THE CONDUCT OF METROPOLITAN RAILWAY TRAFFIC.

THE occurrence of three serious accidents within a very short period on the metropolitan railways in the north of London has directed attention very forcibly to the system adopted on metropolitan railways by those who have the management of the traffic on them. The first of these accidents took place on the 10th of December at Canonbury, and was due to the complete failure of the block system, as interpreted by a signalman of many years' experience. The second happened at Hornsey on Wednesday week, on the Great Northern line. A train from Victoria, running over the London, Chatham, and Dover Company's lines and the Metropolitan Railway, continued its journey from King's Cross to Enfield, arriving at Hornsey at 5.27 p.m., or three minutes late. While standing in the station it was run into by a following train from Moorgate-street. This train ran past all the signals intended to protect Hornsey, because the fog was so dense that the driver could not see them, and no fog signals had been put down because the fog came on, it is said, so suddenly that there was not time to get men to place them on the rails. Here again the block system failed. The third accident took place on Saturday night on the North London line between Old Ford and Bow. A coal train left Poplar for Brent at 10.10 p.m., and while running it is said that a draw-bar under one of the wagons broke. The long end of this bar dropped down and stuck in the sleepers, and lifted the wagon off the road; other wagons followed it, and in a few seconds both lines were obstructed. A passenger train travelling in the opposite direction ran into the *débris* and much damage was done. In all three cases lives have been lost. It does not appear quite so clear as is perhaps desirable that the coal wagon was thrown off by the breaking of the draw-bar. It is, indeed, possible that the wagon left the rails, and in doing so broke the bar; but this is beside the question. Here we have another example of the failure of the block system to protect the lives of passengers. The three cases of failure were all different, and each illustrated a peculiar form of danger. The first showed how easily a trained signalman may make a mistake; the second illustrated the incompetence of the system to deal with sudden changes in atmospheric conditions; and the third shows that the system being incapable of recognising any form of obstruction on more lines than one, fails to deal with an obstruction on the up as well as the down road. Thus tested in three different ways, the system breaks down. The question remains, is it possible to so modify and supplement it that it will prove efficient under all conditions?

We may at the outset admit that on the whole the system works well in the country, but it does so only because it can be supplemented. Once the local metropolitan system is cleared, trains succeed one another only at comparatively long intervals. Thus, on any main line, and at a distance of say thirty miles from London, it will be found that intervals of from fifteen to thirty minutes intervene between the passage of any two trains over a given spot. At certain periods of the day the intervals may be still longer. Under these conditions there is time to provide for contingencies. Thus, for example, if a signalman made a mistake such as that which caused the Canonbury accident, the signalman at the receiving station would, when he found the other man insisted on sending on trains, have had time to despatch a man with a red flag to stop them, and to take other precautions sufficiently obvious. If a fog came on suddenly, as in case No. 2, there would have been time after the arrival of one train in the station to send a man back with fog signals to stop a following train; and if both lines were blocked, as in case No. 3, then the guard of the tail end of the goods train could run forward with his lamp and fog signals and stop a coming train. Now in the conduct of metropolitan traffic there is no time to supplement the block system. Trains follow each other at intervals of two or three minutes, and when the semaphore signal fails to do its work, there is nothing else to fall back upon. Can anything be provided which can be used with the ordinary semaphore arm or immediately afterwards to supplement and enforce its indications?

Those who will say yes are legion, but they are not men possessing a practical knowledge of the working of railways. Signal makers, traffic managers, and station masters, to say nothing of signalmen, guards, and engine-drivers, will all be slow to reply in the affirmative. There is much to be thought of which will not strike the unpractised at first sight. Thus it is very difficult to see how the existing arrangements can be superseded without very much increasing the complication of a system which is incredibly complex as it is. However, it is not equally difficult to deal with all the three cases we have cited. For example, there are two ways of working semaphore signals, either or both of which would have prevented the accident at Hornsey, and both are in use. The first consists in fitting every semaphore post with a small steel plate or toe, which is turned across the rail when the signal is at danger. If the engine passes the signal it must run over the steel toe. There is no danger incurred in this, and it is impossible for either driver or stoker to escape the knowledge that they have passed across it. Running over the least obstruction, a spoonful of gravel on a rail, can be recognised at once on a foot-plate. The toe has been used experimentally for some time by Mr. Stroudley in the Brighton station yard, and with perfect success. There is, however, a yet simpler plan in use on several lines. This consists in placing a signal lamp low down on the semaphore post, that is to say, about on a level with a driver's eyes when he stands on the foot-plate, and this lamp is so arranged that the light beats full on the spectacle plate of the cab as the engine passes it. It is impossible in the densest fog on the darkest night to miss seeing a bright red light within 4ft. of one's eyes. At Willesden Junction there is in use on some of the siding semaphores an arrangement under which a lamp well focussed throws its light on the arm of the semaphore, the lamp itself not being visible. It would be interesting to know how far such a system answers in a fog. Whether it does or not is, however, of little consequence, as the low signal can always be seen. It may, we think, be taken for granted that without the aid of any expensive appliances, or the introduction of any complication, or arrangements for the automatic placing of fog signals—for doing which dozens of patents have been taken out—it is possible to render the block system competent to contend with a fog. All that is needed is a lamp where it can be certainly seen, instead of being fixed 20ft. or 30ft. above the driver's head.

Turning to that class of failures represented by the accident, it is evident that here not the mechanism of a semaphore is in fault, but the intelligence which uses it. The only remedy for deficiencies in the signalman must lie in supplementing, not the signalling apparatus proper, but his own intelligence. It is not likely that two men will break down although one does; but it is not therefore necessary or even at all advisable to put two men in the same box; on the contrary, they should be at opposite ends of the section to be protected. It has been proposed that each man should be able to lock the other's signals at danger, the locking bolts to be worked by electricity. We look on the idea with apprehension, knowing as we do how easily electrical apparatus can be put out of gear, and seeing that it would be next to impossible to adopt it without giving each man the means of shifting responsibility on to his fellow. By far the better system consists in doing what we have already suggested, namely, in the first place establishing telephonic communication between all signal boxes in large cities and their neighbourhoods, and automatically registering the time of reception and nature of every message sent by the bell signals. In this way if a mistake was made by one man it might be almost instantly rectified or explained to him by his fellow, while there could be no getting out of the responsibility thrown on the receiver and sender by the record against them. Furthermore, it is, we think, desirable that the precise number of strokes of the bell given and received should be recorded visibly to both men. This could very easily be done by fitting the bell with a dial like that of a clock, and one hand. The hand would always point to the number of blows given, just as the hand of a clock does to the number of the hour just struck. Mistakes are very easily made in counting numerous beats, as five for six, and it is as well that the chance of this occurrence should be eliminated from the system when it can be done without trouble or expense.

With the third and last class of accident the block system seems to be quite powerless to deal. There is no way conceivable in which it can be made to operate to stop a train already running on any given section. Everything in such a case depends on the presence of mind and bodily powers of the guards, drivers, or others in the train which has broken down. The only thing that it seems possible to do is to enable those close to the obstruction to make advancing trains aware of its existence without delay. Seconds very often in such cases represent lives. Each guard should be provided with the means of producing a very brilliant light. It matters nothing about its colour. Chemists will find no difficulty in making what is wanted. A signal light of this kind could, if necessary, be fitted with a simple reflector, and being stuck in the ground at the rear of the broken-down train would be seen a long way off by an advancing driver. Two lights could be used, one to protect each road. The unusual glare would not fail to attract his attention. In the daytime the light would be useless, but on the other hand he could, unless he was coming round a curve, see the obstruction a good way off, when he would, with the aid of a continuous brake, easily pull up his train. In tunnels the signal light would act admirably. Among the other advantages which it would possess, too, would be that of lighting up a wrecked train and enabling assistance to be rendered at once to the sufferers.

Summing up our conclusions concerning the conduct of metropolitan railway traffic, they may be thus explained. In the first place, a system of signalling which answers very well in the country, when the trains do not follow each other at very close intervals, is not sufficient to secure safety on metropolitan lines, where trains follow each other at intervals of less than five minutes. In the second place, London being liable to be suddenly visited by fogs, it is essential that fog-signals and the ordinary signals should be supplemented by what may be called glare signals close to the ground. It would not be difficult to make the same lamps illumine large boards carrying each a distinctive number which would indicate to a driver precisely where he was. Every engine ought, too, to be fitted with a speed indicator, which could convey useful information to a sharp man as to his whereabouts in thick weather. An instance occurred within our own experience when a driver ran nearly two miles on a wrong line without knowing it, in a fog, and had to back his train up to the junction from which he started. The fault lay with the signalman, who made a mistake about the train, which he could not see because of the fog, while he took three signal whistles for four. The driver accounted for his not arriving at a given station as soon as he expected on the theory that he was running slower than usual. He put on more steam to make up for this, and so would have intensified an accident had one occurred. A speed indicator such as Stroudley's would have obviated all this. Thirdly, all signal-boxes within the metropolitan district should be coupled up on each line of railway by telephones, and all the bell instruments should be made self-recording. Fourthly, every guard and driver should be provided with the means of making a very brilliant light which will burn in any weather for at least ten minutes, or at all events for such a time as will enable a man to proceed to a reasonable distance to protect the broken-down train. And, lastly, we earnestly recommend the employment in the metropolitan district of none but the best signalmen, to whom liberal wages ought to be paid, while the hours of work hould never exceed eight out of twenty-four. There is nothing exacting in any of the demands we make on metropolitan railway companies. No necessity is created for applying for help to outsiders. The outlay entailed will be small. Until, however, the suggestions we have made are put in practice, railway companies must not say that they have taken all possible precautions to protect the lives and limbs of their passengers.

LEGAL INTELLIGENCE.

IN THE COURT OF APPEAL.

(*Before the* MASTER *of the* ROLLS, *Lord Justice* BRETT, *and Lord Justice* HOLKER.)

January 27th.

OTTO *v.* LINFORD.

THIS was the hearing of the appeal of the plaintiffs from the decision of the Vice-Chancellor Bacon, which dismissed their action on the ground of the invalidity of the patent upon which they were sueing.

Mr. Aston, Q.C., Mr. Hemming, Q.C., and Mr. Lawson appeared for the plaintiffs; and Mr. Millar, Q.C., and Mr. Brett for the defendants.

The evidence and arguments in the Court below were very fully reported in THE ENGINEER for April 1st, 1881. The arguments upon the appeal sufficiently appear from the judgment of the Court.

The MASTER of the ROLLS: "This is an appeal from a decision of Vice-Chancellor Bacon dismissing with costs an action brought by a patentee, on the ground that the patent was anticipated, and the subject matter of it published to the world in the specification of another patentee. He also intimated an opinion not favourable to the plaintiff on various other points, which have been the subjects of discussion in this appeal.

Now, before going into the very numerous objections to which we have listened in detail, the first thing is to have a general idea of what the invention consists in, and whether it was a new invention, and was so accepted by the body of people to whom it was addressed, namely, the people who were working in the trade which employed gas motor engines. Now, upon that we have two sources of information. We, first of all, have the statements in the specification itself—which, of course, must not be taken as proved facts, but still they do show us that the view taken by the patentee of the state of knowledge as regards gas motor engines, and the mode of working them, was in practice at the time that the patent of the plaintiff's was granted. He says: "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 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 gas to expand very rapidly. According to the present invention, combustible gas or vapour 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 gas 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." So that he tells you shortly this: "Unless you use something very particular and special for very rapid expansion, a great amount of heat is lost. Now, I will show you how to save your heat and to make your machine work more effectively, not by rapid expansion, but by slow expansion—if I may say so, a gradual development of heat and a gradual expansion." That is in substance what he says—"I will show you how to do it." Then he goes on to describe three kinds of machines, which he calls modifications 1, 2, and 3, which will effect the objects; and then there comes a claim which, in the first instance, is a claim for what has been called No. 1—that is, the first machine, which is for admitting the combustible mixture with air separate from a charge of air or incombustible gas, so that the expansion is rendered gradual and "substantially as and for the purpose herein set forth." That is the claim, "substantially as herein set forth." He claims to do it, therefore, by the machine "herein set forth substantially." It is not a mere claim for admitting the mixture, but it is for admitting it "as herein set forth;" and therefore, in my opinion, it is not correct to say that the claim is merely for a principle; it is for a principle together with a mode of carrying out, the principle being the putting in a cushion of air between the explosive mixture and the piston, which will produce gradual combustion, and thereby save the heat, and which also, he says, will make the machine more effective. Then the second claim—which is the only other one we have to do with—relates to what is called the third modification, by which the charge put into the machine is compressed; and then it claims "compressing by one instroke of the piston a charge of combustible and incombustible fluid drawn into the cylinder by its previous outstroke, so that the compressed charge, when ignited, propels the piston during the next outstroke, and the products, after combustion, are expelled by the next instroke of the piston, substantially as herein described." Now, of course that is not merely a claim for the third modification as distinguished from all the rest of the patent—that is, for what is added in the third specification—it is a claim for the third modification itself; that is, for doing what he does by the application of the cushion of air, adding to it the compression. It is therefore a claim for the combination. The compression was old, but he claims the combination of compression with his system of introducing air and this combustible mixture so as to make, as he says, a gradual expansion or increase of pressure. Now, that is a perfectly intelligible invention; assuming, of course, that his drawing enables the workman to make the machine, it will be the mode of carrying it out.

Having said so much as to its general nature, was that a new thing and an improved thing? for, to my mind, that makes the greatest possible impression. I have heard judges say myself—for I argued several patent cases at the bar—and I have read what other judges say, that there should be a benevolent interpretation of specifications. What does that mean? I think, as I have explained elsewhere, it means this, when the judges are convinced that there is a genuine, great, and important invention, which, as in some cases, one might almost say produced a revolution in a given art or manufacture, the judges are not to be astute to find defects in the specifications; but, on the contrary, if it is possible, consistently with the ordinary rules of construction, to put such a construction on the patent as will support it; they are to prefer that construction to another which might possibly commend itself to their minds if the patent was of little worth and of very little importance. That has been carried out over and over again, not only by the Lord Chancellor on Appeal, but by the House of Lords. There is, if I may say so, and I think there ought to be, a bias as between two different constructions in favour of the real improvement and genuine invention to adopt that construction which supports an invention. Beyond that I think the rule ought not to go; but that is what I understand is the meaning of "a benevolent construction." Then it is necessary to see whether this is an invention of that kind. Upon that, of course, we have evidence; and I may say, although there is some conflict on other parts of the evidence, there is no conflict upon this. Two very eminent engineers are examined on the part of the plaintiff; there was at least one eminent engineer—called on the part of the defendant, and another scientific witness. If they could have contradicted this I have no doubt they would. Sir Frederick Bramwell says that "up to 1876"—question 10, page 2—"and he is stating generally as was the fact, that in gas motor engines there was drawn in, or admitted in some way, to the cylinder, a mixture of gas and air, which simply on being ignited produced necessarily a great deal of heat." Then he goes on to say that "that heat was lost by absorption;" and he quotes the words. Then in answer to

questions 13 and 14, he says there were defects in those engines which it was considered a desideratum to somebody to remedy in 1876—defects of such importance, that the doing away with them would be a step in advance. He says, "a very great step in advance—a step which made the gas engine from a thing which was very little used into that which has been used to a very large extent. It made the whole difference." That is the main effect of the plaintiff's invention. The other eminent engineer called was Mr. Imray, and what he says is this. At 281 he is asked to state generally what is the state of knowledge. He says: "Well, there had been many attempts to use the combustion of gas as a motive power, because it had been known for many years that you could get a powerful explosion when you mixed gas and air together. The only attempts that were practically used at all were about 1861 and 1865, when engines were made to work by the explosion of a gaseous mixture; but these had very serious defects. The expenditure of gas was very great in proportion to the power obtained, and the engine altogether was of an inconvenient and troublesome kind to deal with." Then he says at page 21, question 299, after stating what had occurred in the interval: "The next step of any practical value was the patent which is now the subject of action—the 1876 patent. There was no engine that I know of, or ever heard of, that came into use between 1866 and 1876 of any practical use." Then he is asked did he hear Mr. Bramwell's evidence. He says he did. "Q. Did you concur in his view of the action of that invention and the mode of operation of that machine? A. Yes, quite." So that we have there evidence as to the important results of this invention, and even as far as their knowledge was concerned it was a new invention—something not known at all. On the other hand we have Mr. Imray called, who does not contradict it, and, I assume, cannot contradict it; and Mr. Gardner is called and he does not contradict it, and, I assume, cannot. Therefore the evidence, as I said before, is wholly on one side, that we are dealing with an invention of great merit and of great importance; of great merit, because it produces a most remarkable result as to the use of the gas engine. It may appear very simple when it is known—most great inventions do appear to be very simple when they are known. But that does not affect the question. Well, that is the evidence. The assumption on the other side that this patent is bad for want of novelty is, as I said before, founded not on any engine or machine, not on anything that was known before; but they tell us there is described in the specification in the Patent-office the very invention for which this patent is taken out; and it is a very singular thing, if it is so, that nobody knew of it. Well, now, I will take in detail, as I am bound to do—but I hope it will not be at any very great length—the various objections that are made to the patent, and I am not going to say that they are futile or absurd objections at all. It is very difficult to draw a complete specification, and there are very few lengthy specifications to which some objections, neither absurd nor futile, cannot be made; and it is only fair to say that some of the objections here are deserving, and have received from me and my brethren most serious consideration.

The first objection is that this is not the subject matter of a patent; because it is said that what is claimed is a principle as it is sometimes called—I do not know whether it is the best term to use, but I use it because it has been used in some patent cases—that it is not a machine, and that what is claimed by the patentee is the principle, or, as it is sometimes termed, the "idea," of putting a cushion of air between the explosive mixture and the piston of the gas motor engine, so as to regulate, detain, or make gradual what would otherwise be a sudden explosion. Now of course that could not be patented. As I have before said, I do not read the patent so; I read the patent as being to the effect that the patentee tells us that that is the idea that he wishes to carry out; but he also describes other kinds of machines which will carry it out; and he claims to carry it out by substantially one or the other of these machines. That is the subject of a patent. If you have a new principle, or a new idea, as regards any art or manufacture, and then show a mode of carrying that into practice, you may patent that; though you could not patent the idea alone, and very likely could not patent the machine alone, because the machine alone would not be new. One of the strongest illustrations that I know of is the patent for the hot blast in the iron manufacture, where there was nothing new at all except the idea that the application of hot air instead of cold air to the mixture of iron ore and fuel would produce most remarkable results in the shape of economy in the manufacture of iron. The inventor or discoverer of that could not patent that, but what he did was this: he said, "I will patent that idea in combination with the mode of carrying it out—that is, I tell you you may heat your air in a closed vessel next your furnace, and then that will effect the object;" and it was held that that would do, and that nobody could use the hot blast in the iron manufacture, during the period of that patent, for the purpose of manufacturing iron. Now, that is a much stronger illustration than this of the validity of a patent, as regards the subject matter. For here is a complicated machine. Nobody says that this identical machine has ever been seen before, but what they do say, and what I have no doubt is true, is that, given the state of knowledge as regards mechanics, you do not want much invention when you are told what the idea is to find out this machine and carry it out. That did not require invention at all. In the case of the hot blast the man did not pretend to invent anything; he said a machine of any shape in which you can heat air. In this case Mr. Otto does allege he has invented a machine. It appears that he did, although a machine which, *per se*, was not of sufficient novelty, probably, to support a patent alone. It comes, therefore, to this, that we have a principle and a mode of carrying it out, and, I will assume for this purpose sufficiently described; and that is a good subject for a patent. I now pass to the next set of objections.

The next set of objections are objections which I am very familiar with, and that is insufficiency of specification. The insufficiency in this case is an allegation, or a series of allegations, as to omissions, and a series of allegations as to mistakes in the drawings. They are both classes of objection which are quite familiar to those who have had to do with patent cases, and are always remarkable in this way, that they are never found out until the action is brought. The workman always makes the machine, and the machines are made in hundreds or in thousands, and nobody has found them out. But when you come to study the specification, and then to study the machine, you find them out. I recollect many years ago I was counsel in a case which is not reported, but which is a very good illustration for all that. I was counsel for some machine makers who made a thrashing machine, and a very clever thrashing machine it was, and they sold thousands of them. The beaters, as everybody knows, of a thrashing machine are both cut across, and the cuts should be set opposite to one another, otherwise they will not thrash grain at all; but the stupid draughtsman by some mistake had put them all parallel, so that, if it was made according to the drawing, it would not have thrashed anything. Nobody found that out until we came into Court; and Ransome and Co. had made thousands of them, and, of course, they had made them with the beaters set crosswise. Well, when it came to be discussed the thing was too absurd, it would not have been a thrashing machine at all, and, of course, the drawing was corrected by the letterpress, which told them that the thing would thrash, and, as I said before, the remarkable part of the matter was that until we got into Court nobody found out the mistake in the drawing; though the patent had been sold, and the machine had been made, the mistake had not been discovered. In these matters, therefore, it is not for us to find out how not to do it, but when you find that the drawing does not work exactly, the workmen sets himself at once to see how it ought to be done, and, as I have already said, in practice the thing never arises at all.

Now, I will take these mistakes one after the other. The first mistake is a very odd one. The mode which the patentee points out to work out his machine is that he is to admit air, and then gas and air, into his cylinder, and his drawing is so constructed that it will not admit either the one or the other. In fact, the slide as put into his drawings instead of admitting air, as it ought to do, will not admit it—shuts it off when it comes to the point. Well, of course, when the workman found out he would say, "There is some mistake in this slide," and it turns out that by a very simple thing indeed—simply enlarging it at one end—it will work, and do exactly that which the patentee says it ought to do. We have the usual evidence in this case. Engineers are called who say that a workmen will find it out and put it right, and on the other side I must say there is no conflict of evidence on this point, for the scientific gentlemen who were called on the other side do not dispute that the workman ought to, and could, put it right. Then the next objection taken to it was that they say there is no excentric or cam. Says Mr. May, "they work a slide, while there is none in the drawing," but there is in the letterpress. They are told they are to have an excentric or cam. There, again, the workman will have to supply it. Then, in the letterpress, there is none. Then it is said there is no excentric or cam in the drawing for working the exhaust valve. Well, the valve will not work of itself, and, of course, the workman would put something of that kind in. I need not read Sir Frederick Bramwell's evidence, although I have a note of it, in which he says the workman would do it all. Then the next point is, they think that it does not show properly—nor does it show properly—how the fire in drawing No. 1 is to get to light the mixture; it requires a slight shifting, as Sir Frederick Bramwell points out. Well, of course, the workman would know it was to be lighted, and he would easily make a hole or orifice in the slide. That is what Sir Frederick Bramwell says. Then there is this difference between Sir Frederick Bramwell and Mr. May—on the whole, although he does not differ about one, he says he thinks all these together would make too many. That is the real distinction between their evidence; he puts those four objections altogether—the want of the two excentrics, the non-communication between the charge chamber and the flame, and the alteration of the slide. Then he thinks it is altogether too much to expect of the British workman that he will find out all four. He does not say that he would not find out each one separately; but he says he thinks he would not find out all four. Upon that Sir Frederick Bramwell differs from him, and you will find his evidence at page 45. He says he would have to do exactly the same things. Then he is asked what he would have to do. Q. He would have to alter the passage D, would he not? A. Yes. Q. He would have to provide the cam or excentric to work this slide? A. Yes. Q. He would have to alter the passage by which the gas flame was communicated to the combustible charge? A. Yes; no, not alter the passage; he would have to alter the drawing in front; he would not have to alter the passage. Q. If he made the passage according to the drawing it would not communicate the flame? A. That is so. Q. Then he would have to alter the passage according to the drawing? A. Yes. Q. Then he would have to provide means of opening valve F. A. Yes. Q. That would be a different means, but the same thing as opening the slide? A. Yes. Q. Then the workman would have to do all these things? A. Yes. Q. He might? A. Yes." So that he is of opinion that there is no difficulty at all in the matter, and the workman would be able to put it right. As I said before, I prefer that opinion; I know by experience that that is so, and there is not produced on the other side a workman who said he had ever tried to make the machine, and could not, or that he had any difficulty in making it. No practical man was brought forward who had failed in making it, and I entirely give credence to the testimony on the side of the plaintiff, that the workman would do it. But I do not discredit the evidence on behalf of the defendant, because all he says is, "It is expecting an amount of intellect which I do not think you will find." That is all that Mr. May says upon it. He does not say that he has ever tried a workman, or that he has ever heard of one who failed. It seems to me that that is exactly the class of objection which ought not to prevail, and according to my experience—which is very great—which never has prevailed.

I new come to an objection or a far more serious kind. It is said the specification does not show the proportion in which the air is to be put in as regards the combustible mixture. Well, now, the answer is, first of all, no exact proportion is wanted. Upon that I think the evidence is clear enough; but it is equally clear that a mere film of air will not do. You must have what is called by one of the witnesses for the plaintiff a notable quantity, which is called by another of the witnesses for the plaintiff a considerable quantity, and which, no doubt, must be a substantial quantity, having regard to the quantity of mixture. Now these words, "notable quantity," or "substantial quantity," or "considerable quantity," are not to be found in the specification; and the question one has to consider is whether the specification tells you fairly enough to inform a person about to make the machine, that there must be this quantity, or, I should rather say, a person about to use the machine. Well, I think it does. The first thing to be remembered is, in specifications of patents, that they are addressed to those who know somethlng about the matter. A specification for improvement in gas motor engines is addressed to gas motor engine makers and workers, not to the public outside. Consequently you do not require the same amount of minute information that you would in the case of a totally new invention, applicable to a totally new kind of manufacture. In this case the inventor says this: "I am going to turn that which was a sudden explosion of gas into a gradual explosion of gas, and I am going to do that by the introduction of," what he calls, "a cushion of air, in one place between the piston and the combustible mixture." Well, now, if a man is left without any more information, he asks, "How much air am I to let in?" He lets in a little air, and he finds that the thing explodes as before; and he lets in some more, and he finds directly, on the mere regulation of his stop cock, how much is required; and he finds very soon that he has let in enough, and now there is a gradual expansion, and no longer a sudden or explosive expansion. It does not appear to me that that requires invention. It requires a little care and watching, and that is all. If a man told you to mix a glass of brandy and water, and to use brown brandy, and that you were to mix it until it was pale yellow, the exact quantity need not be told to you. You would soon find out when it was pale yellow. That is the object to be achieved. Nobody would say it requires invention, and that is what this man tells you. But he does tell you a great deal more; he does not leave you there. When you come to look at his specication he has drawings, and his drawings, with the letterpress, shows that he really does put in nearly as much air as explosive mixture. You will find that in the description at page 4, where he describes the Fig. 1, and shows, between lines five and ten, "When the piston is at the end of its instroke, its inner surface being at A, the slide D is in such a position that, as the piston begins its outstroke, air entering by the aperture D^2 passes by D and C into the cylinder. When the piston has reached the point *b* the slide has moved so as to admit combustible gas or vapour," and when you look at the drawing you will see that the distance from *a* to *b* is the same as from *b* to *c*, so that the man who read the description of the drawing and read the letter-press would know that he was admitting a very considerable quantity of air as regards proportion. A similar thing occurs as regards Fig. 3. I will not read it. It is page 5, between the lines 15 and 25, and there he speaks of the air acting as a cushion.

It seems to me there is sufficient in this specification to tell the maker of the engine and the user of the engine, without requiring him to use an inventive faculty, how to make the engine, and in what proportion it will be necessary for the air to be let in—not definite proportions—but proportions, as far as proportions are wanted, to make the machine workable.

And here again the same remark applies. Nobody was called to say they had ever found any difficulty. Nobody said, "I made, or tried to make, a machine according to the plaintiff's specification, and I was unable to produce the result, because I did not know the proportions." Nothing of the sort. Those are theoretical difficulties suggested by the defendants to defeat the patent. No practical workman or practical user of a gas motor engine was called as a witness to give any evidence on any of these points.

Well, then, a suggestion was made at the bar that as regards machine No. 3 (I notice it because it was urged upon us with some force—I will not explain it in detail because the parties are perfectly aware what it is) that the compression of the air would blow out the simple gas flame, and prevent ignition. There was no evidence upon that point, and I decline to admit the assertion of counsel that it would have that effect. I am by no means convinced that it would. In fact I think it would not. I decline to be asked such a question. A matter of that kind requiring scientific knowledge should be brought forward in the ordinary way by evidence. It is not sufficient for counsel to assert that that would be the effect, and especially to bring forward a point of that kind in the Court of Appeal for the first time, when it cannot be met by evidence on the part of the plaintiff.

That, I think, disposes of all the objections as regards the specification. Then it was said that the gradual expansion of gas did not apply to the machine No. 3.

Now the only evidence on the point—if I may call it evidence—is to be found in this way. First of all the inventor thought it did, and says so. Then Mr. Imray is cross-examined, and he is shown a series of diagrams marked on an indicator card; he is asked what those mean, and he says: "Those appear to me to be produced by a gas motor engine similar to plaintiff's." He says that "it is as nearly like those I have seen taken from the out-stroke engine as possible." They are said to be taken from the defendants. Then he is asked, "From which one? A. From the plaintiff's. Q. Which of the plaintiff's? A. The plaintiff's compression engine. Q. Made under the patent? A. Yes. Mr. Aston: Modification No. 3? A. Modification No. 3." Then he is asked what it shows, and his answer is, "It shows distinctly a gradual combustion and a gradual increase of pressure."

Now that is the only evidence upon that, and upon that we are asked to say that Mr. Imray did not understand his business; that the thing was hopelessly opposed to the first principles of mechanics, and I do not know what. All I can say is, I go upon the evidence, and I am not going to take upon myself to say that Mr. Imray did not understood what he was about; and if he had said anything to which all these adjectives ought to be applied, it was very easy to ask Mr. May or Mr. Gardner to say something to the contrary, which they were not asked to do.

Well that disposes of all that class of objections. The next objection is that there was no evidence of utility. Now that is an objection of the most moderate kind. It is quite true that it has been said that it is *primâ facie* evidence of want of utility if you do not make and vend your machine, but that is subject to this observation, that you may make and vend an improvement upon it, and if you have found out immediately after you have patented your invention that it can be improved, it does not by any means show that the first invention was useless.

In a case which I argued, which is reported—*Renard* v. *Levinstein*—I was for the defendant and took the same objection. That was an invention for a dye. There they never sold an ounce of dye made according to the patent, because immediately afterwards the inventor had discoverd an improvement, and they had always sold the improved dye, and they were obliged to call a witness to show they had made a few ounces of dye and tried it, and that it would dye. The answer was that under these circumstances the mere fact of not selling the original dye was nothing at all.

As in this case we have rather a stronger illustration because the inventor has patented three modifications, and it turns out that what he had used, made, and sold, have been almost entirely No. 3's, and that the other things sold have been almost entirely—not quite—improvements on No. 1. No. 1 itself does not appear ever to have been sold, but then they say that No. 1 will work, and they call witnesses to prove it, and there is no evidence on the other side. Of course nothing could have been easier for the other side than calling witnesses who had made machines according to No. 1. Therefore there is evidence of utility. It is very small indeed as regards No. 1, because that is not the one which proved most useful, but it is quite sufficient for the support of a patent; and, as to this question of utility, as we know, very little will do.

Then that disposes, I think, of every material objection, at least the only ones I have taken a note of except the most important ones of novelty and infringement.

As regards novelty, that was the one upon which the defendant succeeded in the Court below, and it turns upon this.

The defendants say that by the patent of one Johnson—which is really a communication from Lenoir—so long ago as the year 1860—that is, sixteen years before the patent—there was a description of that for which the patent was taken out. Well, now this is very remarkable, because it turns out in the evidence that Lenoir, the inventor and communicator, so far as Johnson's patent is concerned, is a great maker of gasomoter engines, and it seems that a very large number of his engines which appear, according to the evidence, or, at least, according to my recollection of the effect of the evidence, to be made under a subsequent patent of his of 1861; great numbers of these were made and sold and publicly exhibited, and if, therefore, this invention of the patent had been proved, it is very remarkable that they could not produce a witness who has either made, or sold, or seen in work an engine made according to the plaintiff's patent which produced the effect which the plaintiff said could be produced. That is strong evidence to my mind that Johnson's specification did not disclose the plaintiff's patent. It is not like a sealed document; it is not like a book not generally known; it is one of Lenoir's own patents, and therefore, as I said before, it would have been a most remarkable thing if it did disclose it and was not put into practice, being a very valuable thing. Of course that is not conclusive; it is only a remark as to the probability; the specification itself must be considered by the Court like any other document. Still we have to observe that there is no machine to be set against the plaintiff's patent; none could be shown to have been worked; and there was not an attempt to show it, or at least it did not succeed, before the date of this patent in 1876. Then how are we to find out that it describes the plaintiff's invention? We can only find it out, it appears to me, in the same way in which the Court considers other documents, that is, by reading it and finding out the natural meaning. Now having read it and considered it most attentively, I have arrived at this conclusion—that so far from pointing out the principle or idea published by the plaintiff, and the mode of carrying out that principle or idea, the machine described in Johnson's specification is a machine worked by the sudden expansion of an inflammable mixture, and intended to be worked in that way; and that so far from telling the public that you can make the machine to work by gradual expansion, by the protection of a cushion, the only reason for which air is introduced into this machine is for a totally different purpose, and with a view to the quickening or making more sudden the expansion of the gases. If that is so, there is no description of the plaintiff's invention which is a new principle or idea with the mode of applying it, but of something entirely different. If, however, this had been the case, that it was a necessity in constructing Johnson's machine to make a machine which would work according to the plaintiff's invention, so that I mean only a machine could be made which would work by gradual expansion, which was one part of Mr. Millar's argument, then I agree that it would have been anticipated. But there again it is plain from reading the description of Johnson's specification that it is not so, because I suppose he tried it, and he described it as an explosive machine. It is so described by the witnesses, and nobody ever saw it in action as a gradual expansion machine, and, indeed, the plaintiff's witnesses say that a quantity of air admitted through the aperture, in the first instance, would only be a film, and would not have the effect at all. There is another part of Johnson's invention which I must say I may be mistaken in, but it does appear to me that the man who drew out this specification—whether it was the inventor or not I cannot tell—was under the impression that the gas was inflammable *per se*, and he has, it appears to me, so described the

invention. It does not affect the point upon which my decision turns. But it is plain, if you look at page 3, between lines 25 and 30, and read the description there, or turn to page 5, between lines 5 and 10, and read the description there, the notion is that the gas explodes, that it heats the air and expands the air, and then the expanded air drives the piston—that is the notion. Well, then, he does introduce a supply of air into the cylinder before the gas is allowed to enter. That is the only expression which is at all like the plaintiff's scheme. Look at what he says between lines 10 and 15—"The object of introducing a 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." That appears to me to be a total mistake; but, still, we are only considering now what he is disclosing to the public, and that is what he is disclosing to the public; and there are no quantities here. Now apply the same test as I applied before. What is a workman to do? He lets in a little air, and then he finds the thing explodes. If he had let in none it would not explode—I mean none of the previous air. Then he lets in air and gas together. He does not go any further, as the machine does not work, and he has no idea disclosed to him that if he had put in some air he would have changed the sudden explosion which works the machine into the gradual explosion, which is the object of the plaintiff's specification. It appears to me, therefore, that, quite independent of the surrounding circumstances, nobody ever understood that specification of Johnson's as describing or intending to describe that which the plaintiff has claimed by his specification; that Johnson's specification does not tell the public at all that which the plaintiff has told them, and is by no means an anticipation of the invention.

I now come to the last point, which is that of infringement. It is quite true that the defendants' machine is a double-action machine, or, rather, a machine with two pistons, and works in rather a different way—there are six motions to four motions; but does it or does it not adopt the plaintiff's idea with a substantially similar mode of carrying it out. Well, I think it does. When you come to examine the defendants' machine you will find it works in this way: There is a cushion of air, as described by the plaintiff, or a stratum of air next the piston; there is the combustible mixture next that; then there is more combustible mixture, that is on the other side; another stratum of air, and another piston on the other side; and then you light it in the middle—that is, you light it at what has been called in the plaintiff's invention the richest part, or that which contains most gas. The only difference is, that it has a double action. The action is exactly the same—the explosion is modified in exactly the same way; and though, of course, as you have doubled your piston, you have to alter a little your cams and excentrics and slides. That is exactly what is meant by being "substantially the same."

Here, again, the evidence on the part of the plaintiff wholly preponderates. Their engineers are quite positive that there is no difference, and when you look at the defendants' engineer's evidence it really does not contradict them. Taking it to be a patent for a machine he says it is not the same, but he never contradicts it in the view that I have expressed of the patent; he does not say that supposing the patent was really for an idea with a mode of carrying it out substantially the same as in the plaintiff's, that it is not substantially the same; and that is the only point which we have really to determine. I think, therefore, the infringement is made out, and the result will be, that the decree of the Vice-Chancellor will be reversed, and the plaintiff will have his injunction with costs.

LORD JUSTICE BRETT: I have been inclined not to express any judgment in this case, because I know I shall be followed by my brother Holker, who has been, to my knowledge, engaged in very nearly every patent case which has arisen in the North of England for the last twenty years—the North of England being the great nursery of patent inventions, and being fully aware, therefore, that he knows a good deal more about this subject than I do. But inasmuch as this case has been elaborately argued, and all the points have, to my mind, been most clearly stated by Mr. Millar, I think it due to the arguments which have been adduced before us to give my opinion, as shortly as I can, upon the separate points that have been made.

Now, I will take the objections in the order in which they have been presented to us, presuming only that the judgment of the Vice-Chancellor seems to be substantially on one point, and, therefore, we have not the benefit of a full exposition of his views upon the other objections.

The first objection, as my lord has pointed out, was that there was not a sufficient subject matter for a patent, and the ground taken was that it was a claim for a principle only, and without any reference to a machine. In order to determine that point and some of the other points which have been made, it is necessary to consider what is one's own view of the construction of the plaintiff's patent. To my mind there is no great difficulty in construing the plaintiff's patent. It seems to me to be a patent which is more than usually clearly expressed. The patent begins by pointing out what was the alleged defect in gas motor engines, and I take it that the defect pointed out in such machines is that in working them in the way in which they were constructed, there was a too sudden expansion of the gas and development of heat. That was the mischief in the machines which produced certain evil results, both of which seem to me to be pointed out in the patent. The evil results were a waste of heat, as it was said, and also a shock, both of which are pointed out at different parts of his patent.

Now, what the plaintiff states in his specification that he intended to do by his patent was to cure the evils in the machine, and in the working of the machine, that is, to cure the evils in such machines of a sudden expansion of the gases and development of heat. It seems to me that he points out the mode in which he intends to do that, namely, by so introducing matter into the cylinder that instead of a sudden expansion of gases and a sudden development of heat, there shall be a gradual expansion of the gases and a gradual development of heat. Those are the evils pointed out, and that is the cure that he proposes to adopt.

He then points out the means by which he intends to obtain that gradual expansion; and it is really by introducing, first, next to the piston, simple air—pure air—and then a combustible mixture after that. Now having done that, it is obvious to my mind that he does not mean that those two strata are to remain absolutely and mathematically distinct. The moment the combustible mixture is introduced behind the air it will begin, where it is next to the air, to impregnate itself, as it were, into the air. But then, before it can do that, there having been air next to the piston, he fires the combustible mixture at the opposite end from where it touches the simple air, and by that means he gets what he calls a gradual explosion.

Well, it seems to me that if he had said only that in this patent, applying it to the working of the machine, that would have been sufficient to make it the subject matter of a patent. But he goes further, and he so arranges the machinery of the machine as to carry out that object of introducing first of all the air, and then the combustible mixture. That certainly is true as to his first and second modifications. It seems to me to be equally true of the third—that the third consists of first of all introducing the air, and after that the combustible mixture, in the same way as he has done before, and then compressing them, but compressing them not so as to make one homogeneous mixture; for after his compression, it seems to me he states distinctly that it will not be homogeneous—that the compression cannot take place perfectly, but that, because of the introduction of air first, and afterwards of combustible mixture, although they will be more amalgamated than they had been under the first modification, yet even then they will not be wholly amalgamated before the ignition; so that the effect will be substantially the same. It seems to me that he describes that effect in the third modification as clearly as he described it in the two first. Therefore, that being what his invention is, it seems to me to follow that, supposing it to be sufficiently described, it is a sufficient subject matter for a patent; and about that, I think, there can be really no substantial doubt. That, therefore, disposes of the first objection.

Now the second objection is that the description in the specification of that invention is not a sufficient description, so as to enable the matter to be worked. And first of all it was said that it was not sufficient on account of the mistake in the drawings. I shall refer no further to that mistake than to say that I do not think the objection was much pressed by Mr. Millar; and I think he was quite right in not pressing it. It is obvious to my mind that, in the present case, at all events, it is not a valid objection. The real objection upon this point seemed to me to be the statement that there was no sufficient description of the proper proportion between the simple or pure air first introduced, and the combustible mixture which was to come in behind it.

In the first place I maintain the view which I expressed during the argument, that any exact proportion between those two is no part of this invention at all; that if at one time, for instance, the proportions might be as 4 to 7, or if, on another occasion, they were as 3 to 7, yet if, in both cases, it would not be a sudden explosion, but a gradual explosion—although in one case more gradual than in the other—both of them would be within this patent. It does not tell you any exact proportion, and moreover, in order to obtain the result, no exact proportion is necessary, as I have just shown. Therefore, to say that it does not show the proportion—meaning thereby the exact proportion—is no objection at all. Then if it is urged that it does not show that there must be a substantial introduction of simple air next the piston, that has been met by what my lord has pointed out, and what was pointed out in the argument and in the evidence, that that was the necessary consequence of any man with a willing mind attempting to work this machine. It does not require experiment, it requires only regulation; and, if so, the objection fails.

But then, as to the third modification, it was said that there was no sufficient specification in this case, because in the third modification there will not be a gradual expansion or development. Now the objection must come to this, as was pointed out. It is certain that the plaintiff in his specification describes and declares that there will be that same gradual expansion in the third modification as there was in the first. He says so, and therefore this objection comes to be, not that the specification has not stated that it would be so in the third, but that it has stated wrongly that it will. That of course must be a matter of evidence, that goes beyond the mere construction of the specification; it must be a matter of evidence as to how, when the specification is applied to a machine, it will work.

Now, certainly Mr. Imray, to my mind, distinctly stated that in the third modification there would be a gradual expansion or development; and it seems to me that Mr. May did not contradict that really, in fact he was not asked upon this point. But it is said that this indicator or diagram, or paper, or whatever you please, proves it conclusively, and we are told that that proves it so conclusively that if we say it does not we shall be saying something which is contrary to the laws of mechanics. Well, if we are it is unfortunate, but I cannot think so, because, at all events, we have the authority of Sir Frederick Bramwell for thinking that there would not be that sudden explosion; and as for that diagram, I take it it is very like arithmetic. The diagrams which are put in in patent cases almost always seem to me to be able to prove anything, and therefore they prove nothing. But I care not. I do not flinch from that diagram myself, and if I do say something which is very ignorant, so much the worse for me; but as far as I understand it, it does not show that the effect of this explosion throughout the cylinder will be instantaneous or sudden. Therefore, to tell me that it is evidence, and conclusive evidence that it will, is to ask me to say something which, upon my own view of the diagram, I do not believe, and upon the evidence I do not think is accurate. Therefore all the objections as to this not being a sufficient description seem to me to fall to the ground.

Then the next point taken was inutility, and there it seemed to me that the whole matter was based first of all upon a wrong view of parts of the evidence, and secondly, upon an illogical inference; because the argument that was used was this: that if an inventor takes out his patent and makes his specification, and files it, and then soon after he takes out another patent, declaring that it is an improvement upon his former one, the logical inferencc is that he has come to the conclusion that the first one is wholly useless. All I can say is that that is an illogical conclusion, and one which I am not therefore prepared to draw.

Then it was said that there was no evidence that anything had ever been done with machines under this specification of 1860, and that that was strong evidence against the inventor that he thought that specification was wholly useless. With regard to the first modification, it is true that he never has done anything; but with regard to the second, there was one model made; and with regard to the third, the evidence seemed to me to be that several machines had been made according to it, had been sold, and had never been returned. Therefore it is untrue as a matter of fact to say that it had never been used by the first inventor of this patent. With regard to the first modification never having been used, and the second only having been tested by one model, the answer seems to me to be that that is not conclusive as against their having some utility; and the evidence is that they were of some utility.

Well, then, you come to that which is the ground of the judgment of the Vice-Chancellor, namely, the question of novelty, which—all the others being mere fringe—is the real subject of construction in this case. With regard to the question of novelty, it seems to me to present itself in rather an unusual form. I do not mean to say that it has not been so presented before, because I recollect cases in which it has been, but the anticipation here is not an anticipation by the user of machines. If there had been machines made, it seems to me that it would have been quite immaterial whether they were made under Johnson's specification or however they were made—whether Johnson's specification accurately described them or not would have been immaterial. Whether, supposing them made according to Johnson's specification, Johnson's specification was good or bad for other reasons would have been wholly immaterial. In other words, the moment you say that the anticipation is the user of machines, you may throw all former specifications under the table. The question is one of user of machines. Well, now, as to whether a user of machines has been an anticipation or not—and when it has come to be material in this case, because there have been no machines produced which are vouched as anticipations, none whatever—the only anticipation here relied upon is the publication of a former specification; that is to say, that the alleged anticipation is one wholly in writing and not in action. The moment you come to an alleged anticipation by writing, it seems to me immaterial whether the description in writing is contained in the specification or not—it is the same—and saying that it is in a specification gives it no more effect than saying that it is in a book. But when the alleged anticipation is one which is in writing, the law is that the interpretation of that writing, or the interpretation of that specification, is a question for the Court. It is not truly and strictly a question of evidence of fact at all. The Court must construe it. The Court no doubt would be much aided by an explanation of that writing given by skilled witnesses, and as to the mode in which that writing if carried out would act, but it must in the end construe the matter for itself.

Then what is the rule when you rely only upon a description in writing as being an anticipation? It seems to me that it is not sufficient to say that if a machine were made by a person who had read that writing, something in that machine would, if it had been really a machine used, have been by reason of that user an anticipation of the plaintiff's patent. You must go further, and where you allege that the anticipation is in writing, and in writing only, you must show that a person—I mean a person conversant with such matters—reading that writing, would find in it a reasonably clear description of the plaintiff's invention, in the writing alone. If it requires that a machine should be made in order that the anticipation may be seen, the subsequent inventor is not obliged, when his attention is called to a mere writing, to make a machine from it in order to see what will be the effect of that machine. He has to find a description of his own invention on the face of that writing, construing that writing reasonably as an invention. Therefore, even if the defendants here could show that with the correction suggested by Sir Frederick Bramwell a machine could be made according to Johnson's specification which would work, and if they showed that in that machine, or a part of it, the same effect as is in the plaintiff's machine would really and substantially take effect in the machine, yet they cannot succeed unless they show that the working of the machine is described substantially in Johnson's specification, and described so clearly that a person conversant with such things upon reading Johnson's specification carefully would say, "that is a description of the plaintiff's invention." That seems to me to be the effect of the judgment in *Hill* v. *Evans*, and also if you apply what was said in *Betts* v. *Menzies*.

Therefore the question is whether Johnson's specification fairly read by a person conversant with such matters would give a reasonably clear description of the plaintiff's invention—that is, would give a reasonably clear description that it would in a machine effect this—the introduction next to the piston of a substantial column of simple air; after that a combustible mixture, and those being so ignited as to produce a gradual expansion.

In my judgment, after hearing all that can be said, there is nothing of the kind in Johnson's specification. It is not described. That may be the result of a machine made—no, I will not say that; but I say that even supposing that would be the result of a machine made, it is not described, and I do not think that it is so material that one ought to take notice of it; it certainly is not claimed; it is not described with anything like clearness, and to my mind for a very good reason—the man could not describe it because it was not in his mind.

A little flinching from that which I understood was my lord's opinion, namely, from the supposition that Johnson, or whoever was the inventor, there blundered quite so egregiously as my lord supposed upon the construction of the specification, I am inclined to agree with the opinion which was elicited from Sir Frederick Bramwell—but which ought not to have been elicited because it was not evidence—as to what the construction of that specification was. I incline to agree with it, and to my mind the idea of the inventor—I say not whether it could be worked out—was that he would introduce into the cylinder a mixture which before it was ignited would become homogeneous, and that that would be a combustible mixture, and that it would by the ignition explode at once—it would be a sudden explosion and expansion, and not a gradual one. And at that time, not seeing and not having the least idea of what the plaintiff has now arrived at—in fact having an idea exactly the contrary—which might well be at that stage of the invention—having an idea that what he wanted was a sudden and immediate explosion, his description goes on to declare that he took means to procure that. Therefore, so far from describing what is the substance of the plaintiff's invention and claim, it seems to me that he described exactly the contrary, and therefore it is impossible to say that the mere writing in his specification is an anticipation.

The only remaining question is whether there was sufficient evidence of infringement by the defendant. Now, I take it that upon the question of infringement the specification of the defendant is of very little importance. Supposing that he drew out and registered and published a specification which was the same description as the plaintiff's, the mere registration of a specification is not an infringement. The infringement must be by the use of the plaintiff's invention. Where the plaintiff's invention is really the mode of working, or the mode of manufacturing an engine, there is no infringement until another engine is worked or made in the same way as his. Therefore, the question of infringement here would depend upon this—has the defendant made and sold, or made and used a machine in which a substantial and independent part of it is an infringement of the plaintiff's invention? Now, looking at the model which was admitted to be a correct model of the machines made and sold by the defendant, and looking at the machines, I cannot have the least doubt myself upon the subject, and there is no evidence to the contrary of what I say, excepting one matter to which I will refer immediately. It seems to me clear that at all events a substantial part of what the defendant's machine does is to do in duplicate what the plaintiff's machine does singly. It was said that there was evidence by Mr. May on the part of the defendant which declared that that was not so. Well I accept Mr. May's evidence with respect, but having heard it I should be obliged then to judge from the view of the model which has been produced. But it seems to me that Mr. May in his evidence has not contradicted what I say; because his evidence as to the want of infringement was founded upon a hypothetical case, given to him, which contained a mis-description of the plaintiff's invention, and, adopting that mis-description, he says: "If that is the plaintiff's invention, I do not think the defendant's machine is an infringement of it." It may be that it is not, but that is not evidence which ought to countervail the evidence of the plaintiff's witnesses.

Therefore, having given the best attention to this case, and it having been so completely argued out before us, I, with great deference, and with great reluctance, am obliged to differ from the judgment given by the Vice-Chancellor as to this want of novelty, and if he is supposed to have given a judgment upon any other of the points against the plaintiff, I differ from that also, and to my mind the plaintiff has made out a case here upon which his suit ought to be maintained.

Lord Justice HOLKER: I am very much obliged to Lord Justice Brett for his kindly, and, as I consider, complimentary reference to my experience in cases of this sort. It is quite true I have had some experience, perhaps a good deal. I should like more, because I confess I look upon these patent cases, many of them, as exceedingly interesting. But I do not think it follows that because I have had considerable experience in patent cases therefore I should deliver an elaborate judgment in this case when an elaborate judgment is not necessary. And an elaborate judgment is not necessary, because I agree entirely in all that has fallen from my lords. At the same time I do not want to avoid expressing my opinion upon the points that have been raised, and I will do so as shortly as I possibly can.

It seems very clear from the evidence that the motive power in gas motor engines prior to the invention or alleged invention of the plaintiff had been produced by means of explosion—a sudden explosion—producing, of course, very rapid expansion of the gases, and evil had been found to result from this. The heat had not been perfectly utilised and the sudden action of the piston—the violent shock occasioned by the piston—had injured the machine. In fact, a very violent shock in a machine of this kind would naturally produce injury. Well, it was desirable to obviate these defects, and apparently the plaintiff turned his attention to the matter. Anyone would say that if he would in some way or other modify the explosion, if he could make the expansion of the gases which would drive the piston a gradual expansion instead of a sudden expansion, as it was when the result was a sudden explosion, the great object would be effected. But then, of course, the difficulty was to find out how this could be done, and apparently Mr. Otto, the patentee in this case, did hit upon this idea. He said: "If I can introduce between the explosive mixture, formed of air and gas, and the piston a body of air or a body of any other incombustible vapour, and then explode behind this body the stratum of explosive gas, I shall by that means expand the air, and, expanding the air, I shall, in fact, produce a gradual, instead of a sudden, development of heat or expansion of the gases." Accordingly he says, "I will do that," and it has been found that his idea was a right idea, and that by so doing he could make a gradual expansion of the gases.

He says in his specification: "I will do this in several ways. I will either have a body of air between the explosive material and the piston, or I will have a body of the products of combustion, or I will have a mixture of air and the products of combustion—it

does not matter which—and I will do it either without subjecting these vapours to compression, or I will do it by subjecting them to compression, and I will point out the means of doing all this." The idea, no doubt, would not be patentable, but if the discoverer of this idea points out in his specification the means by which all this may be accomplished, in my opinion—and I think there can be no doubt about it—that is the subject matter of letters patent. He says, to take his simpler form: "I will introduce a layer, so to speak"—it would not be really a layer, but it might be called a layer—"of air in a certain way by a certain mechanical contrivance which I point out to you. I will then introduce a stratum of explosive gas or explosive compound, and I will then fire that compound in the way which I point out to you." It seems to me that this was a most useful discovery. It appears, as my lord says, to have really and truly revolutionised the manufacture of gas-motor engines; and as the inventor discovered this principle, and at the same time told the public, as it seems to me, how it was to be carried into effect, there can, in my opinion, be no doubt whatever that his invention is the subject matter of letters patent.

The point which has produced the most doubt in my mind, I confess, has been that which was taken with reference to the sufficiency of the specification. It has been said that the specification is not sufficient, because it does not tell you the proportion of explosive material and the proportion of air that has to be introduced. It is said that the great feature of the invention is using a certain body of air and inserting that between the piston and the explosive mixture formed of the gas and air, and we are not told by the patentee in his specification what proportion we are to use. No doubt that is an objection of a somewhat formidable character, but I think you are told practically. You are told that you require a considerable—at all events, a substantial—body of air. I do not think there can be any difficulty with reference to the proportion of air which is to be mixed with the gas to make it an explosive compound, that is well known; but with reference to the amount of air that has to be introduced between the combustible material and the piston, I think you are told that you must have a substantial amount of air, because you are told that the particles of the combustible material will penetrate into this layer, so to speak, of air, and be surrounded by it. Therefore you must have a sufficient amount of air, into which the particles of the combustible material can penetrate. And then again if you refer to the drawings, as I think you are entitled to, you see the sort of proportion which the inventor apparently contemplated. I do not mean to say that he made these drawings for the express purpose of showing the quantity of air which it was necessary to introduce. I do not think he did, but he makes drawings for the purpose of showing his machine, and showing how he uses it, and incidentally he shows you about the amount of air that he intends to introduce.

Then, again, this is not a case in which any exact proportions are required. I suppose if you introduce a substantial quantity of air so as to make a substantial layer or stratum of air, although practically too little, if you introduce a substantial quantity the machine would work to some extent. You would have to modify a retarded explosion or gradual expansion of the gases to some extent. Then you would have the machine working; if you introduced a little more you would have it working a little better; and if you introduced a little more you would have it working a little better still; and if you introduced some more perhaps it would cease to work so well, and by introducing a little more it would cease to work altogether. So that this is not a case where the proportions are essential. Therefore, taking the facts I have mentioned, and bearing in mind that specific proportions are not essential, I think the difficulty which that point which was raised by Mr. Millar presented to my mind can be got rid of.

Then with regard to the question of utility, I really shall say nothing upon that except this—it seems to me that if you had gas-motor engines constructed before this patent, and they had been driven by means of the power obtained by a very sudden explosion, if you invent a machine which instead of having a sudden explosion has an explosion of gases which is gradual, that must of necessity be a useful machine. It may be that you may make many improvements upon it, but if you only do this—given a machine which for the first time produces a gradual expansion of gases, and thus gives the necessary motive power, it seems to me you must necessarily have a machine of some utility, and if it is a machine of some utility that is enough.

Then with reference to the infringement, a good deal has been said about that, but when the machine which constitutes the alleged infringement is produced you find that it is apparently constructed upon exactly the same principle as this:—It is desirable to get a gradual expansion of the gases. In the alleged infringement you have a layer of air introduced between the combustible material, or the explosive material, and the piston. You have the explosive material then introduced, at the densest or richest part, as it has been called, of the explosive material you have the means of firing. All that you find in the plaintiff's specification; indeed, it is the essence of his invention.

But then it may be said that the alleged infringement is not an infringement because the machines are different; and we have this piece of evidence given by Mr. May. He is examined by Mr. Kay in this way:—"I want you to follow me in supposing the plaintiff's claim were, what I submit it is not, a claim for a particular engine in which these effects he describes are produced, a particular engine and nothing more, and that he did not claim these effects in any way in that particular engine, do you say that this engine is similar or dissimilar from the engine of the defendant? A. It is dissimilar, setting aside the compression and the admission and all that sort of thing." Well, but that is the very essence of it. The means of introducing the material, the means of compressing it, and the means of igniting it, are the means which the plaintiff employs to carry out his idea.

Well, then if the defendant takes the plantiff's idea and takes his means too, how can anybody successfully contend that there was not an infringement. Of course it may be different, and in many respects it is different, but the idea is the same. The means of introducing the material are the same, the means of exploding the material after it has been introduced are the same. For these reasons I think that the infringement has been abundantly shown.

There is only one other point, and that is the want of novelty. That seems to have been considered the most important point in the case—at all events that is the point upon which the Vice-Chancellor has decided against the plaintiff in this case.

The anticipation which is relied upon consists of a specification filed by Johnson. Well, the question is not whether these letters patent have been filed, not whether these letters patent show any invention—that is not the question, but whether it describes in an intelligible way the invention of the plaintiff. I take it to be clear that unless the specification describes the invention of the plaintiff there is no anticipation. It seems to me there is a great difference between a specification which is relied upon as an anticipation, and a machine which is relied upon as an anticipation. If you were to produce a machine which was made for a particular purpose, and which would accomplish when used results which were not thought of when it was made—were not anticipated—possibly the machine itself without any user would be an anticipation. I should doubt that very much myself. I do not find any authority upon it one way or the other, but I think it is perfectly clear that the machine, if used so that the public could ascertain what it would effect, would be an anticipation. But this is quite a different thing from producing as an anticipation a specification, for you cannot tell, except from the language of the specification, what results the contemplated machine may accomplish. We have it declared in *Hill* v. *Evans*. It is not necessary for me to read the passage; but it is stated there as the law, and it seems very reasonable that the specification which is relied upon as the anticipation of an invention must give you the same knowledge as the specification of the invention itself. That seems a very sensible and reasonable rule.

Now, what do you gather from this specification of Johnson's? Do you gather that he made, or intended to make, or dreamt of making a machine in which the expansion of the gases would be retarded or would be gradual? On the contrary, his object seems to have been entirely different. His object seems to have been by introducing a little layer of air before the mixture of air and gas to accelerate, so to speak, the explosion, to make the explosion more immediate and more perfect. He says that in so many words. Then how can you say that Johnson pointed out, or intended to make an engine of this description, the main feature of which is the gradual explosion of the gases, when it is clear if you read it, that he intended simply to make an engine where the explosion would be more sudden. I must say, having considered this specification of Johnson's very carefully, that I have come to the same conclusion as my lord has. I do not believe that Johnson had any idea that it was necessary to mix air with the gas, in order to produce an explosion. I think his notion was that he would produce the explosion of the gas by igniting the gas, and that then the explosion of the gas having been produced, the heat would be communicated to the air and the air would expand. I do not think, therefore, that he has in any shape or way shadowed forth the invention which is claimed. I observed that Mr. Millar struggled very hard, and for a long time, to make out that the plaintiff's engine was an engine in which the motive power was produced by explosion, and not by the gradual expansion of the gases. Of course if he could have made that out he would have been, no doubt, in clover, because if he could have shown that the plaintiff's engine was an explosive engine, he could have turned to Johnson's and said, "Here you have another explosive engine made in the same way."

Now, besides the remarks I have made, the evidence shows—I do not know that it satisfies my mind, but at all events there is a good deal of evidence to show—that even if you take the best view of Johnson's engine for Mr. Millar's purpose, Johnson's engine, if it were made according to his specification, would not work, but I do not, in giving judgment, rely upon that evidence at all.

The only other remark is about something that was said as to the diagram. I do not give my judgment upon any belief that I understand this diagram properly, but I think I can appreciate the evidence of Mr. Imray, and Mr. Imray tells me that that is not an explosive diagram. He tells me this, further, that the engine of the plaintiff is not an explosive engine, and I think Mr. Imray saying that, and being a man of great experience and great reputation, and not being contradicted by a single witness on the other side, ought to be believed.

But just one word with reference to that diagram. The diagram shows an explosion, it is said, and that when the explosion takes place the highest pressure at a certain point is obtained; but, according to Mr. Imray, there is something more, that pressure is sustained, and the descending line shows how it is sustained. There is something more than an explosion—there is an explosion which effects the expansion of the other gases, and, if I understand him, that descending line shows how the explosion is sustained throughout. He says, if you had explosion and nothing but explosion, you would have a line ascending and going up straight, and a line descending and coming down straight; but when you have a line of this description that shows that the pressure produced by the explosion has been sustained by the expansion of the gases.

Mr. Millar: As to the form of the injunction; I suppose you will not ask for the word "permitting" to be in?

Mr. Aston: I shall take the form which your lordship was good enough to settle as Master of the Rolls in *Plimpton* v. *Malcolmson*.

The Master of the Rolls: Yes, you may take that. Do you ask for damages or an account?

Mr. Aston: For damages, my lord. I may say that we will not ask for the machines to be delivered up to be destroyed.

The Master of the Rolls: No, that is seldom asked for.

Mr. Aston: Nor any other harsh measures at all. I would suggest that what should be done in this case should be the same as was done in *Smith* v. *the London and North-Western Railway Company*. There a certain percentage—15 per cent. on the selling price—was taken as the measure of the damages, and I now offer that to my friend.

Mr. Millar: That will be a question of arrangement, but as far as the decree goes, there will be formally a decree for damages.

Mr. Aston: Yes; and instead of an inquiry and the expense attending it, I offer my learned friend 15 per cent. on the selling price.

The Master of the Rolls: If he likes to accept it he can; if not, there will be the usual inquiry, and it will go to the Official Referee or a Special Referee if the parties agree upon one.

Mr. Aston: Yes.

Mr. Millar: It is not usual now to insert in an injunction anything more than selling or causing—it is not necessary to use the words "or permitting."

The Master of the Rolls: I settled the form in *Plimpton* v. *Malcolmson*, and I should desire to adhere to it.

Mr. Aston: The order in *Plimpton* v. *Malcolmson* does contain the word "permitting."

Mr. Millar: But I do not think that that is now usual.

Mr. Aston: Yes; that is the latest form.

The Master of the Rolls: Will you read it, Mr. Aston?

Mr. Aston: "An injunction to restrain from using or exercising, or causing or permitting to be used or exercised, and from selling, letting for hire"—I will not trouble my friend with that in this case—"or making any profitable use or permitting the sale or letting for hire or profitable use, of any roller or runner skates not made by the plaintiff or his licensees." That applied to the articles in question there, but it does not apply here.

Mr. Millar: Well I was going to say the same with regard to the words, "or permitting." That does not apply in this case.

The Master of the Rolls: Yes, you must not permit. You must not permit by agents. You have made machines which might be in the hands of your agents or consignees, and which you can stop.

Mr. Millar: If your lordship pleases. Nobody suggests that we have any, so that, if that is the meaning, it is innocent.

Mr. Aston: We shall have the costs here and below?

The Master of the Rolls: Yes.

Mr. Aston: They have been paid and therefore they will have to be returned.

The Master of the Rolls: That is a matter of course.

Mr. Aston: And within a week.

Mr. Millar: That is a matter which the Registrar will deal with.

Mr. Aston: We have also paid into Court a certain sum as security for costs, as we are a foreigner residing abroad, and we want that returned.

The Master of the Rolls: Yes. What is the amount.

Mr. Aston: £100 I think. Then there is another matter. I want a certificate that the validity of the patent came into question and that the plaintiff proved his breaches.

The Master of the Rolls: Yes.

Mr. Aston: By the Act that ought to be given by the judge who tried the action. There was an omission in the Court below to ask for it, but if I may be at liberty to inform the learned judge in the Court below of the decision which this Court has arrived at, I have no doubt he will give us the certificate that the validity did come into question, and that we proved our breaches, because he was not against us as to breaches.

Mr. Davey: Is not this Court entitled to give it to us? Because under the rules the Court of Appeal may make whatever order the judge in the Court below ought to have made, and if the judge in the Court below who tried the action ought to have given you a certificate, the Court of Appeal has jurisdiction to grant it in its place.

The Master of the Rolls: But the Act of Parliament says that the certificate must be given by the judge who tried the action.

Mr. Aston: Yes, unfortunately that is so. "It shall be lawful for the judge before whom any such action shall be tried to certify on the record that the validity of the letters patent in the declaration mentioned came in question."

The Master of the Rolls: That he will give you as a matter of course.

Mr. Aston: I think so.

The Master of the Rolls: It will be safer to take it from him.

Mr. Aston: I thought so, my lord. Then that will be all that we apply for.

Solicitors for the appellants, Messrs. Faithfull and Owen; solicitor for the respondents, Mr. C. J. Eyre.

THE BOILER EXPLOSION ON THE NORTH-EASTERN RAILWAY.

[Copy.]

The following is the text of the report by Messrs. Johnson, Stirling, and Jeffreys, on the locomotive boiler which exploded on the North-Eastern Railway:—

"Having carefully examined the boiler of No. 204 engine belonging to the North-Eastern Railway Company which exploded on the 26th of December, 1881, we are of opinion that the explosion was caused by shortness of water in the boiler, allowing the firebox crown-plate, which was of copper, to lose its tenacity, and thus caused rupture of the front plate of the inside copper-box over the fire-hole door. The line of rupture of the plate was that in which the fire would strike with greatest effect—in consequenee of the direction given to the fire by the brick arch when the engine was at rest—and would become first damaged in case of shortness of water. We have no doubt whatever that at the time the explosion occurred the crown-plate of the inside fire-box was red hot, evidences of which may be seen by the condition of the nuts and the points of the bolts of the roof stays; these were thickly coated with red oxide of iron, and the copper plate was cleaned of scale and incrustation inside and out.

"Under these circumstances an accession of water in the boiler would precipitate the explosion.

"We have calculated the strength of the boiler and fire-box, and are of opinion that it was quite capable of sustaining the pressure at which it was worked, viz., 140 lb. per square inch.

"We are further of opinion that the materials used in its construction were of the best description and the workmanship good.

"The boiler, No. 204, was two years old and the engine had run 48,843 miles, and was therefore almost new.

"In order to corroborate our opinion with regard to the strength of the boiler, we this morning selected an engine, No. 170, constructed at the same works, and from the same drawings, which was some months older and had run 55,196 miles, for experimental test by hydraulic pressure.

"This boiler stood a test of 300 lb. per square inch satisfactorily, which is 100lb. per square inch more than is usual to apply in testing locomotives, and more than double the ordinary working pressure of boiler No. 204.

"(Signed) Samuel H. Johnson.
"(Signed) P. Stirling.
"(Signed) Edward Jeffreys.

"York, 7th January."

AN AMERICAN LOCOMOTIVE.

We give this week, at page 80, the first of several illustrations of a fine passenger engine constructed at the Altoona Works of the Pennsylvania Railway Company. We shal say more about it in future impressions. For the present it will suffice to say that our engravings are copied from others which have appeared in the U.S. *Railroad Gazette*, and that the engine has 18in. cylinders, 24in. stroke, and 6ft. 6in. coupled wheels. The tube surface is 1085 square feet; the fire-box surface, 120 square feet, or in all 1205 square feet; the grate surface is 35 square feet. The fuel used is anthracite.

An exhibition of industrial art and manufactures, under the presidency of the Right Hon. Earl Spencer, K.G., is to be held in Peterborough from 17th to 29th April next. The exhibition will also include labour-saving and sanitary appliances, and articles of domestic use and economy, and considering the railway facilities that Peterborough possesses, an attractive and large exhibition may be expected.

Practical Ironwork.—A paper on practical ironwork was read before the Civil and Mechanical Engineer's Society last evening, by Mr. Reginald E. Middleton, Assoc. I.C.E., Westminster. In the course of the paper he remarked that sufficient care is not taken in the details of ironwork, and the points of attachment will generally be found to be the weakest parts; the compression members are considered as being able to bear 4 tons per square inch, but experiment and theory both seem to shown that the value of wrought iron columns of the form in which struts are generally made have a value more nearly approaching 2·7 tons per square inch of section, and that the value from defective form often falls much below this. The loss from rivetting in small girders is greater than is generally allowed for. The present form of upper and lower members in girders might be altered with advantage, vertical plates being used in the tension boom and gusset plates employed for attachment, allowing rivets in double shear. In bridges of small span ordinary lengths and sections of iron should be employed, but in large span bridges, when dead load predominates, greater refinement in designs may be used with advantage. All ironwork should be designed with regard to its erection, and in that which has to be sent long distances there should be no overhanging pieces of any length. It is, the author thinks, more advantageous to use single triangulations, particularly in small girders, than double ones. Continuous girders are economical in first cost, but for road bridges they are objectionable, owing to the vibrations, and it is, in the author's opinion, doubtful whether their use is economical or safe in the end, as they are subjected to many more impulses than a non-continuous girder has to endure, an equal number of such impulses being of the same and the rest of less intensity than in the latter form of bridge girder. It is instanced by Mr. B. Baker in his book on long span bridges that certain iron girders of small depth failed after the passage of 4¾ million pairs of wheels, although very few of these could have exerted a strain of 8 tons per square inch of section, and the greater number can only have strained the material to the extent of 2 tons per square inch of section. The author thinks that repeated shock or vibration producing fatigue, will eventually cause the failure of all iron structures in which corrosion is not allowed to alter the conditions under which they were built, and that it may be concluded that as the vibrations in continuous girders are more numerous with an equal number of the same intensity than in those of the non continuous type, so the life of the former will be shorter than that of the latter. Any alteration in foundations will entirely alter the conditions under which a continuous girder works, and may render it unsafe where non-continuous girder would still be safe. Spacing the cross girders of a bridge too closely will increase the number and extent of the pulsations, and will have an injurious effect on the cross girders themselves. The ignorant use of continuous girders may constantly be seen in the construction of warehouses and houses, where no care is taken to space the supports properly, where the quality of iron used is poor, where the margin of safety employed, as found from merchants' lists, is only from 2·7 to 3, and where failure of foundations is probable.

RAILWAY MATTERS.

THE *Glasgow News* states that Mr. James Thompson, goods manager of the Caledonian Railway Company, has been appointed general manager, in the room of Mr. James Smithells, who retires owing to failing health.

DURING the half-year ending December last the engines of the Belfast and Northern Counties Railway ran 450,997 miles, working 179¾ miles of railway. Engine power cost £13,458 17s., out of which repairs and renewals cost £3531 14s., and coal £5202 14s.

THE annual report of the Birmingham Tramways and Omnibus Company shows a profit, including the amount brought forward from last year, of £5768. Out of this it is proposed to pay a dividend at the rate of 15 per cent. per annum on the ordinary shares.

A NEW railway fence is being introduced by Messrs. W. Bain and Co., Edinburgh. It is a strained wire-fence, the novel feature in which is the employment of droppers or hanging uprights, which are suspended on the fence at intervals of 6ft., their function being to hold the wires in position betwixt the posts or standards, which are situated at longer distances apart than it is customary to place them in ordinary practice.

RAILS and flanges need now-a-days to be strong and hard enough to act as powerful shears. As the express train from Euston to Manchester was travelling on the evening of the 26th ult. at full speed a severe jerk was felt, and it was afterwards found that two railway chairs had been fixed to the rails outside the station. They were smashed by the engine, some of the splinters being carried a hundred yards.

THE London, Chatham, and Dover Railway accounts for the past half-year have been submitted to and approved by the Board, and they show a balance available for dividend of £166,000, as compared with £160,000 for the corresponding half of 1880. The directors propose that a dividend of £2 5s. per cent. for the half-year be paid on the Arbitration Preference Stock, carrying forward £43,000 to the credit of the current half-year, as compared with £38,000 at the corresponding period of last year.

AS the 6.40 train from the Central Station, Manchester, was approaching Chorlton-cum-Hardy, of the 26th ult., the passengers were startled by violent jolting of the carriages as the train was suddenly pulled up in order to avoid the *débris* of an over bridge, one of the iron girders of which had snapped in the middle, the two parts being in a slanting direction across the metals. The train, however, was able to proceed to Chorlton station, where it arrived just in time to prevent an up train from proceeding. The bridge was only two or three years old.

IN consequence of an agitation in Russia in favour of the abolition of the taxes on railway tickets, which it was alleged contribute little to the revenue, while they diminish seriously the number of passengers, the Russian Government have instituted an inquiry into the whole system. The tax is officially stated to yield about eight millions of roubles annually, and it is affirmed that railway travelling has not fallen off since it was imposed; under these circumstances the Government has determined that the tax shall be maintained.

ON the Emperor Francis Joseph Railway, Austria, the railway alarm signal for passengers consists of rods under every carriage, coupled together and communicating by a system of cords and pulleys with the steam whistle. Other cords passing round pulleys are attached to the rods, and are led to each compartment, the ends being protected by a frame closed by a sheet of paper. This paper must be burst open before the signal can be given by the passengers. Paper, it may be mentioned, might be employed in many similar situations, as, for instance, in railway carriage communicator boxes, and in the door-key boxes in the Covent Garden Theatre instead of glass.

ON the 28th ult. a serious accident occurred on the North London Railway near to Old Ford station at 10.18 p.m., which resulted in the death of five persons, besides injury to several others. In consequence of the failure, between Bow and Old Ford, of the draw-bar of a truck in the 10 p.m. empty coal train from Poplar to Brent, some of the trucks were thrown foul of the up line near the Old Ford station at the time when the 9.50 p.m. passenger train from Broad-street to Poplar was approaching, The engine of this train ran into the *débris*, and was thrown off the rails, coming in contact with the abutment of the Fairfield-road Bridge.

THE Prussian Parliament has now been presented with the Railway Bill referred to in the opening Address, and which aims at the purchase for the State of six other private lines—(1) the Bergisch-Märlisch; (2) the Thuringian; (3) the Berlin-Görlitz; (4) the Kottbus-Grossenhain; (5) the Märkisch-Posen; and (6) the Rhine-Nahe Valley Railway. The acquisition of these six lines would complete the Government scheme for converting private property of this kind into public capital, and the Centre is showing itself ever more favourable to this railway policy. The six lines above-mentioned represent something like 2000 kilometres of rail. In the case of the Rhine-Nahe Valley route, the Government is said to be chiefly actuated by strategic reasons, and to meditate the addition to it of a second line of rails for the possible contingency of its becoming, at some time or other, necessary to make a rapid transport of troops towards the French frontier. The conversion of the various private shares in the half-dozen lines to be acquired will cost the Government 473,681,550 marks in Four per Cent. Treasury Bonds, in addition to 3,127,807 marks in cash payments.

THE jury, on the accident at Hornsey during the thick fog on the 26th ult., returned the following verdict:—"That the deceased died from the effects of injuries received by the collision of two Great Northern trains at Hornsey Station, and the jury, having taken carefully into consideration the state of the weather and the suddenness of the fog, are of opinion that George Johnson, the driver of the Barnet train, was guilty of great neglect of duty in proceeding past the advance starting signal at Finsbury Park at such a speed that he was unable to stop the train 'short of any obstruction,' as detailed in the rules of the company. They also are of opinion that the servants of the company at the Hornsey Station at the time of the occurence, and during the six minutes that elapsed after the arrival of the Enfield train, which had entered the station at 'dauger,' should have protected the said train by immediately placing fog signals at its rear. And the jury also desire to draw the attention of the Board of Trade to Rule 269 in the Great Northern Railway Company's rules and regulations, which they consider not sufficiently definite as to what is meant by 'reduced speed.'"

MAJOR MARINDIN, in his report on a collision which occurred on the 3rd of December last at Miles Platting, upon the Lancashire and Yorkshire Railway, says that this accident was caused by the giving way of a faulty joint in the rod working the facing points of the goods line connection with the up line of the Ashton branch, so that when the signalman pulled over the lever in his cabin to set these points right for the passenger line, they did not move, but remained as set for the goods line about twenty minutes previously, and were bolted again in this position. The condition of the joint could not have been detected by any superficial examination, but if it had been examined when the rod was actually being used in working the points it would have been seen to be loose, and this is suggestive of the necessity for this sort of examination of thousands of points and rod joints all over the country. It was only because this train was going so very slowly that a fearful accident did not occur. Major Marindin also remarks that "if the train had been fitted throughout with a continuous brake of quick action it ought, running as it was at less than 15 miles an hour, to have been stopped before the collision took place, seeing that the driver made use of what brake-power he had at a distance of more than 125 yards from the point of collision."

NOTES AND MEMORANDA.

THE observatory which has been some time in course of construction on Mount Etna has been completed. It is 9653ft. above sea level, or 1483ft. higher than the Great St. Bernard Monastery, and 2847ft. higher than the St. Gothard.

A PROCESS for obtaining magnesia from sea water has been discovered by Professor Schloesing. According to the "Journal" of the Society of Arts, a cubic metre of sea water, treated by lime, yields a precipitate of magnesia, in a gelatinous state, about 80 litres in volume.

ACCORDING to Mr. Otto Hehner, 10,000 volumes of air, taken in Billiter-street during the foggy 25th January last, contained 10·84, 8·83, 9·63, 8·93, 9·45 9·56, 4·77, and 7·78 volumes of carbonic acid gas. The normal quantity of carbonic acid in pure air is not quite four parts per 10,000.

FETTAN, a village of the Grisons, in the valley of Inn, is menaced with ruin, owing the the sinking of the ancient moraine on which it is built; another of the many recent evidences of the continuous operation of physical and mechanical forces in levelling the earth's surface, and producing scratches and grooving. The moraine is moving slowly forward, and as it moves, the houses are engulfed or fall asunder. Engineers have been called to the spot to see if anything can be done to avert the impending destruction of the village; if not, it will have to be abandoned.

DR. R. KONIG has recently described a method of investigating the nodes in the vibrating column of air in an organ-pipe. It is thus described in *Nature*: The pipe—a large one—is laid horizontally on its back, and a long slit is made the whole length of the pipe. The slit is closed by water, the pipe lying in a trough. A small curved tube, open at the end, passes down through the water and up through the slit into the pipe. Its other end is joined to a manometric capsule in conjunction with a flame apparatus of the usual type. The nodal surfaces can be determined to within two millimetres. The introduction of the tube interferes less with the conditions of vibration than the introduction of a tissue-paper disc or other explorer hitherto used.

A USEFUL comparison of the numerous determinations of the expansion of water by heat is made by Herr Volkmann in a paper contributed to Konigsberg Institute. Experimenters, it is known, have used two methods—the hydrostatic and the dilatometric. The author gives in a table the average values for volume and density of water—deduced from the observations of Hagen, Matthiessen, Pierre, Kopp, and Jolly—for all temperatures from zero to 25 deg.; also the volumes every 5 deg. from 25 deg. up to 100 deg. The temperature of greatest density of water is, according to the best data, + 3·94 deg. C. Herr Volkmann thinks there is no occasion to study the subject anew on the lines hitherto adopted; but it might be well, in his opinion, to observe the absolute expansion of water in the same way as Regnault determined that of mercury—with communicating tubes.

A RHEOMETER, for measuring currents at different depths in water, has been described by Signor Scardona. It acts by pulses generated at intervals (according to the speed of the current) in a tube, and affecting a bell. The water-current acts on two screw-vanes on a horizontal shaft in a case attached to a vertical rod. This shaft (which a flat vane keeps in a line with the current) actuates, at intervals, through an endless screw and a reducing system of wheels, a lever applied to a caoutchouc capsule at the end of a metallic tube, through which, and a flexible tube attached, the resulting pulses pass to the bell-arrangement (which is in a portable case). The rod and the metallic tube are each made up of several pieces screwed together, and the vane case and tubes can be fixed at any part of the rod. The advantages claimed over Amsler's rheometer are simplicity (in dispensing with electrical action), and a better kind of signal one stroke of the bell for each turn of a wheel.

A BAROMETER, automatically recording the variations on an amplified scale, has been made by Marshall Delaey. It is thus described: The barometric tube, having a capacious reservoir at top, is fixedly suspended. The cistern is a tube slightly wider and nearly as long; it bears on one side an index, and on the other a pencil working on a moving cylindrical surface, and it forms the upper part of a kind of areometer, having a downward extension in the form of a closed tube floating in mercury in a wider tube, which communicates below through a U-tube, with a wide and shallow covered cistern, the level in which is approximately constant. The variation of pressure is marked by the variation of the height of mercury in the reservoir, and this latter is to that of the total height in the barometric cistern in the ratio of the section of the cistern to that of the reservoir. A barometer with an amplified range of movement of the indicating fluid has been in construction the past two years in London.

SOME very important experiments have recently been carried out at the Conservatoire des Arts et Métiers, upon the accumulating power of Faure's secondary battery. A committee, *Nature* says, consisting of MM. Tresca, Potier, Joubert, and Allard, conducted operations. Thirty-five accumulators of the spiral form, each set in a cylindrical stoneware pot about 35 centims. high and 25 centims. diameter, were charged in series by the current from a Siemens dynamo-electric generator worked by a steam engine. The working electromotive force of an accumulator was found to be from 2·15 to 2·5 volts. For twenty-two hours the battery was charged with a current whose average strength was 8·5 ampères, the total work expended in charging being 6,020,000 kilogrammetres. The total work of the steam engine was also measured by a dynamometer, the Siemens generator having, as it appeared, an efficiency of 71 per cent. The battery was then discharged through eleven Maxim lamps, the potential and current being accurately measured from time to time, and although the discharge lasted eleven hours there appeared to be 70 per cent. of the original energy given out in the discharge.

AN interesting paper has been published by Mr. W. Spring, a German chemist, giving the result of a series of experiments undertaken to ascertain the effect of powerful compression on the most diverse bodies. The substances experimented with were taken in the form of fine powder, and submitted in a steel mould to pressures varying from 2000 to 7000 atmospheres, or about 7000 kilogrammes per square centimetre. The facts observed are given in a series of tables, from which the following have been extracted. Lead filings at a pressure of 2000 atmospheres were transformed into a solid block, which no longer showed the least grain under the microscope, and the density of which was 11·5, while that of ordinary lead is 11·3 only. At 5000 atmospheres the lead became like a fluid and ran out through all the interstices of the apparatus. The powders of zinc and bismuth, at 5000 to 6000 atmospheres, gave solid blocks having a *crystalline* fracture. Toward 6000 atmospheres zinc and tin appeared to liquefy. Powder of prismatic sulphur was transformed into a solid block of octahedric sulphur. Soft sulphur and octahedric sulphur led to the same result as prismatic. Red phosphorus, the *Scientific American* says, appeared also to pass into the denser state of black phosphorus. As may be seen from this, simple bodies undergo chemical transformations by the action of pressure. The change of amorphous powders, like that of zinc, into crystalline masses, is a sort of self-combination. Certain hard metals do not lose their pulverulent structure at any pressure. Binoxide of manganese and the sulphides of zinc and lead in powder weld when compressed, and exhibit the appearance, respectively, of natural crystallised pyrolusite, blende, and galena; while silica and the oxides and sulphides of arsenic undergo no agglomeration. A certain number of pulverised salts solidify through pressure and become transparent, thus proving the union of the molecules. At high pressures the hydrated salts, such as sulphate of soda, can be completely liquefied. Various organic substances, such as fatty acids, damp cotton, and starch change their appearance, lose their texture, and consequently undergo considerable molecular change.

MISCELLANEA.

THE Smoke Abatement Exhibition closes on the 14th inst.

CONSIDERABLE discoveries of asbestos have been made in Canada.

THE palace of the Maharajah of Mysore, in the City of Mysore, is to be lighted by the electric light.

A PROFIT of £1120 was made for the Parkes Museum by the recent "International Medical and Sanitary Exhibition."

THE first locomotive has arrived for the excavation works of the great Panama Canal. The city of Panama celebrated the event by a great *fête*.

AT the instance of the Marquis of Lorne, the initiatory steps have been taken for the establishment of an academy of eminent literary and scientific men in Canada.

A NEW work, by Mr. Richard Meade, Assistant Keeper of Mining Records, entitled "The Coal and Iron Industries of the United Kingdom," will shortly be issued by Messrs. Crosby Lockwood and Co.

THE North Central Wagon Company, Rotherham, has declared a dividend of 8 per cent. The company has nearly 20,000 wagons, and therefore "observes with pleasure the upward tendency in the coal and iron trades."

THE engagement with Mr. F. Thomson, F.G.S., who went out to Zanzibar at the invitation of the Sultan, to make a geological survey of his domains, has been abruptly broken off because in his excursion along the Rovuma he has not found coal.

THE *Daily News* is informed that a Committee, on which the Board of Trade, the War Office, and the Admiralty are represented, is sitting at the Board of Trade to examine into the practicability and the expediency of the projected Channel Tunnel.

IT has been resolved to offer two first prizes of 15,000 marks—£750—each, three second prizes of 10,000 marks, three third prizes of 5000 marks, and ten others of 2000 marks each, for the best designs for the new German Imperial House of Parliament to be erected in Berlin. The jury is to consist of the building committee and eight other architects and artists, one of whom must be a German living abroad.

THE local members and associates of the Institution of Civil Engineers dined together in the Queen's Hotel, Manchester, on the evening of the 24th ult., with the object of acquaintance. The chair was occupied by Mr. Richard Peacock, Manchester. The health of the members and the continued prosperity of the Institution was proposed, and responded to by Mr. I. G. Lynde, Manchester, one of the oldest members on the roll.

MESSRS. NEWTON, CHAMBERS, AND CO. made an interesting experiment at Rockingham Colliery on the 27th inst., by way of testing the producing powers of the pit. The workmen descended about six o'clock in the morning, and at the close of the day's work the weighman announced that 1052 tons of coal had been brought to bank during the day. This is the largest amount of coal ever drawn from the "Silkstone" bed up one shaft in the same time.

AMONG the private Bills which were declared on Friday last by the Examiners to have complied with the requisitions of the standing orders was the East London Railway Bill. The following notice to Parliamentary agents has been issued from the Private Bill Office, House of Lords, Westminster:—"In order to expedite business, the agents having the conduct of private Bills are desired to give immediate notice in this office of any Bill in their charge which, for any reason, will not be proceeded with during the present session."

SIR E. W. WATKIN, M.P., chairman of the Manchester, Sheffield, and Lincolnshire Railway Company, at the half-yearly meeting held at Manchester, stated, in reference to the legal dispute the company had with the Denaby Main Colliery, they had thought one merit of the Railway Commission would be its cheapness, but he was bound to say it was one of the dearest tribunals before which they had presented themselves. Sir Edward thinks the indications of industrial prosperity are very bright, and mentioned Sheffield as a cheerful instance, where the tonnage had risen from 33,000 in 1878 to 56,000 in 1881.

ON the 25th ult. Mr. W. R. Browne read a paper before the Society of Arts, on the causes and remedies of bad trade. From his facts and arguments he drew the following deductions:—"That a country should always encourage, by all means in its power, the carrying out of new industrial enterprises, in all cases where these do not involve an actual waste of the capital invested in them." That the time which should be chosen for encouraging new enterprise should be when trade is bad, and not when it is good." "That the kind of enterprise which it is desirable to foster is that which tends to cheapen production directly, and not indirectly."

WE are informed that Messrs. Barraud and Lunds, the patentees of the System of Time Signalling and Clock Synchronising, largely adopted in London, have applied to the Postal Telegraph Department for an extension of their time exchange to telephone purposes. For some time they have been experimenting with the object of utilising their existing system for telephoning, which has resulted in a perfect success, and they now propose to formally thus duplicate and extend their system, by which every telephone subscriber would be able to receive an hourly Greenwich time current by simply hanging his receiver on a hook in his telephone, marked "Time Signal," without any interference with the speaking power of the instruments.

THIS week in Wolverhampton the two days' examination of candidates for mine managers' certificates granted annually under the Mines' Regulation Act was held in the Town Hall. Nine candidates appeared; six belonging to South Staffordshire, one from Derbyshire, one from South Yorkshire, and one from Durham. The majority of these have been students articled to mining and mechanical engineers, while among the number was one who had earned his livelihood by working in mines. The examiners were:—For chemistry and applied mining, Mr. W. Fairley, of Beaudesert, near Rugeley; mechanical engineering, Mr. Jonah Davies, of Wolverhampton; surveying and the laying out of collieries, and practical mining, Mr. John Williamson, of the Cannock and Rugeley Collieries.

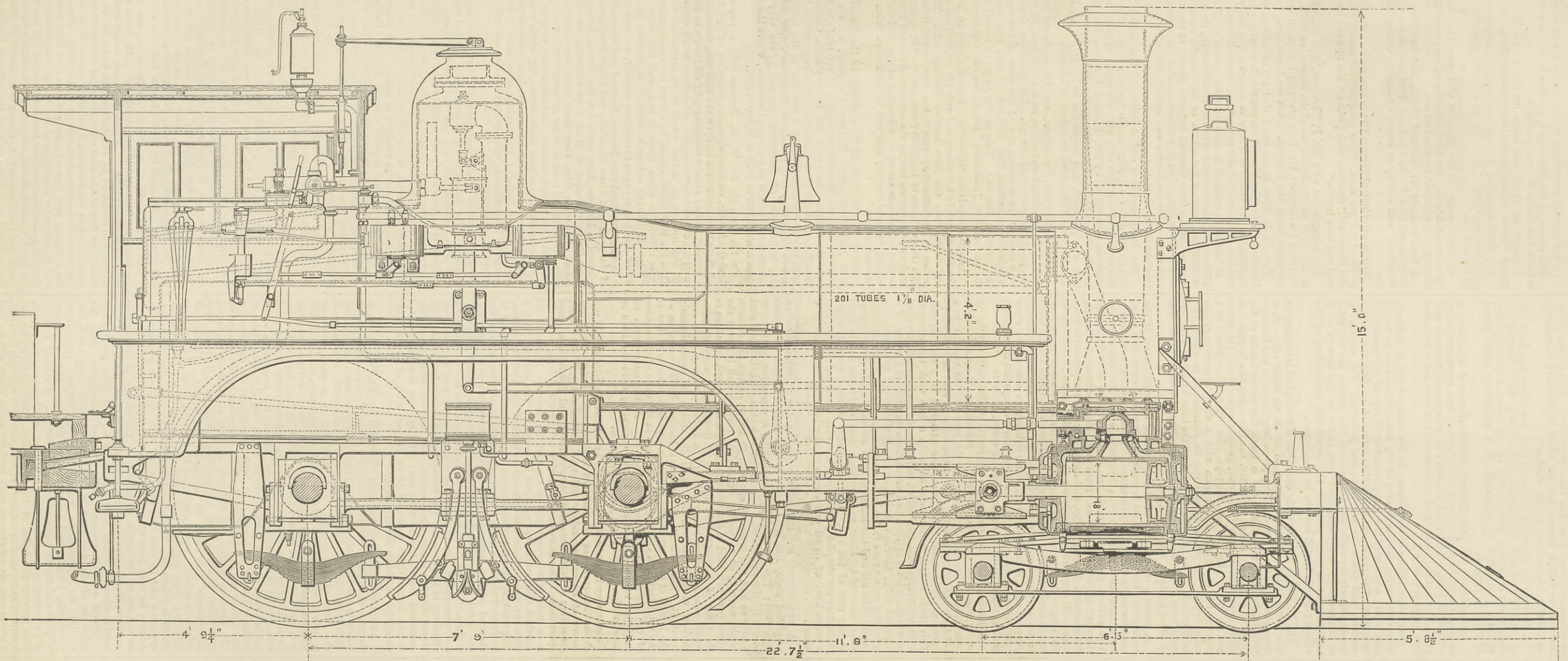
THE chief clauses in the new sliding scale, which has now been formally signed by representative masters and men, for regulating colliers' wages in South Staffordshire and East Worcestershire, are as here:—(1) When furnace coal is selling at 9s. per ton, wages of thick coal colliers' shall be 3s. a day, and shall rise and fall 4d. per day for every 1s. in the price of furnace coal. When furnace coal is selling at less than 9s. per ton, wages of thick coal colliers shall rise 3d. per day only for every 1s. in the price of furnace coal. (2) The selling prices are those per statute ton, as quoted in the Earl of Dudley's circular for furnace coal, east of Dudley. (3) Thin coal and ironstone miners' wages in the Dudley district are to be 2s. 6d. per day when thick coal wages are 3s. and to rise and fall 2d. or 1½d. respectively for every 4d. or 3d. in thick coal wages. (6) This agreement to be binding for six months certain, and afterwards to be terminable by three months' notice on either side.

THE people of Burslem, North Staffordshire, are anxious that the tramway lines should be extended in their town with greater rapidity than at present. A public meeting called by the Mayor in response to a request of the ratepayers, was held on Monday, at which the Mayor said that some feeling of disappointment had been experienced at the company's not carrying out their scheme for a line down Newcastle-street and on to Tunstall. The chairman of the company had, however, assured him that they were doing their best to get on to Tunstall, and the Town Council were very desirous that they should extend the line to that town. It was resolved that the Town Council should be requested to signify to the Board of Trade and the Tramways Company the assent of the meeting to the proposed provisional order of the company for the use of steam on the lines, subject to the right being limited in the first instance to three years.

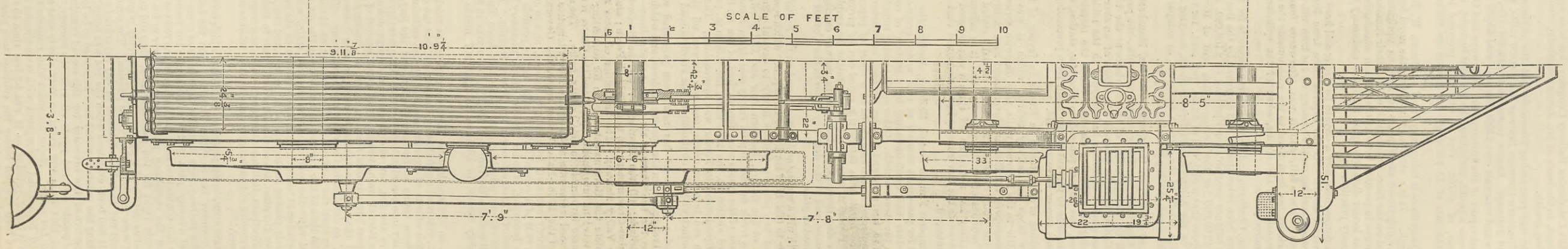
EXPRESS LOCOMOTIVE, PENNSYLVANIA RAILWAY.

MR. T. N. ELY, ENGINEERS, ALTOONA.

(*For description see page 78.*



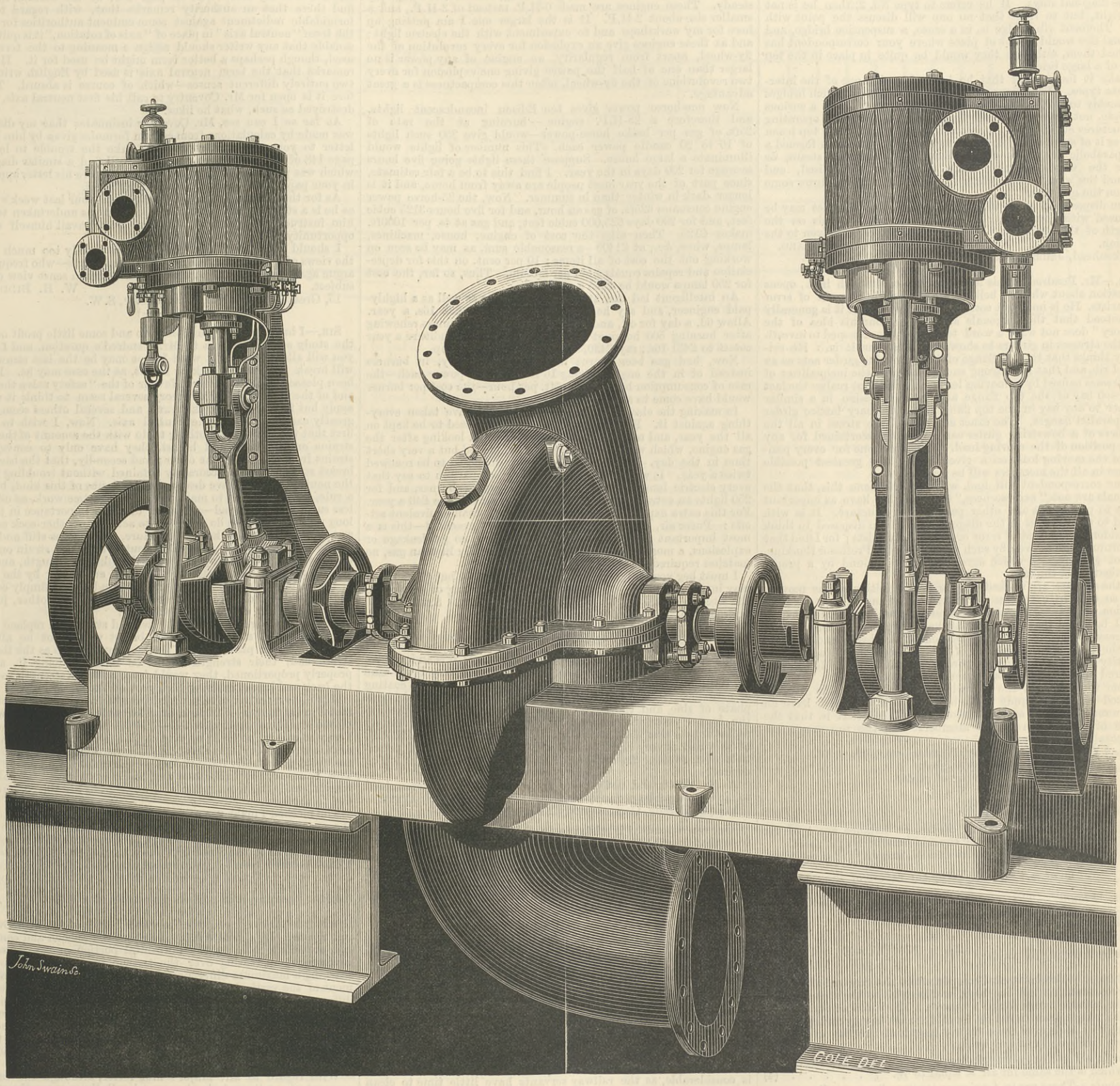
LONGITUDINAL SECTION



SECTIONAL PLAN

CENTRIFUGAL PUMPING ENGINES.

MESSRS. W. H. ALLEN AND CO., LAMBETH, ENGINEERS.



WE illustrate above a pair of pumping engines, one of a set of four which have been constructed by Messrs. W. H. Allen and Co., of York-street Works, Lambeth, for steamers now being constructed in the Clyde by Messrs. John Elder and Co. for the Java line of an Amsterdam firm. These ships are 3000 tons, with 2500 indicated horse-power. As will be seen, the pump, which is of the centrifugal type, is placed between two vertical engines, either of which can be put into gear by the coupling in a few moments. This coupling consists of a steel claw, sliding on two feathers on the shaft, being actuated by the small hand wheel; the claw portion of the coupling is covered with a brass shield. This coupling, which occupies very little room, accomplishes its work, and is very neat in appearance. The engine is fitted with cylinders 9in. diameter, and the whole of the working parts, which are exceptionally strong, are made of selected steel. The bolts of the connecting rod and crosshead are turned down in the middle to the diameter of the bottom of the thread so as to give them more elasticity. The lubricators of these engines are of the most improved patterns, every joint and bearing being arranged so that it can be oiled when running at full speed. In the form of pump Messrs. Allen and Co. make, this arrangement is easily carried out, as it does not interfere with the pump, which can be got at without disturbing any part of the machinery, which cannot be done with side opening pumps. The pipes of the pump are 15in. diameter, and this pump is capable of throwing into the condenser from 3500 to 4000 gallons per minute, or pumping from the bilge 1100 tons per hour. Messrs. W. H. Allen and Co. are making no less than twenty different sizes of these pumping engines, which show that this form of pumping machinery is coming rapidly in favour with shipowners. The workmanship of these engines is exquisite, and the surfaces are so large and so well made that the chances of a failure are reduced to minimum. The cost of such a set of pumping machinery as that which we illustrate is very moderate—as nothing compared to the value of a steamship. Let it be remembered that this pump will lift overboard with ease, as we have said, 1100 tons of water per hour, or if pressed, as much as 1300 tons, and it will be seen how great a safeguard can be provided at a small cost. A great many ships founder because of leaks which admit less than one-half what these pumps could deal with.

LETTERS TO THE EDITOR.

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

SNOW-HILL STATION ROOF.

SIR,—In your issue of the 13th inst. you publish a letter from Mr. T. Timmins on the subject of iron roofs, in which he refers to the roof erected by my late father over the Lime-street Station, at Liverpool, and states, when finding fault with the Snow-hill roof:—"I believe I am correct in stating it was copied from the old Lime-street Station roof, with metal altered in proportion to the span, disregarding the fact that it was made at a time when iron roofs were but little understood, and I believe it failed under the very ordinary tests applied."

Now, as Mr. Timmins cannot be aware of the real facts of the case, and has stated—I expect in ignorance of them—what is decidedly and completely wrong, I, as my father's representative and successor in business, beg to give you the true version of the matter. It is an undoubted fact that my father's notion for covering the Lime-street Station in one span was perfectly novel; and of this I am not a little proud, as it proves that he was the originator of all the extensive and grand roofs since erected all over the kingdom. His proposition to carry out this work in one span was looked upon at first as an utopian idea, which no one, it was said, but a mad Irishman would propose. And though it was acknowledged to be most desirable if it could be accomplished, the idea was only entertained by the directors when my father offered, at his own risk and cost, to erect a portion of the roof full size, and to submit it to any test that might be considered right to prove its perfect safety and efficiency. The directors then said if he was willing to do this they would wait the result.

He set to work, and two bays, consisting of three principals complete, were erected on our premises here, and notice was given that all was prepared and ready. The directors sent over their engineer, the late Mr. Joseph Locke, C.E., and the late Mr. Wm. Fairbairn, who were accompanied by the late Sir Chas. Fox—then Mr. Fox, and calculations having been made as to what one principal should bear, the two outside principals were propped, and weights to the required quantity were put on, and suspended from the centre principal; these it bore without any perceptible effect. The engineers were astonished, and it was suggested that additional weights should then be put on to see what it really would bear. This was done, and it was only when 48 tons 8 cwt. were put on, *i.e.* = 144 lb. per foot superficial, taking the surface acted upon by the wind—viz., the vertical height from the springing to the crown, or 35ft., by the width of one bay 21ft. 6in.; or = 66 lb. per foot superficial—taking the surface acted upon to be = half the span, viz., 76ft. 6in. × width of bay 21ft. 6in.; or 33 lb. per foot superficial, taking the surface affected to be equal to the whole span by 21ft. 6in., that it yielded.

The experiment was considered most satisfactory, and the work was ordered and executed to the perfect satisfaction of the directors and their engineers, and my father was awarded the Telford medal by the Institution of Civil Engineers, of which he was made an Associate.

The roof remained up from 1849 till it was lately taken down to be replaced by a larger one to suit the alterations and further enlargements required at the station, but it never failed in the slightest degree.

As Mr. Timmins's letter is calculated to have a very damaging and injurious effect upon me, and to throw discredit on the design and construction of the roof in question, and those connected with it, I beg that you will be good enough to have the matter corrected by publishing this letter.

I should mention also, as a further proof that everything possible was done to insure its perfect safety and stability, and that nothing was left undone, that the plans were, in the first instance, submitted to and approved by some of the most eminent engineers of the day, and that during the execution of the work every single tension bar was tested, stamped, and certified by the Liverpool Corporation.

These facts will show how misinformed Mr. Timmins has been, and I feel bound, in my own interests, to correct him, and to state them as above.

WILLIAM TURNER.

Hammersmith and Oxmantown Ironworks,
Dublin, January 25th.

BOW-STRING GIRDERS.

SIR,—The question raised by your correspondent, Mr. Pendred, in your last impression, is one of some little importance, and worth discussion; but before it can be discussed with advantage it is well that all parties should clearly understand what they are talking about. Now some confusion exists as to what is and what is not a bow-string girder. Thus, for example, there are girders shaped like the bow-string type, but which are really lattice girders with curved tops. In them the upper boom is comparatively light, much of the strength of the bridge being got out of the lattice bars in the usual way. Again, there is the curved rib bridge, in which

the roadway is suspended from the ribs. In this case nearly the whole strength of the bridge lies in the ribs, and the tie-rods or stays are comparatively light. Between these two extreme cases we have a great variety of bridges, some approaching one type, some the other.

The diagram given by your correspondent does not express which type he means. If he is referring to type No. 1, then he is undoubtedly wrong. In fact, the bridge would tumble down but for the diagonal stays. If he refers to type No. 2, then he is not only right, but so right that no one will discuss the point with him. The bent rib bridge is, in a sense, a suspension bridge, and diagonal ties would be out of place where your correspondent has sketched them, although they would be quite in place in the top boom of a large bridge.

I take it for granted that he has in his mind one of the intermediate types. Now diagonal ties are introduced in such bridges presumably to deal with shearing strains; but there is a curious principle, not quite so generally known as it ought to be, operating in structures of the kind. It is this: The curving of the top boom relieves it of some of the shearing strain, and if the boom formed a true parabolic arc, then there would be no shearing strain, or rather the whole shearing strain would be neutralised, and diagonal ties would not be wanted. This will, I hope, throw some light on the question.

I am disposed to agree with Mr. Pendred that the ties may be dispensed with; but whether they can or not depends on the strength of the top boom. No general answer can be given to the question. H. Ward.

Birkenhead, January 30th.

Sir,—Mr. Pendred, in his letter to you of the 24th inst., opens a question about which, I believe, a considerable amount of error still exists. He is no doubt correct in supposing that it is generally understood that the diagonals act as ties, but his idea of the "theory" does not want a word to anybody accustomed to investigate the stresses in girders to show how erroneous it is. He evidently thinks that the top flange of the bowstring girder acts as an arched rib, and that it is strong enough to resist the inequalities of the stresses caused by a moving load. He does not realise the fact that each bay of the top flange acts in compression in a similar manner to any bay in the top flange of an ordinary lattice girder with parallel flanges. The exact amount of the stress in all the members of a bowstring girder can be easily ascertained for any given position of the moving load. If this is done for every position of the moving load on a given girder, the greatest possible stresses in all the members will be found.

Your correspondent will find, when he has done this, that the diagonals are not "excrescences," but that they have as important duties to perform as any other part of the structure. It is with regard to these duties of the diagonals that I am disposed to think a considerable amount of error or uncertainty exists; for I find that the formulæ given, even by such an authority as Professor Rankine, do not give results which agree with those found by a proper investigation of the case.

If the stresses are worked out for every position of the moving load, so that in each case all the forces acting on each point of junction of the various members keep themselves in equilibrium, it will be found that the diagonals have to bear both tension and compression, according to the position of this load; and further, that the horizontal component of the greatest stress is a constant quantity for all the diagonals throughout the girder. It will also be found that the verticals are never in compression.

From these results the following rules and formulæ may be deduced—they will apply to all bowstring girders which have an even number of bays and a parabolic top flange; that is, that the points of intersection of the members with the top flange are in a parabolic curve;—

Let W = total load per bay of girder = $w + w^1$,
w = dead load per bay of girder.
w^1 = moving load per bay of girder.
S = span of girder = N × B.
B = length of one bay.
N = number of bays.
D = depth of girder at centre, or distance apart of the neutral axes of the top and bottom flanges there.
d = depth of girder at end of first bay from the abutment = $4\,D \times \frac{N-1}{N^2}$ by the nature of the curve.

Bottom Flange.—The greatest stress, which is constant throughout, is = $\frac{N-1}{2} \times W \times \frac{B}{d}$, ... (1)

or by inserting the value of d it is = $\frac{N \times W \times S}{8 \times D}$ . . . (2)

Top Flange.—The horizontal component of the greatest stress is constant for all the bays, and is equal to the stress in the bottom flange found as above. The exact amount of the compression must be found for each bay by multiplying this horizontal force by the length of the bay of the top flange and dividing by B. . . . . (3)

Verticals.—These are always in tension, and the greatest stress, which is the same for all is equal to W. . . . . (4)

Diagonals.—These are in tension or compression, according to the position of the moving load. The exact amount of the stress is the same in either case, and the horizontal component of it is constant for all the diagonals, being equal to $\frac{w^1 \times s}{16 \times D}$. . . . . (5)

From this quantity the exact stress in each diagonal may be found by multiplying by the length of the diagonal and dividing by B. . . . . (6)

For bowstring girders with an odd number of bays, these rules will require a slight modification from the fact that, if the middle bay of the top flange has its centre in the parabolic curve, the points of intersection of the diagonals with the top flange cannot be in that curve.

It is no doubt possible in many cases, by bracing ties and leaving struts unbraced, to make the several members take stresses which are opposite in their nature to what they theoretically ought to bear. This cannot be done without serious injury to the girder, as a member, which should be a strut, must buckle and get out of the way before the stress will pass through another member. This plan is, however, sometimes adopted in bowstring girders; and the practice, no doubt, has arisen from the habit, referred to by your correspondent, of considering the diagonals as ties only. The investigations to which I have referred will show how incorrect this habit is. A properly constructed bowstring girder will have all the diagonals braced, while the verticals may be left unbraced.

Palace-chambers, Westminster, Charles Lean.
January 31st.

Sir,—As on reading over my last letter I perceive it is possible for your readers to misunderstand my meaning, will you kindly allow me to explain that the kind of girder I have referred to is that which is best known as an arched rib girder?

Kingstown, Jan. 31st. H. W. Pendred.

RAILWAY SIGNALS AND ELECTRIC LIGHTING.

Sir,—I notice Patent 2711—Putnam, New York—a short description being contained in your journal of January 27th, 1882, is practically identical with the invention for electric railway signalling I brought forward in 1875, and which I so carefully considered, that probably no possible care has been omitted. I enclose you a copy of my pamphlet that you may assure yourself on the point. Of one thing I am convinced, that until my system, or one almost identical with it, is adopted by railways in England, accidents must occur during fogs, to say nothing of delays. Eventually this system of signalling will undoubtedly become general so soon as the public push vested interests aside in favour of the safest methods of signalling for the prevention of accidents.

Turning to quite another subject, I read your account of electric lighting comparisons, using steam or gas engines, with much interest. I have gone into this matter with great care, as I propose later to adopt that method of lighting here.

You make one oversight in respect to the Clerk engine, which is the gas engine *par excellence* for generating, the current being very steady. These engines are made 6-H.P. instead of 3-H.P., and a smaller size about 2-H.P. It is the larger one I am putting up here for my workshops and to experiment with the electric light; and as these engines give an explosion for every revolution of the fly-wheel, apart from regularity, an engine of any power is no larger than one of half the power giving one explosion for every two revolutions of the fly-wheel, often this compactness is a great advantage.

Now one-horse power gives ten Edison incandescent lights, and therefore a 25-H.P. engine — burning at the rate of 25ft. of gas per brake horse-power—would give 250 such lights of 16 to 20 candle power each. This number of lights would illuminate a large house. Suppose these lights going five hours average for 200 days in the year. I find this to be a fair estimate, since part of the year most people are away from home, and it is longer dark in winter than in summer. Now, the 25-horse power engine consumes 625ft. of gas an hour, and for five hours 3125 cubic feet, and for 200 days 625,000 cubic feet, and gas at 4s. per 1000ft. makes £125. Then take the cost of engine, house, machines, lamps, wires, &c., at £1400—a reasonable sum, as may be seen on working out the cost of all items; 10 per cent. on this for depreciation and repairs equals £140 per annum. Thus, so far, the cost for 250 lamps would be £265 a year.

An intelligent lad can attend a gas engine as well as a highly-paid engineer, and say he gets 18s. a week, or £36 16s. a year. Allow 6d. a day for oil, and assuming each lamp requires renewing after burning 500 hours at 5s. each, the total expenditure a year comes to £431 16s., say £430, or about £1 15s. per lamp.

Now, had gas been burnt in the ordinary way, in burners instead of in the engine, giving 16 to 20-candle power each—the rate of consumption being 6ft. to 7ft. per hour—the cost per burner would have come to about £1 8s. a year.

In making the electric lighting calculation, I have taken everything against it. For instance, the lad is supposed to be kept on all the year, and to have no other work beyond looking after the gas engine, which would only keep him employed but a very short time in the day. Further, every lamp is supposed to be renewed twice a year. It would not be an unfair comparison to say that every electric lamp costs 3s. more than every gas-burner, and for 250 lights an extra expense of £37 10s., or even suppose £40 a year. For this extra expense the following are more than equivalent set-offs:—Purer air, less heat, house decorations preserved—this is a most important item—works of art preserved, no gas leakage or explosions, a more agreeable light, and more easily lit than gas, no matches required, &c.

I must beg your forgiveness for writing so much, but this subject may interest some of your readers who are thinking of employing the electric light. David Salomons.

Broomhill, Tunbridge Wells, January 28th.

NEW SECONDARY BATTERY.

Sir,—I have invented a new secondary battery; it is an improvement on that invented by Mr. Sutton. In my battery I use zinc for the positive element, and the usual lead plate, with its coating of peroxide, for the negative element. The solution used is sulphate of zinc, and the action precisely analogous with Sutton's, the copper plate and sulphate of copper solution being simply replaced by a zinc plate and sulphate of zinc solution. The E.M.F. of this cell is very high, a single cell giving a difference of potentials of 2·4 volts. Its resistance can, of course, be made as low as desired.

As Mr. Sutton did not protect his invention, I have determined to make this public property also. William B. Sayers.

1, Dyke Parade, Cork, January 28th.

[Our correspondent is mistaken in thinking his battery different from that described by Mr. Sutton. In his paper read before the Royal Society, Mr. Sutton distinctly states that he experimented with zinc in a solution of zinc, iron in a similar solution of iron, as well as with copper. Mr. Sutton rejected zinc and iron, for obvious electrical reasons, and put forward the copper electrode as the most satisfactory.—Ed. E.]

THE "WONDERFUL" GRATE.

Sir,—A few days since I had an opportunity of seeing the above in action, and my attention was drawn especially to it by the encomium you passed upon it in your issue April 8th, 1881, an extract from which appeared in a pamphlet handed to me. Having examined the grate carefully, it struck me that its adoption in the waiting rooms of railway stations would afford more comfort to those who, unfortunately, have to "wait" than is usual, on account of its burning twenty-four hours without attention, and I think most railway travellers will agree that fires in waiting rooms are ill-tended. The advantage of requiring no fire-irons in such a case is considerable, as the railway servants have little time to clean them, and waiting passengers I have myself observed prefer breaking down a hollow fire with their boots to touching a rusty poker.

Leeds, January 31st. Francis Campin.

STRAINS ON CRANE POSTS.

Sir,—I have neither the time nor the inclination to enter into a controversy on the above subject, as some of your correspondents have done; but with respect to Mr. Coventry's criticisms in his letter to you of January 20th, in which he says that he does not see where his diagram Fig. 3 differs from mine, I may remark that his diagram shows a cantilever with a weight hanging at the end and a uniform end-on pressure, while in my case the end-on pressure is diminishing from the foot upwards.

I admit that there is very little difference between the strains in his cantilever and those in the foot of my crane, but our diagrams are obviously unlike. I simplify matters by taking the weight of the crane post itself into account which was already at hand, whereas he has had to find an imaginary weight for the pressure at the end of his cantilever; and I have dealt with the crane as a whole, while Mr. Coventry seems to have, or thinks he has, dealt with only a part of it, and I am at a loss to tell what part. His diagram does not represent the horizontal portion of the crane post, since in that part there is no end pressure, nor can it represent the vertical portion, as the weight producing the bending moment there does not act perpendicular to the crane post, but parallel to it and at a distance from its centre of gravity. I have taken an actual case to simplify matters, and not an imaginary one, as Mr. Coventry has done, to complicate them. If Mr. Coventry had taken a little trouble, I think he could not have failed to have discovered this. I presume he means the end-on pressure to be uniformly applied at the end of the beam, and not concentrated at the point B. I also presume he has neglected the weight of the cantilever itself, though he does not say so.

I have really no time to criticise all the curious diagrams and calculations which have appeared on the subject, and therefore I have no remarks to make on them, but in the case of Mr. Coventry's diagram under discussion, I might say a few words. He does not say what becomes of his first neutral axis; yet the line remains, and should have a name; nor does he say why he calls the second or calculated line a neutral axis, which in this case is certainly not one; and I would point out to him that the inclined line which rotated on the neutral axis at n_1 caused by the application of the weight hanging at the end of the cantilever does not rotate again when the end pressure is applied at B, but is simply moved forward in parallel lines from b_2 to b_3; this decides the locus of the neutral point $3n$, and of course any number of points may be so calculated, and a line drawn through them will be the line of demarcation between the part in tension and the part in compression.

Mr. Coventry remarks that he holds the views of an eminent European engineer; perhaps this eminent engineer will furnish Mr. Coventry with a name for his first neutral axis, which he acknowledges is destroyed as such. Now, if he will refer to the work alluded to in my first letter, on page 153, at the bottom, he will find there that an authority remarks that, with regard to my formidable indictment against some eminent authorities for using the term "neutral axis" in place of "axis of rotation," it is quite reasonable that any writer should assign a meaning to the terms he used, though perhaps a better term might be used for it. He also remarks that the term neutral axis is used by English writers in two entirely different senses—which of course is absurd. Therefore it is open for Mr. Coventry to call his first neutral axis, when destroyed as such, what he likes.

As far as I can see, Mr. Coventry insinuates that my diagram was made by calculations from certain formulæ given by him in his letter to you. If Mr. Coventry will take the trouble to look at page 148 of the work above quoted, he will find a similar diagram, which was prepared by me some ten years before his letter appeared in your paper. Of course this speaks for itself.

As for the "Puzzled Student" writing in your last week's issue, as he is a student, has he not a master who has undertaken to give him instruction? and if so, why does he not avail himself of the opportunity?

I should recommend Mr. Coventry not to rely too much upon the views of what he calls eminent mathematicians—who frequently argue against all reason—but to take a common sense view of his subject. W. H. Bidder.

15, Great George-street, Westminster, S.W.

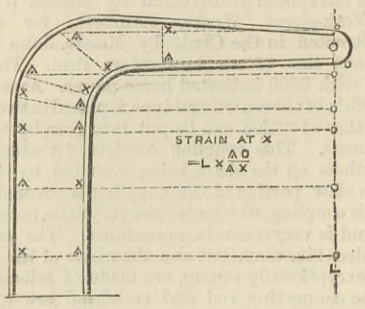
Sir,—I have derived much pleasure and some little profit out of the study of the answers to Mr. Pendred's question, and I trust you will allow me to add what I hope may be the last straw that will break the crane's back or breast, as the case may be. I have been pleased to see so many in favour of the "safety valve theory," and of the opponents of the theory several seem to think it would apply but for the sides of the crane, and several others seem to be greatly exercised about the neutral axis. Now, I wish to show first that the sides have nothing to do with the amount of the main strains on the back and breast, they have only to convey the strains from the one to the other; and secondly, that the back and breast strains can be accurately obtained without troubling about the neutral axis. I have designed several jibs of this kind, but, as a rule, have preferred to make the sides of lattice work, as offering less surface to the wind—a matter of some importance in jibs of long radius, which we do not want to act as a weather-cock as well as a crane. In such a lattice structure, although as stiff and rigid as one with plate sides, there is no neutral axis, the strain on each diagonal tie or strut being the same thoughout its length, and the strains on back and breast are obtained accurately by the lever principle of the safety valve; the ties and struts simply convey the tension and compression from one flange to the other, just as they would in an ordinary lattice girder.

Now, if we were to remove the ties and struts and replace them by a plate, the strains back and breast would not be altered, because the side plates having the same work to do as the ties and struts had, their strength would be used in doing it, and if properly proportioned, they would have no spare strength to assist the back and breast in doing their part of the work.

Again, as a matter of fact, a girder must have the same amount of metal in its flanges—except in in so far as the difference in weight of the structure itself may tell—whether the diagonal stiffness, if I may so call it, be given by diagonal ties and struts, or by a plate or plates; and our crane is simply a girder, and the strains back and front are equally independent of the construction of the sides. This being so, the back-plate and angle irons must take all the tension, and the front plate and angle irons all the compression due to the load.

The method I make use of to obtain the strains is illustrated by the accompanying diagram. First draw a line A x A x through the centre of gravity of the plate and angle irons both back and front, then from any point A on either of these lines draw a horizontal line to meet the vertical through the centre of gravity of the load in O, and another line at right angles to the opposite member, meeting it in x, then the strain at $x = L \times \frac{A\ O}{A\ x}$, and this is true for every point in the whole length of the jib above the roller path. By this it will be seen that the tension and compression are about equal in the horizontal portion or cantilever, the compression increasing over the tension in the curved portion, reaching a maximum difference of once the load at the commencement of the vertical portion, all down which this same maximum difference is maintained. If Mr. Pendred will adopt this simple, practical, and rapid construction, and will properly proportion his metal to the strains found, he will have a perfectly safe structure, and the neutral axis can amuse itself by shifting its position in the side plates, as it undoubtedly does, for every strain and load that comes on the crane.

With regard to Mr. Major's first letter, although the turning moment about the axis is the same in all three cases, the strains on the lever differ very much, as the accompanying sketch will show.



Strain on A = $\frac{4 \times 4}{1} = 16$

Strain on B = $\frac{4 \times 4}{1} = 16$

Turning moment 32

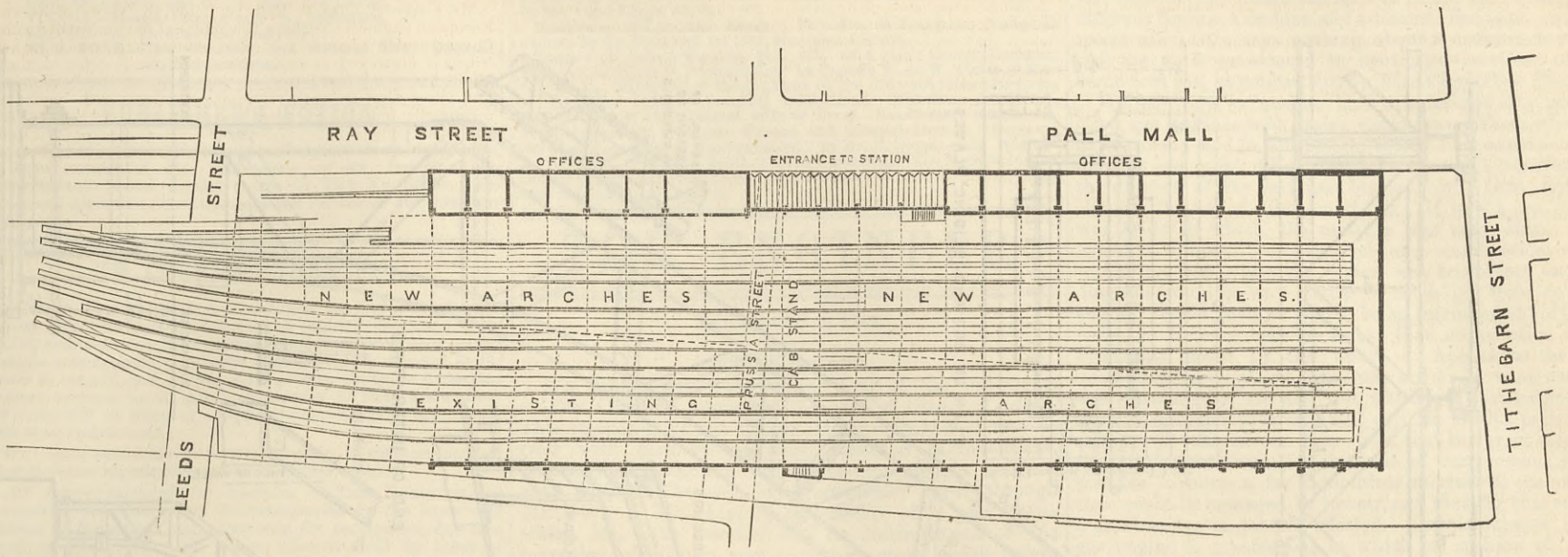
Strain on C = $\frac{4 \times 4\frac{1}{2}}{1} = 18$

Strain on D = $\frac{4 \times 3\frac{1}{2}}{1} = 14$

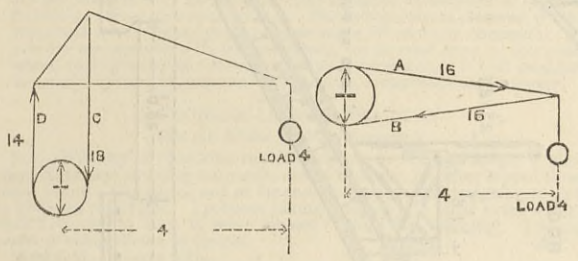
Turning moment 32

And if Mr. Pendred designs his crane properly, "the breaking strain" will never "be approached," so that the front need not "be so strong that it will resist strain beyond the limit at which the back fails," any more than the safety valve and fulcrum pin must each be stronger than each other. Mr. Major says, page 348, "the vertical strain due to the load and parallel to the post may readily be resolved into an equivalent strain at right angles to it." Now, if Mr. Major thinks a little more about this, he will find that it is utterly impossible to resolve one force into one other at all, or even into two, at right angles to itself; and with regard to Fig. 2, same page, the cantilever will fall down, as shown, for there is nothing but the thin tie plate at the top, and the friction of the hard liner at the bottom corner, to hold both itself and the load up.

DESIGN FOR A NEW LANCASHIRE AND YORKSHIRE RAILWAY STATION IN LIVERPOOL.



It wants an angle iron under the bottom corner to put on to the breast the extra strain that it has over the back; Mr. Fyson makes a mistake in distributing this load over the whole section, it really all comes on the breast, and his method reminds me of the absurdity of the crane proposed by Mr. Major, though I should be pleased to see Mr. Major work out his own suggestion of a crane 2ft. across, with the load 1ft. in front of it, and if he makes the strain back and front the same, I should like to see how he does it; and if they are different, then the principle of the safety valve lever is at work, and the only question is, how is it applied. Mr. Hoy is in error in taking the height of his crane into consideration, the strain on a crane is due to the load x, the radius and the height has nothing to do with it, provided the load hangs vertical.



$$\text{Strain at } x = L \times \frac{A\ O}{A\ x}.$$

Derby. OLIVER J. ELLIS.

SIR,—With reference to the last paragraph of Mr. Stokes's letter in THE ENGINEER of January 20th, will you kindly allow me to draw the attention of your readers to the result of Mr. Stokes's experiment on the position of the neutral axis, compared with equation (9) in my letter which you published December 30th. That equation makes the distance of the neutral axis 1·108in. from the centre of the breast flange, while Mr. Stokes finds that distance to be "as nearly as possible" $1\frac{1}{16}$in. = 1·063in., the difference being ·045in. I have little doubt that with a shorter length of jib the results would be practically equal, as an error in measurement would not be relatively so important.

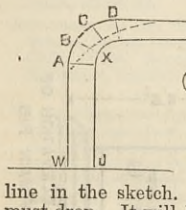
This may appear a trivial matter, but it is nevertheless, to some extent, an answer to those of your correspondents who, having failed (why I cannot say) to comprehend my reasoning, have directly and indirectly accused me of giving calculations which mean nothing as to the point under discussion.

Fordingbridge, 28th January. W. B. COVENTRY.

SIR,—I am not surprised that "A Puzzled Student" has failed to get much information out of the letters which have appeared in your columns on this subject, and as it is possible that neither Mr. Coventry nor Mr. Major will be more willing to answer his question than they are to take my suggestion—although it was backed up by your approval, Sir—I will try to relieve "A Puzzled Student's" mind.

No answer universally applicable can be given to his question. In small cranes the back and breast are of the same thickness, because the thinnest plates which can be properly handled are thick enough In large cranes, the breast must be thicker than the back, because wrought iron is not so strong in compression as in extension, but the additional load due to what has been called the safety valve lever theory has nothing to do with this. Its influence is swallowed up in the difference between the tensile and compressive strengths of wrought iron.

The best way to do is to treat bent cranes as bent box-girders. Fairbairn was the first to make a bent crane in this way. The great point to be attended to is one which has been wholly overlooked by many of your correspondents, viz., the means of preventing the crane from doubling up, or "crippling," which can only be done by making the sides of the box-girder stiff. If "A Puzzled Student" will get a bit of composition gas piping 2ft. long and 1in. in diameter, and will fill it with dry sand, and cork up both ends, he can easily bend it into the semblance of a bent box girder crane, only round instead of rectangular in cross section. If now he takes out the sand and applies a further bending strain, he will soon see what I mean by "crippling." The back and the breast will tend to approach each other, and must be forcibly kept apart. No such tendency exists in a horizontal girder, but this Mr. Coventry and Mr. Major have apparently forgotten. This tendency to approach each other must not be confounded with the shearing strains due to the load, which are quite independent of what, for want of a better name, I call crippling strains. When a box girder has been bent out of a straight line, then similar crippling strains are set up in it, but not before; and, as most girders are made with a small camber, they are practically straight under their loads, and we have only tensile strains in the bottom flange, compression strains in the top flange, and shearing strains in the web to deal with. But in the bent crane the case is different, and the breast and back must at the bend be well stayed apart, or deformation will take place, and the crane will drop at the front, *although no fracture takes place*. The reason is obvious. The back of the crane tends to take the shortest possible direction, and follows the dotted line in the sketch. If it can do this, the outer end of the jib must drop. It will be found a good plan to put some radial angle irons at A B C D, which is the weakest place in the crane.



It must not be forgotten that while increasing the depth or distance from B to X augments the strength of a crane of this kind in one sense, in another it makes it weaker, because the web is more easily bent. Whenever the distance B X exceeds 2ft. and the web is not more than $\frac{3}{16}$in. thick, angle iron stiffeners should be put in as shown. The next place that requires strengthening is the place W J. Here the thickness of the breast may be advantageously augmented up and down for a few feet. If care be taken that the curve is stiff enough not to cripple up, then the jib may be calculated as a cantilever, and the post may be dealt with in the same way with quite satisfactory results. H. WARD.

Birkenhead, January 31st.

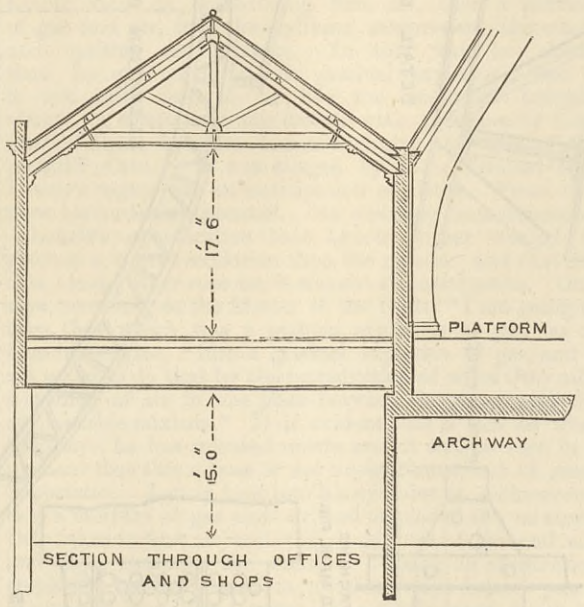
THE EDISON LIGHT.

SIR,—In your description of the large Edison machine, page 42, you speak of the "Commutator." "Collector" is evidently understood, as Gramme machines, of which this is a class, have no commutators. The armatures running in one direction the currents keep one sign; should the machine be reversed, the current takes the reverse sign. Brush collectors are used to collect from the armature rods S, as shown in your engraving, page 46. W. S.

Liverpool, Jan. 27th.

PROPOSED TERMINAL STATION AT LIVERPOOL.

WE have already described and illustrated one of the proposed designs for this station. Mr. Charles Lean, M.I.C.E., submitted a design, and of part of this we now give illustrations. Upon carefully considering the land to be laid out and the levels of the adjoining streets, it appeared that there were serious objections to any design having its main or chief entrance in Tithebarn-street. Any person acquainted with the locality knows the objectionable nature of the present entrance, and would expect in a new station to see the existing evil removed if possible. No entrance from Tithebarn-street could be designed without perpetuating the existing steep ascent for carriages and the painful climb for foot passengers. This design is therefore arranged so as to have the chief entrance in the street called Pall Mall. The proposed entrance is at a point 12ft. higher than the present entrance, and is much more accessible from all parts of Liverpool. Not only is the heavy gradient up to the station avoided, but also the length of that incline, or the amount by which the distance from any of the other railway stations, or from the landing stage, is increased.



From the plan of the site furnished to competitors, it was evident that it has been decided to increase the width of Ray-street and Pall Mall to 60ft. This would make it a far better side from which to enter the station than Tithebarn-street, which is only about 45ft. wide, and very irregular. An entrance in Pall Mall has therefore not only the advantage of better levels and gradients, but also that of being far more free and commodious for the passage of vehicles. In addition to these points, the extra width given to Ray-street and Pall Mall appears to be a waste of very valuable land if the entrance is not to be in these streets; and it would be most unwise to take up the good frontage to a fine, new, and wide street with a dead wall, or even the shops under archways, which would necessarily be small and inconvenient. Advantage has therefore been taken in the design of the permission given in the circular, and the sidings shown on the block plan have been slightly varied, and have been brought away from the Pall Mall side so as to allow the chief station frontage to be there.

The cab-stand is also removed from the position shown, and is placed on a level with the streets and underneath the platforms, &c. This may be looked upon as such a radical alteration that it will be necessary to say a few words in its justification, and some of the advantages which will be gained by it should be pointed out. One great advantage consists in the amount of land which can be saved. The whole area which would be occupied by the cab-stand shown on the block plan, and by an inclined carriage road to and from the station entrance, is saved. This amounts to a saving of at least 6400 square yards of land, which, considering the value of land in the neighbourhood, would, Mr. Lean thinks, probably represent a saving of £100,000. Another advantage is the saving in the cost of roofing. The area occupied by the cab-stand, as suggested, is 2500 square yards. At £36 per square of 100ft., this represents a direct saving of £8100; but by doing away with the cab-road, the weight of iron in the main ribs of the roof, which vary in weight as the square of the span, is saved. The entire cost of one platform is saved also; and the shops and offices facing Pall Mall can be put up for less money than it would take to cover the space with arches to carry the siding, &c., shown on the block plan, and the roofing over same.

The suggested alteration and arrangement of the station has also the following advantages: The station offices, waiting-rooms, &c., are much more accessible from any platform than if they were all placed at one end of the site, as by means of a covered way leading from the booking offices and running parallel to the cab-stand, easy access can be given to each platform at about the middle of its length. The platforms, as suggested on the block plan furnished to competitors, are very long—long enough to take two trains each, each train consisting of an engine and ten other vehicles. By means of the access to the platforms provided, and the "scissors crossings" on the railway lines, one end of each platform could be occupied with an arriving and one with a departing train. The cab-stand is close to each platform. If the cab-stand was carried up to the platforms, it would be reached only from two platforms, and passengers arriving at any other platform would have on an average to walk about 750ft. before they could get a cab. An amount of accommodation in the shape of waiting-rooms, refreshment-rooms, booking offices, &c., is obtained, which it would be impossible to have without putting them on several floors, if the chief entrance was in Tithebarn-street.

It has already been mentioned that these offices would be erected for the money which would otherwise be spent in arching and roofing over the frontage to Pall Mall and Ray-street, and therefore by this arrangement practically the whole cost of the station offices, in addition to the various items already described, is saved. As much platform and siding accommodation, as is shown on the block plan supplied, has been retained by this arrangement, and in addition the curves of the lines entering the station are improved, and the horse and carriage landings are so placed that they would not interfere with the traffic to and from the passenger platform; and as there is a separate entrance for horses, &c., they never cross even the route of the empty cabs. After complying with the requirements mentioned in the circulars and block plan, and having provided an amount of station accommodation and offices equal to any possible requirements of the terminus, and a row of nineteen very large shops fronting Ray-street and Pall Mall, there is by this arrangement a surplus of 7700 square yards of land with the following frontages:—To Pall Mall, 66ft.; to Tithebarn-street, 420ft.; to Bixteth-street, 280ft.; to Ormond-street, 100ft.; or a total of about 866ft.

It is not proposed to remove the present arches unless any parts of them are found defective, but it is intended to remove the present girders and covering of the streets passing under the station and replace them, as regards Prussia-street, by the girders, &c., shown on the drawings. The other streets—which are to be stopped up—would be covered with brick arches. In order to obtain a good light for the cab-stand and covered way to the platforms, it is proposed to carry the platform over these places on lattice girders, and to use where necessary for portions of the platforms themselves Haywood's pavement and floor lights.

Another advantage to be gained by this arrangement is that the whole of the new offices, with platform space sufficient to carry on the ordinary traffic of the station, could be thoroughly completed before any part of the present station was interfered with. If at any future time it was considered desirable to connect the Tithebarn-street and Lime-street stations, this arrangement of the station would allow of the line being carried over Tithebarn-street, without interfering in any way with the new station building.

Notes of Estimate for Design Submitted by Mr. Lean.

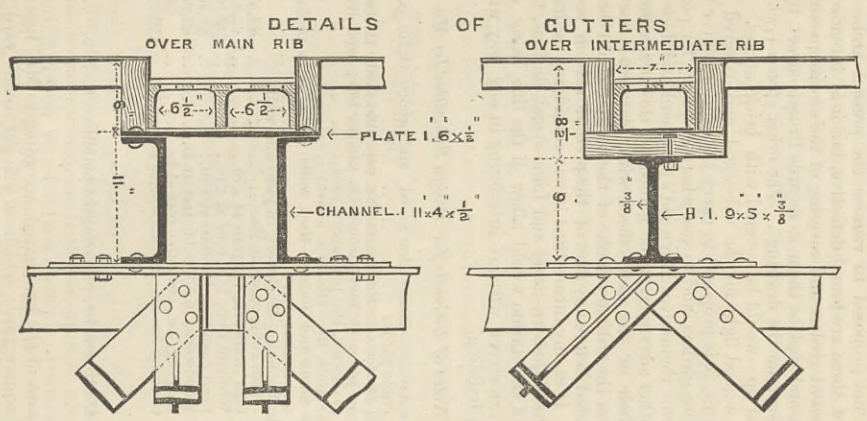
	£
New Arches.—Excavation 1s. 6d. and brickwork 30s. per cubic yard	39,142
New Platforms.—Brickwork, 30s. per cubic yard; timber, 4s. per cubic foot; ironwork, £16 per ton; asphalted platforms, 10s. per square yard	13,493
Cab-stands, &c.—(Rates as above)	2,000
New Shops and Offices.—Back walls included in roofing and Arches	13,500
Main Roofing.—Brickwork in piers and walls, 2808 cubic yards at 25s. £3,510	
Cast ironwork, 782 tons at £10 £7,820	
Wrought iron, 1810 tons at £16 £28,960	
Lead flashings, 280 tons at £30 £8,400	
Woodwork, 16,575 cubic feet at 4s. £3,315	
Ridging, &c., 900 cubic feet at 2s. £90	
Glazing, &c. &c., 235,200 square feet at 13d. £12,740	
	64,835
	132,970
Contingencies, removing old buildings, &c.,	5,030
	138,000

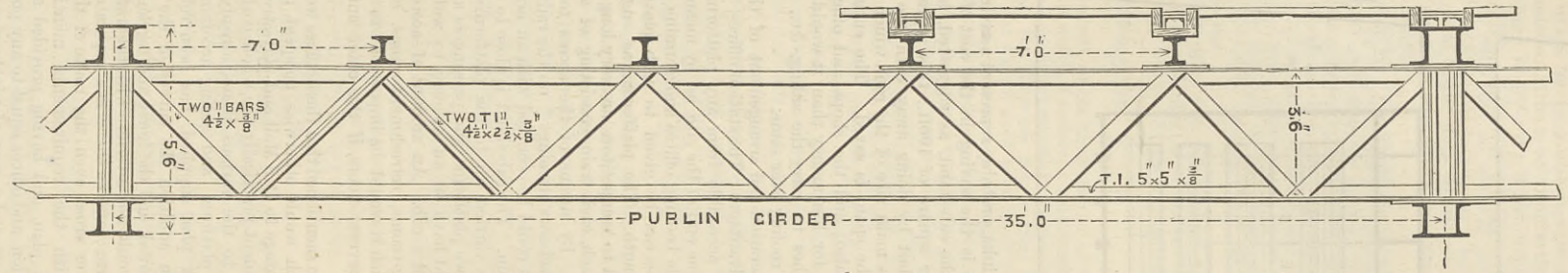
The area of the land saved, according to Mr. Lean's estimate, is 7700 square yards, which at £20 per square yard gives a sum of £154,000, which is more than the total cost of the station, even if an extra 10 per cent. is added to it, to cover fluctuations in the iron market and contingencies.

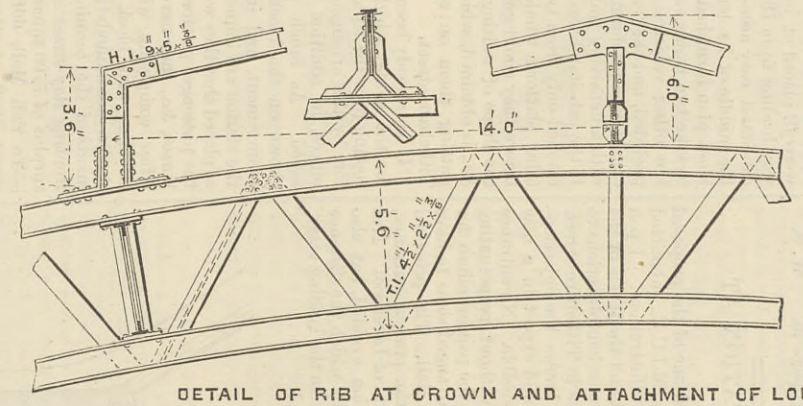
DESIGN FOR A NEW LANCASHIRE AND YORKSHIRE RAILWAY STATION IN LIVERPOOL.

MR. CHARLES LEAN, M.I.C.E., WESTMINSTER, ENGINEER.

(*For description see page 83.*)







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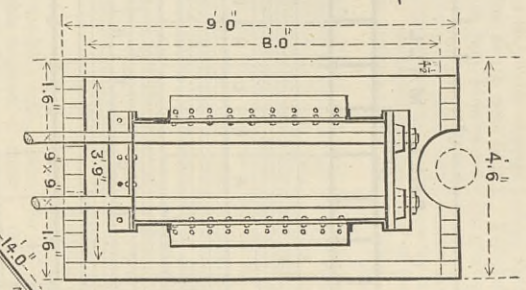
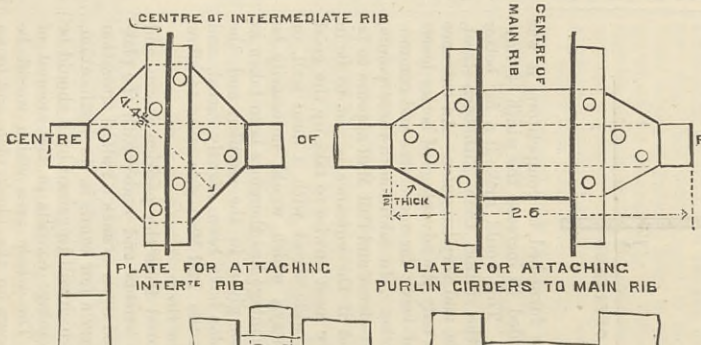
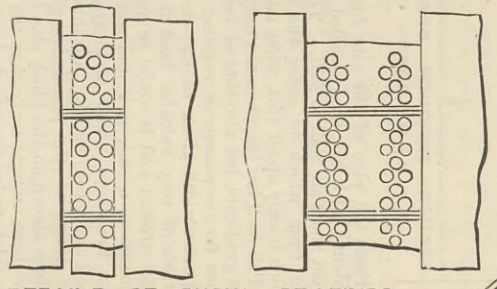
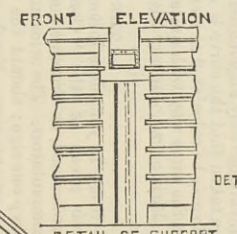
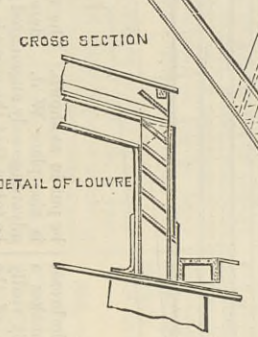


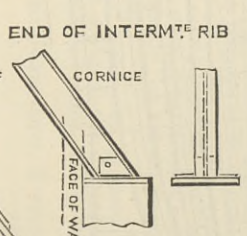


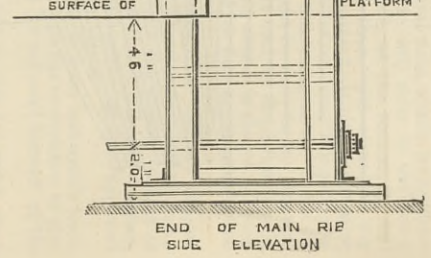


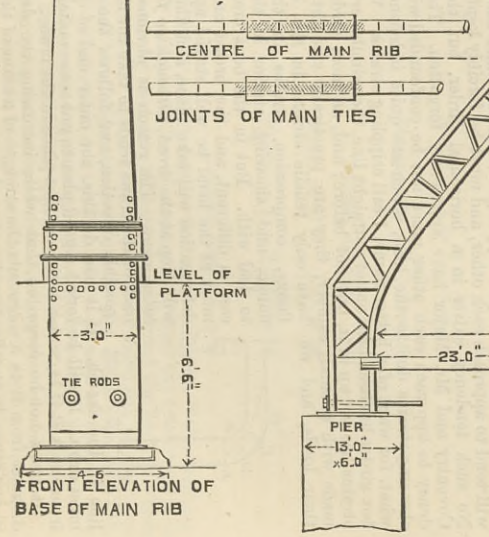
DETAILS OF SNOW CRATINGS











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*** *According to a reasonable request made by several of our friends, we have commenced the publication of an Index to the Advertisements which appear weekly in* THE ENGINEER. *The Index will always be found upon the last but one of our advertisement pages.*

TO CORRESPONDENTS.

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

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

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

A. S.—*We know nothing of the firm you name.*

A DRAUGHTSMAN.—(1) *Du Moncel's book "On the Telephone, Microphone, and Phonograph."* (2) *Fleeming Jenkin's "Treatise on Electricity and Magnetism."* (3) *Greenwood's "Iron and Steel"—Collins' Science Series.*

STRAINS ON CRANE POSTS.—*We have received a letter from Mr. Stokes which is devoted to contradicting the statements made by Mr. Major concerning his "change of ground." We cannot see that it is of the slightest interest to any one, save Mr. Major and Mr. Stokes, whether the former has changed his ground or not, and for this reason we do not publish Mr. Stokes' letter. We have seen, with great regret, that both Mr. Major and Mr. Coventry have yet much to learn concerning the courteous discussion of a technical subject. We have received from the latter gentleman a note on bowstring girders which is couched in terms which render its publication in our pages impossible. These correspondents have yet to learn, it would seem, that there are two sides to every question, and that arrogant assumption of superior knowledge carries no weight with it. The correspondence columns of* THE ENGINEER *have always afforded a clear arena for scientific discussion. We give our correspondents the widest latitude, but we must draw the line somewhere, and we insist that discussions shall be carried on in it with good feeling, and without manifestations of petulance, arrogance, and ill-temper.*

A PROBLEM IN ROPE TRACTION.

(*To the Editor of The Engineer.*)

SIR,—Will any of your kind readers help me in the following? I have an endless rope working 400 yards, and it is driven by being lapped three times round a 6ft. wheel, and at far end I have a weight weighing 12 cwt. to keep the rope tight. I purpose taking one lap off; what extra weight shall I require to keep it same tension? Rope ¾in. diameter. I would prefer it being shown in figures. BIT.

Mansfield, January 30th.

WROUGHT IRON PULLEYS.

(*To the Editor of The Engineer.*)

SIR,—In your issue of 27th we notice a correspondent signing himself "G. J. C." asks for informatfon respecting wrought iron pulleys. We trust we are in order in replying that we are the only makers of wrought iren pulleys of Rodgers's patent. These are made entirely of wrought iron—rim, arms, and boss—while all other wrought iron pulleys in the market have cast iron bosses. We have made them for a great many years, and have already supplied over 29,000. This fact alone shows the superiority of wrought iron pulleys. We have made pulleys light enough to drive a sewing machine, and others strong enough to transmit the whole of the power in a large factory. HUDSWELL, CLARKE, AND CO.

Railway Foundry, Leeds, January 30th.

GUN-METAL CASTINGS.

(*To the Editor of The Engineer.*)

SIR,—I am obliged by the replies of your correspondents, and conclude that the fault is with the gas generated in the loam by the heat of the metal, and that if it cannot penetrate and escape into the interior of the core in attempting to pass towards the metal which is still fluid, it bursts off the surface of the core in flakes as described, so that if this is the reason, the remedy is, as suggested by more than one of your correspondents, in so constructing the core that the gas may pass into its interior, but not the metal. "Foundry Manager" says, "If the loam be good," but does not give any information about the nature of good loam. Would not interesting and useful information be forthcoming if your readers who are up in the subject were to give their practical experience of different loams, such as the analysis, proportion of silica, alumina, &c., size of granulation, such as that in dry powder it should pass through a sieve so many meshes to the inch, mixtures and their method, proportion of hair or other additions, grinding, mode of application, thick or thin coats, slow or rapid drying, plain or other water used in mixing, localities from which good loams are obtained and their peculiarities, the construction and ventilation of large moulds and cores, &c. &c. Those who have had experience in casting large gun-metal screw propellers must have met with many interesting difficultise; the same may be said of statue founders. The few books published which include the subject give but meagre information to a practical founder, probably because the writer either has not gone into the matter himself, or thinks it too trivial. At Woolwich Arsenal I understand they use the same sand for loam as that used in the brass and iron foundry, but ground wet with hair, and it does not appear that the fineness of its grain affects the escape of the gas, although it might appear to do so.

January 31st. PNEUMATIC.

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

MEETINGS NEXT WEEK.

THE INSTITUTION OF CIVIL ENGINEERS.—Tuesday, Feb. 7th, at 8 p.m.: Paper to be read and discussed, "Candle Power of the Electric Light," by Mr. Paget Higgs, LL.D.

SOCIETY OF ENGINEERS.—Monday, Feb. 6th, at 7.30 p.m.: Inaugural address by the President for 1882, Mr. Jabez Church.

SOCIETY OF ARTS.—Monday, Feb. 6th, at 8 p.m.: Cantor Lectures, "Recent Advances in Photography," by Captain W. de W. Abney, F.R.S. Lecture II.—The effect of the spectrum on the different molecular forms of the silver haloids. Practical applications. Sensitisers considered. Sensitiveness of the different salts of silver. Sensitomers considered. Tuesday, Feb. 7th, at 8 p.m.: Foreign and Colonial Section, "Notes on the Trade Capacities of Newfoundland," by Mr. E. Hepple Hall. Wednesday, Feb. 8th, at 8 p.m.: Tenth ordinary meeting, "The Manufacture of Ordnance," by Colonel Maitland. Sir Frederick Bramwell, F.R.S., chairman of Council, will preside.

THE ENGINEER.

FEBRUARY 3, 1882.

OTTO *v.* LINFORD.

WE publish this week the full text of the judgments of the Court of Appeal in the case of Otto *v.* Linford. This decision is of the utmost importance, and should be read with care by everyone interested in inventions, patents, and patent law. It will be remembered that last vear Messrs. Crossley, of Manchester, sued, through Mr. Otto, a Mr. Linford, the maker of a gas engine which Mr. Otto asserted was an infringement of his invention. This case was argued at great length before Vice-Chancellor Bacon, and he decided for the defendant Linford, and thereupon Otto appealed. This appeal came on for hearing last week before the Master of the Rolls and Lord Justices Brett and Holker. The evidence taken at the trial was before the Court, and counsel were heard on both sides. The result of the appeal has been, it will be seen, to reverse the decision of Vice-Chancellor Bacon; and an injunction has been granted to restrain Mr. Linford from making or vending gas engines. This decision has a far wider range perhaps than appears at first sight. For some years great attention has been devoted to the invention and making of gas engines; within the last two years especially something like 250 patents have been granted for improvements in this class of machinery. There are several firms employed in their manufacture. Should it be found that these engines come within the decision of the Court of Appeal, the practical result will be that Messrs. Crossley will enjoy a monopoly of the construction of gas engines for several years to come. In a word, the verdict of the Master of the Rolls and his two brother judges may be found to affect a very large amount of capital, and even to deprive inventors who have worked hard and successfully, of the fruits of their labour. We do not say that it will. That is a question which remains for discussion.

The Court of Appeal has interpreted Otto's specification with great care; and no doubt exists as to what the judges, at all events, hold that it means. This is a great gain—it clears the ground. According to the Master of the Rolls—his fellow judges concurring—Otto patented the idea of producing a gradual explosion in the cylinder of a gas engine, and the means of applying the idea in practice. It was urged by Linford, be it understood, that Otto's patent was bad. The Court hold it to be good on two points, but these cover much. To explain them it is necessary to say that Otto secures the end he has in view by introducing first air, then a mixture of gas and air, into the cylinder, compressing the whole and igniting the mixture. In this way he claims that he gets a quiet or gradual explosion; but it is not quite clear to us how the result is brought about. A comparison was drawn with precision by Lord Justice Brett between Lenoir's engine and that of the plaintiff Otto. It was alleged by the defendant that Lenoir's engine was an anticipation of Otto's. From this view his lordship dissented. He deduced from Johnson's—Lenoir's—specification that Lenoir rather wanted to produce a violent explosion than the reverse; and that for this, among other reasons, it was not an anticipation. Otto says, according to the Master of the Rolls, "I am going to turn that which was a sudden explosion of gas," as in Lenoir's engine, "into a gradual explosion of gas, and I am going to do that by the introduction of what Otto calls a cushion of air in one place between the piston and the combustible mixture." It is evident that if this be what Otto says, he has misused words, and it will be seen in a moment that this misuse is not insignificant, but of great importance. Lenoir took into his cylinder at each revolution a mixture of gas and air, and exploded the mixture. Otto takes in first air and then a mixture of gas and air, and then explodes the mixture. Using an illustration employed by the Court in another way, Lenoir put a mixture of brandy and water into a tumbler and drank it; while Otto first half fills the tumbler with water and then adds to the water a mixture of brandy and water, and drinks the latter before it has time to mingle with the former. He does not propose to make the explosion *per se* less violent than it was in Lenoir's case, but he does propose to mitigate the effects of the explosion by introducing a cushion of air between the explosive and the piston. This last is the interpretation of Otto's patent by the Court of Appeal; but the Court nevertheless speaks of a gradual explosion, which is quite a different thing from the use of a cushion. The effect of this method of working is that, as is well known, a diagram is produced which shows a sudden rise of pressure at the beginning of the stroke, and a gradual falling away to the end. In fact, it somewhat resembles the expansion portion of a diagram taken from a steam engine with a leaking slide valve. Our readers will do well to peruse very carefully every portion of the ruiings of the Court of Appeal on this point; and they will find that throughout it is held that the quietude of the Otto gas explosion is due to the use of the air cushion, and that special force is attached to the statement that the mixture of gas and air is ignited at the place where it is richest in gas; but it is evident that the cushion could not in any way reduce the violence of the explosion *per se*, but only act as a buffer to take the shock off the piston. But it is not clear that this is what the Court held that Otto meant. It is at least certain that either Mr. Otto or the Court has spoken of the air as acting at different times as a cushion and a diluent. But in the original specification Otto says nothing about a cushion, but only that the air is introduced to neutralise the effects of carbonic acid gas, as pointed out by Vice-Chancellor Bacon.

We have now to consider how this decision may bear on other gas engines with quiet explosions. From what we have already said it will be understood that explosions are more or less quiet, other things being equal, according to the dilution of the mixture burned; but Otto lays no claim to the use of dilute mixtures. If now a gas engine was made in which the mixture was very dilute, there would be obtained comparatively slow combustion, which would proceed while the piston was travelling, and the diagram would be very similar to those got from an Otto engine. Would such an engine be an infringement of Otto's patent? It may here be stated that no mention whatever was made by the Court of Appeal to the fact much insisted on at one time, and no doubt true, namely, that mixtures of air and gas, which will not explode or burn at ordinary pressures will explode if the pressure is raised. It was at one time held that the great merit of the Otto engine was that, because of compression, it was possible to burn a far more dilute mixture of gas and air than could be managed by Lenoir, and that, for this reason, a great saving in gas was effected. Let us suppose that a gas engine is constructed in which no cushion of air is used, but into the cylinder of which a certain quantity of gas and air is drawn at each outer stroke from a gasholder or vessel in which they have been previously mixed; that this full charge is then compressed by the return stroke, and subsequently exploded. Will this engine be an infringement of Otto's? Now Sir John Holker has defined exactly in what way Linford infringed Otto, and we may take this definition as an answer to the question:—"When the machine which constitutes the alleged infringement is produced you find that it is apparently constructed upon exactly the same principle as this:—It is desirable to get a gradual expansion of the gases. In the alleged infringement you have a layer of air introduced between the combustible material, or the explosive material, and the piston. You have the explosive material then introduced, and at the densest or richest part, as it has been called, of the explosive material you have the means of firing. All that you find in the plaintiff's specification; indeed, it is the essence of his invention." Our readers can draw their own deductions.

Advancing a step further, we find that the Master of the Rolls held that the Court had only two claims in Otto's specification to deal with, namely, claim No. 1, "for admitting the combustible mixture with air separate from a charge of air or incombustible gas;" and claim No. 2, for "compressing by one in-stroke of the piston a charge of combustible and incombustible fluid drawn into the cylinder by its previous out-stroke, so that the compressed charge when ignited propels the piston during the next out-stroke, and the products after combustion are expelled by the next in-stroke of the piston, substantially as herein described." The Master of the Rolls adds, "The compression was old, but he—Otto—claims the combination of compression with his system of introducing air and this combustible mixture so as to make, as he says, a gradual explosion or increase of power. Now that is a perfectly intelligible invention." From this it appears that compression may be used, and that so long as the air and gas enough to fill the cylinder are mixed before they enter it, they may be used; and further that both may be used in combination without infringement. The question then arises, is such a combination likely to be useful?

It has never been conclusively shown that cushioning such as Otto claims does take place in a gas engine. Yet it would appear that this action is the very essence of his invention. The contention that a well-defined line of demarcation existed between the air and the explosive mixture was abandoned by Mr. Aston when the case was heard before Vice-Chancellor Bacon; and it seems difficult to believe that mixture does not occur, considering how violent is the agitation that must be produced in the cylinder during the return or compressing stroke. Lord Justice Brett dwells on this point, and explains very lucidly what he believes to take place: "He—Otto—then points out the means by which he intends to obtain that gradual expansion; and it is really by introducing, first, next to the piston, simple air—pure air—and then a combustible mixture after that. Now having done that, it is obvious to my mind that he does not mean that those two strata are to remain absolutely and mathematically distinct. The moment the combustible mixture is introduced behind the air it will begin, where it is next to the air, to impregnate itself, as it were, into the air. But then, before it can do that, there having been air next to the piston, he fires the combustible mixture at the opposite end from where it touches the simple air, and by that means he gets what he calls a gradual explosion." A very large class of gas engines which do not use compression, or air and a mixture of air and gas in combination, will remain practically unaffected by the decision; and it is all events satisfactory that compression is left open for adoption by all the world of gas engine makers. It will be seen that after all the limits within which alone Otto's patent is valid have been very sharply defined, and it may, we think, be found quite possible to continue the manufacture of many excellent engines without risk.

Nothing can exceed the lucidity and good sense of the opinions expressed by the Court of Appeal on the construction of patent specifications. In interpreting them we are told that the common sense of the reader must be used. It is well understood that a specification must be so complete that the thing patented can be made from it; but on the other hand, it is not to be supposed that a specification must be competent to instruct persons who know nothing about the subject of it. Specifications are supposed to be written for trained understandings. "I think," says the Master of the Rolls, "that when judges have to deal with an important invention, they should not be astute in finding defects

in the specification." In this we fully agree with his lordship. The Master of the Rolls brushed aside as unworthy of notice the objection that Otto's specification was bad because there were certain omissions in the drawings. He sets his face against the red tape interpretation which is too often put on the wording of specifications. With this decision, we believe the mind of many an inventor and patent agent will be made easier. The construction of a specification will no longer seem such a weighty matter as it has hitherto appeared; but it must not be hastily assumed that anything will do for a specification. The words used by the Court bear no such construction, but only that so long as a specification is intelligible to a skilled reader, it does not much matter whether it is intelligible to the general public. It is quite possible to draw a specification which even an engineer may not understand.

We have endeavoured to set forth one or two of the more prominent features of this most important decision, but it would be useless to dilate at much greater length upon it. It will bear and demands careful study as the thoughtful utterances of three of the most able and experienced lawyers of the day. We hope that the Patent-office authorities will have bound up in a convenient form for reference a complete set of all the papers, minutes of evidence, &c., used in the case from the first day of hearing by Vice-Chancellor Bacon. They will prove invaluable for future reference. A very full illustrated report of the case will be found in The Engineer for April 1st, 1881. Whether Mr. Linford will or will not remain satisfied with the decision remains to be seen. He may if he sees fit carry the case to the House of Lords. If the decision of the Court of Appeal be acquiesced in or affirmed it will be practically impossible to dispute Otto's patent, and no attempt worthy of the name has been made to show that Linford's did not resemble it closely. In fact, if Linford's defence had succeeded, it might have gone far to invalidate his own patent. Whether the interpretation of the Master of the Rolls and Lord Justices Holker and Brett is the right one or not will be questioned; but of its utility there can be little doubt. Messrs. Crossley have won it is true, but the territory they have obtained is very strictly defined, and much will probably be done now by other gas engine makers which they would hardly have attempted before.

INVENTORS AND INVENTIONS.

In a former article we considered, under the guidance of M. Poillon, the inventor and his inventions, taken by themselves, and without reference to other parties. We will now look at him in his relations, first to the manufacturer who is to give his discovery a bodily shape, and secondly to the agent who is to make its existence and its value known to the civilised world. What are the duties of the former of these gentlemen, whom, following our guide, we may call for brevity's sake the constructor? He has first, as we have said, to give to the invention a bodily form, and one under which it will work to satisfaction; and secondly—often a much harder task—he has to do so at such a cost that it can be sold at a profit under fair ordinary conditions of trade; for to rely on novelty or fashion to keep up an exorbitant value for any article is a most unsafe course. The constructor stands then to the inventor in somewhat the same relation as the tiller of the soil to the landlord, and his joint interests demand quite as careful and generous consideration.

Looked at from this point of view, what are the qualities which should decide an inventor in placing his interests in the hands of Mr. A. rather than of Mr. B.? Our author has summarised them well. They are, first and foremost, straightforward honesty; secondly, a certain conformity of views and temperament, without which joint effort is sure to end in failure; thirdly, technical skill and experience in the particular branch of manufacture; fourthly, the habit of turning out good work; fifthly, ample resources in the way of capital and connection; sixthly and lastly, a firm faith in the invention itself, and in its final success. To this last quality we must add, however, the use of sound judgment and courage, which will enable him to tell the inventor at once if he sees that the enterprise is doomed to failure, and to refuse to spend any more of his own time and money upon it. This last qualification is one which no inventor can expect to possess himself; for him to give up his cherished faith in the future of his own discovery is well-nigh impossible; and it is therefore all the more important that he should secure a true friend who will do the thankless office for him. There is little need to enlarge on these various qualities; they speak for themselves. We may repeat, however, M. Poillon's earnest warning, to have nothing to do with the numerous gentlemen who, as we say in English, are "too clever by half;" and who understand all the tricks of the trade so well that they will neither make anything succeed themselves nor allow anyone else to do so. He also insists strongly on the habit of turning out good work, which, as he says, can be formed in a factory by nothing except the inflexible determination and constant watchfulness of the manager; but which, once formed, will show its effect in every article that leaves the shop, utterly irrespective of the fact whether it has been made at a profit or a loss. As to the number of his licensees, an inventor will do well, at least towards the commencement, to restrict himself to one or two at the outside. To make a new thing into a success demands great sacrifices of time and thought, if not of money, on the part of all concerned; and a constructor, if he has the qualities we have enumerated, is hardly likely to make these, unless with the prospect that success will give him some such reward as the sole licence of a profitable invention will confer. At any rate, without some such inducement he will hardly embark much of his own money in the enterprise, and the inventor is rarely to be found to whom this is a matter of indifference. It is no doubt better for him if he can secure two strings to his bow, but if so he must be able to pay all the costs of his shooting himself.

A very important question to be settled between the inventor and constructor is the selling price to be put on the article. As to this, however, very little can be said in general terms; it obviously must not be too high to prohibit the sale, but short of this it is as well to fix it as high as possible at starting, inasmuch as it is always easy to reduce but seldom or never to advance it. Moreover a good profit leaves scope and leisure for the improvement and subsequent cheapening of the methods of production. If an article is only just paying its way, nobody is likely to spend much money in new and improved machinery for producing it. We may, perhaps, be allowed, as non-inventors ourselves, to enter here our emphatic protest against the shortsighted and selfish cry that when some skilful inventor has enabled an article in common use to be made at a greatly reduced cost, the price ought at once to be lowered by a like amount, so that all, or nearly all, the advantage of the discovery should be given forthwith to the consumer; in other words, to the public in general, who have not contributed anything whatever towards the discovery, and will never, as individuals, really feel a sensible benefit from it. Could any more foolish way be devised of spending a fortune than by distributing it among the whole of her Majesty's liege subjects at, say, three-halfpence a head? Let the inventor reap his harvest while he can; the public will get theirs before long, and that a harvest on which they have bestowed no labour whatever.

With regard to the financial relations between inventor and constructor, the first care of the former should be that they are such as will give the latter a real interest in pushing on the work. An invention placed in hands that will not concern themselves with it is buried before it is dead. The arrangements for division of profits should therefore be made on a liberal scale, and should have regard to the time, thought, and money which each party has spent upon the enterprise. If the inventor, as he often delights in thinking, finds brains, the constructor finds plant, capital, and practical skill; and the latter class of possessions possess at least as high an intrinsic value in the world as the former. Again, in fixing the capital to be invested in the enterprise, it is quite as possible to err, especially at the commencement, on the side of excess, as of defect; and too much capital is no slight evil. Money, says M. Poillon, has to be paid like other things; and it is a very bad plan to pay it for doing nothing. Nor will much be gained by employing it in the furnishing of sumptuous offices, and in maintaining an army of clerks, even of the most distinguished appearance; dust to throw in the eyes of the public is, except in rare cases, a very expensive article.

With regard to competitors in the same line of business, M. Poillon's advice seems to be to leave them entirely alone. We should be inclined to go further, and say, if you possibly can, make them your friends. The internecine war which two rival inventors often wage with each other is much more harmful to both than it can possibly be advantageous to either. If there is much to be got out of the business, there is plenty of room for both of you; if little, it is far better to divide it than to tear it to pieces between you. A firm was once concerned with a very valuable patent relating, we will say, to the sheet iron trade. The cheapening of production was so great that all the makers of sheet iron became eager, sooner or later, to adopt it. But there was a competitor in the field who effected the same object by somewhat different means; and for some years the makers whenever they altered a mill, successfully played off one of these against the other, screwing down the terms of each in succession by threatening to call in his rival. Had the two but possessed the common sense to combine together, and make one purse, they would have had the trade at their mercy, and would have far more than doubled the gains which either of them succeeded in amassing under the system of competition.

We come now to the third and last part of our inquiry, namely, the relations between the inventor and his agent —"*vulgarisateur*" is the more lofty French title—in other words, the gentleman who undertakes to get his invention known, tried, and eventually bought. In very many cases this duty is undertaken by the constructor; but our author insists, and we think with justice, that this is usually a mistake. The two operations are quite different; they require a different character, different habits, different experience, in the men who undertake them. The constructor must be always at home, and have his soul wrapped up in his workshop: the agent should be continually roaming abroad, hunting up an order here, outflanking a competitor there, and making the invention known everywhere. It may be objected that the separation of the two leaves three persons to be satisfied out of the gains of the same invention; but if all three persons have contributed a share of the capital and energies invested, and if by their adopting separate departments their interests are prevented from clashing, we think this is an advantage rather than the reverse. What an inventor should aim at is, that his invention should make a profit for somebody; its exact division, when made, is not so vital a question. Of course this does not affect the case of many large works where one member of the firm attends to the constructive, and another to the commercial part of the business; this is often an excellent arrangement, but it leaves the fact the same, that the constructor and the agent are different persons.

Granted the existence of this agent, what are his duties? The first and most obvious is that of advertising. M. Poillon appreciates fully the present and future development of this great art, and looks forward to the time when advantage will be taken of every spring to print fresh advertisements on the leaves of the trees. But he observes that even advertising has its limits, and especially so in the case of mechanical inventions. It is no use advertising a new form of boiler anywhere and everywhere, like a new solvent for corns. The latter may appeal to anybody, of whatever rank or occupation; the former cannot possibly interest more than a few. Nor is it possible to describe, or even to exaggerate, the merits of an hydraulic rivetter in a couple of lines, as the American editor did with a new hair restorer, when he simply said he had tried it on an old nail-brush, and it brought out a fresh crop of bristles in less than twelve hours! All that the advertisement of a machine can do is to print its name, and that of its maker, firmly upon the mind of the reader, so that it seems familiar to him when he sees it subsequently on the outside of a pamphlet or a prospectus. The only other point to which it can successfully draw attention is that of cheapness in first cost. This is the only fact that comes home at once to the mind of the reader, and needs no explanation or embellishment. Where this important advantage is absent, M. Poillon prefers to profuse advertising what may be called the "paragraph" system—that is the insertion in the body of a newspaper of a short, pithy statement, giving a brief sketch of the machine, and dwelling upon some one chosen advantage which it possesses.

Of exhibitions and shows M. Poillon holds but a low opinion; he profanely calls them—at least those of provincial societies—"mere raffles for medals." Possibly English exhibitors at French exhibitions might be inclined to go further, and say that they are raffles with the dice loaded the wrong way for them. On the other hand, he highly commends official trials; but these are very difficult to command, and are practically unknown in England, except in connection with certain implements of war. Personal canvassing of buyers, according to M. Poillon, is of little use in comparison with the time which it absorbs. If you call on ten men in a morning, you will find that five were out, three were too busy to listen to you, and two listened without comprehending. This especially applies to canvassing by paid travellers, who for the introduction of a novelty, at least an engineering novelty, are almost worthless. With this we are inclined to agree, unless where it is possible to supply a small and cheap sample, as in the case of a new engine packing for instance; but, on the other hand, personal influence has, we are convinced, a very powerful effect if it is carried on in the right way, and by a salesman who is already known and liked by the prospective customer. "Men only buy from interest," says M. Poillon, "not from friendship;" and this may be true. But many men are much more easily led to think it is their interest to buy, when it is a friend who persuades them. Such work can, however, be done for any particular district only by a district agent thoroughly acquainted both with the article he has to sell and the persons to whom he is to sell it; and such a person, as our author observes, is most valuable when found, but most difficult to find.

The two best modes of pushing an invention, M. Poillon considers, are the letting out of machines on hire, or for purposes of trial, and the description of them in papers read before scientific societies, or inserted in technical journals, and afterwards reprinted for circulation. The former method he regards as involving too much trouble and risk to be resorted to, unless in cases where there is a real security that the machine, if successful, will be effectively taken up. The latter, though it can only be worked gradually and as circumstances admit of it, has perhaps the most powerful effect in proportion to the time and expense which it involves. When an invention has been thoroughly and satisfactorily tried in practice—and till then there is little good in pushing it at all—it is generally easy to get some engineering or scientific society to accept a paper upon it. It is then read and discussed; and if the opinions expressed are favourable—and that some at least shall be favourable the inventor can make sure beforehand—the report forms altogether a powerful testimony to the merits of the invention. When this has been published, the author can usually obtain at a cheap rate as many reprints as he desires for distribution in the form of pamphlets. Such a pamphlet, even if not studied or even read, hardly ever fails to make some impression on the mind of the recipient, and disposes him to think that at least "there is something in it." Next to this a good description in a high-class technical journal is the best alternative; but in that case there is lacking the appearance of having passed the ordeal of hostile criticism, which is given in the other. In preparing such publications, M. Poillon holds that the best plan is to make as much capital as you like out of the exaggerations of your competitors, but to steer quite clear of any exaggeration, much more any falsehood, on your own part. In inventions, even more than in most things, "the proof of the pudding is in the eating," and no amount of skilful puffing will bring an article into extended use, unless it proves on trial that there is real advantage in using it.

THE STRIKE IN THE IRON TRADE.

By far the most serious and immediate question for the manufactured iron trade of the North of England is the attitude of the ironworkers employed therein. They have held meetings at all the principal centres of the trade, and have passed unanimous resolutions against the sliding scale, and they are striking for a general advance of wages. The thing they cannot understand is that there should be so great a difference as 23s. per ton between present quoted prices and the realised prices of last quarter. This bewilderment is not confined to ironworkers. In fact, any and every person quite unacquainted with the trade would think the same way. Given the quoted price of a commodity, it is only natural to conclude that those who manufacture it have recently been obtaining that price for it. This would be true of most articles such as ironworkers and the general public are in the habit of buying, and to which their experience alone extends. It is not, however, the case with iron for shipbuilding purposes, which constitutes the bulk of what is now made and sold at the manufactured ironworks of the North. If, indeed, you wish to calculate the price which at any moment is being realised by an iron manufacturer, you must ascertain the quoted prices current six months before, making, of course, the necessary deductions for discount, commission, delivery, and so forth. The prices of six months ago may be higher or may be lower than present prices; but however that may be, they, and not present prices, are what regulate recent prices actually obtained. This peculiarity of the trade arises entirely from the necessity of selling about six months forward. Ships and bridges, which are the constructions using up the bulk of the iron made, require from six months to two or three years to build. The moment a contract is made

the builder buys his iron. He cannot afford to run the risk of the market, which would be the case if he did otherwise. And so the practice has arisen by which iron manufacturers must commit themselves for many months ahead. At the present time many thousand tons have been sold for delivery to the end of the present year, and some even to June 30th, 1883. If manufacturers were not to adapt themselves to the needs of the consumers, it would simply mean that the constructive trades could not be carried on; at all events in present hands, and under present conditions, and with them would disappear or would be transformed the manufactured iron trade. The secret, however, of prosperity in any business is for those who are concerned in it to adapt themselves as completely as possible to the wants and peculiarities of their customers. If, therefore, the ironworkers were to succeed in forcing their employers to sell only from hand to mouth, they would probably also succeed in forcing them to such a condition that they would cease to pay wages at all, and what object would at best be gained? Merely that obtained prices should more closely follow quoted prices. There would be no solid benefit to ironworkers in this. It is not as if six months had no end. In six months' time from now wages, if the sliding scale continues, will be proportionate to present quoted prices. The benefit will certainly be obtained by workmen if the higher prices are realised by employers. It is only a question of waiting till they are realised. It is questionable, however, if the reasoning powers of the ironworkers generally are sufficiently developed to enable them to understand an explanation such as the above. Quoted prices they watch daily; realised prices they only know once a quarter. The former, which are a guide for the future only, they persist in taking as a guide for the present and even for the past. It is difficult to know what is to be done to obviate a difficulty of this nature, which must recur every time the market rises quickly. These men will not look back and cannot see forward. What they apparently would like, and what might satisfy them if practicable, would be to pay each week wages proportionate to the prices actually obtained by their employers during that week. This, however, would certainly not be practicable. It is easier to imagine than to describe the uproar there would be at the pay-office window, supposing during a particular week some old low-priced contract had of necessity been worked on after the advent of higher prices generally. Continual explanations would have to be made to men incapable of understanding them. This would result in incessant misunderstandings and frequent ruptures, with the consequent loss of wages on the one side and profits on the other. It is possible that the periods if ascertained might be shortened in any future sliding scale with advantage. They might be made monthly perhaps instead of quarterly. This would cause more trouble to the accountant and more expense in remunerating him. But that need scarcely be considered if it resulted in securing that wages varied more immediately and closely in accordance with the actual condition of trade, and with the expectations of the recipients. The men who are out on strike number at the time of writing about 6000. If the strike continue, it will become of larger proportions, because the workmen at many places have given in a formal notice to terminate their engagements. Some of the workmen ask for a large advance, in addition to the return of the 7½ per cent. which has been taken from them. On Tuesday night the men at Stockton, West Hartlepool, Hartlepool, and other places, came out on strike. The standing committee of the Board of Arbitration met on Wednesday afternoon, and determined not to consider the matter unless the men would return to work.

DEVELOPMENT OF A NEW COAL-FIELD IN SOUTH YORKSHIRE.

THERE now seems to be every probability of a large and important coal-field between Hemsworth and Hukleton, in the South Yorkshire district, being developed. A limited company, with a capital of £100,000 in £100 shares, has been formed to finish and work the South Kirkby Colliery, which has heen to a great extent lying dormant since the early part of 1879. The colliery, which was sunk on the estate of the Rev. John Allott, will when completed form one of the finest concerns in South Yorkshire. It was started by the Rosedale and Ferryhill Iron Company, which suspended payment in 1879, with liabilities amounting to £280,000. Two splendid 15ft. shafts 150 yards apart were commenced within a short distance of the Doncaster and Wakefield Railway. At the time of the stoppage of the company no less a sum than £76,778 had been expended on the plant. One shaft was sunk through the Barnsley nine-feet seam, which was met with at a depth of 639 yards. The other shaft had reached a depth of 130 yards, and had to a great extent been lined with metal tubbing. The company, of which Mr. J. Shaw, of Darrington Hall and Featherstone Main Colliery, is the chairman, has already advertised for tenders to sink the unfinished shaft to the coal. Mr. Thomas Cooper, of Rotherham, colliery proprietor, is appointed manager. The surface plant, which is of the most modern construction, embraces all kinds of workshops, and a massive engine-house with two fine winding engines made by Messrs. Davey Brothers, of Sheffield, each of which is of 120-horse power. The minerals leased comprise 1700 acres, and date from February, 1874, for a period of sixty-four years. As previously stated, the shafts are sunk in the heart of a virgin coal-field measuring something like eighty square miles, and within a short distance of the new Hull and Barnsley Railway.

WAGES SCALES FOR MANUFACTURED IRON.

IN more than one of the localities where the manufactured iron trade is extensively carried on there is just at the present time agitation as to the renewal or otherwise of the sliding scales that have for some time regulated wages. In the Staffordshire district the dissatisfaction seems to be with the basis of the scale. In Cleveland, on the other hand, it appears rather to be with the results. The general principle of the scale does not seem to be attacked, but the carrying out of that principle does not appear to have been satisfactory. And yet there is no reason why this should not be the case. Of all industries, the manufactured iron trade should be the one where the principle of the sliding scale should be best known, and where the results should be best estimated. For many years the practice has prevailed of wages varying with the selling prices of iron, and the formula has become almost proverbial in some parts of the country, though it varies from "shillings to pounds" to "shillings to pounds and a shilling over." Again the system of sliding scales has been often put into practice for short periods in Cleveland and Staffordshire, and once in the two districts unitedly. Hence its working should be known, and there should have been such an experience that the dissatisfaction that is now existing should not have arisen. In regard to the results of the working, it needs to be repeated for the benefit of the Durham workmen that the scale follows the market quotations at a distance only, and that the fact that there is no increase in the prices for the past quarter is not to be wondered at when it is borne in mind that contracts for plates and other kinds of iron are made for long periods—often for six or twelve months. It is tolerably certain that at the end of the quarter now entered upon there will be an increase in the average prices of iron, and that sufficient to give higher wages. The policy, then, of the Durham ironworkers should be to work steadily on for the current quarter, and to endeavour in the meantime to improve the basis of the scale which will in the course of three months expire. Hitherto, one of the evils of the attempts to adopt the system has been that the scales have been tried for so short a period, so that the workmen have scarcely experienced the full benefit. A prolongation of the system over a few more years would enable its benefits to be reaped by the employed, and would alter materially the views with which some of the workmen now regard it. The system of defining the rate that wages should receive by the price of the product of the labour is in every way sound, though it is not to be expected that the first or second attempt to define the exact proportion will be successful. It is only by the experience of the past that a more perfect scale can be made—that is to say, one that defines with greater skill the proportion of the increases or the decreases in the average price the workman shall receive or yield. A patient working out by experience of these principles will give good results to both employers and employed.

LITERATURE.

Transactions of the Liverpool Engineering Society. Vol. I. The Institution, and H. Young. Liverpool. 1881.

THIS is the first volume of the "Transactions" of a young but active society, and its contents show that although the leading literary engineering work will ever remain with the central representative institutions in London, a great many really useful papers may be communicated to and valuable work done by well-conducted societies in the large engineering centres of the country. The Liverpool society was started by six pupils of Mr. G. Fosbery Lyster in 1875 as the Liverpool Engineering Students' Society, and weekly meetings were held, but as the few members could not keep up the supply of papers fortnightly meetings were afterwards held. In 1877 the word "students" was dropped from the name of the society, the number of members having increased. The number now is one hundred. A considerable number of papers was read by the young society, but the "Transactions" commence with a paper read in January, 1877, by the editor, Mr. W. S. Boult, "On Walls in Portland Cement Concrete, Low-water Basin Conversion, Birkenhead." This paper describes the use of concrete in the works for closing the river entrance of the low-water basin at Birkenhead in order to convert it from a basin into a wet dock. The volume contains sixty papers in its 288 pages. The general contents of many of them have been briefly given in our columns from time to time, but some of them are of more interest and value than would appear from the very short notices we have published. Amongst these are the paper "On the System of Sluices at the New North Works of the Canada Basin," by A. G. Lyster; "On Portland Cement Concrete," by W. S. Boult; "On Hydraulic Machinery," by A. Ross; "On Transatlantic Lines of Steamships," by A. J. Maginnis; "On the Permanent Way of Railways," by A. Ross; "On Storing Water," by T. Duncanson; "The Use of Cast Iron in Engineering Structures," by J. S. Brodie; "Notes on Sewers and Sewerage," by E. H. Albis; "Sinking a Shaft Under Exceptional Difficulties in Cheshire," by W. C. Fagan; "On Sewerage," by O. S. Pilkington; "On Earthworks and the Steam Excavator," by H. O. Baldry—abstract only. Of many of the papers an abstract only is given. Sixteen sheets of lithograph drawings illustrate the papers. The printing is well done, and the type and arrangement are good, the titles and other particulars being of the same character as those of the "Proceedings" of the Institution of Civil Engineers, but with the advantage that the subjects treated in the papers are given by numerous sub-heads. An index is not, however, supplied, but only a table of contents. If information is to be gained and exchanged by the reading and discussion of papers, it is evident from this volume that the Liverpool society has the means at its disposal.

THE CHANNEL TUNNEL.

AN ANSWER TO "PUNCH."

IT is all very well to be praising in verse
Any great engineering accomplishment won,
But it seems to be almost the very reverse
If you praise up a project that cannot be done.

Even so with a tunnel from England to France,
Which I see Mr. Punch in his fancy has made;
Adding strides to our known scientific advance,
And thus leaving all former great works in the shade.

Only please, Mr. Punch, will you crack me this nut,
Just before I decide upon taking a share?
With full ten miles of drift, and one end of it shut,
What will miners do then for a breath of fresh air?

J. B. S.

NAVAL ENGINEER APPOINTMENTS.—The following appointments have been made at the Admiralty:—Chief Engineers William Bryan, to the Asia, additional, for torpedo instruction on board the Vernon; and John Pearse, to the Asia, additional, for service in the Cyclops, vice Bryan. Engineers James S. Gilbert and Richard T. Serle, to the Indus, additional, as instructors of machinery of torpedo boats, vice Harris and Cole; William Mooreto the Lord Warden, additional, for service in the Foam, tender, vice Rose; and John A. Cock, to the Agincourt, for temporary service, vice Jeffery.

NEW FLOATING DOCK FOR VLADIVOSTOK. — Messrs. Clark and Stanfield have just completed, at their works at Millwall, the first portion of a large depositing dock for the Russian Government, for use at the port of Vladivostok. This first part will be able to dock and deposit vessels of about 1850 tons displacement; but the entire dock will be able to accommodate vessels of nearly 8000 tons, and it can at any time be extended so as to lift and deposit vessels of any length or breadth, and of as much as 20,000 tons dead weight. The outrigger of this dock is fitted up to be used as a floating workshop. It will be covered by a galvanised iron roof, and provided with machinery driven from a line of shafting worked by one of the dock engines. This will enable disabled vessels to be very rapidly repaired.

THE INSTITUTION OF MECHANICAL ENGINEERS.

THE early annual meeting of the Institution of Mechanical Engineers took place in the hall of the Institution of Civil Engineers on Thursday and Friday evenings, the 26th and 27th ult. On Thursday evening, after some preliminary business, referring to the annual report, Mr. E. A. Cowper acknowledged in suitable terms the honour that had been done him in making him president of the Institution, and the generous help he had received at the hands of the members and Council, by which he had been able, he hoped, to maintain the position of the Institution during his term of office. He was one of the oldest members of the Institution, and had always taken great interest in it, and he hoped that now he vacated the chair in favour of Mr. Westmacott, it would be found that the Institution had thrived in every way during his period of office. A vote of thanks to Mr. Cowper was proposed in eulogistic terms by Mr. J. Head, and seconded by Mr. Crampton, and the chair then taken by Mr. Westmacott, the president elect, who, in a few well chosen words, acknowledged his appreciation of the honour conferred upon him by the Institution and of the responsibilities which belonged to his office.

The following list of officers newly elected was then read:—President, Percy G. B. Westmacott, Newcastle. Vice-presidents:—I. Lowthian Bell, F.R.S., Northallerton; Geo. B. Rennie, London; Charles P. Stewart, Sunninghill. Members of Council:—William Anderson, London; Thos. R. Crampton, London; Francis C. Marshall, Newcastle; John Penn, London; E. Windsor Richards, Middlesbrough; William Richardson, Oldham. Remaining in office—Past Presidents:—Sir William G. Armstrong, C.B., Newcastle; Sir Frederick J. Bramwell, F.R.S., London; Edward A. Cowper, London; Thomas Hawksley, F.R.S., London; James Kennedy, Liverpool; John Ramsbottom, Alderley Edge; John Robinson, Manchester; C. William Siemens, D.C.L., F.R.S., London; Sir Joseph Whitworth, Bart., Manchester. Vice-Presidents:—Charles Cochrane, Stourbridge; Jeremiah Head, Middlesbrough; Francis W. Webb, Crewe. Members of Council:—Daniel Adamson, Manchester; David Greig, Leeds; J. Hawthorn Kitson, Leeds; William Menelaus, Dowlais; Arthur Paget, Loughborough; Richard Peacock, Manchester; Sir Jas. Ramsden, Barrow; Joseph Tomlinson, jun., London; R. Price Williams, London.

The Secretary then read a paper by Mr. J. J. Tylor,

ON METERS FOR REGISTERING SMALL FLOWS OF WATER.

Mr. Tylor's paper, which had been postponed at three different meetings, commenced with a brief description of the chief water meters which have been used in this country and on the Continent, his object being to show how far the designs were effective in the measurement of small flows. The first of these was Parkinson's meter. This is an adaptation of Parkinson's gas meter, described in the Proc. I.M.E., January, 1851. It is necessary that this meter should be placed on the highest point of the house service, which is objectionable. The meters are, however, very reliable, and are capable of registering a very small flow of water with exactness. Kennedy's meter was next explained. It was described in the Proc. I.M.E., 1856. It consists chiefly of a cylinder, in which a piston, packed with a rolling ring of india-rubber, works upwards and downwards, each stroke of the piston being recorded on an index by means of a rack on the piston-rod driving a pinion fixed to a tumbler. According to Mr. Tylor, the working of this meter was not satisfactory. Frost's meter, described in the Proc. I.M.E., 1857, consists of a piston, fitted with leather buckets, working in a cylinder, the reciprocating motion of the piston being caused by a double set of ported slide valves. The mechanism is more complicated than Kennedy's, but the meters weigh much less, and are quieter in action, registering with great accuracy at high and low velocities as long as they are in good order. To this, however, as to other piston meters, frost is a dangerous enemy; and the expense of repair is great in such cases, because the cylinder is usually the part

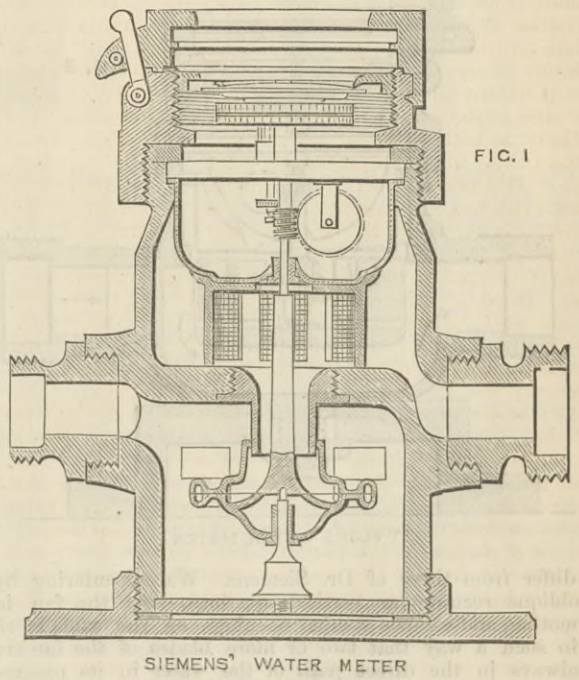


FIG. 1

SIEMENS' WATER METER

which gives way. The water-power consumed is not always inconsiderable at quick speeds, and if no water passes through the meter for several weeks the piston is apt to stick. These meters are also noisy in action, and the flow somewhat intermittent. For these reasons they are not so well

adapted for small flows or for domestic purposes as inferential meters. Siemens' turbine meter was next referred to. This was brought out in two forms, one (Proc. I.M.E., 1853, 1856) consisting of a vertical Barker's mill or reaction turbine, the other a turbine driven by water entering at the circumference of the wheel and finding its way out at the centre. The latter form was first tried in practice; but the author describes them as useless for measuring small flows, though reliable for large flows. The makers in England of these meters appear to have definitely adopted the reaction turbine, in which form this water meter has come into very extended use both in England and abroad. The modified construction of this meter, as shown in Fig. 1, includes a reaction turbine, rotating on a steel-shod pivot, provided with means of lubrication. The water enters at the upper part of the wheel, which at the point of entrance has its neck suddenly contracted, so as to form a more or less water-tight joint with the stationary neck conducting the water to the wheel. The water, passing downwards to the larger and lower portion of this pear-shaped drum, makes its exit into the case or meter box through contracted tangential openings. The friction of the water in these openings, as well as the resistance of the more quiescent fluid in the case, causes the drum to revolve. Vanes

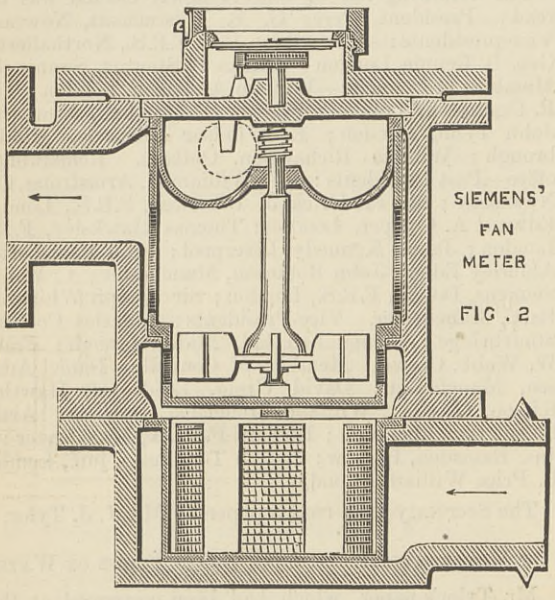


FIG. 2

project from the moving drum to make the increase in velocity proportionate to the increase in the velocity of the water. Any leakage at the neck allows water to escape without measurement. The bearings at this neck cannot be made long or very close-fitting, as the friction of the drum is a very important element when small flows have to be measured. The neck, being of considerable diameter, is liable to set fast if the meter remains unused. The correct action of the drum does not, however, depend on its exact fit into the outer case, so that considerable wear of the toe-piece, or vibration through the wear of the bearing, does not much affect the registration, or stop the drum by causing contact with the case. Siemens' fan meter differs from the former in the substitution of a wheel with blades for the reaction turbine, as shown in Fig. 2, in which wheel is driven by the impact of the water through oblique circular apertures in the casing, and the water, after setting the fan in motion, passes upwards towards the exit. The projecting plates shown are altered in size as required for regulation. This meter is largely used on the Continent though little known in England, and proves successful when carefully made. For small flows this meter has an advantage over the other design, because in the absence of the turbine neck all water has to pass the blades of the fan, and so produces an effect on the registration as long as the quantity passing is sufficient to move the fan at all. The author then described Tylor's meter. This, like the last, consists of a fan revolving in a case, Fig. 3, but both fan and case

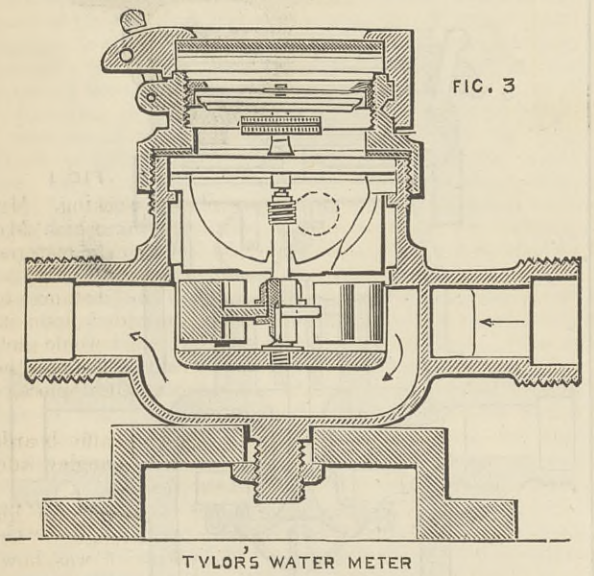


FIG. 3

TYLOR'S WATER METER

differ from those of Dr. Siemens. Water, entering by oblique rectangular vertical openings, sets the fan in motion, and escapes at other openings on the same level, in such a way that two or more blades of the fan are always in the direct path of the water in its passage through the meter. The fan itself consists of a solid wheel made from a strong preparation of india-rubber of about the specific gravity of water. It is provided with blades or teeth, which in some cases, especially for the larger sizes of meter, are made of brass. In that case the shoulder, where the blade joins the boss, is placed at an angle to the axis of the spindle, so as to tend to lift the fan at the higher velocities, and thus avoid wear of the toe-piece. The same end is obtained in the india-rubber fan by its low specific gravity. The toe-pieces are made of bronze. The

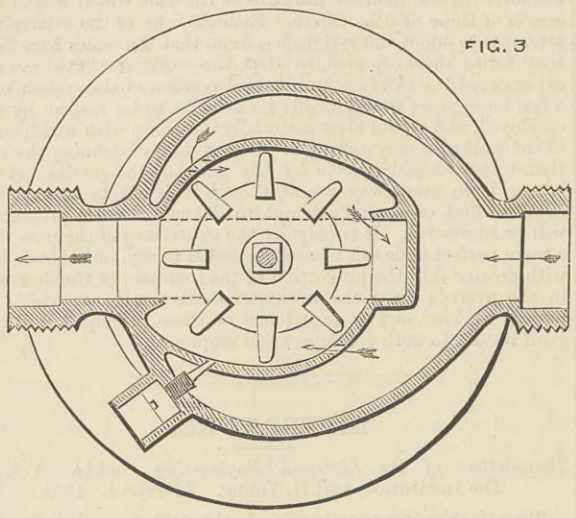
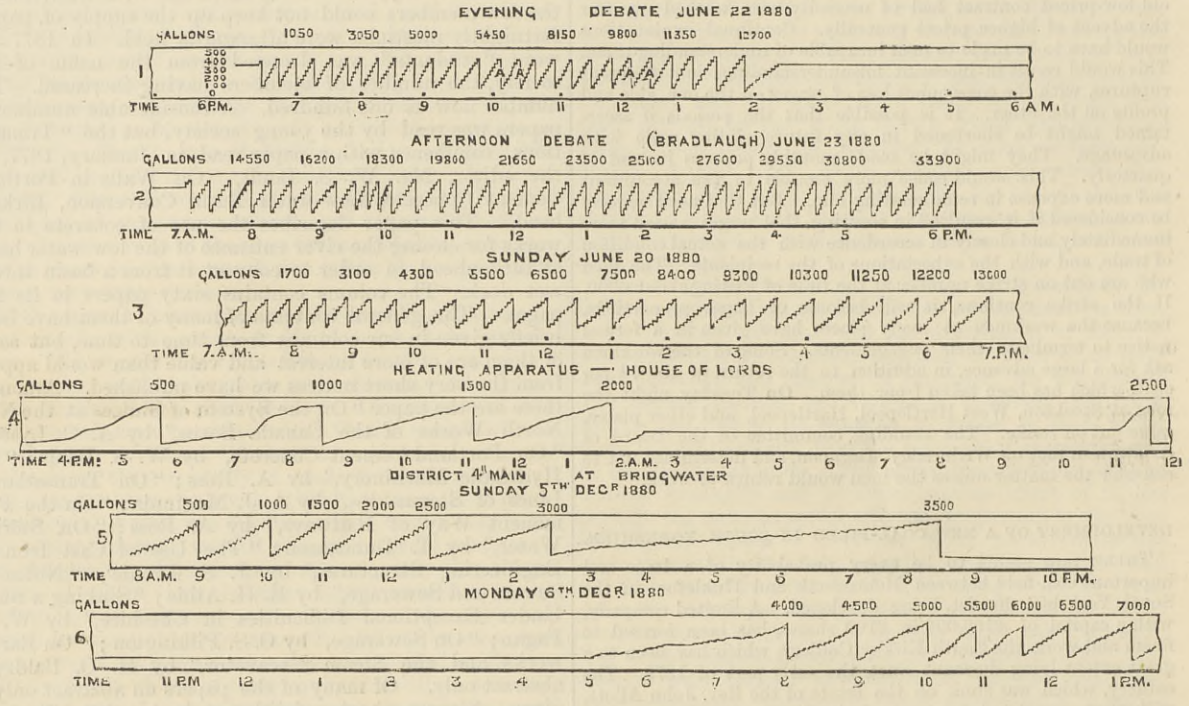


FIG. 3

SECTIONAL PLAN OF TYLORS METER

fan only approaches the case at four points, namely, where the water comes in and goes out, and at the projections. The object of this form is to prevent choking by sediment or rust, and also to prevent the current of water from continuing to turn the fan after the source of supply is shut off, partly by the *vis viva* of the fan, and partly by a



water current continuing for a time to revolve in the lower part of the case. The projections in the case regulate the velocity of the fan. There is an appliance for regulating the speed of the fan by a counter current of water, so arranged that it is adjustable from the outside of the case. The defect of the meter is that, like all rotary meters, it is liable to pass a certain quantity of water without registration, but this quantity can be limited to an amount comparable with the minimum registration of piston meters; but at the expense of rendering the meter too delicate for use in corrosive water. The author drew attention to the great influence of Dr. Siemens' invention on the introduction of rotary meters.

In practice abroad, where rotary meters are mostly employed for domestic supply, a meter having moderate accuracy with very small flows is found the most advantageous. Cisterns are not in use, and the consumer cannot therefore conveniently defraud the company by allowing the water to trickle slowly. As a matter of fact, it is certain that in ordinary use the quantity of water drawn at very slow speeds, in domestic supplies, is very small. Accordingly in Russia, Germany, Austria, Italy, and France, the rotary meters described in this paper are used almost exclusively for domestic supply, and the payments for water are collected according to the registration of the meters. If meters are to be employed for domestic service, it will be necessary to register small quantities. The experience of the Continent proves that there is no difficulty in registering small quantities, whether with a rotary or piston meter, provided they are not drawn at a very slow speed. Here the author gave several tables showing that the records of some rotary meters were practically the same as piston meters; and afterwards proceeded to point out the great advantage of meters as a means of preventing waste, and thereby of increasing the efficiency and diminishing the cost of the service, under whatever system that service may be administered. If the water companies were willing to grant supply by meter instead of by rate, there would be no difficulty in arranging existing meters to fulfil any conditions necessary. He then referred to the system introduced by Mr. Deacon at Liverpool, with his waste-water meter, and carried out by Mr. Muir, of the New River Water Company, and other engineers, and gave a description of an apparatus for the same purpose, which has been applied by the author to the existing Tylor meter. The average gross income of all the London waterworks is at the rate of less than 7d. per 1000 gallons, and the trade supply is about one-fifth of the whole. The author suggests that if the water rates were raised by a charge of 1s. per 1000 gallons of measured water, divided into average charges of 6d. for trade and 1s. 2d. for domestic purposes, it will be seen that the water companies of London would —if waste in the mains were limited to 8 per cent.—obtain additional profit to the extent of 4d. per thousand gallons supplied. On the other hand—as indicated by one table—even the most extravagant consumer would for an efficient supply pay less than he now does, as long as his fittings were in good order; and if his fittings were out of order, he, and not the water company, would pay for the wasted water.

Some tables attached to the paper showed that domestic consumption is in some fully occupied houses as low as 5 gallons per day, and seldom more than 15.

Mr. Tylor exhibited several specimens of the meters he described, one being fitted with the recording apparatus such as that with which the accompanying diagrams were made. The vertical movements of the pencil were, he remarked, made by the flow of the water, and the descent of the pencil caused by the liberation of the pencil by the meter. He made some remarks on the teachings of these diagrams, and to the steadiness of the flow between eight and eleven o'clock. From that time the quantity increased as preparations for the mid-day meal were being made, but decreased after that time to a low flow. He spoke at considerable length on these diagrams, and of their value in locating waste and exceptional consumption, either in time or locality. Mr. W. Anderson gave the result of his experiments with a large number of meters made to select the best for the Antwerp water-supply. The Galasse meter was adopted for small supplies, and the Kennedy meter for large supplies. The Galasse meter consisted of two cylinders with ordinary slide-valves, the valve of one cylinder being worked by the piston of the other. The inferential meters he had tried gave irregular results; but the best he tested was the Tylor meter, the next being the Siemens meter. Respecting the movement of the meter after the drawing-off was stopped, his experiments indicated that this was compensated for by the time taken to get the meter into motion after flow commenced. The rotary meters were, he considered, very valuable for many purposes where small dimensions were necessary, but they were not as accurate as piston meters.

Mr. Hawksley remarked that the impulse meters described were from 100 to 200 years old, in one form or another; and he showed how it was that they always tended to move more slowly than the water going through them. He mentioned that the use of rotary meters gave rise to manipulation by which a householder having a cistern could diminish the record, by causing the flow from the supply cock into the cistern to be so slow as to be only just sufficient to give the total quantity required in the twenty-four hours. He thought rotary meters useful for rapid flows, but not for low velocities and small quantities. The cost of supplying the London public by meter would be exactly 50 per cent. of the entire cost of constructing waterworks without meters. That increase was so great that he did not think that we should in this country come to supply by meter. Mr. Hawksley described a number of meters, and mentioned their characteristics. He thought the introduction of meter measure supply would be materially detrimental to cleanliness. In Nottingham, with about a quarter trade supply the consumption had been reduced to 17 gallons per head by waste water meters and proper regulations not in any way troublesome to consumers. Mr. Newman gave the results of some experience in South America. At one place where rating by meter had been adopted by 2639 out of 4480 consumers by choice, the charge for water had gone from 23, the rate charge, to 39 the charge by meter. Different kinds of meters were used—Kennedy's, Tylor's, and Halske's being preferred. Mr. Rich said that in London inferential meters were used, but they were usually changed every two years, and he suspected that the registration at the end of that time was usually detrimental to the water company. He mentioned instances of the sticking of rotary meters, and many instances of the substitution of piston meters in their place—as in Paris and Brussels. A recent committee has decided that every Parisian householder must take water by meter, and four positive types of meter are admitted for their selection. He also suggested that these meters should be fitted to receive apparatus of a character similar to that of the steam

engine indicator, so that water companies or consumers should not be saddled with the cost of such numerous sets of clockwork, &c., which need, perhaps, only be used once every few months. Mr. Paget said that the objections which had been urged against supply of water by meters had years ago been urged against meter gas supply, but no one now argued that the companies or the consumers were robbed by their use. He had lately built his house in a town where the water supply was 40 lb. per square inch, and charged by rate. He proposed to pay by meter, but the company refused. He, however, found that a clause in the Company's Act required charge by meter if a water engine was worked by the water, and so he decided to put down a cheap water engine. Upon this being known, the company said Mr. Paget need not put down the engine, the water should be charged by meter. When Mr. Paget found at first that the company would not charge by meter, he got tenders for fittings and cisterns for paying by rate; afterwards he got tenders for supply by meter, and he found that it was so much less, that instead of 50 per cent. greater cost, as mentioned by Mr. Hawksley, for construction, &c., it would not be any more, if as much, because waste preventers, instead of having to be fitted to each water-closet, and other draw-off fittings, were not required, the waste, if any, being thrown on the consumer; and he thought that many companies would soon follow Paris example. Mr. Hawksley explained that Mr. Paget's cost was only that of the householder, and did not affect the accuracy of his statement of the cost of works of water supply, which might be put at £5 per head, and if the water company had to add meters the cost would add 50 per cent. to the capital without meters. Mr. Chaney referred to the difference of record by rotary and piston meters, and gave some figures indicating that in practice the percentage of error was greater or less with either kind of meter according to the rate of flow. Mr. Price Williams regretted the tone of Mr. Hawksley's remarks, and said that the supply per head in London ought to be only about 15 gallons, instead of about 27, as now appeared, and that this saving on the 6¾d. which the companies received per 1000 gallons would be 3d., representing a money saving of £639,800 per year, and this Mr. Williams seemed to consider a reason for settling with the companies, and paying the enormous sum proposed by the late Mr. Smith. Mr. E. A. Cowper remarked that a large proportion of the whole of the capital of a water company went in reservoirs, and supply of less water would not enable them to save much under this head. If waste could be prevented, the consumption would be reduced by about 50 per cent., but he did not see how the companies were going to save by putting in meters. Mr. Hawksley, in explanation, said the average cost all over England was 9d. per 1000 gallons, including dividends, interest on capital, &c., and the cost of pumping, even where coal was expensive, did not amount to more than a farthing per 1000 gallons for every 100ft. through which it was lifted. In London, taking the lift as 300ft., the cost would be but three farthings, out of a cost to consumer, including waste, of 7d., the remainder of the cost going for numerous expenses and interest on enormous capital. If consumption was so reduced at each house as indicated in the paper, the charge would have to be raised to something like 2s. 6d. per 1000 gallons, to pay even 5 or 6 per cent. on the capital. The discussion was then adjourned until Friday evening.

On Friday evening Mr. Chas. Hawksley and several other speakers referred to the quantity of water which a rotary meter would pass into a house with a large cistern, which could be gradually filled with a cock turned on only a dribble, which would not be recorded by a rotary meter. Mr. C. Hawksley mentioned that the Bridgewater water supply works were constructed for 20,000 inhabitants, and the cost was £2 per head.

Mr. Paget thought few people would trouble to manipulate their water supply cock to cause the reduction of the meter record when they would have to manipulate for a week to save 6d. Mr. Tylor, in reply, said that the consumption per head in Germany amounted to from 8 to 15 gallons, and most towns elected to be supplied by rotary meters, the companies paying for the meters in many cases. In reply to Mr. Rich, he remarked that the clock could be removed from his waste detector meter in a minute. He referred to the great saving in water which had been effected in Liverpool by Mr. Deacon's meter—in many parts of the town as much as 50 per cent.

A vote of thanks was accorded to Mr. Tylor for his paper, which had opened up an important subject.

A paper by Mr. A. A. Langley was then read on

THE BAZIN SYSTEM OF DREDGING.

This paper is a description of the construction and working of a dredger on M. Bazin's system, as used by the author for the past three years in dredging sand and other material in Lowestoft Harbour. The dredger is represented in its general features on the diagram, Fig. 1. The total length of the hull is 60ft., with 20ft. beam. In the after part of the hold is placed a horizontal boiler A, which supplies steam to a pair of inverted vertical engines B. These engines drive, through belts and overhead pulleys, a centrifugal pump C, which discharges into the open trough H. The suction pipe D of this pump passes through the side of the dredger, and then forms an elbow bent downwards at an angle of 45 deg. To this elbow is attached a flexible pipe E, 12in. in diameter and 25ft. long, made of india-rubber, with a coil of iron inside to help it to keep its shape. At the lower end of this pipe is an elbow-shaped copper nozzle which rests on the bottom, and is fitted with a grating to prevent stones getting into the pump, and stopping the work. The flexible tube is supported by chains that pass over the head of a derrick F, mounted at the stern of the dredger, and then round the barrel of a steam winch. By this means the depth of the nozzle is altered, as required to suit the depth of water. A man stands at the winch, and lifts or lowers the pipe as is required, judging by the character of the discharge from the pump. If the liquid discharged is very dark and thick the nozzle is too deep in the sand or gravel; if of a light colour the pipe must be lowered. The best proportion of water to sand is 5 to 1. When loose sand is the only material to be dealt with, it can be easily sucked up, even if the nozzle is deeply buried; but at other times stones interfere with the work, and the man in charge of the flexible tube has to be very careful as to the depth to which the nozzle may be buried in the sand. The pump is shown in Figs. 2 and 3. The fan is 2ft. diameter, and has only two blades, a larger number being less efficient. The faces of the blades, where they come in contact with the sand, are covered with flaps of india-rubber. Small doors are provided at the side of the pump for cleaning it out, extracting stones, &c. The fan makes 350 revolutions per minute, and at that speed is capable of raising 400 tons of sand, gravel, and stones per hour, but the average in actual work may be taken at 200 tons per hour. This is with a 10-horse power engine, and working in a depth of water varying from 7ft. to 25ft. The great advantage of this dredger is its capability of working in disturbed water, where the frames of a bucket dredger would be injured by the rise and fall of the vessel. Thus at Lowestoft bucket dredgers are used inside the harbour, and the Bazin dredger at the entrance, where there is sand and gravel, and where the water is more disturbed. The dredger does not succeed very well in soft silt, because, owing to its slow precipitation, it runs over the sides of the hopper barges without settling. Nor does it do for dredging solid clay. It gives, however, excellent results with sand and gravel, and for this work is much superior to the bucket dredger. The experience in working was then described, showing that a great many very discouraging failures preceded successful working, about a year being expended in getting good results.

Cost of Working.—The vessel or barge for carrying the machinery and pumps cost £600, and the contract price of the machinery and pumps was £1200. But before the dredger was taken over by the company the alterations before enumerated had cost about £300, bringing the total for barge and dredger up to £2100. In building a second dredger this might of course be greatly reduced. The cost of repairs for one month's working has been only £5. The contractor receives for labour alone 2⅛d. per ton, being at the rate of about 1¾d. for the dredging and ⅜d. for taking to sea—a lead of two miles—all materials being supplied to him. The consumption of coal is at the rate of about 1 ton for 1000 tons of sand dredged. At Lowestoft Harbour the total amount of dredging has been about 200,000 tons yearly, but this is now much reduced in consequence of the pier extension recently constructed by the author, which now prevents the sand and shingle from the sea blocking the mouth of the harbour. The total cost of working has been 2·572d. per ton, which with 10 per cent. interest on capital, ·240d., makes the total cost per ton 2·812d. The repairs to steam tug, hopper, barges, and dredger have averaged about 2d. per ton.

Before the discussion on the paper commenced, Mr. Langley remarked that attempts had been made to connect the engine direct to the pump of a Bazin dredger, but this arrangement failed, and the belt acted as a safety arrangement and prevented breakage by slipping, when the pump was choked in any way. A new lock was constructed near Lowestoft a short time ago, and the dredger pump was used to empty it; when half empty the men placed a net in front of the delivery pipe and caught a cartload of fish, many of which were uninjured. In the discussion Mr. Wallick, who had superintended the use of the dredger at Lowestoft, gave some of his experience there, and repeated the information and opinions given by Mr. Langley in the paper.

Mr. Ball, London agent for M. Bazin, said that as devised by M. Bazin the pump was placed below water level, so that the head of water outside should be utilised; but he—Mr. Ball—now placed the pump considerably above water level, as no specially-formed craft was thus necessary. He also described some of the steps by which he had arrived at the present arrangements of the whole plant, and gave some particulars of its working. Mr. Crampton asked some questions, in reply to which Mr. Ball said the longest distance they had carried the material was 1200 yards in two relays—namely, a second pump on a floating barge with special engine. The distance to which they could carry the material depended upon its character. Fine sand would travel well; mud would not, boulders would not, though gravel would. To give the water a rotary motion he had inserted a helical piece of angle iron, and so prevented deposition.

Mr. Chas. Hawksley suggested the use of baffle boards to cause the deposition of mud; but Mr. Langley said these had been tried without much success.

A vote of thanks was accorded Mr. Langley for his paper; and a paper was then read by Mr. Ellington, "On Hydraulic Lifting Apparatus." The discussion was, however, postponed to another meeting, and to this time we shall postpone a report.

A vote of thanks was proposed and seconded to the Institution of Civil Engineers for the use of the hall, and the proceedings terminated.

FIG.1

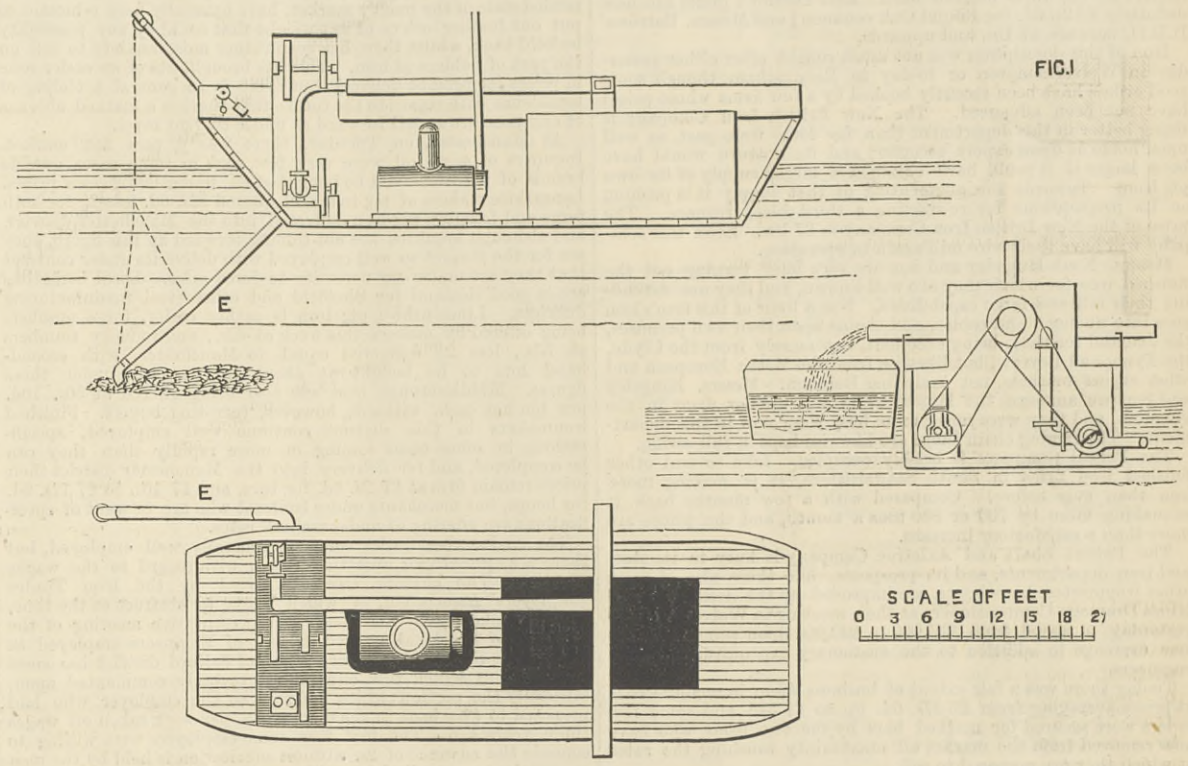


FIG.3

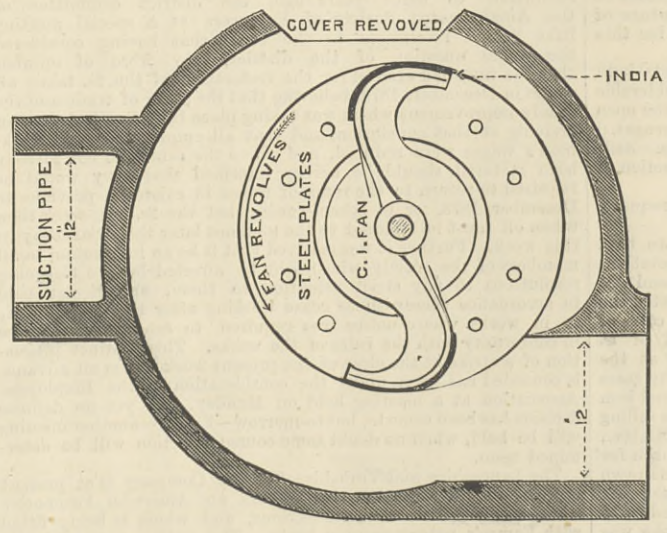
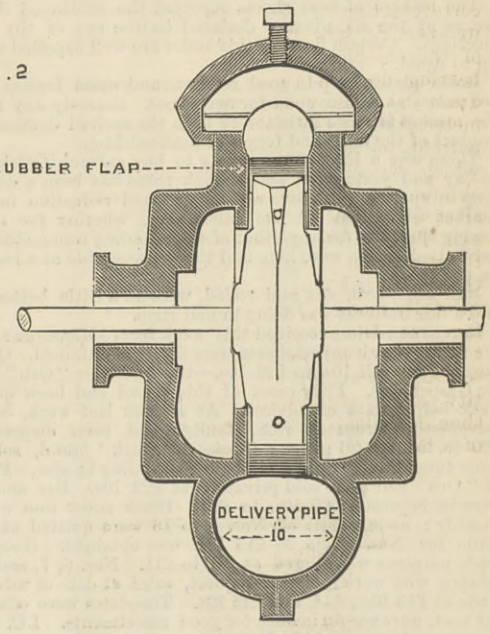


FIG .2



AT the meeting of the Metropolitan Board of Works at the 29th ult., it was agreed that the superintending architect should temporarily have two additional assistants for the work of surveying and reporting upon the London theatres and other places of amusement, with a view to alteration, to secure public safety in case of fire.

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

(*From our own Correspondent.*)

TO-DAY—Thursday—business on 'Change in Birmingham was influenced by circulars this morning received from Earl Dudley and from Messrs. Wm. Barrows and Sons. It will have been borne in mind that immediately after the late quarterly meetings both these firms notified that their prices must now be subject to those ruling at date of execution of order. These announcements were made after Messrs. John Bradley and Co. had put up marked bars to £8, a rise of 10s. per ton.

The circulars to-day made known that the price of iron at the Round Oak Works—Lord Dudley's—have not been advanced, and that orders can there be received as heretofore; while as to the iron trade at the Bloomfield Works, Messrs. Barrows on their part state that they do not anticipate that they shall find it necessary to advance the price of iron, and that they are therefore open to receive orders at present prices, subject to their approval of specifications.

I have before intimated that the indefiniteness of the previous circulars was leading to the holding back of orders whenever buyers were not bound to obtain immediate supplies. Customers preferred to buy from firms who were prepared to quote; and such firms were getting the bulk of the business doing in that quality. Having retrieved their mistake, alike the Earl Dudley and Messrs. Barrow may reasonably hope to share the orders now upon offer. Messrs. John Bradley and Co. are understood to still require £8 for their marked bars. Earl Dudley's prices are now definitely £8 2s. 6d. for Round Oak common; and Messrs. Barrows' B.B.H. bars are £7 10s. and upwards.

Iron of this description was not much sought after either yesterday in Wolverhampton or to-day in Birmingham, though some good orders have been recently booked by a few firms whose prices have not been advanced. The New British Iron Company is doing better in this department than for some time past, as well upon home as upon export account; and its outturn would have been larger if it could have obtained a larger supply of its own pig iron. Towards the augmenting of that supply it is pushing on its preparations for re-starting a third blast furnace. The price of the New British Iron Company is £7 10s. Soon this company will have their wire mill again in operation.

Messrs. Noah Hingeley and Son are very busy turning out the finished iron for which they are well-known, and they are extending their mill and forge capabilities. Not a little of this firm's iron goes into anchors, and cables, and chains upon their own premises, the demand for these being excellent, not merely from the Clyde, the Tyne, and Barrow, but likewise from the North European and other export markets, not excluding Belgium. Messrs. Hingeley and Son are amongst the largest cable and anchor firms in the kingdom, and they were never more busy than now in this department. The rigging chain shops are likewise kept in full swing.

The Pelsall Company is briskly occupied. Like several other finished iron firms in South Staffordshire, it is making more iron than ever before. Compared with a few months back it is making more by 700 or 800 tons a month, and the prices are more than a satisfactory increase.

The Patent Shaft and Axletree Company is busy in its steel and iron departments, and its prospects, like those also of most other ironmasters hereabouts, are improved by the decision of the Mines Drainage Commissioners at their meeting in Wolverhampton yesterday to spend from £35,000 to £40,000 upon mines and surface drainage in addition to the customary expenditure of the engineers.

To-day there was a fair extent of business done in medium bars at prices averaging from £6 17s. 6d. up to £7 5s.; and some few orders were secured for marked bars by the two firms who have now removed from the market all uncertainty touching the rates at which they are prepared to sell.

The makers of best sheets reported the continued delivery of orders at the £1 advance declared on the eve of the quarterly meetings. Certain firms of this order are well supplied with work up to April.

Boiler plates keep in good request, and some brands cannot be got unless at a rise upon former prices. Scarcely any feature of the market is more satisfactory than the revived demand for this product of the mills and forges of Staffordshire.

There was a little less anxiety to buy galvanising sheets both to-day and yesterday; and though there has been a considerable drop in spelter, yet there was no declared reduction in the open market quotations by the galvanisers, whether for corrugated roofing sheets or for any other of their leading commodities. Still galvanised sheets were here and there procurable at a reduction of 5s. per ton.

Nail rods, both slit and rolled, were in a little better request, and a fair business was doing in nail strip.

Merchant advices received this week from Melbourne state that the values of galvanised sheets were firmly maintained. Quotations ranged from £21 10s. to £22 10s.—the latter for "Orb"—and £23 for Gospel Oak. Fifty cases of this brand had been quitted the week before date of advices. At auction last week, 50 cases of galvanised corrugated iron, faulty, had been disposed of at £20 2s. 6d. for 26 gauge; 48 cases "Stork" brand, sold at the same time, brought £21 to £21 10s., according to size. Fifty cases of "Orb" had been sold privately at £22 10s. Bar and rod iron were in request at £9 10s. to £11. Black sheet iron was selling steadily; assortments of Nos. 8 to 18 were quitted at £11 10s., while for Nos. 20 to 26 £13 10s. was obtained. Hoop iron for trade purposes was offered at £10 to £11. Nos. 6, 7, and 8 drawn fencing wire were in better request, sales at date of advice being made at £13 10s., £14, and £14 10s. Tin-plates were offered at 15 per cent. advance on invoice for good assortments. I.C. coke was moving at figures ranging up to 20s. on spot.

Pig iron at Melbourne, the advices further state, was moving only for requirements; £5 10s. was asked for small lots, but over £5 5s. could not be got for larger bales. A shipment of 100 tons had been sold to arrive, although its arrival was two months away.

In Wolverhampton and Birmingham pig iron is unchanged upon the week. Transactions were rare both yesterday and to-day, consumers having mostly supplied their requirements for some time to come. Prices are without quotable change. Common qualities were somewhat strengthened by the assumption that they have been proved to be suitable to the making of steel by the basic process.

Coal is very abundant for the time of the year. There is no difficulty in getting supplies as well for manufacturing as for domestic consumption, in other than rare and exceptional instances.

An accident which has thrown 700 miners out of work and has ruined colliery plant worth £9000 happened on Monday, at the pits of the Pelsall Hall Colliery Company. The headings have lately been driven towards some disused workings and all precaution has been taken to prevent accident. These seem to have failed, for on Monday water was tapped unexpectedly. Fortunately only a few men were working at the time, these escaped themselves and got the horses and part of the plant up. By Tuesday morning the water had got into two adjoining pits of the Pelsall Coal and Iron Company. Work was suspended here and powerful pumping machinery was put on. The efforts to get the flood under are continuing with vigour; but it is feared that work cannot be resumed until some weeks ahead. The special rules of the Regulation Act were being strictly complied with at the time of the accident, five holes having been bored at a distance of 15ft. from the back of the heading where the men were working. The stoppage of the pits of the Pelsall Coal and Iron Company will not affect the iron-making operations of the firm. In November, 1872, twenty-two lives were lost at the Pelsall Hall Colliery through inundation.

Frenchmen have been through England recently seeking nut and bolt-making machinery. That old seat of the trade, Darlaston, has not, of course, been overlooked; and there the French have placed some of their orders.

Bridge and roofing work is affording a fair extent of employment to the fitters. Among the contracts under execution at the works of the Darlaston Bridge and Roofing Company is a pier for Ballymascanlin, Ireland, which will be erected in connection with some railway extension work at that place. The same firm has recently sent away a considerable area of roofing for Mexico, and bridge work for railways about London.

Messrs. Horton, Son, and Co., engineers, Darlaston, are supplying a second shelter roof to the order of the London and North-Western Railway Company, to be erected in connection with extensive station enlargements in Wolverhampton.

The railway fastening firms remain well employed all round. While some firms are occupied mostly in filling the orders of home railway companies, others are busy upon export work, the needs of South America bulking largely.

The promoters of the Bromgrove Gas Bill have successfully started the measure on its parliamentary course. The powers sought are for the dissolving of the present Bromgrove Gas Company, Limited, and its re-incorporation with further powers, chiefly the power to suppy electricity.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—There has been very little doing in the iron trade of this district during the past week. Buyers, in view of the unsettled state of the money market, have naturally been reluctant to put out further orders of any weight that could by any possibility be held back, whilst there has been rather more anxiety to sell on the part of holders of iron. This has brought about an easier tone in prices for prompt delivery, but there is so general a feeling of confidence with regard to the future that there is a marked absence of any pressure to sell forward at under current rates.

At Manchester, on Tuesday, there was a very flat market. Inquiries of any kind were very few, and in some cases outside brands of pig iron could be bought at 6d. under last week's prices. Lancashire makers of pig iron still quoted 52s. 6d. less 2½ for both forge and foundry pig iron delivered into the Manchester district, and although inquiries are not coming forward at this figure, they are for the present so well employed with deliveries under contract that they are under no necessity to force sales. Local hematites are in good demand for Sheffield and other steel manufacturing districts. Lincolnshire pig iron is rather easier, forge numbers being offered by makers this week at 52s., and foundry numbers at 53s., less 2½ delivered equal to Manchester, with second-hand lots to be bought at about 1s. per ton under these figures. Middlesbrough iron was also being offered at 50s. 10d. per ton net cash, without, however, tempting buyers. Finished ironmakers in this district continue well employed, specifications in some cases coming in more rapidly than they can be completed, and for delivery into the Manchester district their prices remain firm at £7 2s. 6d. for bars, and £7 10s. to £7 12s. 6d. for hoops, but merchants under contract who are in want of specifications are offering at under makers' rates.

The engineering trades continue generally well employed, but there is at present an unsettled feeling with regard to the wages question. The circular recently issued by the Iron Trades Employers' Association, of which I gave an abstract at the time, has been taken up by the men. A representative meeting of the members of the Amalgamated Society of Engineers employed at the various shops in the Manchester and Salford district has since been held at which this circular was severely commented upon, especially the portion which referred to the employer who had proposed to give back to the men the 2s. per week taken off wages three years ago. The fact that some employers were willing to concede the advance of 2s. without solicitation is held by the men as sufficient contradiction to the statement that the margin of profit was still too small to admit of higher wages being paid. Taking the view that the Employers' Association did not intend to redeem the promises made that as soon as a revival of trade took place they would restore the amount of reduction submitted to three years ago, the district committee of the Amalgamated Society of Engineers at a special meeting have passed resolutions to the effect that having considered the wages question of the district, they were of opinion that the time had arrived for the restoration of the 2s. taken off wages in December, 1878, believing that the state of trade and the steady improvement which was taking place fully justified them in arriving at that conclusion, and that all employers, whose workmen's wages were reduced, and where the same had not already been restored, should be hereby informed that they would be required to return to the rates of wages in existence previous to December, 1878, or in other words, that the 2s. per week then taken off must be restored to the men not later than Saturday in this week. Further it was resolved that it be an instruction to all members of the society who might be affected by the foregoing resolutions to pay strict attention to them, and if not paid in accordance therewith to cease working after the date named, or in works where notice was required to tender such notice in conformity with the rules of the works. This distinct intimation of a strike at the close of the present week unless an advance is conceded has been under the consideration of the Employers' Association at a meeting held on Monday. As yet no definite decision has been come to, but to-morrow—Friday—another meeting will be held, when no doubt some course of action will be determined upon.

The Lancashire and Yorkshire Railway Company is at present erecting at its Miles Platting Works an American locomotive which has been sent over in sections, and which is being fitted with Eames's patent vacuum brake. The engine was originally built for the Philadelphia and Reading Railway, and has not been brought over here with any idea of introducing American locomotives to this country, but solely with the view of illustrating the working of the brake, and no doubt the exceptional construction of the locomotive as compared with those running on English lines will tend to give the brake additional prominence. The American locomotive, with a fire-box extending nearly 2ft. beyond the frame on either side, and carrying, like a saddle, on the top a covered-in cab for the driver, and in every other respect so altogether different from the ordinary English locomotive, will certainly, if nothing else, be an object of curiosity. The brake has already been described in the columns of THE ENGINEER, and it is only necessary to say that the chief feature is the arrangement of the diaphragms, which are also left open to the action of the atmosphere, which, it is claimed, renders them more durable. The Lancashire and Yorkshire Company has already had the brake in use on several of their passenger trains for two years, and I learn from the officials that it has given satisfaction. The further trials with the American locomotive—which, when completed, I understand, will be attached to one of the company's passenger trains—will be made as a public test, and it is the intention of Mr. Eames afterwards to put the locomotive on the continental lines for additional experimental tests in Germany and France.

The coal trade shows no improvement. All classes of round coal continue a drug, and low in price; and engine fuel is also fairly plentiful. List rates have only been reduced this month in exceptional cases, but there is a great deal of underselling, and there are heavy stocks, with the bulk of the Lancashire collieries on short time.

The committee of the Manchester Coal Exchange in their annual report, which will be shortly issued to the subscribers, are able to show a continued steady increase, both as regards members and the amount of subscriptions. The income for the past year has been £220, with an expenditure of £156; the subscribers have increased from 336 to 404, and the subscriptions from £167 to £218. Mr. George Green, of the Tyldesley Coal Company, has been unanimously recommended as president for the ensuing year.

Barrow.—Hematite pig iron, as regards the demand from abroad, is very fully sustained, while the demand on continental and home account is furnishing evidence that the wants of users are increasing. Owing to the large consignments of metal, which of late have been purchased, a heavy tonnage of metal will shortly be exported, and I believe that makers are doing their utmost to increase their already very heavy output. In the Furness district I note that three furnaces will shortly be lighted which at present are undergoing repairs and improvements. At other works in the district makers are in a very good position for turning out metal, having had all their furnaces put into blast. The Furness district, including Cumberland, yields about 33,000 tons of pig iron per week. Only a small amount of iron is held in stock, and is chiefly in the hands of producers and merchants, who are waiting the shipping season to be more advanced. On the local railways the traffic has increased very much of late, and in Furness two locomotives have been ordered to meet the increased demand for carriage. I cannot say, however, that prices show any great variation, but, as I have in my former note pointed out, that quotations cannot be taken as a sure guide of the business done in the market. No. 1 Bessemer is 65s. 6d.; mixed parcels, 63s. 6d.; and Nos. 3 and 4 forge at 62s. 6d. per ton on truck or f.o.b.

In the steel trade makers have of late not booked any large number of contracts, but this is on account of their hands being already pretty full. I am in a position to state, however, that American buyers are anxious to place new orders, although the production of the mills in America has been greatly augmented. During the year a very heavy tonnage of metal will have to be made to America.

In the iron shipbuilding industry I have nothing new to chronicle, except that inquiries are being made with a view to placing orders almost daily. A very fair supply of work, however, yet remains in the hands of builders. So far as the finished iron which is produced in this district is concerned, I am informed it is a commercial failure, principally on account of the disadvantages makers have to contend with in the carriage of the class of iron which is used. Engineers, both in the marine and ordinary department, have a good number of orders in hand. Boiler-makers, railway rolling stock manufacturers, and minor branches are similarly situated. Iron ore realises from 16s. 6d. to 18s. 6d. per ton at mines, but as most of the mines are well bought forward, the sales of late have not been numerous. A large tonnage of Antrim ore is being imported into this district, and sales are plentiful. The coal trade shows no change, there being a heavy demand at prices varying from 10s. to 14s. 6d. per ton delivered. Shipping moderately employed.

Several gentlemen interested in the iron and steel industries are about to pay a visit to Barrow-in-Furness with a view of establishing large forge works there.

To meet the great demand for cottage houses which is said to exist at Barrow-in-Furness, a Middlesbrough firm are about to erect 400 on Barrow Island.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

MR. F. BRITTAIN, the president of the Sheffield Chamber of Commerce, warns manufacturers of steel rails against expecting a continuance of the heavy orders which have recently, and are still being, received from the United States. "America," he says, "is so rapidly increasing her powers of production that in a very short time she will be able to supply not only herself, but the world." Mr. Brittain, who has given great attention to the French Treaty negotiations and has been before the Commission at Paris, declares that a solution of the present difficulty in regard to the Treaty would be found if the English Government would give a kind of pledge that it would not sign a Treaty which was less favourable than the present.

Mr. Brittain devoted part of his speech to setting forth the importance of Goole as a port for Sheffield goods.

An important movement is at present going on among the ironworkers in the Sheffield and Rotherham district. Mr. Copper, the operating secretary of the Staffordshire Board of Arbitration, has been urging the ironworkers of the district to join the Staffordshire organisation. He has had long experience in settling disputes, and believes that conciliation and arbitration are the only true methods. Those who thought otherwise were the men who believed in strikes. Dividing the last twenty years into two periods he showed that from 1860 to 1870—being the period during which strikes and lock-outs were the agencies employed for the regulation of wages, the average tonnage rates paid for puddling in South Staffordshire were 8s. 4½d. per ton, and during the next decade—from the end of 1870 to 1881, the period during which boards of conciliation and arbitration had been the means of regulating wages, the average rate was 9s. 7d. per ton, notwithstanding the fact that the last ten years included seven years of unparalleled trade depression. A resolution was passed with the view of securing 6d. extra per ton for puddling, and a second resolution was passed calling upon the ironworkers of the district to join the board with the view of strengthening it, and of sending a representative from South Yorkshire.

Many miners' meetings have been held since my last letter, and affairs are not quite so promising as they were. The Wharncliffe Silkstone colliers, having heard the result of the operations of the sliding scale in force for the last half-year, approved of the proposal to continue the arrangement. The Thorncliffe colliers, however, meeting the same day, resolved to oppose the sliding scale unless it was accompanied by an immediate advance in wages of 10 per cent. Mr. Frith and Mr. Pickard are encouraging the colliers to insist on an advance before accepting the sliding scale, though they know well enough the employers will not concede any such demand.

The men employed at Thrybergh Hall Colliery held a meeting at Kilnhurst on Monday, when a Wombwell miner expressed himself as a determined opponent of strikes, which, he said, had never benefitted either the colliers or the country as a whole. Speaking at the same meeting, Mr. W. Chappell, secretary of the Sheffield and Rotherham District Miners' Association, stated that the masters had become thoroughly sickened of past proceedings, which had resulted in disastrous loss not only to themselves, but to the men; and they saw that the only means of preventing a repetition was the sliding scale. Forty-five thousand pounds had been spent in strikes in South Yorkshire, and the only battle won, notwithstanding this enormous expenditure, was that at Denaby. The result of the strike at Thorncliffe, according to Mr. Chappell, was that at the present time not 600 men out of the 1800 men working there were in the Union.

There is no change in the heavy trades, which continue exceedingly brisk. The Australian orders in the lighter departments continue to be exceptionally good. At the London ivory sales several of our local manufacturers managed to secure a considerable weight of handles, and in doing so have saved 10 per cent., as cutlers and dealers, in consequence of the higher prices current at the sales, have been compelled to raise their prices. The supply was considerably below the average. The 20 tons of Egyptian ivory withdrawn in October formed the bulk of that kind on offer.

An important local trade which is seldom noticed is that in spectacles. Messrs. Chadburn Brothers, Nursery-street, Sheffield, have a great reputation for the finest classes of these indispensable articles, and they have of late years made a speciality of spectacles for poor people. "R." in the *Times*, gives an interesting account of the uses to which he has put these cheap "glasses." An invalid in the country, with time and money to spare, he has been spending both in providing spectacles for the poor, and he gives many interesting incidents of the good to be done in this way among lace-makers and others. He specially recommends our local opticians' productions for this purpose.

THE NORTH OF ENGLAND.

(From our own Correspondent.)

A CHANGE for the worse has overtaken the northern iron trade. This is partly because of the financial panic which is unsettling every commercial centre—especially the Glasgow iron market—and partly because of the threatening attitude of the ironworkers. A 6 per cent. bank rate makes it very desirable for every person to hold money, and very undesirable to hold any other commodity. This is sufficient to account for the alacrity with which hitherto speculators in warrants are now forcing them on the market. It accounts also for the almost total absence of buyers, for no one wishes to become possessed of what may easily prove a "white elephant." Cleveland warrants were on Tuesday about the same price as makers' iron. No. 3 g.m.b. was sold at 42s. f.o.b., but the amount of business done was very small. The stock held at Messrs. Connals' Middlesbrough stores is now 175,686 tons, being 550 tons less than a week since. This would almost seem to indicate that the cause of the reaction is from without, and not from within, the iron trade.

The finished iron trade is decidedly slack. The unreasonable, and, indeed, childish petulance exhibited by the ironworkers because the realised price of finished iron during last quarter is not up to their ideas, founded on more recent quoted prices, is having a bad effect. Manufacturers are refusing to book more orders until they see how their cost of production is likely to be affected by their workmen's demands, and shipowners having also taken fright, are keeping back or cancelling for the present their orders for new ships. Few new contracts are being placed, and if this state of things continues lower prices may be looked for. In the meantime prices remain nominally the same, though little or no new business is being done. Plates are quoted £7 5s., and bars and angles at £6 15s., free in trucks at Middlesbrough, less 2½ per cent. discount.

It is announced that the North Yorkshire Ironworks, the last of those still remaining idle, is about to be re-started for the manufacture of angles. This is what it was originally designed for. The first directors are to be Messrs. Joseph Richardson, C. A. Head, Mark Robinson, and William Anderson, all of South Stockton.

The annual meeting of the Board of Arbitration was held at Darlington on Monday. After routine business the present unsettlement of the men in regard to Mr. Waterhouse's recent returns was denounced. Mr. Trow, workmen's secretary, said that "the men were now doubtful of everybody, and accused everybody of doing unjustly by them." Eventually it was unanimously carried "That all men must continue at full work, and that any special circumstances affecting the present wages agreement shall have the immediate consideration of this board, and in case of failure to effect an agreement, the whole question of the sliding scale and future wages shall be submitted to an arbitrator." Mr. Townsend, a delegate, said that "after that resolution if every delegate present did his duty there would be no difficulty in keeping the men at work."

NOTES FROM SCOTLAND.

(From our own Correspondent.)

THE Glasgow pig iron market has been very irregular during the past week in consequence of the financial crisis on the Continent, the advance in the price of money and the purchases of pig iron on the part of the United States turning out less important than was anticipated. A large business has, however, been done in warrants by speculators, and a downward tendency in prices, which has been going on for a fortnight, has continued. The shipments have been a little better than they were last week, but still continue very moderate, in view of the fact that we shall now be entering upon the spring trade. They amounted in the course of the past week to 8041 tons as compared with 7742 in the preceding week, and 8906 in the corresponding week of last year. The deliveries of pig iron into store have been comparatively small, but stocks are accumulating at the ironworks. There is a steady demand for pig iron at home, although the consumption of Middlesbrough pigs in Scotland has for the time been somewhat diminished by a strike in the number of the foundries which use a large quantity of this metal.

Business was done in the warrant market on Friday morning at from 50s. 9d. to 50s. 7½d. cash and 50s. 11½d. to 50s. 10½d. one month, the quotations in the afternoon being 50s. 9d. to 50s. 11d. cash and 51s. to 51s. 2d. one month. The market was irregular on Monday when transactions were effected at 50s. 10½d. one month and 50s. 8d. to 50s. 4d. cash in the morning, and at 50s. to 50s. 2d. cash and 51s. 4½d. one month in the afternoon. On Tuesday business was done at 49s. 8d. to 49s. 5d. cash and 50s. to 49s. 8d. one month.

The market was a shade firmer on Wednesday, with business between 49s. 5½d. and 49s. 10d. cash, and at 50s. 1½d. one month. To-day—Thursday—the market has been steady at from 49s. 8d. to 49s. 10½d. cash.

Business in makers' iron this week has been, like that of warrants, of a somewhat irregular character, and it has not been easy to obtain reliable quotations. The different brands, however, are offered by merchants as follows:—Gartsherrie, f.o.b. per ton, No. 1, 60s. 6d., No. 3, 53s.; Coltness, 60s. 6d. and 54s.; Langloan, 61s. 6d. and 55s.; Summerlee, 60s. and 52s.; Calder, 60s. and 52s. 6d.; Carnbroe, 55s. 6d. and 51s. 6d.; Clyde, 51s. and 49s.; Monkland and Quarter each, 50s. 6d. and 48s. 6d.; Govan, at Broomielaw, 50s. 6d. and 49s. 6d.; Shotts at Leith, 61s. and 55s.; Carron, at Grangemouth, 53s. 6d. (ditto specially selected, 56s.) and 52s. 6d.; Kinneil, at Bo'ness, 51s. and 49s.; Glengarnock, at Ardrossan, 54s. 6d. and 51s. 6d.; Eglinton, 50s. 6d. and 48s. 6d.; Dalmellington, 50s. 6d. and 49s. 6d.

The foreign shipments of Scotch pigs from Christmas to date, amount to 34,548 tons, as against 36,601 in the same period of last year; and there are 105 furnaces in blast, as compared with 122 at the same date in 1881. The stock in Messrs. Connal and Co.'s stores amounts to 631,000 tons, as compared with 514,000 at the same date last year. There is a total increase to date of the imports of Middlesbrough pigs of 7604 tons. There have been considerable arrivals of iron ore at Glasgow since the date of last report.

The manufactured iron trade continues busy, particularly all those branches that in any way contribute to the shipbuilding trade. Merchants, however, find business somewhat quieter at the moment, there being decidedly less doing throughout the lighter branches of the hardware trade. It is expected, however, that business will improve shortly.

The report of the directors of the Glasgow Caradon Consolidated Copper Mining Company, Limited, to be submitted to the general meeting of the shareholders in Glasgow next week, expresses regret that business has not been of a more favourable character. The directors state that the low price of copper has seriously affected the results of their working. They expect, however, a better return from their mines, and this, along with the improvement in the prices of ore, which the directors consider it is only reasonable to expect during the present year, will enable them to present a very different account at its close. The working for the year shows a loss of £2522.

The coal trade, looked at as a whole, appears to have slightly improved since last report. The shipments from Glasgow are several thousand tons larger, and there has been also more doing on the Ayrshire coast, and at the ports of the Firth of Forth. The inland trade, however, is in a rather backward state. Main coal in the West sells at from 5s. 10d. to 6s. 6d. per ton; ell, 6s. 10d. to 7s. 6d.; splint, 6s. 9d. to 7s. 3d; and steam, 7s. 6d. to 8s. 3d.

Messrs. Galloway, of Ayr, have opened up a new coal-field in the neighbourhood of Stair. The quality of the coal, which lies below a hard body of whinstone, and was at first difficult to get at, is reported to be very rich, especially in the qualities that make it useful for manufacture of coke.

In the course of the past month, sixteen vessels, with an aggregate tonnage of 24,000, have been launched from the Clyde shipbuilding yards, compared with thirteen vessels of 9900 tons in January last year.

WALES & ADJOINING COUNTIES.

(From our own Correspondent.)

ONE of the projected railway schemes of the future is to be a line from the Llwydcoed station of the Great Western Railway into the Rhondda; a short tunnel is about the only difficulty, and the advantages are numerous.

An advance in house coal to the extent of 1s. per ton has taken place, and it is expected that the house colliers' wages will also be advanced at the end of the month. Dowlais, Plymouth, and Cyfarthfa ironworks gave notice of an advance in the prices of house coal dating from the beginning of February.

In coal and iron good work is being done in all parts of the district. Swansea has continued to retain its high average of coal exports, and last week sent away over 30,000 tons. A similar quantity was sent from Newport. Mon., and Cardiff despatched over 130,000 tons. The complete total from the three leading ports of Wales of foreign coal shipments was 192,000 tons. This is one of the largest totals I have recorded, and shows that the estimate of Mr. Joseph, of Tydnaw, Treherbert, given us last year, that 200,000 tons would be reached, was a prophetic one. Prices, too, are firm, even in questions of large contracts.

I have long maintained in this column, though opposed by such a weighty authority as Mr. Menelaus, of Dowlais, that owners of special coal, such as Rhondda No. 3, should unite for the purpose of getting a just return for this excellent, but fast becoming exhausted coal. A few days ago a meeting of owners was held, and a resolution passed to advance the price, and retain it at a uniform rate.

No further action has been taken by the house coal men in their opposition to the sliding scale. Probably they are waiting to see the course that will be taken by the executive. I have a strong impression myself that it is the men's representatives who are trying to get up a commotion. These men in good prosperous times like the present are of little importance, and get little pay. In stormy times, when their help is needed, the subscriptions come in more freely. This is a low estimate, but I am afraid it is a true one.

Financial troubles on the Continent have not been without a deteriorating influence on our iron trade. Still this may be regarded as only a temporary matter. Trade continues active, and prices in all but pig iron are kept up. In the Swansea district bars are quoted at £6 per ton; iron rails, £5 10s.

Old iron and scrap are bought freely, and Cyfarthfa is clearing off its surplus accounts, evidently with the idea that steel will be the entire future make there. Practical movement in that quarter may be expected in March.

Steel rails exhibit little change, and order books are sufficiently full to allow of Krupp carrying off a substantial one for Spain without a murmur.

Tin-plate shows that last advances have been retained. Tin has fallen £2 per ton.

Amongst the clearances this week was a cargo of nearly 1000 tons of old rails for Baltimore.

A serious accident occurred in the Ferndale Valley this week. About a dozen men were employed in sinking at the Cutch Colliery, and having prepared several holes, fired them and ascended. As soon as the charges had exploded, they again descended, when one which had not gone off burst upon them, killing one man and severely injuring others.

The Glyncorrwg line—Swansea and Rhondda—is regarded as the favourite at Swansea, and, I hear, is to be matured.

Blaenavon works have adopted the electric light, and like Rhymney is going ahead. Dowlais Works are also progressing, and several well-thought out improvements are being applied.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

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

Applications for Letters Patent.

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

24th January, 1882.

343. BRAKES, J. J. Tansley, Liverpool.
344. ROOFING TILES, S. H. Bevan, Neath.
345. WIND INSTRUMENTS, L. Varicas.—(*The Autophone Company, New York, U.S.*)
346. ELECTRIC LAMPS, R. E. B. Crompton, London.
347. LAWN-TENNIS MARKERS, W. Thomson, Manchester.
348. GUNS, F. J. Cheesbrough.—(*J. Nemetz, Vienna.*)
349. BOOTS and SHOES, H. Loads, Norwich.
350. FUEL, J. H. Johnson.—(*J. A. Strupler, Paris.*)
351. TANKS, J. Holroyd, Leeds,
352. CUTTING CHEESE, W. Chisholm, Hawick.
353. WATER-CLOSETS, P. J. Davies, London.
354. ACETIC ACID, H. J. Haddan.—(*Fröhlich and Company, Germany.*)
355. FIREPLACES, W. J. Doubleday, London.
356. SHIPS, A. W. Reddie.—(*J. McAdams, Boston, U.S.*)
357. CRAVAT FASTENINGS, J. Hinks, T. Hooper, and F. R. Baker, Birmingham.
358. SOUNDING APPARATUS, C. A. McEvoy, London.
359. ELECTRIC LAMPS, J. N. Aronson, London.
360. WINDOW SASHES, W. R. Lake.—(*P. W. Blythe, Boston, U.S.*)
361. ELECTRICAL CONDUCTORS, W. R. Lake.—(*H. A. Clark, Boston, U.S.*)
362. GAS ENGINES, F. W. Turner, St. Albans.
363. ROTARY MOTION, A. M. Clark.—(*F. Elbing, Algersdorf, Austria.*)
364. TABLETS, W. Carter, Essex.
365. HANDLES of DOORS, J. A. Macmeikan, London.
366. LOOMS, S. C. Lister and J. Reixach, Yorkshire.
367. SULPHURIC ACID, W. Windus, Bristol.
368. PURIFYING LEAD, W. J. Carr.—(*P. Négris and E. Rizio, Ergastiria, Greece.*)

25th January, 1882.

369. PUBLIC CONVEYANCES, J. Clark, London.
370. CONCRETE FLOORS, A. Cordingley, London.
371. PRINTING MACHINES, T. G. and J. Dawson, Yorkshire.
372. CANAL LOCKS, J. Revel, Dukinfield.
373. SHUTTLES, J. R. Richards, Kirkham.
374. SMOKING TOBACCO, H. E. Meyer.—(*Jeanket-Dazid, St. Claud, France.*)
375. CATTLE FOOD, C. D. Abel.—(*O. Zucker, Berlin.*)
376. PIANO-ORGANS, C. D. Abel.—(*Messrs. Cæsare, Donadoni, and Pohl, Berlin.*)
377. ELECTRIC LAMPS, Sir C. T. Bright, London.
378. SIGNALLING APPARATUS, W. P. Thompson.—(*W. Gary, Boston, U.S.*)
379. FLUSH CISTERNS, W. Wright, Plymouth.
380. ELECTRO-MAGNETIC PIANO PLAYERS, C. N. Andrews, San Francisco, U.S.
381. DISINFECTANTS, E. G. Brewer.—(*E. E. Eyasse, France.*)
382. DRYING TEA, J. H. Johnson.—(*J. Allen, Bengal.*)
383. DRAWING BOARDS, G. Low, Ipswich.
384. COLOURING MATERIALS, W. R. Lake.—(*E. D. Kendall, Brooklyn, New York, U.S.*)
385. DRYING BRICKS, G. Woolliscroft, Stoke-on-Trent.

26th January, 1882.

386. CORES for CABLES, W. T. Henley, Plaistow.
387. PURIFYING COAL GAS, J. Walker, Leeds.
388. TRANSFERRING DESIGNS, J. M. Moss, Patricroft.
389. FIRE-ARMS, W. Lake.—(*W. Trabue, Louisville, U.S.*)
390. TERRETS, W. R. Lake.—(*E. Johnson, Boston, U.S.*)
391. WRITING INSTRUMENTS, W. P. Thompson.—(*G. W. Carleton and E. Coffin, jun., New York, and A. S. French, Brooklyn, U.S.*)
392. OBTAINING LIGHT, W. P. Thompson.—(*Union Electric Manufacturing Company (Incorporated), New York, U.S.*)
393. CUTLERY, H. M. Marsden, Sheffield.
394. ISOLATING FIRE, H. M. Bennett.
395. PHOTOGRAPHICAL COPIES, R. Schroer, Vienna.
396. CONFECTIONERY, J. Greenwood, Bacup.
397. GAS ENGINES, C. Emmet, Leeds.
398. SUGAR, C. Scheibler, Berlin.
399. DECORATING GLAZED EARTHENWARE, W. H. Slater, Stoke, and E. C. Hancock, Worcester.
400. REVOLVING PROPELLER, C. Corneby, Poplar.
401. CASKS, S. Wright, Harriston, Canada.
402. SAWING WOOD, T. N. Robinson, Rochdale.
403. EXHIBITING APPARATUS, T. Whetstone, London.
404. GLASS BOTTLES, T. Wood, Portobello, N.B.
405. DREDGING, C. J. Ball, London.
406. BOLTS, A. M. Clark.—(*T. J. Bush, Lexington, U.S.*)
407. SAVING LIFE at SEA, W. Fewster, Margate.
408. COOLING APPARATUS, F. C. Glaser.—(*H. F. Schöller, Düren, Germany.*)

27th January, 1882.

409. HEATING FEED-WATER, M. Ashworth, Manchester.
410. SEPARATING OIL, G. Chapman, Glasgow.
411. SEWERAGE GULLIES, C. Pieper, Betlin.
412. BUTTONS, L. A. W. Lund, London.
413. PROTECTING ROOFS, B. L. Thomson, London.
414. ADVERTISEMENTS, A. Cracknell, Peckham.
415. VELOCIPEDES, W. Hill, Coventry.
416. FURNACES, J. Cliff and J. H. Dawes, Lincoln.
417. GAS ENGINES, S. Withers, Torquay.
418. LATHES, J. Dewrance, London.
419. COFFEE-POTS, W. R. Lake.—(*J. Herttan, Bohemia.*)
420. ENGINES, H. J. Haddan.—(*E. Schonfer, France.*)
421. FELLOES, &c., G. Perks, Stafford.
422. LUBRICATING APPARATUS, R. Simon, Nottingham.
423. EMBROIDERY, C. Barlow.—(*C. Wetter, Switzerland.*)
424. WASTE of WATER, M. Ingram, Manchester.
425. DAMPING PAPER, A. Stierlin, Manchester.
426. CALCINING LIMESTONE, S. Collier, Glamorgan.
427. BOILERS, P. Jensen.—(*W. Wilmsmann, Germany.*)
428. GLOVE HOLDERS, A. W. Child, Barnet.
429. WOOL, W. Cliffe, T. Ainley, & J. Shaw, Yorkshire.
430. ROVING MACHINERY, W. R. Lake.—(*W. E. Whitehead and A. T. Atherton, Lowell, U.S.*)
431. LATHES, F. Wirth.—(*G. and E. Heyne, Germany*

28th January, 1882.

432. TRIMMING MACHINES, F. Myers, London.
433. CYANOGEN COMPOUNDS, L. Mond, Northwich.
434. SHAPING WOOD, E. Bahn, Germany.
435. GUN WADS, H. E. Newton.—(*Messrs. De Condé, Schmid, and Du Houx, Paris.*)
436. PRINTING APPARATUS, J. Imray.—(*J. Baudot, Paris.*)
437. FIREPROOF APPARATUS, J. Imray.—(*K. Plaff, Vienna.*)
438. DECORATING PAPERS, J. Imray.—(*A. Cottais, Paris.*)
439. TRICYCLE SEATS, A. Burdess, Coventry.
440. ABSTRACTING AMMONIA, G. Neilson, Summerlee.
441. PROPELLING CARRIAGES, C. F. Varley, Kent, and W. Judd, Penang.
442. NAILING MACHINES, F. Myers, London.
443. OPENING DOORS, G. V. Fosbery, Bristol.
444. DYEING COTTON YARNS, F. A. Gatty, Accrington.
445. FIRE-GRATES, J. Jaffrey, Manchester.
446. COFFER DAMS, C. J. Fox.—(*R. P. C. Sanderson, New York, U.S.*)
447. WARPING MACHINES, E. and W. A. Rothwell, Walkden.
448. SCREW NAILS, H. H. Lake.—(*American Screw Company (Incorporated), Providence, U.S.*)
449. KITCHENERS, J. W. Brown, Leamington.
450. HORSESHOES, H. Turner and E. Price, Birmingham, and H. Oliver, Tamworth.

30th January, 1882.

451. COLOURING MATTERS, J. A. Dixon.—(*C. Rumpff, Germany.*)
452. HOISTS, W. Adair and G. B. Smith, Liverpool.
453. WINDING ENGINES, W. Paulson, Nottingham.
454. METALLIC BRUSHES, G. and E. Ashworth, Manchester.
455. BEAMING YARN, R. Hindle and G. Greenwood, Blackburn.
456. CRUSHING APPARATUS, R. E. Shill, East Dulwich.
457. KITCHEN UTENSILS, H. Hartung, Berlin.
458. COAL-GETTING MACHINERY. M. Burnett, sen., and C. Burnett, Durham.
459. PERAMBULATORS, E. Andrews, Sudbury.
460. PAPER PULP, F. Bauman, Budapesth.
461. SIGNALLING APPARATUS, C. Barker, Shadwell.
462. STOPPING TUBES, J. Turner, Plaistow.
463. TANNING HIDES, W. R. Lake.—(*C. Vanderstraeten, Belgium.*)

Inventions Protected for Six Months on Deposit of Complete Specifications.

335. VACUUM PAN APPARATUS, H. H. Lake, Southampton-buildings, London.—A communication from A. R. Mackenzie and J. F. Maclaren, Mackay, Australia.—*23rd January*, 1882.
345. WIND INSTRUMENTS, L. Varicas, Montague-place, Russell-square, London.—A communication from the Autophone Company, Ithaca, New York, U.S.—*24th January*, 1882.
380. ELECTRO-MAGNETIC PIANO PLAYERS, C. N. Andrews, San Francisco, U.S.—*25th January*, 1882.
384. PRODUCING ANILINE, W. R. Lake, Southampton-buildings, London.—A communication from E. D Kendall, Brooklyn, U.S.—*25th January*, 1882.
411. SEWERAGE GULLIES, C. Pieper, Berlin.—*27th January*, 1882.

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

288. MAKING BARRELS, H. J. Haddan, London.—*23rd January*, 1879.
296. TWISTING FIBROUS MATERIALS, W. Murray, Selkirk.—*24th January*, 1879.
475. COAL MINING MACHINES, B. J. B. Mills, London.—*6th February*, 1879.
541. LUBRICATORS, J. Dewrance and G. H. Wall, London.—*11th February*, 1879.
558. LACING-STUDS, W. R. Lake, London.—*12th February*, 1879.
5318. TOOLS, J. Goodrich, Illinois, U.S.—*30th December*, 1878.
333. REFINING OZOKERIT, H. Ujhely, Vienna.—*27th January*, 1879.
367. NUTTING SCREW-BOLTS, S. Pitt, Sutton.—*29th January*, 1879.
568. LEAD PIPES, S. Gratrix, Manchester.—*13th February*, 1879.
369. BICYCLES, W. Bown, Birmingham.—*29th January*, 1879.
375. WRINGING HANKS, S. Mason, jun., Manchester, and J. Conlong, Radcliffe Bridge.—*29th January*, 1879.
415. PERFORATING MACHINES, H. J. Haddan, London.—*1st February*, 1879.
439. CLAMP SKATES, F. W. Hilliard, Edinburgh.—*4th February*, 1879.

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

362. VENTILATORS, J. Hill and J. E. Hey, Halifax.—*30th January*, 1875.
294. BALL JOINTS, W. G. Cannon, London.—*26th January*, 1875.
336. TRAIN-SIGNALLING, R. R. Harper, London.—*28th January*, 1875.
354. SHEET-METAL ROOFING, A. Moore, London, and A. C. Moore, Liverpool.—*30th January*, 1875.
345. SPINDLES of MULES, H. T. Palmer, Middleton.—*29th January*, 1875.

Notices of Intention to Proceed with Applications.

Last day for filing opposition, 17th February, 1882.

3833. VALVES, A. E. Lucas, London.—*3rd September*, 1881.
3870. TOILET CABINET, E. R. Johnson, London.—*6th September*, 1881.
3967. LAMPS and BURNERS, J. G. Ellis, Earl's-court.—*14th September*, 1881.
4069. INDICATING APPARATUS, W. P. Thompson, London.—Com. from W. W. Gary.—*21st September*, 1881.
4070. INDICATING APPARATUS, W. P. Thompson, London.—Com. from W. W. Gary.—*21st September*, 1881.
4081. SAFETY VALVES, J. Challender, Manchester.—*22nd September*, 1881.
4082. STEAM GENERATOR, L. Shaw and P. T. Fletcher, Manchester.—*22nd September*, 1881.
4091. TRICYCLES, J. Adams, Camberwell.—*22nd September*, 1881.
4093. ELECTRIC CABLES, E. G. Brewer, London.—Com. from P. Delany & E. Johnson.—*22nd September*, 1881.
4097. MAKING CARDS, J. Sellers, Scholes.—*23rd September*, 1881.
4098. STEAM BOILER FURNACES, W. Ireland, Macclesfield.—*23rd September*, 1881.
4106. LAMPS for BICYCLES, J. E. Leeson, Oldham.—*23rd September*, 1881.
4108. UMBRELLAS, H. A. Davis, London.—*23rd September*, 1881.
4111. DRESSING CASES, T. H. Mann, London.—*23rd September*, 1881.
4113. TUNNELLING, &c., J. D. Brunton, Westminster.—*23rd September*, 1881.
4118. MONEY APPARATUS, G. E. Absell, Kentish Town.—*24th September*, 1881.
4131. LACE CURTAINS, W. C. Horne, Bexley.—*24th September*, 1881.
4137. MOTIVE POWER, R. Watson, Glasgow, N.B.—*26th September*, 1881.
4139. COATING METALS, T. S. Webb, London.—*26th September*, 1881.
4143. EMBROIDERY, J. Renals, London.—A communication from J. Steiger.—*26th September*, 1881.
4166. BEER BARRELS, W. Smedley, Burton-on-Trent.—*27th September*, 1881.
4208. STANDS for LIQUEUR, J. Meeson, Sheffield.—*29th September*, 1881.
4209. CUTLERY, L. Meyer, Sheffield.—A communication from L. Frobeen.—*29th September*, 1881.
4244. MOTOR ENGINES, C. D. Abel, London.—A communication from J. Spiel.—*30th September*, 1881.
4277. SUBSTANCE for FOOD, E. J. T. Digby, Hammersmith.—*3rd October*, 1881.
4304. DYNAMO-MACHINES, H. Aylesbury, Bristol.—*4th October*, 1881.
4309. ELECTRIC BATTERIES, F. Wirth, Frankfort-on-the-Main.—Com. from J. Stebbins.—*4th October*, 1881.
4388. EXTRACTING CALORIC from LIQUIDS, C. Tellier, Paris.—*8th October*, 1881.
4634. FIREPROOF COMPOSITION, A. M. Clark, London.—Com. from C. C. Gilman.—*22nd October*, 1881.
4636. MATCH-BOX, A. M. Clark, London.—A communication from La Société Anonyme de l'Imprimerie Marseillaise.—*22nd October*, 1881.
5029. FELTS, &c., W. L. Wise, Westminster.—A communication from A. Marthaus and A. Polster.—*16th November*, 1881.
5038. CLIPS for SHEARING, F. Guillauma, Paris.—*17th November*, 1881.
5050. TRANSMITTING SIGNALS, F. R. Francis and C. Donovan, London.—*18th November*, 1881.
5186. SEWING MACHINES, M. H. Pearson, Leeds.—*28th November*, 1881.
5453. PRESERVING MILK, H. W. L. O. von Roden, Hamburg.—*14th December*, 1881.

5530. Sternposts, &c., E. Hayes, Stony Stratford.—17*th December*, 1881.
5600. Electric Lighting, S. Pitt, Sutton.—A communication from E. T. Starr.—21*st December*, 1881.
5651. Electric Current Meters, St. G. L. Fox, London.—24*th December*, 1881.
226. Protecting Bottles, &c. J. M. Thorpe and J. A. Bellori, San José, U.S.—17*th January*, 1882.
345. Wind Instruments, L. Varicas, London.—A communication from The Autophone Company.—24*th January*, 1882.

Last day for filing opposition 21*st February*, 1882.

4132. Opening Asbestos, C. J. Allport, London, and A. Hollings, Salford.—26*th September*, 1881.
4136. Heating Appliances, W. Truswell, Sheffield.—26*th September*, 1881.
4140. Mules, T. H. Blamires, Huddersfield.—26*th September*, 1881.
4153. Stop-cocks, H. Hughes, Loughborough.—27*th September*, 1881.
4182. Making Paper, &c., G. Tidcombe, Watford.—28*th September*, 1881.
4184. Printers' Type, W. R. Lake, London.—Com. from J. E. Perrachon.—28*th September*, 1881.
4185. Calcareous Bricks, F. H. F. Engel, Hamburg.—Com. from J. A. A. Renck.—28*th September*, 1881.
4189. Steam Winches, E. Latham, Birkenhead.—29*th September*, 1881.
4205. Counting Needles, V. Milward, Redditch.—29*th September*, 1881.
4220. Metal Wheels, W. R. Lake, London.—A communication from L. May.—30*th September*, 1881.
4223. Gas Motor Engines, C. W. King, Manchester.—30*th September*, 1881.
4243. Generating Steam, G. W. Wigner and J. Dixon, London.—30*th September*, 1881.
4271. Electro-magnetic Apparatus, W. R. Lake, London.—A communication from A. D. Maikoff and N. de Kabath.—1*st October*, 1881.
4319. Bicycles, J. A. Lamplugh, Birmingham.—4*th October*, 1881.
4346. Checking, &c., Coins, J. T. R. Proctor, Dundee.—6*th October*, 1881.
4454. Measuring Electric Currents, J. T. Sprague, Birmingham.—12*th October*, 1881.
4540. Filter Presses, H. E. Newton, London.—Com. from A. L. G. Dehne.—18*th October*, 1881.
4695. Utilising Electric Currents, W. F. Barrett, Monkstown.—27*th October*, 1881.
5103. Distilling Water, E. Wimshurst, London.—22*nd November*, 1881.
5418. Electrical Apparatus, J. E. Liardet, Brockley, and T. Donnithorne, London.—10*th December*, 1881.
5523. Separating Ammonia, G. Chapman, Glasgow.—17*th December*, 1881.
5717. Brushes, W. Willeringhaus, London. — 30*th December*, 1881.
5721. Hydraulic Lifts, J. S. Stevens and C. G. Major, Battersea.—30*th December*, 1881.
5725. Linoleum, M. B. Nairn, Kirkcaldy.—30*th December*, 1881.
5745. Softening Water, F. H. and W. G. Atkins, London.—31*st December*, 1881.
16. Shoes for Horses, J. Buckham and G. Jackson, Lanchester.—2*nd January*, 1882.
39. Colouring Matters, J. A. Dixon, Glasgow.—Com. from Dr. C. Koenig.—4*th January*, 1882.
53. Mining Coal, W. P. Thompson, London.—A communication from J. Du Bois.—5*th January*, 1882.
61. Engines, J. James and W. Wardrop, Lambeth.—5*th January*, 1882.

Patents Sealed.

List of Letters Patent which passed the Great Seal on the 27*th January*, 1882.)

3297. Peat Fibre, H. Armstrong, Darlington, and J. A. London, London.—28*th July*, 1881.
3310. Valves, A. E. Carter and D. Young, London.—28*th July*, 1881.
3330. Gas, &c., E. A. Brydges, Koeniggraetzer-strasse.—2*nd August*, 1881.
3362. Electric Lamps, J. Hopkinson, London.—3*rd August*, 1881.
3372. Ships' Sleeping Berths, W. R. Lake, London.—3*rd August*, 1881.
3375. Traps for Water-closets, C. Parker, Amberley.—4*th August*, 1881.
3380. Detecting Electric Current, W. P. Thompson, London.—4*th August*, 1881.
3427. Permanent Way, F. C. Glaser, Berlin.—8*th August*, 1881.
3439. Automatic Gear, C. Pieper, Berlin.—9*th August*, 1881.
3443. Absorbing Sulphurous Acid, C. D. Abel, London.—9*th August*, 1881.
3451. Regulating Apparatus, E. Lee, Torquay, and A. C. Moore, Deptford.—9*th August*, 1881.
3475. Umbrellas, &c., E. Posselt, Bradford.—11*th August*, 1881.
3476. Cutting Wood, C. F. Parsons, London.—11*th August*, 1881.
3481. Rotary Pumps, C. Comstock, New Canaan, U.S.—11*th August*, 1881.
3488. Screw Propulsion, J. Wilkinson, Blackpool.—12*th August*, 1881.
3514. Petroleum, &c., W. R. Lake, London.—12*th August*, 1881.
3534. Shoes for Horses, E. G. Brewer, London.—15*th August*, 1881.
3556. Breakwaters, E. C. G. Thomas, London.—16*th August*, 1881.
3589. Mounting Rotary Shafts, J. Tangye, Birmingham.—17*th August*, 1881.
3799. Electric Lamps, W. Crookes, London.—31*st August*, 1881.
3813. Joints of Tin Vessels, M. Benson, London.—2*nd September*, 1881.
3834. Faucets or Taps, W. P. Thompson, London.—3*rd September*, 1881.
3880. Revolving Armatures, W. R. Lake, London.—7*th September*, 1881.
4037. Secondary Batteries, W. Clark, London.—19*th September*, 1881.
4060. Regulating Batteries, A. M. Clark, London.—20*th September*, 1881.
4342. Gas Stoves, T. Fletcher, Warrington.—6*th October*, 1881.
4412. Food, E. Wylam, Southwark.—11*th October*, 1881.
4544. Hyponitric Anhydride, E. Turpin, Paris.—18*th October*, 1881.
4552. Dynamo, &c., Machines, P. Jensen, London.—18*th October*, 1881.
4571. Measurement of Electricity, E. G. Brewer, London.—19*th October*, 1881.
4576. Meters, E. G. Brewer, London.—19*th October*, 1881.
4624. Screw Presses, C. S. Mair, Glasgow.—22*nd October*, 1881.
4671. Rings, W. R. Lake, London.—25*th October*, 1881.
4726. Metal Dressing Machines, R. H. Brandon, Paris.—25*th October*, 1881.
4906. Mules and Twiners, J. Chisholm and J. Clegg, Oldham.—9*th November*, 1881.
4946. Uncoupling Apparatus, C. F. C. Morris and F. H. Bennett, London.—11*th November*, 1881.
5028. Telephone Receivers, R. and M. Theiler, London.—16*th November*, 1881.
5037. Dressing Grain, W. Korth, Belfast.—17*th November*, 1881.
5079. Cleaning Wire Ropes, M. W. Parrington and C. Almond, Sunderland.—21*st November*, 1881.
5159. Galvanic Batteries, R. E. B. Crompton and D. G. Fitz-Gerald, London.—25*th November*, 1881.
5192. Gun Barrels, W. C. Stiff, Birmingham.—28*th November*, 1881.
5221. Signals by Electricity, W. R. Lake, London.—29*th November*, 1881.
5265. Screws, W. R. Lake, London.—1*st December*, 1881.

(*List of Patent Letters which passed the Great Seal on the* 31*st January*, 1881.)

2595. Lever Hammer, J. Cuthbert, Landport, and G. H. King, Portsea.—15*th June*, 1881.
3334. Wire Fencing, W. J. Smith, Inverness, N.B.—2*nd August*, 1881.
3335. Steam Cranes, A. Barclay, Kilmarnock.—2*nd August*, 1881.
3340. Felting Hats, H. A. Bonneville, London.—2*nd August*, 1881.
3341. Securing Door Handles, W. Neilson, Glasgow.—2*nd August*, 1881.
3347. Steam Boilers, H. W. Blake, London, and J. Shepherd, Manchester.—2*nd August*, 1881.
3352. Extracting Copper, W. W. Hughes, London.—2*nd August*, 1881.
3371. Velocipedes, F. Wirth, Frankfort-on-the-Maine.—3*rd August*, 1881.
3382. Stands for Bottles, G. Green, Birmingham.—4*th August*, 1881.
3383. Lavatories, J. Shanks, Barrhead.—4*th August*, 1881.
3423. Actuating Musical Boxes, J. G. Dudley, Carmarthen.—8*th August*, 1881.
3523. Venetian Blinds, W. Brierley, Halifax.—13*th August*, 1881.
3527. Gas Engines, T. H. Lucas, Birmingham.—13*th August*, 1881.
3610. Ribbed Fabrics, H. M. Mellor, Nottingham.—19*th August*, 1881.
3677. Registering Apparatus, J. N. Maskelyne, London.—23*rd August*, 1881.
3718. Sizing Textile Materials, J. Wolff, Manchester.—25*th August*, 1881.
3751. Paints, A. B. Rodyk, London.—29*th August*, 1881.
4001. Baths, &c., J. Shanks, Barrhead.—16*th September*, 1881.
4144. Checking Apparatus, J. N. Maskelyne, London.—26*th September*, 1881.
4369. Nitrogenous Substances, W. and H. Marriott, Huddersfield.—7*th October*, 1881.
4553. Secondary Batteries, P. Jensen, London.—18*th October*, 1881.
4587. Plaiting Machines, J. Dowling, London.—20*th October*, 1881.
4739. Pegs for Violins, J. Wallis, London.—29*th October*, 1881.
4968. Trunks, &c., W. B. Worger and E. M. Richford, London.—12*th November*, 1881.
5004. Securing Tubes, W. R. Lake, London.—15*th November*, 1881.
5015. Cooling Apparatus, J. F. Littleton, Battersea.—16*th November*, 1881.
5116. Incandescent Burners, H. J. Haddan, London.—23*rd November*, 1881.
5166. Sewing Machines, H. J. Haddan, London.—26*th November*, 1881.
5223. Ornamented Fabrics, G. Pitt, Sutton.—29*th November*, 1881.
5312. Alkaline Solutions, H. W. Deacon and H. Gaskell, Widnes.—5*th December*, 1881.
5321. Cleaning Rice, &c., S. Pitt, Sutton.—6*th December*, 1881.
5344. Non-conductor, J. G. Accles and J. D. Scott, South Shields.—7*th December*, 1881.
5346. Target Trap, H. J. Haddan, London.—7*th December*, 1881.

List of Specifications published during the week ending January 28th, 1881.

2333, 4d.; 2458, 6d.; 2656, 6d.; 2674, 6d.; 2690, 6d.; 2694, 6d.; 2704, 4d.; 2708, 6d.; 2710, 8d.; 2718, 6d.; 2717, 6d.; 2720, 8d.; 2722, 10d.; 2735, 4d.; 2738, 6d.; 2740, 10d.; 2745, 6d.; 2747, 4d.; 2757, 8d.; 2759, 6d.; 2761, 6d.; 2762, 4d.; 2765, 4d.; 2773, 6d.; 2775, 6d.; 2782, 6d.; 2785, 2d.; 2786, 6d.; 2878, 6d.; 2789, 2d.; 2790, 6d.; 2792, 6d.; 2794, 6d.; 2799, 2d.; 2800, 6d.; 2801, 10d.; 2802, 4d.; 2808, 2d.; 2805, 6d.; 2807, 2d.; 2809, 8d.; 2810, 6d.; 2811, 2d.; 2812, 6d.; 2822, 2d.; 2823, 2d.; 2824, 6d.; 2825, 6d.; 2827, 2d.; 2829, 2d.; 2832, 6d.; 2833, 2d.; 2835, 2d.; 2837, 4d.; 2838, 4d.; 2841, 4d.; 2842, 2d.; 2843, 4d.; 2866, 2d.; 2848, 4d.; 2849, 4d.; 2850, 6d.; 2851, 6d.; 2854, 2d.; 2856, 2d.; 2858, 2d.; 2862, 2d.; 2863, 4d.; 2865, 4d.; 2870, 2d.; 2871, 2d.; 2872, 4d.; 2873, 2d.; 2177, 2d.; 2879, 10d.; 2830, 2d.; 2889, 6d.; 2932, 4d.; 2939, 8d.; 3251, 6d.; 3251, 6d.; 4612, 8d.; 4729, 6d.

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

ABSTRACTS OF SPECIFICATIONS.

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

2333. Navigable Vessels, *J. F. Jacques, London.*—27*th May*, 1881.—(*A communication from W. Atwood, Troy, U.S.A.*) 4*d.*

This consists in constructing a vessel of sufficient beam to carry one or more propellers, laterally in the centre of the vessel and beneath the water line.

2458. Displaying Advertisements in Cabs, &c., *H. H. Banyard, London.*—4*th June*, 1881.—(*A communication from J. I. Czettel, Vienna.*) 6*d.*

This relates to means for enabling passengers to change the advertisement exhibited through an aperture in a suitable case, by pulling a cord and so withdrawing a pawl from a ratchet wheel, when a spring effects the shifting of the band which bears the different advertisements.

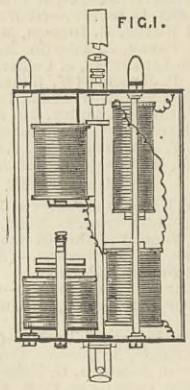
2484. Neutralisation of Currents in Telegraph and Telephone Lines, *W. P. Thompson, Liverpool.*—*June* 8*th*, 1881.—(*A communication fron F. V. Rysselberghe, Brussels.*)—(*Not proceeded with.*) 2*d.*

The reception coils are made of enormous resistance compared with the line, hence, the inventor states, the inductive currents will be practically neutralised.

2563. Improvements in Electric Lamps, *G. G. André, Dorking.*—13*th June*, 1881. 6*d.*

The feed of the carbons is regulated by the amount

2563 FIG.1.

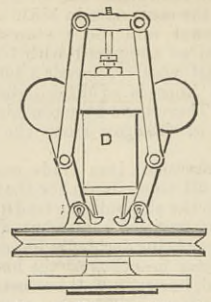


of friction of the armatures of electro-magnets. The figure shows the arrangement.

2656. Governors for Motive Power Engines, *J. Bourne, London.*—17*th June*, 1881. 6*d.*

This relates to improvements on the spring governor patented 8th October, 1838, and also upon the modifications of this governor patented 30th June, 1870, No. 1859. It consists in neutralising, by means of adjustable springs contained in the box D (either in compression or tension), the centrifugal force generated in centrifugal spring governors until the intended normal speed of the engine has been reached, and thus

2656



preventing the action of the throttle valve until that speed is exceeded.

2674. Type Composition, Distribution, and Justification Machinery, *I. Delcambre, Brussels.*—18*th June*, 1881. 6*d.*

The First part relates to loading the machine for a day's work by placing several reservoirs in a single slide, and when one is empty the slide is pushed a little, so as to present the next reservoir. To indicate when a line is ended a signal apparatus is placed on the outside of the frame and is operated by a spring inside the frame, so that when the line is filled the following letters will set off the signal apparatus, which may be operated by electricity or other convenient means.

2690. Lamps for Sewing Machines, *E. P. Alexander, London.*—20*th June*, 1881.—(*A communication from G. C. Desprin, Gironde, France.*) 6*d.*

The body of the lamp consists of a reservoir to receive the liquid to be burned, and to the centre of its cover is fitted a tube descending inside the same, and serving to supply the liquid and to indicate the level. Under the cover and at the rear side is a counterweight to maintain the proper steadiness of the lamp. The front of the reservoir has a large opening, to which is secured a horizontal tube in the form of a truncated cone, to the smaller outer end of which is fitted a cup with perforated sides to admit air, and over which fits the glass or chimney. To the side of the cup is fastened a curved wick tube. The reservoir fits into a recessed supporting plate made adjustable, so as to place the lamp in the most convenient position.

2694. Lamps for Railway Carriages, &c., *W. H. Bulpit, Birmingham.*—20*th June*, 1881. 6*d.*

This relates to means for rendering the ventilation more complete, so as to enable petroleum and other volatile oils to be employed. The bottom part of the guard glass is pierced with a hole to supply air, and is bulged upwards internally to serve as a guide for the air and as a protection against oil running down into the carriage. The lamp is suspended under the reflector by two light rods fastened to a plate at the back of the reflector, and which rises in a conical shape against the chimney, which projects downwards, the conical plate being perforated. A chamber is formed round the case, and within it air circulates freely, so as to keep the lamp cool.

2704. School Slates, *J. T. Walters, Bayswater, and W. Pickering, Strand.*—20*th June*, 1881. 4*d.*

This consists in marking divisions on the sides and ends of the frame, and in fitting a slide (either marked or plane) to move over the slate, whereby lines of any desired dimensions may be readily drawn on the slate.

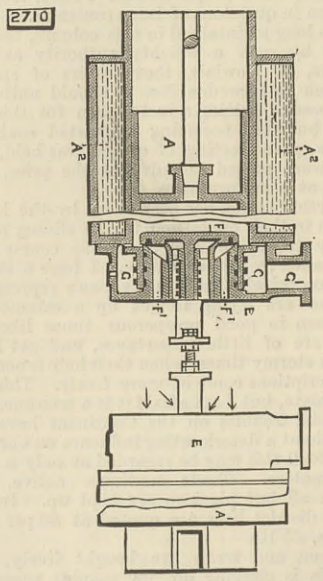
2708. Escapement for Watch and Clock Movements, *A. Browne, London.*—20*th June*, 1881.—(*A communication from E. Weasch, Vienna.*) 6*d.*

The escapement, instead of transmitting the motive power direct from the escapement wheel to the balance or pendulum, only serves to bend a spring, which, after being set free by means of the balance or pendulum, gives the impulse for the movement of this latter.

2710. Air-compressing Engines, *E. Holt, Radcliffe.*—21*st June*, 1881. 8*d.*

The drawing shows a side view half in section of the air compressing cylinders of the engine. A A^1 are two single air-compressing cylinders surrounded with water casings A^2. These cylinders are fixed concentrically with one another on the same bed plate, and are each fitted with deep pistons C, the respective rods of which pass out at the opposite open ends of the cylinders, and are there coupled respectively to

2710



crossheads, these crossheads being again connected together by side rods passing through guide brackets. The covers E are formed of cast iron, and are secured to the cylinders by flanges; they form boxes or casings for both the air inlet valves F and the air outlet valves G, whilst openings or passages F^1 are also formed in these covers for passage of the air entering the cylinders, and branch pipes G^1 are provided for carrying off the compressed air.

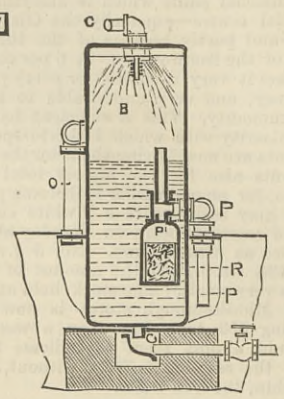
2713. Combing Machines, *J. C. Walker and J. E. Stephenson, Shipley, Yorkshire.*—21*st June*, 1881. 6*d.*

This relates to the feeding or filling head, and consists in dispensing with the feed rollers and applying a square motion feeding apparatus, consisting of a number of gills sliding freely within the feeding head, and moved forward by cams whilst the head is in motion, carrying the wool with them. Each gill after moving the required distance drops free of the material and is moved forward again to the other end and raised to its former position. Instead of cams, screws can be used to give motion to the gills. Rawson's filling head may be used in combination with the filling head described. The excentric which actuates the filling head is adjustable so as to regulate the stroke.

2717. Feed-water Heating Apparatus for Steam Boilers, *H. H. Lake, London.*—21*st June*, 1881.—(*A communication from E. J. Hall, Buffalo, U.S.A.*) 6*d.*

This consists in the combination with the steam boiler of a feed-water heater connected with the steam space of the said boiler by the pipe O, and with the water space thereof by the pipe P and the feed-water pipe C, terminating in the upper portion of the said heater, and provided at its mouth with a spray valve. The pipe P is provided, within the heater B, with a downwardly extending enlargement or exten-

2717



sion P^1, inside which is a filter R, whereby water is taken from a point sufficiently below the surface of the water to prevent the scum and other impurities which accumulate thereon from entering the feed pipe.

2720. Washing or Cleansing Wool, &c., *J. Petrie jun., Rochdale.*—21*st June*, 1881. 8*d.*

The cleansing liquid is contained in a trough, within which is placed a number of longitudinal stationary bars on which the material rests, and between which are other bars mounted so as to be capable of being raised and at the same time advanced in the direction of their length, and then lowered beneath the surface of the fixed bars, their motion being obtained by a crank and cam. The wool is thus caused to travel along the trough and then passes between squeezing rollers. Above the bars are plungers raised and lowered by cranks, and which act upon the wool so as to squeeze out the dirt or extraneous matter.

2722. Wax Thread Sewing Machines, *W. R. Lake, London.*—21*st June*, 1881.—(*A communication from G. W. Copeland, Boston, U.S.A.*) 10*d.*

The machine comprises a horn capable of revolution upon which the work is supported, stitch-forming devices, a needle feed, a presser foot, connecting mechanism whereby the presser foot and needle bar govern the position of the cast-off, and mechanism to operate the whirl. Further means for improving the method of sewing, and also movements whereby the length of stroke of the needle bar is determined by the position of the presser foot, and movements whereby the cast-off bar is adjusted automatically by the needle bar and presser foot.

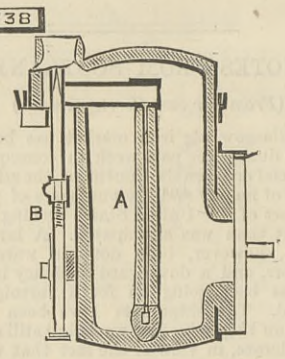
2735. Buckles, *J. Belicard, Manchester.*—23*rd June*, 1881. 4*d.*

This relates to buckles in which the strap is held by jamming or friction. To the central pin fixed to the frame is jointed the stationary part of the buckle, and on the pin is a movable jam, while on one end of the frame is jointed a locking lever. When the strap is held by the jam, the lever is revolved and locks the latter in position.

2738. Treating Bessemer Metal, *P. Jensen, London.*—22*nd June*, 1881.—(*A communication from Dr. H. Tholander, Sweden.*) 6*d.*

This consists in the mode of treating Bessemer metal in order to attain compactness and freedom from redshortness, according to which it is exposed to a

2738



partial vacuum in its molten state in the converter A, by the application of ejectors B or air pumps or other exhausting apparatus, and whether a converting chamber is used at the tapping or not.

2740. Refrigerating Apparatus, *A. S. Haslam Derby.*—22*nd June*, 1881. 10*d.*

This relates, First, to the construction and arrangement of the air expansion cylinder, the receiving chest and expansion chest, or snow box, of which are at opposite sides of the cylinder, or preferably one at the side and the other at top of the cylinder. This allows separate valves to be used for the supply and exhaust, whereby the former may be fitted with a variable cut-off, and the valves reduced to a small size, which diminishes the friction to a minimum and effects a saving of power. This arrangement permits short ports to be used in all connections in the exhaust, and the air expanding does not allow snow or ice to form in such ports and so obstruct the passage of air. Secondly, to starting gear to put the engine in motion when stopped on a dead centre, and it consists in forming teeth on the fly-wheel, and with which a pawl on a rocking piece engages, the latter being worked by a hand lever. Thirdly, to one air-compressing cylinder taking the water used to cool its surface direct from the condensing tank of the engine, the water circulating through helical passages in the jacket and through the covers and round the valves, the covers being fitted with suction valves with springs on the outside of the covers; and Fourthly, to a special arrangement of the parts constituting an air cooling or freezing machine, so as to secure compactness, efficiency, and easy access to all parts.

2745. Treatment of Fibrous Animal Matter for Manufacture of Manure, *E. Davies, Liverpool, and E. Massey, Dewsbury.*—23*rd June*, 1881. 6*d.*

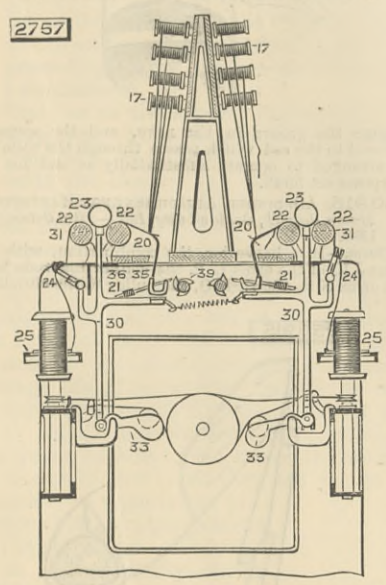
The fibres are heated in a closed vessel to from 350 deg. to 500 deg. F. in the presence of non-oxidising gas, preferably carbonic acid, and then they are removed and ground to powder.

2747. Purification of Water, *G. Bischof, Bloomsbury.*—23*rd June*, 1881. 4*d.*

This relates to improvements on patent No. 2137, A.D. 1879, in which the water was filtered through spongy iron mixed with other materials, and it consists in means for depriving the water of carbonic acid before it enters the filter, so as to prevent it carrying off with it any iron. One method consists in providing a small reservoir for lime water near the settling bed in which the water is allowed to settle. The lime water is allowed to flow into the settling bed and mix with the water, which, after settlement, is then passed to the spongy iron filter.

2757. WINDING, DOUBLING, AND TWISTING YARN OR THREAD, *J. and T. A. Boyd, Shettleston, Lanark.*—*24th June*, 1881. 8*d*.

This relates to improvements on patents Nos. 323 and 3386, A.D. 1880, and in the modification shown in the drawing the yarns to be doubled are drawn off bobbins 17, set on spindles fixed in longitudinal boards carried above the middle of the machine, and pass downwards to wire guides 20, forming part of detector levers 21, and thence between two continuously rotating feed rollers 22 and an upper feed roller 23, from whence they pass down through a



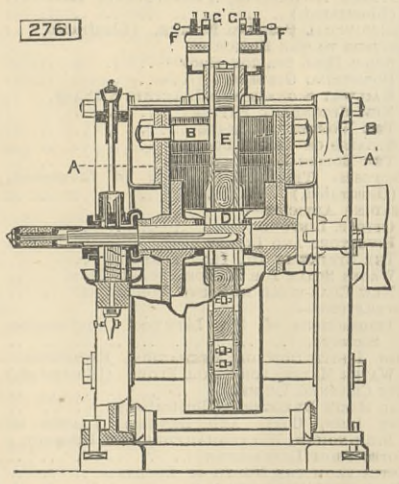
guide on lever 24, and then to the traveller of a ring 25 held by the traversing rail, or instead of the ring and traveller, a flyer or other twisting arrangement may be adopted. The stopping of the feed action when a yarn breaks is effected by a rod 30, having a cradle 31 on its upper end, which, when the yarn breaks, lifts the top roller out of contact with the bottom rollers, and stops the feed. The rod 30 is pressed upwards by counterweight 33, but is kept down by the detachable catch plate 35, engaging a similar plate 36. When a yarn breaks the levers 21 descend, and are acted on by the wiper shaft 39, and cause the catch plates to be disengaged. The counterweight lever 33 carries a pulley which tightens or slackens the driving cord.

2759. DOOR LATCHES, *S. L. Coales, Newport Pagnell, Bucks.*—24*th June*, 1881. 6*d*.

This relates to a door latch in which the bolt is released by lifting, pulling, or pushing, instead of turning the handle connected therewith.

2761. A NEW OR IMPROVED ELECTRO-MAGNETIC INDUCTION MACHINE FOR DIVIDING A DIRECT CURRENT INTO ALTERNATE CURRENTS, *L. A. Groth.* 24*th June*, 1881.—(*A communication from D. Lachaussée, Liege, Belgium.*) 6*d*.

The figure gives a sectional view of the machine. The machine consists of two plates A and A^1, which serve to support the revolving coils B, and which are separated by fixed drum D. In this latter are placed any suitable number of coils E. These coils are all independent of one another, and are contained in wooden boxes with gun-metal handles, and can be removed at any time, even while the machine is work-



ing. These coils are connected to separate terminals F to F^{24}, and are so arranged that only enough coils may be left in for a certain number of lights, or, if required, the whole coils can be joined up in tension or quantity by the terminals G and G^1. The advantages claimed for this machine are that all luminous points may be independent of one another, that different kinds of lights may be worked by the same machine, and that the latter does not heat.

2762. ADJUSTING ACTION FOR CHAIRS AND COUCHES, *T. Barnby, Birmingham.*—24*th June*, 1881. 4*d*.

This relates to rack actions for adjusting the back of chairs and the head and foot ends of couches, and it consists in making the rack by piercing or sinking the slots thereof in the form of a continuous scroll, or a series of curves, so that there are no angles or dead points to overcome.

2765. MOTIVE-POWER ENGINE, *J. Levassor, Paris.*—24*th June*, 1881. 4*d*.

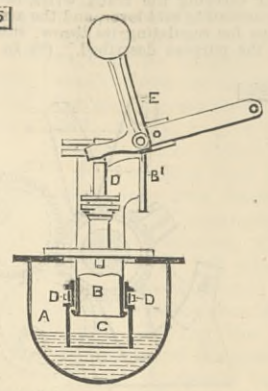
This relates to a motor in which the power is produced by the explosion of a detonating body from the effect of shock or heat. The detonating body is preferably fulminate of mercury, and it is placed in a granulated state in receivers, from which it is conducted to the bottom of a motive cylinder, where the shock of a piston explodes it, and the gases produced escape into the atmosphere, when the piston is at the end of its stroke.

2773. SPINNING AND TWISTING MACHINERY, *A. M. Clark, London.*—24*th June*, 1881.—(*A communication from P. Townson, Hartford, U.S.A.*) 6*d*.

The object is to automatically change the speed of the spindles when the bobbins are about two-thirds filled, and also to facilitate the stopping of the spindles when the flyers have been stopped, and it consists in combining with the main shaft and countershaft two sets of gear wheels, and a vibrating frame carrying two of the gear wheels, whereby the speed of the spindles can be changed by shifting the sets of gear wheels; also in the combination with the forked upper end of the vibrating frame of a cam and its driving mechanism, a two-toothed ratchet-wheel, and a pawl and its operating mechanism, whereby the cam is moved quickly as it vibrates the frame in changing the gearing to prevent the movements of the operating parts being interrupted; also in the combination with the spinning spindle of a double wheel and a weighted lever, whereby the spindle can be readily stopped; and also in the combination with the arms of the flyers of a guard ring, whereby the threads of adjacent bobbins are kept from being entangled.

2775. MANUFACTURE OF GAS, *J. Woodward, Manchester.*—25*th June*, 1881. 6*d*.

This relates to arrangements for opening and closing the communication between each retort and the "hydraulic main," by causing a "head" of the liquid in the main to close the outlet from the dip pipe when the retort is opened. A is the hydraulic main, and B the dip pipe, partly within and partly without the



main. The exterior part has a bend and flange B^1 to connect it to the retort pipe. Its upper end has a lid to allow for cleaning, while the lower end forms a seat for the valve C, the lower end of which dips into the liquid in the main. The valve is lifted by a forked rod D controlled by a weighted lever E.

2785. SLEEPERS FOR RAILWAYS AND TRAMWAYS, *C. G. Clarke, Kingston-upon-Hull, Yorkshire.*—25*th June*, 1881.—(*Not proceeded with.*) 2*d*.

The sleepers are composed of concrete, asphalte, or artificial stone, and upon them the rails are supported with packings of an elastic nature.

2786. KILNS, *T. Carder, Chudleigh, Devon.*—25*th June*, 1881. 6*d*.

A series of arched kilns are arranged in succession or in an elliptical or circular form, and each connected with a chimney and provided with arrangements for feeding it with a hot blast of highly heated air. Special means are provided for opening or shutting off communication between the different kilns.

2789. ROLLER FOR ROLLER BLINDS, *H. Otway, Surrey.*—25*th June*, 1881.—(*Not proceeded with.*) 2*d*.

This relates to curved rollers to allow the blind to follow the curve of the window, and it consists in placing loosely upon a curved roller a number of short rollers fitting loosely into rings, and all connected by pins passing from one to the other. To the first segment of the curved roller is fixed the spring or pulley to wind up the blind which is fixed to the loose rollers.

2790. EVAPORATING AND DRYING APPARATUS FOR TREATMENT OF SEWAGE, *G. W. von Nawrocki, Berlin.*—25*th June*, 1881.—(*A communication from J. Swiecianowski and S. Adamczewski, Warschau, Poland.*) 6*d*.

A number of evaporating pans are arranged in an oven on each side of a central bridge, each pair having a fire-grate; and there are two drying rooms divided into chambers corresponding in number to the pans. The space under each pan is divided into two flues, one containing a grate and the other pipe systems to heat air, and is by a flue connected with the firing space under the next pan, and by another flue with a main smoke flue leading to a chimney or condenser.

2792. CARRIAGES, *A. B. Dalzell, Pall Mall.*—25*th June*, 1881. 6*d*.

This relates to hansom cabs, and consists in making the sides of the upper part in plan curved to the arc of a circle, the centre of which is about the centre of the front of the seat. The opening in front is the same width as the back of the cab. To close in the upper part of the front two glazed frames, curved like the sides, are employed, and can be slid round in guides at top and bottom, so as to meet in front. The lower part of the opening in front can be closed by a flap or door hinged to the foot-board.

2794. LOOMS, *W. H. Beck, London.*—25*th June*, 1881.—(*A communication from J. C. N. Mouret, Esquennoy, France.*) 6*d*.

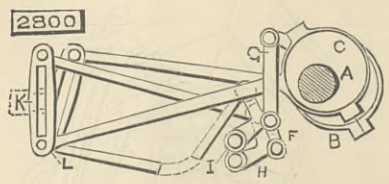
The unwinding of the warp is effected by the movement of the loom itself, in proportion as the manufacture of the cloth goes on, by an arrangement of mechanism in which cords, chains, levers, or steelyards are suppressed.

2799. STEAM BOILERS, *R. Thompson and J. Watson, Liverpool.*—27*th June*, 1881.—(*Not proceeded with.*) 2*d*.

This relates to means for economising fuel, and also of space on board ship, to the saving of first cost and repairs by simplicity of construction, and to the decrease in liability to break down by using dry steam instead of wet, and it consists chiefly, First, in placing a boiler above an ordinary boiler, each of them having separate water spaces, so that the water of the one is independent of that of the other, while their steam spaces are in communication; Secondly, in fitting the upper boiler with tubes, preferably horizontal or inclined, through which the products of combustion from the lower boiler pass, whereby the steam is dried or superheated.

2800. REVERSING GEAR OF ENGINES, *G. P. Renshaw, Nottingham.*—27*th June*, 1881. 6*d*.

In the drawing A is a cranked axle, B the fore excentric giving motion forward to, say, the right-hand engine; C the back excentric, giving motion backward to, say, the left-hand engine; then as the cranks are (as usual) at right angles, it follows that a link F and lever H moved at a suitable angle from the



forward excentric B will serve to actuate the upper end of the link K, and in like manner a link G deriving its motion at a suitable angle from the excentric C will serve to actuate through the lower end of the link L the B engine for its back gear motion through the link G and lever I.

2802. WEAVING, *O. Drey, Manchester.*—27*th June*, 1881.—(*Not proceeded with.*) 4*d*.

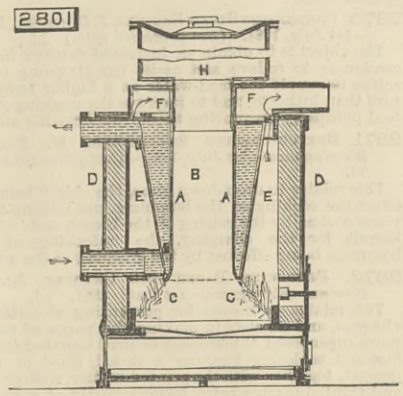
This relates to the manufacture of velvet in which the pile is formed by cutting the face or pile weft picks, and it consists principally in floating the face or pile picks over six, ten, or any other even number of warp threads, which is double an odd number, and not too large for practical purposes, and working all the warp threads in pairs, by which means a variety of new cloths may be produced.

2803. HULLING AND CLEANING RICE, *R. Douglas and L. Grant, Kirkcaldy, Fife.*—27*th June*, 1881.—(*Not proceeded with.*) 2*d*.

The object is to form an apparatus which will occupy less room than the ordinary apparatus, and it consists in enclosing within a casing three or more millstones or discs covered with a suitable cement composition, the stones or discs being placed one over the other, and so arranged with reference to the central spindle that either the middle one will revolve and the other two remain stationary, or the top and bottom stones revolve and the middle one remain stationary.

2801. CIRCULATING WATER BOILERS, *F. Hocking, Liverpool.*—27*th June*, 1881. 10*d*.

This consists in an arrangement whereby the furnace is automatically fed with fuel. The boiler is in the form of a tapered closed cylinder A, in the centre of which is a fuel feeding pipe B. The boiler is mounted with its broad end upwards over the fireplace C, and



is surrounded with a fire-clay or water casing D, between which and the boiler is left the uptake E to allow the products of combustion to pass into the smoke-box F. Above the latter and connected with the feeding pipe B is placed the fuel hopper H, so that the fuel can pass automatically down on to the grate C.

2805. DEAD-EYES AND ROPE ATTACHMENTS, *H. J. Haddan, Westminster.*—27*th June*, 1881.—(*A communication from W. P. Healey, Mass, U.S.A.*) 6*d*.

This relates to a dead-eye cast in one piece, and provided with a chamber, rope-eyes and their terminal grooves, and also with a metallic socket piece open at one end and having a filling inlet at its bottom, such socket piece being used in combination with a wire rope chambered and introduced therein, a metallic filling being cast in the inlet and into and around the rope.

2807. IMPROVEMENTS IN TELEGRAPH CABLES AND OTHER CONDUCTORS, *A. C. Ranyard, London, and J. A. Fleming, Cambridge.*—27*th June*, 1881.—(*Not proceeded with.*) 2*d*.

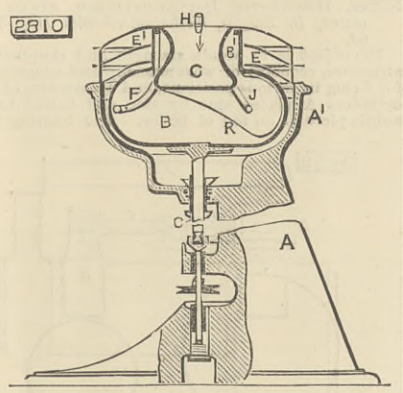
This consists in using manilla or other rope fibre in combination with "paraffine butter"—that is, a composition of paraffine mixed together at different boiling points, so as to render it always soft—as a covering for the wires of a cable.

2809. CEMENT, *W. Joy, Aylesford, Kent.*—27*th June*, 1881. 8*d*.

This relates to improvements on patent dated 25th Sept., 1877, and consists of a floor on which slurry is to be dried, formed in a longitudinal chamber built nearly on a level with the top of the kiln, which is covered with a roof forming part of the drying floor, and over which part of the said chamber extends. Beneath the floor is formed a flue communicating at one end with the interior of the kiln and at the other end with the interior of the chamber, which communicates with chimneys, one of which is built at the end nearest the kiln, and the other at the end farthest from the kiln. Dampers are provided in the flues to open and shut off the communication.

2810. APPARATUS FOR SEPARATING FLUIDS OF DIFFERENT SPECIFIC GRAVITIES, *F. H. F. Engel, Hamburg.*—27*th June*, 1881.—(*A communication from G. de Laval, Stockholm, Sweden.*) 6*d*.

A is a cast iron column provided with a broad base and surmounted by a hemispherical basin or shell A^1; B is a centrifugal chamber or vessel fixed upon a vertical shaft C, and adapted to rotate rapidly in basin A^1. B^1 is a cylindrical prolongation or neck of chamber B, and is furnished with two discharge openings which communicate respectively with annular receptacles E E^1, arranged one above another around the neck B^1. F is a pipe leading from near the internal periphery of the centrifugal vessel B to the mouth of neck B^1, to the side of which it is secured. G is a supply reservoir suspended into the



neck or prolongation, and supported by the upper edge thereof. This reservoir is supplied with the compound fluid through a pipe H, or by any other convenient mechanical arrangement; and extending from reservoir G down into and out toward the periphery of the chamber B is a pipe J, through which the fluid enters said chamber. R is a radial blade.

2811. PAPER-CUTTERS OR KNIVES, *J. Gruneke, Paris.*—27*th June*, 1881.—(*Not proceeded with.*) 2*d*.

Sheets of cardboard are printed with advertisements and cut to the form of a paper-knife, after which they are steeped in gum, size, or paste, and pressed between heated moulds so as to render them hard and produce a sharp edge.

2812. SEWING MACHINES, *T. J. Denne, Red Hill, Surrey.*—27*th June*, 1881. 6*d*.

A top shaft has fixed to it the shuttle-cam which works a vibrating lever which gives rocking motion to a lower shaft by means of a lever connected to the vibrating lever by means of a plunger. To the other end of the rocking shaft is fixed another lever to give motion to the shuttle through a link connected to the carrier. The top shaft can be worked by treadle or hand. On the top shaft is a cam actuating a roller to give motion to the needle slide. Two levers are fixed to the upper part of the frame and are actuated one by a projection on the cam, and the other by the edge of same, the levers serving to work the presser foot. To work button-holes a pinion is fixed on the main shaft and gears with a wheel of double its size, and having a cam on its face to actuate a lever connected to a second lever which is attached to a pressure-foot or slide.

2822. PUMPS, *E. Wolf, New Bond-street.*—28*th June*, 1881.—(*A communication from G. Wolf, Missouri, U.S.A.*)—(*Not proceeded with.*) 2*d*.

This relates, First, to a novel construction of pumps; Secondly, in the combination therewith of registering apparatus; Thirdly, to the construction of an extensible spout adapted to connect the discharge pipe of pump with various heights of cans, bottles, or other receptacles.

2824. RATCHETS, *C. Geddes and P. Sword, Liverpool.*—28*th June*, 1881. 6*d*.

A ratchet toothed wheel is fixed on a shaft which projects on each side, and on it is mounted a lever with a boss surrounding the wheel, the eye of the boss being of oval shape longitudinally with the lever, and has cut therein one, two, or three teeth at the handle end of the boss and a corresponding number at the opposite end. These teeth correspond with those of the ratchet wheel, and when the lever is upright the upper teeth are in gear with it, and when the lever hangs down the lower teeth are in gear.

2825. SEPARATING IRON, STEEL, OR MAGNETIC OXIDE FROM OTHER SUBSTANCES, *B. Hunt, Glasgow.*—28*th June*, 1881.—(*A communication from J. King, Carrigal, Bajo, Chili.*) 6*d*.

As applied to apparatus for separating bits of wire from grain, there is a hopper to receive the grain and from the bottom, of which it is supplied, in a well regulated stream to the upper end of an inclined shoot, the bottom of which is made up of sheet zinc or brass, and beneath which there is a series of magnets. At the lower end of the series of magnets the shoot bottom is curved round, and there is an opening for the iron bits to pass off by, whilst beyond the opening the shoot is continued without any magnets.

2827. FELTED AND FULLED MATERIALS EMPLOYED IN THE MANUFACTURE OF HATS, &c., *W. H. Beck, London.*—28*th June*, 1881.—(*A communication from La Société A. Ruffin and Cie., Paris.*)—(*Not proceeded with.*) 2*d*.

This consists in applying by batting a covering of wadded silk to felt composed of any material capable of being fulled, and afterwards fulling the felt so covered, and then steaming or shrinking it in order to render the silk floating.

2829. HULLING AND CLEANING RICE, *J. Halliday, London.*—28*th June*, 1881.—(*Not proceeded with.*) 2*d*.

A cylinder revolves with its outer surface in proximity to one or more fixed frames, the surface of which, as well as that of the cylinder, is faced with the cement usually employed to hull rice. Below this hulling apparatus is a winnowing chamber containing a fan.

2832. LAUNDRY IRONS, *F. A. K. Cook, Londonderry.*—28*th June*, 1881. 6*d*.

This relates to a combined smoothing and glossing iron, and consists of a hollow iron body tapered at each end, at one of which is a curved and tapered projection to effect the polishing. The iron is heated internally by jets of vapour or gas.

2833. IMPROVEMENTS IN INCANDESCENT LAMPS, &c., *G. G. André, Dorking, and E. Easton, Westminster.*—28*th June*, 1881.—(*Not proceeded with.*) 2*d*.

The inventors use vegetable substances, such as rushes, grass stems, &c., for the carbons, and stretch them between two metallic conductors in a straight line, instead of the curved or horseshoe form usually adopted.

2835. ENDLESS OR BAND SAWS, *J. H. Johnson, London.*—28*th June*, 1881.—(*A communication from H. Tuyssuzian, Paris.*—(*Not proceeded with.*) 2*d*.

The object is to enable band saws to be passed through holes in plates, for example, and it consists in joining the two ends, so that they may be detached, by forming them with interlocking hooks, the overlapping parts being so reduced that the point will be of the same thickness as the rest of the saw.

2837. DYEING, *W. E. Gaine, Hammersmith.*—28*th June*, 1881. 4*d*.

In dyeing black the tannin is dissolved with an alkaline salt the fabric prepared with the solution, and then passed into sulphate of iron, and afterwards exposed to the action of an alkali, whereby the action in the iron solution is rendered rapid, and by the alkali the colour is intensified and permanently fixed.

2838. PURIFICATION OF COAL-GAS, *C. F. Claus, London.*—28*th June*, 1881. 4*d*.

This relates to removing carbonic acid and sulphide of hydrogen from coal-gas by means of anhydrous ammonia, or ammoniacal gas obtained from purified gas liquor.

2841. PLAIN AND MIXED REPPS, &c., *J. Horrocks, Bolton.*—29*th June*, 1881. 4*d*.

This relates to the manufacture of plain and mixed repp cloth, and in the method of weaving the same by introducing an additional warp, the yarns of which are conducted between the ribs of the cloth, so as to form a stitch, the effect of which is to prevent the threads being pulled apart or giving way under pressure.

2842. MOTIVE-POWER ENGINE, *G. O. Topham, Maida Vale.*—29*th June*, 1881.—(*Not proceeded with.*) 2*d*.

This relates to a motor which will enable the utilisation of the pressure of water in mains, or from a fall of water, or otherwise, or from compressed air. The engine consists of four plates hinged together in pairs at one end, the two inner and the two outer plates being also hinged to each other at the opposite end, so as to open like a book. Each pair is surrounded at the edges by a flexible material, so as to form collapsible and expansible spaces connected by a flexible tube, a suitable inlet and outlet being provided for the fluid.

2843. INDICATING AND RECORDING WORDS AND SYMBOLS, *J. M. Jones, Battersea Park-road.*—29*th June*, 1881. 4*d*.

A box has one side made of glass, and contains at one end a roller with spring attachment, and on which a length of paper is wound. The paper can be wound off on to a second roller actuated by a crank, and causing a bell to be sounded when the desired length has been wound on. Words can be written on the paper through holes in the glass.

2846. IMPROVEMENTS IN APPARATUS FOR TRANSMITTING SOUND BY MEANS OF ELECTRICITY, *E. J. Paterson, London.*—29*th June*, 1881.—(*Not proceeded with.*) 2*d*.

The inventor does away with the diaphragms generally used, and substitutes blocks of carbon fixed firmly to a base, said blocks being connected by carbon rockers, and the bases being in connection with the two poles of the battery. The sound waves are thus made to impinge directly on the carbon without the intervention of the diaphragm.

2848. IMPROVEMENTS IN THE TREATMENT OF CARBON FOR ELECTRIC LIGHTING AND OTHER PURPOSES, *J. G. Lorrain, London.*—29*th June*, 1881. 4*d*.

This invention consists in improving the carbons by impregnating or coating them with precipitated carbon, so as to fill up the interstices, the carbons being first saturated with some hydrocarbon, which is then decomposed by the action of chlorine gas.

2849. PURIFICATION OF COAL GAS, *J. G. Hawkins, Wigan.*—29*th June*, 1881. 4*d*.

The object is to produce a continuous revivification in the purifiers of the oxide of iron employed without injuriously affecting the quality of the gas, and it consists in causing a regulated quantity of air to be forced in with the gas into the purifiers, the air having been first brought into intimate contact with the tar produced, so that it has become saturated with the more volatile hydrocarbons.

2850. TREATING FISH FOR USE AS MANURE, *S. D. Cox, Woolwich.*—29*th June*, 1881. 6*d*.

The waste fish is subjected to the action of steam until thoroughly cooked and the albumen is completely set, when it is cut into small particles and subjected to the action of a hydro-extractor, and dried upon a floor if necessary. The dried fish is then reduced to a powder.

2851. IMPROVEMENTS IN ELECTRIC LIGHTING, *W. R. Lake.*—29*th June*, 1881.—(*A communication from J. J. Wood, New York.*) 6*d*.

Fig. 1 gives a side view of this arc lamp. The carbons are controlled by the electro-magnets and

core on the right hand side, which core is attached to a lever working a train of wheels as shown. Fig. 2 gives an end view of the regulating electro-magnets, showing dash-pot to prevent the too sudden motion of lever. A stop shown in Fig. 1 limits the movement of

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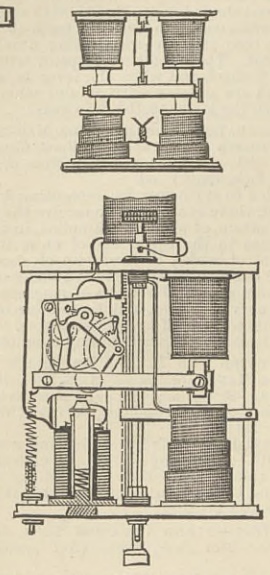

the core. Should the regulating mechanism of the carbons stick, or the latter become broken by any means, the left-hand electro-magnet will no longer hold its core depressed, and the latter will make contact with the point immediately above it, and as a consequence, "the branch or safety circuit," as the inventor calls it, through the electro-magnet at the top, will be closed.

2854. BATHS, &c., *L. A. Brode and R. Muir, Glasgow. 30th June*, 1881.—(*Not proceeded with.*) 2*d.*

Slabs of marble are built up to the shape of the bath and a mould formed round it, leaving a space to be filled in with a liquid cement or artificial stone.

2856. SPINDLES FOR DOUBLING MACHINES, *L. A. Groth, London.*—30*th June*, 1881.—(*A communication from W. Schmid, Italy.*—(*Not proceeded with.*) 2*d.*

The spindle is formed with a channel and arm for twisting the yarn as usual, and it is placed in a bearing at an angle of about 50 deg., a collar bearing, below which the whirl spindle and flyer is applied, serving as a second bearing to support the inclined spindle. The inclined position causes the spool on it to remain stationary.

2858. LAMP AND BURNER FOR CULINARY PURPOSES, &c., *F. J. Cheesborough, Liverpool.*—30*th June*, 1881. —(*A communication from C. Fritz and Co., Vienna.*) —(*Not proceeded with.*) 2*d.*

This consists essentially of two vessels, one placed within the other and both supplied with any suitable combustible fluid. The ignition of the fluid in one vessel heats the liquid in the other vessel, thus generating gas which issues from its holder, and lights itself from the surrounding flame of the burning liquid in the other holder, and gives a powerful and very hot flame.

2862. FELTING HAT BODIES, &c., *G. Atherton, Stockport.*—30*th June*, 1881.—(*A communication from G. Yule, Newark, U.S.A.*)—(*Not proceeded with.*) 2*d.*

This relates to apparatus wherein rollers are used in the felting or "planking" of hat bodies and other articles, and it consists in the first place in loading the upper roller by means of a weighted lever; and in the Second place the roller frame is arranged to be raised and lowered, in order that the goods may be immersed in the liquid in the kettle during the felting operation.

2863. MANUFACTURE OF DYE-PRODUCTS FROM INDIGO AND SULPHO-CONJUGATED DERIVATIVES OF ANILINE, *A. M. Clark, London.*—30*th June*, 1881.—(*A communication from C. Collin, Paris.*) 4*d.*

This consists in obtaining a series of dye-products by the mixture of indigo or indigotine, or sulphate of indigo or indigo carmine with any reducible blue obtained from an alkaloid derived from coal tar, and more especially from any one of the sulpho-conjugated derivatives of aniline, and among others "noir-bleu."

2865. PURIFICATION OF COAL GAS, *C. F. Claus, London.*—30*th June*, 1881. 4*d.*

This consists, First, in employing carbonic acid from extraneous sources sufficient to produce a quantity of bicarbonate of soda and ammonia respectively equivalent to the acid impurities in the coal gas which is to be purified by ammonia; Secondly, the distillation of the chloride of ammonium with lime for the production of anhydrous gaseous ammonia for the purpose of purifying coal gas of its acid impurities; Thirdly, in the purification of coal gas by gaseous ammonia, the regulation of the supply of ammonia in such a manner that it shall not be greatly in excess of the chemical equivalent of the acid impurities in the gas; fourthly, in the purification of coal gas by gaseous ammonia, the employment of mixing chambers of large dimensions, through which the gas passes together with the ammonia; Fifthly, the heating in closed vessels of chloride of calcium for the purpose of expelling the ammonia from the chloride of calcium in a fit condition for further use.

2879. IMPROVEMENTS IN RAILWAY SIGNALLING, &c., *E. Tyer, Dalston.*—1*st July*, 1881. 10*d.*

This invention relates to a means of signalling with incandescent electric lamps, which can only be lighted by the actual passage of the train itself, and only keep alight for a certain time after its passage, thereby effecting an economy in lighting as well as insuring the efficiency of the signals. Near a signal cabin the inventor provides a battery, which is connected with the electric lamps on the signal post, and also with two contact-making and breaking relays. When a train is about due, the levers, worked by the signalman, employed for setting the ordinary day signal makes an electrical connection, and transmits a current, which by acting on the relay near the signal, post shifts its contact, so as to connect the battery to the green lamp—for instance—but does not complete

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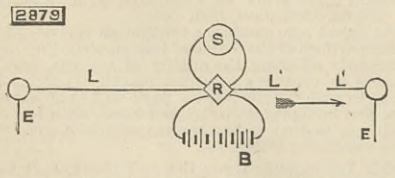

the circuit thereto. At some distance in advance of the signal a contact apparatus is provided, which by the deflection of the rail caused by the passage of the train, causes a current to be transmitted to the second relay near the signal post, and completes the circuit of the lamp, at the same time that it closes a local circuit extending to a second contact apparatus under the rails, at a suitable point beyond the lamp, and nearer to the signal-box. Thus the train by its passage having rendered the electric lamp incandescent and the green light visible, passes on until it comes to the second contact apparatus, which breaks the local circuit mentioned above, the second relay resumes its normal position and the lamp circuit is broken, the lamp consequently being extinguished. The diagram will explain the working of the apparatus. L L' signify line of rails, A and C are two contact apparatuses before and after signal at S, E represents earth connection, B battery, and R relay. The arrow indicates the direction in which the train is going. Several modifications of the above are described, and detailed drawings of the apparatus given in the specification.

2870. CONDENSING STEAM ENGINES, *J. Chapman, Leith.* —1*st July*, 1881.—(*Not proceeded with.*) 2*d.*

The object is to obtain an increased vacuum in the condenser to relieve and assist the air pump in its action to supply the feed-water at a higher temperature than hitherto, and to improve the working of the feed pumps by preventing them from drawing air.

2871. BREECH-LOADING SMALL-ARMS, *W. Tranter, Birmingham.*—1*st July*, 1881.—(*Not proceeded with.*) 2*d.*

This relates to drop-down guns, the object being to effect the cocking of the hammers and locking them when cocked by the raising of the breech ends of the barrels for the charging, the unlocking of the hammers being effected by the grasping of the gun.

2872. PREPARING PAPER FOR CHEQUES, &c., *F. Nowlan, Soho-square.*—1*st July*, 1881. 4*d.*

This relates to means for preventing alteration of cheques, and consists in making the paper of two or more superposed thicknesses secured together face to face and enclosing together a tinted, lined, or other ground, together with the printed matter, such ground and printed matter being formed partly of a permanent or chemically unalterable pigment, and partly of another pigment of such a nature as to be visibly acted on by any reagents capable of attacking writing ink.

2873. LOCKING THE NUTS OF BOLTS OF RAIL-JOINTS, *H. Wedekind, London.*—1*st July*, 1881.—(*A communication from L. Imperatori, Milan, and C. Buelowius, Bochum.*)—(*Not proceeded with.*) 2*d.*

The nut is formed with radial teeth or grooves on its inner surface, and between it and the fish-plate is interposed a spring washer with similar teeth or grooves.

2877. CASTORS FOR FURNITURE, *H. B. Harding, Birmingham.*—1*st July*, 1881.—(*Not proceeded with.*) 2*d.*

This relates to ball-and-socket castors, and consists in making the ball either hollow or of some light material with a metallic case.

2880. ORNAMENTAL GLASS, *T. D. McD. Farrall, Bermondsey.*—1*st July*, 1881.—(*Not proceeded with.*) 2*d.*

This consists in the application to glass for decorative purposes of metals in various states combined with alkalies, enamels, calcareous or other substances, the whole being welded or secured together by the application of heat.

2889. COMBINED BED, COUCH, AND CHAIR, *C. W. Torr, Birmingham.*—2*nd July*, 1881. 6*d.*

The chair consists of the seat, head, and foot parts together with a framing for supporting them. The head and seat are jointed together and also the foot and seat. The head and foot parts are each provided with counterbalance weights so that they can easily be moved into any required position. The edges of the head part have rods fixed to them forming prolongations downwards of the sides, their lower ends being secured to connecting-rods jointed to the lower end of the foot part, so that the head and foot parts are moved together. The position of the head part is regulated by a rack.

2932. WHITE METAL AND MALLEABLE BRONZE, *J. C. Mewburn, London.*—5*th July*, 1881.—(*A communication from La Société Raynaud, Bechade Girè and Co., Paris.*) 4*d.*

This relates to the manufacture of a white metal and a laminable or malleable bronze by the decoloration of copper by means of ferro-manganese.

2939. MACHINES FOR MINCING MEAT, &c., *H. Dollman, Birmingham.*—5*th July*, 1881. 8*d.*

Within a cylindrical case is mounted a hollow axis, within which is a solid axis, the latter being caused to revolve more rapidly than the former. The hollow axis is fitted with a screw to convey the meat from one end of the case to the other, it being acted on in its passage by knives fixed in the case, and as it issues through holes in a plate at the outer end of the case knives on the solid axis act upon it and thoroughly mince the same.

3258. HORIZONTAL DOUBLE-CYLINDER STEAM ENGINES, *D. Halpin, Westminster.*—26*th July*, 1881. 6*d.*

The object is to obtain strength and simplicity of structure, economy of workmanship and adaptability for fixing in various positions, and it consists of two cylinders A placed side by side and bolted to the saddle piece C on top of boiler. The framing E at

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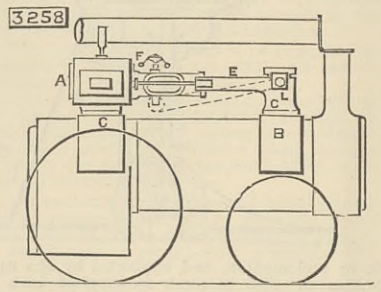

one end is formed with a flat face F forming the cylinder covers, and at the other end with feet G to secure it to saddle pieces B. The part of the frame next the cylinders is bored with two cylindrical cavities to form guides for the two crossheads, and at the sides holes are bored to guide the slide rods. The other end of the frame is bored transversely to form bearings for the crank shaft L.

3251. SUPPLYING WATER TO MARINE ENGINES, *D. Halpin, Westminster.*—25*th July*, 1881. 6*d.*

The water for the engines is drawn from outside the vessel through a water-tight syphon chamber formed within the vessel close to the side, and extending from below the water-line up some distance above it, and this chamber is divided into two channels by a vertical partition. At the bottom of one channel an aperture opens outwards to the water, which passes upwards above the water-line, over the partition, and down the channel on the other side.

4612. STEAM PRESSES FOR COLOURED PRINTING, *L. M. Schmiers, Leipzig.*—21*st October*, 1881.—(*A communication from Schmiers, Werner, and Stein, Leipzig.*)—(*Complete.*) 8*d.*

The paper to be printed on is rolled upon an excentric cylinder, which is caused to revolve once for each revolution of the cylinder carrying the printing plates, which consists of a polygon, on the sides of which the printing plates are secured. The cylinder revolves twice for each print, bringing the plates twice in contact with the colour rollers, whereas the excentric cylinder revolves only once, and stops during the second revolution for giving time to put fresh paper on.

4729. LOWERING AND RAISING SHIPS' BOATS, *A. M. Clark, London.*—28*th October*, 1881.—(*A communication from R. H. Earle, Newfoundland.*) 6*d.*

The apparatus consists of a swinging frame and gravity cradle for carrying the boat bodily, and these are combined with davits in such manner that either can be used independently.

SELECTED AMERICAN PATENTS.

From the United States' Patent Office Official Gazette.

9951. REVERSING GEAR FOR STEAM ENGINES, *Andrew J. Hoag, Battle Creek, Mich., assignor to Nichols, Sheppard, and Co.*—*Filed November 7th*, 1881.

Claim.—(1) The combination with the valve-rod and the lever carrying the crank wrist, of the rod and lever for actuating said lever, and the arm and adjustable stops for regulating its throw, substantially as and for the purpose described. (2) In a reversing

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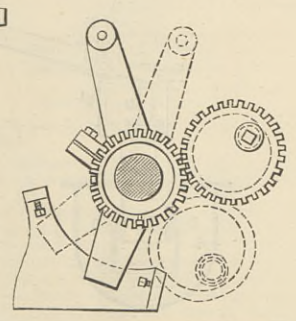

gear for steam engines, the two gears, of equal diameters, mounted one on the main engine shaft and the other upon a lever, adjustable around said shaft as a centre, and carrying the crank wrist, to which the valve-rod is connected, in combination with stops limiting the throw of said lever. (3) In combination with the lever, the gear wheels, and the valve-rod, the segmental guide and adjustable stops, substantially as and for the purposes specified.

250,394. COMBINED HAY-RAKE AND ELEVATOR, *Franklin F. Royer, Hampton, Iowa.*—*Filed April 16th*, 1881.

Claim.—(1) The combination, with the front elevator and standards secured to a carrying-frame, said standards provided with a series of notches and a guard covering the same, of a rod supported in loops attached to the underside of the elevator and adapted to be inserted in the slots or notches in said standards, substantially as set forth. (2) The combination, with a double-toothed hay-rake, main elevator, and vertically-adjustable narrow elevator, of yielding strippers attached to the upper end of the main elevator frame, and the inclined chutes R R, each provided with stationary sides and bottom,

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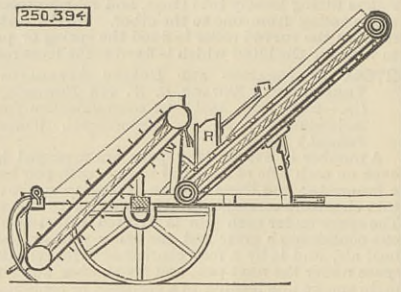

and supported on standards attached to the supporting frame, substantially as set forth.

250,554. ARMATURE FOR DYNAMO-ELECTRIC MACHINES, *James B. Livingstone, New York, N.Y.*—*Filed March 11th*, 1881.

Brief.—The armature cores are made in spiral form, the object being to increase the length of the cores without increasing their diameters. *Claim.*—(1) In an armature for a dynamo-electric machine, a series of spiral cores having their outer ends arranged at equal distances apart, in the circumference of the armature, substantially as specified. (2) In an

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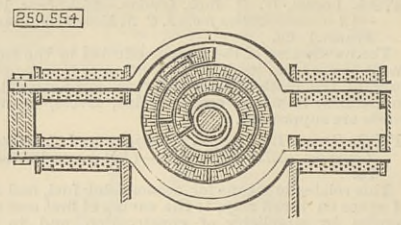

armature for a dynamo-electric machine, a series of spiral cores having their outer ends pointing alternately in opposite directions, as herein specified. (3) In an armature for a dynamo-electric machine, a series of coned spirals overlapping each other, as herein specified. (4) In a dynamo-electric machine, an armature composed of a series of spiral cores having their ends twisted to form a fan, as herein specified.

250,786. FEEDING MECHANISM FOR THRASHING MACHINERY, *John P. Cobb, College City, Cal.*—*Filed September 6th*, 1881.

Claim.—(1) In combination with an elevator-belt adapted to carry straw to the thrashing machine, the

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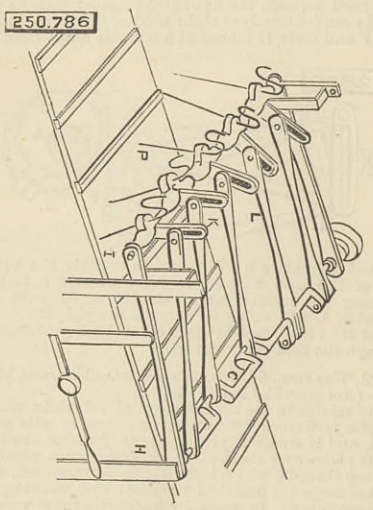

side bars H, axle I, independent oscillating hubs or sleeves J, having pickers or tines P, and arms K connecting L, cranks G, and revolving shaft E, arranged substantially as and for the purpose herein described.

250,803. SUNSHADE HAT, *Gonsalvo R. Gray, Brooklyn, E. D., N. Y., assignor of one-half to John Van Nordstrand, same place.*—*Filed May 16th*, 1881.

Claim.—(1) A collapsible sunshade provided with extensible supports secured at their lower ends to a flexible band to encircle the head, and hinged at their upper ends to the braces of the shade-top, substantially as set forth. (2) The combination, with the cover, braces, and ribs of the shade-top, of the grooved nave to which the braces are hinged, the thimble to which the ribs are hinged, the spring catches attached to said thimble and arranged to

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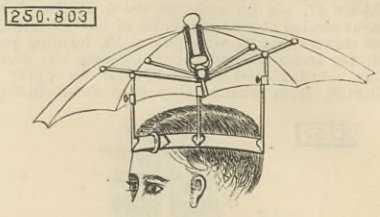

engage the groove in the nave, and the spreader secured to the rod which passes through the thimble, all arranged to operate substantially as and for the purposes set forth.

250,915. AID-BINDER ATTACHMENT FOR HARVESTERS, *Mason Hedrick, Oakland City, Ind.*—*Filed October 1st*, 1880.

Claim.—In a harvester, the combination, with the arms J K, of the arms L P, the connecting rods M Q, the arms N R, the shaft O, the pulley S, the clutch X,

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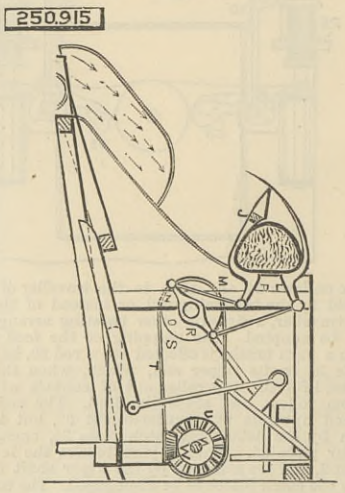

the band T, the pulley U, the shaft V, and the gearwheels W, whereby the arms J K can be drawn together to compress a gavel by the driving mechansim, as described.

CONTENTS.

THE ENGINEER, February 3rd, 1882.