosion. Mr. Inray considered that any engine in which explosion was the result of the way in which the gas and air were admitted to the cylinder would not be an infringement of the plaintiff's patent, the object of which was to prevent explosion and to use the combustion in a more gradual way. Indicator diagrams were handed in in evidence, and Mr. Inray admitted that from these one could judge whether gradual expansion or explosive expansion took place. The specification of M. P. W. Boulton was then handed in for "Improvements in Generating Heat and Applying it for the Production of Motive-power in Steam, also in Apparatus employed Therein." In this it was stated that the inflammable mixtures might be introduced into the cylinder in which they were used, at atmospheric pressure, or at a pressure exceeding that; and again it said the fluid might be introduced into the charging cylinder at a high pressure. A piston working in a larger cylinder might drive it in compressing it. The bearing of this specification upon the plaintiff's was the subject of many questions and answers. One paragraph of Boulton's specification is—"The charge of inflammable mixture may act in the cylinder into which it is introduced; it may be introduced through various passages; it may be in immediate contact with the air or fluid in front of which it is desired to drive into the receiver, or it may be separated from this by a piston which is propelled by the expansive force of the ignited mixture, and drives the air or fluid into the receiver." Mr. Cunningham said: "The proposition is, instead of driving a piston, to drive air—in fact, an air piston. In other words, Boulton takes the power from the explosive mixture, and receives it upon a quantity of air confined, from which he takes and drives the piston." In answer to this, Mr. Inray said that Boulton drove the air into a vessel, and said that, having got compressed air, it might be used for any desired purpose; and this, witness considered, was totally different from plaintiff's invention, because the plaintiff used his combustion to propel the piston of his engine; Boulton used the combustion to propel a quantity of air into the receiver.

Mr. Cunningham: It is the same purpose?

Witness: You may use it for any purpose you like; you may use it afterwards to propel the piston just as you use steam in any other cylinder.

Mr. Cunningham: That is what the plaintiff does?

Witness: No.

Mr. Cunningham: The expanded air is surely compressed?

Witness: Not in that sense; at all events it is not blown into the receiver.

Questions were put to ascertain whether the witness would distinguish between the force taken from the compressed air according to Boulton's specification and the force taken from the compressed air according to the plaintiff's specification, Mr. Inray answering that they were extremely different, as Boulton proposed to use the explosion to propel a loose piston, which piston compressed air in a receiver, that air to be used if desired to work another piston in another cylinder, while the plaintiff used the combustion of the fluid to propel the working piston of the engine. The witness was then re-examined with reference to Boulton's specification by Mr. Aston, and particularly with respect to a specification of Boulton in 1868, which Mr. Inray described as relating to an engine entirely different from the plaintiff's, but more like the Langen and Otto engine, and having a piston propelled by the explosion, but instead of utilising the vacuum so produced as in Langen and Otto's engine, Boulton proposed to utilise the compression of the air in front of the piston.

Mr. Charles Denton Abel was next sworn and examined by Mr. Lawson as to the importation of the invention and securing the patent for Mr. Otto.

Mr. Bramwell was then recalled and further cross-examined by Mr. Kay. His examination turned on the correctness of the drawing as respects the communication of the gas flame and certain inaccuracies in the letters referring to the parts relating thereto. Mr. Bramwell re-explained the large drawings of these parts. In the plaintiff's specification the slide was said to be regulated by means of a cam or eccentric on the engine shaft. Mr. Kay asked whether it would be possible so to fix an eccentric as to make the slide whilst the piston is rising first go downwards and then go back. Mr. Bramwell said the eccentric would have to be fixed in such a way as to make the slide perform this motion, partly while the piston was going downwards and to come back while the piston was rising. Mr. Bramwell said that this was a common mode of fixing eccentrics in steam engines, and that the workmen could do it without experiment. Further examination referred to the modes of actuating the slide valve. Succeeding questions related to the explosion of an inflammable mixture under a piston connected to a crank shaft, and the loss of effect due to the loss of heat through the walls of the cylinder, this evidence repeating that of Mr. Inray. The cross-examination proceeded upon Johnson's specification of Lenoir's, 1860, invention.

Mr. Kay said, with respect to this Lenoir's specification: There is a description of an engine in which air is first introduced, then air and gas not entirely mixed, which things being introduced exist in distinct strata, and, it is said, the effect of heating the combustible mixture is to heat the air?

Mr. Bramwell: Yes.

Mr. Kay: Does not that do precisely that which you say—does it not describe precisely that which you say is the pith and marrow of the invention?

Mr. Bramwell: Yes, those words are applicable to the pith and marrow of the plaintiff's invention, taking the words by themselves, irrespective of what is to be found elsewhere in the specification.

Proceeding with the above question as to heating the air, Mr. Kay said: And the pressure produced, that is the pressure produced by the explosion and expansion, operates on the piston so as to force it to the opposite end of the cylinder. Now is not that precisely the operation which you say is the pith and marrow of the invention in this case of the plaintiff's patent?

Mr. Bramwell: Those words are quite applicable to that which is the pith and marrow of the plaintiff's invention, but they are no disclosures of it.

The cross-examination continued on modifications shown in the drawings and shown in the specification, relating to the methods of introducing—First, air, and then air and gas, without pressure; Secondly, doing the same with pressure outside the cylinder; and, Thirdly, doing it by pressure inside the cylinder; the witness coupling with these alternatives the use of the residuum in conjunction with the air. No claim was made for the second modification, but witness considered it was covered by the first. Mr. Bramwell did not consider that compressing in the cylinder was old in fact at the date of plaintiff's specification, though it might be in description.

Mr. Bramwell was next re-examined by Mr. Aston, who asked whether witness knew of any prior specifications wherein there was compression inside the cylinder of the gas engine. Witness said that of Barnett in 1838 proposed to obtain compression inside the cylinder of an engine, but he had so constructed his engine that by no possibility could the charge ever have got into the cylinder at all for the purpose of being compressed. Witness could not therefore, he said, answer yes or no whether there was compression inside the cylinder. He then referred to Boulton's specification, 1868, saying that he did not think it was a gas engine in the proper sense of the term at all.

Mr. Nicolaus August Otto was next sworn and examined through Sigmund Hayman, sworn interpreter, by Mr. Hemming. He explained that the essence of his invention, 1876, was to bring

together in a cylinder a combustible mixture of gas and air to separate it from a charge of incombustible fluid. He explained that there were two modifications of his gas motor engine, the one to work without compression, the other to work with compression. There was only one mode of getting the compression, but since the patent he had made an engine which drew in compressed air; but this machine, he said, did not work as well as the others. He had made an engine according to the first description in his patent, but had never sold one. Mr. Kay was cross-examining Mr. Otto, when the interpreter said he must resign, because he could not translate the technical expressions. It was proposed that Mr. Abel should interpret, but to this Mr. Kay objected. After some persuasion the interpreter resumed. The witness was asked whether, in the patent taken out through Crossley, the stratified condition of the combustible charge was not dispensed with, and a uniformly diluted charge used instead of first introducing air and then a mixture of gas and air. The answers, however, were not satisfactory, and the Vice-Chancellor said that more help would be obtained from the specification.

M. F. W. Crossley was next called and examined by Mr. Aston. The first part of his examination related to the 1876 patent, the plaintiff's business relations with Otto, and the subsequent patents taken out by Crossley and Otto and by Mr. Crossley alone. Mr. Crossley stated that over 2000 engines had been made, and that the pith and marrow of the invention was as described by the witness called on plaintiff's behalf, namely, the admission of a charge of combustible mixture in the presence of incombustible fluid, both being admitted into the cylinder, then compressed and then fired, and upon this principle the 2000 engines had been made. Mr. Crossley had from time to time made improvements, but not of a material character. One improvement rendered ignition more easy and certain, and consisted in drilling a hole in the slide through which gas passes to the lighting frame, so that the gas passed to the lighting frame a moment earlier than the flame came in contact with the charge within the cylinder. This caused the flame to burn a little more strongly, and made ignition more certain.

In cross-examination, Mr. Kay asked if the 2000 engines or any of them had been made according to witness' own patents, and Mr. Crossley answered that none of them had been made without one of the improvements described in his own patent specifications. Questions then followed asking which were Mr. Otto's and which Mr. Crossley's parts of the joint patents, and what the licence under which plaintiff used Otto's invention. Witness said the licence was an agreement which came into operation at the date of the 1876 patent. A previous agreement had been made in 1868. Mr. Kay then read from the 1876 patent, No. 2081, that part which described the mode of admission and character of the charge and nature of the combustion, and asked if that was a correct description of the essence of the invention; the witness said it was. Mr. Kay then referred to the 1877 patent, and read: "It has been found that this stratified condition of the combustible charge is prejudicially affected if the peculiar tapering form of the cylinder described in the said specification be departed from, as also if the speed of the engine be varied," and asked: Is that a true statement? Answer: Yes. Mr. Kay then further read: "Now according to our present invention, we dispense with the said stratified condition of the combustible charge, and introduce into the cylinder a uniformly diluted charge, that is, combustible gas mixed uniformly with a greater proportion of air than is necessary for its perfect combustion, so that the entire charge is of a slow burning nature," and asked if that was an improvement upon the stratified charge. Mr. Crossley said it was an improvement so far as the combustion of the charge was concerned for small engines, but not for large engines. Mr. Kay then read from the specification that which related to the ignition and burning of the charge, and asked if the rapid combustion then referred to was better than the gradual combustion produced by the stratified charge; and Mr. Crossley said that it was not, but that it was a more certain means of obtaining that degree of combustion which was the most desirable degree; that it was the same in principle, but it carried out the principle in a more perfected and practical way. Mr. Kay asked if after the 1877 patent was taken out the engines were made according to the patent of 1876. The witness answered that he had made large engines in which the air was first introduced, and then the combustible charges. Mr. Kay asked if the mixture was compressed in all the engines witness had made, and he said in all but one, which was made recently to show the scientific witnesses.

The witness was next asked in what respect defendants' engine was an infringement of his, and he answered that the cycle of operations was practically the same, the arrangement of the charge was practically the same, the gradual dispersion of the gas—the combustible mixture—amongst the incombustible mixture was the same, and that the use of a space for the mode of compression was the same.

There-examination by Mr. Aston proceeded on the points dwelt upon by Mr. Kay respecting the stratified and uniform charges, witness saying that combustion would be slower with the uniform charge than with the stratified, and the words "rapid combustion," referred to by Mr. Kay, applied to the arrangements adopted to obtain a sufficiently rapid combustion of the charge when the slow burning charge was used, and that the charge described in the 1877 patent specification was practically the same as that of the 1876 patent; the 1877 specification described the charge as having a richer and stronger mixture next the point of ignition, and that dispersion remained practically like that of 1876, but was more perfect. Mr. Aston then notified to the Vice-Chancellor that that would be his case, but that he thought he need not occupy time by summing up then; he would have a general reply.

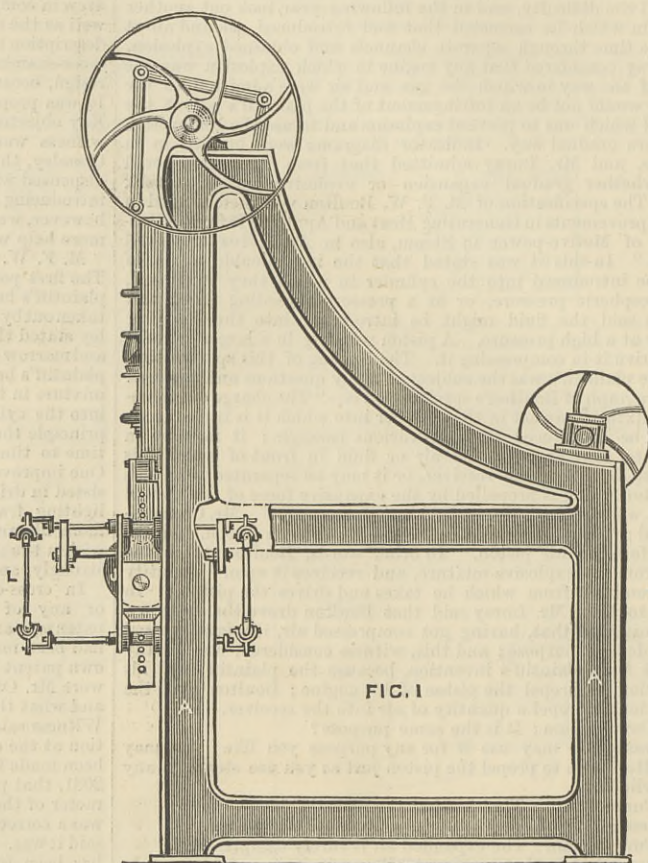
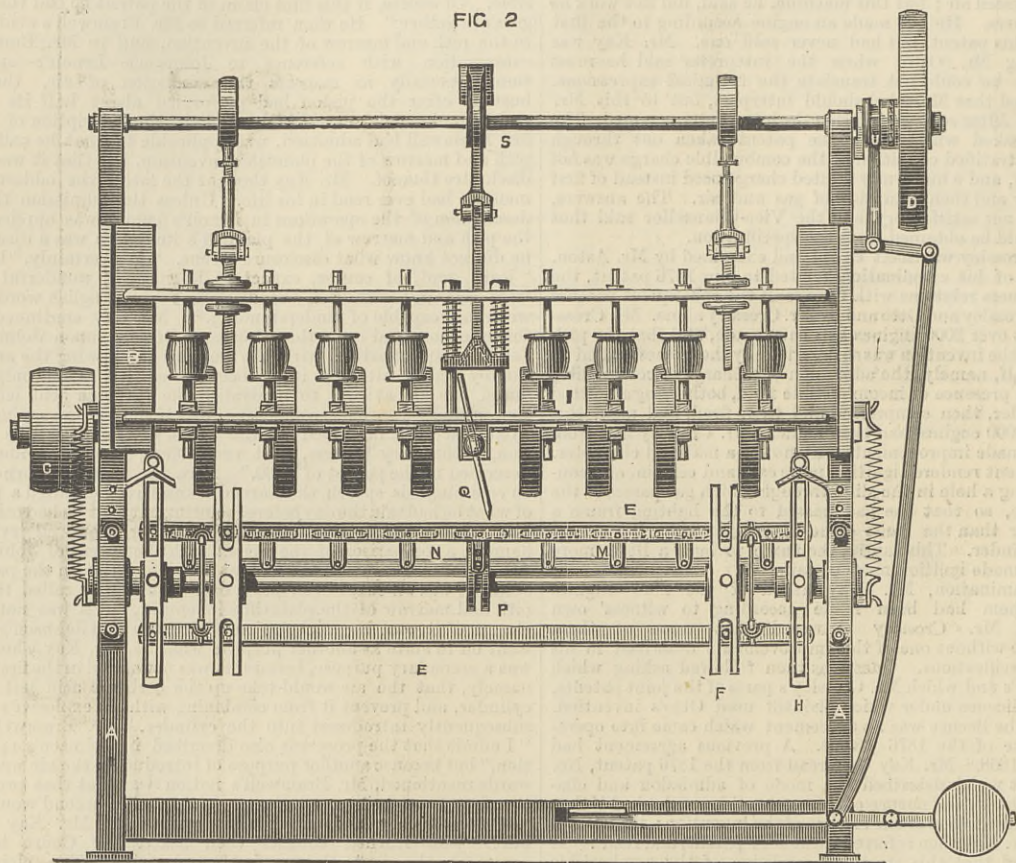
Mr. Kay thought that would be the better way, and proceeded to open the case for the defence. He said the case had opened with a great deal of irrelevant evidence, and that they had had eminent engineers put into the witness-box for the purpose of doing that which was not their province, namely, to construe specifications, and to read specifications at length, in order to enable them to give their opinion on them, which was after all a matter which has to be determined by the Court. The meaning of every specification was a thing which the Court had to decide for itself upon the construction of the words unless there were some terms in art which required explanation in evidence by a skilled witness. They had there a patent which described three modes of making gas engines. The first mode was a mode which had never been practically used at all, but it was a mode which was claimed. Mr. Kay next referred to the answers to interrogatories describing a gasometer engine made but not sold, in which the particles of combustible mixture were more or less dispersed, and the combustion of the whole charge took place gradually as described in the specification, such an engine having been made in 1875 at Deutz, and that this was the plaintiff's case. The first modification which was the subject of the first claim had never been sold, and it was perfectly useless. The first claim he said was for a particular mode of introducing first air, then combustible mixture into the cylinder, that there was to be no compression, and that was the only difference between it and the other claims. In the second claim there was to be compression outside the cylinder, for which no claim was made; and in the third claim there was to be compression of the same kind of mixture in the cylinder itself. Those were the three things, but of those three only two were claimed. Referring to the first claim, he had put it to the witnesses for the plaintiff whether there was anything special in the mechanism shown in drawing No. 1, and he had said there was not. Mr. Kay then went fully into the evidence of Mr. Bramwell respecting this mechanism and the admission of the charge, the combustion and expansion of the charge, and the question of converting the heat lost in previous engines into work, instead of its being absorbed by the walls of the cylinder, saying that Mr. Bramwell and the other scientific witnesses had dropped the notion of there being any gradual combustion, but that the merit of the invention was the use of heat that would otherwise be lost. He considered that everything turned upon this, and he put it to his lordship that this was the whole of the plaintiff's claim, for the machinery which related to

this claim, Mr. Bramwell had said, had no novelty in it at all. That claim, he continued, was for the use of that machinery for introducing first air and then combustible mixture; and the merit and advantage was the utilisation of the heat which would be otherwise lost by expanding that air which was first introduced into the cylinder. Now, Mr. Kay said, "the question is whether it is possible. Of course, if this first claim in the patent be bad the patent goes altogether." He then referred to Mr. Bramwell's evidence as to the pith and marrow of the invention, and to Mr. Bramwell's examination with reference to Johnson's—Lenoir's—specification, especially as respects the admission of air, the combustion after the piston had performed about half its stroke and the subsequent expansion of the air, the description of which, Mr. Bramwell had admitted, was applicable to what he called the pith and marrow of the plaintiff's invention, but that it was not a disclosure thereof. Mr. Kay thought the latter the oddest statement he had ever read in his life. Unless the admission that the description of the operations in Lenoir's engine was applicable to the pith and marrow of the plaintiff's invention was a disclosure, he did not know what disclosure means. "We certainly," he said, "learn, and, of course, expect to learn, most wonderful things from scientific witnesses, but disclosure is an English word which we are all capable of understanding." Mr. Kay continued upon this question, and upon the evidence as bearing upon Johnson's—Lenoir's—specification, with the purpose of showing the anticipation by Lenoir, although it had been stated that Lenoir only introduced the air at first to neutralise the carbonic acid left from the preceding stroke, concluding on this day by saying that what had been described as the merit of the plaintiff's invention, "that very process, that very effect, was the prime thing described in the patent of 1860." Here the Court adjourned, and on resuming his speech the learned counsel recapitulated a portion of what he had said the day before, pointing out that he had called the attention of the Court to a legitimate point in Mr. Bramwell's evidence, namely, a comparison of the patent with the patent of Johnson or Lenoir. Mr. Bramwell stated that the description in the patent of Johnson was an exact description of that which he called the very pith and marrow of the plaintiff's invention, but it was not a disclosure of it, and the explanation of this was that Johnson's patent went on to state as another purpose what he, Mr. Kay, should say was a secondary purpose, because it was not stated in the first place, namely, that the air would take up the carbonic acid left in the cylinder, and prevent it from combining with the explosive mixture subsequently introduced into the cylinder. Mr. Bramwell said, "I admit that the process is also described in Johnson's specification," but because another purpose of introducing the air was afterwards mentioned, Mr. Bramwell's notion was that that prevented the first from being a disclosure, because the second would lead you to another as well. This seemed to Mr. Kay to be idle. The learned counsel then asked the Court to look again at the first claim of the plaintiff. The claim was virtually for admitting to the cylinder a mixture of combustible gas or vapour with, in a separate form, a charge of air or incombustible gas. The effect of this process was a separate thing; but the process was described in the claim. The plaintiff's claim was not for a machine, there was no description of a machine or reference to one; it was a claim to do a certain thing, no matter how it was done. On this point Mr. Kay dwelt at considerable length, enforcing his arguments by quotations from Mr. Aston's speech, and from the plaintiff's specification. The claim was a claim to have a patent right for introducing air into a cylinder, and combustible gas mixed with air separate from the first introduced air for the purpose described. If that claim were valid it would be infringed by any gas engine in the world in which that was done. The Court would have to consider whether it was possible to have a patent for a thing of that kind. If there were any meaning in words, it was a claim for a principle and not for a machine, and it was not possible, according to patent law, to have a patent for a mere principle, disconnected from a particular mode of applying it. On the face of it, all questions of novelty apart, this was a bad patent, because it was for a principle. The claim was too wide. The plaintiffs said to the defendant, "Although your machine is widely different from ours and any other gas engine ever made, you are introducing first air and then gas, and therefore, for that reason amongst others, you infringe our patent." Mr. Bramwell admitted that the plaintiffs' own drawings showed an ordinary cylinder and slides, with nothing special about them at all; yet they claimed by this patent, which, as explained by their own scientific witness, was only a patent for a process, that the defendant infringed—a contention which could not be maintained. Mr. Kay next quoted at length from 4th D. Gex, Fisher and Jones, page 293, to the effect that the construction of a specification belongs to the Court. This portion of the learned counsel's speech was strictly on a point of law, and was intended to prove, by a decision of Lord Westbury, that a specification is of necessity a publication, because the very object of a specification is to make the invention described public. It is the condition upon which a man gets his patent that he shall make his invention public, so that an ordinary workman, seeing the specification, would be able to make the very thing, or to understand the process, and carry it out. When a man has done that, it is entirely impossible for him to say, "I have not published my invention." "I apprehend," said the Judge, "that the antecedent statement must be such that a person of ordinary knowledge of the subject would at once perceive, understand, and be able practically to apply the discovery without the necessity to make further experiments, and gain further information before the invention can be made useful." Mr. Bramwell stated that Fig. 1 in the plaintiff's specification was inaccurate, but that such was the state of knowledge that any ordinary workman could correct the error without difficulty. The error was a very peculiar one, such that gas and air could not be drawn in together through that slide. The answers given by Mr. Bramwell were precisely what he, Mr. Kay, wanted. Mr. Bramwell thought that he was beating him, but he, Mr. Kay, could not have thanked him more heartily than he did in his mind for those replies at the time. In the drawing was shown no cam or eccentric to work the slides, nor a word of description of them, but Mr. Bramwell said such things were not wanted in a specification; that they were matters of ordinary knowledge. "Once you explain that you want to get in first air, and then gas and air, into the cylinder of a gas engine, any ordinary workman will do it for you." Therefore, Mr. Kay held, Johnson had described in his patent that his object was to introduce air, and then gas and air, and that the effect would be that when explosion took place the air would be expanded by the heat. All this went to prove that the plaintiff patented not an engine but a process, and this process had already been patented by Johnson in anticipation of Otto; and Johnson's patent was better than Otto's in that it showed how the principle was to be applied, while Otto's did not, leaving the matter to the intelligence of the workman. But Mr. Bramwell said that Johnson's specification was mechanically incorrect. He, Mr. Kay, cared nothing for that; so was Otto's. On Mr. Bramwell's own showing any ordinary workman could do by Johnson's patent what he could do by the plaintiff's—correct the errors and make a machine which would work. His, Mr. Kay's, points were two; firstly, the plaintiff claimed not a machine, but a process; and, secondly, that the process was not novel, having been first patented by Johnson.

The learned counsel then reverted to Mr. Bramwell's contention that the object of introducing air into the cylinder, as stated by Johnson, was to neutralise the carbonic acid gas which might otherwise prevent explosion, and that this was a different purpose from that of the inventor in introducing air, contending that this was only a secondary purpose of Johnson's, and could not possibly affect his great purpose in any way. If Johnson had claimed only the introduction of air for the purpose of dealing with carbonic acid gas, another man could not get a patent for the introduction of air for another purpose. "You have been stirring tea with a teaspoon all your life to mix the sugar; another man says, 'I will

[For continuation see page 238.]

BRUSH AND BROOMHEAD BORING MACHINE.



NEARLY all brush and broomheads have, until recently, been drilled by means of a small headstock carrying a short, rapidly revolving spindle and a boring bit, varying in size according to the size of the brushes or brooms to be bored. The headstock is covered in and the operative leans over the headstock, his chest pressing against the cover at the back end of the spindle. He holds the broom or brush head in his two hands and pulls it towards him against the boring bit, and thus bores the holes at the rate of from 40 to 100 per minute. The work is rapidly done by experienced men, but in boring broomheads and large brushheads a great saving of time is effected by means of the machine we illustrate herewith. The machine is made by Mr. H. J. C. Keymer, Great Yarmouth, who is also the patentee. The cost of boring brushheads by hand varies from 4d. to 1s. per thousand, but it is only a small part of this when the boring is done by the machine, and the very heavy work of boring large brushes, causing continued pressure upon the chest in a stooping position, is avoided. The machines have now been at work several months, and one or two are at work at the brush manufactory of Messrs. Ludbrook and Co., Government brush contractors, Harford-street, Mile End.

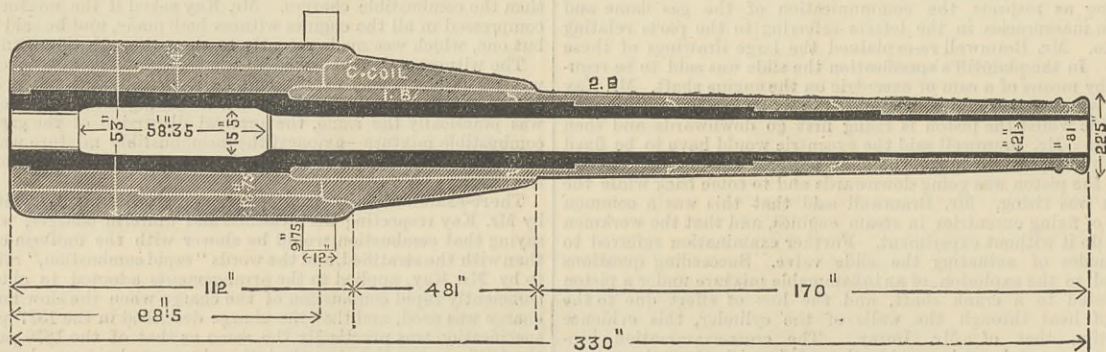
In our illustrations Fig. 1 represents a side elevation of the machine; Fig. 2 is the complete front elevation; and Figs. 3 and 4 represent longitudinal and end views of work or brush-

holder M; all holders M are also connected by bar N. It will thus be seen that when one of the work holders is tilted the frame E moves longitudinally, and the whole of the work holders are thus tilted and brought directly under each drill spindle, and the angle of all the holes will be the same. The holder M in the centre of the frame E holds the required pattern of work to be done, or a dummy brushhead covered with a plate of iron, while the holders on each side of the centre hold blanks to be operated upon. For the purpose of bringing each hole of the template, and through it the proper position of the successive holes in the eight heads, a very simple but ingenious device is employed. A pointer rod Q, pivotted in a ball in a cylindrical socket, is directed by the attendant to the hole next to be drilled. The hollow cone R then descends upon the

upper part of the pointer rod, its motion being communicated by the cam S, causing the rod to assume a position parallel to and in a line with the drill spindles. All head holders M are thus tilted and the holes drilled by the further descent of the drill frame, which receives its motion from the eccentrics, on the shaft D thrown in or out of gear by the clutch V and connections T.

Figs. 3 and 4 show the frames of the holders M; *b b* are jaw bars pivotted at their lower edges, and provided with points or pins *f* to grip the blanks; *c c* are levers fixed to *b b*, and pivotted nuts are attached to the right and left-handed screws and hand wheel *e*. The periphery of the hand wheel *e* works in a groove in *a*, and thus causes both jaws to be operated upon by screws *c*. Fig. 4 is a plan of one of the holders M.

THE NEW 43-TON BREECH-LOADING GUN.



In the above engraving we give the principal dimensions of the new 43-ton breech-loading gun tried at Shoeburyness on the 16th ult. We gave a brief account of the firing of this gun in the Royal Arsenal in THE ENGINEER for January 14th. The Shoeburyness trial related to accuracy at comparatively short ranges over water, the long ranges over the sands not being available just now, owing to a legal question which has been raised with regard to a certain portion of them. Accuracy can, however, be tested at targets firing over water. This is specially desirable on account of the form of rifling under trial. The form of groove is peculiar, being much eased away from the driving edge to obtain contact as far as possible in that part where it is not secured by the pressure due to driving. We mentioned the fact that with a projectile weighing 703 lb., and a charge of 300 lb., a velocity of 1930ft. had been obtained. The charge of 285 lb., with a projectile 714 lb. weight supplied to Shoeburyness, of course entails a rather lower velocity.

The breech-loading fittings are not shown in section; they are of the same form as those of the smaller breech-loaders recently made in the gun factories—see THE ENGINEER of October 29th and June 25th, 1880—except that mechanical power is employed for moving the breech-piece. A winch is applied to a quick-pitched screw to draw back the breech-piece, a slow screw being provided for use if necessary to start the movement after firing. The locking lever is moved through the necessary angle by the application of the same winch handle to a train of three pinions working on a toothed arc fixed on the breech end of the gun, on the same principle as that shown in the end view of the Spanish breech-loading gun in Fig. 7—see THE ENGINEER of July 30th last. This gear has worked excellently hitherto.

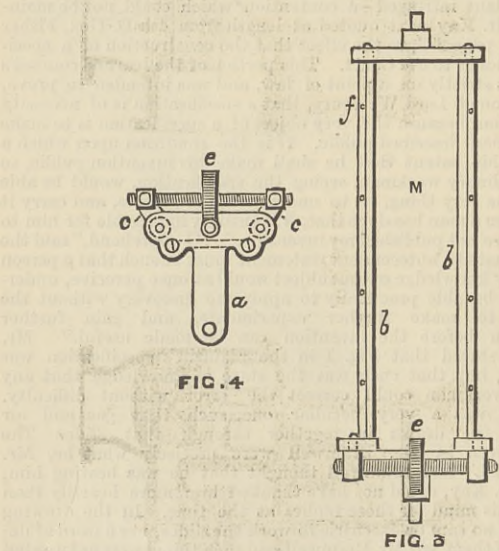
The gun is now mounted on a carriage with a peculiar form of yoke, suggested by the Engineer Department with a view to holding the slide down, taking the place of a pivot. There is an alternative method, we believe, designed to meet the same end. This matter, indeed, is as yet in a very imperfect state of development. As regards power, as we have before remarked, this gun is very successful. The stored-up work with the shot and velocity above mentioned, is about 18170 foot-tons, the penetration being equivalent to a plate of somewhere about 23in. thick. It was at one time hoped that a carriage with a new brake, designed by Mr. Vavasseur, might have been tried with the 6in. new type

Armstrong gun, but it is not yet quite ready. We propose to give a description of it shortly.

When the 43-ton B.L. gun was fired at Shoeburyness on March 16th, a velocity of 1850ft. was obtained, accompanied by a pressure of only 17.3 tons. The actual charge was 286 lb., the chamber being found to hold one more pound than was reckoned on. The yoke employed to replace the front pivot acted very well.

LEEDS CIVIL AND MECHANICAL ENGINEERS' SOCIETY.—The ordinary fortnightly meeting was held on the 25th inst., at the Yorkshire College, Leeds, the chair being occupied by Mr. G. F. Charnock, vice-president. An interesting paper on "Pumping Engines" was read by Mr. F. W. Armitage, in which the author pointed out the improvements that had been made from the time of the earliest pumping engines. There was a large attendance, and a long and animated discussion followed the reading of the paper. On the motion of Mr. C. M. Dorman, seconded by Mr. A. Beard, a cordial vote of thanks was given to the author of the paper.

THE CITY OF LONDON DIRECTORY FOR 1881.—We have received a copy of the eleventh annual issue of the "City of London Directory." This directory and guide is now widely known, but a few of the chief features may be mentioned. It contains a street list, clearly arranged; every house, occupier, and the business carried on is given, and the floor occupied, the latter being indicated by 1 fl., 2 fl., &c., and an alphabetical list, gives the name, address, and business of everybody in the City. There is a banking, insurance, and public companies' list, and in this section is given particulars of all the banks, life and fire insurance companies, monetary and finance companies. The trades list is unusually complete, and the classification concise. The conveyance directory is a ready reference guide to the despatch of parcels and goods to all parts of the suburbs, and to all towns of importance in the United Kingdom, but we still miss the list of all cities, towns, and villages in the kingdom, with their railway connections and distances from London. A considerable section is occupied by the livery companies of London, and a list of liverymen who have votes for the City. There is also a list of railway officials. A coloured map gives the parish and ward boundaries, with alterations to date of issue. There is also a list of bankrupts, and of traders who have compounded with their creditors during the past year. The directory is published by W. H. and L. Collingridge, at the City Press office, 154, Aldersgate-street, London, E.C.

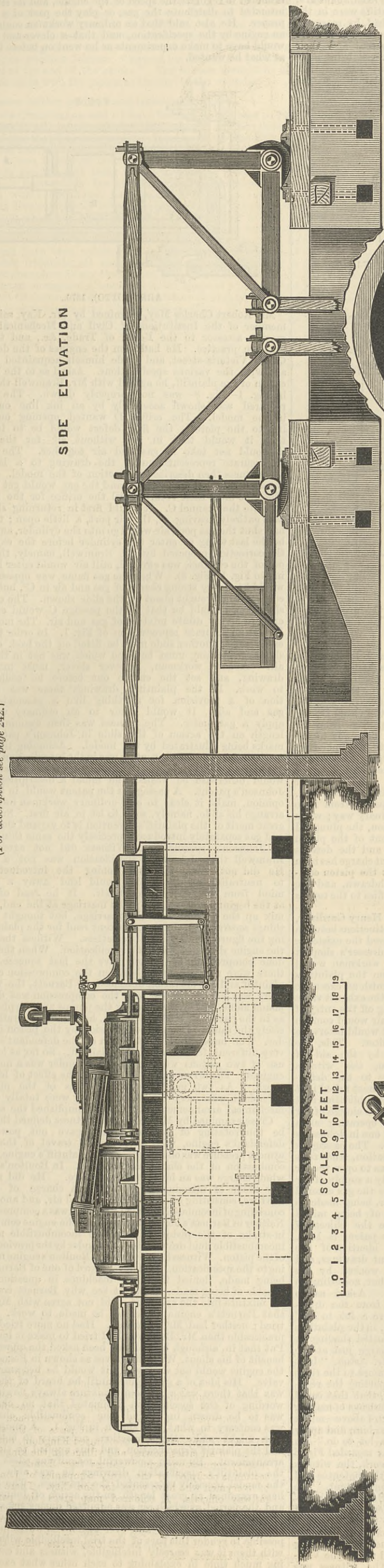


head holders M. In these illustrations A represents the frames of the machine; B is a head with vertical reciprocating motion carrying eight drill spindles, which are driven by straps from the driving shaft and pulleys C. The head B receives its motion from and through the shaft D, pulley D, and eccentrics E. E is a pair of frames, the upper of which carries within its two horizontal main members a number of work holders M—see Figs. 3 and 4. The transverse connecting bars of the lower frames E have formed in them, at mid length, balls which rest and work within sockets in the main levers F. These levers are pivotted on joint pins, so that they may take angular positions in the plane of the front elevation. G is a shaft capable of vertical parallel movement in bearings J, and to this axle the main levers F are also jointed. Upon sliding bearings J work guide levers H, which are jointed in the centre, and receive motion similar and simultaneously with F or G. In the top ends of the slotted levers H runners are affixed, which rest upon pieces I which are fixed to the frame. The levers H also carry runners K, upon which rest and work the frames E. The frames E being held parallel by universal jointed rods L, the work holders M are caused to tilt to or from the centre lines of the drill spindles. This motion is necessary in order to drill the holes in the brush head normally to the head at the centre and gradually divergent towards the edges of the head, so that the bristles spread out and make the brush or broom much wider than the head. On the centre of the shaft G are fixed two discs or plates P, between which the shaft G are fixed two radius rods attached to the tail end of the centre work or pattern

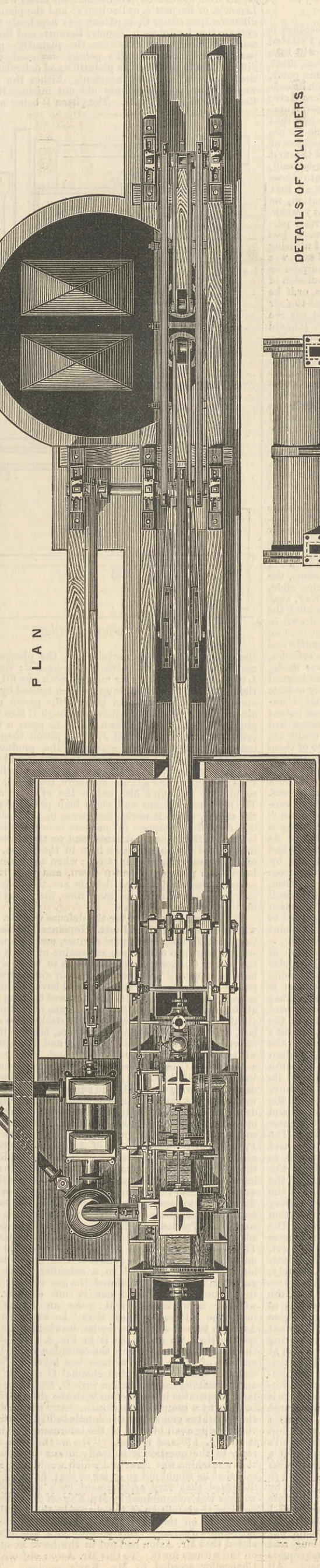
PUMPING ENGINE AND WINDING ENGINE DETAILS, KAI-PING COLLIERY, CHINA.

MESSRS. HATHORN, DAVEY, AND CO., LEEDS, ENGINEERS.

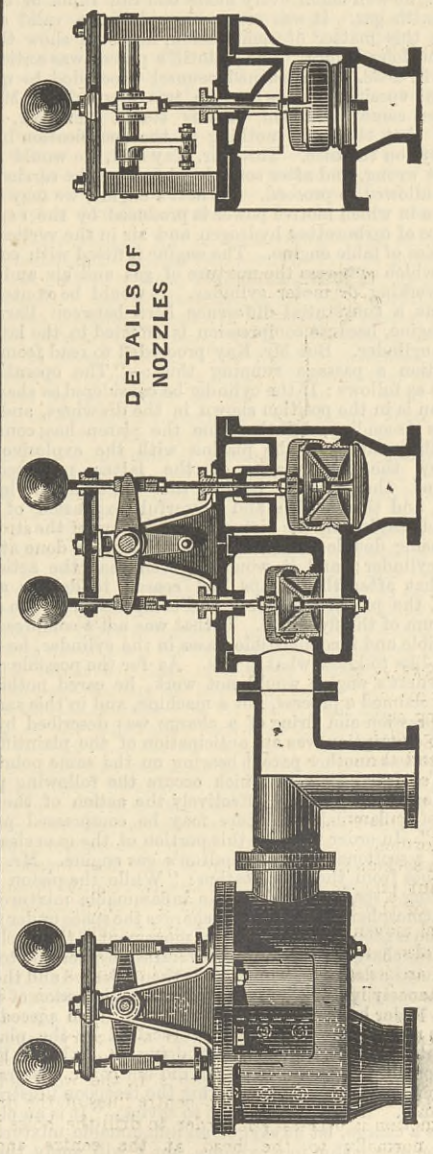
(For description see page 242.)



SIDE ELEVATION



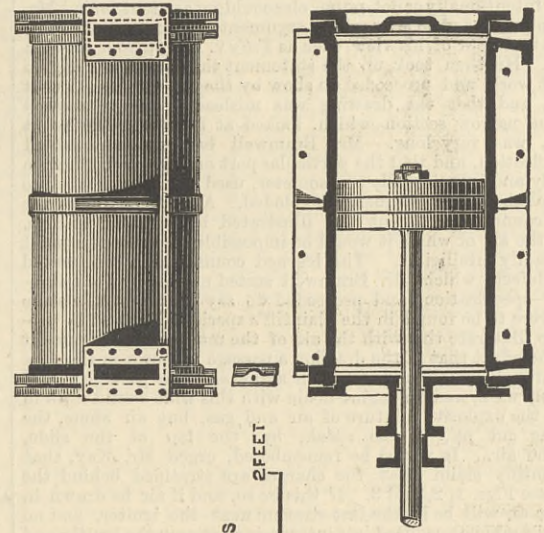
PLAN



DETAILS OF NOZZLES

SCALE FOR NOZZLES

12 9 6 3 0 1 2 FEET



DETAILS OF CYLINDERS

SCALE FOR CYLINDERS

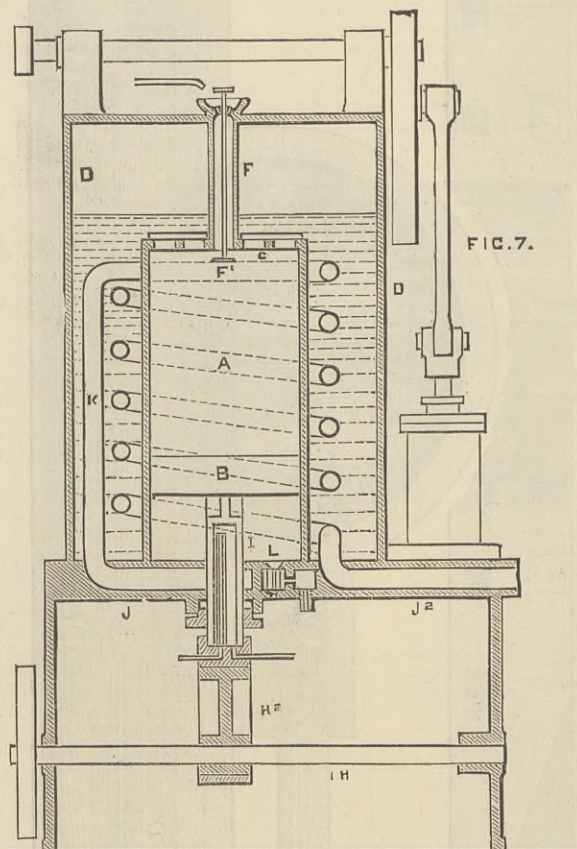
12 6 0 1 2 3 4 FEET

LEGAL INTELLIGENCE.

[Continued from page 235.]

take out a patent for stirring the tea with a tea-spoon, because it mixes the milk too." "Well, but it mixed the milk when I started it." "True, but you did not know that, and therefore I will take out a patent." This could not be done. They had a case, *Bush v. Fox*, in the House of Lords which bore precisely on this point. A man patented a caisson for hydraulic operations, in which he constructed compartments, and into these compartments he forced air; the pressure of the air kept the water out of the compartments. This was a new and a very valuable idea, but it turned out that another man, Lord Dundonald, had before made a caisson for use on land in which air was forced into compartments. The idea of using this caisson for working under water never entered the first patentee's head. Nevertheless, the House of Lords said, "He has made a caisson with chambers, and into these chambers he has described the forcing of air; you do all that and you do not do anything more, and there is invention, no doubt, in your case, because your apparatus is different; but you cannot get a patent for the same thing to be used for another purpose." Supposing that Johnson's—Lenoir's—patent were less explicit than it was, and there was omitted all mention of utilising the waste heat by expanding the air, which, Mr. Bramwell said, was the whole merit of the invention, and that the only purpose he described was the taking up of carbonic acid by the admission of air; still, if he did admit air, and then exploded the gas, or if he described the effect, although he might not know it, that the air would be expanded by the explosion of the gas, he could get the advantage just as in the teaspoon matter mentioned just now. If he did the thing intentionally or not, no one else could get a patent for it. Mr. Kay then proceeded to support his argument by citing various legal decisions in favour of his view, such as *Telly v. Easton*, and *Ralston v. Smith*. He then took up the statement that Johnson's engine could not work, and proceeded to show by the aid of a model that it could, and that the drawing was misleading, as it showed a port in narrow section which, looked at from another point of view, was very long. Mr. Bramwell had not understood the specification, and that the particular port or passage in question was really and intentionally a gasometer, used to hold the mixture of gas and air to be subsequently exploded. All this portion of the learned counsel's argument was illustrated by sectional models, without the aid of which it would be impossible to make the point raised readily intelligible. The learned counsel then commented on the defects which Mr. Bramwell stated existed in Johnson's—Lenoir's—specification, and proceeded to say that just the same defects were to be found in the plaintiff's specification, and he proceeded to illustrate this with the aid of the model. His argument was to the effect that in the drawing a passage is shown in the slide valve, through which is admitted air and gas. This passage is not sufficiently wide, and an engine made with this slide would draw in last, not the explosive mixture of air and gas, but air alone, the gas being cut off, so to speak, by the lap of the slide, before the air. It would be remembered, urged Mr. Kay, that the plaintiffs claim that the charges are stratified behind the piston—see Figs. 1, 2, and 3. If this be so, and if air be drawn in last, then air will be in the last stratum next the igniter, and no explosion could be produced, air interposing between the igniter and the explosive mixture, which would be further on in the cylinder. The defect was so serious that only two machines were ever made, and none ever sold according to that construction. The learned counsel then proceeded to argue that the case was entirely outside that of *Murray v. Clayton*, in which it was held that a unworkable machine, not a process, being patented, that patent was not an anticipation; indeed, the plaintiff's own witnesses had not attempted to argue that Johnson's—Lenoir's—engine could not be made, for Mr. Bramwell admitted that he had seen two of them at work. He then went on to deal with the remaining clauses of the plaintiff's patent, considering that the second, which was for compressing the mixture of gas and air, was far too wide to be a good subject for a patent, being, in short, a claim for a process. The plaintiff virtually said, "I claim every mode you can conceive of compressing gas in a cylinder by the stroke of the piston;" a man might well claim every mode one can think of of filling a balloon with gas. It was much too wide for a valid claim. As regarded this matter of compression, he could show that it had been done long before. The plaintiff's patent was anticipated by Barnett in 1838. The learned counsel proceeded to quote from Barnett's specification, when he was stopped by Mr. Aston, and after some discussion, it was stated that Mr. Bramwell had said that there was nothing in the specification in question which bore on the case. This, Mr. Kay said, he would proceed to show was wrong, and after some legal fencing, he carried his point and was allowed to proceed. Barnett's engine, we may explain, is an engine in which motive power is produced by the expansion of a mixture of carburetted hydrogen and air in the vertical cylinder of a species of table engine. The engine is fitted with compressing pumps, which compress the mixture of gas and air and deliver it to the working or motor cylinder. It would be contended that there was a substantial difference here between Barnett's and Otto's engine, because compression is effected in the latter in the working cylinder. But Mr. Kay proceeded to read from Barnett's specification a passage running thus:—"The operation of the engine is as follows: If the cylinder be considered as charged when the piston is in the position shown in the drawings, and that the piston is ascending, by the time the piston has completed its ascent, the contact of the platina with the explosive mixture, aided by the compression of the latter produced by the ascent of the piston, causes the mixture to ignite and explode, and the sudden and powerful expansion of the gases thus produced impels the piston to the bottom of the stroke." The engine being double-acting, the same thing was done at each end of the cylinder; and it would be seen that the action was so timed that after the pumps had ceased to deliver air to the cylinder, the piston completed the compression by the aid of the momentum of the fly-wheel. If that was not a compression of the combustible and incombustible gases in the cylinder, he—Mr. Kay—would like to know what it was. As for the possible contention that Barnett's engine would not work, he cared nothing. The plaintiff claimed a process, not a machine, and in this same process the compression and firing of a charge was described by Barnett, and that description was an anticipation of the plaintiff's patent. But there was another patent bearing on the same point, namely, Boulton's, dated 1868, in which occurs the following passage:—"In order to utilise more effectively the action of the heat, the charge of inflammable mixture may be compressed previous to ignition." In order to make this portion of the case clear, we give in Fig. 7 a sectional view of Boulton's gas engine. Mr. Kay went on to quote from the specification:—"While the piston is moving and leaving a space behind it, the inflammable mixture enters at or near atmospheric pressure, and charges the space under the piston. The piston is then drawn back by the movement of the catch rod, compressing the charge to a pressure of several atmospheres, or to such pressure as may be desired. The catch is then released and the charge is simultaneously ignited." Here they had compression of the charge in the cylinder by the action of the piston. He agreed it was a different mode of doing it to that described by the plaintiff, but the plaintiff claimed every mode of doing it. As to Mr. Bramwell's contention that compression of air did not cover compression of a specific charge, that would be taking the teaspoon illustration with a vengeance. It was tantamount to saying, "It is an old thing to compress a charge, let us say, of an inflammable mixture only, by the action of a piston in a cylinder, but I will apply the principle to a charge of first air and then inflammable gas and air, and I will get a patent for that," which would be quite idle; and he was surprised that a man of Mr. Bramwell's experience should put forward such a proposition. Mr. Kay brought his long and eloquent speech to a conclusion by saying that he would not trouble the Court by saying much on the question of infringement. All

he would say was that the Linfood gas engine was widely more different from the Crossley engine than the latter was from Johnson's, Lenoir's, or Barnett's, or Boulton's; and the plaintiffs were in the dilemma that either their patent was hopelessly bad, by reason of anticipation by Johnson, Lenoir, Barnett, and Boulton, or if there was such a difference between the plaintiff's patent and their patents, that the plaintiff's patent was good, there being more difference still between the plaintiff's and defendants' patents, then the latter was not an infringement. Either the plaintiff's patent was bad, or the defendants did not infringe it. We illustrate Boulton's engine in Fig. 7. The piston B being at the bottom of

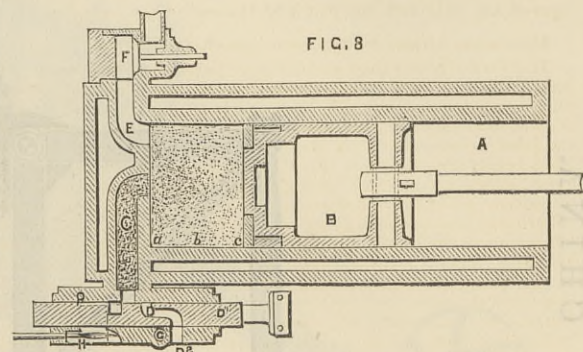


BOULTON, 1868.

the cylinder A, which contains air, the plunger I is caused to rise by the cam H², and with it the piston B; the double valves in L rise, and atmospheric air mingled with gas fill the space under the piston, the inflammable gas is then ignited by the aid of a cam on shaft H. The explosion propels the piston upwards, and the air and water above it are driven through C into the vessel D; the plunger I being drawn down so as to open a passage from the cylinder A to the channel J. The piston then descends to the bottom of the cylinder, expelling the product of combustion through the coil K, which heats the water and generates steam, which rises to the upper part of the boiler. As the piston descends the valve opens and admits air above the piston. The feed-water supplied to the cup F also enters the cylinder and lubricates it. The mixture of steam and air at high pressure passes from D to the engine, which it works like steam in the ordinary way; when it is desired to compress the mixture before ignition, the plunger I is fitted with catches or detents, and on the descent of the piston it is moved up and enters a hole in the piston, and the detents catch on projections in the piston; when a sufficient charge has been taken, the plunger is drawn down, and with it the piston compressing the charge. The detents are then withdrawn, and the charge being ignited at the same time, the piston flies to the top as before described.

The first witness called for the defence was Mr. Henry Gardiner, who was examined by Mr. Brett. He pointed out distinctions between the plaintiff's and defendants' engines, and he proved the existence several years ago of a Lenoir gas engine at a hair dresser's shop at the foot of Chancery-lane. Asked as to what a workman would have to supply if he tried to make an engine from the plaintiff's patent specification, he said he would have to furnish an eccentric or cam, to work the slide, and a means of opening the exhaust valve at the proper time, and also some means of cutting off the entry of air after the valve had completed its stroke, also air would come in last, and ignition would not take place, because it would intervene between the inflammable mixture and the igniter. This, the witness explained very clearly and lucidly by the aid of a model. Cross-examined by Mr. Aston, the witness was asked if he had given his best services to the defendant, and having replied in the affirmative, he was next asked if it was not a fact that he had been unable to find any publication that described Lenoir's invention as the use of a separate charge of air introduced before the combustible mixture and operating as a cushion. Mr. Gardiner replied that there was one in Johnson's *Practical Mechanics' Journal* of August 1st, 1866. The passage is nearly a reprint of Johnson's—Lenoir's—specification, and runs thus:—"The valve was so worked and adjusted as to open the air inlet a little before the gas inlet, and consequently a supply of air was drawn into the cylinder by the piston before the gas entered therein, the air and gas, as stated by the inventor, being made to form distinct strata under the piston in lieu of being mixed together. Previous combustion is stated to be the object of admitting the air first." The date of Johnson's patent is 1860. The witness was then examined as to the identity of the model to which we have referred, with the patent drawings, and his attention was called to a subsidiary slide worked by the governor, and which regulated the gas supply; but, according to the witness, would not cut it off entirely. Asked as to whether a workman could make an engine from the drawings, the witness replied that "he would have a lot to do." As much turned on the particular drawing, Fig. 1, in the plaintiff's specification, we reproduce it in Fig. 8. The dotted shading at the end is supposed to show the condition of a charge just at the moment of firing. The witness was asked by Mr. Aston, "Is it not true that by taking the channel D a little more to the right and by making the connection with G, and by importing the regulating apparatus in connection with the governors, that that could be done by a competent workman. Any person desirous of making the apparatus and seeing the details in Fig. 3—Fig. 4 above—might very readily avail himself of the information given him, and apply it to Fig. 1?" and replied, "He would have a lot to do." In reply to the question if he really meant to say as regarded Fig. 3 that a machine was described which would not work, the witness said that he would not go so far as that, but that the patentee had discarded that very arrangement by a subsequent patent. The witness was re-examined by Mr. Kay on the drawings in the specification, the condition of the charge in the cylinder at the time of firing, and on the description of Lenoir's engine in the *Practical Mechanics' Journal*. But nothing new was elicited. Mr. Kay stated that Mr. Aston had put in the book in question by calling on the witness for it. To this Mr. Aston objected; but the Vice-Chancellor acceded to Mr. Kay's request. The witness was

examined as to the use of the governor, which he explained was intended to regulate the speed of the engine, and its slide was not intended to distribute the gas, or play the part of a slide valve proper. He also said that an ordinary workman could not make an engine by the specification, and that a clever and skilful man would have to make experiments as he went on before he could get at what he wanted.



ABEL (OTTO), 1876.

Mr. Robert Charles May, examined by Mr. Kay, said he was a member of the Institutions of Civil and Mechanical Engineers, marine assessor to the Board of Trade, &c., and twenty-eight years in practice. He had seen the engines of the defendants in Queen Victoria-street, and made himself acquainted with them, and with the various specifications. Asked as to the 1876 specification of the plaintiff, he agreed with Mr. Bramwell that the slide in Fig. 1—Fig. 8—was not properly drawn. The connection required was shown accurately by an ink line on the slide in the model. The orifice D wanted opening out. According to the picture, the first defect would be to take in air; then it would take in gas without air for the moment; it would not take in gas and air together. The model was an accurate representation of the drawing to a larger scale. The witness then described the action of the model. Practically the air would get in by itself, and the gas would get in by itself. The slide must then return until the orifice for the flame came opposite the channel C. It would first in returning shut the gas port entirely, leaving d², the air port, a little open; then after it had shut the gas port, air would go into the cylinder, and air would be the last thing to enter the cylinder before the explosion. If the correction proposed by Mr. Bramwell, namely, the widening out of the channel, was effected, still air would enter last, according to Fig. 1 (Fig. 8). When the gas flame was opposite C there would be a very strong charge of gas and air in C², but that effect could not be brought about by the slide shown. The effect of the slide shown would be that in the passage C would either be air only, or a very dilute mixture of gas and air. The model marked D² was an accurate reproduction of Fig. 1. In order to make the engine work another slide must be fitted on the back of the main slide. Something must be done which was not in the patent at all. A good workman, however clever, must make a new drawing, and set the engine out before he could make it to work. In the plaintiff's drawings there was no description of a provision for anything like a gasometer to hold gas and air. It would occur to an ordinary workman to apply a gasometer. The witness was then examined at great length on the action of the slide in Johnson's patent, his remarks being illustrated by the model. Assuming that the great merit of the plaintiff's invention was in the introduction of air before gas and air for the purpose of utilising in expanding air, heat that would otherwise be wasted, he found a description of that in Johnson's patent. A passage in the patent would, in the witness's opinion, make it clear to any ordinary workman how he would arrange his slide, namely, so as to let in air first. Supposing the great merit of the plaintiff's invention is to expand the air and air and gas separately introduced, precisely the same thing was found in Johnson's specification. Witness did not agree with Mr. Bramwell that Johnson's specification was not a disclosure. He did not think that mentioning the introduction of air to neutralise carbonic acid would lead away a workman's mind from the expansion of air. If he read of a murder at the beginning of a novel, and a marriage at the end, he did not mix up the murder and the marriage, but thought of the two things separately. Johnson's patent read for the plaintiff's, altering the figures and altering the letters. Witness then described the engine shown in Barnett's specification. When the pumps had done compressing, the piston gave the last squeeze. Asked if there were any difference between the compression claim of the plaintiff and the operation described by Barnett, the witness said there was none. In one case the compression was done by the piston alone, and in the other by the pumps and the piston. Asked as to the patent of 1868 of Boulton, he said the operation was precisely the same. It was a compression by the piston in the cylinder. The mechanical construction of the defendant's engine was very different from that of the plaintiff. So far as he knew, the use of two pistons working in one cylinder was a novelty in gas engines. The arrangement would have the effect of lessening the shock. As two machines, the engines of the plaintiff and defendant were very dissimilar. They were totally different in mechanical arrangement, but they accomplished the same object. Cross-examined by Mr. Aston, the witness defined that object to be the rotating of a shaft which gave out power. In the defendant's engine, with a very small travel of the piston the utmost pressure was obtained. In the plaintiff's engine, a less rapid combustion of the charge was obtained. In Boulton's engine the whole charge was an inflammable mixture. He did not describe any mode of introducing separately a charge of combustible mixture, consisting of combustible gas and air, and another charge consisting of incombustible fluid; Boulton's was a compressing patent. Neither in Barnett's nor in Boulton's did the engine compress by one in-stroke of the piston a charge of incombustible mixture and incombustible fluid drawn into the cylinder by the previous out-stroke of the piston. Witness had never seen a Boulton's engine made according to the specification. Had never heard of one of Barnett's engines being made, denied that the machines in question were not capable of being made. Did not see why Barnett could not get his mixture into the cylinder. Did not agree with Mr. Bramwell that Barnett's engine could not be made to work. Had never tried; neither had Mr. Bramwell. Had no more tried to make it practicable than Mr. Bramwell had tried to make it impracticable. Put that in, although he had not been asked the question, for the benefit of his client. With the valves as shown in Barnett's engine, the engine would not work well; it would be necessary to alter a valve. His idea of a gas engine, until he heard of the plaintiff's, was that there was a compound mixture always flowing in. The wording of the specification intimated that no charge of air was to be drawn in behind the combustible charge. This was contrary to what was shown in Fig. 1. A competent workman might make the corrections necessary in both Johnson's and the plaintiff's specification, and this applied to the governing arrangement. By using a powerful magnifying glass to examine the plaintiff's specification drawings he was able to say that the model precisely represented the drawings. The witness was here examined at great length on the action of Johnson's engine, and the period at which air was admitted during the stroke of the piston. This examination occupied a great deal of time, the same ground being gone over and over again. It would be quite impossible to render this part of the trial intelligible without models; with them it was scarcely intelligible, witness and counsel spending much time in explaining to each other what each meant to

say with the aid of models and drawings. The point endeavoured to be made by counsel was that the action of Johnson's—Lenoir—engine was not the same as plaintiff's, in the period of the stroke at which the air was admitted, the gas was admitted, the precise arrangement of the mixture in the cylinder, and the period of ignition. Great doubt existed in the witness's mind on these points, the doubt arising from the incompleteness of the drawings; all depending on whether Johnson "figured his slide in the passage or the piston at the end of the stroke." The witness thought he had figured his slide with the piston at the end of the cylinder.

After some further evidence and speeches of counsel.

The VICE-CHANCELLOR said: I have listened to this case so long that I think it will be unnecessary that I should add anything to the knowledge that I already possess. It seems to me that although a great deal has been said and a great deal of time occupied, the question is one merely of law. As far as I can gather from the facts before me, the first thing I have to consider is whether the specification upon which the plaintiff's claim does explain that invention which Mr. Aston has described in his own words—whether it does sufficiently inform the public of the nature of the invention on which the plaintiff relies. In proceeding to inquire into that, I must ascertain what was the state of public knowledge at the time when the plaintiff took out his patent, because the cases which have been referred to in the House of Lords and before other tribunals, all recognised the same principle. It is merely commonplace to say that a man who proposes to secure to himself the advantages of a monopoly in the shape of a patent must make a full disclosure of the invention which he claims and the means by which he professes to carry it into practical effect. He must prove that it is new, in the words of the statute, that it is a "new manufacture"—elastic words, no doubt, which have a very extensive application, but at all events he must prove that it is new. Well it is new. It is not a new discovery that a gas motor engine may be made in which the combustion of air will perform an office similar to that which the expansion of steam does by working a piston, giving power to work other machinery. Barnett's specification, which has been referred to, contains a plain and distinct enunciation of that principle and that invention. He says in that, "My invention consists in certain methods of producing and employing as a prime mover of machinery the explosive or expansive force of certain inflammable gases, as hydrogen or carburetted hydrogen gas, mixed with oxygen or atmospheric air, in such proportions as to form an explosive mixture, the various proportions and explosive force of which are well known to chemists generally. Well, then, I must assume that the whole world knew—I believe, in point of fact, they knew it long before, but I must assume that from the date of Barnett's patent the whole world possessed that knowledge—that by a mixture of carburetted hydrogen with atmospheric air there could be obtained a vapour in its nature explosive, and that by its explosion motion could be given to machinery. That we have to start with. Barnett's specification shows the thing which is to be done; it shows the means of doing it; and after that had become public property, I do not think any patent could be sustained for making a piston in a cylinder move by means of the explosion of atmospheric air and carburetted hydrogen. But that is not all. The patent of Johnson seems to me to cover the whole subject of the discussion before me. Johnson in his specification says:—The invention consists in the application and use of an inflammable gas mixed with a proper proportion of atmospheric air, and ignited inside the cylinder by the aid of electricity, the expansion thereby produced acting upon the piston, and imparting motion thereto. Suitable means are employed for admitting atmospheric air into the cylinder; along with the air there is also admitted, by means of a pipe employed for that purpose, a supply of ordinary lighting or other inflammable gas or vapour. The learned judge then referred to Johnson's specification in detail, and proceeded: "Now, what has been insisted upon in the course of the argument before me—and the most liberal interpretation is given to the plaintiff's specification—is that the great invention upon which he relies is, that he introduces a quantity of air, which, by ascending in the cylinder, impinges upon what is called the cushion. The residuum of combustion which has before taken place, and after that comes in the mixed atmospheric air and gas upon which the combustion takes place. Here the very words are: 'A supply of air will have already entered the cylinder.' It goes on—'The slide opening one of the orifices, the gas and air both enter the cylinder; but without becoming entirely mixed together, and will exist in the space behind the piston in distinct strata. Then after describing the slide B, and the electric spark being produced, it says, 'The gas explodes and heats the air, and its combustions which expand considerably, and the pressure produced operates upon the piston so as to force it to the opposite end of the cylinder.' And then that there can be no doubt about the supply of air, upon the same page, at line 13, it says, 'The object of introducing the supply of air into the cylinder before the gas is allowed to enter, is to neutralise the effect of the carbonic acid gas formed by the combustion of the first portion of the inflammable gas, as the carbonic acid gas without being thus neutralised might prevent the ignition of the remainder of the inflammable gas.' No words can describe what the plaintiff calls his invention more perfectly than those words do. In the examination of witnesses it is admitted that Johnson's invention, as he specifies it, is in substance the same as that of the plaintiff, but the witnesses say that Johnson's machine is not workable, and, thereupon, I have an argument addressed to me that, as the defendant has not proved that Johnson's machine was workable, therefore not only Johnson's patent, but what is much more to the defendant's purpose, the knowledge conveyed to the public in the words I have read is not available by the public for public use. It is not necessary for the defendant to prove what Johnson did or did not do with his engine. It was like the case of Mr. Strutt's wheel. No doubt the decision in that case would be applicable if this was a plaything—a mere attempt to make a machine which had utterly failed and had been thrown aside. But another man, who never saw it or heard of it, makes a wheel of his own. The man says my right is not to be evaded because this plaything was made use of sometimes in the road, and sometimes to take things to the farm, and then thrown aside and never used by anyone. It is not in the slightest degree like that; but here it is to all whom it may concern—all who want to make gas motor engines. Know all men from this moment that by the means which Johnson describes—the end which Johnson says is attainable will be perfectly attained, and in the course of it a separate supply of air is one of the ingredients, and the main feature in the invention which Johnson insists upon. Can I say that any man who avails himself of that knowledge which Johnson's specification conveyed to him is not entitled to use it? What is there in the plaintiff's specification which would induce me to believe—as, if I adopted what Mr. Aston said to me, I must be bound to believe—what the plaintiff said:—'Now, people before this have made atmospheric gas motor engines; they have all blundered about it; I have invented quite a new thing; it has occurred to me, and I have tried and proved, and I now demonstrate that by letting in some cold air or pure atmospheric air just then, you can perform the combustion which the others knew of and invented, and which I have a right to use.' There is no such thing said in the plaintiff's specification; the plaintiff nowhere claims to be an inventor of anything. He says:—'In making a gas motor engine, this is the process which I adopt,' and then he describes a process perfectly identical with Johnson's—not a particle of difference between them. The pith and marrow of Johnson's specification is adopted by him, and because he lets in a quantity of cold air or atmospheric pure air independently of the supply of mixed atmospheric air and combustible gas, therefore he says he is entitled to hold this as a perfect invention and in the terms of the first claim, which is the thing upon which the argument has principally turned, he says, 'I claim admitting to the cylinder a mixture of combustible gas or vapour

with air separate from charge of air—which was exactly what Johnson had done—or incombustible gas, so that the development of heat and the expansion or increase of pressure produced by the combustion are rendered gradual substantially as and for the purposes herein set forth.' If the defendant is entitled, as I think he is entitled, to have all the knowledge and apply all the means which Johnson had indicated, can it be said that he is not at liberty to do that which he has done because the plaintiff has claimed in these terms, with Johnson's patent before his face, and with the admission on all sides that Johnson's invention—whether it was capable of supporting a patent or not is a matter of indifference—had shown the very thing which the plaintiff does or tries to do, and which the defendant is accused of having imitated. That he has imitated is a fact not in dispute—he has done that thing which Johnson described in his patent, and he has made his machine in a somewhat different form, making a double piston instead of a single piston. Now what is there in the case but that? The statement of defence puts in issue the validity of Johnson's invention as far as it would sustain the allegation in the defence that the plaintiff's invention was not new at the time he took out his patent. Unless the words of Johnson's patent can be erased or obliterated, or unless it can be decided that Johnson's machine never was an acting—and I do not think that would be enough—an acting and useful machine, there is no ground whatever for saying the plaintiff is an inventor. There is no invention in letting in the atmospheric air separately from the combined air and gas. The mode of ignition is the same, the invention is the same, and in my opinion there is no ground whatever upon which the plaintiff can insist that the defendant has evaded his invention, nor is there any ground upon which the plaintiff's patent can be sustained against the defendant. There is another part of the case which I need not refer to very particularly, but upon which if it was necessary to decide conclusively, I should require some further information. It is admitted that there was an error in the drawing by which the plaintiff shows the means of performing his invention. It is treated very lightly by the plaintiff's witnesses, it is called a clerical error. The defendant's witness, Mr. May, entertains a different opinion; he says: 'It is not what you would expect an ordinary workman to find out and correct.' The plaintiff's witnesses say if you read the specification and the drawing together an ordinary workman might find out the mistake and might readily supply the connection. I must have much more distinct and positive evidence upon that subject before I admit that as an excuse. It is admitted—and no reason is ascribed for not making it—the drawing is erroneous, it is misleading. On the other side, I cannot help observing that Mr. Bramwell seemed to think that Johnson's patent misled the reader from the true merit of the invention. I cannot say so. I have read Johnson's specification, which is an extremely plain and distinct document—much more explicit and plain than the plaintiff's specification—and I cannot say that there is anything in it which engenders in my mind the slightest doubt but that Johnson did invent a mode of moving a piston in a cylinder by means of the combustion of atmospheric air and gas, and having first admitted a supply of atmospheric air into the same cylinder that the invention is fairly and fully described. It might be doubtful whether the principle, if it is a principle which the plaintiff relies upon, is one which would sustain a patent. I do not find it necessary to go into that. But upon the short ground I have mentioned that the invention the plaintiff claims is not only in substance, but literally and entirely described in Johnson's patent, I am of opinion that the plaintiff fails in his demand before me.

Solicitors for the plaintiff, Messrs. Faithfull and Owen; solicitor for the defendant, Mr. C. J. Eyre.

GOODS ENGINE, LANCASHIRE AND YORKSHIRE RAILWAY.

We publish this week a working drawing of a goods engine. In our next impression we shall give the specification to which the engines have been built, and additional drawings.

THE ELECTRIC LIGHT IN THE CITY.

LAST night witnessed the commencement of a real experiment to determine the value of the electric light for street purposes. The lighting of the Thames Embankment can hardly be said to have been a test of the electric light for ordinary out-door illumination. The installation, however, of the light in narrow, crowded thoroughfares will soon enable us to judge whether it is superior to gas. We shall have to consider, not so much the mere fact of its being supplied at a certain cost, as to whether the increased and purer illumination facilitates the better carrying on of business. It has been said that the electric light will pay for itself in the increased work obtained out of labour in consequence of its use. If this is correct we may be certain that the fact will soon commend itself to the practical mind in the City. At the present moment the complete experiment is not being carried out, the company owning the Jablochhoff light having failed almost at the last moment to fulfil the agreement. The district allotted for this system was reallocated to the Lontin light, and it will be another month before the work is complete. Two other districts are given over to the application of the Siemens and the Brush systems respectively. Messrs. Siemens have their centre of operations at No. 3, Old Swan-lane, where two of Marshall and Sons' 10-horse power engines drive the dynamo machines which supply the current. A third engine is kept in reserve in case of accident. There are in this district twenty-eight lights of about 300 candle power each, divided into four circuits of seven lamps each. There are also six large lights placed on lattice-work standards at a great height of about 5000 candle power each. The small lights are fixed on posts similar to the ordinary lamp posts.

The Anglo-American Company has fixed 32 lamps in the district allotted to the Brush system, upon standards also similar to the ordinary lamp-post, but increased in height about 3ft. The centre from which the current is sent is at the works near Waterloo station. The engine of 35-horse power is by Brotherhood, and already drives the machines used to supply the current for the lamps at Charing Cross and Waterloo stations. The electric current was turned on at half-past eight, and the large crowd that had gathered around the great lights near the Mansion House witnessed a curious scene. But a moment before the streets were comparatively dark, and each with difficulty recognised his neighbour; but in the course of a minute, as with the bursting of the moon from behind a cloud, the scene was changed, the space was illumined, and the sharply-defined shadows of the moving mass showed the increase in the intensity of the light. Passing onwards through the streets, one was forced to confess that the new light was better than the old.

THE GEORGE STEPHENSON CENTENARY.—It has been decided to hold a demonstration in Newcastle-on-Tyne on the 9th June in commemoration of the centenary of George Stephenson. It is proposed to observe the day as a public holiday, and to request the inhabitants to decorate the houses. In the evening there will be a public banquet, at which a subscription will be initiated for the erection of a building for the college of physical science, to be called the Stephenson College, of the University of Durham.

ZARSKOJE-SELO RAILWAY.—This line, which is constructed on the broad-gauge system, is to be re-constructed next May, so as to conform with other Russian railways.

SPAIN IN THE LEVANT.—A Spanish company is now establishing a line of steamers between Gibraltar and Odessa. It will have a station at Corfu, so as to form a communication with Trieste.

A FEAT IN NICKEL-PLATING.—The Plating Company of the Bishopton-lane Works, Stockton-on-Tees, have successfully plated with nickel three large cylinder covers for marine engines, on account of Messrs. Maudslay, Son, and Field, the eminent engineers. The largest of these covers weighs nearly 1½ tons, and is 6ft. 6in. in diameter. It was plated in the large nickel bath, and polished all over with perfect ease by one of Fenwick's patent portable polishing machines. The same company have also nickel-plated the whole of the bright fittings for Sir James Ramsden's yacht engines.

THE ROYAL AGRICULTURAL SHOW.—It may not be amiss to remind intending exhibitors at the forthcoming show of the Royal Agricultural Society, to be held at Derby next July, that entries of everything, except live stock, butter, cheese, and bees, definitely close on April 1st. We understand that every year a large number of applications for space at the Royal Show are refused solely on the ground of being too late, and as the Council of the Society are exceedingly strict in enforcing their rules, firms intending to be represented in the Derby showyard would do well to place their applications—on the forms provided for the purpose—in the hands of the secretary in London without delay.

THE SUEZ CANAL.—The "Bulletin de la Navigation par le Canal de Suez" for the fourth quarter of 1880, with a general report for the year, has, according to "Continental Correspondence," been published by the Statistical Bureau of Egypt under the direction of Amic-Bey. In the course of 1880, 2017 ships passed through the Canal with a tonnage, according to official reckoning, of 2,860,448 but really amounting to 4,378,964. The number of hands employed in the navigation was 128,453, the number of passengers 53,517. Of the 2,860,448 tons official reckoning, 2,247,306 were British, 177,771 French, 75,820 Austrian, 124,083 Dutch, 71,039 Italian, 56,245 Spanish, 38,162 German, 29,607 Russian, 7203 Turkish, and 8032 Egyptian; 25,180 belonged to other States.

A REUTER'S telegram, published in the *Evening Standard* of Wednesday night, says:—"A New York afternoon paper reports that the Earl of Caithness died at an hotel in that city on Monday." Many years ago he took a prominent part in perfecting locomotives for working on common roads; he also invented some railway points of a new description. His inventive genius was likewise displayed in a new machine for washing railway carriages by mechanical means, a whole train being cleansed in a few minutes by drawing it between two large vertical revolving brushes, well supplied with water, and driven by steam. He was skilled in photography; one of his landscape pictures carried off a prize at one of the exhibitions held in the earlier days of the photographic art-science. At Stagenhede he had two rooms fitted up with photographic and engineering appliances, for experimental purposes. The Earl of Caithness was Lord-in-Waiting to the Queen in 1856-58 and 1859-66. He has been Lord-Lieutenant of Caithness since 1856, and he sat in Parliament as Baron Barrokill.

ENGLISH PLEASANTRY.—The *American Manufacturer* is vexed, and writes of us thus:—"The American weather they have been enjoying in England this winter seems to have had its effect even upon our ultra-English exchange THE ENGINEER. It has got to be almost as playful as a kitten. Hear it: 'This continent,' says the *American Manufacturer*, 'seems destined to be the highway of the nations of the world, between the Atlantic and Pacific oceans. The Union and Central Pacific is completed; the Atchison, Topeka, and Santa Fe will in a few weeks connect with the Southern Pacific, of California; the completion of the North Pacific, the Texas Pacific, and the Mexican National roads is secured; the Canada Pacific is pushed with such backing that its completion may be looked upon as assured within ten years; while two schemes for ship canals and one for a ship railroad are in such shape that the completion of two of the three may be counted among the great engineering works to be completed in this generation.' If a continent like America will get in the way what can it expect? People must cross it somehow, especially English people, who, when they take a fancy to go anywhere, generally go in spite of obstacles." Nevertheless, Englishmen always went "around the Horn" until the Yankees removed the obstacles to their crossing the best continent "the world ever saw"—and if there is anything an Englishman dislikes it is going around "a horn." Our contemporary forgets that all Americans are Englishmen. None of them can go back more than four or five generations without arriving at an English ancestor. It is to their inherited British pluck and perseverance that they are indebted for their present position. If they had not British blood running in their veins, Americans would not be what they are.

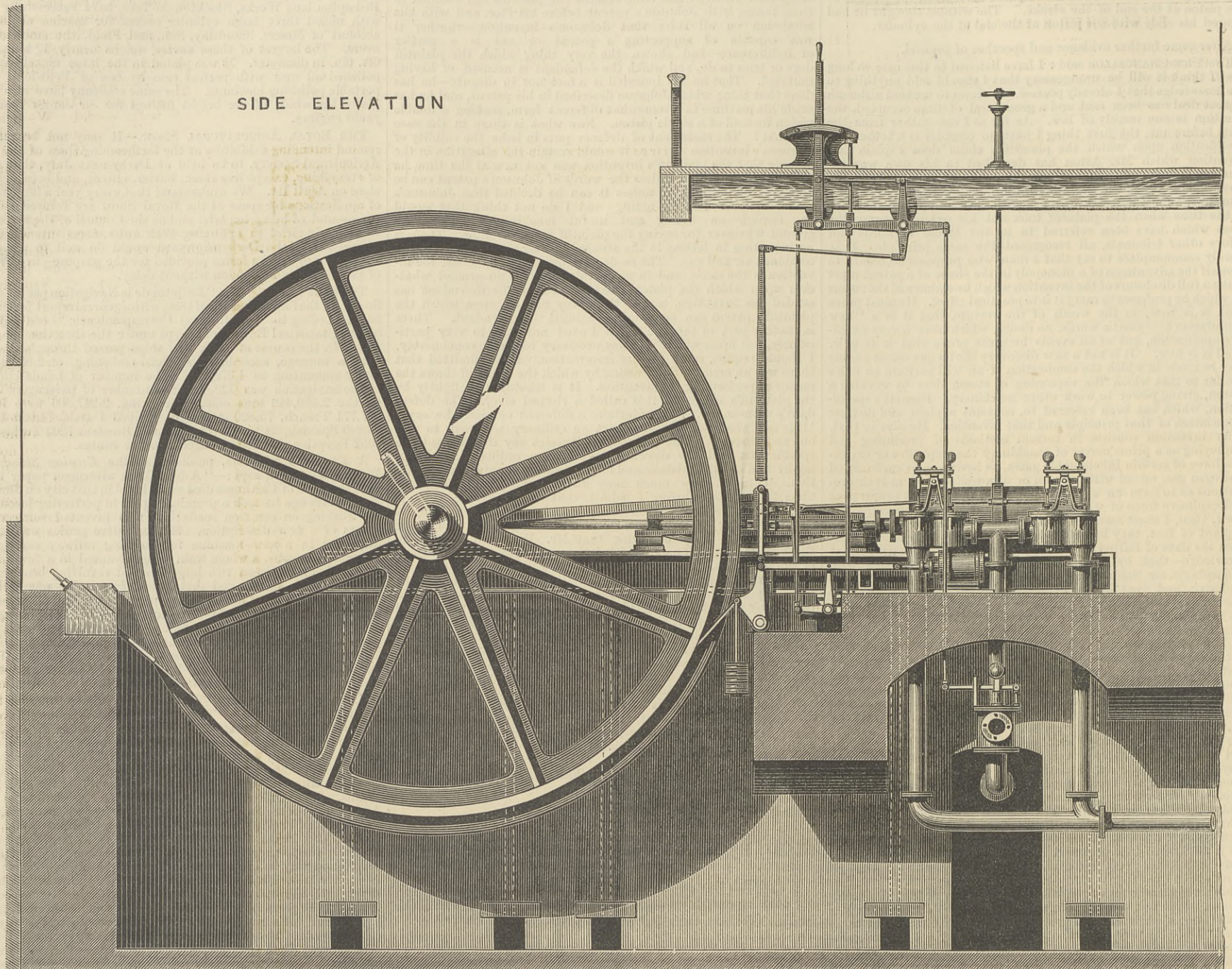
THE INSTITUTION OF NAVAL ARCHITECTS.—The annual meetings of this Institution—session 1881—will be held as follows:—In the hall of the Society of Arts, John-street, Adelphi—by permission of the Council. On Wednesday, April 6th, morning at twelve o'clock; on Thursday, April 7th, morning at twelve, and evening at seven o'clock; on Friday, April 8th, morning at twelve and evening at seven o'clock. The Right Honourable the Earl of Ravensworth will occupy the chair. The Council of the Institution will meet in the library of the Society of Arts, John-street, Adelphi, on Wednesday, April 6th, and should there be business requiring it, on Friday, April 8th, on both days at 11.15 a.m. The following is a programme of proceedings:—Wednesday, April 6th, morning meeting at twelve o'clock—(1) Annual report of the Council; (2) election of officers and of the Council; (3) address by the president. The following papers will then be read and discussed:—"The Almirante Brown, Argentine cased Corvette, and the Effect of Steel Hulls and Steel-faced Armour on Future War Ships," by J. D'A. Samuda, Esq., M.I.N.A., and vice-president; "On Peculiarities of Behaviour of Steel used in Boilers, for the Russian Yacht Livadia," by W. Parker, Esq., Chief Engineering Surveyor of Lloyd's Register, member of Council; "On the Increasing use of Steel for Shipbuilding and Marine Engineering," by J. R. Ravenhill, Esq., member of Council. Thursday, April 7th, morning meeting at twelve o'clock—"On the Stability of Certain Merchant Ships," by W. H. White, Esq., Assistant Constructor at the Admiralty, instructor in naval architecture, Royal Naval College, member of Council; "Waves raised by Paddle Steamers, and their Positions Relatively to the Wheels," by James Hamilton, Esq., member; "On the use of Mild Steel for Shipbuilding in the French Dockyards," by M. Marc. Berrier Fontaine, member. Evening meeting at seven o'clock—"On Local Education in Naval Architecture," by W. Denny, Esq., member of Council; "On Crank Shafts," by J. T. Milton, Esq., member; "On the Influence of the Cut-off and Length of Stroke, on the Working of Steam Engines," by C. Stromeier, Esq. Friday, April 8th, morning meeting at twelve o'clock—"On the Rolling of Sailing Ships," by W. H. White, Esq., Assistant Constructor at the Admiralty, &c., member of Council; "On the Leading Phenomena of the Wave-making Resistance of Ships," by R. E. Froude, Esq., Associate; "Freeboard and Displacement in Relation to Strains in Ships among Waves," by W. W. Rundell, Esq., Secretary to the Underwriters' Registry of Iron Shipping, Associate. Evening meeting at seven o'clock—"On the Imperial Russian Yacht Livadia," by Capt. E. Goulaeff, I.R.N., member; "On the Injuries Sustained by the Livadia in the Bay of Biscay," by Sir E. J. Reed, K.C.B., M.P., vice-president; "On Some Results Deduced from Curves of Resistance," by J. Biles, Esq., member; "Notes on Screw Propulsion," by Charles Hall, Esq., A.M.I.C.E.; "Shipbuilding a Thousand Years Ago," by Colin Archer, Esq., member. The annual dinner of the Institution will be held on Wednesday, April 6th, at the Criterion Restaurant, Piccadilly, at half-past seven precisely. Tickets for the dinner six shillings each. Evening dress.

WINDING ENGINE—KAI-PING COLLIERY, CHINA.

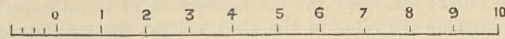
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(For description see page 242.)

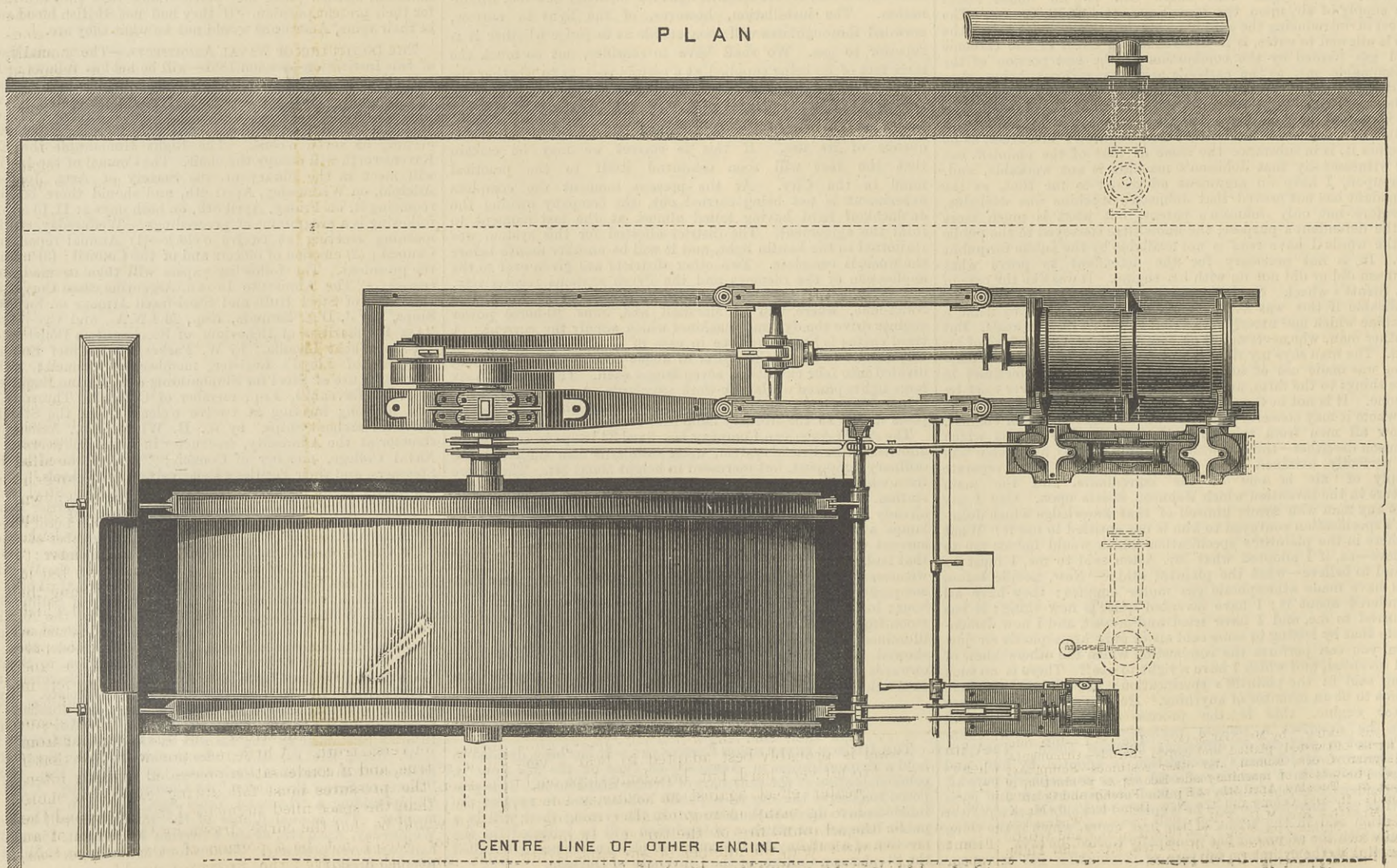
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* * * With this week's number is issued as a Supplement, No. CXXIII. of THE ENGINEER Portfolio of Working Drawings, representing a Goods Engine for the Lancashire and Yorkshire Railway. Every copy as issued by the Publisher contains this Supplement, and subscribers are requested to notify the fact should they not receive it.

TO CORRESPONDENTS.

* In order to avoid trouble and confusion, we find it necessary to inform correspondents that letters of inquiry addressed to the public, and intended for insertion in this column, must, in all cases, be accompanied by a large envelope legibly directed by the writer to himself, and bearing a 2d. postage stamp, in order that answers received by us may be forwarded to their destination. No notice will be taken of communications which do not comply with these instructions. * We cannot undertake to return drawings or manuscripts; we must therefore request correspondents to keep copies. * All letters intended for insertion in THE ENGINEER, or containing questions, must be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever will be taken of anonymous communications.

CAUTION.—We are given to understand that "the Long Firm" has located itself just now in Parliament-street, from which place orders are being freely issued. Our advertisers are advised in all cases to assure themselves of the responsibility of correspondents of whose commercial position they have no positive knowledge.

T.—Use well-made clear starch free from lumps. G. G.—We cannot advise you to send your son into the navy as an engineer. C. S.—No description of Dudgeon's rotary engine has appeared in our pages. S. W. H.—You cannot expect good diagrams with the valve gear shown in your sketch. We presume that the stroke is not equal on both sides of the vertical line to compensate for the obliquity of the connecting-rod, owing to which, you will understand, that the piston is not in the middle of its stroke when the crank is truly horizontal.

STEAM ROCK DRILLS.

(To the Editor of The Engineer.)

SIR,—Can any of your readers kindly tell me whether steam rock drills are made; if so, where can I find the address of the makers? I have circulars by me of rock drills worked by compressed air, but this is not the article I am asked to purchase. P. R. H. Cardiff, March 25th.

THE COST OF MELTING STEEL.

(To the Editor of The Engineer.)

SIR,—Can some of your readers give me the following information, viz., the cost per ton of melting mild steel and the cost of furnaces for same? First, in the ordinary crucible furnace; Secondly, in the Siemens regenerative crucible furnace; Thirdly, in the Siemens open-hearth furnace; and, Fourthly, by any system that would be less expensive than above processes. Also say whether small castings of ½ in. thickness or so can be made from mild steel containing only ½ to ¾ per cent. of carbon. March 30th. MILD STEEL.

PROBLEM IN WINDING GEAR.

(To the Editor of The Engineer.)

SIR,—If "R. R. N." will again read the above he will find the conditions are: that the circumferences of the wheels must be as 5 to 3, the difference in the length of ropes to be 280 yards plus the difference in the circumference of wheels, the number of wraps on larger wheel to exceed those on smaller by 12, and that to unwind the ropes in same time the revolutions must be as 3 to 1. With all the above conditions my solution agrees. The conditions given by "R. R. N." I cannot find in the problem. J. FORREST BRUNTON. Grantham, March 26th.

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Advertisements cannot be inserted unless delivered before six o'clock on Thursday Evening in each Week.

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

MEETINGS NEXT WEEK.

THE INSTITUTION OF CIVIL ENGINEERS.—Tuesday, April 5th, at 8 p.m.: Paper to be read and discussed, "The Actual Lateral Pressure of Earth-work," by Mr. B. Baker, M. Inst. C.E.

SOCIETY OF ENGINEERS.—Monday, April 4th: "Illumination by Means of Compressed Gas," by Mr. Perry F. Nursey, the leading features of which are as follows:—The necessity for improvement in the illumination of railway carriages. Reference to railway carriage lighting by means of ordinary gas. Sugg and Clarke's system of compressed enriched coal gas as applied to railway carriage lighting. Bower's system of compressed enriched coal gas as applied to the same purpose. Pintsch's system of compressed oil gas as applied to lighting railway carriages, steamships, and buoys. Conclusions.

SOCIETY OF ARTS.—Monday, April 4th, at 8 p.m.: Cantor Lectures, "The Art of Lace-making," by Mr. Alan S. Cole. Lecture I.—Introduction.—Early forms of twisted, plaited, and looped threads.—Ornamental borders of Assyrian, Greek, Roman, and other costumes.—Sumptuary laws.—Effect of production of machine-made lace upon production of hand-made lace, &c. Tuesday, April 5th, at 8 p.m.: Foreign and Colonial Section, "Canada; the Old Colony and the New Dominion," by Mr. E. Hepple Hall. Mr. John Rae, M.D., F.R.S., will preside. Wednesday, April 6th, at 8 p.m.: Ordinary meeting, "The Discrimination and Artistic Use of Precious Stones," by Professor A. H. Church, F.C.S. Sir Philip Cunliffe-Owen, K.C.M.G., C.B., C.I.E., will preside.

THE ENGINEER.

APRIL 1, 1881.

ARTILLERY FEATURES IN THE NAVY ESTIMATES.

IN our review of Mr. Trevelyan's speech on the Navy Estimates last week we particularly called attention to two features in the proposed programme—namely, the new swift seagoing "protected" ships and the introduction of breech-loading guns. We now propose to consider these points, together with other features in construction, in rather more detail. The first point to notice is one in the construction of our most powerful vessels now approaching completion—namely, that they are all "citadel" ships, with turrets placed diagonally. This applies to the Inflexible, the Ajax, and the Agamemnon, which are all shortly to be finished; and to the Majestic and Colossus, which are to be partly built this year. We say all our most powerful ships, because the Conqueror can hardly compare with them, although it a little surprises us to hear Mr. Trevelyan term her merely "a ship of the Hotspur class." In the fact of having single turrets, the Conqueror and the Hotspur in her altered state certainly resemble one another, but the former vessel is a seagoing ship, and the latter only suited to coast defence. The former is to have 40-ton breech-loading guns, while the latter has comparatively short feeble 25-ton muzzle-loaders. The Conqueror is, according to Mr. King, 270ft. by 58ft. against the 235ft. by 50ft. of the Hotspur, and 6200 tons against 4010 tons. Nevertheless the Conqueror, with the disadvantage of possessing only a single turret, cannot take rank with those powerful vessels we have mentioned. Committed then, as we are, to the Inflexible type, we desire to have its merits brought out as distinctly and as soon as possible. The Inflexible is reported to have behaved admirably on her trial at Portsmouth; but there is one matter specially bearing on the diagonal arrangement of turrets which could not be fully tried at Portsmouth, namely, the power of firing ahead and astern with the whole of the four heavy guns. In announcing the design and scope of this ship at the Institution of Naval Architects, Mr. Barnaby dwelt on this power of firing "at an enemy ahead, astern, and on either beam all four guns together." The diagonal position, like any other, interferes with fire approximating the line drawn through the two turret centres; this being diagonal instead of fore and aft, both turrets are able to fire directly ahead and astern. We have, however, to consider another feature in the ships, which we may call a less fundamental one, but when embodied in a vessel affects it as completely as any feature inherent to the system, namely, the structure containing the officers' quarters, &c., on the deck. When the guns are all pointed ahead, owing to the width between the turrets, there remains—as many of our readers are aware—a strip running longitudinally along the deck between the lines of fire of the turrets, in which a narrow structure containing admirable quarters can be erected without interfering with the fire of the turrets right ahead, and the same thing applies to the fire astern. It follows, however, that the guns cannot fire diagonally across this part of the deck, or they would fire right through this structure. We have laid stress on this for the following reason. It was reported in the Portsmouth trials that the guns fired within a very few degrees of the line of the keel, that is to say, the guns of each turret have hitherto not fired directly ahead, but in a direction inclining slightly outwards. Now, it will be seen that this means that they have not yet been brought to bear on the same point or in the way that is absolutely necessary to enable them to bear on the same enemy. We cannot expect to have two enemies conveniently situated a few degrees to the right and left, consequently the main object of the fire right ahead has not yet been achieved. We do not say it might not be achieved. Probably the fire would tear up the deck and injure the structure, for we believe that the Duilio, which has diagonal turrets but no deck structure, can only fire three of her four guns straight ahead, the inner gun of the stern turret being omitted. In action it may be that the Inflexible would do what she has not done on trial, and would fire right ahead at the expense of some tearing and damage. We think, however, that it is important to learn the extent of such damage, and we hope that on some occasion the Inflexible will fire directly along her keel with all four guns. Incidentally we may observe she had only three guns mounted at the Portsmouth trials. These trials showed that a boat or top lumber of any kind falling unintentionally within the zone of action of the gas was carried away. It is just possible that the deck structure to which we have referred might be rent and displaced in such a way as to interfere with the future fire of the turrets. It seems to us running a risk to make five enormous first-rate armour-clad ships without trying this, especially as we suppose it would be easy to make a change in respect of the deck structure if necessary, though no doubt to the detriment of the comfort of the crew.

With regard to the swift cruisers spoken of, two are soon to be built of about 7000 tons displacement, with 8000-horse power, and a speed of sixteen knots. In bulk these ships lie between the Bellerophon and Swiftsure, but in engine power they equal the Inflexible, and their speed is to exceed that of any ships in our own or any other navy except that estimated for the Lepanto and Italia. They will be armour belted, and carry four 18-ton new type guns—breech-loaders we presume—and also smaller guns. This will, we think, be deemed a desirable step. Our navy has at present a large proportion of turret ships each carrying a few very heavy guns. A turret vessel is probably best adapted to bear a very heavy fire and to hit very hard, but broadside ships ought to produce a greater effect against an ordinary enemy, owing to their having many more guns, after making all allowance for the all-round fire of the turret. In proportion to our strength then, the number of our guns is few, as may be seen by comparing our sea-going armour-

clad ships with those of France. This naturally brings us to a third question, namely, that of breech-loaders. Mr. Trevelyan says:—"At the present moment there is not a single heavy breech-loading gun mounted through the fleet, but by the end of the year a substantial commencement will have been made in arming the fleet with these guns. High velocity is now required for the projectile, and this can only be attained by length of gun, and a gun beyond the usual length cannot be loaded at the muzzle under ordinary conditions." We are very glad to hear this important fact so clearly stated. We have just noticed that the English ships carry but few guns. It is specially desirable then that they should be powerful. We trust that means may soon be found to substitute long breech-loaders for many of our muzzle-loaders. Most of our readers may not be aware that the new 9in. gun of 18 tons, spoken of has actually greater power of penetration than the 12in. gun of 35 tons, and although doubtless by chambering, the latter gun might be made to deliver a heavier blow—that is, one containing a little more stored-up work, and therefore one that might produce more effect on steel or chilled armour—yet it is much more likely that an antagonist would be protected by wrought iron plates for some time to come. The work we now indicate then we regard as of special importance, namely, the substituting for our short muzzle-loading guns long breech-loaders in our first line of defence. The introduction of breech-loading broadside guns of great length and short recoil is, we trust, a comparatively easy matter. The heavy turret guns may be more difficult to deal with, but we think their case may also be faced now that the general bearings of the question are clearly understood. When we speak of special importance, we do not mean that it need be pressed on in such haste as to prevent our trying fairly any system of construction which is well represented. We are glad to know that one or two guns constructed on our present built-up system have produced results which are as great, or perhaps greater, than have been attained by steel guns. This may be due to good proportions. The question, however, is which gun will bear a greater pressure. Latterly we have had to record notable cases of explosion with most disastrous consequences. However these are accounted for, it remains to be seen whether confidence is not shaken by such accidents. On all accounts it is most desirable to demonstrate in fair competition how our service built-up guns will stand as compared with other systems. If anyone questions this, we would point to the enormously increased demand for Krupp guns. It is a comparatively new thing to have guns and ammunition sent over from Germany for vessels fitting out in the Thames.

CONDENSATION IN STEAM CYLINDERS.

CERTAIN communications which we have received, elicited by the discussion which has recently taken place in our pages concerning the efficiency of a tandem compound engine, lead us to believe that the phenomena of condensation in steam engine cylinders, and the influence which that condensation exerts on the economical performance of the machine, are not quite so well understood as is desirable. All that is known, or, perhaps, need be known, on the subject admits, however, of being stated briefly and simply. It is understood by most persons who have devoted any attention to the theory of the steam engine that indicator diagrams do not give any information concerning the quantity of steam actually used per horse per hour. They show what is the smallest quantity that could be used by any particular engine in producing a given power, but the weight of steam sent into the cylinder is always in excess of that accounted for by the diagrams. The difference is lost by leakage and condensation. But the leakage in good engines is very small, and consequently cylinder condensation must be regarded as the great element of waste in practice.

When a perfect gas is expanded the pressures will vary in the inverse ratio of the pressures, and a line drawn through the pressures plotted for the stroke of a piston in a cylinder will be a hyperbola. It is convenient to regard steam as a perfect gas for some purposes, and the well-known formula, $\frac{(1 + \text{hyp. log.}) p}{R} = \text{average pressure, is}$

based on the assumption that steam is perfect gas, and that the expansion curve is a hyperbola. In order to determine the quantity of steam accounted for by the indicator in any case, it is only necessary to ascertain the volume of the space which must be filled at each stroke before the steam port is closed. The space is to be assumed to be filled by a perfect gas the weight of which is identical with that of steam; and the weight so calculated is the least that the engine could possibly have received, for if it were less the space swept by the piston could not be filled with steam of the pressure shown by the indicator. The power can be calculated from the diagram, and the space to be filled from the drawings and dimensions of the engines; and the space and weight per cubic foot of the steam being known, a very simple calculation gives at once the weight of steam said to be accounted for by the indicator. Such a calculation is very convenient and very useful when we have to compare the efficiencies of two or more engines; but it, as we have said, tells us nothing whatever concerning the actual weight of steam admitted to the cylinder, and which is not unfrequently two or even three times as great as that accounted for by the indicator. We shall for the present assume that no leakage exists in steam engines, and proceed to consider when and how the condensation in question takes place. It is often maintained that condensation proceeds within a cylinder from the moment the steam valve opens to the end of the stroke; but this is very far from being a universal truth. A little reflection will show that if it were true, and if condensation proceeded without intermission, the pressures must fall during expansion more rapidly than the space filled augmented in volume, and the result would be that the curve drawn by the pencil of an indicator would not be a portion of a true hyperbola, but some other curve; the pressures would no longer vary in the inverse ratios of the spaces. In practice

nothing of this kind takes place, provided the engines do not leak steam past the pistons and valves. With this condition operating, the curve of expansion will in all cases be very nearly a true hyperbola, and the departures from that curve which manifest themselves are due to other causes, to which we shall come in a moment, and not to condensation. We have lying before us a report on the testing of three engines all fitted with automatic trip valve gear, at the Cincinnati Millers' Exhibition in June, 1880. At the end of this report are given copies of twenty-four diagrams taken from the engines tested. On all these diagrams the hyperbolic curve has been put in in dotted lines for the sake of comparison, and the indicator curve in every case approximates closely to it; in some instances it exactly coincides with it; and in none of the diagrams does the space between the two curves represent more than about 1 lb. difference in pressure, and this, be it borne in mind, with nearly ten expansions. It is evident that this result would not have been brought about had condensation taken place to any considerable extent, after the steam valves had closed, during the period of expansion. The indicator curves when lower than the theoretical curve were probably so, to some extent, because of leakage. The fact that some of the indicator curves were identical with the indicator curve, proves that not only did no condensation take place, but that re-evaporation occurred; for steam is not a perfect gas, and water is always present in a steam cylinder, and when steam, in the presence of water, is expanded or compressed, the curves of expansion and compression are not true hyperbolas. We cannot stop here to explain why, and in what way, they depart from them. We must refer the reader who wishes to go further into this question to Clerk-Maxwell's "Theory of Heat," page 113 *et seq.* We can only repeat here that the curve will be naturally below that calculated; and in the American diagrams, to which we have referred as being lower than the theoretical curves, the lines are very nearly those proper to a mixture of steam and water expanding in a cylinder. When the indicator curves were higher, they show, as we have said, that re-evaporation took place. We cannot, we think, too strongly insist on this fact, that in well-made engines condensation does not occur after expansion begins, for many engineers find it very difficult to believe it. It may help to convince them if we add that, when steam is compressed, it is condensed—provided the heat generated by compression is permitted to escape, as through the walls of a cylinder. "If," writes Maxwell, "we diminish volume and still maintain the same temperature, the pressure will no longer increase, but part of the steam will be converted into water; and as the volume continues to diminish, more and more of the steam will be condensed into the liquid form, while the pressure remains exactly the same." Conversely, if steam be allowed to expand, water being present, and heat being supplied, say, from the walls of the cylinder, the pressure will remain constant instead of falling, and the water will evaporate.

If what we have thus laid down be correct, and that it is true is proved by hundreds, if not thousands, of diagrams from well-made engines—diagrams from engines with imperfect valve gear teach nothing in this connection—it follows that all the steam condensed in a steam engine cylinder must be liquefied during the time the steam valve is open and before expansion begins. We cannot do better than use the Cincinnati engines of which we have already spoken, to illustrate what we have to say, as they were all three excellent, and economical in no ordinary degree. The three engines had each one 18in. cylinder, 4ft. stroke, and a piston speed of a little over 600ft. per minute. They were fitted with condensers which could or could not be used at pleasure. With the condenser the Reynolds-Corliss engine used 20·61 lb. the Harris-Corliss 19·36 lb., and the Wheelock engine 19·47 lb. of steam per horse per hour. But the indicator diagrams account in each case for 14·88 lb., 13·75 lb., and 13·91 lb. only. Thus in the Reynolds-Corliss engine 27 per cent., in the Harris-Corliss 29 per cent., and in the Wheelock engine 29 per cent., in round numbers, of all the steam made in the boiler was condensed, or leaked away. That the leakage must have been very small is proved by the diagrams. We shall be quite close to the mark, then, if we say that in very good and economical engines one-fourth of all the steam supplied by the boilers is liquefied in the cylinders during the time the steam port remains open. This is a very important statement, and deserves careful consideration. Let us see what it implies. If we take the case of the Wheelock engine, the most economical of the three tested, we find that the area of the piston was 254·47in. that of the lid being the same, while the surface of the belt of cylinder included between the piston and the lid at the time the steam valve closed was about 368in. Adding 123·46 square inches for port surface, we have a total of 1000 square inches of condensing surface at each end of the cylinder. This could operate as a condenser for only about one-tenth of the time required to make a stroke. Summing up, we find that a surface of about 1000 square inches acting for about 12 minutes, or two surfaces of 1000 square inches each acting for 6 minutes, sufficed to condense one-fourth of all the steam produced by two boilers, with 1300 square feet of heating surface; or to put it in another way, the surfaces in question condensed the fourth part of 3084 lb., or 771 lb. of steam, in the course of each hour, the actual time of condensation being as we have shown, but 12 minutes.

We have made no allowance here for the condensation due to work done, while the steam valve was open. This would be relatively very small. Nor have we alluded to one or two other sources of small loss which will suggest themselves to our readers. Our object has been to call attention to the enormous cooling power possessed by the comparatively small surfaces of the piston and the cylinder covers, and our readers will hardly fail to draw the deduction that while the piston and cylinder covers are left un-jacketed, little or nothing is to be gained by jacketing the sides of a cylinder. It is to reducing the condensing powers of the piston and cylinder covers that those who

seek to promote greater economy must give their attention. It will be readily understood that, as each of the surfaces to which we refer is heated and cooled alternately in the Wheelock engines 75 times in a minute, they may be regarded as multiplied in area to an equivalent degree, and our 1000 square inches at each end of the cylinder becomes, in a sense, 75,000in., or, for both ends, 150,000in., or 1041 square feet. The best method of preventing condensation would consist in covering the face of the piston and cylinder lids with a non-conducting material, or one with small specific heat and bad powers of conduction. Lead complies with these conditions, and its use was suggested for the required purpose many years since in this journal. An American engineer acted on the suggestion, but, unfortunately, it was found at the time impossible to make the lead adhere to the iron, the relative expansions of the two metals being so different that the lead tore itself away from the iron. The specific heat of nickel is, unfortunately, almost the same as that of iron, namely, .10863. What its conducting power is precisely does not seem to be well ascertained, but it is probably about the same as that of iron. Were it not for these facts, nickel might be used to plate the faces of pistons and cylinder covers with advantage. There does not appear, however, to be any obstacle in the way of using porcelain or slate for the intended purpose, plates of the material about an inch thick could easily be let into and secured by cement in seats cast for the purpose in the metal. The experiment would be well worth trying. Any expedient, in short, which holds out fair promise of neutralising the enormous condensing powers of the piston face and cover would be worth testing. To the prevention of this condensation we can alone look for further progress in the direction of economy.

ENGINEERING TRADE PROSPECTS.

TRUSTWORTHY returns, which during the past month have been collected throughout the engineering trades of the United Kingdom, are of anything but a satisfactory nature as regards the present position and prospects of this important branch of industry. The revival in trade which appeared to have taken place a few months back has not continued, and has been confirmed only in some exceptional or special departments. From nearly all parts of the kingdom the reports recently sent in speak of trade as dull or bad; the inquiries which were being made during 1880 have not led to much actual work, and there appears to be generally an increasing feeling of depression. With but few exceptions there are no districts or branches of trade in which there is any declared activity, and the result of the returns is to show that the iron trades, taking them all through, are in the year 1881 really in no better position than in 1880. It is true that there are some exceptions to the otherwise general depression which is reported. The most marked exception has been in the iron shipbuilding and marine engineering trades, in which great activity has prevailed throughout the kingdom. In all the English ports, in Scotland, and in Ireland the producing powers in these branches of trade have been kept in full employment, and in some cases shipbuilders are reported to be so fully engaged that for the present they are unable to take on any new orders. One or two other branches of trade, although far from being generally active, have in some districts been fairly supplied with work. Tool-making has in several districts been moderately active. Locomotive builders are also in many cases fairly well supplied; whilst some branches of the textile machine trade are tolerably well engaged. In all these branches of trade, however, it is reported that work has been taken under severe competition, and consequently at prices which have given but poor results to employers. That this general depression has also been disastrous to the interests of the men is borne out by the official reports of the engineers', ironfounders', and boiler-makers' trades unions. So far as the condition of trade is concerned these reports completely substantiate the returns which have been collected from the employers; but they show in addition that the funds of the unions have suffered considerably, a special levy having been necessary in the Amalgamated Society of Engineers to keep up the cash balance to the amount required by the rules. Additional evidence is also furnished by Mr. J. M. Ludlow, the Registrar of Friendly Societies, of the serious effect which the depression of trade has had upon the workmen's unions. There has been a decrease both in the number of societies and in the number of members, the returns sent in to Government showing a decline of one-fifth in members, whilst the funds have declined considerably more than one-sixth, and in view of the present condition of some of the societies we understand that Mr. Stark, who some time back reported on the financial position of the Amalgamated Society of Engineers, has now in hand other inquiries in the same direction with the object of thoroughly investigating the funds of several trades union societies.

CONTINUOUS BRAKES ON THE LONDON AND NORTH-WESTERN RAILWAY.

THE recent fatal accident at Dalston has, it seems, given point to the long-continued adverse criticism of the Board of Trade officers, of almost all railway engineers, and of the public, of the system of continuous, or partly continuous, brake which has been largely applied to the stock of the London and North-Western Railway. The chairman of the line has usually endeavoured at all the meetings of the company to persuade the shareholders and the public that an emergency brake could be a good brake, but at the last meeting his arguments showed their own weakness and the insufficiency of the brake. The emergency brake is, however, it is said, to be discarded, and another to be adopted. Now the settlement of the brake question on a line like the London and North-Western is a matter of great importance, and it is to be sincerely hoped that the directors, or their chief officers, will not make a mistake in their selection. Broadly speaking there are but two kinds of continuous brakes that are likely to be considered, namely, the automatic vacuum and the automatic pressure. Of the former of these there are several forms, of the pressure brake there is but one, namely, the Westinghouse brake. Conjecture will, of course, be busy on the subject of choice between these, but the question remains, is it on public grounds politic that the matter should be determined by a few railway chiefs, who, however desirous of making the best possible selection, may have biased opinions on a question which has been so long before all interested? All the evidence, experimental and working, that can be necessary to a decision on the brake question has been for many months available, and it may be again suggested that a small Commission should be appointed to consider, from already printed evidence, which brakes of those actually in use on any English railway fulfil the requirements as at present laid down by the Board of Trade or the amended

requirements which the Commission should recommend for adoption by the Board of Trade. The Commissioners should be practical engineers not directly connected with railways, and they might be nominated by the Board of Trade, the Institution of Civil Engineers, and by the Institution of Mechanical Engineers. It would be a matter much to be regretted that a great railway should be isolated by the form of brake it might adopt; but as the London and North-Western already runs in connection with other lines, and one on which the Westinghouse brake has been adopted, it may be the intention of the company to use that brake. Such a company cannot of course make the cost a primary consideration. There is, moreover, no time now for a new set of experiments on new ideas; indeed the brake question is so far covered with patents that no combination can be conceived which would not infringe one or other patents. We may, therefore, hope that if the company has decided to remove the chain brake, the question of general adoption of the best brake by all railways will receive the attention which so important a matter deserves.

NORTHERN IRON TRADE.

THE question whether there is an over production of pig iron in the Cleveland and Durham district seems likely to be settled, and that in the way that is most desirable. There is now a marked growth observable in the quantities of pig iron shipped out of the chief ports of the district; and it is especially noteworthy that the growth is not alone in the quantities that are being sent to Scotland, but to the Continental ports as they are opened out, whilst there have also been a few shipments to the United States, but the quantities in the latter case are far below those in the corresponding month of last year, and they are in part, but not entirely, of hematite iron, and whilst there is this decided growth in the shipments, the malleable iron trade of the North is slowly recovering from the dulness which fell upon it from the stoppage of constructional operations at the shipyards during the protracted winter. Should the shipments return to what was their normal height last winter—and there seems some probability of this, judging from the experience of the last few weeks—it is almost certain that that increase of the stocks in the hands of the makers and in the warrant stores will be stopped. It is this growth of stocks which is the source of weakness in the trade, and in the prices of iron. So soon as the natural equipoise is attained—so soon as the demand is as large as the production—we shall find the prices will steady, and may rise; and the earliest symptoms of this will be the sign for which users are waiting before they begin to cease working from wagon to furnace or foundry. The past few months have caused mill-owners and foundry-owners to keep their stockyards bare; but with any determined upward movement in prices, there would be a change, and a decrease in the stocks in the hands of the makers would be the result with probably a more rapid rise in the prices. It cannot be said that there is at the present time any indication of a large demand for crude iron from the United States, but there is a slight and fitful demand. It remains to be seen how far this will continue, but it is evident that for the present there will be a dependence more upon the demand from Germany and Belgium and Scotland, as well as for that for the forges and foundries of Durham, than upon that which last year so markedly affected the iron trade of the North, in common with that of other British districts. Now that there are indications of more settled weather, and that the constructional trades that benefit the metallurgical industries so much are beginning to be active, we have fair ground for hoping that we shall find a better trade in iron and steel for the year than two months ago seemed probable. There are large orders for rails being given out in the United States, and it may be that a part of these will prove a full counterbalance for the loss that we shall probably find from the high figures of a year ago for America for crude iron.

TENDER.

SEWERAGE WORKS, CALNE, WILTSHIRE.

Engineers: Messrs. Dudley and De Salis, 1, Westminster-chambers, S.W.

	£	s.	d.
James Dyer, Camberwell	7027	10	9
Saunders and Gibbs, New Swindon	5905	14	6
W. Rigby, Worksop	5843	7	6
J. Dickson, Sevenoaks	5445	7	0
J. Neave, Lewisham	5319	5	5
J. Simmons, Sidecup	5206	6	10
W. Harris, Camberwell	5064	8	4
G. Rayner, Bootle	4864	1	8
S. Cowburn, Hindley	4766	14	6
J. Mackay, Hereford	4730	12	4
Ambrose and Son, Bath	4369	13	10
Strachan and Co., London—accepted	4311	2	7½

COAL MINING IN CHINA—CHINESE ENGINEERING AND MINING COMPANY.

IN our impression of the 18th ult. we gave general drawings of the arrangements of the coal mining plant of the Chinese Engineering and Mining Company at Kai-Ping. We now give engravings showing the pumping and winding engines to a larger scale, together with details of the winding engine. The pumping engines are direct-acting engines with Davey's differential valve gear, the winding engines being fitted with Cornish double beat valves made of gun-metal. Both engines are constructed by Messrs. Hathorn, Davey and Co., Leeds.

The general drawing of the surface plant given at page 204 of our last impression shows the four boilers and the winding and pumping engines in position. Space has been provided for four more boilers, and another winding engine as shown.

Another pumping engine exactly similar to that already sent out, and to that shown at page 237, has been sent to China to work over the second pit. One engine raises the water from a depth of 600ft. to 300ft. from the surface, and the other raises the water from that level—300ft.—to the surface. Our illustrations in almost all respects explain themselves, so that it is only necessary to give the leading dimensions.

The pumping engines have cylinders 30in. and 50in. diameter × 6ft. 3in. stroke; and work 21in. pumps, capable of pumping 250 cubic feet of water per minute from a depth of 300ft. The air pump is worked from an arm on the quadrant shaft.

The winding engine is capable of raising 800 tons a-day from a depth of 500ft. in twelve working hours. It has two cylinders each 25in. diameter × 4ft. 6in. stroke. The winding drum is 18ft. diameter × 5ft. wide. The valves, as already stated, are double beat Cornish, worked as shown in the general drawing—page 240, and in detail, page 237. At present there are four multitubular boilers 10ft. long, 5ft. 6in. diameter, the working pressure being 60 lb. In addition to the above, a small semi-portable boiler of locomotive type, with winding engine having a pair of cylinders 8in. diameter × 16in. stroke, has been supplied for sinking; also pit-head gear, cages, pulleys, wire ropes, &c.

RAILWAY MATTERS.

THE highest railway bridge in the world is said to be that on the Cincinnati Railway, across the Kentucky river. It is 283ft. above the level of the water.

THE electric railway and the letter post were the subjects of a lecture delivered last week by Herr Brunner von Wattenwyl to the scientific club of Vienna.

IT is reported from Warsaw, according to *Continental Correspondence*, that the establishment there of a large factory for building railway engines is in contemplation.

THE railway receipts for 1880 in New South Wales were £212,664 in excess of those of the previous year, and the Post-office receipts showed an increase for the year of £26,964.

WE learn from Milan that the St. Gothard Tunnel will be built up through its entire length. The previous intention was not to build up the central part of the tunnel, which passes through hard rocks.

THE Victorian Minister of Railways has refused compensation or damage done to crops by fires arising from sparks from the engines. He expressed an opinion that many ricks were purposely placed near the railway.

THE tramway lines to Greenheys, Openshaw, and Newton Heath were inspected on the 25th ult. by Colonel Hutchinson, representing the Board of Trade, and it is expected that the three routes will be opened for traffic early next week.

THE Austrian Minister of Commerce has granted to Baron Nicholas Mustatza, in Czernowitz, a concession for preliminary works of a branch line of the Lemberg-Czernowitz-Jassy Railway, running from a point near Zuczka to Novoselitz and the Austrian frontier.

IN view of the proposed construction by a French company of a railway in opposition to the Rubattino line, Hammelif Bey has suggested to the Italian company to submit the question to arbitration. Signor Rubattino has agreed to this proposal, and chosen Commander Martorelli to represent him in the arbitration.

THE Arlberg Tunnel, which will connect Switzerland with Austria, owing to the favourable nature of the rock on the eastern side, had in the middle of March been penetrated to a distance of 600 metres. At the western end the work proceeds more slowly, the harder stone causing repeated interruptions of the boring.

THE Bill relating to the construction of the Pest-Semlin Railway is expected to be laid before the Hungarian Diet within a few days. The Bill names the group of the Société de l'Union Générale at Paris as contractors, which has now fulfilled the main condition required, namely, the acquirement of the concession to construct the railway in Servia.

IN a recent number of *La France* a short account is given of the results of working of the Franco fireless locomotive by the Paris General Omnibus Company on the tramway from the Louvre to Versailles. It speaks in high terms of the economy and rapidity of transport which the engines secure, and no inconvenience seems to be experienced in the streets with ordinary traffic and horses.

AN American contemporary learns that the Northern Pacific railway will be lengthened 400 miles the present year. This will leave a gap of 450 miles between the western terminus of the eastern section and the eastern terminus of the Columbia river section, and a second gap of 150 miles between the Columbia river and Puget's Sound. The entire length of the road when completed will be 2700 miles.

THE Pennsylvania Railroad Company has recently made surveys of a new route, by means of which the famous Horseshoe Bend will in future cease to be used by passenger trains. The contemplated new line will be more nearly straight, but with steeper grades. With steel rails and heavy engines, it is thought that these grades will be less objectionable than the sharp and frequent curves of the present track.

IT is now proposed, says the Ontario correspondent of *India and the Colonies*—and the Government have taken up the matter—to open up telegraphic communication between the Dominion and Eastern Asia by way of British Columbia. This is another indication of the future channel to travel between England and Asia, the distance being shorter *via* the Dominion than by the present routes. Already a line of steamers to connect with the Canadian Pacific is spoken of.

THE directors are rapidly organising, and will have everything in shape to commence work on the Pacific Railway at the opening of spring. "The impetus given to emigration to Manitoba by the final settlement of this question is, says a colonial contemporary, shown by the fact that already a party has gone up to the North-West from London fully a month earlier than usual. On all hands a very large emigration is looked for this summer, and very large orders for manufactured goods, especially agricultural implements, are coming down from the Winnipeg dealers to our manufacturers. Whole train-loads of ploughs, wagons, &c., are now awaiting shipment in London (Ontario)."

A MEETING was held in Middlesbrough Exchange on Tuesday afternoon, to consider the question of railway rates, with especial reference to the Railway Commission of Inquiry. Various anomalies were considered, and the petty policy of railway companies in taking undue advantage of their customers where there is no competition, and conveying even at a loss when there is, was also spoken of. A general feeling prevails that pig iron rates, after adjustment in a liberal spirit, should equally be made to apply to manufactured iron. Such traffic is loaded by the sender, unloaded by the receiver, and nothing whatever is done by the railway company beyond finding trucks and conveying it. Why, then, different gradations should be made in the rates payable for iron, all of which is equally undamageable, and simply because there is a little difference in intrinsic value, cannot be understood by any except railway official intellects!

THE preliminary works of tracing a line of railway from Ragusa through the Narenta Valley to Mostar, and thence past Konjiza to Serajevo, will, according to *Continental Correspondence*, be undertaken next month as soon as the weather shall permit. It will be under the auspices of the Austrian Government, and supported by the local commission of the annexed States. Several merchants of Ragusa have subscribed towards the preliminary cost of the undertaking, as Ragusa is chiefly interested in the establishment of the projected line. The expenses of constructing the railway in question are, however, considered enormous, in consequence of the technical difficulties that will have to be surmounted in so mountainous and rocky a country, and it is a matter of doubt whether the undertaking will be a financial success in the face of the two competing lines in contemplation, to be constructed from Spalato, the chief commercial town in Dalmatia.

THE following figures taken from the *Railroad Gazette* give the United States railway accidents from 1873 to 1880 inclusive, for each month, and are interesting as showing that though there is a general tendency to larger numbers of accidents in the first and last five months of the year the late summer and winter months are by no means invariably accompanied by most accidents:

	1873.	1874.	1875.	1876.	1877.	1878.	1879.	1880.
January ..	178	108	131	60	147	75	113	62
February ..	133	90	211	91	56	67	88	64
March ..	112	88	122	109	58	49	61	65
April ..	101	59	60	56	69	46	50	71
May ..	79	89	54	64	46	50	37	46
June ..	90	83	61	52	49	56	64	56
July ..	90	64	73	79	53	54	81	78
August ..	150	73	114	78	98	75	79	112
September ..	106	89	116	106	84	76	78	124
October ..	88	81	88	103	82	61	104	120
November ..	76	82	87	96	83	68	86	145
December ..	80	74	84	88	66	63	69	135
Total ..	1283	980	1201	982	891	740	910	1078

NOTES AND MEMORANDA.

IT is estimated that the annual deposit of silt in the Yarra mouth and Hobson's Bay varies from 150,000 to 250,000 cubic yards.

ASBESTOS powder, made into a thick paste with liquid silicate of soda, is used with great advantage for making joints, fitting taps and connecting pipes, filling cracks, &c. It hardens very quickly, stands any heat, and is steam tight.

THE total number of telegraphic despatches sent in Italy in 1880 amounted to 26,332,579. This includes 199,579 foreign telegrams, which were transmitted through Italian wires. The increase on 1879 in the total number is 2,398,824.

ALBUMEN, from which the blood corpuscles have been entirely removed, has been bleached by subjecting it to the action of the electric light, the rays of which are properly collected by means of lenses, &c. It is stated that the albumen may be bleached within twenty-four hours. The albumen may be in a dry or fluid state.

A SEMI-OFFICIAL Hungarian paper gives the following summary of the late census in the "countries subject to the Crown of St. Stephen":—Hungary and Transylvania, 13,697,999; Fiume and its district, 21,363; Croatia and Slavonia, 1,191,845; the Military Frontier, 697,516; total, 15,608,723. The total population in 1870 was 15,417,327, the increase being 191,396, or at the rate of only 1.24 per cent. for the whole period of ten years.

TEN years ago the centre of the population of the United States was about forty-eight miles east of Cincinnati, Ohio. The superintendent of the late census announces that the growth of the great West during the past decade carried the centre of population about fifty miles west, while the large increase in the Southern States carried it a little southward. The result places the centre of population within the limits of Cincinnati.

A COLUMN of air 10ft. in height will balance one 10ft. 5in. in height, which is 20 deg. warmer. Thus with a column of air in a ventilating pipe 20 deg. warmer than the outer air, and 10ft. 5in. high, the balancing colder column may be supposed to have a fall of 5in. This induces a velocity of movement of 310ft. per minute, and if the ventilating pipe or chimney have a sectional area of 1 square foot, the discharge of vitiated air will be 310 cubic feet per minute.

M. J. JOUBERT finds that in electro-magnetic machines, for a given intensity of field, under whatever other conditions the machine may operate, at the moment when it gives the maximum work the intensity is constant and equal to the quotient by $\sqrt{2}$ of the absolute maximum intensity; the electro-magnetic work is proportional to the velocity; the velocity is in a constant ratio to the resistance. The machines, therefore, differ from ordinary batteries, inasmuch as the battery maximum requires no external resistance.

THE best dynamite was formerly made with the "Kieselguhr" of Hanover, which, according to a recent paper by M. Gobi in the "Memoirs of the St. Petersburg Soc. of Nat.," can absorb as much as 75 per cent. of nitro-glycerine, but is now made with the diatomaceous deposits from Randanne, in the department of Puy-de-Dôme, which will absorb from 73 to 78 per cent. of nitro-glycerine. It is worthy of notice that both these formations have been described by Ehrenberg. It is obvious that the good quality of dynamite prepared from these two deposits depends upon the porosity of the small *debris* of the frustules of the microscopical diatoms. Thus, M. Gobi recommends especially those deposits which contain mostly frustules from the species of *Ephthemia*, *Navicula*, *Synedra*, and *Melosira*, their frustules being of a greater size and more porous than those of the *Fragillaria*, *Cocconeis*, *Nitzschia*, &c.

IT is not the first attempt that is usually successful in tinning iron in the cold. The chief point which requires attention is, according to a contemporary, that the tinning of iron in the cold cannot succeed at all unless the bath contains, in solution or suspension, an organic substance like starch or glucose, although no precise scientific explanation of this indispensable condition has hitherto been given. To 100 litres of water are added 3 kilos. of rye meal; this mixture is boiled for half-an-hour, and next filtered through cloth; to the clear but thickish liquid are added 106 kilos. of pyro-phosphate of soda, 17 kilos. of protochloride of tin in crystals—so-called tin salt—67 kilos. of neutral protochloride of tin, 100 to 120 grammes of sulphuric acid; this liquid is placed in well-made wooden troughs, and serves more especially for the tinning of iron and steel wire—previously polished—for the use of carding machines. When, instead of the two sorts of tin just named, cyanide of silver and cyanide of potassium are taken, the iron is perfectly silvered.

A PATENT for the dephosphorisation of pig iron in employing the Bessemer process has been obtained, according to "Continental Correspondence," by the Hörde Mining and Furnace Union and the Rhenish Steelworks at Ruhrort. The method consists in throwing a quantity of magnesium lime, or a mixture of eight parts of lime to one of iron oxide, into the converter just before the metal flows in. Its weight is almost equal to the double quantity of the silica and phosphorus contained in the iron. After blowing for from six to ten minutes, the converter is quickly turned, and a mixture of from two to three parts of lime to one part of iron oxide free from silicic acid is thrown in. The second quantity is about two-thirds of the first. The converter is then raised, and blowing continues until the carbon lines of the spectrum disappear, and a thick brown smoke, with a well-defined edge of white smoke encircling the flame, appears at the mouth of the converter. The time taken in blowing is in general from one-fourth to one-seventh of that previously required.

TWO methods of preventing endosmose in a too fluid cell are described by M. D'Arsonval in the *Comptes Rendus*. First for cells without a porous diaphragm. A layer of powdered copper sulphate is covered by a layer of animal charcoal, and the zinc and exciting liquid placed on the top of these layers, as in an ordinary Callaud element. The zinc will remain unaltered for any length of time as long as the circuit is not completed. The internal resistance of the cell is increased by the charcoal, but not more so than by the sand usually used. The second method is to use a depolarising liquid, which forms a precipitate with the exciting liquid. This precipitate soon forms an impermeable coating on the walls of the porous cell, which prevents the mixing of the liquids by diffusion. The precipitate must conduct electricity and be an electrolyte. An element formed of zinc in zinc chloride in the outer cell, and silver in silver nitrate in the porous cell, has an E.M.F. of 1.5 volt, and a very small resistance. A cheaper element, composed of zinc in zinc sulphate, with lead in lead nitrate, has an E.M.F. of .6— .75 volt.

THE two newly-opened pyramids of Sakkarah have just been completely described by M. Brugsch in the Egyptian Institute at Cairo. They are situated in the desert west of Sakkarah. The galleries and chambers are covered with hieroglyphics, in which the two words "Merina" and "Pepi" occur as royal names. M. Brugsch showed from the context that the two pyramids were the monuments of the two kings, Pepi, and his son Horemsaf, of the sixth dynasty of Manetho. The granite sarcophagi, also covered with hieroglyphics, still stood in their old places; but of the mummies only one was found—that of Horemsaf, deprived of its ornaments and robes. The pyramids have evidently been plundered in ancient times. They are the earliest examples of royal graves in Egypt which are adorned with hieroglyphic inscriptions of a religious nature. The star Sothis—Sirius—the constellation Orion, and the planet Venus are represented. It is most remarkable that in the Cairo Museum there is a tombstone erected to the memory of a certain Una, an official at the court of King Pepi. The inscription on the stone refers to the building of the now opened pyramids of Sakkarah, which was superintended by Una.

MISCELLANEA.

WE notice that Mr. Arthur Rigg has removed his offices from 1, Fenchurch-street, to 42, Old Broad-street.

THE offices of Mr. James Cleminson have been removed from No. 5 to No. 7, Westminster-chambers, Victoria-street, Westminster.

THE firm of MacNaught, Robertson, and Co. has been re-constructed, and the well-known stock of iron and steel and girders will be again available.

MESSRS. WILLIAM DENNY AND BROTHERS have established a station of the Meteorological Society of Scotland in their ship-building yard at Dumbarton.

PRINCE LEOPOLD has consented to lay the foundation stone of the City and Guilds of London Technical College, Finsbury. The ceremony will probably take place early in May.

DE LESSEPS says the Panama canal will certainly be finished by 1888, on an estimated cost of 100,000,000 dols. The work will not require more than 8000 to 10,000 workmen in the most busy period.

FOR the construction of the new Whitty Harbour the local Harbour and Port Commissioners have received ten tenders from as many well-known contractors. The highest tender is £39,000 and the lowest £24,000.

ELECTRIC telegraphy made very small progress in China, owing to difficulties connected with the alphabet. The telephone, on the other hand, is hailed as a great acquisition, and is being largely adopted officially.

WE understand that Messrs. Dorman, Long, and Co., of the Britannia and West Marsh Ironworks, Middlesbrough, have appointed Messrs. Gill, McBride and Co., of 53, Gracechurch-street, E.C., their London agents.

THE Commissaire-Général of the Paris International Exhibition of Electricity informs those interested that the delay in the deposits of demands for admission, the period of the receipt of which was to have expired on the 31st, is prolonged up to the 15th of April.

IN a recent discussion before an architectural society in Paris, one of the engineers attributed the fall of the roof of St. Martin market to the unequal distribution of the snow, which had been swept by the wind and drifted in some places to a depth that had never been anticipated.

RULE of thumb modes of estimating the strength of ropes and chains have often killed people, and a man was killed, and another frightfully injured a few days ago at the Bankfoot Colliery shaft by the breaking of a rope, by which pipes were being raised and which fell upon and broke among the staging.

WE are informed that Messrs. R. Hornsby and Sons have been awarded ten separate highest awards at the Melbourne Exhibition for engines, thrashing machines, one-horse mowers, two-horse mowers, reapers, ploughs, winnowers, root pulpers, hedge cutters, and for their collection of general machinery.

ON the 4th ult., the U.S. excise order, which admitted plate and boiler iron in which holes are punched at 35 per cent. *ad valorem* was, according to the *American Manufacturer*, revoked by Secretary Sherman, and hereafter the rate of duty on all plate and boiler iron will be £5 per ton, as prescribed by law.

A VERY interesting biographical notice of Henri-Victor Regnault, to whom all engineers and every physicist owe so much, was read on the 14th inst., before the Institute of France, by M. J. B. Dumas, the perpetual secretary of the Académie des Sciences, and has been since published in the *Annales Industrielles*.

IT is proposed to lay a cable between the island of Sakhaline and the mainland of Western Siberia, a distance of about 63½ nautical miles. This island is a large Russian penitentiary, and, with the exception of four months in the summer, is cut off from the mainland, the only means of communication being by sledges.

ANOTHER joint stock company, we learn from "Continental Correspondence," has been formed, this time at Stettin, to enter on the business of letting out steam ploughs on hire to farmers. The benefit of this system seems already to be appreciated, for there is evidently a tendency to form similar companies all over the Continent.

ROUEN is investing heavily in the electric light. This city is to be illuminated, and tenders have been received from Messrs. Siemens and a local firm. The project includes the establishment of a motor of 500-horse power, capable of supplying 1200 lamps, of 50 Carcel burner power each. The light will be distributed amongst subscribers, who will be enabled to turn their own lights off and on at will.

IN the manufactures of England, the operatives employed number 2,930,000, against 2,781,000 of Germany, and 1,936,000 of France, and 1,150,000 of Russia. The production per operative is given as—United Kingdom, £224; France, £220; Germany, £103. In the principal textile manufactures, cotton and wool, the United Kingdom produces a total of the value of £155,000,000; the United States, £84,000,000; France, £68,000,000; Germany, £48,000,000.

ACCORDING to the Public Works report to June last, the total expenditure on public works in South Australia was £1,189,629, and the miles of railway open 631. The excess of receipts over expenditure during the twelve months pays £2 18s. 3d. per cent. on the capital expended. The largest profit was from the Port Pirie line, amounting to 11.14 per cent., due principally to goods traffic. The workings of the North-West Bend line show a profit of £10,000.

ON Friday last the directors in the firm of Bolckow, Vaughan, and Co., assembled at the Eston Steel Works to witness the inaugural "blow" of their third fifteen-ton Bessemer converter. The general manager, Mr. E. W. Richards, directed the proceedings. The new converter is fitted with a worm-and-wheel apparatus, as suggested by Mr. E. W. Richards, for preventing the calamitous liability of the converters to unexpectedly empty the contents into the "pit."

MESSRS. G. BAILEY TOMS AND CO., of 7a, Laurence Pountney-hill, have just published a new edition of their List of Sections. Many additional sizes of iron and various sections rolled in steel are given, so that shipbuilders, engineers, architects, and others, will have a ready means of finding out at a glance what rolls exist and what sizes they can most economically employ when designing work. The list contains over 1450 sections of angle, tee, bulb, joist, and channel iron and steel. The addition of steel sections is an important item, and the list should be in every constructor's office.

THERE is a Bill now before Parliament to give London the benefit of the system of compressed air clocks, which has been successfully and extensively established in Paris. The compressed air clocks consist of a new and very simple construction of the works of the ordinary timepiece, by which all the clocks of any city or town, however much separated and distant from each other, can be governed and wound up and regulated by means of a pneumatic air current and connecting mechanism that secures their regular going and their constant synchronisation. The movement can be applied to all existing clocks or timepieces, wherever placed, and there may be either one central motor or several, according to the area of each municipality. If the system were adopted in London and the environs, as proposed by the Bill already referred to, which has the consent and sanction of the City authorities and the Metropolitan Board of Works, the result would be that every clock embraced within the system, no matter where situated, would always indicate precisely the same time of the day or night. The number of stations proposed for the metropolis by the promoters of the Bill now before Parliament is ten. The maximum charge for public clocks is not to exceed 12s. 6d. per annum.

THE FUTURE DEVELOPMENT OF ELECTRICAL APPLIANCES.

PROF. J. PERRY delivered a lecture on this subject at the Society of Arts last week, which contains in an epitomised form the salient points of the hopes and fears of the more sanguine spirits of the electrical world. Prof. Perry is one of the two Professors who have been dubbed the "Japanese Twins," and whose insatiate love of work induced one of our most celebrated men of science to say that they caused the centre of experimental research to tend towards Tokio instead of London. Professors Ayrton and Perry have for some time been again resident in England, but it is evident that they did not leave any of their energy in Japan, for those who know them intimately, know that they are pursuing numerous original investigations, and that so soon as one is finished, another is commenced. It would have been difficult then to have found an abler exponent of the future of electricity.

Prof. Perry, after referring to what might have been said of the great things physical science has done for humanity, plunged into his subject. The work to be done was vast, and the workers altogether out of proportion to the task.

The methods of measurement of electricity is not generally understood. Perhaps when electricity is supplied to every house in the city at a certain price per horse-power, and is used by private individuals for many different purposes, this ignorance will disappear. Electrical energy is obtained in various ways, but the generators get heated, and one great object of inventors is to obtain from machines as much as possible electrical energy of the energy in the first place supplied to such machine. The lecturer called particular attention to the difference between electricity and electrical energy, and attempted to drive home the fundamental conceptions of electrical science by the analogies derivable from hydraulics. A miller speaks not only of quantity of water, but also of head of water. The statement then of quantity of electricity is insufficient, except we know the electrical property analogous to head of water, and which is termed electrical potential. A small quantity of electricity of high potential is similar to a small quantity of water at high level. The analogies between water and electricity were collected in the form of a table shown on a wall sheet as follows:

We Want to Use Water.

1. Steam pumps burn coal, and lifts water to a higher level.
2. Energy available is amount of water lifted x difference of level.
3. If we let all the water flow away through channel to lower level without doing work, its energy is all converted into heat because of frictional resistance of pipe or channel.
4. If we let water work a hoist as well as flow through channels, less water flows than before, less power is wasted in friction.
5. However long and narrow may be the channels, water may be brought from any distance, however great, to give out almost all its original energy to a hoist. This requires a great head and small quantity of water.

We Want to Use Electricity.

1. Generator burns zinc, or uses mechanical power, and lifts electricity to a higher level or potential.
2. Energy available is amount of electricity x difference of potential.
3. If we let all the electricity flow through a wire from one screw of our generator to the other without doing work, all the electrical energy is converted into heat because of resistance of wire.
4. If we let our electricity work a machine as well as flow through wires, less flows than before, less power is wasted through the resistance of the wire.
5. However long and thin the wires may be, electricity may be brought from any distance, however great, to give out almost all its original energy to a machine. This requires a great difference of potentials and a small current.

The difference between potential and electro-motive force was explained thus—"difference of potential" is analogous with "difference of pressure" or "head" of water, howsoever produced; whereas electro-motive force is analogous with the difference of pressure before and behind a slowly moving piston of the pump employed by an unfortunate miller to produce his water supply. Electricians have very definite ideas upon the subject they are working at, and especial attention is paid to the measurements on which their work depends. Examples of these measurements were shown by the following tables on wall sheets:—

ELECTRICAL MAGNITUDES (SOME RATHER APPROXIMATE.)

Resistance of

One yard of copper wire, one eighth of an inch diameter	0.002 ohms.
One mile ordinary iron telegraph wire	10 to 20 "
Some of our selenium cells	40 to 1,000,000 "
A good telegraph insulator	4,000,000,000,000 "

Electro-motive force of

A pair of copper-iron junctions at a difference of temperature of 1 deg. Fah.	= 0.000,0 volt.
Contact of zinc and copper	= 0.75 "
One Daniell's cell	= 1.1 "
Mr. Latimer Clark's standard cell	= 1.45 "
One of Dr. De la Rue's batteries	= 11,000 "
Lightning flashes probably many millions of volts.	

Current measured by us in some experiments:—

Using electrometer	= almost infinitely small currents.
Using delicate galvanometer	= 0.00,000,000,040 weber.
Current received from Atlantic cable, when 25 words per minute are being sent	= 0.000,001 weber.
Current in ordinary land telegraph lines	= 0.003 "
Current from dynamo machine	= 5 to 100 "

In any circuit, current in webers = electro-motive force in volts ÷ resistance in ohms.

RATE OF PRODUCTION OF HEAT, CALCULATED IN THE SHAPE OF HORSE-POWER.

In the whole of a circuit = current in webers x electro-motive force in volts ÷ 746.
 In any part of circuit = current in webers x difference of potential at the two ends of the part of the circuit in question ÷ 746.
 Or, = square of current in webers x resistance of the part in ohms ÷ 746.
 If there are a number of generators of electricity in a circuit, whose electro-motive forces in volts are—E₁, E₂, &c., and if there are also opposing electro-motive forces, F₁, F₂, &c., volts, and if C is the current in webers, R the whole resistance of the circuit in ohms, P the total horse-power taken at the generators, Q the total horse-power converted into some other form of energy, and given out at the places where there are opposing electro-motive

forces, H the total horse-power wasted in heat, because of resistance, then—

$$C = \frac{(E_1 + E_2 + \&c.) - (F_1 + F_2 + \&c.)}{R}$$

$$P = \frac{C}{746} (E_1 + E_2 + \&c.); Q = \frac{C}{746} (F_1 + F_2 + \&c.)$$

$$H = \frac{C^2 R}{746}$$

The lifting power of an electro-magnet of given volume is proportional to the heat generated against resistance in the wire of the magnet.

The future of many electrical appliances depends on how general is the public comprehension of the lessons taught by these wall sheets. If a few capitalists in London would only spend a few days in learning thoroughly what these mean, electrical appliances of a very distant future would date from a few months hence.

A number of experiments were shown, in some of which electrical energy was converted into heat, in others into sound, in others into work. At this part of the lecture reference was made to the work of Prof. Ayrton and his pupils at Cowperstreet (City and Guilds of London Institute Classes). They measure (1) the gas consumed by the engine, (2) the horse-power given to the dynamo machine, (3) the current in the circuit in webers, and (4) the resistance of the circuit. Thus exact calculations can now be made as to the horse-power expended in any part of the circuit, and the light given out in any given period by an electric lamp. The dynamometers used in these measurements were described, but at present, in some cases, the description given is for various reasons incomplete, so that we shall take a future opportunity of writing of these instruments. To measure the light a photometer, constructed by Profs. Ayrton and Perry, is used, which obviates the necessity of large rooms, and enables the operator to give the intensity in a very short period of time. A number of measurements of the illuminating power of an electric lamp were rapidly made during the lecture with this photometer. By means of a small dynamo machine, driven by an electric current generated in the Adelphi arches, a ventilator, a sewing machine, a lathe, &c., were driven; in the latter a piece of wood was turned. "What," said the lecturer, "do these examples show you?" "They show that if I have a steam-engine in my back yard I can transmit power to various machines in my house, but if you measured the power given to these machines you would find it to be less than half of what the engine driving the outside electrical machine gives out. Further, when we wanted to think of heating of buildings and the boiling of water, it was all very well to speak of the conversion of electrical energy into heat, but now we find that not only do the two electrical machines get heated and give out heat, but heat is given out by our connecting wires. We have then to consider our most important question. Electrical energy can be transmitted to a distance, and even to many thousands of miles, but can it be transformed at the distant place into mechanical or any other required form of energy, nearly equal in amount to what was supplied. Unfortunately, I must say that hitherto the practical answer made to us by existing machines is 'No,' there is always a great waste due to the heat spoken of above. But, fortunately, we have faith in the measurements, of which I have already spoken, in the facts given us by Joule's experiments and formulated in ways we can understand. And these facts tell us that in electric machines of the future, and in their connecting wires, there will be little heating, and therefore little loss. We shall, I believe, at no distant date, have great central stations, possibly situated at the bottom of coal-pits where enormous steam engines will drive enormous electric machines. We shall have wires laid along every street, tapped into every house, as gas-pipes are at present; we shall have the quantity of electricity used in each house registered, as gas is at present, and it will be passed through little electric machines to drive machinery, to produce ventilation, to replace stoves and fires, to work apple-parers, and mangles, and barbers' brushes, among other things, as well as to give everybody an electric light."

It is possible, as Prof. Ayrton first showed in his Sheffield lecture, that electrical energy can be transmitted through long distances by means of small wires, and that the opinion that wires of enormous thickness would be required is erroneous. The desideratum required was good insulation. He also showed that, instead of a limiting efficiency of 50 per cent., the only thing preventing our receiving the whole of our power was the mechanical friction which occurs in the machines. He showed, in fact, how to get rid of electrical friction. A machine at Niagara receives mechanical power, and generates electricity. Call this the generator. Let there be wires to another electric machine in New York, which will receive electricity, and give out mechanical work. Now this machine, which may be called the motor, produces a back electro-motive force, and the mechanical power given out is proportional to the back electro-motive force, multiplied into the current. The current, which is, of course, the same at Niagara as at New York, is proportional to the difference of the two electro-motive forces, and the heat wasted is proportional to the square of the current. You see then, from the last table, that we have the simple proportion—power utilised is to power wasted, as the back electro-motive force of the motor is to the difference between electro-motive forces of generator and motor. This reason is very shortly and yet very exactly given as follows:—

Let electric motive force of generator be E; of motor F. Let total resistance of circuit be R. Then if we call P the horse-power received by the generator at Niagara, Q the horse-power given out by motor at New York, that is, utilised. H the horse-power wasted as heat in machines and circuit; C the current flowing through the circuit.

$$C = \frac{E - F}{R}$$

$$P = \frac{E(E - F)}{746 R}$$

$$Q = \frac{F(E - F)}{746 R}$$

$$H = \frac{(E - F)^2}{746 R}$$

$$Q : H :: F : E - F$$

The water analogy was again called into play in the shape of a model for the better demonstration of the problem. The defects in existing electric machines and the means of increasing the E.M.F. were discussed, the conclusions pointing to the future use of very large machines and very high velocities. The future of telephonic communication received a passing remark, and attention called to the future of electric railways. The small experiments of Siemens have determined the ultimate success of this kind of railway. Their introduction is merely a question of time and capital. The first cost of electric railways would be smaller than that of steam railways; the working expenses would also be

reduced. The rails would be lighter, the rolling stock lighter, the bridges and viaducts less costly, and in the underground railways the atmosphere would not be vitiated.

"About two years ago, it struck Professor Ayrton and myself, when thinking how very faint musical sounds are heard distinctly from the telephone, in spite of loud noises in the neighbourhood, that there was an application of this principle of recurrent effects of far more practical importance than any other, namely, in the use of musical notes for coast warnings in thick weather. You will say that fog bells and horns are an old story, and that they have not been particularly successful, since in some states of the weather they are audible, in others not.

"Now, it seems to be forgotten by everybody that there is a medium of communicating with a distant ship, namely the water, which is not at all influenced by changes in the weather. At some twenty or thirty feet below the surface there is exceedingly little disturbance of the water, although there may be large waves at the surface. Suppose a large water-syren like this—experiment shown—is working at as great a depth as is available, off a dangerous coast, the sound it gives out is transmitted so as to be heard at exceedingly great distances by an ear pressed against a strip of wood or metal dipping into the water. If the strip is connected with a much larger wooden or metallic surface in the water the sound is heard much more distinctly. Now, the sides of a ship form a very large collecting surface, and at the distance of several miles from such a water syren as might be constructed, we feel quite sure that, above the noise of engines and flapping sails, above the far more troublesome noise of waves striking the ship's side, the musical note of the distant syren would be heard, giving warning of a dangerous neighbourhood. In considering this problem, you must remember that Messrs. Colladon and Sturton heard distinctly the sound of a bell struck under water at the distance of nearly nine miles, the sound being communicated by the water of Lake Geneva."

The next portion of the lecture discussed the great value of a rapid recurrence of effects, the obtaining of sound by means of a rapid intermission of light rays on selenium joined up in an electric circuit being instanced as an example. Then recent experiments on the refractive power of ebonite were detailed—through results tending to give greater weight to Clark-Maxwell's electro-magnetic theory of light. The index of refraction of ebonite was found by Profs. Ayrton and Perry to be roughly 1.7. Clerk-Maxwell's theory requires that the square of this number should be equal to the electric specific inductive capacity of the substance. For ebonite this electric constant varies from 2.2 to 3.5 for different specimens, the mean of which is almost exactly equal to the square of 1.7.

The lecture concluded with a description of Profs. Ayrton and Perry's plan for seeing at one place a moving object at a distant place.

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

(From our own Correspondent.)

NOT much business was done upon 'Change either in Birmingham to-day—Thursday—or yesterday in Wolverhampton; yet such sales of raw iron as one lot of 2000 tons and a few of 200 tons each were reported. In the terms by which these sales had to be regulated, buyers' terms had to be accepted in a somewhat larger degree than sellers were prepared to recognise a week ago. Prices in these, and most other transactions which are now taking place, are not amenable to conspicuous mention. Nevertheless, there are firms in the crude and also the finished iron branches who refuse to give way upon the prices which they had been demanding for the past three weeks.

Derbyshire iron, of the Staveley brand, could not be got at less than £2 7s. 6d., though the make is in excess of the demand; and offers at only a little below £3 7s. 6d. for Tredgar hematite qualities of forge pigs were promptly rejected. Northampton pigs were quoted by sellers at £2 5s. down to £2 2s. 6d. All these prices were too high to secure sales. More was done in cinder iron at £2 down to £1 17s. 6d., and in rare instances down to £1 16s. 3d., and even £1 15s. per ton. All-mine iron was again quoted £3 5s., but the money could not be got; and between that figure and £3 was occasionally accepted. There continues a tendency by some mill and forge proprietors to delay the receiving of pigs whose delivery is, nevertheless, somewhat overdue.

Few mills can be kept at full work, yet there are cases this week in which less difficulty than existed a week ago is found in getting specifications from customers, and where, consequently, more work is being done than at the date of my last. Other firms of the same class, to secure orders have this week to accept for sheets a drop of 2s. 6d. per ton upon the prices which they were before demanding. In working-up sheets of the less valuable sort a steady business is being transacted, and the demand for sheets for galvanising does not show a reduction on the week. Orders received on Tuesday afternoon from the Cape, and yesterday from Australia, have improved the galvanisers' position, and to-day more business than yesterday was done in sheets for corrugating, but at no improvement in rates. These were mostly determined by the necessities of the ironmasters. No quotation ruled which the firms deemed themselves called upon to recognise.

Boiler plates of good brands were not in much request either in Birmingham or Wolverhampton; but the manufacturers expressed confidence in a better trade at an early date. The facts set forth in the paper by Mr. D. Phillips, M. Inst. C.E., read on the 22nd March before the Institute of Civil Engineers, on "The Comparative Endurance of Iron and Mild Steel when Exposed to Corrosive Influence," have done much to excite this hope. Ironmasters here were prepared to learn that the anti-corrosive properties of iron were superior to those of steel even to the extent of percentage ranging from 11.8 to 32.7; but they scarcely expected to hear news so good to them as that in the metals testing in sea-going ships the ordinary "best best" Staffordshire iron proved 9.6 per cent. better than the best Yorkshire, as regarded loss of weight. Indeed, so good is the news, that before they accept it without any sort of questioning, certain of them who are experienced in the chemistry of metals, are awaiting the discussion upon the paper. Still such testimony coming from a man of Mr. Phillips' professional standing, after experiments of an important character, is deemed likely to prove incapable of serious refutation.

Some business was done to-day in cheap bars for railway nut and bolt, and also hurdle-making, and for 100 tons a price was stated to have been accepted which I decline to publish. Nevertheless, such bars were to be had at from £5 17s. 6d. down to £5 15s. and £5 12s. 6d. per ton without much difficulty. Prices were not strengthened by the growing expectation by merchants that at the quarterly meetings there will be a reduction declared in the leading brands of iron. No more encouragement to this view than a week ago was, however, offered by ironmasters.

Coal was tendered yesterday at slightly less money. The advance of 1s. per ton recently put on has been taken off by Earl Dudley, who has also taken 6d. off slack.

A meeting of the South Staffordshire Mill and Forge Wages Board was held in Birmingham on Tuesday. The most important business was a complaint by the representatives of the operatives that they were receiving 6d. per ton in extras less than the men in the North of England, and they applied to be placed on an equality with the men in the North. The employer denied that the men

in this district were receiving less than the men in the North; and the president intimated that he would consider his decision, and, if necessary, visit the North of England to inquire into the customs prevailing there before making his award.

The new president of the South Staffordshire Mill and Forge Managers' Association—Mr. Joseph Morris—while returning thanks for his election at the recent annual meeting, gave the Association some wholesome advice. Speaking of the general longing for better trade, he said that manufacturers should remember that when the good trade did come, it would bring with it a host of the keenest competitors. If America would forego her shallow policy or if China could be opened up, there would be good trade for many years to come; but they must always recollect that other countries were progressing equally as fast as the old country. Therefore associations like theirs should aim at the greatest excellence in their products. He spoke also in favour of a revised and liberal rate of tariff being conceded by the carrying railway companies to South Staffordshire.

The machinery and constructive ironwork manufacturers in the locality around Birmingham continue mostly actively engaged, but a great deal of the business undertaken, more especially by the heavy ironfounders, scarcely yields a profit, so keen is competition.

Wrought iron tubes keep in good request. Some large orders are under execution for Bombay in particular, and on behalf of Australia individual inquiries are being made in this district for between 200,000ft. and 300,000ft. of gas and water tubes. But for some such contracts a price is stipulated which would leave manufacturers almost £1 per ton to the bad. The offers are therefore rejected by firms of acknowledged position.

Messrs. Jno. Hunt and Co., manufacturers of chandeliers and gas-fittings, Birmingham, have received a first-class award at the Melbourne Exhibition.

A meeting of the Birmingham Chamber of Commerce was held on Tuesday—Mr. E. Booth presiding—at which the subject of bi-metallism was discussed, after a paper recommending its adoption had been read by Mr. J. P. Turner. In the discussion Professor Leone Levi argued against the principle as economically erroneous. It was resolved to memorialise the Government to send unpledged delegates to the proposed International Conference on the subject.

NOTES FROM LANCASHIRE.

(From our own Correspondent.)

Manchester.—The continued depression in the iron trade of this district is tending to create a despondent feeling as to the course of events in the immediate future. The anticipations which were entertained in January and December of an active trade during the spring and summer are not being realised, and unless there is some marked change during the next two or three weeks the prevailing belief is that a very dull trade all through the summer is more than probable. There has again been an extremely sluggish market during the past week; transactions are confined to small purchases for hand-to-mouth requirements, and, although sellers are willing to accept very low prices to secure orders, buyers do not care to speculate in the face of the continued downward tendency of the market.

Lancashire makers of pig iron are securing no new orders of importance at present, 10-ton parcels representing the average character of the business at present being done, and considerable stocks are accumulating at the works. For delivery into the Manchester district 45s. for No. 4 forge and 46s. for No. 3 foundry less 2½ are the nominal quotations, but local makers are open to offers, and there is little doubt iron could be bought at 1s. per ton under these figures.

Outside brands are being offered here at very low figures, and Lincolnshire and Derbyshire irons delivered equal to Manchester could be bought at from 44s. 6d. to 45s. 6d. per ton less 2½ for g.m.b. Middlesbrough iron, 46s. 4d. to 46s. 7d. per ton net cash being quoted.

There is no very material change to report in the position of finished ironmakers. But few new orders are coming in and prices are weak. Ordinary bars delivered into the Manchester district are quoted at from £5 15s. to £5 17s. 6d.; hoops, £6 10s.; common plates, £7; and common sheets £7 10s. per ton.

A dull tone prevails throughout the coal trade of this district. The output of the Lancashire collieries has already considerably overtaken the requirements of consumers, and large quantities of coal are held in wagons on the railway sidings, whilst many of the pits are being stopped one day a week. With the present output it is evident that before long short time will have to be adopted generally at the collieries, or large quantities of stock will have to be put down on the pit banks. The superabundance of supplies is naturally causing a downward tendency in prices, good slack, of which there is a probability of scarcity during the summer, being the only class of fuel in which any real stand is being made. Best coal at the pit mouth is quoted at from 9s. 6d. to 10s.; seconds, 7s. 6d. to 8s.; steam and forge coals, 5s. 6d. to 6s.; burgy, 5s.; and slack, 3s. 6d. to 4s. 6d.

Coke is in fair demand, and prices at the ovens remain at about 10s. to 11s. for small, and 12s. to 15s. per ton for large coke.

A small apparatus, invented by Mr. T. W. Embleton, of Methley, for testing safety lamps with gas, was exhibited by Mr. J. Dickinson, H.M. chief inspector of mines, at the meeting of the Manchester Geological Society on Tuesday. The apparatus consists of a ring 6in. in diameter with an entrance pipe on one side, through which the gas is allowed to pass. The ring is constructed of ¼in. copper tubing perforated on the inside where the lamp is placed with twenty-four small jet holes. Mr. Dickinson said he had seen the apparatus in use, and also the box or case test, and of the two he preferred the ring.

Messrs. W. and J. Galloway and Sons, of the Knott Mill Ironworks, Manchester, have been commissioned to construct the engines, gearing, boilers, &c., for driving the machinery in the Woollen Exhibition, which is to be opened in June at the Crystal Palace, it is expected by the Prince of Wales. The engines will be of 120-horse power, compound horizontal, of the well-known Galloway type, and similar to those which gained a grand prize at the Paris Exhibition. The same firm have also in hand a pair of vertical direct-acting blowing engines of large dimensions for the Carnforth Iron Company's blast furnaces.

As an indication that mining enterprise is being developed in China, I may mention that Messrs. W. H. Bailey and Co., of the Albion Works, Salford, have just completed a very large delivery to a Chinese company of miners' safety lamps, consisting of the improved Glanny and Stevenson types, pumping machinery, and boiler fittings of various classes. A new engine lubricator, which I am informed is taking very well, is also being brought out by the above firm. This is termed the "oleojector," or injector lubricator, and briefly described, consists of a small vessel to contain the oil, which is placed over a small steam injector, into which the oil is dropped by a regulated supply, and at the end of every stroke of the engine the injector forces the oil in a spray into the cylinder.

The contract for the new Manchester Post-office has just been secured by Messrs. R. Neill and Sons of this city. The building, the erection of which will occupy about three years, will include a large amount of fire-proof work.

The Manchester and Suburban system of tramways is being gradually completed, and further sections connecting Manchester with Oldham, Ashton, and Withington, were inspected by Major-General Hutchinson on Friday. The systems on which the lines are being laid down I have already described in previous letters.

It is proposed by the Manchester Corporation to erect additional baths for one of the most populous parts of the city, and I understand they have decided to introduce all the modern improvements that are available.

The Cheshire Lines Committee are practically returning to their original scheme with regard to their railway route between Manchester and Liverpool, and have commenced the construction of a short length of two and a-half miles between Padgate and Sankey

on their Liverpool Extension line, which will considerably shorten the distance between Liverpool and Manchester. The line is being constructed over a perfectly flat country, and apart from a few girder bridges, there are no engineering features connected with it deserving special notice.

At a special meeting of the Manchester Scientific and Mechanical Society, held on Friday last, the recommendation of the council that the society should be dissolved was unanimously adopted. There was, however, only a very small attendance, and this decision will have to be submitted for confirmation or otherwise to a general meeting of the members to be held on the 29th inst.

The report of the Belgian Commission on fire-damp in mines, which has just been issued, shows that during a period of fifty-nine years, up to 1879 last, over which the report extends, there were in the Belgian mines 412 fatal explosions of fire-damp, and of these no less than 120 are set down as having been caused by gunpowder.

Barrow-in-Furness.—In my last week's report I noticed that a much better tone was apparent in the hematite pig iron market. I have still to note that the improvement continues, although perhaps not to the extent which was expected. The furnaces are turning out a heavy tonnage of metal; but most of the business which is being transacted is through second-hand parcels. Makers being well sold forward do not show any great inclination to do business on a large scale at rates now ruling. This is considered the best part of the year for orders, and makers having plenty of orders to execute, feel sure ere long better prices will be obtained. From appearances and trustworthy information, however, I should say that the tone this week has a very healthy appearance, and buyers seem disposed to place their orders in hand.

America is giving proof that her demands will be large, inquiries from that quarter are on the increase. The home and continental demand is better. All round things appear to be brightening up. As the shipping season sets fairly in, there will be heavy consignments made.

Metal is changing hands at from 60s. to 64s. at makers' works for Bessemer qualities. Producers of pig iron are turning out a heavy tonnage. A few furnaces in the district are out of blast, but this is on account of necessary repairs.

The steel trade is very well employed, good orders are held and others could be secured, but makers are asking higher rates.

Shipbuilders still keep up their activity, and with the orders in hand, activity will prevail for some time. Contracts, in some instances, have not, I hear, brought a profit, but a loss.

Engineers, boiler-makers, and others, fairly supplied with work. Iron ore meets with a ready sale at from 13s. to 16s. 6d. per ton.

THE NORTH OF ENGLAND.

(From our own Correspondent.)

THE tone of the iron market, held at Middlesbrough on Tuesday, was decidedly better than it was a week since, although prices could scarcely be said to be higher. The improvement is traceable to two causes, viz., a slight rise in the value of iron at Glasgow, and a very considerable increase recently in shipments from the river Tees. During January the total shipments of pig iron were 47,702 tons; during February, 57,164 tons. During the first week in March, 16,633; during the second, 15,059; during the third, 15,928; and during the fourth, 26,154 tons were shipped. It is clear, therefore, that a great impetus has been given to shipments during the last week. The results of the first three weeks are very poor, and only about equal to the average of January—certainly far below February; but last week will help to bring up the total of the month to a fair amount for the time of year; and, indeed, it is not unlikely that 90,000 tons will be very nearly, if not quite, attained. What business was done in pig iron on 'Change was almost entirely for prompt delivery, neither buyers nor sellers caring to commit themselves far ahead. The price of No. 3 foundry iron was 38s. to 38s. 3d. for immediate delivery, or 38s. 6d. over the next two months. Forge iron was 9d. per ton less, and warrants 1s. per ton more. It is noticeable that the premium paid for warrants has gradually diminished from 1s. 6d. to 1s. per ton, indicating weakness among warrant holders. Stocks are not likely to be so large as was expected a short time since, but still they will probably be found to have increased something like 15,000 tons for the month. The official statistics will be announced in about a week. Connal's stores contain 2690 tons more than when last reported, the total at Middlesbrough being 159,666 tons. In manufactured iron competition has told considerably in reducing prices still further. The value of ship plates in quantity may be considered to be £6 5s. per ton, or £6 7s. 6d. for small lots. These prices are f.o.t. at makers' works, and less 2½ per cent. for cash. Angles and bars are the usual 20s. per ton less. Old rails may be had at £3 7s. 6d. c.i.f. for "flat bottoms," and 5s. per ton more for "double-heads." Purple ore is offered, for delivery over the second half of the year, at 18s. per ton f.o.t. Middlesbrough, cash less 2½ per cent. Heavy scrap for piling fetches £3 7s. 6d. to £3 10s., and light scrap and turnings, for use in the puddling furnace, £2 10s. per ton. The foundry trade continues dull; heavy covered sand castings are obtainable at £4 per ton, and other descriptions in proportion.

The coal trade is decidedly flat, and prices are tending downwards, though scarcely perhaps to a quotable extent. Coal shipments from most of the Durham ports have diminished as compared with the corresponding month of last year. The Baltic and North Sea Swedish ports are still closed, but this cannot continue long, and, therefore, an early improvement may be looked for in exports.

A nice little message has been sent to the manager of the Jarrow Shipbuilding and Iron Company—Palmer's—by the secretary of the Ironworkers' Association, comprising platers, riveters, &c., employed in shipyards. The message gives formal notice that the association cannot in future think of allowing overtime to be worked on new work under any circumstances! How persistently the British workman delights to quarrel with his bread and butter whenever he has any to quarrel with! Not eighteen months have passed since the Tyne shipyards were mostly idle, and crowds of these same ironworkers were loitering about the gates, lean and famished, and eager for employment, which was not then to be had. Now there is work for a time, and if their one object was to drive it away, they could scarcely have adopted a better policy for achieving it than the above. In another twelve or eighteen months the new French, and perhaps other foreign yards, will be in operation, manned with foreigners and restricted to the use of foreign iron. Members of the British Ironworkers' Association may then again be loitering about the shipyard gates, eager for the work they have driven away, never, perhaps to return in their time.

Efforts are being made to put into operation the North Yorkshire Ironworks at South Stockton.

THE SHEFFIELD DISTRICT.

(From our own Correspondent.)

I HAVE been over most of the large steel and iron concerns during the week, and have come to the conclusion that trade affairs are not quite so "rosy" as they have been represented to be. No fresh orders of any consequence have been received in railway material for some time, and other heavy branches are also more languid. The complaints as to "cutting" of prices increase on every side. Competition keeps excessively keen, and there can be little doubt that a great deal of work is being done at prices which are not profitable. I hear of firms sending out travellers with instructions to sell steel between certain prices. They are to do business—anything between a maximum and a minimum price which is named. This is not a healthy state of affairs.

One remunerative speciality—the manufacture of armour-plates—is in a prosperous state. Our Government spent a long time in deciding about the adoption of the armour-plate of the future, and

there has been wisdom in the delay—for the plates that are being made to-day are far superior to those made twelve months ago. Now that they have made up their minds, heavy orders for immediate delivery are dropping in, and the armour-plate mills are busier than they have been for a long time. There is not much doing on foreign account, though I hear that Messrs. Charles Cammell and Co., limited, have an order for composite armour plates in hand for the French Government.

I mentioned last week that by the Northfield Iron Company application for a petition to wind up its affairs in voluntary liquidation had been made. Private meetings of creditors, debenture-holders, and shareholders, have been held this week. The liabilities of the company are £88,000, and the assets £78,000, showing a deficiency of £10,000. The liabilities are made up of £48,000 ordinary debts, &c., and the share capital, which amounts to £40,000. The shareholders have passed resolutions in favour of liquidation.

Messrs. Brown, Bayley, and Dixon, Limited, whose affairs are in liquidation, have also held a private meeting this week. The object of the meeting was to decide on a composition to be made to the creditors. The liquidators state that under their management they have made a profit of £1161 in six weeks, and the opinion was expressed that seeing such a profit could be made, it was well worth making an effort to preserve the business.

NOTES FROM SCOTLAND.

(From our own Correspondent.)

THERE has been rather more strength in the Glasgow pig iron market this week, but no particular reason can be given for this change, except that the shipments of the past week are considerably larger than was anticipated. They amounted to 12,262 tons, which compare with 7893 in the preceding week, and 23,597 in the corresponding week of last year. It is natural to expect, now that the weather has somewhat improved and that the ice-bound ports of the Continent are gradually opening, that the foreign demand will exhibit some improvement. A few orders have also been placed on American account, and the prices are so moderate as to give rise to the expectation that customers will now send in their orders. An advance of 1s. in quotations would at least lead to some speculative buying, of which there has been little on the part of the outside public for several weeks. Stocks continue to increase, the addition for the week to those in Messrs. Connal and Co.'s stores having been 3170 tons, bringing up the aggregate while I write to 537,221 tons. One furnace has gone out at the Clyde Ironworks, but an additional one has been lighted at Chapelhall, and another at Eglinton, making an increase of one, the total being 121, against 114 at the same date last year, and seven of the number are making hematite.

Business was done in the warrant market on Friday forenoon at from 48s. 2d. to 48s. 5d. cash, and 48s. 4d. to 48s. 6d. one month; the quotations in the afternoon being 48s. 4d. to 48s. 1d. cash, and 48s. 6d. to 48s. 3d. one month. On Monday transactions were effected at 48s. 2½d. to 48s. 1½d. cash, and 48s. 3½d. to 48s. 3d. one month in the morning, and at 48s. 1½d. to 48s. 1d. cash, and 48s. 3d. to 48s. 2½d. one month in the afternoon. The market was firmer on Tuesday at 48s. to 48s. 3d. cash. A large business was done on Wednesday, at 49s. 3d. to 49s. 5d. one month, quotations being rather easier at the close. To-day—Thursday—the market was strong, with business up to 49s. 4d. eight days.

Makers' prices have been a shade firmer, and the following are the quotations at which the different brands can be purchased:—G.m.b., f.o.b. at Glasgow, per ton, No. 1, 49s. 6d., No. 3, 47s. 6d.; Coltness, No. 1, 58s. 6d., No. 3, 50s. 6d.; Gartsherrie, 58s. 6d. and 50s. 6d.; Langloan, 58s. 6d. and 50s.; Summerlee, 57s. 6d. and 50s.; Calder, 58s. and 50s.; Carnbroe, 55s. and 49s. 6d.; Clyde Monkland, Quarter, and Govan, 49s. 6d. and 47s. 6d. each; Shotts at Leith, 59s. and 51s. 6d.; Carron, at Grangemouth, 52s. 6d.; (specially selected, 56s.) and 51s. 6d.; Kinnell, at Bo'ness, 50s. and 48s. 6d.; Glaengarnock, at Ardrossan, 55s. and 50s. 6d.; Eglinton and Dalmellington, 49s. 6d. and 47s. 6d. cash.

Arrivals of iron ore from Spain continue large.

The malleable trade is well employed, but in some cases fresh contracts would now be welcome.

The ship joiners in the Glasgow district have resolved to solicit an advance of 7½ per cent. on their present wages, requesting an answer from the employers by the 8th April.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

SOME idea of the dimensions of the Welsh coal trade now going on may be gathered from facts that I have gleaned in the Rhondda Valley. From one colliery in this Valley—the Clydach—1000 tons per day have been sent regularly since the first day of the year. From the Ocean collieries, again, it is estimated from the quantity sent that one acre of coal per day is not only cut, but sent away. The anthracite trade is decidedly dull, and the conclusion seems to be forced more strongly than ever upon the buying world that its province is pretty well confined to malting, and that for household purposes and quick engineering necessities it is unsuited. Taking the two leading coals of South Wales as bituminous and anthracite, those coals occupying a middle position seem to be most in favour. The 4ft. seam, that of Cyfarthfa, will soon be increased in output. Plymouth and Dowlais are also well in demand, and, though there has been a slight dullness during the last week or two, prices are firmer for the last few days. Thus for best qualities at Cardiff the market rate is 10s. 6d. to 11s., for the best qualities f.o.b., and for second-class, 9s. 6d. to 10s. These may be regarded as the prevailing prices, and if not maintained at Swansea so firmly as at Cardiff it may be considered as due to the coal not being of so good a quality. Steam coal is in freer demand than house coal, especially in Monmouthshire, where the invariable spring dullness in this branch has made itself conspicuous a little earlier than usual.

I am glad to note that the capital for the Newport, Caerphilly, and Rhondda Valley Railway has at last been paid up, and now it may be taken for granted that operations will begin forthwith. The Taff Vale line up the Clydach is progressing well.

A deputation from South Wales will have an interview with the Great Western Railway authorities at Paddington next week respecting a connection between the Taff and Great Western at Cardiff.

I am glad to report that steel rail orders to the extent of several thousand tons have been booked in the district lately on American account. Prices for steel are firm, but are dropping for iron. Welsh bar quotations are £5, iron rails at £5 2s. 6d. The other branches, tin bar and hematite bar, are moderately good, and, in fact, most of the works continue at full time.

I hear at Swansea that a movement is on foot to start a new patent fuel works on a greater scale than any now existing in the country. Prospects for this trade are certainly good. The works which have returned *nil* for a long time yielded 5 per cent. last dividend.

No improvement of any appreciable kind has taken place in the tin-plate trade, and prices hang heavily at 14s. 6d. to 15s. This means a loss on every box of coke plate made. Deducting cost of freight to Liverpool or London, it will be evident that the residue is worse than unremunerative.

A new mill was started at Machen Tin-plate Works last week. The report of the British Iron Trade Association is favourable as showing a marked improvement in the make of 1880 over 1879. As regards South Wales the production of iron was 207,572 tons over the previous year, and in North Wales 34,077 tons. There is, however, good scope for further improvement, as in South Wales only seventy blast furnaces are in operation and ninety-five are still idle.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

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

Applications for Letters Patent.

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

- 1246. AERO-STEAM MOTOR, G. W. von Nawrocki. (Paul Lockmann, Zeitz, Germany.)
1247. ICE MACHINES, H. Haddan. (O. Kroppf, Germany.)
1248. TWIST LACE MACHINES, J. Newton, Kimberley.
1249. TAPS, &c., P. O'Connor, Wavertree.
1250. SHOW-STANDS, L. Groth. (A. Dubois, Paris.)
1251. DIP-PIPE, S. Chandler, Surrey, and G. Stevenson, Westminster.

- 1252. LIFTING, &c., WINDOW SHADERS, J. Lewis, Halifax.
1253. COFFEE, J. Challinor, Liverpool.
1254. STEAM-ENGINE INDICATORS, C. R. F. Schloesser. (Messrs. D. Rosenkrantz and Droop, Hanover.)
1255. PRINTING FABRICS, R. Ritchie and J. Ferguson, Dunbarton.
1256. COLOURING MATTERS, G. W. von Nawrocki. (J. R. Geigy, Basel, Switzerland.)
1257. LAYING TELEGRAPH WIRES, S. Pitt. (W. B. Espeut, Spring-gardens, Buff Bay, Jamaica.)
1258. PACKING BOTTLES, S. C. Davidson, Belfast.
1259. LUBRICANTS, J. Dickson and J. Mills, Liverpool.
1260. REVERSIBLE GARMENTS, W. E. Gedge. (S. Rosenthal, Baltimore, U.S.)
1261. SULPHO-CYANIDES, &c., H. E. Newton. (Ury de Ginzburg and J. Tcherviac, Paris.)
1262. LAMPS, C. G. Crawford, London.
1263. ADVERTISING, J. P. Bennett, London.
1264. VELOCIPEDS, W. Lake. (G. B. Scuri, Turin.)
1265. UNOCCUPING, &c., C. F. C. Morris and F. H. Bennett, London.

- 1266. COP TUBES, J. C. Vanlohe, Providence, U.S.
1267. COUCH, &c., F. W. Sinnock, Bristol, and G. R. Martin, Bath.
1268. STOPPERS, N. Thompson, London.
1269. NECKTIES, &c., S. W. Robinson, Nottingham.
1270. FASTENING STRAPS, W. R. Lake. (C. F. Littlejohn and H. Ford, New Haven, U.S.)
1271. PICKLING, &c., PLATES OF IRON, D. Rosser and W. Rosser, Gloucestershire.
1272. COTTON-COVERED WIRE, W. R. Lake. (H. Splittendorf, New York, U.S.)
1273. WHEELS, A. Uljee, and J. Cleminson, Westminster.
1274. WHEEL TIRES, A. Uljee and J. Cleminson, Westminster.

- 1274. HOPPERS, &c., J. Redgate, Nottingham.
1276. CUTTING PAPER, J. H. Johnson. (H. Schlatter, Reutlingen, Germany.)
1277. FURNACES, &c., H. Grant. (A. Prevot, Bergerac.)
1278. PULP, J. Fisher, London.
1279. PREPARING WOOL, &c., I. Holden. (W. C. Bramwell, Hyde Park, U.S.)
1280. STEAM, &c., ENGINES, W. Johnson, Liverpool.
1281. WATCHES, H. Aspinall, Liverpool.
1282. STEAM BOILERS, C. W. King, Manchester.
1283. CHOLERA COMPOUND, W. Williams, London.
1284. GUNS, F. Cheesbrough. (J. Haskell, U.S.)
1285. GOVERNORS, M. Benson. (P. Jordan, U.S.)
1286. RESERVOIRS, O. Wolf. (A. Nieske, Dresden.)
1287. HIDES AND SKINS, A. M. Clark, London. (C. J. P. Desnos, Paris.)
1288. ORNAMENTING FURS, A. M. Clark, London. (L. Havassy, New York, U.S.)
1289. SOAP, P. Jensen. (J. Weinek, Grafendorf.)
1290. BELLS, &c., W. R. Comings, London.
1291. HOMINY, B. J. B. Mills. (W. S. Boon, St. Louis, and R. H. Hall, Watertown, U.S.)
1292. CORES, &c., J. Watson, Rotherham.
1293. KITCHEN RANGES, J. Watson, Rotherham.
1294. PURIFYING GASES, C. F. A. W. and A. L. Lawton, Rochester, U.S.

- 1295. PRESERVING SUBSTANCES, C. F. A. W. and A. L. Lawton, Rochester, U.S.
1296. SAFETY VALVES, T. Adams, Manchester.
1297. COATING, &c., IRON, W. Welch, Portsmouth.
1298. FOLDING CRATES, J. R. Kelsey, London.
1299. PACKING, &c., G. Pritchard, Seaford.
1300. BOOTS AND SHOES, A. Sumner, London.
1301. TOBACCO POUCHES, H. A. Fleuss, London.
1302. GRATES, &c., T. Parker, Coalbrookdale.
1303. WATCHES, &c., H. H. Lake. (K. Vogel, U.S.)
1304. BINDING, J. Rettle, London.

- 1305. SAWING MACHINES, O. and R. Fleck, Berlin.
1306. STEAM ENGINES, E. Davies, Liverpool.
1307. WASHING, T. Wilson, Newcastle-upon-Tyne.
1308. HORSESHOES, &c., S. Gibbs, Herne Bay.
1309. SAFETY WICKET, A. C. Henderson. (J. M. A. Montclair, Paris.)
1310. CHARCOAL BOX IRONS, G. Asher, Birmingham.
1311. CASTING APPARATUS, A. Howat, Manchester.
1312. STOVES, H. Massioks and W. Croke, Millom.
1313. BICYCLES, &c., J. Harrington, London.
1314. VENTILATION, G. L. Shorland, Manchester.
1315. VALVES, &c., J. Snelling, Kennington Park.
1316. SKYROCKETS, J. C. Pain, Walworth-road.
1317. BEARINGS, &c., W. R. Oswald, London.
1318. SEWING MACHINES, C. T. Bastand, Camberwell.
1319. SUSPENDING APPARATUS, G. Kee, Birmingham.
1320. DRAINING LAND, W. Lavender, Biddenham.
1321. RECORDING APPARATUS, J. B. Moscrop, Stretford.
1322. IRON, J. Johnson. (W. E. Sander, Liege.)
1323. CARTRIDGES, W. R. Lake. (L. Lefrange, Paris.)
1324. BOILING APPARATUS, A. Clark. (H. Coker, U.S.)
1325. INDICATOR LOCKS, A. M. Clark. (Eagle Lock Company, Incorporated, Terryville, U.S.)
1326. RAILWAY BRAKES, A. M. Clark. (J. Meissner and H. Fleischman, New York, U.S.)
1327. HEATING STOVES, T. Morgan. (O. Elterich, Bavaria.)
1328. BOILERS, W. Arnold, Barnsley.

- 1329. VALVES, L. Berry, Rotherham.
1330. COUPLINGS, B. Finch, London.
1331. ENRICHING GAS, J. Livesey, London.
1332. ORGANIC SUBSTANCES, F. S. Barff, London.
1333. CARRIAGE LOCKS, J. Edwards, London.
1334. SNOW, F. N. Mackay, Liverpool.
1335. PENHOLDERS, H. Haddan. (H. Burckas, Leipzig.)
1336. ROUNDING PILLS, J. G. F. Richardson, Leicester.
1337. LOOMS, W. Priestley and W. Deighton, Laisterlyke.
1338. ROLLERS OF BLINDS, S. Bee, Grantham.
1339. STAMPS, F. Van den Wyngaert. (A. Weylandt, Berlin.)
1340. ALARM APPARATUS, W. Lake. (C. Haas, Paris.)
1341. COAL, &c., J. Macnab and R. Jenkins, London.
1342. BREWING APPARATUS, C. Clinch, Exeter.
1343. MAGAZINE GUNS, P. Mause, Oberndorf.
1344. VELOCIPEDS, E. R. Settle, Coventry.

- 345. LAMPS, A. E. Ragg, Bebbington.
346. VALVES OF COCKS, A. A. Joy, London.
347. COMBING WOOL, J. Midgley, Bradford.
348. CLEANING, &c., BOOTS, T. Lever, Nelson.
349. RABBIT, &c., TRAPS, T. Douglas, Wire Bridge.
350. PICKLING IRON, J. Williams & G. Morris, Landore.
351. CAPSULING BOTTLES, J. Dunbar, Glasgow.
352. REGULATING FANLIGHTS, W. Leggett, Bradford.
353. HEATING APPARATUS, T. Ritson. (T. Ritson, U.S.)

- 1354. CASTING, J. C. Mewburn. (J. Demogot, Paris.)
1355. COCKS, &c., E. Brice, Inchbrook, near Stroud.
1356. CONDENSING, &c., T. N. Kirkham, T. Hersey, D. Hulet, S. Chandler, sen., J. Chandler, and S. Chandler, jun., London.
1357. HOT-AIR ENGINES, W. H. Bailey. (Partly a com. from Messrs. Zipp and Langsdorff, Oberwald.)
1358. ELECTRIC LAMPS, R. Harrison and C. Blagburn, Newcastle-upon-Tyne.
1359. SCREW PROPELLERS, N. D. Spartali, Liverpool.
1360. ROLLING RAILWAY AXLES, &c., J. H. Johnson. (A com. from M. Lignier, Creusot.)
1361. IRON, &c., G. Love, Lanchester, and B. Cochran, Aldin Grange, near Durham.

- 28th March, 1881.
1362. REGULATING HEAT IN KILNS, &c., A. S. Tomkins, F. M. Courage, and F. A. Cracknall, London.
1363. ENGINES, S. Bickerton and H. N. Bickerton, Ashton-under-Lyne.
1364. SHIPS, J. H. Johnson. (A com. from B. C. A. H. C. de Winter, Paris.)
1365. LOOMS, E. Smethurst, Manchester.
1366. TRAP, F. Hagen & G. Akrigg, Kingston-upon-Hull.
1367. CEILINGS, T. Wrigley. (A com. from S. Mueller, Nurnberg, Germany.)
1368. GAS, E. P. Alexander. (E. Mertz, Biele.)
1369. WHEELBARROWS, W. B. Williamson, Worcester.
1370. GENERATING HEAT, A. Boulton. (C. Holland, U.S.)
1371. OMNIBUSES, H. W. Hart, Westminster.
1372. IRON, &c., W. J. Clapp & T. Griffiths, Monmouth.
1373. COLOURING MATTERS, O. Witt and H. Koehlin, Mühlhausen.
1374. HOLDING APPARATUS, H. J. Coles, London.
1375. REGULATING STEAM, F. Eames, Watertown, and J. McIntosh, Liverpool.

Inventions Protected for Six Months on deposit of Complete Specifications.

- 1294. PURIFYING GAS, C. F. A. W. and A. L. Lawton, Rochester, U.S.—23rd March, 1881.
1295. PRESERVING ORGANIC SUBSTANCES, C. F. A. W. and A. L. Lawton, Rochester, U.S.—23rd March, 1881.
1315. VALVES, &c., J. Snelling, Gilbert-road, Lambeth.—24th March, 1881.

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

- 1181. PRODUCING SULPHUR FROM PYRITES, J. Hollway, Jeffrey's-square, London.—21st March, 1878.
1184. CARDING FIBRES, J. Thornton, Cleckheaton.—21st March, 1878.
1153. DYEING, &c., FABRICS, D. Stewart, Glasgow.—23rd March, 1878.
1250. STABLES, T. F. Shillington and J. A. Anna, New Bond-street, London.—29th March, 1878.
1326. INTERLOCKING POINTS OF SIGNALS, C. Hodgson, Canterbury-road, London.—4th April, 1878.
1364. MOULDINGS, A. C. Engert, Three Mills-lane, London.—5th April, 1878.
1465. HEADED NAILS, J. L. Howard, Dos Works, Newport.—12th April, 1878.
1163. SCREW FERRULE JOINT, R. Watkinson, Salford.—23rd March, 1878.
1242. STEAM BOILERS, &c., F. Livet, Western-road, Ealing, London.—29th March, 1878.
1179. SANITARY PIPES, &c., A. and T. Sabine, Swadincote.—25th March, 1878.
1180. GRINDING GRAIN, &c., H. Simon, St. Peter's-square, Manchester.—25th March, 1878.
1244. PROPELLERS, H. J. Haddan, Strand, London.—29th March, 1878.
1295. LUBRICATOR, E. I. H. E. and J. T. Whitehouse, Coseley.—2nd April, 1878.
1314. FILLING CASKS, &c., J. Smith, Derby.—3rd April, 1878.
1191. CHILDREN'S CHAIRS, A. Janes, West End-road, High Wycombe.—26th March, 1878.
1198. SPANNERS, J. Pattinson, Sheffield.—26th March, 1878.
1208. STARTING, &c., CARRIAGES, L. Hill, Glasgow.—27th March, 1878.
1312. SHAPING, &c., HATS, E. de Pass, Fleet-street, London.—3rd April, 1878.
1281. WINDOWS, &c., H. C. Gover, South Hill Park, Hampstead, London.—28th March, 1878.
1243. VALVES, S. Cutler, London.—29th March, 1878.
1260. PURIFYING GAS, A. P. Ker, Birmingham.—30th March, 1878.
1280. PROTECTING IRON, &c., G. and A. S. Bower, St. Neots.—12th April, 1878.

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

- 1117. RAILWAY CHAIRS, J. Nuttall, Oldham, and J. Taylor, Bradford.—31st March, 1874.
1005. COLLECTING, &c., MONEY, J. and J. Kaye, Kirkstall, near Leeds.—23rd March, 1874.
1086. STRETCHER JOINTS, W. Holland, Birmingham.—25th March, 1874.
1087. WATERPROOF PAPER, J. W. Clayton, Hampton, London.—25th March, 1874.
1066. GAS, J. Keith, Arbroath.—27th March, 1874.
1094. IRON, A. Warner, London.—28th March, 1874.
1075. CASTING TUBES, &c., in GLASS, J. Chedgoy, Great Guildford-street, London.—27th March, 1874.

Notices of Intention to Proceed with Applications.

- Last day for filing opposition, 15th April, 1881.
4769. ROLLING MILLS, C. Herbert, Edinburgh.—19th November, 1880.
4777. SLICING MACHINES, A. C. Herts, Bloomsbury, London.—Com. from J. Herts.—19th November, 1880.
4786. TEAPOTS, W. H. Andrew, Sheffield.—19th November, 1880.
4806. PUMPING VALVES, W. Stainton, Liverpool-street, London.—20th November, 1880.
4810. UMBRELLAS, E. Edmonds, Fleet-street, London.—Com. from C. C. Juif.—20th November, 1880.
4812. COUPLING, &c., F. Barnes, Tylehurst, Reading.—20th November, 1880.
4815. PRESSING APPARATUS, G. H. Nussey and W. B. Leachman, Leeds.—20th November, 1880.
4820. EYELETS, &c., C. Varlot, Grenoble, France.—20th November, 1880.
4824. SAUCES, D. Henderson, Birkenhead.—22nd November, 1880.
4830. BOUQUET HOLDERS, F. Wirth, Frankfurt-on-the-Main.—A communication from C. Erhard.—22nd November, 1880.
4832. WOODEN PAVEMENTS, E. Young, High-street, Steyning.—22nd November, 1880.
4836. SEWING MACHINES, C. Necker and R. Horstmann, Berlin.—22nd November, 1880.
4845. FURNACES, W. R. Lake, Southampton-buildings, London.—A communication from J. Wolstenholme.—22nd November, 1880.
4855. VENTILATING, &c., W. R. Lake, Southampton-buildings, London.—A communication from P. Mihan.—23rd November, 1880.
4873. BICYCLES, &c., T. J. Palmer, Fulham, and C. F. Dietrich, Dalston, London.—24th November, 1880.
4898. CASTING METALS, L. Groth, Finsbury-pavement, London.—A communication from F. Teller.—25th November, 1880.
4915. STEERING GEAR, W. Clarke and J. B. Furneaux, Gateshead-upon-Tyne.—25th November, 1880.
4926. COPPERS, T. Bloom, Boston.—26th November, 1880.
4945. WORT, B. Mills, Southampton-buildings, London.—A communication from H. Husak and A. Hanl.—27th November, 1880.
4957. PROPELLING VESSELS, F. W. Richardson, West Hartlepool.—29th November, 1880.
4959. BRICKS, H. Bonneville, Cannon-street, London.—Com. from E. Beaumont.—29th November, 1880.
5029. SPINNING FRAMES, A. M. Clark, Chancery-lane, London.—A communication from J. J. Bourcart.—2nd December, 1880.
5080. CLOCKS, A. Clark, Chancery-lane, London.—Com. from F. A. Lane.—6th December, 1880.

- 5107. PUMPS, G. Tangye, Birmingham, T. Jefferiss and J. R. Williams, Handsworth.—7th December, 1880.
5136. COUPLINGS, A. Clark, Chancery-lane, London.—Com. from T. R. Almond.—8th December, 1880.
5254. CONSTRUCTING SUBMERGED STRUCTURES, F. Reeves, Eardley-crescent, London.—15th December, 1880.
5271. REGISTERING, W. Lake, Southampton-buildings, London.—A communication from T. M. Vieillemaire.—15th December, 1880.
325. BRASS HINGES, C. H. and F. W. Brampton, Birmingham.—25th January, 1881.
536. COVERINGS, &c., R. H. Gudgeon, Winchester.—8th February, 1881.
603. SPINNING, &c., YARNS, H. Illingworth, Bradford.—11th February, 1881.
626. SCISSORS, A. J. Boulton, High Holborn, London.—Com. from T. Fischer.—14th February, 1881.
679. TRICYCLES, &c., J. Harrington, Norman's-buildings, London.—16th February, 1881.
739. MARKING APPARATUS, F. H. Ayres, Aldersgate-street, London.—21st February, 1881.
794. BOAT DAVITS, R. Burdes, Sunderland.—24th February, 1881.
856. DRYING TEXTILE FABRICS, W. Mather, Manchester.—1st March, 1881.
890. AIR PUMP BUCKETS, J. Musgrave, Bolton.—2nd March, 1881.
903. TANNIC BLACK, W. G. Gard and T. H. Cobley, Dunstable.—2nd March, 1881.
959. CROCHETED FABRICS, E. Whitehall, Nottingham.—7th March, 1881.
970. MINING LAMP, F. Foster, Forston-street, and H. A. Fleuss, Haverstock-hill, London.—7th March, 1881.
999. DYEING YARNS, F. A. Gatty, Accrington.—9th March, 1881.
1010. PREPARING HEMP, J. Barbour, Belfast.—9th March, 1881.
1028. MOTIVE POWER, J. and G. Weir, Glasgow.—10th March, 1881.
1032. SHEAF BINDING, J. Howard and E. T. Bousfield, Bedford.—10th March, 1881.

Last day for filing opposition, 20th April, 1881.

- 4854. REGULATING GAS, E. A. Brydges, Koenigraetzer-strasse, Berlin.—A communication from J. Schuelke.—23rd November, 1880.
4856. LOOMS FOR WEAVING, J. Crook, Blackburn.—23rd November, 1880.
4881. GAS MOTOR ENGINES, L. Simon, Deering-street, and F. Wertenbruch, Briar-street, Nottingham.—24th November, 1880.
4899. COFFEE, &c., L. A. Groth, Finsbury-pavement, London.—A communication from P. Schwing.—25th November, 1880.
4907. MANIPULATING, &c., J. D. Ashworth, Blackfriars-street, London.—25th November, 1880.
4913. BATH, &c., VALVES, F. E. Tompson, Wolverhampton.—25th November, 1880.
4914. ELECTRIC LIGHT, W. L. Wise, Whitehall-place, London.—Com. from J. Mandon.—25th November, 1880.
4920. EARS FOR HANDLES, R. Read, Liverpool.—26th November, 1880.
4925. UMBRELLA, &c., RIBS, T. Warwick, Aston.—26th November, 1880.
4931. MATTRESSES, W. E. Brown, Camden Town, London.—26th November, 1880.
4938. GAS STOVE, W. Wyman, Southgate-street, Gloucester.—27th November, 1880.
4942. FILTERING APPARATUS, G. Mant, Louise-road, Stratford.—27th November, 1880.
4947. CHARCOAL BOX-IRON, T. B. Salter, West Bromwich, and G. Asher, Balsall Heath.—27th November, 1880.
4969. DRAWING BEER, &c., A. Specht, Hamburg.—Com. from K. W. Weissenborn.—29th November, 1880.
4977. HYDRAULIC PRESSES, J. Watson, Gloucester-crescent, London.—30th November, 1880.
4979. CIRCULAR SAWS, H. J. Haddan, Strand, London.—Com. from J. Kitz.—30th November, 1880.
4984. TREATING JUTE, &c., C. F. Cross, Brentford.—30th November, 1880.
5058. ARTIFICIAL TALLOW, M. de la Vega, New York.—4th December, 1880.
5066. SUGAR, M. de la Vega and L. D'Oliveira, New York.—4th December, 1880.
5083. CABLES, &c., E. Berthoud, Cortailloil, and F. Borel, Boudry.—6th December, 1880.
5315. TACKS, &c., E. P. Alexander, Southampton-buildings, London.—A communication from W. R. Clough.—18th December, 1880.
5319. ALPHABET, A. M. Clark, Chancery-lane, London.—Com. from C. G. Burke.—18th December, 1880.
5397. SAW FRAMES, T. N. Robinson, Rochdale.—23rd December, 1880.
5445. VALVES, &c., T. Meacock and A. W. C. Ward, Chester.—28th December, 1880.
14. PORTABLE FURNACES, J. Tenwick, Spittlegate, Grantham.—3rd January, 1881.
70. STOP MOTION, A. T. Lawson and S. Dear, Leeds.—6th January, 1881.
343. FIRE BARS, E. G. Brewer, Chancery-lane, London.—Com. from J. Alves.—26th January, 1881.
370. GAS MOTOR ENGINES, H. P. Holt, Park-road, Leeds, and F. W. Crossley, Great Marlbro'-street, Manchester.—27th January, 1881.
375. BANKERS' CHEQUES, A. Dupré, Broad Sanctuary, and O. Hehner, Holborn Viaduct, London.—27th January, 1881.
409. DRYING COFFEE, J. Gordon, New Broad-street, London.—A communication from J. Stewart.—31st January, 1881.
498. KILNS, &c., E. Edmonds, Fleet-street, London.—Com. from C. Amand.—5th February, 1881.
561. ROOFING TILE, C. D. Phillips, Gaer Fach Farm, Newport.—9th February, 1881.
565. GAS ENGINES, A. T. Alcock, Newark-on-Trent.—9th February, 1881.
802. CUTTING SPLINTS, E. Pace and J. H. Howard, Bow Common, London.—25th February, 1881.
880. HARVESTING MACHINES, H. Andrews, Little Langford.—1st March, 1881.
930. PREPARING SHIPS, A. Kirk, Glasgow, and R. Sim, Jermyn-street, London.—4th March, 1881.
978. FOG BELLS, W. P. Thompson, High Holborn, London.—A communication from the International Fog Bell Company.—8th March, 1881.
990. WRITING SLATES, E. J. J. Dixon, New Deanfield Works, Bangor.—8th March, 1881.
1009. TRACTION, &c., ENGINES, J. Braby, Rudgwick.—9th March, 1881.
1013. POTTERY WARE, C. Westwood and R. A. Windmill, Brierley Hill.—9th March, 1881.
1031. ATTACHING DOOR KNOBS, G. Price, Birmingham.—10th March, 1881.
1051. HEATING STOVES, F. Arnold, New John-street West, Birmingham.—11th March, 1881.
1058. BRAKE APPARATUS, F. W. Eames, Leeds.—11th March, 1881.
1169. SADDLES OF BICYCLES, W. R. Lake, Southampton-buildings, London.—Com. from C. H. Veeder.—17th March, 1881.
1175. BREAKING PIG IRON, W. R. Lake, Southampton-buildings, London.—Com. from T. A. Blake.—17th March, 1881.

Patents Sealed

- List of Letters Patent which passed the Great Seal on the 25th March, 1881.)
3905. LOOMS, P. Banks, W. Slater, and J. Banks, Adlington.—27th September, 1880.
3909. HEATING APPARATUS, W. Standing, Nassau-street, Dublin.—27th September, 1880.
3911. FLOORING CRAMPS, W. Riley, Keighley.—27th September, 1880.
3921. LOCOMOTIVE ENGINES, W. Morgan-Brown, Southampton-buildings, London.—28th September, 1880.
3932. PAPER BAGS, J. Baldwin, Birmingham.—28th September, 1880.
3934. SETTING, &c., TYPE, W. Morgan-Brown, Southampton-buildings, London.—28th September, 1880.
3941. DOCKING KNIFE, J. McKenny, Stephen's-green, Dublin.—29th September, 1880.

- 3942. STEAM PUMPS, F. Pearn, S. Pearn, and T. Addyman, West Gorton, Manchester.—29th September, 1880.
3945. SPINDLE BEARINGS, J. Elce, Manchester.—29th September, 1880.
3952. CHANGING, &c., CARTRIDGE SHELLS OF TUBES, &c., W. R. Lake, Southampton-buildings, London.—29th September, 1880.
3963. POCKET KNIVES, W. R. Lake, Southampton-buildings, London.—30th September, 1880.
3995. BRACE BUCKLES, C. N. Eyland, Walsall.—2nd October, 1880.
4003. REVOLVING HEELS, W. Brown, King-street, and W. Peover, Leigh-street, London.—2nd October, 1880.
4007. SIGNALING, G. Zanni, Holborn Viaduct, London.—2nd October, 1880.
4024. NECKTIE FASTENING, L. Michaux, Paris.—4th October, 1880.
4026. HARDENING CEMENT, &c., W. R. Lake, Southampton-buildings, London.—4th October, 1880.
4081. ELECTRICAL SIGNAL, W. R. Lake, Southampton-buildings, London.—7th October, 1880.
4116. TRANSMITTING ELECTRICAL CURRENTS, W. Lake, Southampton-buildings, London.—9th October, 1880.
4126. WATER-CLOSETS, D. T. Bostel, Duke-street, Brighton.—11th October, 1880.
4131. NAVIGABLE VESSELS, A. W. L. Reddie, Chancery-lane, London.—12th October, 1880.
4184. COMPRESSING AIR, D. Greig and M. Eyth, Leeds.—14th October, 1880.
4186. ROAD LOCOMOTIVES, &c., J. Marshall, Gainsborough.—14th October, 1880.
4274. RAISING, &c., WATER, &c., C. Kessler, Berlin.—20th October, 1880.
4294. PACKING MEAT, W. R. Lake, Southampton-buildings, London.—21st October, 1880.
4317. FRED-WATER HEATERS, W. Chance, Calcutta.—22nd October, 1880.
4437. BUFFER BOXES, &c., W. Eyre, Ellesmere-road, Sheffield.—30th October, 1880.
4452. WRITING INSTRUMENTS, A. P. Hansen, Weiden-allee, Hamburg, Germany.—1st November, 1880.
4463. PRESERVING SHIPS' BOTTOMS, W. Renney, Cawley road, Victoria Park, London.—1st November, 1880.
4522. ECONOMISING NITROUS PRODUCTS, J. Imray, Southampton-buildings, London.—4th November, 1880.
4576. PRODUCING DESIGNS, W. L. Wise, Whitehall-place Westminster.—8th November, 1880.
4768. DECORATING GLASS, J. Couper, jun., Glasgow.—19th November, 1880.
4797. EMBROIDERY, C. A. Barlow, Warren-street, Manchester.—20th November, 1880.
4817. DERIVATIVES FROM COAL TAR, C. Lowe and J. Gill, Manchester.—20th November, 1880.
4963. PLOUGHS, &c., J. Howard and E. T. Bousfield, Bedford.—29th November, 1880.
5005. SECURING SHEETS OF PAPER, &c., L. de Horwath, Paris.—1st December, 1880.
5102. PIPE JOINTS, N. Talard, Boulevard Magenta, Paris.—7th December, 1880.
5103. EMPTYING CESSPOOLS, &c., N. Talard, Boulevard Magenta, Paris.—7th December, 1880.
5172. LAMPS, &c., F. Siemens, Southampton-buildings, London.—10th December, 1880.
5181. JUTE, W. M. Black and A. Taylor, Dundee.—11th December, 1880.
5227. BRAKES, N. Talard, Boulevard Magenta, Paris.—14th December, 1880.
5278. DREDGING, J. Standfield and J. L. Clark, Westminster.—16th December, 1880.
5328. SKATES, &c., T. B. Drybrough, Edinburgh.—20th December, 1880.
5363. GUNS, H. E. Newton, Chancery-lane, London.—21st December, 1880.
5458. HEAVY ORDNANCE, B. J. B. Mills, Southampton-buildings, London.—28th December, 1880.
5459. MACHINE GUNS, B. J. B. Mills, Southampton-buildings, London.—28th December, 1880.
20. DENTAL ENGINE, P. Shaw, Manchester.—3rd January, 1881.
84. BURNERS, J. Douglas, Dulwich.—7th January, 1881.
92. EMBOSING, T. J. Palmer, Fulham, and C. F. Dietrich, Dalston, London.—8th January, 1881.
117. BRUSHES, G. W. von Nawrocki, Leipziger-strasse, Berlin.—10th January, 1881.
203. STOP VALVES, J. Dewrance and G. H. Wall, Great Dover-street, Borough.—15th January, 1881.
207. STEAM ENGINES, &c., T. Robertson, jun., Glasgow.—15th January, 1881.
290. LOOMS, W. Adam, Kidderminster.—22nd January, 1881.

(List of Letters Patent which passed the Great Seal on the 29th March, 1881.)

- 3066. PIANOFORTES, F. Wolff, Copenhagen.—30th September, 1880.
3975. FERMENTED, &c., BEERS, J. A. Fawcett, Wakefield.—1st October, 1880.
3977. BEVERAGES, W. P. Thompson, High Holborn, London.—1st October, 1880.
3979. STOVES, W. Smith, jun., Barnard Castle.—1st October, 1880.
3993. PURIFYING MACHINERY, H. Simon, St. Peter's-square, Manchester.—2nd October, 1880.
3998. METAL FRAMES, H. Tonkinson and W. Rockcliffe, Sunderland.—2nd October, 1880.
4000. WARP BEAMS, J. R. Aldred, Manchester.—2nd October, 1880.
4002. FURNACES, J. Salter, Manchester.—2nd October, 1880.
4005. DYNAMO-ELECTRIC MACHINES, E. G. Brewer, Chancery-lane, London.—2nd October, 1880.
4011. FILTERING MACHINES, P. A. Maignan, Great Tower-street, London.—2nd October, 1880.
4040. HOLDING FLIGHT FEATHERS OF BIRDS, &c., M. Arnold, Acton, London.—5th October, 1880.
4050. OBTAINING, &c., MOTIVE POWER, J. Robson, Fal-mouth-road, Surrey.—5th October, 1880.
4063. UMBRELLA FURNITURE, B. B. Cox, North Audley-street, London.—6th October, 1880.
4089. SPRINGS, J. Davol, Providence, Rhode Island, U.S.—7th October, 1880.
4089. STEAM BOILERS, H. J. Haddan, Strand, Westminster.—8th October, 1880.
4097. PRODUCING DESIGNS, H. C. Webb, Worcester.—8th October, 1880.
4101. SECURING CORES, H. T. Lufkin, Chelmsford.—9th October, 1880.
4127. PULVERISING MACHINES, W. Michaëlis, Royal Hotel, Blackfriars, London.—11th October, 1880.
4151. STAYS, &c., E. A. Allibert, Brompton-square, London.—13th October, 1880.
4167. EXTRACTING TAR, &c., P. J. Wates, Brooklands, Bedford Hill, Balham, Surrey.—13th October, 1880.
4169. CONVERTING GRAINS INTO FLOUR, F. Wirth, Frankfurt-on-the-Maine.—13th October, 1880.
4170. PIPES, W. Lake, London.—13th October, 1880.
4176. TUBES, C. Moseley, Manchester.—14th October, 1880.
4185. VALVE GEARING, F. C. Marshall, Tynemouth.—14th October, 1880.
4206. CARPETS, &c., T. B. Worth, Stourport.—15th October, 1880.
4241. UMBRELLA STICKS, C. D. Abel, Southampton-buildings, London.—18th October, 1880.
4244. CRUSHING, &c., MACHINERY, R. Cook, Sheffield.—18th October, 1880.
4281. NAILS, L. Boynton, U.S.—20th October, 1880.
4314. PREPARING STEREO TYPE PLATES, A. M. Clark, Chancery-lane, London.—2nd October, 1880.
4363. BRACES, H. Haddan, Strand.—26th October, 1880.
4473. PRINTING MACHINERY, A. Sauvée, Parliament-street, Westminster.—2nd November, 1880.
4607. ENGINES, R. Brown, Morton.—9th November, 1880.
4706. CLOTH, S. Thacker, Nottingham.—15th November, 1880.
5145. SKATES, R. H. Bishop, Holloway-road, and H. F. Hales, Hoinsey, London.—9th December, 1880.
5151. NAILS, J. Coleman, London.—9th December, 1880.
5247. ILLUMINATING, J. Macdonald, Queen Victoria-street, London.—14th December, 1880.
5339. FINISHING SILK HATS, D. M. Easton, Areola.—20th December, 1880.
69. CASTING METAL PIPES, &c., C. Palmer, R. Compton, and J

- 154. IRON, &c., J. A. Huggett, London.—12th January, 1881.
- 199. STEERING, J. K. Kilburn, Brixton, and G. Fossick, Stockton-on-Tees.—15th January, 1881.
- 206. FURNACES, E. Barry, Berks.—15th January, 1881.
- 213. INSERTING BOBBINS IN CARRIAGES, H. Boden and S. Whitehurst, Derby.—17th January, 1881.
- 245. LIGHTING GAS, C. L. Clark and J. Leigh, Manchester.—20th January, 1881.
- 256. AXLE BEARINGS, W. R. Lake, Southampton-buildings, London.—20th January, 1881.
- 278. MATCH-FILLING MACHINES, C. R. E. Bell, Knight-riding-street, London.—22nd January, 1881.
- 329. CARBONIC ACID, &c., J. Williamson, Westoe, South Shields.—25th January, 1881.

List of Specifications published during the week ending March 26th, 1881.

- 1349*, 4d.; 2775*, 4d.; 2539, 8d.; 2617, 6d.; 2750, 4d.; 2944, 6d.; 3124, 6d.; 3173, 6d.; 3204, 6d.; 3238, 6d.; 3265, 6d.; 3267, 6d.; 3272, 6d.; 3275, 6d.; 3277, 6d.; 3286, 6d.; 3293, 1s. 2d.; 3295, 4d.; 3297, 6d.; 3301, 4d.; 3302, 6d.; 3309, 6d.; 3313, 4d.; 3319, 4d.; 3323, 6d.; 3327, 6d.; 3328, 4d.; 3339, 4d.; 3348, 6d.; 3354, 2d.; 3356, 6d.; 3364, 8d.; 3378, 6d.; 3386, 6d.; 3396, 6d.; 3397, 6d.; 3400, 4d.; 3401, 2d.; 3403, 2d.; 3404, 2d.; 3405, 4d.; 3407, 2d.; 3414, 4d.; 3415, 2d.; 3416, 2d.; 3417, 2d.; 3418, 2d.; 3420, 6d.; 3421, 2d.; 3423, 2d.; 3424, 4d.; 3425, 2d.; 3426, 2d.; 3427, 6d.; 3429, 2d.; 3430, 2d.; 3431, 2d.; 3432, 2d.; 3434, 4d.; 3435, 2d.; 3437, 2d.; 3439, 2d.; 3440, 2d.; 3441, 2d.; 3442, 6d.; 3443, 4d.; 3445, 2d.; 3446, 6d.; 3447, 2d.; 3450, 8d.; 3453, 8d.; 3454, 6d.; 3455, 4d.; 3458, 6d.; 3460, 2d.; 3461, 2d.; 3462, 2d.; 3465, 4d.; 3466, 2d.; 3468, 6d.; 3469, 6d.; 3470, 2d.; 3472, 2d.; 3475, 6d.; 3476, 2d.; 3477, 2d.; 3485, 4d.; 3513, 6d.; 3521, 6d.; 3531, 1s. 4d.; 3559, 6d.; 3591, 4d.; 3629, 6d.; 4354, 6d.; 38, 6d.

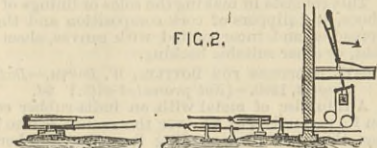
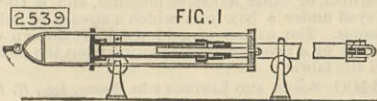
** Specifications will be forwarded by post from the Patent-office on receipt of the amount of price and postage. Sums exceeding 1s. must be remitted by Post-office order, made payable at the Post-office, 5, High Holborn, to Mr. H. Reader Lack, her Majesty's Patent-office, Southampton-buildings, Chancery-lane,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

ABSTRACTS OF SPECIFICATIONS.

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

539. APPARATUS FOR OPERATING POINTS AND SIGNALS ON RAILWAYS, H. Johnson.—Dated 22nd June, 1880. 8d.

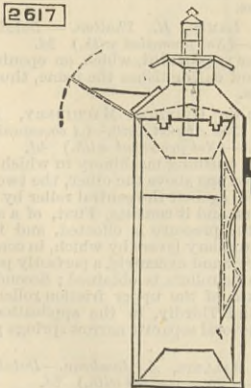
This consists, First, in a method of compensating for alterations in the length of wire or wires which connect the points to the actuating levers, or other such parts, which alterations arise from variations in temperature. To counteract these alterations the wire or wires are caused to act through the medium of a fluid, which by expanding or contracting maintains the wire or wires at a uniform tension. One end of a wire is connected to a piston, and the other to a cylinder containing the piston and filled with a fluid, which, as it expands or contracts, compensates for



similar altered conditions in the wire. The cylinder and piston may be caused to move bodily with the wire. Fig. 1 is a vertical section of the apparatus for compensating the variations in the length of the wire or wires which connect the points with the actuating lever. The second part of the invention relates to shifting the points by the action of rods moved in two directions, that is by push and pull. It is proposed to employ wires or chains, instead of the rods, but to employ them in duplicate, and to enable them to be operated in both directions by attaching them to opposite ends of levers. The first part of the invention may be applied to these arrangements by using the cylinder and pistons in duplicate. Fig. 2 shows the arrangement for shifting points.

2617. LAMPS, &c., J. G. Wilson.—Dated 26th June, 1880.—(A communication from W. J. Breiser.) 6d.

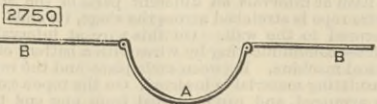
This consists in arranging a series of concave reflectors above the light in a converging direction towards the light, leaving a space in the centre for the glass chimney of the gas or other burner to pass through. Above this reflector is a similar reflector of smaller dimensions, with an opening through the centre leading to a smoke-box or cap. Round the outside of the lamp, and adjoining the edge of the reflectors before



mentioned, are mounted curtain reflectors, which may be either fixed, or capable of being adjusted at any angle, so as to catch the rays of light from the reflectors, and also from the light itself, and to throw or reflect such rays down in any desired direction. The drawing represents a side view of a wall lamp fitted with the reflectors.

2750. BACKS OF BOOKS, W. Hartin, jun., and A. D. Collier.—Dated 6th July, 1880. 4d.

The object of the invention is to form the back of account books so that when open the centre part of the book will present a level surface, and for this

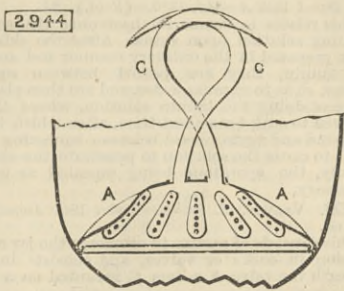


purpose the back is formed of a piece of steel A bent as shown, and having flaps B hinged to each edge, and secured to the boards or sides of the binding.

2944. WASHING CLOTHES, &c., W. E. Partridge.—Dated 17th July, 1880. 6d.

The apparatus is to be used in a copper, and consists of a conical vessel A, the lower edge of which fits the copper, and from its upper end pipes C rise upwards

above the level of the clothes, on to which a continuous stream of water is delivered from these pipes. The two pipes preferably cross each other as shown, so as to form a handle. The conical vessel is corrugated, so



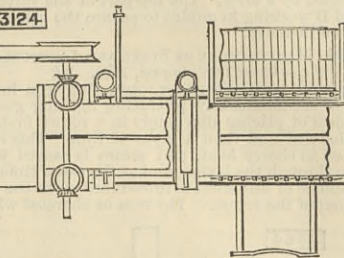
as to direct the water upwards to the pipes, and in the corrugations small holes are pierced for the passage of water to the interior.

3098. FORMING TYPE MOULDS OR MATRICES, &c., W. R. Lake.—Dated 27th July, 1880.—(A communication from J. G. Thoma.) 6d.

A bridge piece carries a lever at its centre, and attached to one end of this lever is a counterweight which keeps a treadle connected with the other end of the lever in its raised position. A short link on the lever presses on a bolt passing through the centre of the bridge piece, the pressure being exerted through the treadle. The plate of papier maché is placed on the bed-plate, and the type in a ring moved by means of two racks. The bolt causes the desired type to be pressed down on the papier maché, the type being raised as the pressure ceases by means of spiral springs.

3124. MANUFACTURE OF BRICKS, &c., A. McKerlie and R. Bradshaw.—Dated 29th July, 1880. 6d.

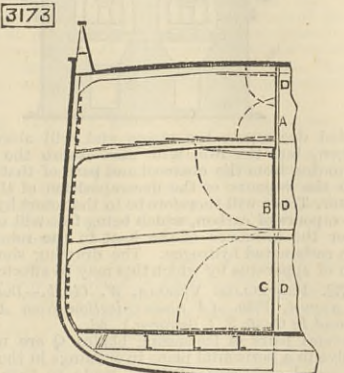
A double engine is geared direct to the horizontal pug mill shaft, and a pug mill is placed on each side of the engine, with hopper and blades, but without a



terminal bearing, the two mills and the various blades balancing each other. The drawing shows part of the machinery, with cutter shaft placed above the clay, and with gearing to drive the dies or rollers.

3173. FITTINGS FOR VESSELS CARRYING CARGO IN BULK, T. J. Stevens.—Dated 3rd August, 1880. 6d.

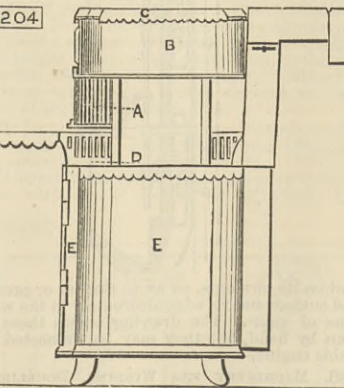
This relates to improvements in shifting boards for preventing the shifting of loose cargo, and consists in forming them of two flaps of sheet iron A connected together and forming a bulkhead. These flaps are hinged respectively at their top and bottom edges so as to be capable of being turned back when not in use.



In the drawing the shifting boards B and C of the lower holds are shown formed in a single piece hinged, B being hinged so as to turn upwards, and C hinged so as to turn downwards. When in use the edges of B and C overlap and are secured together. D are stiffening bars to further secure the shifting boards.

3204. COOKING STOVES, &c., I. Chorlton.—Dated 5th August, 1880. 6d.

This relates to improvements on patent No. 1051, dated 16th March, 1878. Instead of leaving a space beneath the dust chamber, such space is utilised by constructing an oven therein, this oven being enclosed in an outer metallic casing, the intervening space constituting the heating chambers or flues of the oven, which are arranged to communicate at each side through suitable openings or side flues with the bottom of the heat chamber, and at the back with the

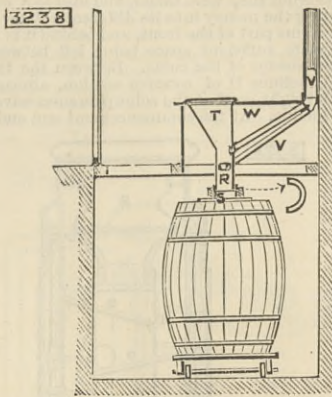


nozzle or flue of the stove, a damper being applied to control or entirely shut off the communication between the oven and heat chamber, as desired. A is the brazier or fireplace depending from the heating chamber B, C is the top plate, and D the dust chamber, E is the oven enclosed in an outer metallic casing F.

3238. PAIL OR TUB CLOSETS, C. Kessler.—Dated 7th August, 1880.—(A communication from E. Hirsche.) 6d.

The main object of this invention is to render pail or tub closets inodorous by providing efficient ventilation. The hopper basin T is of the usual form in its upper part. The down outlet pipe R below is made in one piece with it, and has an enlargement behind to prevent the adhesion of excrement. In the back of the hopper basin and at the enlargement of the outlet pipe there is an air circulation pipe W and two ventilating pipes V entering the down outlet pipe, one each side, and proceeding in a curved upward slanting

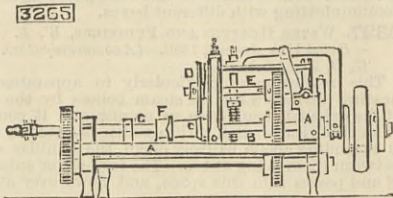
direction to the air shaft V, which reaches up above the building and is fitted with a cap. The bottom of the outlet pipe is fitted with packing to make a tight



joint with a sliding sleeve S secured to the top of the pail or tub. The lid of the hopper basin is perforated so as to allow the passage of air.

3265. MACHINERY FOR SECURING THE ENDS OF SHEET METAL CANS, CASES, &c., J. E. Parry.—Dated 10th August, 1880. 6d.

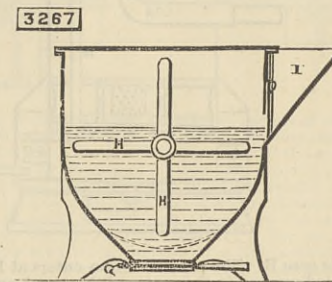
This relates to machinery for crimping or securing the bottoms or ends of sheet metal cans upon their bodies or sides. The drawing shows a side elevation of the machine. A is the main frame, which is supported in suitable standards; B is the main or driving



shaft carrying the head C for the reception of the can bottom, and D is the crimping or compressing head fixed upon the shaft E; F is an adjustable head designed to press against one end of the body of the can, to retain its other end within the rim of the can bottom during the crimping operation; G is the shaft carrying the said head.

3267. GAS PURIFIERS OR SCRUBBERS, J. Whiteley and R. Pickles.—Dated 10th August, 1880. 6d.

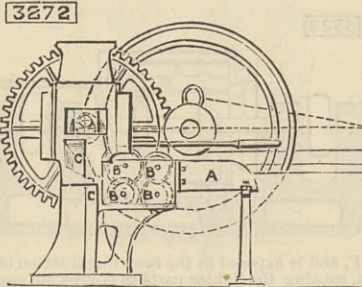
The layers of oxide through which the gas is caused to ascend are turned over by means of beaters H attached to a revolving shaft, and when required to replace the oxide a door Q at the bottom of each com-



partment is opened, when the used oxide falls out, the sides of the compartments being made slanting to facilitate the discharge. The new oxide is delivered into a shoot I and passes through a sliding door into the purifier.

3272. RE-WORKING IRON SHEARINGS, W. H. Nevill.—Dated 10th August, 1880. 6d.

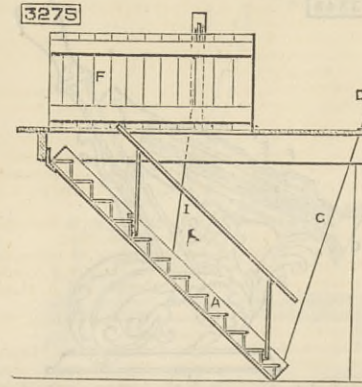
This consists of a method of, and apparatus for, cutting up and preparing the shearings of iron sheets, rolled for the manufacture of tin plates or other purposes. The shearings to be operated upon are placed in the feeding trough A, from which they are passed between rollers B B, of which one or more pairs may



be used. These rollers may be formed with grooves running around the same, or of any other pattern best suited to the nature of the shearings. The motion is so arranged that the length of the shearings to be cut off is introduced between the shear blades, when the upper blade reaches its highest elevation.

3275. STAIRCASE OR STEPS, E. A. Day and P. Price.—Dated 11th August, 1880. 6d.

The staircase is capable of being raised or lowered so as to leave the whole of the floor space available, and also serves to remove communication between two floors. For this purpose the upper end of the staircase A is hinged, and is provided with safety bolts in case of the hinge breaking. The other end has cords C



attached to it, and passing over pulleys D are fitted with counter-balance weights. The aperture in the upper floor may be covered by a flap F, which may be automatically raised and lowered with the staircase by

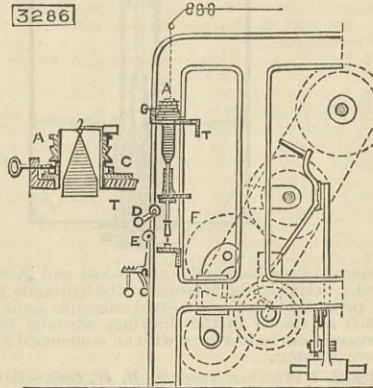
means of the cord I attached at one end to the staircase, and passing over a pulley fixed to the wall, its other end being secured to the flap.

3277. SPREADING JAM OR FRUIT ON DOUGHS, &c., G. C. Bacon.—Dated 11th August, 1880.—(A communication from W. S. Orms.) 6d.

This relates to an apparatus for the above object and consists of an endless belt, and two pairs of rollers, one of which delivers a thin layer of dough on to the belt. The belt conveys the dough under a box containing jam which issues from a narrow opening at the bottom under the action of a piston, and is delivered on to the dough. The other pair of rollers deposits a second layer of dough over the jam, when the whole can be cut into any desired shapes.

3286. SPINNING MACHINERY, J. H. Johnson.—Dated 11th August, 1880.—(A communication from L. E. Planton.) 6d.

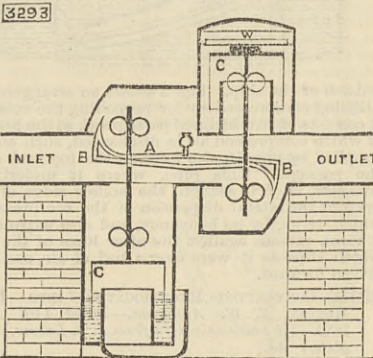
This relates to spinning machines with continuous take-up, and it consists, First, in the combination of a flyer or ring A, caused to revolve by a cord on a hollow axis cast with an oil cup C, and secured to a cross-bar T. A screw thread is formed on the interior of the flyer, so as to distribute the oil, and a movable flyer is carried on the upper part of A, being mounted in bearings so as to allow it to accommodate itself to



the varying diameter of the cop, and thus enable it to remain constantly in contact therewith; and, Secondly, to the taking-up apparatus in which a guide pulley D causes the cord driving the cop spindle to run in succession over the different diameters of the cone F attached to the cop spindle, while the tension pulley E always maintains the cord at the same tension; and, Thirdly, of a differential motion for actuating the spindle, and which is obtained by a combination of two differential movements which neutralise one another with respect to the speed of the spindle.

3293. PRESSURE GOVERNORS OR REDUCING VALVES, G. P. Grace.—Dated 12th August, 1880. 1s. 2d.

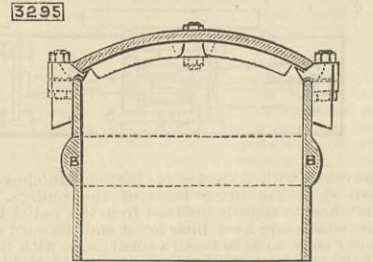
The drawing shows the balance pressure regulator or reducing valve as adapted to gas mains, and it consists of a balance lever A turning on a central pivot placed midway between the inlet and outlet, and formed with shut-offs B. Two pressure surfaces C are connected with opposite arms of A, and also with orifices on opposite sides of the passage through the



governor for the passing fluids, which act on the surfaces C, so that a variation of pressure above the required pressure overbalances by the connections the counter-balance weights W, and thus closes the inlet and throttles the outlet; and a variation below the desired pressure reduces the pressure of the surfaces C, and thus allows the weights W, by their reaction, to fall and open the inlet and outlet.

3295. ANNEALING POTS FOR USE IN TIN WORKS, S. Williams.—Dated 13th August, 1880. 4d.

This relates to means for preventing the extreme contraction and expansion caused by the heat from injuriously affecting the annealing pot, and consists in casting the lid separate from the case, and when desired to make the joint it is done with fire-clay, the



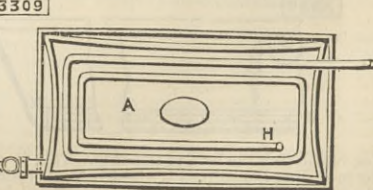
lid being secured by bolts. The interior of the lid is provided with brackets or ribs to support it, and prevent it cracking. A band B is formed round the pot to prevent it from "buckling" and collapsing.

3301. STOPPERS AND SPREADERS FOR VARNISH BOTTLES, &c., B. Biddow.—Dated 13th August, 1880. 4d.

The stopper consists of a wooden handle and stem to which a sponge is attached, and serves to spread the varnish over a surface. The stem is fitted with a cork stopper to close the bottle.

3309. BREWING, DISTILLING, &c., A. Collingridge.—Dated 14th August, 1880.—(Partly a communication from R. F. Leecr.) 6d.

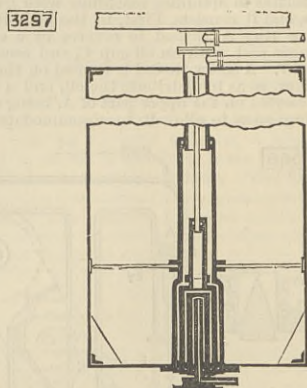
As applied to brewing the object of the invention consists in facilitating the more thorough extraction



of the bitter and aromatic principles of the hop, and it consists in the use of a hermetically closed boiler A,

formed with its sides, ends, crown, and sole plates dished inwards and secured by stays, so as to withstand an internal pressure equivalent to the contents attaining a temperature of 360 deg. Fah. during the process of extracting the essential oils from the hops, after which a vacuum is produced subsequent to completing the charge in the boiler. An auxiliary pneumatic apparatus is connected with the closed boiler, and takes off from its crown, and is set on to a refrigerating apparatus of sufficient cooling capacity to condense vapour at 360 deg. Fah. The drawing shows a plan of the boiler heated by a coil H.

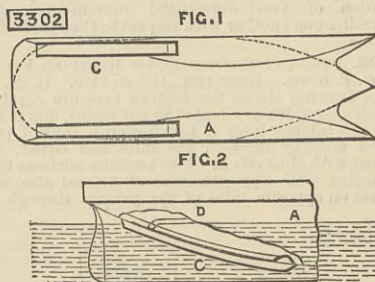
3297. BRICKS, TILES, &c., W. H. Turner and W. R. Renshaw.—Dated 13th August, 1880. 6d.
This relates to apparatus for compressing pulverised clay in a dry state into moulds. The moulds are superposed, the pulverised clay being placed thereon and the whole subjected to great pressure in a hydraulic or other press, after which the articles are



removed from the moulds and baked and glazed. In order to supply the pressure to the hydraulic press it is preferred to use a compound telescopic accumulator, such as shown in the drawing, whereby the final pressure can be increased with an economical expenditure of power.

3302. NAVIGABLE VESSELS, H. W. Cook.—Dated 13th August, 1880. 6d.

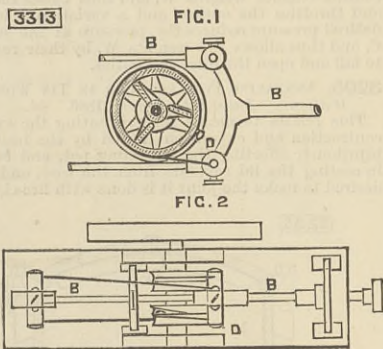
In order to obtain increased speed a twin vessel is used, each consisting of half of an ordinary vessel A placed with their curved outer surfaces towards each other, leaving a clear water-way between them, and being braced together. Fig. 1 shows a plan of the twin ship, and the effect of this arrangement is that the waves thrown against the stern lines by the bow lines of the two halves will be utilised to aid the pro-



pulsion of the ship. Fig. 2 shows an arrangement for utilising compressed air for propelling the vessel, and it consists of two inclined passages C, at the lower end of which compressed air is discharged, such air being supplied by pipe D, also forming the top and sides of the passages. This pipe, where it underlies the passages, is of U section, the hollow sides of which prevent the lateral dispersion of the compressed air, which, rising by its buoyancy, and also expanding as it rises, presses against the after lines of the vessel, which slips as it were over a bed of air, and is thus driven forward.

3313. CONVERTING RECIPROCATING INTO ROTARY MOTION, E. W. Anderson.—Dated 14th August, 1880.—(A communication from J. S. Lumar.)—(Complete.) 4d.

The piston B is formed with an elongated yoke connected to pulleys D by means of belts or ropes. These pulleys are mounted loosely on their shaft and have broad rims which project on adjacent sides, and between them a collar is secured to the shaft, and is



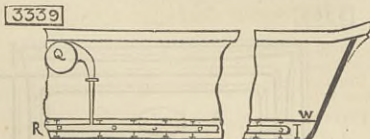
provided with a series of friction clutches which extend to the inner faces of the pulleys. These clutches are slightly inclined from the radial lines of the wheel, and have their lower ends forward of their outer ends, so as to make a small angle with the rims of the pulleys, whereby they are free to yield to the pulley when the direction of their motion is such as tends to enlarge the angle of contact, and will firmly engage with the pulleys when these move in the opposite direction.

3319. GLUING AND ADJUSTING THE LEATHER PADS TO BILLIARD CUES, &c., B. Martin.—Dated 16th August, 1880.—(A communication from L. Rigollet.) 4d.

The cues are placed in a frame, the top plate of which has a number of pressure screws which bear on the pad on the end of the cue, while the thick end of the cue is held in the bottom plate.

3339. SHIPS FOR TRANSPORTING GRAIN, J. Wetter.—Dated 17th August, 1880.—(A communication from L. S. Cheval, L. Janssens, and E. Bodart.) 4d.

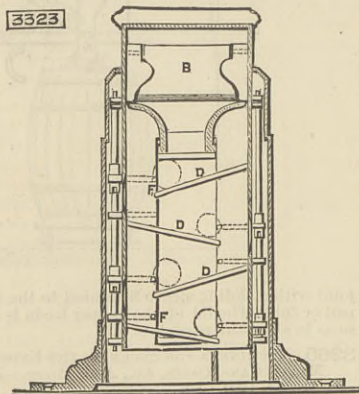
This relates to means for preventing the deterioration of grain cargoes, and consists in providing means



for ventilating the hold of the ship. This is effected by providing the ship with a false bottom of perforated sheet metal, beneath which air is supplied by pipes from ventilators Q.

3323. MONEY TILLS, H. E. Sambrook.—Dated 16th August, 1880. 6d.

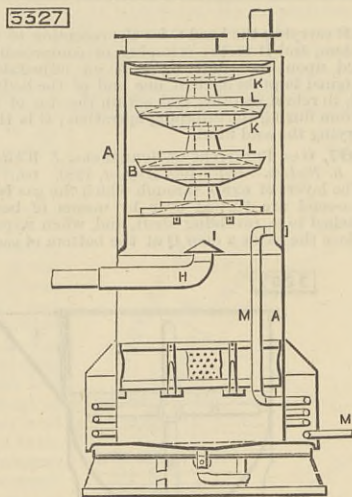
This relates to tills in which the last coin and some of those preceding it are so arranged as to be visible in the order they were taken, and also to a method of assorting the money into its different values. A glass plate forms part of the front, and behind it is a second glass plate, sufficient space being left between them for the passage of the coins. Between the two are a set of inclines D of concave section, alternately to left and right, so that the coins pass successively down each incline. At the commencement and end of each



incline are stops F connected with side pillars capable of being rotated, so as to remove one set and bring the other set of stops into position. When the flap B is pushed back to insert a fresh coin these pillars are automatically operated. For sorting, the last incline is formed with a series of different sized openings, communicating with different boxes.

3327. WATER HEATERS AND PURIFIERS, W. L. Wise.—Dated 17th August, 1880.—(A communication from G. H. Zschech.) 6d.

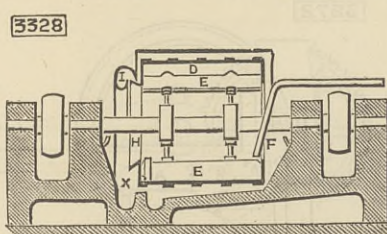
This relates more particularly to apparatus for heating the feed-water for steam boilers by the heat of the exhaust steam from an engine, and it consists of a cylindrical shell A within which is a second shell B extending about halfway down, the annular space between them being at top. The feed-water enters at M and passes into this space, and flows over at top



inside case B. The exhaust steam enters at H and is directed upward in the centre of the vessel, and comes in contact with the underside of cone I, which spreads it in all directions. The feed-water falls into a cone K, and flowing towards the centre is directed on to an inverted cone L, from the outer edge of which it is directed towards the centre of another cone, a suitable number of which are provided to thoroughly heat the water by bringing it in contact with the steam.

3328. CENTRIFUGAL EXTRACTING OR SEPARATING MACHINE, F. Wolff.—Dated 17th August, 1880.—(A communication from G. A. Hagemann.) 4d.

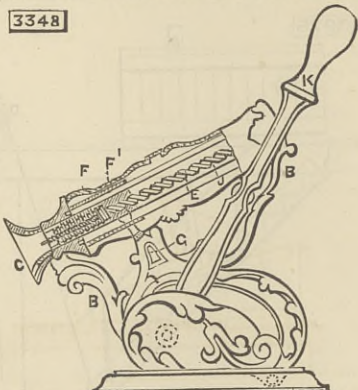
This consists of a centrifugal drum D fitted with paddles E to carry the fluid along, and caused to revolve within a case. The fluid to be separated into its light and heavier constituent parts enters by



pipe F, and is exposed to the centrifugal action of the drum, causing the lighter parts to occupy an annular space near the centre, while the heavier ones fly to the circumference. The lighter parts will flow over the flange H and pass into a passage I formed in the casing while the heavier parts enter at X into a pipe fixed radially to the inner circumference of the drum near the exit end.

3348. DRAWING CORKS, A. Muir.—Dated 18th August, 1880. 6d.

The bracket B supports a cylinder C to receive the cork to be withdrawn. E is a double-threaded screw carrying the corkscrew at its forward end and revolved by a nut F which slides freely upon guides, while the nut F is partly stationary, only moving a sufficient distance to withdraw the cork, for which purpose the hand lever K has an arm carrying a roller working in



a curved slot of a reeling lever G, the end of which engages with the nut F. The screw E has a coarse thread which binds the nut F, while the finer thread actuates the corkscrew. A hook holds the nut F at

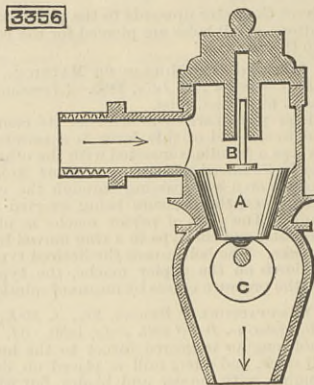
the mouth C until the nut F has passed the incline J, and the nut F has a corresponding incline, so that when the nuts have passed each other the hook is lifted, when the nut follows the screw.

3354. TANNING HIDES AND SKINS, F. G. Vedova.—Dated 18th August, 1880.—(Void.) 2d.

This relates to means for hastening the action of tanning solution upon skins. After the skins have been prepared in the ordinary manner and are ready for tanning, they are passed between squeezing rollers, so as to express water, and are then placed in a pit containing the tannin solution, where they are allowed to soak for a short time, after which they are removed and again passed between squeezing rollers, so as to cause the solution to penetrate the skin uniformly, the operation being repeated as often as necessary.

3356. VALVES, E. Smith.—Dated 18th August, 1880. 6d.

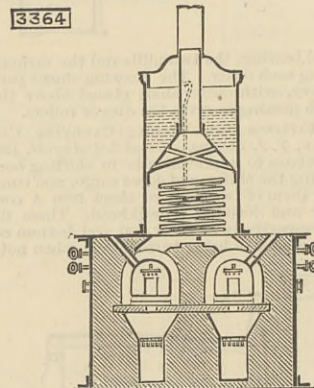
This consists of means to overcome the jar and concussion in cocks or valves, and consists in fitting beneath the valve A a cam C mounted on a spindle



operated by a lever. The top part of the valve carries a rod B working in guides to ensure the valve moving perpendicularly.

3364. MANUFACTURE OF STEEL AND LIGHTING GAS, P. Aube.—Dated 19th August, 1880. 8d.

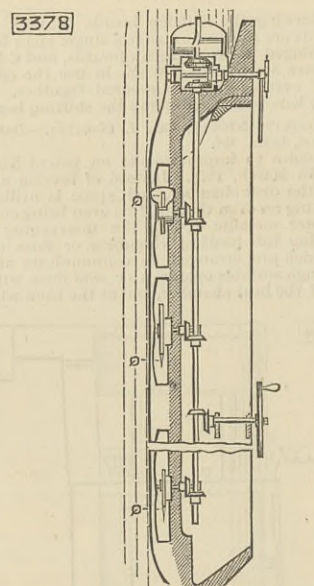
This relates to means for converting iron into steel and of simultaneously producing lighting gas, and it consists of placing alternately in a retort first a layer of charcoal and then a layer of iron. This retort is heated to cherry heat, and steam is caused to penetrate through the layers, and at the same time a fatty substance of any kind is introduced on to the red-hot bottom of the retort. The iron or charcoal which are



ignited decompose the steam and will absorb the oxygen, but the iron will also absorb the carbon emanating from the charcoal and part of that arising from the vapours of the decomposition of the fatty matter. There will therefore be in the retort hydrogen and vapours of carbon, which being free will combine under the influence of the heat in the retort, and form carbonated hydrogen. The drawing shows one form of apparatus by which this may be effected.

3378. PROPELLING VESSELS, W. Clark.—Dated 19th August, 1880.—(A communication from A. Figge and Le Comte S. J. Ostrorog.) 6d.

Several pairs of feathering blades Q are made to revolve in a horizontal plane in openings in the keel of the vessel, and each blade is made to turn partly

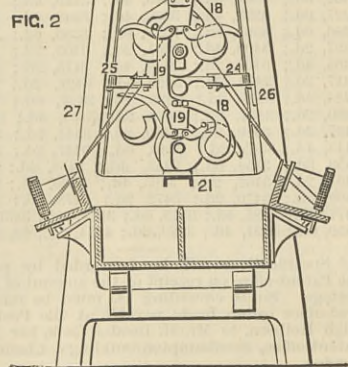
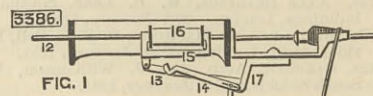


round on its own axis, so as to feather or present its broad surface and its edge alternately to the water by means of cams. The drawing shows these blades driven by hand, but they may be connected to any suitable engine.

3386. MACHINERY FOR WINDING, DOUBLING, AND TWISTING YARN OR THREAD, J. and T. A. Boyd.—Dated 20th August, 1880. 6d.

This relates, first, to the winding of yarn or thread in the cop form, and consists in modifying the form of an inclined guide, described in patent No. 2226 of 1873. Fig. 1 is a vertical section showing the spindle 12 and parts carrying it; also the weighted lever 13, by the action of which on a fixed inclined guide 14 the end-on pressure on the spindle 12 is regulated, the lever 13 being jointed to a buckle or bracket 15, which loosely embraces the spindle at each end of the driving pulley 16. The inclined guide 14 is provided with a part 17, which is either horizontal, as shown, or less inclined than the main part, and which diminishes the action of the weight. In some cases the part 17 may even be made or set with a slight reversed inclination. A second improvement relates to a modification of the machine with upper and lower sets of "drum" winding details, which may be arranged either for single winding or for doubling. Fig. 2 is a transverse vertical section of one of these machines,

with the improvement applied to it. The improvement consists in part in dispensing with the middle longitudinal rail of the framing, and in carrying the bobbin holders 18 and other details on strong brackets 19, extending from the top rail 20 to the bottom rail 21. In connection with this arrangement, the traverse guides are carried by a longitudinal bar of a tubular form, and occupying a position between the upper and lower winding details. In this way a single



traverse bar is made to serve four rows of bobbins, an upper and a lower row on each side of the machine. The traverse bar is supported and guided at intervals between its ends by transverse arms 24 fixed on it, and fitted with rollers 25 at their ends to rest and move on short guide brackets 26 fixed to the intermediate transverse vertical frames or spring frames 27 of the machine.

3396. HOLDING OR CARRYING EGGS, J. Hally and A. Barr.—Dated 21st August, 1880. 6d.

This consists in fitting boxes, trays, or frames with spring holders, which hold the eggs securely, and prevent injury from shaking and concussion. The holder is preferably made of bent wire, and consists of two or more spring fingers capable of moving towards or away from one another.

3397. DEPOSITING GOLD DUST, &c., UPON PRINTED FABRICS, J. Lloyd.—Dated 21st August, 1880.—(Not proceeded with.) 2d.

The design is first printed upon the fabric in some varnish or other adhesive medium, and is then conveyed under a box from which a stream of gold dust issues. The excess of gold dust is thrown off the fabric by a revolving beater acting upon the underside of the fabric.

3400. SOLES AND LININGS FOR BOOTS, &c., H. B. Fox.—Dated 21st August, 1880. 4d.

This consists in making the soles or linings of boots, shoes, and slippers of cork composition and the like, spread on and incorporated with canvas, sheet celluloid, or other suitable backing.

3401. STOPPERS FOR BOTTLES, W. Bowen.—Dated 21st August, 1880.—(Not proceeded with.) 2d.

A thin disc of metal with an india-rubber cushion on its underside, to fit over the mouth of the bottle, has three arms depending from its periphery and terminating in hooks, which, when forced inwards by means of a sliding ring, take under the shoulder of the collar round the neck of the bottle.

3403. ATTACHING DOOR KNOBS, &c., TO THEIR SPINDLES, S. C. Emery.—Dated 21st August, 1880.—(Not proceeded with.) 2d.

A plate is secured to the lock plate, and has a projecting collar with aperture, the interior of which is recessed. The edge of the collar has a key way, and the neck of the knob is correspondingly keyed. The spindle is passed through the square in the lock and out through the plate into the square in the knob. A second plate is now passed over the end of the spindle and the other knob placed in position, its key entering the key way in the second plate, which is then turned and screwed to the door.

3404. APPLYING WATER FOR OBTAINING MOTIVE POWER, W. H. Thompson and F. G. Herwood.—Dated 21st August, 1880.—(Not proceeded with.) 2d.

This consists in conducting water by tubes to the machinery employed in mines.

3405. WARMING RAILWAY CARRIAGES, &c., W. R. Lake.—Dated 21st August, 1880.—(A communication from S. L. J. Lepicard.)—(Not proceeded with.) 2d.

The carriages are heated by steam conveyed by pipes from the boiler of the locomotive, a special form of coupling being used to connect the tubes between the different carriages.

3407. MINING LAMPS, H. Thallon.—Dated 23rd August, 1880.—(Not proceeded with.) 2d.

An extinguisher is provided, which, on opening the lamp, descends and extinguishes the flame, thus preventing accidents.

3414. REDUCING OR GRINDING MACHINERY, W. R. Lake.—Dated 23rd August, 1880.—(A communication from W. Seck.)—(Not proceeded with.) 4d.

This relates to crushing machinery in which three rollers are arranged one above the other, the two outer ones being pressed against the central roller by levers and friction rollers, and it consists, first, of a special lever by which the pressure is effected, and in the arrangement of auxiliary levers by which, in combination with a set screw and eccentric, a perfectly parallel position of the three rollers is obtained; secondly, in employing the axle of the upper friction roller as a feeding roller; and thirdly, in the application of a scraper made of several separate narrow springs placed side by side.

3415. DENTAL MALLETS, A. Jamieson.—Dated 23rd August, 1880.—(Not proceeded with.) 2d.

This relates to dental mallets containing a plunger for actuating the plunger, and it consists, first, in actuating the plunger by means of an air pump driven by a cam or eccentric; secondly, in fitting between the pump and plunger a disc, with a small orifice through which the air from the pump passes; and thirdly, in making the stroke of the plunger adjustable, so as to regulate the force of the blow.

3416. ILLUMINATING AND PRODUCING THEATRICAL EFFECTS, C. H. Frome and G. C. Gibbs.—Dated 23rd August, 1880.—(Not proceeded with.) 2d.

In order to represent an effect such as would be produced on persons or objects that have to be seen in a flash at intervals on different parts of the stage, a wire rope is stretched across the stage, its ends being secured to the wall. On this wire at intervals are plates communicating by wires with a battery or electrical machine. Between each plate and the rope an insulating material is inserted. On the rope a carriage is arranged, and can be pulled from one end to the other. The wheels of the carriage are formed of two outside metallic plates and a central insulating plate, and as the carriage runs over the metal plates the current will pass down on either side to a lamp fastened to the person or object to be seen.

3417. MEDICINAL PREPARATIONS, W. E. Gedge.—Dated 23rd August, 1880.—(A communication from A. G. da Motta Basto.)—(Not proceeded with.) 2d.

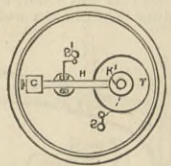
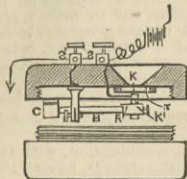
This relates to a preparation to be applied outwardly

to burns, scalds, sores, rheumatic and other pains, and consists essentially of sugar, methylated spirits, and cordial bitters.

3418. COLOURING COMPOSITION FOR IMPRESSION STAMPS OR PRINTING ROLLERS, A. Ungerer.—Dated 23rd August, 1880.—(Not proceeded with.) 2d. The composition consists of 2 parts agar-agar or Bengal isinglass—36 parts water, 54 parts glycerine, and 12 parts starch syrup, to which is added a colouring matter, preferably an aniline or tar dye.

3420. APPARATUS FOR TRANSMITTING SOUNDS, G. F. R. von Wreden.—Dated 23rd August, 1880. 6d. The principle of the construction of the instrument is that of the microphone. In the figures, T is a stretcher membrane, K K' pieces of carbon, K being fixed to T, K' to a thick ring R on the contact regulator

3420



H, K is in electrical contact with screw S, K' is similarly connected to S'. G is a counterweight whose position regulates the pressure between the carbons. The inventor claims the arrangement as shown.

3421. VELVET, E. and R. Collinge.—Dated 24th August, 1880.—(Not proceeded with.) 2d.

This consists of an improved ribbed back velvet woven with twelve ends and thirty picks to the round, the pile threads floating over nine ends, and there being four face picks between each two back picks.

3423. GULLEYS AND SEWER GAS TRAPS, J. M. Hale and L. Saunders.—Dated 24th August, 1880.—(Not proceeded with.) 2d.

This relates to the construction of gulleys and sewer gas traps, so as to prevent gases escaping therefrom, and it consists in forming below the grating a box, the outlet from which to the sewer is near the upper part. The bottom of the outlet is shaped so as to form a trough, which is filled by the water as it rises in the box, and then overflows into the sewer. A division or dip descends into the trough below the level of the water, so as to form a trap.

3424. IMPROVEMENTS IN ELECTRIC CONDUCTORS AND IN A COMPOUND FOR PREVENTING THE DETERIORATION OF RUBBER INSULATORS, G. Barker.—Dated 24th August, 1880.—(A communication from W. W. Jacques.) 4d.

The inventor impregnates the pores of the rubber insulator with a mixture of equal parts of Venice turpentine and beeswax. He takes a vessel with preserving compound in it, heated to about 80 deg. C., the rubber being added in the form of sheets; the heat is then raised to about 100 deg. C., and the air gradually exhausted from the vessel and also from the pores of the rubber. The air is then admitted, the mass cooled to 80 deg. C., and the rubber removed; it is then mixed on warm rolls in usual way with powdered sulphur, and with an equal weight of steatite or asphalt to give it bulk.

3425. HAIR BRUSHES, F. L. Lawrence.—Dated 24th August, 1880.—(A communication from A. Camille.) 2d.

The usual bristles are replaced by fine metallic wires of brass, nickel, zinc, and tin in proportions varying with the degree of hardness or softness to be given to the brush.

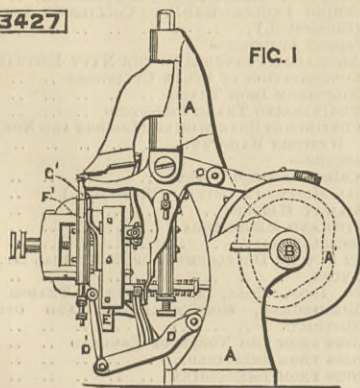
3426. ORNAMENTATION OF CLOCKS, V. L. A. Blumberg.—Dated 24th August, 1880.—(Not proceeded with.) 2d.

This consists of a means whereby clocks may be made to correspond with the hanging and furniture of the apartment in which it is placed, and consists in the application of an inlaying or embossing to the clock of textile fabrics in place of plaques of porcelain, metal, wood, &c.

3427. MACHINES FOR CHANNELLING AND TRIMMING SOLES FOR BOOTS AND SHOES, W. Morgan-Brown.—Dated 24th August, 1880.—(A communication from F. S. Potter.) 6d.

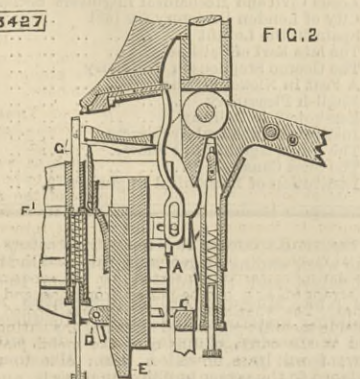
This invention consists partly in the production of a machine containing a channel cutter and an edge-trimming device or blade to channel and trim a sole

3427



of a lasted shoe or boot. Fig. 1 is a side elevation of a machine, and Fig. 2 a partial vertical section. The frame A is of suitable shape to support the working parts, and the main shaft B driven in any usual way. This shaft has upon it a cam grooved disc C provided with a cam groove A' shaped as designated in dotted lines, Fig. 1, to receive a roller stud of a lever D

3427



connected by a link D' with a slide or carriage E', upon which is attached the holder F', to which is secured the edge-trimming device or blade G', shown,

as a chisel or gauge-like device, which strikes through and cuts away the sole edge.

3429. PADLOCKS, G. W. von Nawrocki.—Dated 24th August, 1880.—(A communication from W. B. Miksch.)—(Not proceeded with.) 2d.

The casing is made horseshoe-shaped, and is provided with a sliding bolt, the ends of which are hidden in the two shanks of the casing. One end of the bolt is screwed to a cover plate or slide, having a tongue projecting into the interior of the casing, and having two springs attached to the free end of the tongue and flaring outward horizontally, so that the ends nearly touch the inside of the casing, and prevent the withdrawal of the cover plate and tongue until the springs are pressed together by a special key.

3430. ENVELOPES, E. Manger.—Dated 24th August, 1880.—(Not proceeded with.) 2d.

A small hole is cut in the envelope at the place where the stamp is to be affixed, so that the latter, when in position, is gummed partly on to the letter placed in the envelope. By this means, when the stamp is obliterated, a clear indication of the date of posting the letter will remain on the letter itself. To prevent the letter being torn when withdrawn, the hole is surrounded by perforations enclosing a space larger than the stamp, and which allows the stamp to be separated from the envelope.

3431. DEW SQUIRTS, E. A. Brydges.—Dated 24th August, 1880.—(A communication from H. Alisch.)—(Not proceeded with.) 2d.

This relates to apparatus for delivering a fine spray of water by the action of a current of air impinging on and breaking up the water as it issues from a nozzle.

3432. BOTTLES AND STOPPERS, &c., J. Cole.—Dated 24th August, 1880.—(Not proceeded with.) 2d.

On top of, and rising above the bottle, are two projections with recesses to receive lugs formed on the stopper.

3434. CLOTH, J. Coomer and S. Shepherd.—Dated 24th August, 1880.—(Not proceeded with.) 2d.

This relates to improvements in weaving cotton cloths known as eight shaft cords, having six ends of warp to each rib of cord. The 1st face pick passes under the 7th and 12th ends, the 2nd under the 1st and 6th, the 3rd back pick passes under the 2nd, 4th, 6th, 8th, 10th, and 12th, the 4th face pick under the 7th and 12th, the 5th under 1st and 6th, while the 6th back pick passes under 1st, 3rd, 5th, 7th, 9th, and 11th ends.

3435. UMBRELLAS AND PARASOLS, J. Keet.—Dated 24th August, 1880.—(Not proceeded with.) 2d.

The different sections of fabric forming the cover are triangular, the ribs when opened out standing perfectly horizontally above the stop and the rib tube. Advertisements can be placed on each section.

3437. VASES, &c., J. Bevington.—Dated 25th August, 1880.—(Not proceeded with.) 2d.

The vase when formed of clay or other body has its outer surface roughened by the application to it of small fragments of china or like ware, and upon the roughened surface flower ornaments are applied, and the vase is then burnt, after which it is dipped into glaze and again burnt. The flowers are then painted, and the roughened parts coated with a liquid known as "beleick."

3439. CORKING BOTTLES, W. H. Beck.—Dated 25th August, 1880.—(A communication from E. Guichard.)—(Not proceeded with.) 2d.

The cork to be inserted is compressed concentrically at all points of its height at the same time by means of a spring formed of several blades as wide as the height of the non-compressed cork.

3440. STEAM TRAPS AND STEAM DRYING APPARATUS, W. I. Sutcliffe and R. C. Ferguson.—Dated 25th August, 1880.—(Not proceeded with.) 2d.

A hollow cylindrical shell is provided at its centre with an inlet for the mingled water and steam, and at the lower part with a valve over the water outlet, while the steam outlet is at the upper part. The water outlet valve consists of a cylindrical float covering the outlet.

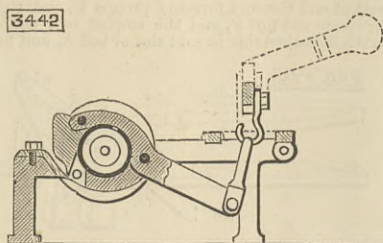
3441. LAMPS, H. Clinch.—Dated 25th August, 1880.—(Not proceeded with.) 2d.

The lamp is formed so that the wick can be lighted and trimmed without removing the chimney, globe, or shade, for which purpose the burner and socket are so arranged that the chimney and globe may be raised with a portion of the lamp above an aperture in which the light may be inserted.

3442. MACHINE FOR CAPSULING BOTTLES, &c., F. A. Glaeser.—Dated 25th August, 1880. 6d.

The machine is constructed of a pair of excentric jaws jointed together shear wise in a suitable stand or frame; the lower or fixed jaw may be cast in one piece with the stand. The upper or movable jaw is provided with a projecting arm jointed by links or otherwise to the shorter arm of a hand lever working on a fulcrum in the frame of the machine. To the

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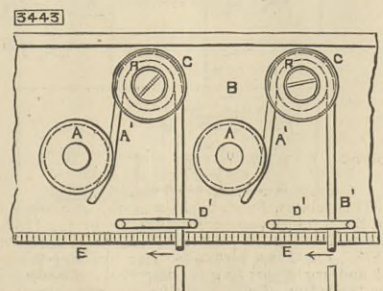


outer end of the upper or movable jaw is jointed a cam-shaped jaw working in a slot in the stand of the machine. To the inner surface of the cam-shaped jaw is attached a segment of a circle made of spring steel, which adapts itself, when compressed, to the circle of the lower jaw. In the central space enclosed by the jaws is an india-rubber socket serrated on its inner surface of the usual construction.

3443. BRAKES FOR BOBBINS OF THROSTLE FRAMES, J. C. Meuburn.—Dated 25th August, 1880.—(A communication from H. Detrouze.) 4d.

This consists in filling the bobbins of the throstle frames with brakes formed of adjustable metallic

3443



springs. A A are the bobbins, and B is the bar which supports them; R R are metallic springs, one for each bobbin. These springs are enclosed, except at their ends, in boxes or caps C C, which are fixed to the bar B by bolts. The end A' of each spring bears against the lower flange of the corresponding bobbin, while the other end B' is held in one of the notches E' in the front edge of the bar B; D' D' are loops or straps to guide the ends B' of the springs.

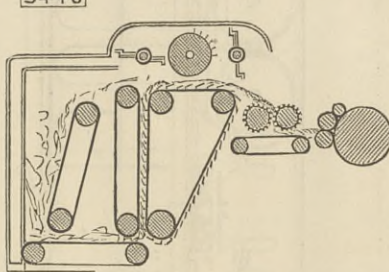
3445. TRAMWAYS, &c., W. T. Gunson.—Dated 25th August, 1880.—(Not proceeded with.) 2d. This relates to means for changing the tram cars

from one line of rails to another, and consists in the employment of short lengths of a third rail placed between the tramway at the points of desired change, where one set of rails is allowed to join at an angle up to the other, and a wheel on the car can be depressed so that its flange will take into the groove in the third rail, and direct the car as desired.

3446. SCRIBBLING AND CARDING ENGINES, H. Marsden.—Dated 25th August, 1880. 6d.

This relates to improvements in the feeding. In front of the machine is a hopper, into which the wool or other fibrous substance to be scribbled or carded is placed, and by the application of a "chain lattice

3446



sheet," arranged in conjunction with a series of rollers and distributors, each of which has a rotary motion imparted to them in suitable directions, the wool or other fibrous substance is made to travel towards the scribbler in regular and uniform quantities.

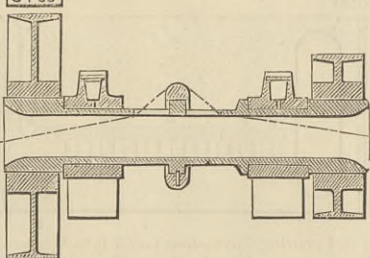
3450. APPARATUS FOR FACILITATING GYMNASTIC EXERCISE, AND CONVERTIBLE INTO A TABLE, BED, &c., W. R. Lake.—Dated 26th August, 1880.—(A communication from C. H. and J. H. Gifford.) 8d.

The apparatus combines a rowing machine, chest bars, horizontal bar, and means for exercising all parts of the body not affected by the above devices, and which will be capable of being converted into a bed, a crib having a lateral motion, an adjustable table, and a chair.

3453. APPARATUS FOR WRINGING WARPS IN DYEING, &c., J. Conlong and J. Robertshaw.—Dated 26th August, 1880. 8d.

In lieu of the squeezing rollers hitherto employed a hollow cylindrical metal roller, mounted in bearings and rotated by means of a driving pulley fixed thereon, is used. The hollow roller is formed with a collar, which may be cast with the hollow cylinder and at about the middle of its length. On each side of the said collar suitably formed slots or openings are made

3453

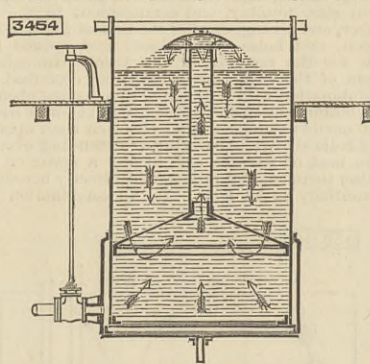


in the hollow cylinder, in order to permit of the warp or fabric being carried over the collar from out of the said hollow cylinder. The periphery of the said collar is fitted by means of a screw, or otherwise, with a rim of glass or metal, which rim can be readily removed and replaced with a rim of a different diameter when it is required to increase or decrease the tension or drag on the warp by the said rim. The said hollow cylinder is suitably rounded off at the parts of contact of the warp therewith, and preferably bell-mouthed at each end.

3454. APPARATUS FOR BOILING BEER, &c., J. Atkinson.—Dated 26th August, 1880. 6d.

This relates principally to improvements in apparatus for preventing beer from running over in the boiling operation. Within the boiler is fitted a seating extending around the interior of the boiler. To and on the seating is placed an apparatus consisting of a conically-shaped perforated false bottom, terminating at its apex into an opening or thoroughfare to allow

3454

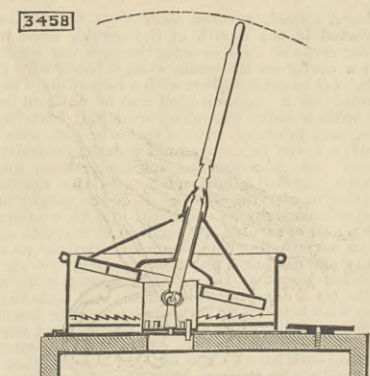


of the boiling liquids to ascend up a funnel. Around the said opening or thoroughfare is formed a seating, and resting thereon is a cylindrical or other shaped funnel extending above the height of the contained liquor in the boiler, and above the funnel is arranged a crown or deflector, the object of which is to deflect the stream of boiling liquid issuing up the funnel downwards and on to the liquor in the boiler at a lower level.

3458. COMBINED CLOTHES-WASHER AND WRINGER, W. Clark.—Dated 26th August, 1880.—(A communication from A. Atkinson.) 6d.

This consists of a tub provided with a false bottom, which bottom has radial ribs on its underside,

3458



and radial ribs in which are fixed hexagons or circles of wire on its upper face or side; and it consists further of a plunger whose upper face is provided with circular ribs and radial wires; also of a short upright shaft fixed in the centre of the tub, and

of a vertical lever or handle that passes down through the centre of the plunger, and is connected with the upright shaft by a ball-and-socket joint, whereby the said plunger can be rocked and rotated at will; and further of a perforated cylinder resting centrally on the bottom of the tub, and surrounding the short upright shaft and ball-and-socket joint, thereby preventing the entangling of the clothes therewith.

3447. MIXTURE FOR CHOLERA, &c., W. Williams.—Dated 25th August, 1880.—(Not proceeded with.) 2d.

The compound or mixture for curing cholera, &c., consists of 1 lb. flour, 1 lb. ground rice, 2 oz. ground cinnamon, 2 oz. caraway seeds, 2 oz. ground ginger, 8 oz. raw sugar, 1 oz. ground cloves, and 2 oz. Cayenne pepper

3460. FOUNTAIN PEN, N. Treinen.—Dated 26th August, 1880.—(Not proceeded with.) 2d.

The case terminates with a point pierced with a small hole, and is closed at top by a removable cover. A needle projects through the hole in the point, and as it is pressed on the paper is forced inwards, allowing the escape of the writing fluid.

3461. SAFETY JOINTS FOR RAILWAYS, E. E. Talbot.—Dated 26th August, 1880.—(Not proceeded with.) 2d.

This relates to the joints of steel rails, and consists in forming a slot about 3in. long by 1/4in. deep in each end of the rail, such spaces being afterwards filled in with liquid cast iron when the rails are in position, thus effectually binding the two ends together.

3462. WEIGHING MACHINE AND MECHANICAL LEVEL, &c., T. Poseck and I. Sellen.—Dated 26th August, 1880.—(Not proceeded with.) 2d.

A bent lever works on an axle mounted in bearings in the front and back plates of the apparatus. At the front end of this axle an indicator is fitted, and an index is formed on the front plate. At the back end of the axle the bent lever is fitted with an adjustable weight on its lower end. The upper end of the back plate has guides for a rod, to the top of which the scale is fitted. A connecting rod has one end jointed to the upper end of the bent lever and the other to the upper end of the rod. Between the ends of the main axle is a toothed wheel gearing with a pinion, the axle of which bears a pointer moving over an indicator, the movement of which being much greater than that of the first pointer enables the most exact readings to be taken.

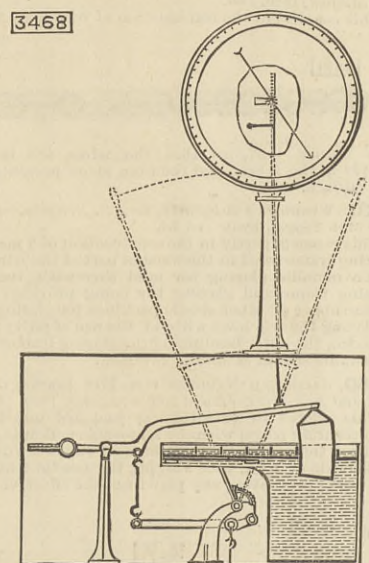
3466. COUNTING AND REGISTERING APPARATUS, A. Rousselle and J. Mariotte.—Dated 26th August, 1880.—(Not proceeded with.) 2d.

The apparatus consists of a ratchet wheel mounted on a central axis in a suitable case, and having an even number of teeth, say 100. This wheel is driven by the action of a pawl carried by a lever on the ratchet teeth. The lever rocks on the central axis, and is worked by a rod flexibly connected to any convenient part of the machine, the work of which is to be counted. On the face of this ratchet wheel is fixed a pin, which once in a rotation comes into contact with one point of a ten-pointed star wheel. A finger on this star wheel acts upon a second and similar star wheel, which in turn actuates a third star wheel. These wheels carry on their faces numbers which show through openings in a dial placed in front of the wheels.

3468. WEIGHING MACHINES, J. Hines.—Dated 26th August, 1880. 6d.

This consists in erecting and arranging the balance counterpoise weighing lever or steelyard of the machine as a lever of the second order, with its carrying knife edged centres at the one end resting in their hollow fixed steel bearings below them, and with the inverted steel knife edge load carrying centres fixed in the lever for having the shackle and rod to the main levers of the machine below at a distance proportionately near the fixed centre, that the whole length of the lever to its free end is to the power exerted by the counterpoise acting upwards, would balance and weigh the maximum load on the platform, which the weighing machine is made for; and further, and especially, in fixing and applying under the free end of the steel-

3468

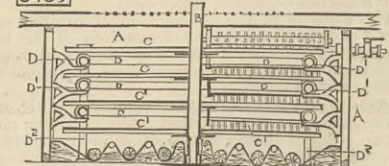


yard a hollow float counterpoise with a fluid-tight bottom and sides, but preferably open at top for free admission of air or adjustment of its weight, and made of a little greater length or depth than the whole motion required by the lever and parallel in its sides, and preferably of a square or rectangular form in horizontal cross section, and segmentally concentric to the stationary bearing centre, all for the purpose of, and fitted to act as a float counterpoise, which would be immersed in a small cistern of water erected for the purpose below it, all proportionately to the weight of the load exerted on the lever as to carry it, and displace a nearly equal or uniform quantity of water for every hundredweight of the load or aliquot part thereof, and of the motion of the lever.

3469. MACHINERY FOR DRYING CORN FLOUR, STARCH, &c., J. Currie.—Dated 26th August, 1880. 6d.

This consists in the apparatus for drying corn-flo, starch, &c., in which the material is agitated, broken,

3469



and made to pass through a series of horizontal sieves or screens C C, fitted to a revolving shaft B within a heating and drying chamber A, heated by steam pipes D D'.

3470. MOUNTING AND ADJUSTING STEREO PLATES, &c., A. J. Parker.—Dated 26th August, 1880.—(Not proceeded with.) 2d.

A series of notches or slots is formed in the edges of blocks, the slots having undercuts, into which shoulders or slide pieces or catches can engage to prevent the catches being lifted out of the slots except when turned partly round by hand. These

catches can be slid or opened out to suit the register and sizes of the stereo plates to be used, filling in pieces being inserted either in front or behind them, that they hold the plates firmly in position.

3465. COMBINATION OF LETTER LOCKS, E. du Sart.—Dated 26th August, 1880.—(A communication from E. Alleboss.)—(Not proceeded with.) 4d.

There are four alphabetical ratchet buttons; and a slider is actuated by the stem of a button or handle and engages with the alphabetical buttons.

3472. MOWING AND REAPING MACHINES, E. Manisty and J. W. Gibson.—Dated 27th August, 1880. 2d.

To the body of the machine is fixed a circular rack, in which works a wheel of equal pitch revolving on a pin hung on the arm or disc of the road or ordinary driving wheel, the latter revolving on a shaft or spindle, on which also revolves a pinion wheel, but which pinion is loose on the said shaft or spindle. This pinion is connected by a clutch to a bevel wheel which drives the shaft or spindle which actuates the crank for working the sickle.

3475. LETTERS AND FIGURES FOR SIGNBOARDS, &c., J. H. Wilson.—Dated 27th August, 1880. 6d.

This consists in constructing letters or figures for signboard and like purposes (of cast, wrought, or stamped metal, or other material), so that they can be mounted off from the background.

3476. SPIKE-SCREW OR LOCK-NAIL, R. C. Perry.—Dated 27th August, 1880. 2d.

This consists of a spike-screw with a flat or smooth side or sides, so that it may be quickly driven or forced into its place, and with segments of a spiral or non-spiral thread or threads, or projections, so that when turned partly round it is secured.

3477. INCREASING LIGHT FROM GAS-BURNERS, J. Haworth.—Dated 27th August, 1880.—(Not proceeded with.) 2d.

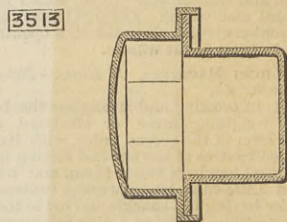
This consists of a small blade attached to a ring or other support, by which it may be fixed on or near the gas-burner in such a manner that the blade, which may be of any suitable metal or material, crosses the burner at right angles just above the aperture or opening by which the gas issues from the burner, so that when the gas is lit the blade divides the flame into two parts.

3485. FOUNTAIN APPARATUS, W. R. Lake.—Dated 27th August, 1880.—(A communication from W. Böckmann.)—(Not proceeded with.) 4d.

This comprises apparatus whereby the pressure of the water in the fountain may be utilised for raising over again a portion of the water which has been already used, so that the same comes into play again before it escapes.

3513. OIL CUPS OF CARRIAGE AXLES, E. Ludlow.—Dated 30th August, 1880. 6d.

This consists in making the oil cups in two parts from sheet brass or other ductile metal or alloy by dies and pressure, the said parts being of different diameters, and each part being provided with a



flange, the said two parts being joined together by their flanges. The drawing shows the two parts connected together by turning the edge of the shallow cup over the edge of the flange of the smaller part.

3521. MACHINE BELTING, &c., G. S. Long.—Dated 31st August, 1880. 6d.

This consists in the combination of wire warp and a



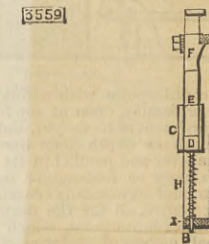
soft fibrous web, so that the wires are bedded deeply in the fabric, and the fibre alone presented at the surface.

3531. WINDOWS AND SASHES, &c., H. Brittain.—Dated 31st August, 1880. 1s. 4d.

This consists partly in the construction of a metallic glazing frame fixed in the wooden part of the window, and a metallic glazing bar used therewith, the said glazing frame and glazing bar being provided with india-rubber or other elastic packings for glazing and reglazing the windows without the use of putty; also covering the outer beadings of the glazing frames with a metallic sheath or sliding covering.

3559. JACQUARD NEEDLES FOR BOX LOOMS, G. C., and J. Vickers.—Dated 2nd September, 1880. 6d.

This relates to constructing jacquard needles in two separate parts, whereby a movable action is given to keep the shank block always in contact with the jack blade or hook, thus keeping the needle always at its work, preventing any play from the effect of wear



and tear. The drawing shows a side view. The bottom part is made with a shank B and block C, having cut out parts D, in which slide the forked ends E of the head F of the needle; the block C is kept pressed on the side of the jack blade by means of a spiral spring H, which is passed over the shank B and kept in position by the inside of the flange I of the jacquard grate A.

3591. BOXES OR BRUSHES OF AXLES FOR WHEEL CARRIAGES, J. Lones, C. Vernon, and E. Holden.—Dated 3rd September, 1880. 4d.

This consists in the employment of an alloy composed of 50 parts by weight of cast iron of the kind known in commerce as Carron or Scotch Carron iron, 7 parts of scrap steel or Bessemer steel, and 1 1/2 of black oxide of manganese.

3629. MANUFACTURE OF ARMOUR-PLATES, J. D. Ellis.—Dated 7th September, 1880. 6d.

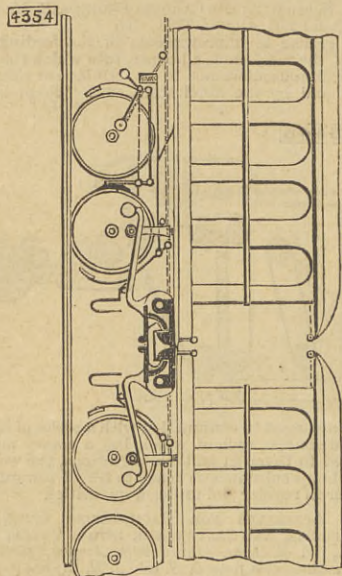
This consists in the manufacture of armour-plates composed of iron and steel combined, the combination



of a wrought iron plate or frame of wrought iron or steel applied to the said plate, and a worked steel plate covering the said frame and wrought iron plate, the whole forming an inclosure into which molten steel is introduced.

4354. BRAKE AND COUPLING APPARATUS FOR RAILWAY VEHICLES, S. Fairman.—Dated 25th October, 1880.—(Complete.) 6d.

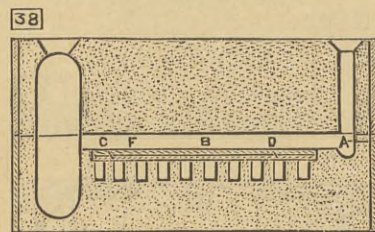
This consists in a combined car brake and coupler having the following essential elements in combination—that is to say, a pair of brake shoes consisting of shells conforming somewhat in shape to the edge of



the car wheels, suspended by means of flexible bars to a plate adapted to have a sliding movement longitudinally of the car, and a coupler having a movable jaw which is depressed or opened to discharge the coupling link upon the falling of the said brake shoes, and the movement of the said plate consequent thereupon.

38. CASTING METALS, H. J. Hadden.—Dated 4th January, 1881.—(A communication from S. L. Clemens, D. Slot and C. Sneider.)—(Complete.) 6d.

This consists in the process of producing relief line plates, blocks, or types for printing, embossing, and other like purposes, by securing a sheet or coating of suitable substance upon a plate of glass or other destructible material, placing the same in a suitable



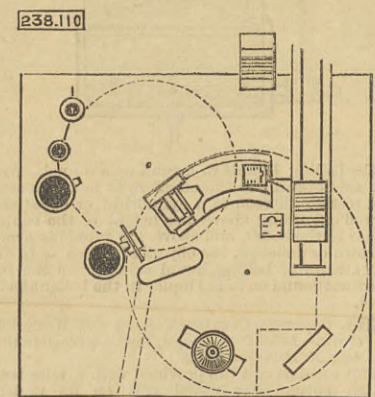
flask, and pouring the molten metal into the same so as to pass over the face of the matrix, and carry the air and slag before it prior to cooling and forming upon the same. A indicates the flask. B is matrix or matrices, which consist each of a plate of glass C or other destructible material. D is the facing of the matrix, F the cavity for the reception of the metal which is to form the body of the casting.

SELECTED AMERICAN PATENTS.

From the United States' Patent Office Official Gazette.

238,110. BESSEMER PLANT AND APPARATUS, Wm Hainsworth, Pittsburg, Pa.—Filed December 30th, 1880.

Claim.—(1) An apparatus to be used in connection with a Bessemer plant for the pouring, casting, and removal of ingots, consisting of a cage adapted to be swung by a crane in one part of the operation and to be run on a track in another part of the operation, said cage having holes in its bottom plate corresponding in size, number, and arrangement to the size, number, and arrangement of the nest of ingot moulds thereon, said holes being closed and opened from below for the removal of the ingots through the bottom of the cage, substantially as described. (2) In combination with a swinging cage having openings in its bottom closed and opened from below, a nest of ingot moulds arranged one over each such opening, and a ladle above and covering or extending over the entire nest of moulds, and having a sprue or gate opening therefrom into the mould directly beneath it, substantially as set forth. (3) In combination with

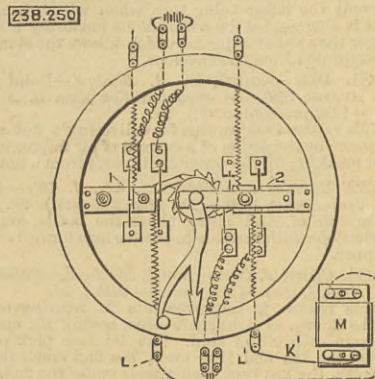


an ingot mould, a cover adapted to fit into and be supported in the mouth of the mould, made with a casting sprue or gate directly through the same, and with a cavity on its under side, substantially as set forth. (4) In combination with a nest of ingot moulds standing on a common level and of uniform height, and with a ladle extending over and covering the same, and provided with a sprue or gate over each mould, a cover in each mould mouth, centrally perforated and hollowed on its under side, and of suitable vertical height relative to the mould, for receiving or carrying some or all of the weight of the ladle, substantially as set forth. (5) In combination with a nest of moulds arranged on a movable cage, a jacket surrounding such moulds, and air or water supply and discharge pipes for applying an air blast or water jacket to the moulds, substantially as set forth. (6) A cage, carrying moulds and ladle thereon, made with holes in its bottom plate for the downward discharge of the ingots from the moulds, and supplied with blocks, transverse bars, and suitable fastenings for securing such bars to the cage, in combination with the bearings and recess of a car-platform, arranged substantially as set forth, whereby, when the cage is seated on the car and the fastenings loosened, the cage may be lifted off and the ingots removed, while leaving the blocks and bars in the proper position to be attached to the same or to another like cage, sub-

stantially as set forth. (7) In a Bessemer plant, the construction, for conjoint operation, of a system of apparatus consisting of a rotary converter, a pit of proper size and depth for the swinging under the mouth of the converter, when in a pouring position, of a cage carrying a nest of ingot moulds and a ladle thereon, a crane for lowering and swinging the cage into position under the pouring mouth, and for swinging it away, raising it out of the pit, and transferring it on to a track arranged within the sweep of the crane, substantially as set forth. (8) An improved ladle, having side trunnions, a close top, a filling opening, and a pouring spout, substantially as set forth. (9) The swing pipe, in combination with converter, substantially as set forth.

238,250. TELEGRAPH MECHANISM, Samuel M. Plush, Philadelphia, Pa., assignor to himself and William P. Phelps, same place.—Filed September 15th, 1880.

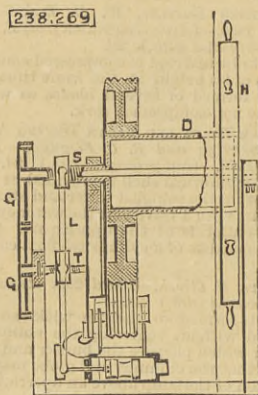
Brief.—A device for preventing burning of contact points in pole changers. A condenser is arranged in circuit so as to neutralise heating effect due to spark by discharge on reversal of poles. Claim.—(1) In combination with pole changers, No. 1 and No. 2, the



single condenser M, two line wires L L', and condenser wires K K', all connected and operating substantially as and for the purposes described. (2) The combination, with two line wires, Land L', the circuits in which are broken simultaneously, of single condenser M and condenser wires K K' the said two condenser wires being connected to the opposite ends of the condenser, substantially as and for the purposes described.

238,269. STEAM STEERING APPARATUS, Geo. W. Baird, Engineer Corps, U.S. Navy.—Filed December 2nd, 1880.

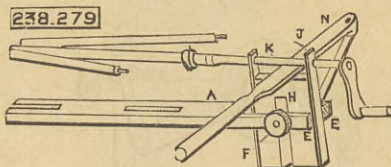
Claim.—(1) In a steering apparatus, a friction wheel arranged upon the barrel (or drum), in combination with the movable key, substantially as specified. (2) In a steam steering apparatus, the drum having the screw thread on its prolonged axis, in combination with the valve lever, hand operating screw, and fric-



tion gear, all substantially as shown and described. (3) In a steam steering apparatus, the drum D, having the screw thread on the prolonged axis, in combination with the adjustable journal boxes, the friction gear, lever L, screw T, gears G G, shaft S, hand wheel H, all substantially as shown and described.

238,279. MACHINE FOR TENONING AND BORING SPOKES AND FELLIES, Melvin P. Ellison, Middlesex, N.Y.—Filed December 18th, 1880.

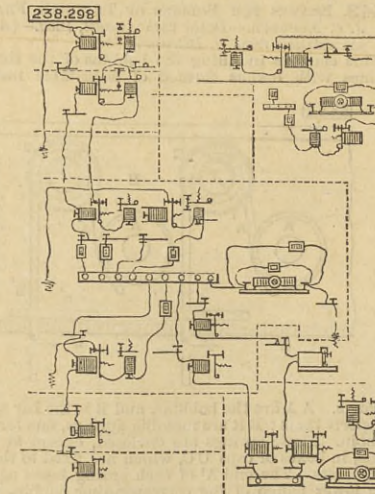
Claim.—The combination of the bed A, having vertical end slot and forming prongs E, and tightening screw and nut F, and the slotted tool carrier H, vertically adjustable in said slot of bed A, and having



the usual supporting brackets J J, sliding tool handle K, and operating lever N, the several parts constructed and relatively arranged to operate in the manner herein shown and described.

238,298. DYNAMO-ELECTRIC TELEGRAPH, Orazio Lugo, New York, N.Y.—Filed December 20th, 1880.

Claim.—(1) The combination, substantially as hereinbefore set forth, of a dynamo-electric generator,

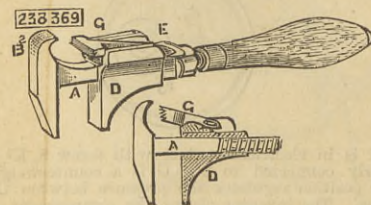


a constantly-closed shunt circuit connecting the opposite poles of said generator, two parallel lines or circuits connected to the said generator in multiple arc with each other and with the said closed shunt circuit, two or more relays having their helices

included in one of said parallel circuits, and their circuit breaking devices in the other parallel circuit, and one or more signalling keys in each of said parallel circuits. (2) The combination, substantially as hereinbefore set forth, in a dynamo-electric generator, of a revolving armature coil and a stationary field magnet, both of which are included in the same circuit with the exterior resistance, two or more independent shunt circuits, which connect the opposite poles of the generator with each other, and thereby act to keep the circuit of the armature and field magnet continuously closed irrespective of the condition of the exterior or working circuits, and means for adjusting or regulating the resistance of said shunt circuits with reference to each other. (3) The combination, substantially as hereinbefore set forth, of a dynamo-electric generator, a constantly-closed shunt circuit connecting the opposite poles of said generator, one or more main lines extending from one pole of said generator to one or more distant stations, and a commutator, whereby the opposite pole of said generator may be connected to the earth either with or without an interposed resistance, or to another main line leading to another distant station.

238,369. WRENCH, Bernard Donohue, Yonkers, N.Y.—Filed November 22nd, 1880.

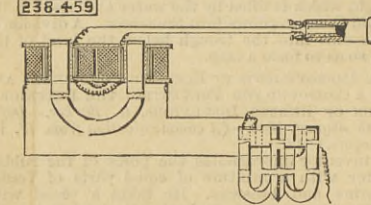
Claim.—The combination, with the stock A, having the jaw B of the slide D, having the recess F and the movable toothed jaw G, provided with the shank, having near its rear end a slot, through which passes a pin, extending between the walls of said recess, and



with the shoulders arranged in front of the ends of said walls, the said slot being of such length as to permit longitudinal movement of the shank to bring said shoulders against said walls, thereby relieving the pin of strain, and throwing the strain wholly upon the slide, essentially as set forth.

238,459. TELEPHONE RELAY, Cornelius T. Tomkins, Red Bank, N.J., assignor to Eaton Telephone Company, Brooklyn, N.Y.—Filed November 29th, 1880.

Claim.—The means, substantially herein described, of re-enforcing and continuing the transmission of telephonic sounds or articulations through long distance or great resistance, consisting of one or more permanent magnets, having upon its or their pole or



poles a double induction coil, interposed at given points between the transmitting and receiving instruments, and having a closed metallic local circuit between the helix on the magnet of the telephone and the primary helix on the re-enforcing magnet, the terminal ends of the secondary coil being the line and earth circuit, substantially as described.

CONTENTS.

THE ENGINEER, April 1st, 1881.

Table listing various articles and their page numbers, including sections for Literature, Legal Intelligence, Tenders, and Paragraphs.

SOUTH KENSINGTON MUSEUM.—Visitors during the week ending March 26th, 1881:—On Monday, Tuesday, and Saturday, free, from 10 a.m. to 10 p.m., Museum, 10,187; mercantile marine, building materials, and other collections, 3533. On Wednesday, Thursday, and Friday, admission 6d., from 10 a.m. till 5 p.m., Museum, 1517; mercantile marine, building materials, and other collections, 250. Total, 15,487. Average of corresponding week in former years, 15,332. Total from the opening of the Museum, 19,785,088.

WORKING DRAWINGS
THE ENGINEER
SUPPLEMENT
PORTFOLIO OF

GOODS ENGINE
LANCASHIRE & YORKSHIRE RAILWAY

Designed by Mr. Robert Wright, Locomotive Superintendent,
(Contracted for)
By THE VULCAN FOUNDRY CO. NEWTON-LE-WILLOWS.

