CRYSTAL PALACE ELECTRICAL EXHIBITION.

No. III.

In our impression for February 24th we briefly described the steam engines employed at the Crystal Palace for generating electricity for the numerous lamps exhibited. We should have stated that all the shafting used with the Edison plant was made and erected by Messrs. Hayward Tyler and Co., Luton. We carried our description down to engine No. 29, and we now propose to speak of the remaining engines to be found in the Palace.

Close to the stand of Messrs. John and Henry Gwynne —whose quick running engines continue to attract many visitors — are three engines, Nos. 30, 31, and 32, shown by Mr. Hindley, of Bourton, Dorsetshire. All these are self-contained, and have vertical boilers. No. 30 has a horizontal cylinder, 10in. diameter and 14in. stroke. It is nominally a 10-horse engine. The fly-wheel is 5ft. in diameter. The heating surface of the boiler is 110 square feet. It drives a 20-light Gramme dynamo, working twenty Jablochkoff lights on four circuits. No. 31 is a nominal 4-horse engine, with a vertical cylinder, 5¾in. diameter and 8in. stroke; fly-wheel 3ft. 3in. diameter, and heating surface 42ft. It carries a Gramme dynamo on the same frame, and is supported on wheels. It actuates sixty Swan lamps; and No. 32 is a nominal 6-horse engine, with a cylinder 7¼in. diameter and 10in. stroke; fly-wheel 4ft. diameter, heating surface 86 square feet. This engine actuates the Joel lamp in the Pompeian Court. These are well-finished, compact engines, and apparently do their work very satisfactorily. This completes our list of steam engines actually in the Palace.

At the side of the long arcade extending from the Palace to the station of the London and Brighton Railway is a shed of considerable dimensions. In this shed are three steam engines and a gas engine. No. 33 is a semi-portable engine by Messrs. Paxman, Davey, and Co., of Colchester. This engine has a single cylinder below the smoke-box, and it is fitted with Paxman's patent valve gear. We shall have more to say concerning this engine which will best be said when we illustrate it. It drives a 7A Brush machine, making 750 revolutions per minute.

No. 34 is a compound semi-portable by Messrs. John Fowler and Co., of Leeds, with cylinders 9½in. and 16in. diameter and 18in. stroke. The heating surface in the fire-box is 52·8 square feet, in the tubes 303 square feet, total 355 square feet. The grate is 12 square feet. It is fitted with two fly-wheels, and drives two 7A Brush machines at 750 revolutions.

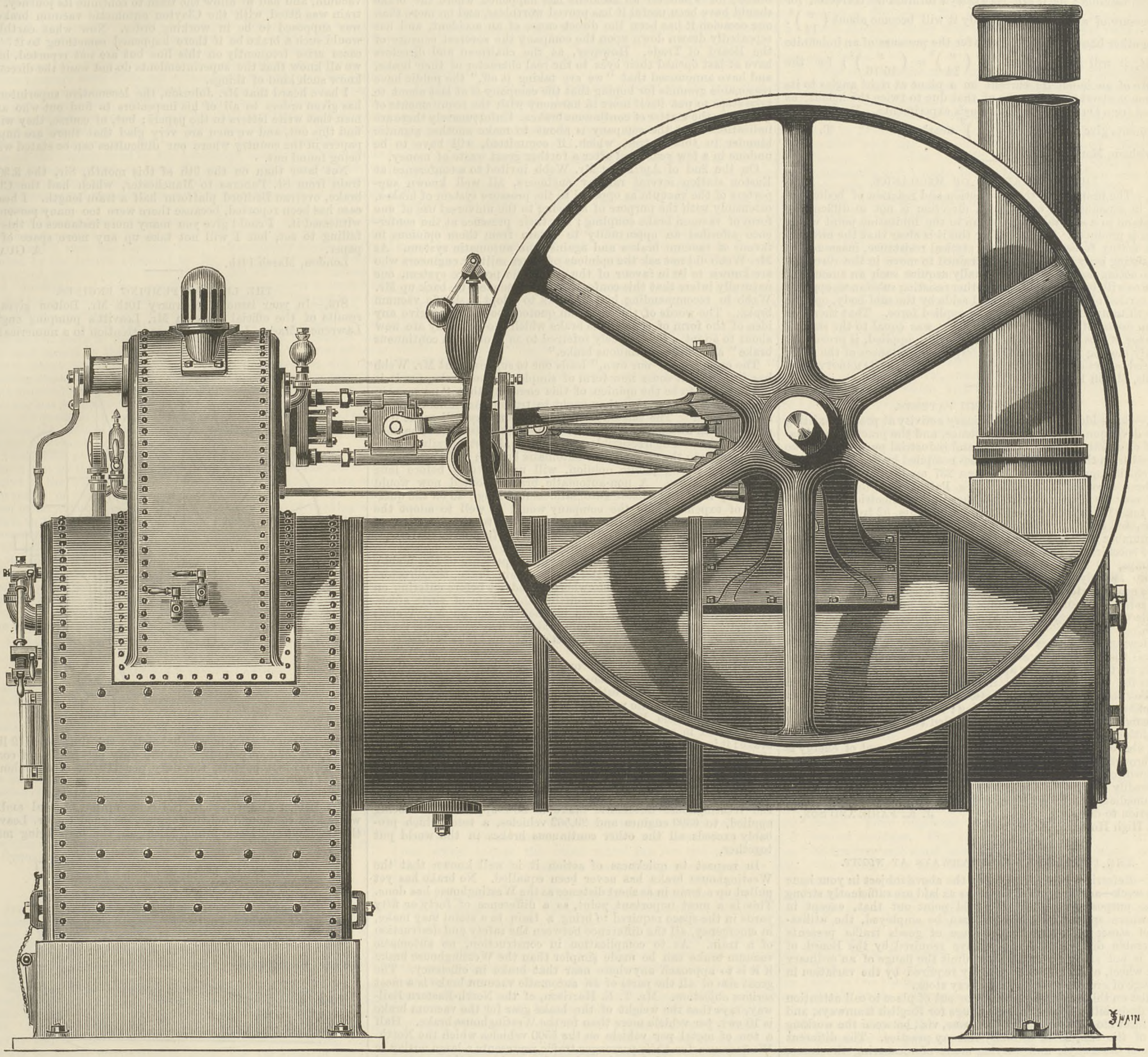
No. 35 is a double-cylinder portable engine by Messrs. Hornsby and Sons, of Grantham. The cylinders are 7½in. diameter and 14in. stroke. The heating surface is 173 square feet; the fly-wheel is 7ft. in diameter, and makes 135 revolutions per minute, driving one 7A Brush machine at about 780 revolutions per minute.

We continue our series of illustrations of the Crystal Palace engines with an engraving of this engine, which is very similar in type to those which have long been built by the firm, and have earned an excellent reputation. The type is peculiar in several respects. The cylinders, it will be seen, are fixed in a kind of steam chest of plate iron raised on the top of the outer fire-box, and the valve chests, cylinders, and passages are all enveloped in boiler steam. Thus the most perfect jacketting possible is obtained, nothing being left unprotected save the cylinder covers. The guide bars are round and fitted with adjustable slippers. The fly-wheel, it will be seen, is of great diameter, much larger than is generally fitted to portable engines, and a high speed can be got for the dynamo at once without countershafting. We may here say that this is an obvious advantage possessed by the Brush machine, for which a speed of about 750 revolutions suffices, for countershafting means expense and loss by friction; and furthermore, it is highly desirable to have as little to do with belts in driving dynamos as possible. A dynamo cannot be run with a slack belt as a thrashing machine can be; for in such a case slip would be sure to occur, and as the slip would be a variable quantity, uniformity of velocity of rotation could not be secured, and want of uniformity means bad lighting.

In the same shed is a gas engine by Messrs. Fawcett and Preston, of Liverpool—Beachey's patent. This engine has as yet been worked only a few times. It is nominally 7-horse power, and drives a 6-light Brush dynamo. It will suffice to mention the engine now. We shall describe it fully when we come to deal with the gas engines in the Palace, of which a large number is exhibited by Messrs. Crossley, of Manchester, and by Mr. Turner, of St. Albans.

Close to the London and Brighton station is another shed in which will be found No. 36, a single-cylinder portable engine, by Messrs. Marshall, Sons, and Co., of Gainsborough. The cylinder is 10in. by 14in., and the fly-wheel is 6ft. in diameter by 10in. wide. It drives a lay shaft at the opposite end of the shed, from which return two belts, driving the one a 10-light and the other a 20-light Gramme machine. The smaller of the two makes 1500 and the larger 1200 revolutions per minute. These machines are used to supply the Jablochkoff lamps in the railway station and its approaches. This engine is the first that the visitor entering the building from the London and Brighton station will see.

We believe we have now named all the engines in the Exhibition up to the present minute. One or two more will probably be used before the Exhibition can be considered complete, which will not be for about three weeks. For example, Mr. Edward Easton has not yet got his André lamps on the terrace to work. These will be actuated by a compound semi-portable engine by Messrs. Fowler, of Leeds. From what we have said it will be readily understood that the engines exhibited may be divided into classes. We have first the semi-portable, represented by Messrs. Robey and Co., of Lincoln; Fowler, of Leeds; Paxman, Davey, and Co., Colchester; and Messrs. Marshall and Sons, of Gainsborough. Next are the portable engines exhibited by Messrs. Marshall, Ransomes, Head and Jefferies, of Ipswich; and Hornsby and Co. Thirdly, we have fixed engines shown by Messrs. J. and H. Gwynne, and perhaps we ought to add Messrs. Galloway, of Manchester. Next we have movable engines with vertical boilers shown by Mr. Hindley, of Bourton; and, lastly, we have the rotary engines of Mr. Hodson, of which we have spoken in high terms. All the engines exhibited are of great excellence. In fact they may be regarded as the best of their kind which it is possible to make; and nothing perhaps about them is more noteworthy than the excellence to which, under the pressure of demand, the makers have brought the governors with which these engines are fitted. There is scarcely a portable or semi-portable engine in the Exhibition which, running at 100 revolutions with its load, would run at 110 if the load were suddenly taken off, and this excellent result has been attained in almost all cases by the aid of comparatively simple governors. Engineers will find that, however attractive the electric light may be, they will make a grave mistake if they omit to carefully examine the engines on which the electrician depends for success in his undertaking.



PORTABLE ENGINE BY MESSRS. R. HORNSBY AND SONS, AT THE CRYSTAL PALACE.

LETTERS TO THE EDITOR.

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

WIND PRESSURE.

SIR,—I thank your correspondent "A. R.," in THE ENGINEER of last week, for directing me to Mr. Hawksley's paper on this subject in THE ENGINEER of September 30th, 1881, which had escaped my notice. But on referring to it I find that it is assumed that the pressure of the elastic body, air, is no greater than if it were inelastic—which is contrary to the laws of motion of elastic bodies. Besides which Sir Isaac Newton found by experiment that the pressure of air is to that of water as, at a mean, 1 : 460; whereas Mr. Hawksley in constructing his formula has assumed it to be as 1 : 817—making no allowance for the elasticity of air. Moreover the theory of jets, whether as in Rankine's "Applied Mechanics" or in the older books on the motion of fluids, is not applicable to the present case, which is that of an indefinite fluid acting on a limited plane, and even in the case of jets experiments show that the pressure is that due to twice the height only when the plane is much larger than the area of the jet—"at least four times as large in diameter as the jet. (See Tredgold's "Tracts on Hydraulics," p. 208.)

We seem, then, to be thrown back on Dr. Hutton's elaborate experiments on the pressure of indefinite air as the basis of a practical formula; for if Mr. Hawksley's formula be corrected for the pressure of air as an elastic body it will become about $\left(\frac{v}{14}\right)^2$. On the other hand, if corrected also for the pressure of an indefinite current, it will become about $\frac{3}{4} \times \left(\frac{v}{14}\right)^2 = \left(\frac{v}{16{\cdot}16}\right)^2$; for the pressure of an indefinite current on a plane at right angles to its direction is about three-fourths of that due to twice the height, as deduced from Du Buat's and Beaufoy's experiments. Dr. Hutton's experiments give the formula $\left(\frac{v}{21}\right)^2$ nearly. T. G.

Lewisham, March 11th.

THE FOUNDATIONS OF MECHANICS.

SIR,—The proposition that the action and reaction of bodies are equal in amount and opposite in direction is not so difficult to understand in a statical sense, or up to the limitation point where motion is produced. Then or after this it is clear that the measure of the acting force is in excess of statical resistance, inasmuch as the resisting body is not only constrained to move in the direction of the acting force, but to gradually acquire such an amount of motion as will, by friction of air or other resisting substances opposed to, or carried along with, or pushed aside by the said body, operate at length to neutralise this excess of applied force. That there has been an excess of force exerted over what was equal to the statical resistance of the body to which it was first applied, is proved by not only moving it, but also the interposed resistances of the other displaced bodies as well. J. RAMSBOTTOM.

Leeds, March 13th.

ELECTRICITY AND PATENTS.

SIR,—Some idea of the extraordinary activity at present existing in the development of electrical science, and the practical application of electricity to various useful and industrial purposes, may be gathered from the following statistics compiled by us. During the year 1881 it appears that no less than 237 applications for patents have been recorded in her Majesty's Patent-office for inventions which may be classed under the heading of electricity; of this grand total 135 emanate from British applicants, 52 from American citizens, and 50 from residents on the Continent. Classifying the total number of 237 applications under special heads, it appears that 93 specifications have been lodged for improvements in electric arc lamps, 20 for improvements in incandescent lamps, 38 for magneto and dynamo machines, 32 for secondary batteries or electric accumulators, 26 for measuring, controlling, and regulating the electric current, 24 for miscellaneous appliances connected with electric lighting, and 4 for producing power and transmitting motion.

Reviewing the names of the applicants for above patents, it appears that the celebrated American inventor Edison stands highest on the list, having applied for no less than twenty-four patents for various electrical improvements; Messrs. Swan and Lane-Fox each filed seven applications for improvements, mostly in connection with incandescent lighting; Mr. Faure, of Paris, three for secondary batteries, while Maxim filed two, and Brush one for arc-lighting apparatus.

The above figures show what an astounding amount of energy is being brought to bear on the introduction of this wonderful science, and it will certainly not be the fault of inventors if electricity be not speedily reduced to a practical success, and made to serve in the immediate future purposes and ends of which we have little conception to-day. J. K. FAHIE AND SON.

323, High Holborn, March 14th.

THE UTILISATION OF TRAMWAYS AT NIGHT.

SIR,—Referring to the remarks on the above subject in your issue of last week—assuming the tramways as laid are sufficiently strong for the purpose suggested—I would point out that, except in cases where special rolling stock can be employed, the utilisation of street tramways for carriage of goods traffic presents considerable difficulty, as the groove required by the Board of Trade is not sufficiently large to admit the flange of an ordinary wagon wheel, or to allow of the play required by the variation in the gauge of ordinary 4ft. 8½in. railway stock.

Whilst on this subject it may not be out of place to call attention to the desirability of an uniform gauge for English tramways, and an uniform mode of measuring the same, viz., between the working edges of the rail, as in ordinary railway practice. The different gauges of tramways, and varying mode of measuring the same, cause much inconvenience, especially in the interchange of rolling stock; and this is daily becoming greater with the increasing use of mechanical power on tramways. WILLIAM TWEEDIE.

11, Great George-street, Westminster,
March 8th.

THE PRIMING OF BOILERS.

SIR,—Some time ago a slight discussion was raised in your correspondence columns concerning the comparative value of "domed *versus* domeless" locomotives.

In to-day's issue of the *Times* is an article giving an account of the first run of H.M.S. Polyphemus, in which are the words, "The trial was very unsatisfactory, in consequent of the priming of the engines; she returned to harbour sooner than was expected; the average speed was 18 knots an hour." I remember, when she made her first trial alongside the basin at Chatham, that the engineers and others in the stokeholes were very much scared by the occasional total disappearance of the water in the gauge. The boilers are I know domeless and take steam through copper pipes cut at the top with a saw transversely in the usual way. Why should these boilers prime more than locomotives?—I can think of no reason unless it is the excessive draught which causes flame to come even out of the funnel. If you or any correspondent could give information on this subject I should feel grateful.

Byng Luken, Hoddesdon, Wormley, Herts, G. F. B. L.
March 8th.

THE LONDON AND NORTH-WESTERN RAILWAY AND CONTINUOUS BRAKES.

SIR,—The chairman of the London and North-Western Railway Company, at the half-yearly meeting of the shareholders, held on the 18th ult., made the following remarks respecting the action of the company in the matter of continuous brakes: "The whole of our stock is now fitted with either our own continuous brake, or with the chain brake. The chain brake is only on the old stock; we are taking that off, and from this half-year forward the continuous brake will be applied to the whole of the stock." These few vague sentences indicate such a complete change of the company's policy in the brake question that it may be desirable briefly to consider the past action of the company, and its consequences; and, judging from the past, what is likely to be the result of the present action of the company. On the 30th of June last the company had the Clark and Webb chain brake on 3443 vehicles, and had connecting chains—without the brake gearing—on 1752. The cost of fitting this enormous quantity of vehicles must have been very great; how much will probably never be known to the shareholders. Whatever the cost has been, the money has been entirely thrown away, as the present action of the company shows. During the past few years the brake has been periodically held up to the shareholders by the chairman as "perfect," in sentences which have, however, only served to show his complete ignorance of anything concerning continuous brakes. In their anxiety to credit their brake with merits which it did not possess, the company have made statements in Schedule 1 of the half-yearly returns to the Board of Trade which have been flatly contradicted in Schedule 2 of the same returns.

The company have for the last few years been remarkably free from serious accidents, for which, however, no credit is due to the brake; for whenever an accident has happened where the brake should have been useful it has proved worthless, and on more than one occasion it has been the direct cause of an accident, and has repeatedly drawn down upon the company the severest censure of the Board of Trade. However, as the chairman and directors have at last opened their eyes to the real character of their brake, and have announced that "we are taking it off," the public have reasonable grounds for hoping that the company is at last about to take steps to put itself more in harmony with the requirements of the age in the matter of continuous brakes. Unfortunately there are indications that the company is about to make another gigantic blunder in this matter, which, if committed, will have to be undone in a few years and after a further great waste of money.

On the 2nd of April last Mr. Webb invited to a conference at Euston station several railway engineers, all well known supporters of the vacuum as opposed to the pressure system of brakes, ostensibly with the purpose of agreeing to the universal use of one form of vacuum brake coupling; but their presence at the conference afforded an opportunity to obtain from them opinions in favour of vacuum brakes and against the automatic system. As Mr. Webb did not ask the opinions of other railway engineers who are known to be in favour of the automatic pressure system, one naturally infers that this conference was intended to back up Mr. Webb in recommending his directors to adopt a simple vacuum brake. The words of the chairman quoted above do not give any idea of the form of continuous brake which the company are now about to adopt. It is vaguely referred to as "our own continuous brake" and "the continuous brake."

The expression, "our own," leads one to suppose that Mr. Webb has brought out some new form of simple vacuum brake, for it is well known to be the opinion of this company that "no man in his senses would say that they ought to trust their trains to a self-acting brake." The mistake which this company will make if it adopts a non-automatic brake is so obvious that little need be said on this point. The irresistible testimony of almost all railway accidents points to the necessity for automatic brakes; and Parliament, backed by strong public opinion, will undoubtedly before long enforce their use. A non-automatic brake adopted now would infallibly have to be made automatic before long; so on the question of expense alone the company would do well to adopt the automatic principle in the first place. As to the question of vacuum or pressure brakes, Mr. Webb and his friends in conference unanimously recommend the vacuum system.

One would think that after such ample experience of Mr. Webb's ill-starred action in the matter of the chain brake, the directors would be inclined to look elsewhere for advice before entering on such a large undertaking as re-fitting the whole of their stock. However, as the directors seem inclined to act on Mr. Webb's suggestion, and to adopt a vacuum brake, it may serve some useful purpose to point out in what respect a vacuum brake is inferior to a pressure brake.

As there is practically only one pressure brake—the Westinghouse—available, and as a non-automatic brake is out of the question, I will compare the Westinghouse automatic pressure brake with some form of automatic vacuum brake. First, then, on the ground of experience—the Westinghouse brake has been used in this country and in others longer than any form of automatic vacuum brake; it is also much more largely used than any other form of brake; the figures for this country being for the 30th of June last, 650 engines and 5046 vehicles fitted with the Westinghouse, against 442 engines and 2894 vehicles fitted with all the systems of automatic vacuum brakes. If one adds the figures for foreign countries, we find that the Westinghouse automatic brake is now applied, or is being applied, to 6599 engines and 29,562 vehicles, a total which probably exceeds all the other continuous brakes in the world put together.

In respect to quickness of action it is well known that the Westinghouse brake has never been equalled. No brake has yet pulled up a train in as short distance as the Westinghouse has done. This is a most important point, as a difference of forty or fifty yards in the space required to bring a train to a stand may make, in emergency, all the difference between the safety and destruction of a train. As to complication in construction, no automatic vacuum brake can be made simpler than the Westinghouse brake if it is to approach anywhere near that brake in efficiency. The great size of all the parts of an automatic vacuum brake is a most serious objection. Mr. T. E. Harrison, of the North-Eastern Railway, says that the weight of the brake gear for the vacuum brake is 10 cwt. per vehicle more than for the Westinghouse brake. Half a ton of metal per vehicle on the 5500 vehicles which the North-Western use for their passenger traffic represents a large outlay in the first place; and then there is to be considered the cost in coal of continually hauling this weight all over the country, which would amount to a large sum annually. There is also to be considered the extra cost in coal of maintaining a vacuum by means of an ejector over that required to maintain the air pressure by the Westinghouse pump. An air ejector cannot be made to maintain a vacuum with anything like the same amount of steam as the Westinghouse pump will maintain the pressure. The large quantity of steam required for an automatic vacuum brake causes great inconvenience and embarrassment to drivers, who, in order to keep time, are often led to run long distances without vacuum, thus allowing their trains to run those distances without the protection which a continuous brake should afford.

I am not aware what system of brake the company propose to adopt for its engines and tenders; an automatic vacuum brake from the great size of its parts is almost impracticable for use on engines and tenders, and a steam brake is objectionable because it is troublesome to maintain and keep in order, and because, being a separate brake from that which operates on the carriages, there is not that simultaneous action of engine and carriage brakes which is so desirable. Again, the steam brake not being automatic, there is great probability of couplings being broken in case of an automatic application of the carriage brakes, owing to the momentum of the engine and tender not being checked at the same instant as that of the vehicles to which they are attached. Perhaps the company still intends to rely, in this year 1882, on the hand tender brake, and, in emergency, the reversing of the engine, as it is well known that Mr. Webb prefers to reverse his engines rather than put brakes on the driving wheels. The wear and tear of vacuum brake parts is much greater than the wear and tear of the Westinghouse apparatus, as the materials are more perishable and the parts much larger. It is, therefore, greatly to be desired, both in the interests of the company's shareholders and of that large proportion of the travelling public who use the North-Western line, that the directors, before committing themselves to any system of vacuum brake, should carefully investigate for themselves the merits of the vacuum and the Westinghouse systems. If they refuse to do this, and still choose to follow the advice of Mr. Webb and of those engineers whom he had carefully selected as holding views in harmony with his own, they will commit a mistake greater even than that of spending the sixty or seventy thousand pounds which they have wasted on that once much praised but now discarded appliance, the Clark and Webb chain brake. J. N. ARMITAGE.

18, Shakespeare-street, Bradford,
March 10th.

SIR,—I have taken much interest in reading the letters which you published last week, and which spoke about the serious defects in the vacuum brake used on this line. As one of those who have to run with it every day, I take this opportunity to support all what has been said about it; and, Sir, to give you a proof that many trains are run secretly with no vacuum at all, I mention that about three weeks ago—23rd or 24th February—the guard of the twelve o'clock Liverpool train from St. Pancras gave orders to the driver to stop at Garston station to set down a London passenger. By mistake the driver went on to Cressington, and when the guard noticed that the driver was not going to stop at Garston station he opened the valve in the van but found no vacuum, and had to allow the train to continue its journey. This train was fitted with the Clayton automatic vacuum brake, and was supposed to be in working order. Now what earthly use would such a brake be if there happened something to it? Such cases arise frequently on this line but are not reported, because we all know that the superintendents do not want the directors to know such kind of things.

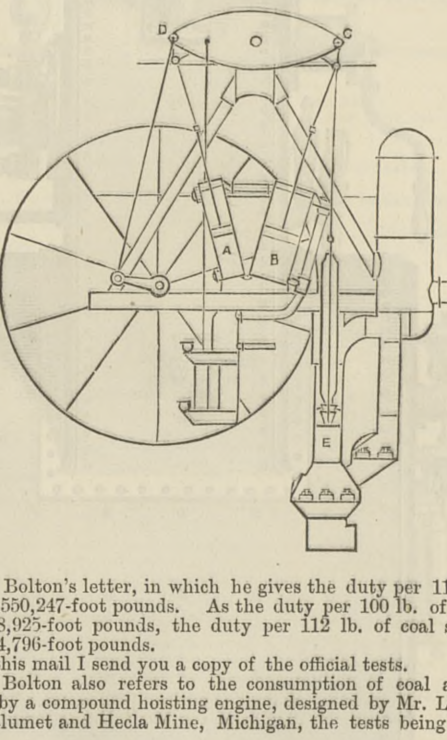
I have heard that Mr. Johnson, the locomotive superintendent, has given orders to all of his inspectors to find out who are the men that write letters to the papers; but, of course, they will not find this out, and we men are very glad that there are impartial papers in the country where our difficulties can be stated without being found out.

Not later than on the 9th of this month, Sir, the 3.30 p.m. train from St. Pancras to Manchester, which had the Clayton brake, overran Bedford platform half a train length. I hear this case has been reported, because there were too many persons who witnessed it. I could give you many more instances of this brake failing to act, but I will not take up any more space of your paper. A GUARD.

London, March 14th.

THE LEAVITT PUMPING ENGINES.

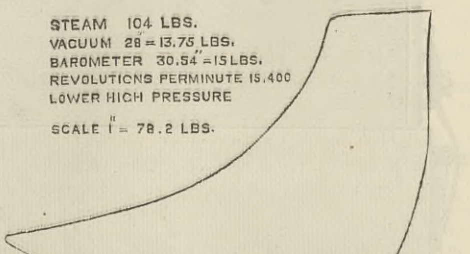
SIR,—In your issue of February 10th Mr. Bolton gives some results of the official tests on Mr. Leavitt's pumping engine at Lawrence, Mass. I would call your attention to a numerical error

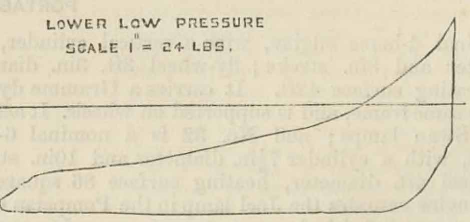


in Mr. Bolton's letter, in which he gives the duty per 112 lb. coal as 114,550,247-foot pounds. As the duty per 100 lb. of coal was 111,548,925-foot pounds, the duty per 112 lb. of coal should be 124,934,796-foot pounds.

By this mail I send you a copy of the official tests.

Mr. Bolton also refers to the consumption of coal and feed-water by a compound hoisting engine, designed by Mr. Leavitt, at the Calumet and Hecla Mine, Michigan, the tests being made in





December, 1880. Since making those tests I conducted a two-weeks' trial on two compound pumping engines at the Calumet and Hecla Mine—the engines designed by Mr. Leavitt—in which the consumption of feed-water per indicated horse-power per hour was 15·4 lb. Both engines took steam from the same boilers, which were fired with wood. With boilers giving the same evaporation as those at Lawrence, it would bring the coal used per hour per indicated horse-power 1·52 lb.

As the indicator diagrams shown in Mr. Buel's report do not do the real cards justice, two are herewith inclosed.

Cambridgeport, Mass., J. S. COON,
February 27th. Office of E. D. Leavitt, jun.

STEAM ENGINE ECONOMY.

SIR,—Referring to the articles on "Steam Engine Economy," in the last two numbers of THE ENGINEER, it would seem, as you say, that it has fallen to the lot of Mr. Michael Longridge "to get hold of two phenomenal engines, the like of which his brother inspectors have never encountered." The results of the trials are not, however, so exceptional as regards steam consumption as you appear to consider them. Taking the average of all the trials, the engines referred to in Mr. Longridge's last report used 17 lb. of feed-water per indicated horse-power per hour; a good result, but not remarkable when it is considered that the steam pressure was about 90 lb. per square inch and the engines were fair examples of compound engines — well arranged, except perhaps in the steam jackets, with appliances for economical working. But after all this result is very little better than the every-day results from single-cylinder Corliss engines, and really not so good if the effective power of the engines is compared. In THE ENGINEER of April 29th last year you published the results of a two days' trial made by Mr. Fletcher of a single-cylinder Corliss engine, indicating then within about 10-horse power of the compound engines tried by Mr. Longridge the steam pressure was, however, only 47 lb. per square inch, and the mean of the two trials gave 17·9 lb. of feed-water used per horse power per hour. In the engines tried by Mr. Longridge the power is transmitted to the line shafts by belting from the main fly-wheel, and the indicated horse-power required to drive the empty engines and shafting was one-third the total power of the engines, being 105-horse power nearly, which is fully 40 per cent. more than the power required to drive the Corliss engine above referred to and the shafting connected with it, the driving being also by belting from the main fly-wheel; moreover this Corliss engine is a much larger engine than the compound ones, being in fact an engine made to drive 500 to 600-horse power with the best economy.

I will give another instance to compare further, where a single-cylinder Corliss engine is driving looms, which is the same work as the engines tried by Mr. Longridge do. In this case the Corliss engine has 4ft. stroke and runs at 56·5 revolutions per minute, the steam pressure being 65 lb. per square inch, and when all the looms are on the power shown by diagrams taken by Richard's indicator is 170·4-horse power. With the engine and shafting alone the power is 28·5-horse power, or only one half the frictional resistance in proportion to the total load that was shown in the engines tried by Mr. Longridge. I mention these facts to show that in the case of the engines tried by Mr. Longridge, one-third of the whole power being required to turn the engines and shafting alone, indicates pretty forcibly that something else than the complication of the compound arrangement must be the cause of this frictional resistance.

Some remarks incidentally made in the report of the trials lead me to suspect that the piston of the low-pressure cylinder was too tight, and if such was the case, the "extraordinary anomalies presented by the results obtained by Mr. Longridge" can be easily explained, and in reality show clearly the advantages instead of the "inutility" of steam jackets. Much more power is consumed in moving a tight piston than is usually supposed. The power is not all wasted, however, for the friction heats up the walls of the cylinder, and in this way, by doing the work of a steam jacket, prevents or helps to prevent condensation; but it is possible that the heat caused by the friction may be more than the heat which a steam jacket would give to the cylinder walls, and in such case putting steam in the jacket really tends to cool the cylinder. It was observed by Mr. Longridge that the economical results from the engines were slightly better when no steam was in the jacket of the low-pressure cylinder. The reason certainly appears to be because the walls of the cylinder were already being unduly heated by the friction of the tight piston.

This seems, at any rate, the reasonable explanation, and is confirmed also by the results obtained when the steam was put in the jacket of the high-pressure cylinder. Mr. Longridge states that the piston of this cylinder was "not quite tight." There would then be no undue friction within it, and the results of working with steam in the jacket of that cylinder showed a decided additional economy, the best of all the results being then obtained.

Of course much of the heat caused by a tight piston must escape to the condenser and run to waste. It is worth noticing that Mr. Longridge found at first more heat in the water from the condenser than he expected to find, and actually for that very reason rejected Messrs. Bryan Donkin, and Co.'s coefficient in the test he made according to their system. This fact goes a long way to confirm the foregoing explanation as to the action of the jackets.

Bolton, March 14th. WILLIAM INGLIS.

SPARKING AT COMMUTATORS.

SIR,—It is impossible to examine the various dynamo-electric machines at the Crystal Palace without perceiving that some of these machines produce an abundance of sparks at the commutators, while others are quite free from them. The great Brush machine used on the 150,000 candle lamp keeps its commutators in a sheet of flame.

Now, sparking is a great source of waste of power, and it would be interesting to know why sparking is not always prevented from taking place, and what are the causes inducing it. It is well known that it leads to the speedy destruction of the commutators, and constitutes one of the worst defects a dynamo can have. The original Siemens machines, first used for lighthouse work, failed for this reason. FELIX.

Sydenham, March 14th.

ELECTRIC LIGHTING DANGERS.

SIR,—It would be highly desirable that some list should be published giving the dangers which attend the various modes of electric lighting. The dangers I refer to are mainly two:—First, That of a man touching the wires so as to receive the full shock; and Secondly, the amount of "flare-up" in any lamp on breaking contact.

The other day an accident of the second kind, or one somewhat similar to it, occurred at Charing-cross station, when for a short time all the lamps went out but one, which flared up some 6ft. I believe all lamps—arc—are subject to this phenomenon under similar circumstances, but the "flare-up" varies, and it would be highly interesting to know the variation in different systems, as a guide how far the lamp should be hung below a combustible ceiling. Either yourself or some correspondent might be able to give such a table.

Respecting the first class of accident, I need hardly mention that under some methods of lighting no danger accompanies the touching of the wires, and in one of the systems it is especially dangerous. It would be a public benefit if some one could publish the comparative risks under all known systems.

I will mention a curious circumstance brought to my knowledge by a gentleman who was the actor. He had occasion to go to some works in Wales, where the Brush light was used with advantage. There were three serious accidents during one week through incautious handling of the lamps. In one case this gentleman was present, and the workman fell back and reeled as if drunk and apparently unconscious. In the inspiration of the moment he knocked the man down, and the result was the shocked individual got up all right, stating that he woke up, as it were, from a dream. But for this blow he might have died. The anecdote is curious but worth knowing. The reason why a violent knock should have brought about the desired result is clear to any physiologist.

From time to time, through your kindness, I may have facts to bring before your readers, and lest it should at any time be thought that I have an interest of a pecuniary character in doing so, I may at once state that I have no interest in any of the electric lighting companies and am therefore unbiassed. In short, until a burner as permanent as a gas burner, and as free from mechanism can be found, besides the price being very low, I shall regard the general adoption of the electric light as a thing impossible in all houses. Gramme machines are near perfection, and only require improving in detail to prevent heating and to be more cheaply constructed. A point which must sooner or later be got over is the great waste of power in incandescent lights, for whereas 1-horse power is said to give 3 to 4000-candle power by one arc light, I doubt if more than 200-candle power has been obtained by ten Swan or other incandescent lamps together to the horse power. This comparison is perhaps not strictly fair, but it tells a good deal.

It might be well for those attending the electric lamps, wires, &c., to wear india-rubber gloves—ventilated so as to avoid the objections to such gloves—and thus avoid all risk of shock.

Broomhill, Tunbridge Wells, DAVID SALOMONS.
March 9th.

MESSRS. PROCTOR AND CO.'S STEAM DIGGER.

SIR,—Will you kindly correct a mistake which occurred in your issue last week. "You say a new steam digger is being made by Messrs. Proctor and Co., Stevenage," whereas the steam digger made by us was finished last month, and underwent a public trial on Wednesday, February 22nd, in the presence of a very large number of people interested in machinery connected with the cultivation of the soil. The trial was a success in every way; the digging attachment can be applied to any portable engine from 8-horse power upwards; and we are now engaged in converting portable engines into combined traction engines and diggers.

Stevenage, Herts, March 8th. PROCTOR AND CO.

A GREAT TURBINE.

WE illustrate on the next page what is, we believe, the most powerful turbine in the world. It is employed in driving the Pillsbury "A" Mill at Minneapolis, Minn., U.S.A., and a short description of this mill will not be out of place here. We are indebted for most of the facts concerning the mill to our contemporary, the *American Miller*.

A couple of years ago it became evident to the firm that the mills which they were then operating were not able to supply the demand for their flour which pressed upon them from the Eastern States and from Europe. About 150 yards below the falls of St. Anthony ground was broken early in the spring of 1880, and the erection of the building commenced from plans made by Mr. L. S. Buffington, of Minneapolis. The structure is built of Trenton limestone, rough ashlar faced and laid in courses. Its length is 180ft., its width 115ft., and the height 137ft., divided into seven storeys and cupola. The foundation side walls are 8½ft. thick, and the end walls 7½ft. The walls taper from a thickness of 5½ft. below the grinding floor to a thickness of 2½ft. in the three highest storeys. The basement storey, which is 20ft. high, is laid in Louisville cement, and the coping, window cills, and two belting courses are of hammer dressed granite. The construction of this vast pile of masonry required a force of 125 men from June, 1880, to the last day of November, the same year. The forebay, which is in the basement, is 125ft. long, and 15ft. wide, built of stone laid in hydraulic cement. The wheel pits are dug out of the solid rock, and are 53ft. in depth, being walled in by solid masonry. Inside the pits are the iron flumes 12ft. in diameter, and made of ⅜in. boiler iron. Here are placed the two Victor wheels, each 55in. in diameter, made by the Stillwell and Bierce Manufacturing Company, of Dayton, Ohio. These two wheels yield 2400-horse power, according to careful measurement, and this is said to be the largest power developed by any two wheels in the world. Water is brought to the mill by means of a canal 650ft. long, 16ft. wide, and excavated 16ft. into the solid rock. After the rock was blasted out the sides were walled up with solid masonry laid in hydraulic cement, and arched over with stone. The bulkhead is 30ft. wide, 30ft. high, and in it are two gates, one on each side of a central pier. A stone arch beneath the basement admits the water into the mill. This canal, it is estimated, cost 100,000 dols. The discharge from the wheels is accomplished by means of two tunnels, each 150ft. in length, running from the mill to the river directly under the wheels. The tunnels discharge into a tail race several hundred feet long. Bevel gear at the top of each water wheel shaft transmits the power to a horizontal shaft 8in. in diameter, 145ft. long, and tapering to 6in. at the end which rests on a solid archwork of masonry inside the forebay. On this line shaft are the driving pulleys, weighing each 6½ tons, upon which run two 48in. belts, each 126ft. long and of double thickness. From the line shaft power is taken off by 30in. belts to drive the machinery of the mill. We may here remark that power is taken from only one of these shafts at present, as the mill is in reality a double mill, and only half of it is now in operation. From this shaft one 30in. belt of double thickness drives the bolting and elevating machinery, two belts of similar size drive the rolls and purifiers, another belt transmits power to the cleaning machinery, and still another one drives the electric machine, which requires from twelve to fifteen horse-power. The mill is so arranged that if one wheel breaks the other wheel can run the whole mill, or the power of both wheels can be used together on each or both sides.

In addition to the driving mechanism which is found on the first or basement floor, there is also a wheat bin capable of holding 35,000 bushels of wheat, extending up through the grinding floor. Here are also the hurst frames for the millstones on the floor above. The second story is the reducing floor, and here, when the mill is completed, there will be over 400 sets of roller mills arranged in twelve lines. As stated above, only one-half of the machinery has been placed. So far 101 Gray roller mills have been furnished by E. P. Allis and Co., of Milwaukee, Wis. All of these machines are double, with rollers 9in. by 18in. in size; and comprise sixty-four corrugated machines, twenty-seven smooth roller machines, and ten porcelain machines. There are 125 of Steven's roller mills furnished by Jno. T. Noye and Sons, of Buffalo, N.Y. There will be twenty pairs of millstones in the whole mill, which will be used on middlings. The millstones are arranged in one line along the north wall of this storey, and are handsomely fitted up in black walnut and ash, and are all provided with Behrns' patent high-pressure millstone ventilation, furnished by Brehmer Bros., of Philadelphia. On this floor there is a weighing hopper and scales, the hopper holding 800 bushels, and a line shaft 120ft. long, from which power is transmitted to drive the flour packers on the floor above. The third floor is the packing room, where on each side of the mill will be placed when the second half of the mill is finished twelve Eureka flour packers, making twenty-four in all, furnished by the Barnard and Leas Manufacturing Company, of Moline, Ill. One end of this floor is partitioned off for a cleaning room, deriving its power from a separate belt. The greater part of this floor is taken up with storage bins, and plenty of room is left for handling the flour after it is packed. On the fourth floor the bolting chests begin and run up to the attic. In the eastern half of the mill now running there are eight double and four single chests, which on the three floors above contain forty reels each, and on the fourth floor above twenty-two reels, making 142 reels in all, each 14ft. long. On this floor there are twenty-three No. 2 Smith purifiers, furnished by the Geo. T. Smith Purifier Company, of Jackson, Mich. Besides this machinery, there are bins over the flour packers on the floor below, made out of boiler iron, 6ft. in diameter and extending through two storeys. In the end of this storey, set apart for wheat cleaning, like the floor below, there are four Richmond brush machines, furnished by the Richmond Manufacturing Company, of Lockport, N.Y., and two large size Kurth cockle separators, furnished by the Cockle Separator Manufacturing Company, of Milwaukee. On this floor there are also four Niagara bran dusters, furnished by the Richmond Manufacturing Company, of Lockport, N.Y. On the fifth floor, besides the continuation of the bolting chests, there are four Richmond brush machines, four Barnard and Leas separators, and two centrifugal flour bolters. On the sixth floor there are four centrifugal flour bolters, furnished by John Fiechter, Son, and Co., of Minneapolis, four Niagara bran dusters, four Victor smutters, furnished by the Barnard and Leas Manufacturing Company, and four Richmond brush machines. The continuation of the bolting chests extends through this storey and the next, and on all these floors are more Smith purifiers, making 100 in all. When the whole mill is completed it will contain 200 of these machines. The Hardenbergh dust-catcher is used on the purifiers. On the seventh floor are three lines of shafting, from which are driven the elevators and bolts. The wheat-cleaning machinery of the mill was furnished by the Barnard and Leas Manufacturing Company, of Moline, Ill., the Richmond Manufacturing Company, of Lockport, N.Y., and the Cockle Separator Company, of Milwaukee.

Mr. W. F. Gunn, of Gunn, Cross, and Co., Minneapolis, furnished the plans for the mill, which were made under his direct supervision, and he also acted as superintending millwright of the mill. Mr. Gunn may well be proud of his work, which shows at every step evidence of a master head and hand. The Pray Manufacturing Company, of Minneapolis, furnished the machinery.

The mill has the most ample facilities for receiving grain and shipping flour. Indeed, this is absolutely necessary when we consider that the mill, when the western half is completed, will use 25,000 bushels of wheat every day it runs. There are two lines in front and three in the rear of the mill, affording connection with the St. Paul, Minneapolis and Manitoba, the Chicago, Milwaukee and St. Paul, and the Chicago, St. Paul, Minneapolis and Omaha Railways. The facilities are such that eight cars of wheat per hour can easily be unloaded. As feeders to the Pillsbury Mills may be counted thirty-six elevators situated in different parts of the State, operated by Messrs. Pillsbury and Hurlbut, and having an aggregate capacity of 2,173,000 bushels. The capital invested in conducting this part of the business will readily be seen to be immense. The mill is supplied with an elevator for passengers and freight, and is lighted by a Brush electric light, of 32,000 candle power. Steam for heating the building is supplied by two steel boilers placed in a fireproof building separate from the mill. Electric call bells are on every floor, and the mill has telephone connection with Minneapolis, St. Paul, and Stillwater. Among other features of the mill which may be noticed, is the central stairway, which is a spiral, and is built of iron. The interior of the mill is painted white with red trimmings, while the roller mills, stairways, and scales are also red.

The half of the mill now completed is capable of turning out over 2500 barrels per day, having recently made forty-seven barrels more than that amount. This will give the completed mill a capacity of 5000 barrels per day, making it the largest mill in the world.

On the next page we illustrate the wheel in position and in detail. The wheel works under a 50ft. head, gives 1400-horse power, and makes 2500 barrels of flour per day. The excavation for the wheel, Fig. 1, is made in solid rock, the first 20ft. to 25ft. being limestone, which is underlaid by sandstone. The wheel rests on I beams and sits in a flume 12ft. diameter, made of ⅜in. boiler iron and surrounded by masonry. The wheel has a draft tube 8ft. long, and the pit is 7ft. deep below the mouth of the draft tube, water being carried away by the tunnel tail race excavated through solid rock. The wheel shaft is 6¾in. diameter and of the best steel, and power is transmitted, as we have said, to an 8in. shaft by a pair of bevel mortice gears 18in. face, 5in. pitch, 48 cogs in the mortice wheel, and 47 cogs in the pinion. The speed of wheel shaft is 145 revolutions per minute. The power is transmitted from two pulleys on the lay shaft 12ft. diameter by 60in. face, driving two 9ft. by 60in. pulleys on the main line shaft, from which the mill is driven, as we have explained, by two 48in. double leather belts.

Fig. 2 is the outer chute case, Fig. 3 the register gate, Fig. 4 is the top of wheel case, Fig. 5 shows the wheel removed from the case, and Fig. 6 the wheel and case complete. We are informed that every separate part is fitted to a standard gauge. Thus duplicate parts that will fit can be furnished in case of accident. Fig. 2 is the outer case and cylinder, with the bridge tree and wood step which support the wheel in position. This cylinder is one casting, and after receiving the bridge-tree and case, which are secured by set screws, is placed upon a horizontal boring mill, and the case is bored out to receive the register gate, Fig. 3, which revolves within it. The cylinder has a projecting flange, which rests upon the floor of the flume, and this flange is faced off true, at a right angle with the wheel shaft, so as to insure the wheels sitting plumb, provided the floor of the flume is level. Fig. 3 illustrates the gate, which is cast in one piece, with fixed water-ways corresponding with the chutes in the outer case—the two combined forming one duplex chute. This gate is bored out to receive the wheel, and is turned off to fit the outer case, within which it revolves, and is moved for the purpose of admitting and shutting off the water by means of a segment and pinion. The movement of this register gate regulates the amount of water supplied to the wheel, and, it is claimed, secures an equal and uniform delivery on all parts of the wheel, without changing the direction of the current or the relative angle of the stream and the face of the bucket, or in any degree checking the velocity of the water admitted to the wheel. Fig. 4 represents the top or crown plate of the wheel case with the pedestal attached, through which the wheel shaft passes. It extends over the register gate, and is fastened by set screws to the outer chute case. This arrangement protects the gate entirely from vertical pressure of the column of water, and renders its movement very easy. The pinion and segment by which the gate is operated are completely housed, so that they are protected from breakage by foreign substances getting in between the teeth. The cap of this housing may be easily detached, as shown in Fig. 6, by simply removing two screws. The pedestal, which surmounts the wheel case, after being faced off true is fastened to the top or crown plate by set screws. The seat below the follower-blocks insures, it is claimed, a rigid upper bearing for the wheel shaft, independent of the follower-blocks; and in connection with the arrangement of the bridge-tree which holds the step for the wheel shaft, secures perfect steadiness of motion, the minimum of friction, and the utmost strength and durability. Fig. 5 shows the Victor wheel on its shaft removed from the chute case. As will be seen, the wheel is radically different from any other wheel in the market. It receives the water upon the outside and discharges it downward and outward, the lines of discharge occupying the entire diameter of the lower portion of the wheel excepting only the space filled by the lower end of the shaft.

VICTOR TURBINE, PILLSBURY "A" MILL, MINNEAPOLIS, U.S.A.

THE STILLWELL AND BIERCE MANUFACTURING COMPANY DAYTON, OHIO, ENGINEERS.

Fig. 1

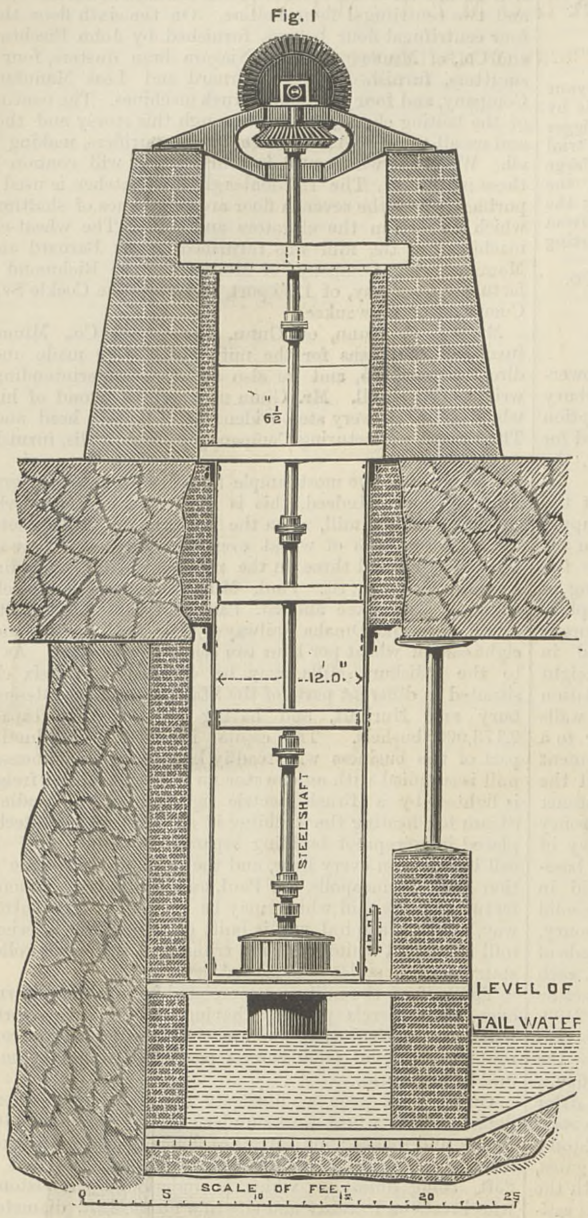


Fig. 2

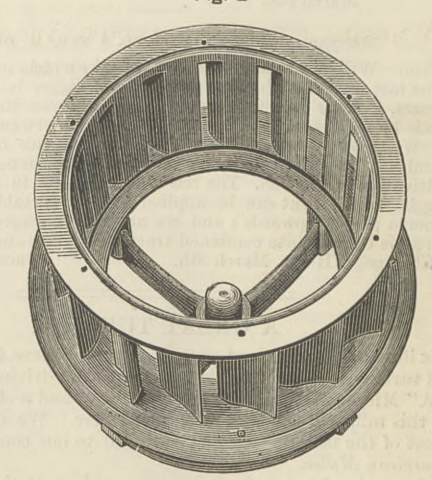


Fig. 5

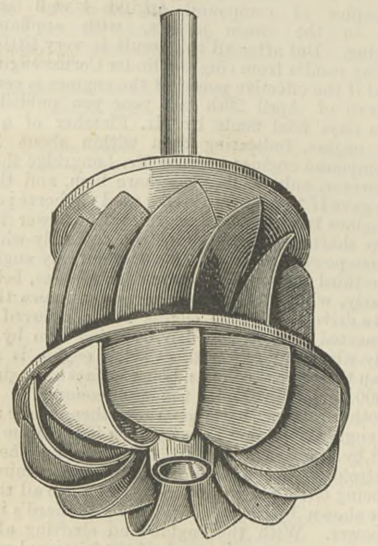


Fig. 6

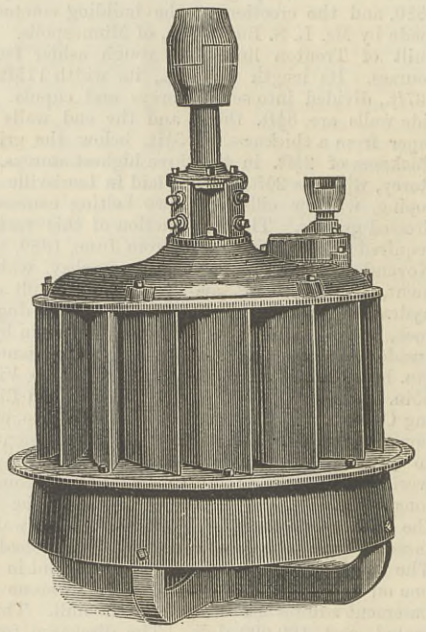


Fig. 3

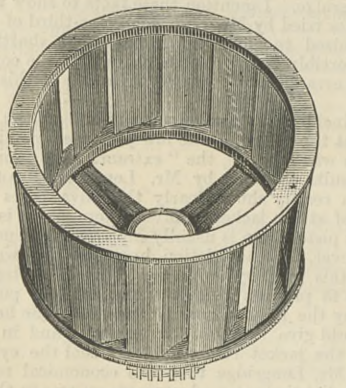
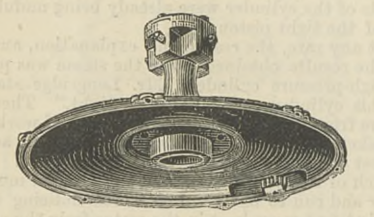


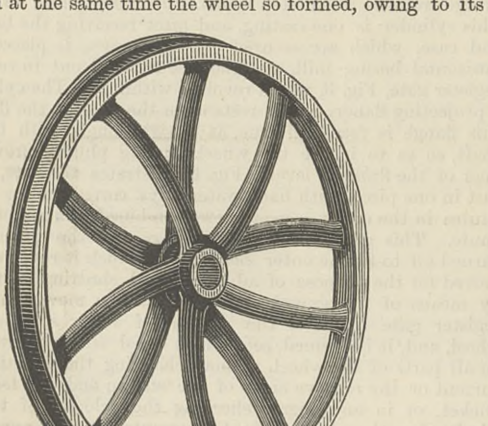
Fig. 4



This wheel has been running nearly a year, and the proprietors of the mill, Messrs. Charles A. Pillsbury and Co., state that they have never been stopped a moment by the wheel, and it has not gone down on its step, a remarkable fact considering the enormous weight of wheel, shaft, gear, and column of water. These facts possess special interest just at present, when the claims of various turbines are being described in our columns.

HANSELL'S STEEL TRAMCAR AND WAGON WHEELS.

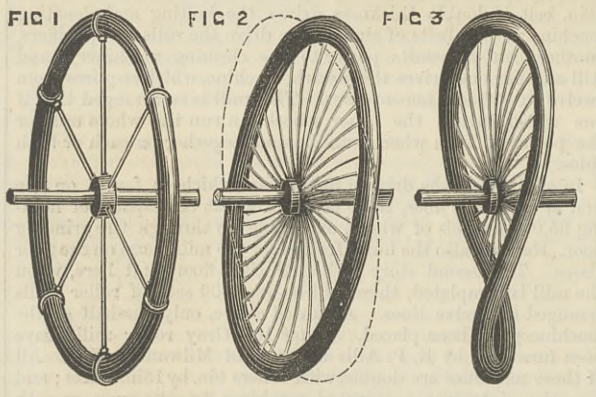
The accompanying engraving illustrates one of many forms of wheels made of crucible cast steel by Messrs. Hansell and Co., Sheffield, this form being specially intended for tramway cars. It will be seen that the spokes are curiously arranged, and of a curved form, so that internal strains which might be initially resident in a wheel with straight or ordinarily formed spokes are avoided, and at the same time the wheel so formed, owing to its



elastic flexibility, is capable of withstanding without fear of fracture the heavy impact strains so common in tramcar traffic. The wheel is, moreover, light in the spokes and boss, and a considerable thickness, 1⅜in., put into the rim, which will thus last a long time, and when worn down may then be turned up and receive a steel tire in the ordinary way. The makers claim several advantages for their wheels, which, we understand, are in extensive use here and on the Continent for tramway car and other purposes.

THE BURSTING OF FLY-WHEELS.

It has been in but a small proportion of the cases of fly-wheel bursting or fracture that centrifugal strain alone can have been sufficient to have overcome the tensile strength of the material of the rim. The velocity at which they have run has seldom been so high as to develope the strain. Another source of fracture has been pointed out by Mr. G. M. Hopkins in the *Scientific American*, namely, the jerking movements transmitted to the wheel rim by crank shafts even slightly loose in their bearings, or bearings which are loose. A fly-wheel may, as is known, be moved in a plane parallel with its axis, or parallel with itself, without creating any more internal disturbance than would result from moving it in the same way while at rest. But when a force tending to produce rotation at right angles to the plane of the wheel's rotation is applied, the effect will be vastly different, and the result will be a tendency to rotate about a new axis between the other two, and the centrifugal strain upon the wheel is supplemented by a twisting strain, which is an important and generally unnoticed factor in the destructive action.

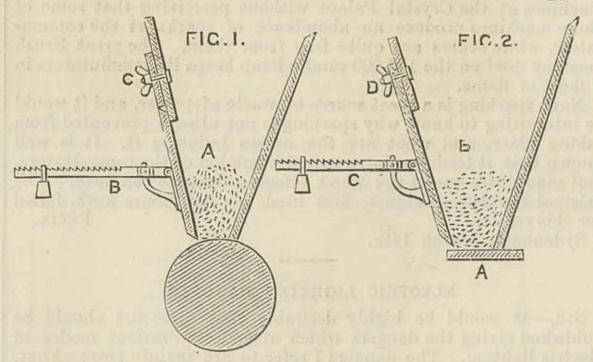


Any wheel whose axis is swung in a plane at right angles to its plane of rotation, either occasionally and irregularly or frequently and regularly, tends to turn laterally on an axis between that of the normal rotation and that of the extraneous disturbing force. The annexed engraving shows a flexible wheel, which clearly exhibits the effects of these disturbing forces. The rim is of rubber, the spokes of spring wire, and when the wheel is revolved very rapidly and moved in a plane parallel with itself no disturbance results, and no effect is produced by moving it at right angles to its plane of rotation; but when the wheel is turned even slightly out of parallelism with the plane in which it was rotating by swinging the shaft angularly, the rim, while preserving its circular form, inclines to the plane of the rotation of its shaft, bending the spokes into a concave form on one side of the hub and convex on the other, showing the effects of the disturbing force on the figure of the wheel, as in Fig. 2. When the disturbing force is rhythmical the wheel sets up lateral vibrations and wave motions in the rim, which are apparently out of all proportion to the extraneous force applied. From this experiment it is evident that the lateral swinging of the shaft of a fly-wheel—for instance, when its journal-boxes are loose, or when the frame of the machine of which the fly-wheel forms a part is yielding—tends to weaken the wheel even when the lateral movement is slight; and where it is great, as when the shaft is broken, the twisting effect is correspondingly great, and the wheel or its support must yield.

Fig. 3 illustrates the effect of a lateral blow on the rim of a fly-wheel. Of course the effect is much exaggerated in the flexible wheel, but it shows the form taken by the rim under a blow, the blow producing a much greater effect on the wheel while in motion than when at rest.

POTTS' AUTOMATIC FEEDER FOR MILLS.

The invention illustrated by the accompanying engraving, which we reproduce from the *American Miller*, is designed to be a simple but effectual method of securing a regular and even feed on purifiers, rolls, grain hoppers, or other machines which are supplied direct from elevators, bins, &c. Fig. 1 shows its application to a machine, with a roller feed, and Fig. 2 its application to a machine having a vibrating feed board. The operation of the device is the same in both cases. When the ordinary adjustable feed-board is on a purifier, it is taken off. A part of the front of the hopper is then cut away, and the narrow piece to which the valve is hinged is fastened to the remaining portion of the hopper, as shown at C. The weight on the beam B is set to keep sufficient material, whether it be grain or middlings, in the



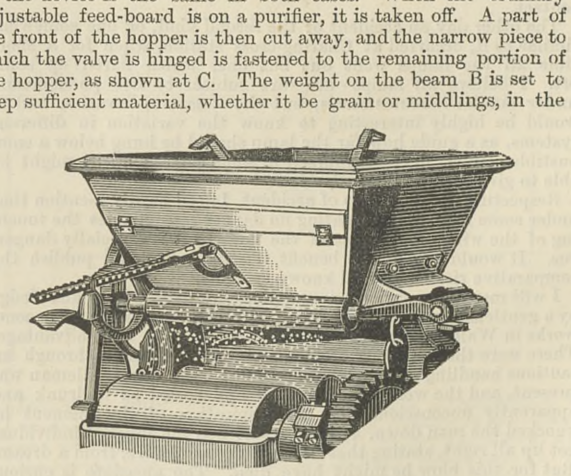


FIG. 3

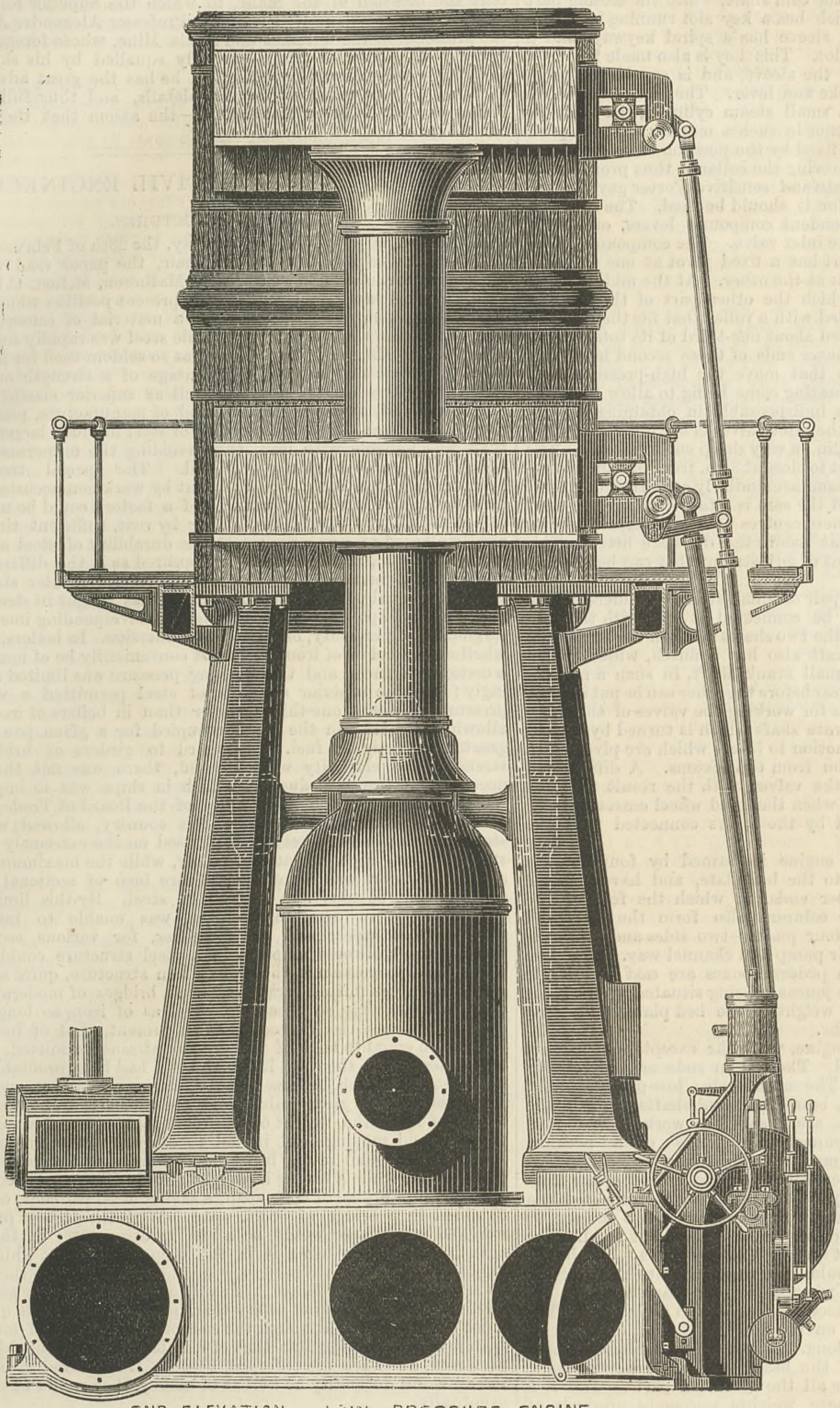
hopper to feed the full width of the machine. When more than this desired amount comes on, the pressure on the valve A on the inside is greater than the pressure on the outside, and therefore opens the space between the feed roll and the valve, thus allowing the material to pass out. It is thus automatic, and does not require constant attention for its regulation.

It is claimed for this device that it saves time spent in adjusting and matching the ordinary feed-board; that it gives a uniform feed at all times, and that it avoids choking caused by the filling up of the hopper, as often happens when a rigid feed-board is used. The feeder is made by the Cockle Separator Company, Milwaukee.

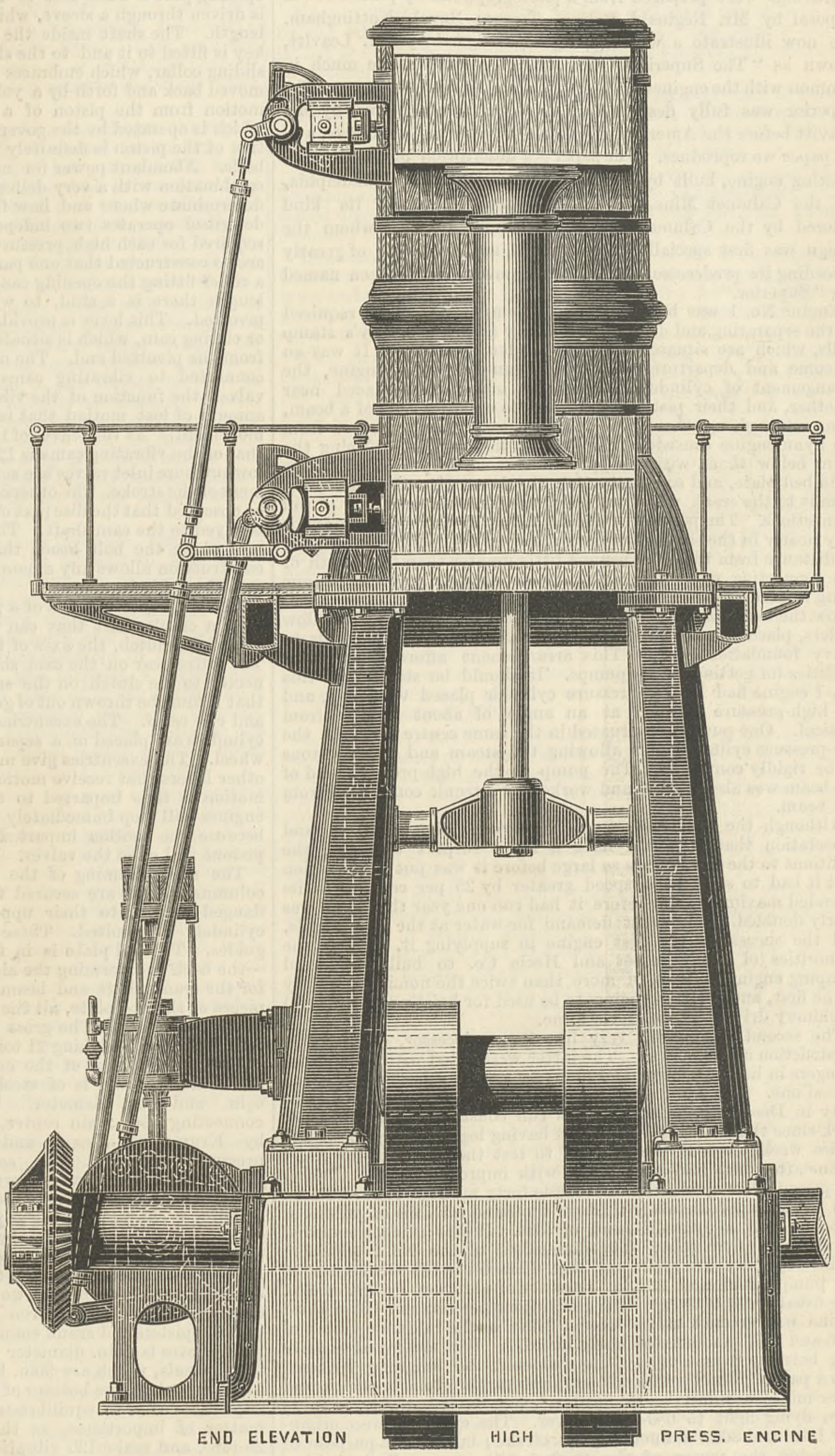
COMPOUND WINDING ENGINE, CALUMET MINE.

CONSTRUCTED BY MESSRS. I. P. MORRIS AND CO. FROM THE DESIGNS OF MR. LEAVITT.

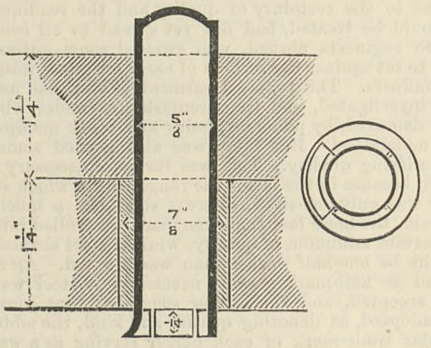
(*For description see page 192.*)



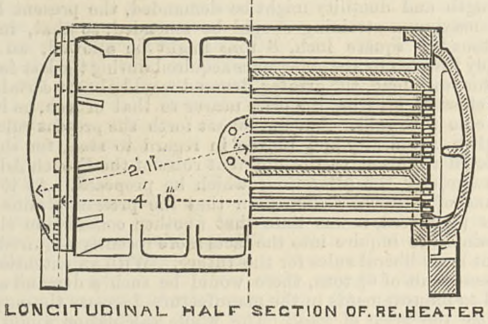
END ELEVATION LOW PRESSURE ENGINE



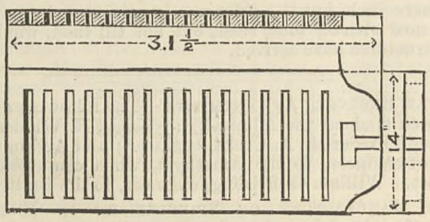
END ELEVATION HIGH PRESS. ENGINE



TUBE PACKING

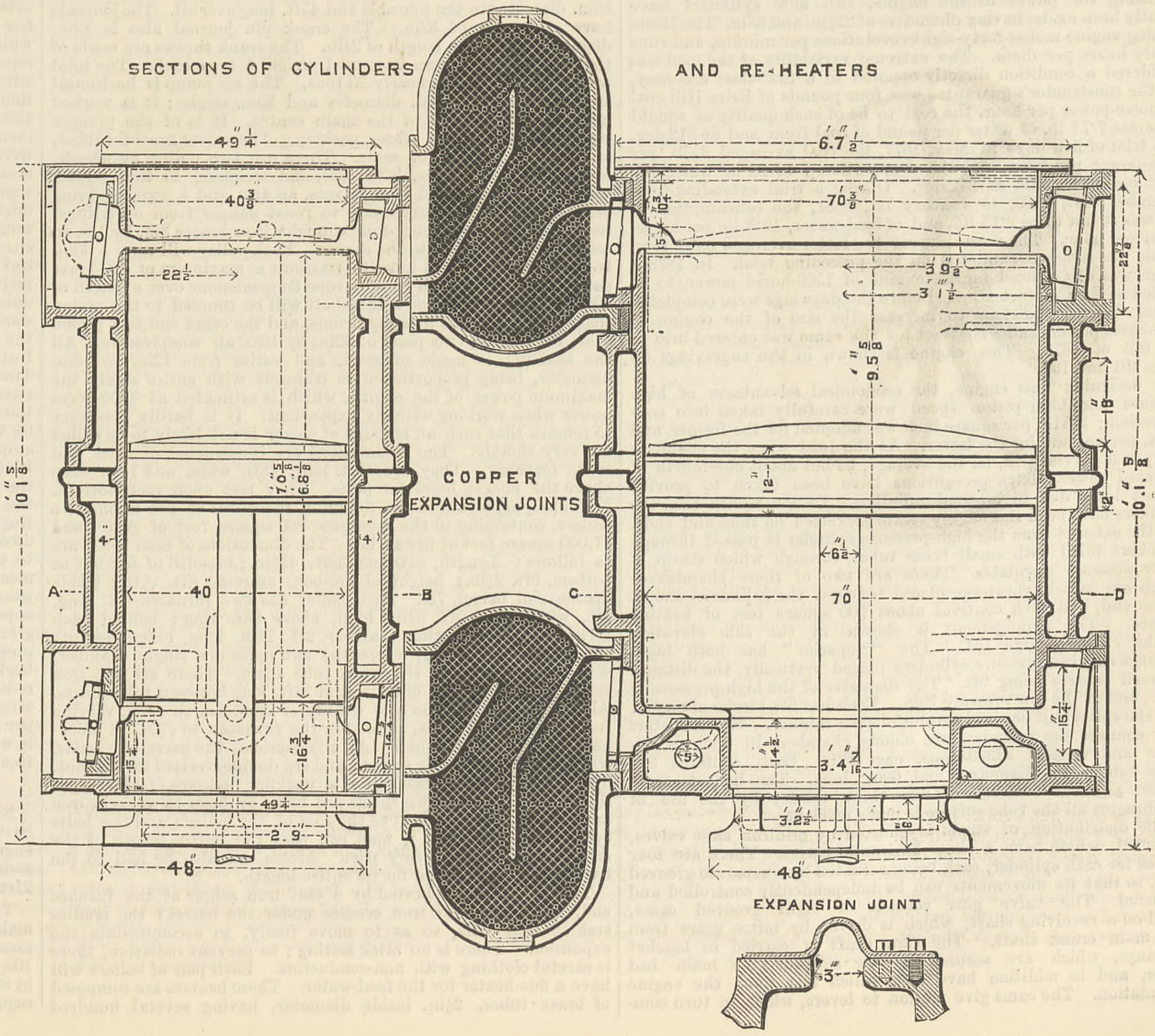


LONGITUDINAL HALF SECTION OF RE-HEATER



SLIDE VALVE

SECTIONS OF CYLINDERS AND RE-HEATERS



EXPANSION JOINT

COMPOUND WINDING ENGINE, CALUMET AND HECLA MINE.

IN THE ENGINEER for February 17th, 1882, we illustrated a compound engine designed for pumping sewage at Boston, U.S., by Mr. Leavitt, an American engineer, enjoying a considerable reputation for the construction of this class of machinery. Our engravings were prepared from a photograph kindly placed at our disposal by Mr. Reginald Bolton, Terrace Royal, Nottingham. We now illustrate a winding engine, designed by Mr. Leavitt, known as "The Superior," the details of which have much in common with the engines we illustrated on the 17th February. The Superior was fully described in a paper recently read by Mr. Leavitt before the American Society of Mechanical Engineers, and his paper we reproduce. The paper is a description of a compound hoisting engine, built by the I. P. Morris Co., of Philadelphia, for the Calumet Mine. It is the fourth engine of its kind ordered by the Calumet and Hecla Mining Co., for whom the design was first specially made in 1874, and by reason of greatly exceeding its predecessors in size and power, it has been named the "Superior."

Engine No. 1 was built in 1874 for pumping the water required by the separating and dressing machinery at the company's stamp mills, which are situated at Lake Linden, Michigan. It was an outcome and departure from the Lynn pumping engine, the arrangement of cylinders with their outer ends placed near together, and their pistons connected to opposite ends of a beam, being retained, together with the valve gear. The departure from the Lynn engine consisted in inverting the cylinders, placing the beam below them, with its journals carried in pedestals on the main bed plate, and so constructing the beam that the connection from it to the crank was situated above and between the piston connections. The position of the shaft was by this means brought very nearly in the same horizontal plane as the main beam centre, its distance from the same being a little greater than the length of the connecting rod. Two pumps were used in this engine, one being located at each end of the beam, and both were hung to and below the bed plate. The latter consisted of a pair of deep hollow girders, placed parallel with each other and bolted at their ends to heavy foundation piers. This arrangement afforded excellent facilities for getting at the pumps. It should be stated that this No. 1 engine had its low-pressure cylinder placed vertically, and its high-pressure cylinder at an angle of about 15 deg. from vertical. One pump was situated in the same centre line with the low-pressure cylinder, thus allowing the steam and water pistons to be rigidly connected. The pump at the high-pressure end of the beam was also vertical and worked by a trunk connection from the beam.

Although the first engine was built with the intention and expectation that it would have a large surplus capacity, the additions to the works were so large before it was put in operation that it had to start at a speed greater by 25 per cent. than its intended maximum, and before it had run one year this speed was nearly doubled. The great demand for water at the stamp mills, and the success of the first engine in supplying it, decided the authorities of the Calumet and Hecla Co. to build a second pumping engine in 1876, of more than twice the nominal capacity of the first, and a third engine to be used for hoisting and general machinery driving at the Hecla Mine.

The second engine was very like its predecessor, save in the construction of the pumps. The latter were fitted with differential plungers in lieu of buckets and plungers, and the change has proved a good one. The No. 2 pumping engine was put in regular service early in December, 1876, and has run constantly 144 hours per week since that date, save on weeks having legal holidays, and one entire week when it was laid off to test the pumps of the No. 1 engine after they had been fitted with improved valves. During the period of its operation it has made forty millions of revolutions and raised approximately thirteen thousand millions of gallons of water against a dynamic head of 51ft. It has neither required nor received any repairs. The dimensions of the No. 2 pumping engine's cylinders are $17\frac{1}{2}$in. and 36in. diameter by 5ft. stroke, and of the pumps, 20in. and $28\frac{5}{16}$in. diameter of plungers, by 5ft. stroke. The usual speed is twenty-four revolutions per minute. The third engine was erected at the Hecla Mine in the fall and winter of 1876 and 1877, and started early in 1877. It is employed to drive four hoisting drums, each 24ft. diameter, and weighing 70 tons, also a pair of 28in. by 48in. air compressors, the stone breakers, and other mine machinery. Its load is exceedingly variable, running from flying light to 650-horse power. The cylinders were originally 18in. and 36in. diameter by 5ft. stroke; but for the purpose of increasing the power of the engine, two new cylinders have recently been made, having diameters of $22\frac{3}{4}$in. and 38in. The Hecla hoisting engine makes forty-eight revolutions per minute, and runs twenty hours per diem. The extreme variability of the load was considered a condition directly opposed to a first-class economy, and the constructor's guarantee was four pounds of Brier Hill coal per horse-power per hour, the coal to be of such quality as should evaporate 7·74 lb. of water per pound of coal from and at 212 deg. On a trial of five days in May, 1877, the coal averaged $3\frac{1}{8}$ lb. per horse-power per hour, and the evaporation 7·42 lb. of water per lb. of coal from and at 212 deg. During a trial extending from December 21st, 1880, to January 1st, 1881, the consumption of coal was found to be 2·13 lb., and of feed-water, 16·3 lb. per horse-power per hour. The power during the latter averaged more than double the average exhibited on the preceding trial. In 1878 a design was commenced for an engine of 1500-horse power, to be located at the Calumet Mine. Before the drawings were completed it was deemed judicious to increase the size of the engine to 2500-horse power, and a contract for the same was entered into in the fall of 1879. This engine is shown in the engravings on pages 191 and 194.

In designing this engine, the economical advantages of high pressure and high piston speed were carefully taken into consideration; 135 lb. per square inch was adopted for the former, and 720ft. per minute for the latter. As the load when the engine is first put in service will, on the average, be but about one-fourth of its rated power, extra precautions have been taken to provide against losses due to internal radiation. To accomplish this, the cylinders have been thoroughly steam jacketted on sides and ends, and the exhaust from the high-pressure cylinder is passed through chambers filled with small brass tubes, through which steam of boiler pressure circulates. There are two of these chambers—which are called reheaters—placed between the cylinders, one at either end, and each contains about 700 square feet of heating surface. The arrangement is shown in the side elevation of the engines, page 194. The "Superior" has both high-pressure and low-pressure cylinders placed vertically, the distance between centres being 9ft. The diameter of the high-pressure is 40in., and of the low pressure 70in. Each has 6ft. stroke of piston, and the speed will be sixty revolutions per minute. The reheaters that connect the cylinders are oblong chambers in their transverse and vertical dimensions, page 191. Each contains 941 brass tubes, $\frac{5}{8}$in. diameter, and 60in. long. The live steam is inside, and the exhaust outside these tubes; by the use of diaphragms all the tube surface is made efficient.

The distribution of steam is effected by gridiron slide valves, page 191, which have a short horizontal travel. There are four valves for each cylinder, each being actuated by a separate grooved cam, so that its movements can be independently controlled and adjusted. The valve gear consists of eight grooved cams, fixed on a revolving shaft, which is driven by mitre gears from the main crank shaft. The cam shaft is carried in bracket bearings, which are secured to the side of the main bed plate, and in addition have feet which rest upon the engine foundation. The cams give motion to levers, which in turn communicate it to the bell cranks that move the valves. The connections between the levers and bell cranks are tubular. The cam levers are made of Chester cast steel; their pins and rollers are of hardened open hearth steel. The throws of the cams are also of hardened steel. The cut-off is effected by the high pressure inlet valves, and is automatically controlled by the governor. The range is from 0 to 0·6 the stroke. This is accomplished by making the cam in two parts, one for opening and the other for closing the valves. The opening part is made fast to the cam shaft, while the closing part is driven through a sleeve, which has a key slot running its entire length. The shaft inside the sleeve has a spiral keyway, and a key is fitted to it and to the slot. This key is also made fast to a sliding collar, which embraces the sleeve, and is capable of being moved back and forth by a yoke and lever. The lever receives its motion from the piston of a small steam cylinder, the valve of which is operated by the governor in such a manner that the position of the piston is definitely fixed by the position of the governor balls. Abundant power for moving the collar is thus provided, in combination with a very delicate and sensitive Porter governor to determinate where and how far it should be used. The cam just described operates two independent compound levers, one being required for each high pressure inlet valve. The compound levers are so constructed that one part has a fixed pivot at one end, and a roller fitting the opening cam at the other. At the middle of its length there is a stud, to which the other part of the lever is pivotted. This lever is provided with a roller that fits the movable or closing cam, which is situated about one-third of its total length from the pivotted end. The outer ends of these second levers are connected to vibrating cams that move the high-pressure inlet valves, the function of the vibrating cams being to allow the large amount of lost motion that is indispensable in obtaining a quick movement. As the travel of the inlet valves is but one inch, while that of the vibrating cams is 12in., a very sharp cut-off results. The low pressure inlet valves are set to close at 35in. from the commencement of the stroke. The other cams are similarly constructed. It will be observed that the disc part of the cam is attached to a centre that is keyed to the cam shaft. These centres have a T-shaped groove, into which the bolt heads that secure the discs are fitted. This construction allows any amount of adjustment that can be desired, as will readily be seen.

The hand gear consists of a pair of small steam cylinders, which turn a crank shaft that can be connected at will with the cam shaft by a clutch, the axes of the two shafts being in the same line. The mitre gear on the cam shaft also has a clutch, which is connected to the clutch on the small crank shaft, in such a manner that it must be thrown out of gear before the other can be put in gear, and *vice versâ*. The excentrics for working the valves of the small cylinders are placed on a separate shaft which is turned by a hand wheel. The excentrics give motion to levers which are pivotted to other levers that receive motion from the pistons. A differential motion is thus imparted to the valves, with the result that the engines will stop immediately when the hand wheel ceases to turn, because the motion imparted by the levers connected with the pistons will close the valves.

The main framing of the engine is formed by four massive columns, which are secured to the bed plate, and have suitable flanged facings to their upper ends, to which the feet of the cylinders are bolted. These columns also form the crosshead guides. The bed plate is in four pieces—two sides and two ends—the back end forming the air pump and channel way. The jaws for the crank shaft and beam pedestal boxes are cast in the side pieces of the bed plate, all the journals being situated in the same horizontal plane. The gross weight of the bed plate is 65 tons, each side piece weighing 21 tons.

The running gear of the engine, with the exception of a beam and crank throws, is of steel. The piston rods are respectively $6\frac{3}{4}$in. and 7in. diameter. The crossheads, low-pressure link, connecting rod, main centre, crank pin and shafts, were made by Krupp, of Essen, and are beautiful work. The low-pressure link and the connecting rod are of a peculiar construction. A jaw is formed for the boxes by cutting in from the side. A binder is then fitted so as to hold the jaw from opening or closing, and the adjustment of the boxes is effected by a wedge, which is drawn up by a screw and nut; two set screws bearing against the upper edge of the wedge hold it solid. The boxes are also held solid by set screws in their flanges. The beam, or perhaps the term rocker, would be more appropriate—page 194—consists of a pair of gun iron wheels, 11ft. in diameter, with the pins for piston and crank connections forced into their rims. The main centre is 18in. diameter on the body, and 15in. diameter in the journals, which are 30in. long. A heavy counterbalance casting is bolted to the bottom of the beam wheels, its weight being adjustable so as to equilibriate all the vibrating parts. This is a matter of importance, as these weights aggregate upwards of 25 tons, and make 120 vibrations per minute. The crank shaft is 18in. diameter in the journals and 45ft. long over all. The journals have a length of 32in. The crank pin journal also is 18in. diameter, and has a length of 24in. The crank throws are made of the best charcoal scrap iron, and weigh 4 tons each. The total weight of the shaft is nearly 30 tons. The air pump is horizontal and double-acting, 30in. diameter and 30in. stroke; it is worked by an arm on the end of the main centre. It is of the plunger construction, and has water packing. The valves are of rubber, and have iron grids for seats. There are two pulley fly-wheels, each 32ft. in diameter, 32in. face, and weighing 45 tons. Each consists of a centre and 12 segments, an arm and a segment being cast together. As a precaution to resist danger from centrifugal force, the rim has twenty-four wrought iron braces 3in. by 1in. in section for securing it to the centre. Each pulley will carry a 30in. treble belt, which will have to transmit a maximum of 600-horse power to be distributed by wire rope transmissions over a length of 2000ft. One end of the crank shaft will be coupled to the pinion shaft that drives the hoisting drums, and the other end to a pinion shaft for driving two pairs of 32in. by 48in. air compressors. All the shafting is made of steel, and varies from 12in. to 18in. diameter, being proportioned to transmit with entire safety the maximum power of the engine, which is estimated at 4700-horse power when working with six expansions. It is hardly necessary to remark that such an amount of power is not likely to be called for very shortly. The foundations are constructed of brick and stone masonry. They are 40ft. long, 18ft. wide, and 18ft. deep above the pocket holes for bolts. They rest upon rock bottom. For supplying steam to the Superior, there will be five locomotive boilers, containing in the aggregate 260 square feet of grate, and 11,000 square feet of fire surface. The dimensions of each boiler are as follows:—Length, extreme, 33ft. $4\frac{13}{16}$in.; breadth of fire-box at bottom, 9ft. $2\frac{1}{8}$in.; height of fire-box, extreme, 8ft. $\frac{9}{16}$in.; inside diameter of barrel, 7ft. Each boiler has two furnaces 8ft. long, 4ft. wide, and 5ft. $6\frac{1}{4}$in. high, above base ring; behind each furnace is a combustion chamber, 2ft. 11in. long, extending into the barrel of the boiler, where the two unite in a single chamber, 4ft. 1in. long, up to the front tube sheet. There are 118 iron tubes, $3\frac{1}{2}$in. diameter outside, and 18ft. long between tube sheets. All the plating is of the best quality of open hearth steel, varying from $\frac{5}{16}$in. in thickness, as used in the furnaces, to $\frac{9}{16}$in. in thickness, for the circular shell. All the joints of the barrel are butts, with outside and inside straps; and are double rivetted throughout. The staying is proportioned for a working pressure of 135 lb. per square inch. The crown sheets are hung by bolts to wrought iron arches, which are rivetted to the roof of the boiler; and the bolts are so arranged that a man can pass the entire length of the crowns and examine every part. Access can also be had to the barrel, below the tubes, for its entire length.

The boilers are supported by a cast iron ashpit at the furnace end, and three cast iron cradles under the barrel; the cradles rest on iron balls, so as to move freely, to accommodate the expansion. There is no brick setting; to prevent radiation, there is careful clothing with non-conductors. Each pair of boilers will have a flue heater for the feed-water. These heaters are composed of brass tubes, $2\frac{1}{2}$in. inside diameter, having several hundred square feet of exposed surface. By this method the water enters the boilers at 140 deg. and upwards. The main steam pipe is of wrought iron tubing, 12in. diameter, and about 75ft. long. It discharges into a receiver near the engine, which is 5ft. in diameter, and 15ft. high. A short pipe, 12in. diameter,, connects the receiver with the high-pressure cylinder. It is expected that the Superior, with three of its boilers, will be completed the present season. In conclusion, the writer desires to put on record the fact that the creation of the plant, to which the Superior forms the latest and greatest addition, is due to Professor Alexander Agassiz, the president of the Calumet and Hecla Mine, whose forecast and sagacity as a man of affairs are only equalled by his skill as a scientist. An engineer by profession, he has the great advantage of being able to grasp engineering details, and thus fully comprehends what is often lost sight of—the axiom that the best is the cheapest.

THE INSTITUTION OF CIVIL ENGINEERS.

STEEL FOR STRUCTURES.

AT the ordinary meeting on Tuesday, the 28th of February, Mr. E. Woods, vice-president, in the chair, the paper read was on "Steel for Structures," by Mr. Ewing Matheson, M.Inst. C.E. The object of this paper was to state the present position which steel occupied, as compared with iron, as a material of construction; and to examine the reasons why, while steel was rapidly superseding iron for ships and boilers, it was so seldom used for bridges. Steel possessed the important advantage of a strength one and a-half to twice that of iron, as well as superior elasticity and ductility; and, owing to the method of manufacture, plates and bars of the usual kind could be made of steel in much larger pieces than was possible with iron, thus avoiding the numerous joints which the smaller pieces involved. The special treatment necessary for steel could soon be learnt by workmen accustomed to iron, and the tools and machinery of a factory could be used for either metal. In regard to wasting by rust, sufficient time had hardly elapsed to prove positively the durability of steel as compared with iron, but at present it appeared as if the difference, if any, was in favour of steel. Because of its greater strength, structures equal to iron could be made of less weight in steel; and in regard to ships, this saving allowed a corresponding increase in cargo-carrying capacity, or a reduced immersion. In boilers, plates, whether of steel or of iron, could not conveniently be of more than a certain thickness, and the working pressure was limited accordingly; but the superior strength of steel permitted a working pressure of steam one-third greater than in boilers of iron, thus allowing a saving in the space occupied for a given power, and greater economy in fuel. In regard to girders or bridges, if strength and elasticity were assured, there was not the same necessity for the great ductility which in ships was so important to resist concussion; but the rules of the Board of Trade, which controlled railway structures in this country, allowed working strains on the parts of steel bridges based on the extremely ductile steel used for ships. That was to say, while the maximum strain allowed on iron was 5 tons per square inch of sectional area, a strain of only $6\frac{1}{2}$ tons was allowed on steel. By this limitation, the engineer, in designing bridges, was unable to take full advantage of steel; and as, moreover, for various secondary reasons, the thickness of parts in a steel structure could not be reduced, in proportion to those of an iron structure, quite so much as even the permitted strains allowed, bridges of moderate span could not be made so cheaply of steel as of iron, so long as the cost of the material exceeded, as at present, that of iron in a proportion equal to that of the greater strains permitted. Until the present time, the cases in which steel had been profitably used were those in which, because of difficult transport in new countries, lightness was of great value, and those where, owing to great length of span, the weight of the material itself, as distinct from the dead and moving load it had to carry, imposed the principal strain, a compound saving being thus afforded by the use of steel. In this way, while a saving in weight of only 12 per cent. could be obtained in a bridge of 50ft. span, a saving of 30 per cent. could be obtained in a bridge of 500ft. span. With the present prices of iron and steel there would be a loss by using steel in the small span and a gain by using it in the large span. But while there might be no immediate pecuniary saving by using steel, there was, owing to the very moderate strains permitted on this new material, a much greater margin of safety than in iron. Hence the question arose whether, even although the cost of steel bridges of moderate span might be greater than that of iron bridges, they should not be preferred, and their use enforced, because, if measured by units of strength and durability as well as of money, they would be cheaper eventually.

There were several means by which the use of steel might be extended. In the first place, the experience gained during the last few years, as to the certainty of quality and the readiness with which it could be treated, had not yet spread to all concerned, especially to engineers abroad, who awaited some authoritative affirmation to set against the records of early mistakes, misapplications, and failures. The proper treatment of steel had now been thoroughly investigated, and the circumstances under which the metal was damaged, by punching holes and other manipulation, were well understood. But there was also needed some ready means of verifying quality. This was far more necessary in steel than in iron, because in the latter the range within which strength might vary was only one-sixth, whereas steel had a much wider range. Again, the mere fact that iron had been rolled into shape ensured a certain minimum of quality, while if steel chanced to be bad it might be one-half weaker than was wanted. An authoritative brand or hall-mark seemed necessary, if steel was to be universally accepted, and the author suggested that some mark should be adopted, as denoting quality and kind, the addition of the particular trade-mark of each maker serving as a warranty. But in order to encourage a further use of steel, the Board of Trade rules should be altered. While a certain minimum of strength and ductility might be demanded, the present limits to the maximum straining should be amended, so that, instead of $6\frac{1}{2}$ tons per square inch, 8 tons might be allowed, an increase amply justified by the experience acquired during the last few years. If this was done, the greater demand would almost certainly have the effect of bringing the price nearer to that of iron, as had been the case with rails. The author set forth the present rules of the English Admiralty and Lloyds' in regard to steel for ships, and directed attention to the different rules of the French Admiralty, to exemplify the alterations which he proposed. As it was by means of a Royal Commission that the present strains on steel were permitted, it was time that another commission should be appointed to inquire into the facts more recently acquired, and to grant more liberal rules for the future. With an extension of the present limit of $6\frac{1}{2}$ tons, there would be such a demand as would lead to improvements in the manufacture, increase the output, and reduce the price of steel. The whole calculation would then be altered, and when steel might not only be worked to 8 tons strain per square inch, but the difference in price over iron was less than it was now with $6\frac{1}{2}$ tons, then, but not till then, would the era of steel structures have arrived.

NAVAL ENGINEER APPOINTMENTS.—The following appointments have been made at the Admiralty:—Robert E. Widdecombe, chief engineer; Frederick A. Cocks, engineer; and Arthur W. Turner, assistant-engineer, to the Amethyst, when commissioned on the 21st inst. William G. Stirling, engineer, to the Bullfrog.

THE MANUFACTURE OF SPIEGELEISEN IN ENGLAND.—The make of spiegeleisen for the Bessemer process is largely increasing in the United Kingdom, and now amounts to nearly 100,000 tons per annum, of which the largest quantity is produced in South Wales. In that district one firm has had three furnaces regularly engaged in making spiegeleisen during 1881.

RAILWAY MATTERS.

THE three railway officials responsible for the collision and loss of life at Charenton last September were sentenced on Saturday last to twelve, eight, and six months' imprisonment respectively.

THE report by the directors of the Callender and Oban Railway, to be submitted to the shareholders next Tuesday, shows that locomotive power for the half-year ending 31st January, 1882, cost £4581 5s., the total train mileage in that time being 131,038 miles.

A MAGDEBURG inventor has, it is said, secured a patent for an indicator with duplicate pistons, springs and cylinders, which is connected to both ends of the cylinder, so as to produce a figure that shall show the amount of work done in a complete double stroke.

SINCE August, 1881, the "American Travellers' Official Guide" has added 2000 new names to its station index. It was either very incomplete before, or the 8242 new miles of line since 1880 have about that number of stations, and this would make them about 4·12 miles apart.

THE Board of Trade have issued a provisional order authorising the use of steam on the main line of the North Staffordshire tramways system for seven years. The extension of the company's line to Tunstall is stopped pending the decision of the Board of Trade on the application for the use of steam in Burslem.

THE American locomotive with Eames' brake, to which we referred some time back in Lancashire Notes, was run a trial trip with a special train from Manchester to Leeds and back, on the Lancashire and Yorkshire Railway, on Wednesday, and has for the present been returned to the locomotive shed. No official statement has yet been made as to the result of the trial.

THE Lancashire and Yorkshire Railway Company has resolved to abandon all previous projects for the extension of Tithebarn-street station at its present distressing high level, and has taken into consideration the alternative of constructing a totally new station on the level of Tithebarn-street. This, the *Bootle Times* says, they are advised by their consulting engineer, Sir John Hawkshaw, is perfectly feasible, and it is stated by the originator of the proposition, who is a talented engineer in the neighbourhood, that a very large saving in cost will be effected by thus placing the new station on the ground level, as may be readily appreciated by anyone who is familiar with the colossal system of vaulting under the present station, which was to have been reproduced in the new.

THE important event for Newfoundland, the first railway trip, took place on the 12th ult. The train ran in on the road as far as it is ballasted, a distance of about ten miles, and then returned to town, the party expressing themselves highly pleased with the success of the trip. It is a strange coincidence, says *India and the Colonies*, that the steamer that landed the first locomotive ever seen in Newfoundland was the one that thirty-two years ago first connected Newfoundland with the United States and British North America by carrying the mails. But the steamship Merlin has degenerated since those days. She was then a steamer of the Cunard line; she is now a seal-hunter, the property of Mr A. M. McKay, superintendent of the Anglo-American Telegraph Company.

THE report of the directors of the Great North of Scotland Railway Company for the half-year ending 31st January, 1882, to be submitted to the shareholders next Thursday, gives the train mileage as: passenger, 328,932¼; goods and mineral, 269,610¾; total train mileage, 598,543 miles. The cost of locomotive power was as follows:—Salaries, office expenses, and superintendence, £381 17s. 6d. Running expenses: Wages of engine-drivers, firemen, &c., £4273 2s. 2d.; coke, coal, and firewood, £4860 15s. 4d.; water, £38 2s. 9d.; oil, tallow, and other stores, £1126 12s. 7d.; total for running expenses, £10,228 12s. 10d. Repairs and renewals: Wages for repairs of engines and tenders, &c., £2298 12s. 5d.; materials for repairs of engines and tenders, &c., £3576 13s. 10d.; total for repairs, &c., £5875 6s. 3d. Total cost of locomotive power, £16,555 16s. 7d.

FROM the time that the United States laid its first rail it has increased its railways much more rapidly than we have, probably because American roads were few and bad, and ours more or less plentiful if bad. America was forced to make roads, and it was easier to lay rails. The Rainhill locomotive trials commenced on the 8th October, 1829. The first official return of the length of English railways was published for 1854, at the close of which year 8053 miles of line had been completed in the United Kingdom. In 1830, 23 miles of railway were open in the United States. By the end of 1840 2818 miles were open. In 1850 the length rose to 9021. In 1854 it was a little more than double the length of English lines, being 16,720 miles. By 1860 the total rose to 30,635 miles against 10,433 in the United Kingdom. In 1870 the respective lengths were 52,914 and 15,537, and at the end of 1879 82,223 and 17,696 miles respectively. The total length of the railroads of the United States at the close of 1880, including some lines which do not report their earnings, was 93,671 miles.

WITH reference to a paragraph on the lengths of English railway tunnels, which appeared in this column in our last impression, several correspondents have pointed out that the Box is not the longest tunnel in England. Mr. J. B. Squire writes: "There are four railway tunnels longer than the first-named, and—including the Box tunnel—eight longer than the Kilsby; these are given in 'Roney's Rambles on Railways' as follows: Woodhead, M.S. and L., 5296 yards; Stanedge, L. and N.W., 5280 yards; Medway, S.E., 3740 yards; Sevenoaks, S.E., 3600 yards; Box, G.W., 3227 yards; Summit, L. and Y., 2869 yards; Sapperton, G. W., 2800 yards; Poh-hill, S. E., 2750 yards; Kilsby, L. and N.W., 2423 yards. In the case of the two first on the list, I know the lengths given are approximately correct from personal observation, and as those given for the Box and Kilsby correspond closely with your figures, I have no doubt that this list is a reliable one; in the case of the Stanedge, moreover, there is a canal tunnel runs through the hill alongside of the railway tunnel of about the same length."

A REPORT by Colonel Yolland on the accident which occurred on the 28th January to an empty down coal train, and the subsequent disastrous collision between a portion of it and a passenger train, between Old Ford and Bow, on the North London Railway, has just been published. Five passengers, it will be remembered, were killed on the spot, ten others were more or less seriously injured, and about forty-five altogether have sent in claims against the company, and three of the company's servants in charge of the passenger train were also hurt. The accident was caused by the fracture of the continuous draw-bar of a truck, which on breaking pulled out, caught the permanent way, threw the next truck off the line and damaged others. The diameter of the draw-bar of wrought iron is about 1⅝in.; the cotter hole in it is 2⅜in. long, ½in. wide, and 1½in. deep. The failure of this draw-bar was evidently due to there having been a flaw running throughout the metal at one side of the cotter hole, covered by a cast iron washer, the iron being of inferior quality. The immediate effect of the cotter holes made in these draw-bars is to reduce the strength to less than ⅔ of the original bar, as far as a tensile strength is concerned; and when one of the sides fails, as in this case, owing to a flaw in the material, its ultimate strength is less than ⅓ of the original strength of the draw-bar. There are no less than four cotter holes in the draw-bars under trucks so constructed. The truck belonged to the Metropolitan Railway Carriage and Wagon Co., had been hired by the Bedworth Coal and Iron Co., and had taken coal from the Charity Colliery, Bedworth, to J. and C. Harrison, Mark-lane, London. Colonel Yolland points out that there is a serious objection to the employment of these long draw-bars, and mentions serious accidents which they have caused—six carriages being, in one instance, thrown down an embankment nearly 40ft. in height. He also mentions that short hooks and bars should be used. the headstocks being held together by long through bolts if required.

NOTES AND MEMORANDA.

AN article was recently published in the *Scientific American* calling attention to the insufferable pain and ulcer which results from insufficiently careful employment of hydrofluoric acid. Dr. Robbins, of the Boston Institute of Technology, describes his experiences after having held the stump of a match which had been saturated with the acid between finger and thumb for about half an hour while etching a hole through a piece of porcelain.

WITHIN the last twenty years the make of pig iron in the United Kingdom has more than doubled. In 1862 the total production was 3,943,469 tons; in 1872, 6,741,929 tons; and in 1875 it had fallen to 6,365,462 tons. In two subsequent years—1878 and 1879—the make fell below this latter figure. Last year the production showed the enormous advance of 2,368,230 tons on 1879, the increase within two years being equal to the whole make of the country in 1850.

THE total production of works engaged in, according to the report of the British Iron Trade Association, or erected for making pig iron in the United Kingdom at the end of last year was 242, being a decline of 5 on the number at the same date in the preceding year. Of that number, 183 were at work and 59 were altogether idle, being an increase of 4 and a decrease of 9 respectively on the corresponding figures for the 31st December, 1880. It may, moreover, be noted that the 28 works that were operative in the Cleveland district produced 32 per cent. of the total make of 1881.

WHEN an alloy of lead, tin, or other metal with sodium, is made in a melting pot, great care must be used in subsequently freeing that melting pot of all trace of sodium before using it for melting tin in it with a view to tinning copper or bronze articles; otherwise these articles when placed in the melted tin will be rapidly eaten away. This has been recently accidentally proved, but it might have been expected from known facts concerning sodium alloys as very long since pointed out by Mallet, who showed, among other things, that if a strip of iron be coated with sodium amalgam, and dipped into a pot of, say, molten tin, the iron will disappear faster than it can be put to the bottom of the pot.

THE shrinking of the waters of Lake Constance, owing to the extraordinary dryness of the winter, has brought to light many interesting lacustrine relics near Steckborn, in canton Thurgau. Among them the *Times* Geneva correspondent says there are bone and flint implements, harpoons, pottery, many specimens of which are intact, clubs, baskets, arrows, field tools, and animal remains. Among the latter are skeletons and part skeletons of the bear, the bison, and the moorhen. The find also includes a considerable quantity of oats and wheat in a good state of preservation, and a remarkably perfect and artistically executed stag-horn harpoon. The relics have all been removed to Frauenfeld and added to the collection of the local historical and natural history society, which is now the richest in lacustrine objects in the Confederation.

THE annual rate of mortality during the week ending the 14th ult. was unusually high. In twenty-eight of the largest English towns it averaged 29·8 per 1000 of their aggregate population, estimated at 8,455,320 persons. London rate, 35·3. In London 2951 births and 2632 deaths were registered. Allowing for increase of population, the births were 159, and the deaths as many as 747 above the average numbers in the corresponding week of the last ten years. The death rate is higher than any recorded in the metropolis since the week ending the 7th of February, 1880, when the rate was 46·7. It was noted in the weekly return for that date that the nearest approach in recent years to the excessive mortality then recorded was in the week ending 20th December, 1873, when the rate was 37·5. The excessive mortality on each of these three occasions was consequent upon, and doubtless determined by, a succession of dense fogs accompanied by low temperature. No age escapes the noxious influence of these fogs, but the effect is most marked on persons of advanced life, and least so on children under five years of age.

AT a recent meeting of the Chemical Society, Mr. R. Cowper read a second paper "On the Analysis of a Piece of Oxidised Iron from the Condenser of H.M.S. Spartan." The specimen consisted of a brownish substance with many shining black particles, and resembled a piece of rusty, grey pig iron. Its Sp. Gr. was 2·63, and it was very friable. Details are given of the quantitative analysis, which yielded the following result:—Insoluble residue, 31·84—carbon, 12·57; hydrogen, 0·24; incombustible, 17·54—SiO_2, 16·98; FeO_3, 0·12; AlO_4, 0·06; CaO, 0·15; MgO, 0·02. Cupric oxide, 0·38; ferric oxide, 3·21; ferrous oxide, 42·33; alumina, 0·16; manganic oxide, 1·02; cobalt oxide, 0·05; sodium oxide, 0·11; phosphoric acid, 5·24; sulphuric acid, 0·31: chlorine, 2·08; vanadic acid, 0·11; water, 16·71. Total, 102·55. The points of interest are that there was not a trace of metallic iron, a great preponderance of ferrous over ferric oxide, and a comparatively large proportion of chlorine in combination with iron and manganese. Ordinary cast iron rust contained 65·4 per cent. Fe_2O_3, and 7·42 per cent. FeO. A somewhat similar preponderance of FeO is given in an analysis of oxidised iron from the blade of a screw propeller by Liversidge, Proc. R. S. of New South Wales. In the discussion which followed the paper, the President believed that a somewhat similar oxidation of iron was mentioned in "Percy's Metallurgy," in the case of an iron pump at the bottom of a coal-pit. Dr. Debus mentioned the conditions under which the oxidation had taken place. The iron formed part of a box through which ran a copper pipe. He then recapitulated the points of interest in the paper, and especially drew attention to the large amount of ferrous oxide. Dr. Dupré suggested that the rapid oxidation was caused by a galvanic action of the iron and copper, rather than by the rusting of iron in sea-water. Dr. Debus disagreed entirely with the suggestion of Dr. Duprés.

THE council of the Meteorological Society have deemed it advisable to supplement the ordinary observations by a series of well-conducted experiments, intended to throw light on such questions as the vertical decrement of temperature, the rate of ascension of vapour, the height of cloud strata, the variations in the velocity of the wind at different elevations, &c. Steps have been recently taken to make observations on the first of the questions by placing thermometers at the summit and base of Boston Church Tower, which is 270ft. in height. This tower is admirably situated for making such experiments, as it is isolated and free from any obstructions, and the ground is quite flat for miles round. By permission of the vicar, Canon Blenkin, the instruments have been placed as follows:—At the summit one of Dr. Siemens' electrical thermometers—placed at the society's disposal by Messrs. Siemens, Bros., and Co.—and an ordinary thermometer are mounted in a small screen fixed to one of the pinnacles of the tower; on the roof of the belfry, which is 170ft. above the ground, a Stevenson screen has been mounted containing maximum, minimum, dry and wet bulb thermometers. In the churchyard another Stevenson screen has been fixed containing a similar set of thermometers, for comparison with those above. All the thermometers will be read every morning at 9 o'clock. The electrical thermometer consists of a coil of wire wound round a cylindrical piece of wood enclosed in a small brass tube; a third wire is joined to one of the wires, and the three insulated by gutta-percha form a light cable, which is brought down to the base of the tower and connected to a galvanometer, the terminals of which are in connection with the two poles of a six-cell Leclanché galvanic battery. The instrument is read by depressing a key, which causes the needle of the galvanometer to deflect; a pointer or vernier—moving a contact roller upon a wire in a circular groove—is then pushed to the right or to the left upon a divided scale until the needle remains stationary on the zero point, when the electrical resistance of the wire is measured upon the scale. The number indicated by the vernier is then read off, and by referring to a table of equivalents the actual temperature in degrees of Fahrenheit is readily ascertained.

MISCELLANEA.

NOTICE of removal to Billiter House, Billiter-street, E.C., is given by Messrs. Witty and Wyatt.

THERE does not appear to be any intention at present in Russia to raise the duty on bar, plate, or other iron, although most of the duties on other imports are being raised.

MR. H. FAIJA, of 4, Great Queen-street, Westminster, has matured a simple process for accelerating the hardening of cement concrete, and which is specially applicable for concrete block, slab, and moulding making.

NEARLY 3000 tons of charcoal iron are still made annually in the United Kingdom. There are, according to the report of the British Iron Trade Association, six charcoal furnaces in existence, all of them belonging to one firm.

AN important paper on the theory of the management of waters considered in their applications to the works of amelioration or improvement of navigable watercourses was read on the 3rd ult., before the Société des Ingenieurs Civils, by M. Cotard.

AT a meeting at Plymouth on Friday the proposed re-erection of Smeaton's Eddystone Lighthouse on the Hoe was practically determined upon. It was reported that about £1000 had been already promised towards the cost of removal and re-erection.

THE success that has attended the efforts of the Wolverhampton Chamber of Commerce to secure for the manufacturers of their town and district greater facilities in tendering for War-office supplies has induced the Chamber to take similar steps in the matter of Admiralty tendering.

THE paper on "Telephonic Communication," by Col. Webber, announced for reading at the Society of Arts on the 22nd March, has been postponed. We understand that the alteration has been made in consequence of the *conversazione* which is to be held the same evening at the Electrical Exhibition at the Crystal Palace.

THE Hardy Patent Pick Company, of Sheffield, is publishing a handy little hard card scale, known as "Bainbridge's Handy Surveyor's Scale." It contains eight scales on the eight edges of one slotted slip, and the four sides at the two ends contain acreage and tonnage rent table, a scale of chains per inch, inches per mile, and acres per square inch, and weight in pounds per cubic foot of different material.

THE official export returns show an exportation of 66,893 tons of pig iron and 29,542 tons of manufactured iron and steel during the month of February. This makes a total of 96,435 tons. Compared with January pig iron shows a decrease of about 5000 tons, and manufactured iron and steel remain about the same. Compared with February of last year the pig iron export shows an increase of nearly 10,000 tons.

A PAMPHLET, useful to apprentices and turners generally, and containing tables of change wheels from one thread per inch to thirty threads per inch, increasing by half-threads arranged for leading screws of two, three, and four threads per inch, by S. Johnson, Bath-street, Sheffield, is being sold at 7d., per post, by F. Schulze, 44, Bennett-street, Sheffield. The pamphlet also contains a table of pitches from $\frac{1}{16}$in. to 6in. pitch for each leading screw, and a table of Whitworth standard threads.

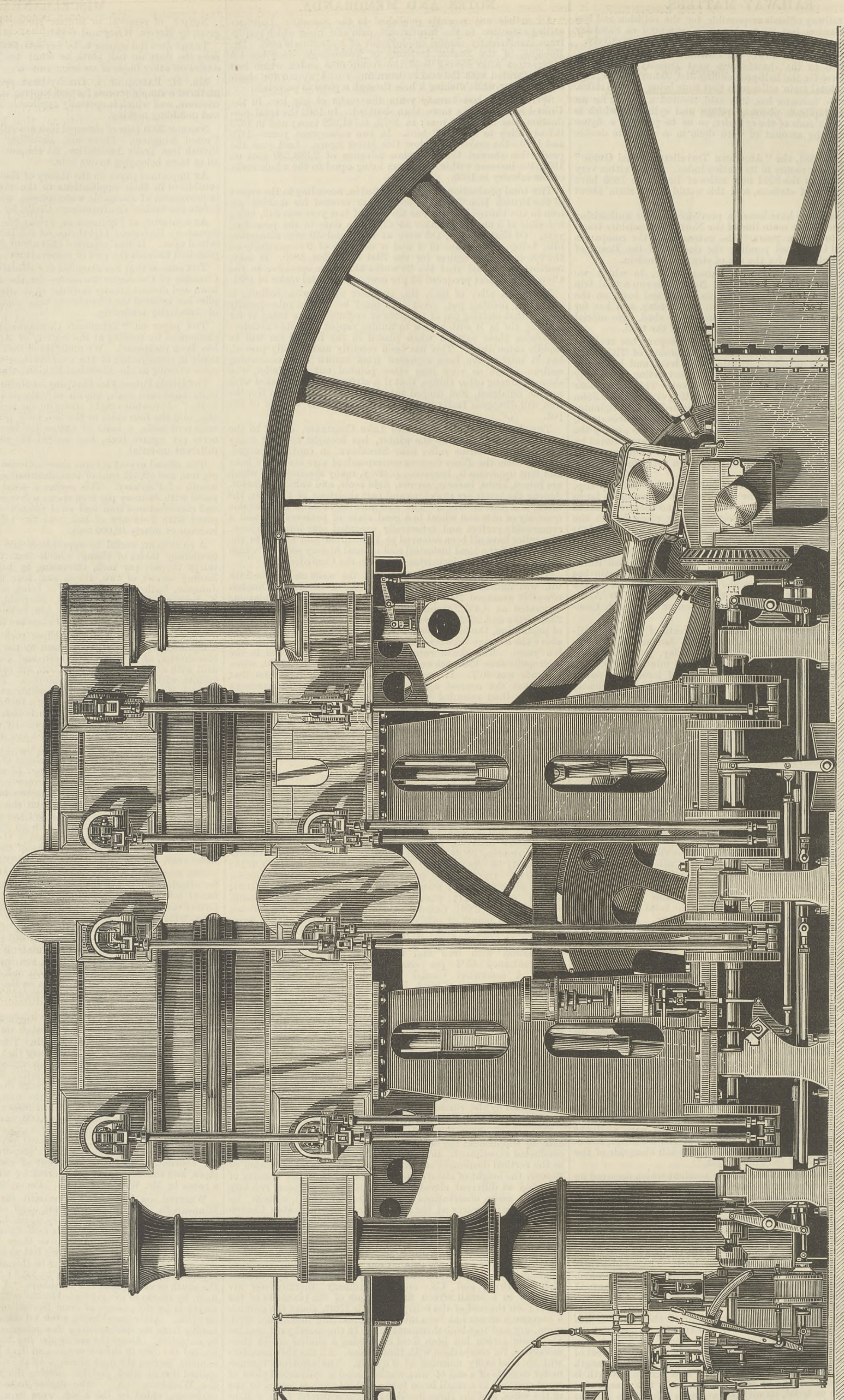
SOME experiments with the Eclipse rock drill and Reliance air compressor were recently witnessed by the Duke and Duchess of Manchester, at Messrs. Hawthorn and Company's Works. The drill with a 2½in. cylinder and 70 lb. air pressure pierced 10in. of granite with a 1½in. hole in 1½ minutes. The same drill has been at work 36ft. under water in the operations now being carried on in Plymouth Harbour, for removing a reef of sunken rocks there, and was employed in preparing the foundation of the new Eddystone Lighthouse, which is to be formally opened by H.R.H. the Duke of Edinburgh in the course of a few weeks.

THE Waterworks Department of the Birmingham Corporation have issued circulars to the householders of the town, asking their opinion on a scheme for the insurance of water fittings, by which they would undertake to keep in proper repair the water surface fittings in dwelling-houses and premises supplied otherwise than by meters, for a small annual sum, on the principle of insurance. The scale of charges rises from 1s. per annum on a water rental of £1, to 5s. on a rental of £5, and so on by 1s. for each pound or fraction thereof. The object in view is the prevention of waste, and ultimately the consequent ability of the committee to reduce water rent.

THE harbour of Arklow, an important station and place of refuge for vessels employed in the sea fisheries on the east coast of Ireland, has of late years been gradually silting up, and a bar is frequently formed across its entrance; but the Wicklow Copper Mine Company, which owns the harbour, is unable to carry out the works necessary for deepening and improving it. Accordingly the Government are proposing to authorise the Irish Board of Works to undertake the execution of these works. With this view, the *Times* says, Mr. Herbert Gladstone, M.P., has introduced a bill enabling the Board to make a grant of £15,000, half the estimated cost, and a loan on the security of the rates on the rest of the cost, and of £5000, the price to be paid to the company for their interest in the harbour.

AT a meeting of the Liverpool Engineering Society, held on Wednesday evening, March 1st, a paper on "Heating and Ventilation," was read by Mr. W. E. Mills. The author, in introducing his subject, pointed out the necessity that existed for a scientific study of its principles and laws, described the various old and modern forms of heating and ventilating apparatus and methods, stated that it was necessary to change the air of a room several times in each hour, according to the number of occupants, gas-lights, &c., allowing for each person 900 cubic feet per hour, for a gaslight 480, and for a fireplace 48,000, and said that the remedy for draughts was the admission of a copious supply of air at the lower part of the room, which some people will question, and concluded with a few rules as to the proportion of inlet and outlet for ventilating shafts, the amount of radiation from hot-water pipes, and the cooling effect exerted by windows. On the 15th, a paper by Mr. W. C. Pagan, on "Paper Machinery," was read.

WRITING on the recent flour mill explosion catastrophe at Minneapolis, Mr. W. M. Brackett, chief of the Minneapolis Fire Department, says:—"The theory which has been advanced with regard to flour mill explosions, or rather the prevention of them by the thorough airing of a mill two or three times each day, would, no doubt, be a partial preventive; but would not have prevented either of the explosions occurring in this city. I quote from my report of the fire and explosion in 1878: 'The fire originated on the south or east side of the Washburn "A" Mill, on the grinding floor, by sparks of fire generated by the millstones running together empty or by the passage of some foreign substance through them, like iron. After smouldering a few minutes smoke was discovered issuing from the dust-spouts a few minutes before the explosion, by outsiders. About the stones the fire burst into a blaze which ignited the dust in the conveyors and dust houses, causing both to explode, jarring the dust throughout the mill into the air, which ignited like so much powder, causing the first great explosion in the Washburn "A." The flames from the Washburn "A" explosion, aided by the wind, were in a flash carried into the windows and dust-spouts of the "Diamond Mill," which stood cornering 25ft. distant, and set fire to the flour-dust which already filled the air in that mill from the shock of the first explosion. Then followed the explosion of that mill from the same cause and the same method. The explosion of the "Diamond" set fire and exploded the "Humboldt," which stood broadside 25ft. distant. The three mills on the river side of the canal, though instantly set on fire by the flames from the Washburn "A," escaped explosion on account of the 50ft. open space between them and the "A" mill, aided by a strong south wind, and further protected by the unusual absence of dust, the two larger mills not having run for several days and being especially clean.'"



COMPOUND WINDING ENGINE, CALUMET MINE.

CONSTRUCTED BY MESSRS. I. P. MORRIS AND CO., FROM THE DESIGNS OF MR. LEAVITT.

(*For description see page 192.*)

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.*

ALPHA.—1500.

J. D. E.—*Apply to the Phosphor Bronze Company, Emerson-street, Southwark.*

W. B. H. (Enderby).—*Send a sketch of your invention in confidence, and we will give you an opinion as to its value.*

T. H. D.—*Your lock nut is very good indeed, but whether it is new or not we cannot pretend to say. Dozens of patents have been taken out for such things.*

A. S.—*It is a matter of agreement rather than law. We do not think you can require them to mark the part as distinct from the whole if you have not made that a stipulation. Of course they cannot mark the part as their "patent."*

J. P. (Swansea).—*You will find in* THE ENGINEER *for Nov.* 26*th and Dec.* 3*rd*, 1869, *two papers by the late Professor Rankine, "On the Outflow of Steam." See also the "Transactions" of the Institution of Engineers and Shipbuilders in Scotland, vol. xviii., page* 13. *Also Clark's "Rules, Tables, and Data," page* 893. *There are very few data available concerning the flow of steam through long pipes. See Box "On Heat," page* 113, *et seq.*

R. M. I.—*The total quantity of heat which must be imparted to every pound of water pumped into the boiler depends on the initial temperature of the feed-water and the pressure of the steam into which it is converted. In each pound of steam at* 65 *lb. total pressure, safety valve load* 50 *lb., there are* 1172 *deg. from* 32 *deg. If the feed-water is pumped in at* 50 *deg., then the total heat used up in converting each pound of water into steam is* 1172 *deg* − (50 *deg.* − 32 *deg.*) = 1154 *deg. If the temperature of the feed-water is raised to* 145 *deg., then* 1172 *deg.* − (145 *deg.* − 32 *deg.*) = 1059 *deg., then* 1172 : 1059 :: 100 : 90·3. *Consequently, the saving in fuel due to the augmented temperature of the feed-water will be* 9·7 *per cent. and your coal bill will be reduced at this rate. You can calculate the saving yourself for any other pressure and temperature with the aid of a set of steam tables. Lest you may not have a set, we give you a few, omitting fractions of degrees. The pressures in all cases include that of the atmosphere, or* 15 *lb. on the square inch, which, of course, increases the safety valve load. Pressures,* 50 *lb.,* 60 *lb.,* 70 *lb.,* 80 *lb.,* 90 *lb.,* 100 *lb. Temperatures,* 281 *deg.,* 293 *deg.,* 303 *deg.,* 312 *deg.,* 320 *deg.,* 328 *deg. Total heat in one pound of steam above* 32 *deg.,* 1167 *deg.,* 1171 *deg.,* 1174 *deg.,* 1176 *deg.,* 1179 *deg.,* 1181 *deg.*

ISTHMUS OF CORINTH CANAL.

(*To the Editor of The Engineer.*)

SIR,—In answer to one of your correspondents' inquiry, Mr. S. Kauzer, of Budapest, Hungary, is the contractor, and Mr. B. Gerster, of the Hungarian Society of Engineers, the engineer for the works in connection with the construction of the above canal. L. L. K.

Hull, March 11th.

MEETINGS NEXT WEEK.

THE INSTITUTION OF CIVIL ENGINEERS.—Tuesday, March 21st, at 8 p.m.: Papers to be discussed:—(1) "The Design of Structures to Resist Wind Pressure," by Mr. Charles B. Bender; (2) "On the Resistance of Viaducts to Sudden Gusts of Wind," by Mr. Jules Gaudard.

SOCIETY OF ENGINEERS.—Monday, March 20th, at 7.30 p.m.: The adjourned discussion will take place on the paper entitled "Notes on Electric Light Engineering," by Mr. C. H. W. Biggs and Mr. W. Worby Beaumont.

SOCIETY OF ARTS.—Monday, March 20th, at 8 p.m.: Cantor Lectures, "Hydraulic Machinery," by Professor John Perry. Lecture III.—Water-wheels and pressure engines. Turbines. Measurement of the horse-power given out. Loss of power by friction. Hydraulic fittings, pipes, valves, &c. Accumulators, cranes, and hoists. Tuesday, March 21st, at 8 p.m.: Foreign and Colonial Section, "Remarks on the Condition and Characteristics of Some of the Native Tribes in the Hudson Bay Territories," by Mr. John Rae, M.D., LL.D., F.R.S. Wednesday, March 22nd, at 8 p.m.: Sixteenth ordinary meeting, "The Tonic Sol-fa System," by Mr. J. Spencer Curwen, A.R.A.M., president of the Tonic Sol-fa College. The paper will be illustrated by experiments on a class of children from one of the London Board Schools. Thursday, March 23rd, at 8 p.m.: Applied Chemistry and Physics Section, "Some Practical Aspects of Recent Investigation in Nitrification," by Mr. R. Warington, F.C.S. Dr. J. H. Gilbert, F.R.S., will preside.

THE ENGINEER.

MARCH 17, 1882.

THE BASIC PROCESS IN THE UNITED STATES LAW COURTS.

THE history of the basic process promises to be remarkable—a history, indeed, abounding in startling episodes and great surprises. The first account of the success of the process came on the steel world like a thunder clap. It had been known, indeed, that Messrs. Gilchrist and Thomas had been, like a great many others, trying to get phosphorus out of steel. But it is not too much to say that the first authentic announcement of their success was contained in the paper read by Mr. Thomas before the Iron and Steel Institute in London in May, 1879. The reception which Messrs. Thomas and Gilchrist's statements received we need hardly mention. The delight of Cleveland was extreme; but scarcely had the applause died away, and the clapping of hands ceased, when Mr. Snelus and Mr. Riley, both eminent chemists, stood up, not to dispute Messrs. Gilchrist and Thomas's success, but their right to be considered the original inventors. It is an open secret that their claims, instead of being disputed, were readily and quickly and sensibly adjusted. The process was put into practice, and with very mixed success. On the Continent it made progress; here it got on slowly, until at last Messrs. Bolckow, Vaughan and Co., and Mr. Windsor Richards took it up, and they have, after a year's experience, pronounced it to be a great success. But at a very early stage Mr. Thomas went to the United States to secure his patent rights and push his claims there. It is not generally known that the result was litigation, and that Mr. Thomas has been defeated in the American law courts, not only on the first trial, but on the appeal. Mr. Jacob Reese has been pronounced a prior inventor.

It is not very easy to get at the facts, even when a patent trial takes place in London; and it is still more difficult to arrive at the truth concerning a trial in the United States. We have nothing to go on but printed evidence and published statements, and we regard these as quite insufficient to enable us to pronounce any opinion concerning the actual merits of the case. The evidence adduced was, however, sufficient to convince American judges that Mr. Thomas was not the first and true inventor of two forms of the basic process; and when it is borne in mind that the late Mr. A. L. Holley watched the case in the interest of Mr. Thomas, it will be admitted that the latter did not throw a chance away. A statement of what has taken place will, we feel certain, interest our readers; but concerning the merits of the case we repeat that we pronounce no opinion, for the reasons we have stated. So far as can be ascertained, the facts are that at a meeting of the American Institute of Mining Engineers, which was held in Pittsburgh in May, 1879, a paper on the Thomas and Gilchrist process was read, and on its conclusion Mr. Jacob Reese started up and gave notice that he claimed to be the original and first inventor of the basic process, that he had patented the process and would stand on his rights. It seems that there were more claimants than Mr. Reese to the rewards to be earned. Mr. Reese assigned his patent to the American Bessemer Steel Company, and the company really fought the action. In the legal technical language of the United States there were two "interferences" to be dealt with. The first, "Interference A," between Sidney G. Thomas, filed May 20th, 1879, patented July 29th, 1879; Jacob Reese, filed July 28th, 1879; Henri Harnet, filed September 19th, 1879; and Fritz Osann, filed December 15th, 1879; and secondly, "Interference B," between Jacob Reese, filed June 27th, 1879; Sidney G. Thomas, filed July 21st, 1879; and Fritz Osann, filed December 15th, 1879. To put this into an intelligible form we may say that on the dates given the parties named filed applications for patents which all possessed one feature in common, namely, that the molten pig iron is first deprived of its carbon and silicon by blowing air through it while contained in a converter with an acid lining, and that after the carbon and silicon are removed the melted metal is run into another converter with a basic lining, and blown therein to get rid of the phosphorus. These applications "interfered" with each other. It was for the court to say which should stand. It will be seen that Reese had priority of Thomas by one day; and Harnet and Osann appear to have been readily disposed of. The true fight was between Thomas and Reese. Jacob Reese has been known in the States for many years as a metallurgist. There is a strong similarity between him and the late David Mushet, and it is by no means to be supposed that although his patent was dated one day before Thomas's that his invention only then originated with him. We have now to explain what is meant by the letters A and B. They refer to two more or less distinct heads of invention and claim. In case A, the second vessel, which is lime-lined, is a converter in which the metal is treated by blowing air through it. In case B, the second vessel is a lime-lined open hearth, wherein it is subjected to a basic bath. The theory of the process it may be as well to state here in the words of Reese's own lawyer. "The necessity of the presence of silicon in the Bessemer converter in which the melted iron is decarburised makes it impossible to dephosphorise the metal by the Bessemer process, and this for the reason that when the phosphorus is oxidised and united with a base so as to form a phosphate of that base—as phosphate of iron or lime—although a basic slag is formed, which would be easily separable from the molten metal under treatment if it could be retained in that condition, yet this is rendered impossible by the presence of silica and of carbonic acid formed during the process of desiliconising and decarburising the metal; and as both silica and carbonic acid will decompose the phosphate before mentioned, the necessary result is that the phosphorus is returned to the melted metal in the very process which removes the silicon and carbon. At this point the invention in cases A and B comes into play; the iron, being desiliconised and decarbonised, is removed for further treatment to get rid of the phosphorus to another vessel to be subjected to either a further injection of air in a converter, or to the longer and more efficient treatment of the open hearth. These secondary vessels being lined with lime, a highly basic substance, and the formation of silicic acid, or carbonic acid, being prevented by the substantial freedom of the metal from silicon and carbon, the phosphorus unites with the lime as a phosphate, forming a slag which is easily removed and is not exposed to the danger of the return of the phosphorus to the iron by the reduction of the phosphate."

We may come now to Mr. Reese's claims to be considered the first inventor. His evidence is too long to be reproduced here, concerning as it does financial failures, want of money, business relations with other persons, and so on. The gist of it is that in 1865 he went to Troy, where he saw a Bessemer plant at work, and was told that they could not eliminate phosphorus by that process. That he brought home some pig metal which had too much phosphorus in it, in order to experiment on removing the phosphorus with lime lining and lime additions; that he experimented then with a lime-lined open hearth, and reduced the phosphorus down to ·015 per cent. That he then conceived the idea of using a lime-lined Bessemer converter. That he wrote to New York to get the exclusive right to use the Bessemer process in Allegheny county, Pa. That he then built a plant on a vacant lot at the works of his firm, which he enclosed in a high board fence; that this plant consisted of a cupola, a blower, two converters, like Bessemer converters, with air blast, and an open hearth furnace. That the open hearth was lined with lime, and that one of the converters was lined with brick—silicious—and the other was lined with lime—basic—lining. That he experimented with this apparatus, and ultimately proved successful with both methods—the two converters, and the one converter and open hearth. That he succeeded in practically removing the phosphorus, reducing it by analysis made by his chemist to one hundredth of one per cent. That his chemist, Dr. Hertz, who made his analyses for him, and who is now dead, exclaimed, "We have got it now," and that he considered these inventions practically complete in the autumn of 1867. Why he did not go on with them he explains by stating that fires, &c., had ruined him for the time being. In 1866 Reese patented "the use of lime or oxide of calcium as a lining for reducers or furnaces wherein ores or metals are decomposed or refined." It was contended that Reese did not fully appreciate the value of lime-lined converters at the time; but the case of Roberts *v.* Ryer was cited, in which the Supreme Court held "that an inventor is entitled to all the uses to which his patented invention can be applied, though ignorant of them at the date of the invention." We believe we have now put Mr. Reese's claims fully before our readers. We regret that we cannot use Mr. Thomas's counter statement, because, as it has reached us from the United States, it is more than probable that full justice has not been done to it.

We have now only to deal with the result of the litigation. The interference in "case B" was dissolved by the Primary Examiner and a patent awarded to Reese. This decision was affirmed by the Commissioner. The patent would then have been issued to Reese, and was on the point of issuing when it was arrested in consequence of an affidavit filed by Mr. Finckel "that Thomas published his invention in a trade newspaper, styled *Iron*, and circulated in England and the United States not later than the middle of May, 1879." On this affidavit the patent to Reese was arrested. It ultimately turned out, however, that what appeared in *Iron* was not an anticipation. It was contended by Reese's counsel that "there ought to be a very strong proof of invention, and something more than the naked conception of an untried idea, to entitle any subsequent inventor to a patent against an undisputed prior inventor who can make such a showing as Reese does in these cases." Two judgments were cited in Reese's favour, and we reproduce them here in part because they go to the very root of a great principle in patent law. In the case of Packard *v.* Sanford the Commissioner says:—"A race of diligence between two inventors never begins until the date of the later conception. The obligation to diligence on the part of the first to conceive does not exist until the day of the later conception, which cannot give to that obligation a constructive existence relating back to the earlier conception. With the reduction to practice, either in public or in private, by the inventor first to conceive, the race of diligence forever ends." In Lake *v.* Kempster the same Commissioner says:—"A reduction to practice is effected by one successful working machine as certainly as by one hundred. But Lake insists that Kempster lost his invention by subsequent lack of diligence; but after such reduction to practice the burden of proof is not on him to show that he did not abandon or forget his invention, but is on the contestant who alleges it to show that he did forget and abandon it."

In the end, as we have stated, Mr. Reese defeated Mr. Thomas. In November last, "cases A and B" were decided in Mr. Reese's favour. An appeal was taken from the November decision in the interest of Thomas and the purchasers of his patent. The case came up on the appeal on the 15th of February, 1882, and Reece was again adjudged to be the prior inventor of the processes described in "cases A and B." It remains, of course, to be seen how far this decision will affect Thomas's other patents, and also whether it applies to the system of completing the whole process in one converter. It is to be regretted, we think, that any litigation was permitted to take place. We believe this to be clearly a case of independent invention—neither Mr. Reese nor Mr. Thomas knowing anything of what the other was doing. The circumstances were just those in which compromise would have been not only desirable, but admissible, and we do not see how it would have done an injustice to the general public. It can, however, hardly be supposed that the last has been heard of Reese *v.* Thomas. "It will thus be seen," says the *American Manufacturer*, "that Reese's claims to priority of invention of the basic dephosphorising process have been fully sustained, and we trust that he may be richly rewarded for his inventive genius and his heroic perseverance under almost crushing discouragements." They appear to have made up their minds at the other side of the Atlantic.

SHIPBUILDING IN THE UNITED STATES.

AN effort is now being made in the United States to add shipbuilding to the numerous industries of North America. It is well-known that while an enormous trade is being done between the United States and Europe, the number of United States ships engaged in that trade are exceedingly few. The great bulk of the ocean-carrying business is done by ships sailing under the British flag, built in Great Britain, and owned by British subjects. This fact has for a long time vexed the soul of Brother Jonathan. It is not to be denied that Americans are now, or could become in a short time, competent to build iron or steel steamers. While ships were made of wood America held her own, and the vessels turned out of United States shipyards compared favourably with those of any other nation. But wooden ships are extinct, as far as the Atlantic trade is concerned at all events, and Americans do not build iron steamers. The reason is easily explained. The ironmasters of the United States will not permit Americans to own iron or steel ships. In order to foster and encourage the growth of the iron trade of the United States, a tremendous tariff is levied on imported iron in every form, whether that of a ship or a puddled bar. The American iron trade flourishes, and ironmasters can afford to pay large wages to their hands. Thus an advantage is gained by the United States; but they cannot have everything. High wages and great profits mean dear iron. Those who work iron into the finished article also demand large wages; but with dear iron and high wages, it is impossible to build a cheap ship; consequently, Americans do not build ships. They are obliged to pay England, France, Germany, and even such little countries as Norway and Belgium, for carrying their goods across the sea. It may be, perhaps, that on the whole they are better off with dear iron, high wages, and no ships than they would be with cheap iron, low wages, and plenty of sea-going steamers. But they have no right to grumble because they cannot combine incompatible conditions. No man in his senses will pay £100,000 for a ship built in the United States if he can get just as good a ship for £60,000 in England or Scotland; and having bought his ship in this country, it is not likely that he will pay some thousands of pounds for the privilege of sailing her under the American flag. It is a patent fact that a considerable number of steamers is owned by Americans, but they keep the fact in the background, and quietly draw their dividends.

All this is regarded as very unsatisfactory by a considerable section of the United States commercial public. The American press are taking the subject up. The free trade papers can speak out plainly; but the protectionist papers are in a cleft stick and know not what to say. They attempt to goad American capitalists on to build ships; but the American capitalist is not patriotic enough to pay a shilling in America for what he can buy elsewhere for sixpence; so special proposals are made. One of the latest is to run a line of Atlantic steamers between Milford, and Southampton, or Liverpool, which shall make the passage to New York in one week. It is assumed that such high fares and freights could be obtained that such a line would pay well, even though the ships were built in the States. We have no hesitation in saying that at present there are no shipbuilders and engineers in the United States who could build a first-class Atlantic steamer, capable of steaming regularly at twenty knots an hour. The country lacks the requisite experience; and does not possess the tools or appliances essential to the construction of marine engines of 12,000 or 15,000-horse power. In saying this we do not intend to disparage American shipbuilders and engineers. In time they could, as we have already said, no doubt do all that can be done here; but there is not a yard in the United States now that could turn out the Servia, nor is there an engineering establishment which could make satisfactory engines and boilers for her, even if she could be built. No demand for work of the kind has hitherto existed in the States; and when the demand does spring up some time will be lost, and a great deal of money wasted, before it can be satisfied. Meanwhile Great Britain can, if the prospect is good enough, do all that America proposes to do, and more. A fleet of ocean steamers, to run from Milford to New York and other American ports in about a week, will probably be afloat while Brother Jonathan is perambulating his seaboard in search of someone to build and engine the ships he wants.

If the people of the United States really desire to build ships, they must consent to forego their tariffs, and admit iron and steel ship-plates, angles, &c., duty free; until they do this they must be content to go without a shipbuilding trade. Unfortunately, a section of the American press cannot see this, and certain journals have resorted to very unprincipled methods of leading the American people to believe that at all costs they ought to have ships of their own. The system adopted by such journals, for example, as the *Nautical Gazette* is very simple—it consists in abusing British ships and British shipbuilders and engineers in language remarkable at once for its mendacity and its absurdity. We need hardly add that respectable American journals take a somewhat different course. We have lying before us a copy of the *Nautical Gazette*, which contains an attack on Messrs. James and George Thomson, of Glasgow, which is more scurrilous than is usual even in an American journal. It is principally devoted to attacking the Cunard ship Catalonia, which met with very rough weather and ran short of coal during her first voyage. The censures of the *Nautical Gazette* are based on a letter written, with one exception, by American passengers to the *New York Herald*. The exception claims to be a retired British naval officer. We have plenty of retired naval officers of the old school who hardly know one end of a screw steamer from the other. The letter in question was signed by nine passengers only, and its statements have been contradicted already by the Cunard agent in the United States. The following passage will show in what spirit the *Nautical Gazette* deals with the subject:—"The Messrs. Thomson, who built this ship, have impaired their reputation very much in the Servia as well as the Catalonia, and it is a question in our minds if ever the Cunard Line in its present frame of mind would feel inclined to give this firm another contract until it gave better evidence of its ability to build better ships than it has turned out of late." Unfortunately, the readers of the *Nautical Gazette* do not know when that journal is speaking the truth or making statements in advance of the facts. If it stood alone, we should pass it by without comment; but it does not stand alone, and its errors are taken up and quoted and disseminated in the States by men only too eager to deprecate British shipbuilders and engineers. For this reason it is worth while to state here that the Catalonia is a ship of moderate speed built for the Boston trade, that on her trial trip she considerably exceeded her contract speed, and that she is a vessel of great strength, and has never manifested any symptom of weakness. In another article the same journal says: "The Catalonia is not his only example of unfulfilled promises, but the great Servia was on his hands for months and months after she was supposed to be completed." We can assure our American readers that the foregoing statement concerning the Servia is absolutely untrue. The ship is a great success in every respect. There was a delay in delivering her, but that was due to the discovery of a small crack in her enormous crank shaft on her trial trip, and the shaft was replaced. The ship is well known by this time at both sides of the Atlantic to be one of the most satisfactory ever built.

It is, we think, greatly to be regretted that Americans should in any way countenance journals which adopt the line of argument (?) taken by the *Nautical Gazette*, and one or two others. A paper quoting such statements without reprobation endorses them. It is true that the United States do not build ships, but it is absurd to abuse those who do. Nothing whatever can be gained by pursuing such a course. The American people are shrewd and far-seeing, and no denunciation of English ships and shipbuilders will persuade Americans to build ships for themselves in the face of a hostile tariff and prohibitory navigation laws. If the *Nautical Gazette* and its followers must abuse some one, let it devote its talents to blaming the ironmasters of the United States, who insist on keeping up the price of iron and steel.

THE VENTILATION OF THE CHANNEL TUNNEL.

An ounce of fact is worth a ton of theory, concerning some subjects at least. The ventilation of the Channel tunnel during the time it is being made is assumed in some quarters to be a matter which will present no difficulty, the compressed air used in driving the boring machines being held to be sufficient for every purpose. Now compressed air was used on a very large scale in driving two great tunnels—the Mont Cenis and the St. Gothard. Herr Pieler recently read a paper on the ventilation of underground works, before the German Society of Engineers, from which we learn that during the period of driving the St. Gothard tunnel, the men employed suffered very seriously from bad ventilation. The quantity of air delivered to the tunnel in the north end was about 2,750,000 cubic feet, and in the south end 3,125,000 cubic feet per day of twenty-four hours. As the number of men employed was 380 and 420 respectively, or 800 in all, the quantity of air furnished per man per minute was 5·0 and 5·2 cubic feet. When this is compared with the quantity of fresh air that is generally considered necessary in mining, or from 35 to 70 cubic feet per man per minute, the quantity supplied at the St. Gothard tunnel will be conceded to have been very small. If it is assumed that a workman requires per hour 0·84 cubic feet of oxygen and a lamp burning 29 grammes of oil per hour, 1·80 cubic feet, and that the former produces 7·60 cubic feet of carbonic acid and the latter 1·14 cubic feet, the total consumption of oxygen would be 2·64 cubic feet, and the generation of carbonic acid in the same time would amount to 8·74 cubic feet, the reduction in the quantity of oxygen in the air in the tunnel would be about 4 per cent., and the increase in the quantity of carbonic acid would be 0·6 per cent. of the total quantity of air supplied. Experience in mining has proved, however, that the deterioration of air brought about by the breathing of the men and the burning of the lamps accounts only partially for the reduction in the quantity of oxygen in the air of mines and the increase in the quantity of carbonic acid. Herr Dr. Schondorf concludes, from experiments made in the Saarbrücken coal mines, that it will account only for one-seventeenth of the former and one-ninth of the latter. It may be urged that the electric light will be used in the Channel tunnel, and that no explosives will be employed, but against this it must be borne in mind that both the Mont Cenis and the St. Gothard tunnels are situated high up in a mountainous region, where natural ventilation must be at its best; while the Channel tunnel can have no natural ventilation of any kind, and that the length of tunnel to be ventilated from one end will be as much as ten miles. The ventilation of the Mont Cenis tunnel is so bad that the enginemen have to wear mouthpieces coupled by tubes to a reservoir of fresh air carried on the top of the cab, while going through it. Putting these facts together, it seems to be tolerably certain that the ventilation of the Channel tunnel presents a problem which should not be flippantly dismissed as of little importance.

A NEW STEEL PROCESS.

Among the various attempts which have been made to improve on the Bessemer process, not the least noteworthy was the idea of using a fixed converter. Such a converter would permit the slag to be run off at an early stage in the blow, by which many advantages might be gained. Hitherto it has been found impossible to prevent the metal from escaping through the tuyeres. A patent has been taken out by Mr. Griffiths which promises to get over this difficulty. A trial took place on Friday last at the works of Messrs. Nurse, Redbrook, Monmouth, with a small low-pressure fixed upright converter capable of holding about 1 ton, in the presence of some of the leading iron and tin-plate manufacturers of South Wales and Staffordshire. Blows were made with a maximum blast pressure of 4½ lb. per square inch, each blow taking only an average of twenty minutes. The yields were good, and the steel produced appears to be of excellent quality, soft and ductile. We have not yet tested its tensile strength, but this we hope to do in a few days. Some of the steel was worked and welded in the presence of those present. We may mention that previous to this trial some twenty blows had been made, the steel of which had all been worked into bars, sheets, and tin-plates. No speigeleisen has been used, the only addition being a little over 1 per cent. of ferro-manganese. The advantages claimed by the patentee for the process are its symplicity and small cost of plant, and that no skilled labour is required to handle it. It can be worked by an ordinary blowing engine which will give a maximum pillar of 5 lb. per square inch of blast. A 2-ton converter working ten hours per day ought to make 120 tons of soft steel per week, thus placing a steel-making plant in the hands of small manufacturers. These converters can, it is stated, be increased in capacity up to any size, and worked in duplicate to any extent. An important point in this converter is that it can be worked with four or six tuyeres fixed horizontally. By a simple mechanical arrangement, which we shall illustrate in an early impression, a stopper or plug in each tuyere is actuated by steam or air and shuts the tuyere at the proper time. We may mention that the converter has been constructed by Mr. White, of Pontymister Steel Works, and the trials were carried out under his supervision and that of Mr. George Geen, of Newport, Mon.

THE SMOKE ABATEMENT EXHIBITION.

The Smoke Abatement Exhibition has virtually been removed to Manchester, where there is even more room for smoke abatement than in London. We do not propose to say anything here upon the merits of this exhibition, or of the general excellence or otherwise of the greater proportion of the articles exhibited, but it may be asked why the report on the South Kensington Exhibition has not been published before the second exhibition is opened, firstly, because exhibitors may fairly expect that the results of the trials made there may present guiding information of some value in directing further labours; and secondly, because there is some curiosity extant to know whether the exhibition is to be considered from a commercial point of view only with respect to the articles exhibited, or whether the reporters will feel themselves at liberty to tell some plain truths to the reading public for their guidance in the avoidance of many of those nostrums in the way of gas and other stoves which are palmed off on the uninstructed public as healthful warming apparatus, when several of them are no better than the boilermakers' "devil" in an enclosed space. Why, for instance, is no official contradiction given to the statement that the many flueless gas stoves are harmless?

AN UNLUCKY EXCURSION TRAIN.

At one time excursion traffic was not managed, to put it mildly, quite so well as was desirable in this country. It would appear that they have now reached in the United States a point which we passed about forty years ago. Indeed, it is doubtful if any English train was so unlucky as a train in Cincinnati, whose recent adventures are recorded in the *Kankakee Gazette*. The train started it seems from Cincinnati all right, but the engine broke down after a run of a few miles. Another engine was then attached which took the train as far as Indianapolis, and just as the train stopped in the station one of the engine axles broke. Another locomotive hauled the train to Colfox, when the grate bearers gave way and the fire fell into the ash-pan. Another engine was procured which took the train to Montmorenci, where it ran off the rails and did a great deal of damage, and a fifth engine had to be obtained to take the train to Kankakee. Thus five locomotives were required to run a trip usually done by one engine. The locomotive superintendents of Illinois appear to want rousing up.

LONDON TRAMWAY SLAUGHTER.

During the past year forty-four people were killed in the streets of London by omnibuses and tram-cars—the latter killing the greater number. A considerable proportion of those killed were run over, and to be run over by a flanged wheel running in a groove is as bad as to get the limbs between the blades of some mighty shears. There is no reason why anyone should be run over by tram-cars. The frames of these vehicles are very near the ground, and they give the greatest facility for the attachment of effectual guards—guards which would keep anything from getting under the wheels. It is remarkable that the London tram-car companies do not adopt a safety appliance which would cost but a pound or two per car, and would prevent many accidents, besides those which result fatally, and it is surprising that the Board of Trade has not enforced the use of proper guards. They are used on some of the Manchester cars, where streets are not so crowded. Why not in London?

INSURANCE COMPANIES AND ELECTRIC LIGHTING.

The insurance companies are making hay while the sun shines, and are adding no less than 21s. per cent. to the 31s. 6d. the Crystal Palace Company already pays. It will require 40,000 shilling-day visitors to pay this extra sum. Probably the insurance companies base their charge as much on the numerous steam engines as upon the possible dangers from electricity. The extra demand is absurdly high. The insurance companies make no extra charge when a gas engine and all its gaspipes and other paraphernalia are introduced into a building, and they must be very ill-advised if they are led to believe that there need be more danger attending the use of electro-dynamic machines, wires, and lamps than accompany the use of gas and gas engines. The insurance companies are not unanimous, however, in this advance, and if it is insisted upon outside the Palace a new company will probably be started.

LITERATURE.

Elementary Lessons in Electricity and Magnetism. By Silvanus P. Thompson, B.A., D.Sc., Professor of Experimental Physics in University College, Bristol. Macmillan and Co., London. 1881.

A writer who had a wide and varied experience in writing articles for cyclopædias, encyclopædias, was once heard to declaim in good set terms against the criticism of a specialist. The latter had pointed out a number of errors which a writer having more than a mere smattering of knowledge of his subjects would have avoided. In the present case Professor Thompson must be regarded as the specialist, and the critic as it seemeth best to the reader.

In our opinion the work before us is one of the best of the elementary books upon the subject. It does not pretend to trespass on the field of Maxwell, nor is it at all similar to the work of Gordon. It is emphatically a schoolboy's book, and as a schoolboy's book must be criticised. Professor Thompson, in his second lecture recently delivered at the Crystal Palace, made some pointed remarks anent the *Saturday Review*. The Professor had been roughly handled by some writer whose knowledge of the whole subject was evidently of a very superficial character, just deep enough, perhaps, to allow him to show off in the lion's skin, but not deep enough to give him the lion's roar. Amongst other things the *Saturday Review* critic had censured the Professor for holding that, whatever electricity was, it had nothing of duality about it. We shall undoubtedly run counter to our contemporary, and in this particular case support Professor Thompson. There is nothing of a dual nature in electricity, and there is no man who has a fair share of common sense, a little knowledge of logic and of electricity, who will support the theory of duality.

We do not hesitate to say that the man who attempts to write a text-book on electricity without some fairly definite idea of its nature will be more likely to mislead than to lead. We differ from Professor Thompson on many points, but not on this. We differ, for example, upon the method he has pursued in this book. He commences with statical electricity—we would prefer the opposite. The phenomena of statical electricity are not so striking, are more difficult of manipulation, and appeal more to the mind, and less to the senses, than those of dynamic electricity. Then the fact that almost all—we do not remember an exception—writers of such books have followed beaten tracks, seems to have conduced to the supression of all ideas of the "circuit" in statical phenomena. We hold that the first object of the teacher should be to show that the "circuit" is, so to speak, the be-all and end-all of electric phenomena. There can be no phenomena without a circuit, and the circuit is as important in statical as in dynamical electricity. We should hear less about repulsion and more about attraction if our plan was followed. It is perhaps rather the interest of the scholastic writer to pooh-pooh such authors as J. T. Sprague; but we are inclined to think that from the physical point of view his book, "Electricity: Its Theory, Sources, &c.," contains a vast amount of important matter that is not yet half appreciated. Mr. Sprague, in a rather half-hearted manner, gives up repulsion and prefers attraction, a digression in the ordinary course of electrical writing that we wish was more considered. What has this question of circuit to do with Professor Thompson's work? Just this, that what is now rendered somewhat difficult might be made quite clear. The reason why no electricity is to be found in the interior of a hollow sphere, the wire nightcap, the ice-pail, &c., with statical charges, is that the matter in these positions is not in the circuit at all, and whilst we look for a current in the wire joining the two terminals of a battery, we do not look for a current in a wire that is ten miles away from those terminals, and has nothing whatever to do with them. It is just as easy to show electrical phenomena in the interior of the hollow ball as it is on the exterior. Another book that would bear a considerable amount of reading by those who would understand more of statical charges is Mr. F. C. Webb's little book on "Accumulation." The discussion of the "circuit" again would show why "points" are effective in discharging the electrical charge. It is from no inherent peculiarity of points—as points—and arises more from their being in the line of least resistance in the circuit.

Our differences with Professor Thompson are almost exhausted. We only wish to protest against any introduction of confusion as to the poles of the magnet. Sir W. Thomson may if he chooses employ distinct terms, and introduce a new nomenclature into every science under the sun, but the time has come when a stand should be made against the desire of every experimenter to introduce new terms and force them upon the public. It is customary to call the north pointing pole of a magnet the north pole of the magnet, and there is no sound reason for calling it a true south pole—till everybody is agreed upon the advisability of such a change. Professor Thompson deals with what is peculiarly his own subject when he comes to that part of the work dealing with "lines of force," though of course the space devoted to its consideration is, comparatively speaking, very small.

After dealing with statical electricity and magnetism, our author comes to the consideration of dynamic electricity. Here, again, the treatment is somewhat historical, commencing with the discoveries of Galvani and Volta. It would lengthen this notice beyond ordinary limits if we attempted to deal with Professor Thompson's book as it deserves; for in this portion he has given us a text book for school use equal, if not superior, to any other with which we are acquainted. The different parts of the theory, which are so interesting in the practical applications which have been developed during the last few years, are carefully treated, and put before the student in a clear and concise manner. An example of the author's method of treatment will be better than any statement. We therefore quote a paragraph, taken almost at random, No. 378, page 340, on "Cost of Working:"—"The cost of working electromotors by batteries is very great. A pound of zinc contains only about one-sixth as much potential energy as a pound of coal, and it costs more than twenty times as much; the relative cost for equal amounts of energy is therefore about 120 : 1. But, as shown above, an electro-magnetic engine will turn 85 per cent. of the electric energy into work, while even good steam engines only turn about 10 to 20 per cent. of the energy of their fuel into work, small steam engines being even less efficient. But, reckoning electro-magnetic engines as being five times as 'efficient' as steam engines of equal power, the necessary zinc is still twenty-four times as dear as the equivalent amount of coal. This calculation does not take into account the cost of acids in the batteries. In fact, where strong currents are wanted, batteries are abandoned in favour of dynamo-machines, worked by steam or water power, or by gas engines." . . .

This is only a portion of the paragraph, but we think it shows the correctness of our contention that the author is clear and concise. It shows *why* batteries as motors must, under existing conditions, be uneconomical, and the constant aim of a teacher should be to inculcate a desire in his pupil never to be satisfied with a mere statement, but to always look deeply under the surface till he comes to a or the why and wherefore. Professor Thompson shows the true teacher in this work, inasmuch as he has constantly kept this fact before him, and attempts to give reasons, or, in other words, to give the "why" of the phenomena described.

WYVILLE THOMSON.

THE death on the 10th inst. of Sir Charles Wyville Thomson makes a serious blank in the list of our greatest naturalists. After his return in 1876 from the Challenger Expedition, of which he was chief of the scientific staff, it was found that his health had certainly not improved, and in June, 1879, he was prostrated by an attack of paralysis. He became unable to conduct his class of natural history in the University of Edinburgh, and his direction of the working out of the Challenger researches became intermittent, and finally he had to resign it entirely into other hands. In October last he resigned his Chair in the University. Some four months ago he had a second paralytic attack, and since then his health has been feeble.

Charles Wyville Thomson was a descendant of an old Scottish family which had long resided at Bonsyde, Linlithgow. His father was a surgeon in the service of the East India Company. Born at the family residence on March 5th, 1830, Wyville Thomson was educated at Merchiston Academy, and afterwards at the Edinburgh University. It had been his intention to enter the medical profession, but he most interested himself in natural history, and became, at the age of twenty-one, a lecturer on Botany at King's College, Aberdeen. The appointment had, the *Scotsman* says, been undertaken with the view of obtaining a short respite from studies, the arduous prosecution of which had begun to tell on his health; but it may be said to have in a manner changed the current of his life. A year later he was appointed to the same office in Marischal College. A good deal of his time was, however, devoted to zoological studies, especially among the lower forms of animal life. Several papers were published by him at this period on "The Polyzoa and Sestularian Zoophytes of Scotland," and other such subjects. In 1853, Thomson became Professor of Natural History in Queen's College, Cork; but he had only been there a year when he succeeded to the Chair of Mineralogy and Geology in Queen's College, Belfast. Holding strong views on the importance of inquiring into the conditions of deep-sea animal life, he was confirmed in these by reports of soundings taken in various parts of the world, and especially by the evidence of the existence of animal life at great depths, obtained when Professor Fleeming Jenkin raised the telegraphic cable between Sardinia and Bona for the purpose of repairing it. Professor Thomson urged Dr. Carpenter to use his influence with the Royal Society to induce the Admiralty to give the use of a vessel for scientific dredging. This resulted in the expeditions of the Lightning and Porcupine in 1868 and 1869, in both of which he took part, the discoveries then made in regard to the fauna of the Atlantic Ocean being subsequently given to the world in a work entitled "The Depths of the Sea." On the resignation of Professor Allman, Professor Thomson was elected Regius Professor of Natural History in the University of Edinburgh. In 1872 the Royal Society again took up this subject, in consequence of what had been done by the Norwegians and Americans, and Thomson was made scientific chief of the Challenger expedition, to investigate the physical and biological conditions of the great ocean basins. Leaving England in 1872, the exploring party was absent for three and a-half years, the longest scientific voyage ever made, during which time 68,890 miles were traversed, and systematic observations made at 362 stations in the open sea, notes being also made on land and in shallow water, as opportunity offered.

Up to the present time three volumes of the report on the expedition have been published, but it is expected that six will be required to complete it. It has been remarked that it is a pity that this report is not printed in larger numbers and sold at a price which would enable the general public to purchase it, but it is to be feared that the number which would have to be printed of the very elaborate coloured plates, in order that they should be cheaply produced, would be much greater than the number which would be sold even at a moderate price. A complete series of the specimens collected will be sent to the British Museum.

The reports are now being directed by Mr. John Murray, Sir Wyville's chief assistant. On the 27th June, 1876, Professor Thomson received the honour of knighthood; the Royal Society of London awarded him one of its gold medals; and subsequently, when, along with Emeritus Professor Balfour, he went as the representative of the Edinburgh Senatus to Upsala on the occasion of the Ter-centenary of that ancient University, the King of Sweden created him a Knight of the Order of the Polar Star. Sir Wyville was also an LL.D. of Aberdeen, a D.C.L. of Dublin, a Doctor of Philosophy of the University of Jena, a D.Sc., a Fellow of the Royal Societies of London and Edinburgh, and of the Linnæan Society, and foreign and colonial institutes. He wrote a preliminary account of the general results of the Challenger Expedition, which was published in two volumes under the titles of the "Voyage of the Challenger" and "The Atlantic."

Sir Wyville Thomson married a sister of the late Mr. Adam Dawson, of Bonnytoun, Linlithgowshire, for some years Provost of Linlithgow, whose father also occupied the same honourable position for the greater part of his life. He is survived by Lady Thomson and one son, M.A. of the University of Edinburgh, at present engaged in the study of law.

DEATH OF MR. HANDYSIDE.—We announce with regret the death of Mr. James B. Handyside, of the firm of Thomson, Sterne, and Co., aged 46. He served his time with Messrs. Smith and Rodgers, of Glasgow and Govan, now the London and Glasgow Engineering and Iron Shipbuilding Company, Limited, and was with them about six years. For about nine years he was in Russia, during six of which he was the principal there of the firm of W. R. and I. Handyside, contracting engineers, during which time he executed a great variety of work; the latter three years he was managing director of the Ogekoff Works, employing over 2000 hands. He joined Mr. W. S. Thomson about eleven years ago, the firm now being Thomson, Sterne, and Co., Limited, and held the position of managing director at their works at Glasgow. Mr. Handyside died of exhaustion due to overwork, and he will be mourned throughout a wide circle of friends and acquaintances.

AMERICAN SOCIETY OF CIVIL ENGINEERS.—This society met at 8 p.m. on the 15th of February, Mr. Welch, president, in the chair. A paper by Mr. R. E. McMath, of St. Louis, Memb. A.S.C.E., on "The Mean Velocity of Streams Flowing in Natural Channels," was read by the secretary in the absence of the author. With this paper was presented a set of diagrams of curves, deduced from the experiments of Mr. J. B. Francis, Memb. A.S.C.E., at Lowell; from the observations of Gen. Thos. G. Ellis, Memb. A.S.C.E., upon the flow of the Connecticut river; from the records of the flow of the Mississippi, made by Gens. Humphreys and Abbott; and also from various other observations of the flow of the Mississippi at Columbus, Ky.; at Vicksburg, Miss.; at Carrollton, La.; and at the passes at the mouth of the Mississippi. The author of the paper then presented for consideration and discussion the suggestion that, to determine a reliable rule for the flow of streams in natural channels, the considerations affecting an artificial channel should be kept entirely distinct; that the definite law of discharge over a weir is usefully applicable at any transverse section above and within the influence of a weir, dam, or shoal; that the relation between mean and maximum velocity cannot be used in streams of irregular section; that head is pressure, but not in all cases fall of surface; that in natural streams the bars or shoals are substituted for the weir or dam; that the level of no discharge is determined by the horizontal plane through the crest of a weir, dam, or natural bar; that two new hydraulic terms may be used, viz., "Permanent Area," or that part of transverse section below the plane of no discharge, and "Ruling Depth," or the depth of the plane below the surface. Formulæ are then suggested in application of these considerations.

THE LIMITS TO SPEED.

BY PROFESSOR OSBORNE REYNOLDS, F.R.S.

No. IV.

THE inertia of the moving parts of a machine besides calling for strength in the parts themselves, as, for instance, in the tires of wheels, often calls for restraining forces in the supports to prevent the moving parts changing their position. Such forces exerted on the frame when they exist will, like those in the moving parts themselves, increase in the ratio of the square of the speed, and hence the possible speed would in such cases be limited by the strength of the attachments or supports of the frame. As a matter of fact, these disturbing forces on the frame constitute one of the commonest difficulties in the way of attaining high speeds, and demand the most careful consideration at the hands of engineers. These forces cannot, like the forces in the moving parts themselves, be considered as fundamental, since, except for the complications involved, it is always possible so to arrange the moving pieces of a machine that their inertia shall cause no resultant disturbance on the whole frame and its supports, the forces being confined to the moving pieces and those portions of the frame which connect them. To accomplish this counterweights have to be employed, and in some cases it would be necessary to add additional moving pieces, the only function of which would be to oppose the inertia of the parts which are necessary for the primary purpose of the machine. When this is done the machine is said to be perfectly balanced. There are, however, many considerations relating to the balancing of machines which have nothing to do with a complete balance, for, as will be presently explained, such a balance is often impracticable.

The general theory of a complete balance involves two conditions: (1) in order that there may be no force to move the frame in any particular direction, or that there may be no tendency to move the centre of gravity of the frame; (2) that there may be no tendency to turn the frame round about its centre of gravity. The condition (1) may be simply expressed. The moving weights must be so arranged that, however the several weights may move, the centre of gravity of the whole system of moving pieces must not change its position during the motion. The condition (2) may also be simply expressed in the language of theoretical mechanics. It is that the moving weights must at no time have any aggregate moment of acceleration about any axis through the centre of gravity. To those who are not familiar with mathematical language, this second condition as thus expressed may not be very intelligible, nor is it easy to express the complete condition in more general language; but as the practical examples are for the most part very simple, it will be sufficient to explain the condition as applied to one of these examples. Suppose the moving parts to consist of two equal weights. Then the first condition involves that the accelerations on these weights shall be equal and in opposite directions, *i.e.*, if the acceleration on the one is north, that on the other must be south. But this first condition does not require that the centres of gravity of the two weights shall be opposite one another in the direction of acceleration; this, however, constitutes the second condition. For instance, in the case of a crank shaft in uniform rotation, the centre of gravity of the shaft itself, lying in the axis, will not move; but the centre of gravity of the crank revolving round the shaft will be subject to continual acceleration, directed from the axis. An equal weight fixed at an equal distance from the axis, and on the opposite side to the crank, will suffice to satisfy the first condition, however far along the shaft it may be from the crank; but to satisfy the second condition, the centre of gravity of the counterweight and of the crank must be in a line perpendicular to the axis of the shaft; and since the connecting rod occupies the space opposite the crank, it is in general impossible to balance a crank with a single weight, two weights having to be used, placed so that the centre of gravity of the whole mass on one side of the crank shaft shall be opposite to the centre of gravity of the mass on the other.

The moving parts of machines consist in general of revolving pieces, such as crank shafts, and oscillating pieces, such as pistons and connecting rods, the motion of which is derived from, or governed by, a revolving crank.

In the case of the revolving pieces, a complete balance may always be effected in each piece by the addition of counterweights on the piece itself. Thus, as far as a crank shaft in a locomotive is concerned, apart from the connecting rods, pistons and other moving parts attached to it, the addition of suitable weights on the driving wheels will satisfy both conditions and prevent any disturbance on the frame arising from the revolution of the crank shaft. Oscillating pieces, however, cannot be balanced in so simple a manner. They require a weight or weights of which the centre of gravity is in the line of oscillation, and oscillating in exactly the reverse manner. Now, the manner of oscillation of, say, a piston depends not only on the motion of the crank, but also on the length of the connecting rod, the varying obliquity of which, when the connecting rod is short, will produce an important effect. The only way, therefore, in which a connecting rod and piston can be completely balanced is by oscillating weights connected with cranks on the crank shaft, by connecting rods of such length that their obliquity is always the same as that of the connecting rod which drives the piston. In this way, however, a complete balance may be effected. That it is rarely or never done is owing to the complexity and increased friction attending such an arrangement, which renders it in other ways a greater evil than the disturbances on the frame which it prevents. Practically, then, it comes to this—that revolving pieces may be completely balanced; but, as regards oscillating pieces, the balance cannot be made complete.

In default of a complete balance, there remains the question as to the desirability of an imperfect balance, or what may be better described as the introduction of other forces, so as to modify the resultant force on the frame. The practical possibility of such modifications is limited by considerations of complexity and friction to the addition of certain weights to the crank shaft, which introduce forces in one direction equal to those which they balance in the direction at right angles. But for the effect of the obliquity of the connecting rod, the force arising from the acceleration of the piston in the direction of its motion will at all times be the same as the component in that direction of the centrifugal force of an equal weight revolving with the crank and having its centre of gravity in the axis of the crank pin. The centrifugal force of the revolving weight, however, would not be confined to the direction of oscillation, so that if such a weight be used to balance the piston, it will introduce an equal force at right angles to the direction of oscillation. Thus if weights be added to the driving wheels of a locomotive of such magnitude as to balance not only the weights of the cranks, but also weights equal to the connecting rods and pistons, having their centres of gravity in the crank pins, the only horizontal forces will be those which arise from the effect of the obliquity of the connecting rods on the motion, while vertical forces will have been introduced nearly equal to what the horizontal forces arising from the pistons and connecting rods would have been. The effect of smaller balance weights is to leave more of the horizontal forces unbalanced, and introduce less vertical force. Such is a sketch of what may be called the practical possibilities of balancing machines, which, like a steam engine, involve oscillating pieces.

There will, therefore, always be disturbances in the frame, unless they are prevented by the strength of the supports, but it is possible to so arrange counterweights as to mitigate these forces in one direction by introducing equal forces in a direction at right angles. The problem as to how far it is desirable to do this, is that which the practical engineer has to solve, and which, owing to a multiplicity of considerations, can in reality only be solved by experiment. There are, however, several leading considerations, a general apprehension of which should much facilitate the task.

When there is nothing to limit the firmness and stiffness that can be given to the frame and its supports in the directions in which the forces which arise from the inertia of the moving parts tend to move it, there is but little inconvenience arising from these forces. Thus in a stationary steam engine founded in the earth steadiness may be obtained by weight and solidity of foundations, almost the only drawback being the expense entailed and the space occupied.

But when an engine has to be carried by a floor or on any structure more or less elastic, then the case is different, and it becomes a question of the greatest importance in which direction disturbing forces will produce the least or the most harmful effect, it being desirable as far as possible to balance the forces in the other direction at the expense of forces in this direction.

It is not, however, simply a question of stiffness, as it may happen from various reasons that equal forces caused by the revolution of the engine might do more harm, and under certain circumstances even cause greater disturbance in that direction in which the supports are stiffest. The consideration of the circumstances on which vibrations depend, as described in the Art. III., in THE ENGINEER, Dec. 9th, 1881, at once shows that the directions in which the greatest disturbance of the frame is likely to result from forces caused by the revolution of the engine, are those directions in which the period of free vibration of the frame on its supports nearly corresponds to the period of revolution of the engine. And where there is any direction in which such a near coincidence occurs, it is an absolute necessary that in this direction the balance should be as nearly perfect as possible. It is often impossible to ascertain beforehand in which direction such a coincidence may be expected, but its existence at once declares itself upon the engine being put to work. Indeed, wherever an engine or revolving machinery causes a visible swinging vibration, it is in consequence of such a coincidence of periods, and the oscillations will be found to occur in batches, the magnitude of the oscillations and the number in each batch increasing as the speed of the engine approaches some particular value. This may be seen in many cranes. In such structures the period of oscillation depends upon the load suspended, and hence it will often be seen that while the engine which works the crane will run quite steadily when the crane is unloaded, when loaded decided oscillations are set up; or it may be just the other way, and oscillations occur when there is no load, while the structure is steady when the load is on. In almost all such cases the osillations might be prevented by counterweights so placed as to alter the direction in which the forces occur.

Such oscillations are, as has been said, to be feared chiefly in cases where the frame of the engine is carried on elastic supports. All engines supported on springs—as portable or traction engines—are liable to them, as are also marine engines, owing to the elasticity of the ship. And in these cases it is only in avoiding such oscillations that counterweighting has to be studied. In some cases, however, notably that of the locomotive, it is not only in causing such oscillations as ensue when the directions and periods of free vibration and of the unbalanced forces coincide that such forces are harmful. In the locomotive, although the frame of the engine rests on elastic supports, namely, the springs, yet the revolving piece—the crank shaft with the driving wheels, whence alone can arise vertical unbalanced forces—rests on the rails, which afford a very rigid support in a downward direction, and to prevent upward motion there is the axle-box with the weight of the locomotive upon it. Unbalanced weights on the crank shaft cannot therefore cause in a vertical direction such oscillations as have just been considered; but they give rise to other evils. If the centrifugal force is sufficient it will lift the axle-box against the pressure of the spring, causing the wheel to leave the rail on to which it will return with a blow, causing what is known as hammering; while short of this a want of vertical balance will cause the wheel to run with varying pressure or tread upon the rail, which will cause the wheel to wear out of the round, even if the pressure be nowhere sufficiently relieved to allow the wheels to slip. Of these evils hammering must be avoided, *i.e.*, the speed of the engine must not reach the point at which this begins, and the load and speed should not be so great as to cause slipping. But the wear arising from unequal tread is not so serious an evil but that it may be faced as an alternative for other evils. A certain limited want of balance in the vertical direction is thus permissible.

In a horizontal direction the character of the support of the engine and crank shaft is altogether different. In this direction the crank shaft is held to the frame of the engine by the axle-boxes, but the frame of the engine resting on the wheels has no backward and forward support at all, except such as is derived from the elastic drawing apparatus which connects it with the train. While as regards twisting about a vertical axis which causes the engine to run with a sinuous motion, the only support is that derived from the comparatively loose fit of the flanges of the wheels between the rails. Thus any want of balance in a horizontal direction causes the engine to move forward with an uneven motion or with a sinuous motion on the rails. The last of these evils is the worst, but they are both bad according to their degree.

As we have seen, the motions of the pistons and connecting rods introduce horizontal forces such as will produce one or other, or generally both, these evils. These horizontal forces can only be diminished by counterweights on the driving wheels, which introduce vertical forces equal in magnitude to those which they balance. It is a question, therefore, between two evils—unsteady horizontal motion or unequal tread. Experience has shown that, up to a certain point, the latter evil is the least, and that it is better, at least in part, to balance the horizontal forces. As to the exact degree in which this should be done practice differs. Nor is there sufficient data on which to lay down a general rule; but the circumstances which in each case should determine the balance weights are to be inferred from the foregoing considerations. The limit to the counterweights lies in the inequalities which they cause in the pressure of the driving wheels on the rails; and hence the permissible magnitude of these inequalities is what should be ascertained in order to determine the balance weights. Or, in other words, what is wanted to be known is the greatest proportion to the gross load on the driving wheels that the vertical component of the centrifugal force may be practically allowed to bear, and the counterweight might then be designed so as to produce this force when the engine is running at its normal speed; unless, indeed—as would never happen—such weight was more than sufficient to balance the horizontal forces.

This method of arriving at the best counterweight is the only logical one. The usual custom appears to be to balance a certain proportion of the horizontal forces. This, however, is not logical, since but for the vertical effect of the counterweights, the more perfectly the horizontal forces are balanced the better, and there is no fixed ratio between the horizontal forces and the load on the driving wheels which determines the allowable magnitude of the vertical forces. The common rules, too, as to the distribution of the balance weights, are apt to be faulty, for by these rules the distribution of counterweights is to be such as would completely balance weights centred in the crank pins bearing a certain proportion to the oscillating weights. So that not only does the imperfection of the horizontal balance produce irregularities in the forward motion of the engine, but it also produces a twisting or sinuous motion. Now, whatever proportion of the horizontal weights may be balanced, the counterweights may be so placed on the wheels as entirely to prevent the twisting or sinuous motion. The rule, therefore, as far as it is possible to state it, should be to use the largest counterweights which the load on the driving wheels will allow, and to distribute it so as to balance all tendency to turn the crank shaft about a vertical axis.

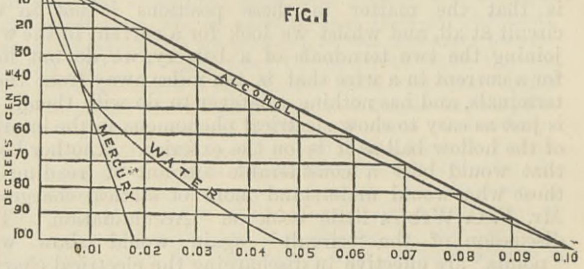
In the case of coupled engines, the balance weights should obviously be equally distributed between the wheels, so that the inequality of wear may also be distributed. In these engines it is a common custom to make the coupling rods and the crank pins which carry them act the part of counterweights for the pistons and driving cranks, by placing the coupling crank pins on the opposite side of the shaft to the driving cranks. This effects a considerable reduction in the actual counterweight, but this appears to be the only point gained, while in order to reduce the forces and friction on the journals, the coupling rod crank should be on the same side of the shafts as the driving cranks, so that the forces transmitted to the coupling rods may not be transmitted through the journals so as to cause increased friction on the bearings.

The disturbing effect of the inertia of the oscillating parts forced itself into notice very early in the days of the locomotive, and immediate good was found to result from the use of counterweights, which, by increasing the steadiness, allowed higher speeds to be attained. It does not appear, however, that any systematic attempts to determine the best arrangements of the balance weights have been recorded. Experiments have been made from which certain conclusions have been drawn, but the subject has not received the treatment which its importance deserves. This is doubtless because the investigation is one which involves the long-continued control, in certain respects, of locomotive engines, while those who have had this control have not been able to devote unclouded attention to this subject. If a railway company would engage the assistance of one of the highly-qualified young engineers to be found at the present time, giving him the control of the balance weights and a sufficient number of locomotives, and power to watch the results, both as regards steadiness and wear, for a considerable period, not only would they be amply repaid, but they would earn the gratitude of all locomotive engineers, and, indeed, of the travelling public.

FREEZING AND MELTING POINTS.

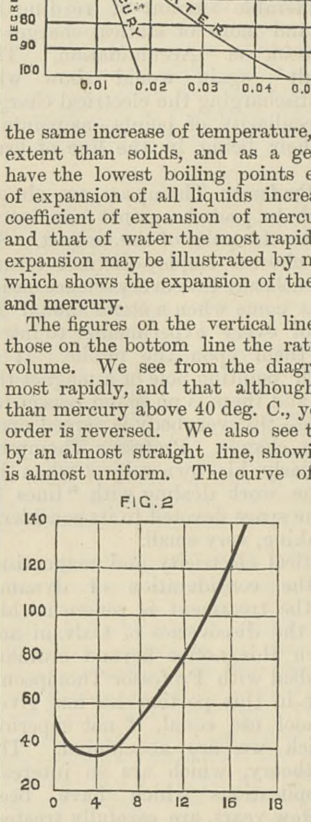
IF we take a solid and heat it, we know that it expands in the first place, and if sufficient heat be applied it will eventually melt, the melting point varying with each substance, but remaining constant for each individual substance. Again, if a substance in the liquid form be cooled below its melting point, it will once more become solid; and as a general rule the melting and freezing points are the same. It is, however, possible to cool water far below its freezing point, by allowing it to remain in a perfectly motionless condition; but should the slightest movement take place, or if the smallest particle of any substance be dropped into it, congelation will immediately ensue, and the temperature will rise to the freezing point. This is a very difficult experiment to make, and is not often successful when attempted, on account of the almost impossibility of keeping the apparatus motionless. The phenomenon can, however, be very easily observed, and nearly always successfully, by using instead of water a glass vessel filled with a saturated solution of sulphate of soda. This phenomenon has been noticed to occur most readily when the liquids are enclosed in a capillary tube, and it is very probably owing to this that some plants are not damaged by the frost, the liquid in their vessels remaining liquid, although far below the freezing point.

The laws of expansion of liquids have been fully investigated by the German philosopher Kopp, and by the French philosopher Pierre, their results being almost identical, and the methods of conducting the experiments being the same—namely, observing the expansion in a thermometer and then making the necessary correction for the expansion of the glass. The following interesting facts were observed by them:—(1) The mechanical force developed in expansion is, as in solids, the same as that required to compress them to an equal amount. (2) For



the same increase of temperature, liquids expand to a far greater extent than solids, and as a general rule, those liquids which have the lowest boiling points expand the most. (3) The rate of expansion of all liquids increases with the temperature; the coefficient of expansion of mercury increasing the most slowly, and that of water the most rapidly of all liquids. This law of expansion may be illustrated by means of a diagram as in Fig. 1, which shows the expansion of the three liquids—alcohol, water, and mercury.

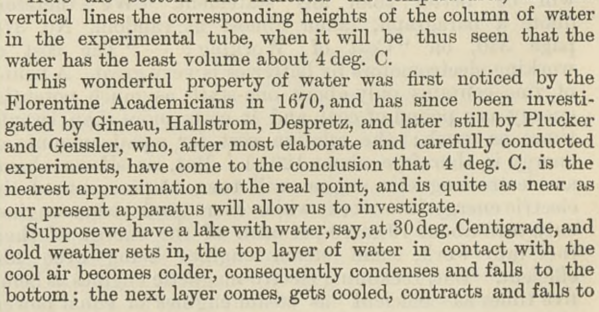
The figures on the vertical line indicate the temperature, and those on the bottom line the ratio of expansion of the unit of volume. We see from the diagram that mercury expands the most rapidly, and that although water expands more rapidly than mercury above 40 deg. C., yet below this temperature the order is reversed. We also see that the mercury is represented by an almost straight line, showing that the rate of expansion is almost uniform. The curve of water is very peculiar, and it is of this point we now wish more particularly to speak. Although the amount of expansion of water between 0 deg. C. and 100 deg. C. is very small, yet it is most irregular—in fact more so than that of any other liquid. Below the freezing point, the expansion of water is far more irregular than above it, for it alone of all liquids has a point of maximum density above its freezing point, and from this point the liquid expands whether it be heated or cooled. This point of maximum density is at 4 deg. C., and can be best shown by the curve in Fig. 2.



Here the bottom line indicates the temperatures, and the vertical lines the corresponding heights of the column of water in the experimental tube, when it will be thus seen that the water has the least volume about 4 deg. C.

This wonderful property of water was first noticed by the Florentine Academicians in 1670, and has since been investigated by Gineau, Hallstrom, Despretz, and later still by Plucker and Geissler, who, after most elaborate and carefully conducted experiments, have come to the conclusion that 4 deg. C. is the nearest approximation to the real point, and is quite as near as our present apparatus will allow us to investigate.

Suppose we have a lake with water, say, at 30 deg. Centigrade, and cold weather sets in, the top layer of water in contact with the cool air becomes colder, consequently condenses and falls to the bottom; the next layer comes, gets cooled, contracts and falls to



the bottom. And so the change goes on until the water gradually becomes colder and colder, until at last it reaches the magic point of 4 deg. Centigrade. Instead now of contracting with the action of the cold air, it expands, and consequently remains at the top, where it gets colder and colder, still expanding, and eventually freezes at 0 deg. Centigrade; and we thus see that the water below the ice thus formed never gets below 4 deg. Centigrade, except, of course, the layer immediately below, which is in the act of being formed into ice. When a solid is changed into a melting state there is generally a sudden change of volume, which in most cases is an expansion, but in the case of water and a few metals the reverse takes place, and they suddenly contract. In the following figure we have shown the curves of contraction and expansion of water, phosphorus, wax, and stearine as being the most remarkable.

It will be noticed from the above figures that phosphorus expands very regularly, like most solids, until it reaches 44 deg. Cent., its melting point, when a sudden expansion takes place, after which it expands regularly as before. Wax, on the other hand, expands very rapidly until it reaches its melting point, 64 deg., and then it expands gradually. Stearine is the most irregular of the lot; it expands gradually until it melts at 50 deg. Cent., when it suddenly contracts, and as the temperature rises, the substance gradually thickens, evidently undergoing a molecular change, and in this form has a new melting point at 60 deg. Water when it freezes, suddenly expands to a great extent—$\frac{1}{10}$ of its volume at zero, this expansion being far greater than the amount it undergoes between 0 deg. and 100 deg.; consequently ice will, as we know, float easily upon water, even if it be boiling. This expansion of water occurs with tremendous force, and it is to this sudden and great expansion we owe our burst water pipes and the consequences.

When the boiler of a hot-water apparatus is heated by means of the kitchen fire, the greatest precautions are necessary in times of frost; and we would advise everyone having such apparatus to thoroughly understand the running of all the pipes, position of taps, &c., so that in a case of emergency they will not have to work in the dark; also to examine the system periodically, and see that all is in working order. Should it be discovered that the feed or other pipes are frozen, shut off all connection between the boiler and the tank by means of the tap, which should be next to the tank, and also shut off the supply of the water into the tank from the main, so that the only water which could escape into the house would be that in the length of pipe between the burst in the pipe and the tap. The fire should, of course, not be used until the pipe has been repaired and the boiler filled. In spite of all precautions, pipes unfortunately will burst, and it is generally after the pipes have burst that the greatest precautions are necessary.

THE BLACKBURN COLLISION.

It will be remembered that Colonel Yolland, in reporting on the Blackburn accident, expressed opinions adverse to the Westinghouse brake. We commented on these opinions in our impression for January 20th. The Westinghouse Brake Company has issued a pamphlet dealing with several questions connected with brakes. The first portion is devoted to replying to Colonel Yolland, and from this we reproduce the following extracts:—

A perusal of Colonel Yolland's report on the Blackburn collision, which occurred on August 8th, 1880, cannot fail to suggest several ideas forcibly to the mind.

1. The strong animus displayed throughout by Colonel Yolland against the Westinghouse brake, as shown, chiefly, by his ignoring all facts and probabilities which told in its favour, at the same time that there was no evidence whatever, except that of the engine-driver and fireman, against it; by his readiness to accept all the engine-driver said as true, in the face of facts which rendered his evidence valueless; by a strained endeavour to make everything fit his own theories; and by a too apparent desire to convey the idea that the collision resulted in some way from the automatic nature of the brake.

2. Everyone must be struck by the introduction of so much irrelevant matter concerning automatic brakes generally, and about the so-called failures of the Westinghouse brake, by applying itself at improper times; whereas he alleges the Blackburn collision to have been caused, on the contrary, by the failure of the brake to act when required, a class of failure which is well known to be peculiar to and inseparable from non-automatic brakes, on account of their defective principle.

Colonel Yolland has, moreover, so contrived to mix up the Blackburn collision with this other irrelevant matter, and so used the alleged failure of the brake as a foundation upon which to build his arguments, that it will be necessary first to explain how the collision really came about; and more particularly is this required on account of the use to which the report has been put by the opponents of automatic brakes.

A train from Liverpool, while standing in Blackburn Station, was run into by an express train from Manchester, at a speed of from twenty-five to thirty miles per hour, killing eight and injuring sixty-four people. The signals which ought to have protected the Liverpool train were off at the time, and this to most people would be sufficient to account for the accident. The driver, however, after having had time for reflection, said that the brake failed to act; but he did not say this, as will be seen, immediately after the accident; and although there is not the slightest evidence, either positive or negative, to support his statement, Colonel Yolland concludes that this man spoke the truth. At the same time, there is evidence, both positive and negative, that the brake acted as perfectly—when it was applied—going into Blackburn as it had done at the previous stations on this journey; and it would have prevented the collision if it had been applied in time.

Several passengers by this train gave evidence before the coroner in Colonel Yolland's presence, and swore to feeling the brake act distinctly on the different carriages in various parts of the train. The following testimony alone is conclusive:—

William Evans: "On reaching the West Cabin I felt the deep grinding bite of the brake on our carriage. We came into the Blackburn Station at as rapid, or more rapid speed, I should say, than at any period of our journey between Manchester and Blackburn. Immediately after the collision, and after we had attended to the injured, I spoke to the driver of the train. I asked him, 'Why in the world did you bring that train into this station at such a rate?' He replied that he could not see the train standing in the station, nor could any other man, until he was coming into the station;" and, "The driver did not say to me that the Westinghouse brake would not act."

The guard, whose van was the third vehicle from the engine, also made an important statement. He said in his evidence, "I opened the valve of the Westinghouse brake in the van after we had passed the West Cabin, and I did not hear any rush of air." Now, the brake is allowed to have been all right at Over Darwen, the previous stop, and five and a-half or six minutes before reaching Blackburn; and the driver says there was 80 lb. of air in the gauge passing the point where he applied the brake, less than one minute from the time of collision. If, therefore, the guard found no air on entering the station, it was clearly because the driver had already let it out of the brake pipe—that is, had applied the brake—although he had done so too late to be of material use.

It is a fact, moreover, that the brake acted on the engine and four uninjured carriages even after the collision, and that nothing was found amiss with the brake couplings, valves, &c., on the injured carriages, or in the state of the train generally, to account for the accident in any way from any failure of any part of the brake.

We maintain that, having regard alone to the fact that the signals were not at danger, it is quite superfluous to turn to the brake as a cause of the collision. The driver states that on the few occasions when he had run to Blackburn before the station had always been clear; that he had never taken that particular train into the station previously; that he had himself worked the brake only two or three times before, without any proper instruction; that his usual place for stopping was the further or east end of the platform, at a point about 165 yards past the point of collision; and that he expected to be able to do so on this occasion. And Colonel Yolland allows in his report that the driver was quite justified in his endeavour to get to this place, so far as the signals are concerned.

Under these circumstances, then, there is nothing to justify the assumption that the brake in any way failed. Had only the last home signal been at danger, had the express then run 240 yards past it, and had it then struck as it did another train at 25 to 30 miles per hour, there might have been grounds for Colonel Yolland's conclusions, but as it is there is no excuse whatever for them.

How the collision occurred is perfectly clear. The driver, having just descended a steep incline of $3\frac{1}{2}$ miles long, was running at a high speed up to the station, intending to proceed to the further end of the platform as usual, and to make a smart stop similar to what he had been doing at previous stations, when suddenly he found another train had got there first. He applied the brake, whistled, and reversed his engine, but for the want of about 80 yards further distance, within which he could easily, by means of the brake at his command, have brought his train to a stand, came into collision with the unprotected train already there.

This view, however, did not commend itself to Colonel Yolland. He preferred to accept the statement of the driver that, on trying to apply the brake—at a point about half a mile from where he intended to stop—some mysterious irregularity, the nature of which cannot be discovered, suddenly occurred to the brake. For the purpose of justifying his theories, Colonel Yolland made a series of experiments with a similar train to the Manchester express, the brake always being applied at the spot indicated by the driver. In one experiment, when the brake coupling was purposely separated between the first and second carriages—as had been suggested might have been the case at the time of the accident, without any evidence to justify the supposition—the train stopped 10 yards short of the point of collision, from an initial speed of 50 miles an hour, as against 40 mentioned by the driver as the speed on the day of the collision. At last, by cutting off the brake from the train, and allowing it to act upon the engine wheels only, the point of collision was in one experiment passed. Colonel Yolland concluded, therefore, that the collision was caused by the brake refusing to act, except upon the engine wheels; notwithstanding the positive evidence that the couplings between the engine and train were found properly connected after the accident. The last mentioned experiment was not made under circumstances stated by the driver to have existed, but it seems to have been necessary to confirm Colonel Yolland in the fixed conviction with which he began, conducted, and concluded the inquiry, viz., that the brake had failed. None of the experiments made, however, were of any sort of value, for the same results might have been obtained by running close up to the station, and then applying the brake over the whole train.

Colonel Yolland's theories did not find much acceptance from the coroner's jury, for, as a result of the experiments and the evidence, they, in their verdict, entirely ignored the brake, and found, as was apparent to those who closely, and with an unbiassed opinion, followed the evidence from the first, that the collision was caused solely by the system of working the signals, and by the recklessness of the driver.

The fact that the Westinghouse Brake Company called no witnesses, is thus remarked on by Colonel Yolland, who says:—"I was prepared to hear what any witnesses they—the Westinghouse Company—might desire to call could state, as to any facts bearing upon the case, or to receive any statement which they might thing proper to make, after hearing all the evidence, and noting all the experiments which were made, and I informed Mr. Westinghouse that I would delay making my report for ten days as he was obliged suddenly to go to the Continent."

As to this remark, it may be mentioned that Colonel Yolland said in substance to Mr. Westinghouse, that any statement made by him would not have weight; and, in reply to Mr. Westinghouse's remark that he could produce passengers who had felt the brakes upon their carriages on entering Blackburn Station, Colonel Yolland said that he would not believe any witness he might present who would make such an assertion, because it was impossible for any one to tell whether a brake was acting upon the carriage he was riding in or not. We may add that, after due consideration of the evidence which had been taken, both before himself and the coroner, and the results of the experiments, coupled with the verdict of the coroner's jury, it was felt that we should derive no benefit from accepting Colonel Yolland's offer, and laying any statement before him. It seemed impossible to this company that Colonel Yolland could so far ignore the facts and probabilities, and allow his antipathies to lead him to such erroneous conclusions.

Nothing further, perhaps, need be said as to Colonel Yolland's allegation of the failure of the brake; but Colonel Yolland has, as we have said, discussed a good deal besides the Blackburn collision in his report, and as it concerns the main subject of this paper, we may follow him a little further.

Much of the irrelevant matter before referred to amounts to a condemnation of both automatic and non-automatic continuous brakes. Now the question of automatic *versus* non-automatic brakes is one of principle only, and Colonel Yolland cannot consistently condemn the principle of the former, both on account of its liability to go on when not wanted, and also for refusing to act when it is wanted; yet this is what he actually does. Indirectly, too, he very effectually condemns non-automatic brakes on account of their inability to stop trains in case of a breakaway, and for giving no indication to a driver of a coupling having come undone. Though clearly not what was intended, Colonel Yolland's report thus furnishes strong arguments in favour of the principle of automatic brakes; his conclusion in effect being:—(1) That the collision was caused by the separation of a hose connection in the front part of the train in such a manner as to render the application of the brakes on the rear carriages impossible; (2) That any brake which may be liable to fail to act in consequence of a brake coupling coming apart so as to render the brake inoperative, should not be used on railways; and (3) that brakes which may fail as above, are dangerous because the train may then overrun the intended stopping place, and thus cause a collision.

We have always contended that any brake so constructed that the couplings can come apart and thus render the brakes useless without warning to the driver, is a dangerous appliance, and we welcome Colonel Yolland's support in favour of these principles, and consequently in favour of automatic, as against non-automatic brakes.

The difficulty of our opponents in this case lies, of course, in the fact that the brake in use was automatic, while the failure suggested was one peculiar to non-automatic brakes. If what was suggested took place, and a coupling came apart, and by closing the valves gave no warning to the driver, the brake in question was thereby only reduced temporarily to the level of a non-automatic brake, the essential principle of which is that its failure must occur without proper warning.

Colonel Yolland makes the extraordinary statement that the Westinghouse brake connections "frequently (!) become uncoupled" without indication to the driver. How many cases would justify the word "frequently" we do not know, but can only say that since the Board of Trade returns have been published—June, 1878—only two of such cases are mentioned, against scores on the part of other brakes. In view of this fact, and considering the opinions he has expressed, it would only have been fair, and certainly more relevant than a good deal in the report, if Colonel Yolland had referred to these other brakes and condemned them in proportion to their liability to become useless when required to prevent an accident. For the six months ending June 30th, 1881, there are no less than eighty cases actually reported in the Board of Trade Returns, of the Smith vacuum brake alone having failed without warning, on account of the couplings coming undone or other equivalent dangerous failure.

We were, however, so impressed with the use which was made of the two instances of alleged failure before referred to, and saw so plainly that, under similar circumstances again arising, we should be laid open to the same accusations, that we promptly decided to make a complete change from the automatic coupling back to the old form with cocks; so that, in future, any such theories as those advanced in this case will be impossible; for should a pair of couplings be separated from any cause whatever, after the train has once been properly coupled up and charged, the warning which Colonel Yolland considers so essential will unfailingly and unmistakeably be given to the driver.

Two cases are mentioned in Colonel Yolland's report where trains fitted with the Westinghouse brake overran stations, viz., Stanningley and Dover. The former is in the Board of Trade Returns, and we need only say that the circumstances were not analogous to those at Blackburn, and were easily accounted for. As to the case at Dover, which Colonel Yolland calls a "somewhat similar case to that at Stanningley," Colonel Yolland showed our representative a letter he had received from Mr. Kirtley, the locomotive superintendent, on this subject; and it certainly did not justify such a statement. The letter was to this effect, viz., that Mr. Kirtley had not reported the occurrence to the Board of Trade, because he did not consider it was owing to the failure of the Westinghouse brake; that the driver had not reported it as a failure of the brake; and that he decided to give the brake the benefit of the doubt. Colonel Yolland's reference to this case, and his omission of this explanatory letter, are sufficiently indicative of his bias.

In the interest of safety on railways, Colonel Yolland, again, should not have singled out one brake in particular. He would have found from the Board of Trade Reports on Accidents, that there had been six collisions resulting from the failure of the Smith vacuum brake, and he should have censured this and other brakes, instead of the Westinghouse alone, if censure were necessary.

After such statements as have been criticised, it is almost with astonishment one reads that an automatic brake is required sometimes, even in Colonel Yolland's opinion. As, for instance, when a train breaks into two parts, so that the rear portion may be prevented from running back down an incline into a following train, or forward into the front part on the speed being slackened. Colonel Yolland has himself, indeed, on the occasion of such a case as this occurring near Blaby Junction on the London and North-Western Railway, made the following remark in his report—dated 26th December, 1877—on it to the Board of Trade: "The collision would not have taken place at all if the train had been fitted with an automatic brake."

The result of this brief analysis, then, is that we find Colonel Yolland has—(1) directly condemned non-automatic brakes, because they give no warning to the driver on a coupling coming undone, and thus rendering the brake useless; and indirectly this is clearly an excellent argument in favour of automatic brakes; (2) He has directly advocated automatic brakes, because they are wanted in case of a breakaway; and indirectly this is an excellent argument against non-automatic brakes.

It is with reluctance that we criticise the report of Colonel Yolland, but we are compelled to do so in consequence of his remarks during his inquiry, by his mode of conducting his inquiry, by the remarks in his report, and by his going out of his way to introduce material entirely outside his inquiry, all of which justify much more than we have said.

Colonel Yolland might, we think, have remembered that the Westinghouse brake complies more nearly than any other brake with the conditions laid down by the Board of Trade, of which he was the representative. And, further, he should have hesitated to be so severe in his strictures in a case where no positive evidence was forthcoming, on what is at all events, an appliance intended to save life and property, and which the proprietors have for many years spared no expense in bringing to perfection.

The Westinghouse Company append a copy of Mr. Chamberlain's minute added to Colonel Yolland's report, the substance of which minute has already appeared in our pages.

Accident Averted by the Westinghouse Brake.—When approaching Ponders End with the 8·35 a.m. Bishop Stortford to Liverpool-street Great Eastern train, the driver observed a horse and cart on the line on which he was running; the horse had run away from the station, and was lying on the line. The Westinghouse brake was applied with full force, and the train was stopped within a few feet of the obstruction. The passengers praised the brake, and remunerated the driver for keeping a sharp look out.

Old Isthmus Canal Schemes.—A contemporary gives some notes culled from a number of interesting articles lately contributed to the *Boletin* of the Geographical Society of Madrid, by Don Justo Zaragoza, on ancient canal schemes between the Atlantic and the Pacific in Central America. The Spaniards, as early as the sixteenth century, pitched upon three places for these schemes—the Isthmus of Tehuantepec in New Spain, now Mexico; the river of San Juan, or the Lake of Nicaragua, in the republic of that name; the Chagres river, and other parts of the Isthmus of Panama. The first-named scheme was abandoned, to be mooted again in the present century; those of Nicaragua were actively pursued in the seventeenth century, and were on the point of being executed in the eighteenth, under the reign of Charles III.; while the scheme of a canal through the Isthmus of Panama, also abandoned, has been renewed by M. de Lesseps. In his last paper, Don Zaragoza furnishes some information on the little known scheme of a canal *viâ* the Lake of Nicaragua, which scheme appeared in the year 1548, with a map of the land prepared by Arias Gonzalo. Sixty years later the Puertos de Caballos and Fonseca Bay were explored; and between 1780 and 1783 a map of the projected canal was prepared, and a survey made between the Pacific and the Lake of Nicaragua. The scheme met with great opposition, being declared to be impracticable, but it is now once more asserted to be perfectly feasible. The map drawn up a century ago is still preserved.

The Channel Tunnel.—Mr. and Mrs. Gladstone and a large party left Charing-cross on Saturday morning by special train, at 8.30, to visit the Channel Tunnel works between Folkestone and Dover. A large number of members of Parliament followed by the 10 a.m. Brussels express. Operations were temporarily suspended during the visit of the party, except such as would enable them to witness the *modus operandi*. The party remained at the works until about 2 o'clock, and then proceeded in two companies to the Lord Warden Hotel at Dover, where they were entertained at luncheon by Sir Edward Watkin. They left for London shortly before 5 o'clock. The progress of the boring is said to continue satisfactorily, the total distance of the heading being now about 1250 yards, but the boring machine is also said to be drilling through considerably softer soil. The *Militär Wochenblatt*, which, says the *Times*, is the semi-official organ of the grand general staff, has an article on the Channel Tunnel scheme, though like all the contents of that journal, it is characterised by a strictly narrative tone. The writer confines himself to reproducing the strategical aspects of the enterprise as urged by Admiral Dunsany and Sir Garnet Wolseley on one side, and Sir Lintorn Simmons on the other, though one or two turns of expression tend to betray his sympathies with the views of the former school. One or two such sentences may be quoted:—"General Sir Lintorn Simmons, who under the pseudonym of Centurio seems to think it his duty to make steady opposition to Sir Garnet Wolseley, . . . seeks to prove the latter's incapacity to pronounce decisively on these things, as he has taken part in no European war since the Crimea, and can only base his judgment on books. But one involuntarily asks where, then, Sir Lintorn Simmons has gathered his experience of war. While trying to show from text books on tactics that the strongest position is one behind a defile, he wholly ignores the cardinal point of Wolseley's apprehensions, who sees danger in the possibility of a successful *coup de main*."

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

(*From our own Correspondent.*)

AT the meetings of the trade in Birmingham this afternoon, and in Wolverhampton yesterday, vendors made the most of the stronger Glasgow and Middlesbrough markets, and business certainly had about it a slightly more cheerful aspect.

From some makers, for prompt delivery, sheets were this afternoon to be had at—singles, £8; doubles, £9 5s., and latens, £10 5s. to £10 10s. These must, however, be regarded as minimum prices.

Hoop makers announced the receipt of further fresh inquiries on American account for baling and barrel hoops. Makers again quoted £7 5s. to £7 7s. 6d. at works for cotton tie hoops. For barrel hoops more money was asked. The Warrington makers, however, are taking the bulk of the hoop orders, since by reason of their position near the seaboard they are able to underquote this district by some 8s. to 10s. per ton. But Staffordshire makers have the advantage again over the Warrington people in the matter of quality. Australia, Spain, and Italy are also good buyers of hoops just now.

Bar makers announced this afternoon a fair degree of activity on home and export account. Staffordshire bars of common quality brought £6 10s. to £6 15s. Some houses quoted £7 10s. for common bars. Sheets and plates rolled by the "list" iron houses were mostly £2 per ton additional on the rate for bars, though here and there the advance was only £1 10s.

Advices to hand this week from Melbourne report a very quiet market out there for all kinds of iron. Even galvanised sheets have been but little dealt in. When the mails left galvanised iron was saleable at from £21 to £22 and £23 for 26-gauge, according to brands. Bar and rod iron were in request at £10 to £11. Black iron had improved steadily, assortments of Nos. 8 to 18 being quoted at £11 10s. to £12, while for Nos. 20 to 26 £14 was required. Plate iron was dull, quotations ranging from £11 to £12. Hoop iron for trade purposes was offered at £10 to £11.

At Melbourne also tin-plates were offered at 15 per cent. advance on invoice for good assortments. I.C. coke was saleable at 20s. to 21s.; 500 boxes had been disposed of the week before the mails left.

All mines were reported at Birmingham to-day and Wolverhampton yesterday as having changed hands at £3 10s. per ton for hot blast sorts, and this was the highest price which could be realised, though one or two makers asked £3 12s. 6d.; cold blast were £4 10s. Agents of hematite producers were more prepared to consider offers, and 72s. 6d. would have been freely accepted for Lancashire, Cumberland, and Welsh sorts. But the figure could not be got.

There was a little more movement in foreign medium class pigs, and vendors spoke more hopefully of prospects. Thorncliffe—South Yorkshire—pigs were quoted 62s. 6d., but might have been easily got for less. Leicestershire pigs were quoted £2 13s. 6d. delivered at railway stations in this district, with 1s. additional for delivery to works. Northampton and Derbyshire brands ranged from £2 10s. to £2 12s. 6d.; Staffordshire part-mines were 52s. 6d. to 57s. 6d., and cinders 40s. to 42s. 6d. and 45s., according to maker.

The puddlers, shinglers, and forge rollers of North Staffordshire have, since my last, applied by deputation to the ironmasters for an advance of 6d. per ton in their respective departments, notwithstanding the recent rise of 7½ per cent. Their plea was that during the depression wages had been reduced to that extent, and that now trade was improved that amount ought to be returned, in addition to the above advance. The deputation withdrew upon the promise of a hearing when more evidence was forthcoming. Meanwhile the South Staffordshire ironworkers themselves have decided to hold mass meetings throughout the South Staffordshire district to consider the same subject.

The assurance question also occupied the attention of the Southerners, and the ironworkers of the district were recommended to accept the benefits offered by the Employers' Liability Assurance Company, Limited.

The operative nut and bolt makers of Messrs. Ford Brothers, Heath Town, Wolverhampton, came out on strike last Saturday. The disagreement is said to have arisen because the men had joined the National Amalgamated Association of Nut and Bolt Makers. The secretary of this association has found work for them, as they are only few in number, at the Birmingham Nut and Bolt Company's Works, Smethwick; and the prices they are promised there are said to be from 10 to 20 per cent. higher than those they worked for in Wolverhampton.

The resolution of opposition to the closing and transferring of certain Midland canals, sent on behalf of the trade of the Midlands by the Wolverhampton Chamber of Commerce to the London meeting of the Associated Chambers, has been adopted, and the Wolverhampton Chamber are now preparing a memorial to accompany the petition against the Canal Bills which is shortly to be presented to Government.

Claims under the Employers' Liability Act, amounting to between £3000 and £4000, have been brought against the Chatterley Coal and Iron Company, on behalf of the relatives of nineteen men killed at the Whitfield Colliery by an explosion of gas in February last year. Special sittings of the Tunstall County-court have been fixed for April next for the hearing.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—The actual new business doing in the iron market here continues very limited in extent, and with the approaching close of the quarter there is the usual tendency on the part of both buyers and consumers to restrict as much as possible any further transactions for the time being. There has, however, been a rather better feeling in the market, stimulated apparently by the improvement reported recently from Glasgow and Middlesbrough, and although this is not backed up by any appreciably increased amount of business, there is a more hopeful tone with regard to the future.

During the last week or ten days there have been rather more inquiries coming into the hands of local makers of pig iron, and orders to a moderate extent have been booked at a little under 50s. less 2½ for foundry qualities delivered equal to Manchester. The output of local pig iron is, however, gradually overtaking the deliveries from works, and unless there is some improvement before long, stocks will again begin to accumulate. Nominally the quotations for Lancashire pig iron delivered equal to Manchester remain at 49s. to 50s. per ton less 2½, but makers would be open to offers.

Although the upward movement at Middlesbrough has altogether withdrawn north-county iron as a competing brand in this market, district brands such as Lincolnshire iron are still coming in at very low figures, and Derbyshire iron, which, owing to makers having sold so largely some time back, has for the past few months been practically withdrawn from this district, is again coming into competition in this market. For Lincolnshire iron delivered equal to Manchester some makers are quoting 48s. 6d. to 49s., but there are sellers at as low as 47s. to 48s. less 2½ for forge and foundry numbers respectively. Derbyshire iron has been offered at prices ranging 48s. up to 50s. per ton less 2½ delivered here, but makers who are still well supplied with orders quote several shillings per ton above these figures.

I hear that preparations are being made for reblowing in the furnaces of the Lincolnshire Iron Smelting Company, Limited.

In the finished iron trade new orders are coming in very slowly, but makers who are not in present want of specifications still quote £7 per ton for bars delivered into the Manchester district. Where, however, new business has to be sought it is only in exceptional cases that this figure can be realised, and the average actual selling prices are more nearly £6 15s. to £6 17s. 6d. per ton.

The engineering branches of trade, so far at least as the leading firms throughout this district are concerned, continue well employed. During the week the agents of one of the large American Railway Companies have placed a number of orders in this district for general locomotive tools, and a portion of the company's requirements has, I believe, also been covered in Leeds. Wheelwrights are very busy, and machinists, although there are complaints that the home trade is not so good as it was, are not short of orders as a rule, and fair inquiries from abroad are reported to be coming in.

An improved radial drilling machine has been constructed by Messrs. Kendal and Gent, of Manchester, for Messrs. W. and J. Galloway and Sons. This machine, which has an elevating arm of 10ft. radius, has been specially designed for drilling holes anywhere within a circle of 20ft. diameter, and at any height from the ground. The machine consists of a radial arm, with the driving cones, gearing, &c., entirely contained within the framing, swinging on a strong pillar, and, as I have already said, can be elevated by power to any height. For driving there is a vertical shaft from pulleys and radial gearing at the top of the pillar—that is, a 2½in. steel spindle with self-acting feed 15in. deep; and the machine is capable of drilling holes up to 2in. diameter, or if required, with powerful double gearing, up to 15in. diameter.

A new system of railway safety facing points was described by Mr. Thomas Ashbury at the meeting of the Manchester Association of Employers, Foremen, and Draughtsmen held on Saturday. The new facing points, of which a model was also exhibited, have been patented by Messrs. Whitehead and Dodd, and the object is to make the railway points work vertically instead of horizontally. This is effected by providing ten cast iron chairs, five on each side, the first three of which are provided with a recess, in which a slide bar and blocks are worked in and out of position, as may be required. The first three chairs carry the main rail, and are also constructed so as to secure the point blade against the side of the main rail and prevent it moving out of position. The fourth chair on each side is arranged to carry the main rail, the heel of the point blade, and the end of the continuation rail, the jointing of the heel of the point blade and the end of the continuation rail being effected about the centre of the fourth chair. The fifth chair is arranged to carry both the main and the continuation rail. To the front of the second chair on either side of the rail a bracket is secured, for the purpose of carrying the bearings for a cross shaft. The vertical motion of the point blades is effected by providing three blocks and one slide bar underneath each point blade, which work in the recesses provided in the three first chairs on each side. At the back of the block on each slide bar a joint is provided, to which a connecting rod is attached, which at the other end is attached to a lever, securely keyed to the cross shaft. This cross shaft is in its turn connected to the rods communicating with the pointsman's box or to a hand lever outside the rails, as may be desired. Near to the toe of each point a link is secured, and is connected with the lever on the cross shaft for the purpose of depressing the point blades after they have been raised. A part revolution of the cross shaft causes one of the point blades to move vertically to its required position, and at the same time places the block and slide bar underneath in their required positions. By the same movement the block and slide bar on the other side of the rails are withdrawn, and the point blade is depressed so as to allow the wheels of the train to pass over it without contact in any way. It will thus be seen that immediately one point is raised the other is depressed, and a train passing over would be turned on to the main or the branch line, as the case might be. The advantages of this system Mr. Ashbury pointed out to be that the bolt lock and all its attendant rods and levers were dispensed with, whilst the points could not possibly foul, and coupling chains hanging from wagons could not disarrange them. A sample set of these points had been laid down on the London and Brighton Railway for the last three or four months, and had given great satisfaction. Mr. Ashbury also described a compensator for regulating the variations in signal wires caused by the fluctations of temperature and a fog-signalling apparatus under the control of the pointsman from his cabin, which have also been patented by Messrs. Whitehead and Dodd.

The only change to notice in the coal trade is that, with the warmer weather, the market, if possible, becomes still more depressed. House fire coals are a drug, and even the commoner sorts, although in tolerably good demand for iron-making and steam purposes, are abundant. The result is that heavy stocks are accumulating, and very few of the Lancashire colliers are working more than three to four days a week. There is so much competition for orders that sales can only be effected at very low figures. Best coals at the pit mouth do not fetch more than 8s. 6d. to 9s. At the pit seconds range from 6s. to 7s., and common coals from 5s. to 5s. 6d. per ton. Engine fuel moves off tolerably well; but there is not the scarcity which might be expected, considering the very small quantity of round coal now being screened. Burgy averages 4s. 6d. to 5s., and good slack 3s. 6d. to 4s. per ton at the pit.

The demand for shipment continues very limited, and good Lancashire steam coal, delivered either at the Garston Docks or the High Level, Liverpool, can be bought at about 7s. per ton, whilst there are large stocks lying at both places.

Barrow.—The quiet state of the hematite pig iron market which I reported last week continues. The inquiry from America on account of the fall in the price of rails there is almost *nil*, and orders which are being put into the hands of makers are of an unimportant character, and come chiefly from home and continental buyers. The iron trade, so far as this district is concerned, has met with a check, and business of any magnitude is not looked for yet awhile. The shipping season is just opening, and the despatch of orders, which are known to be very heavy, will consume the output of the furnaces. Stocks are not increasing. An increased demand is not all unlikely if freights are brought lower, and if this is brought about makers would be in a position to compete with the American markets even at the reduced prices. Mixed samples of iron are quoted at 58s. 6d. per ton, and No. 3 forge 57s. 6d. per ton net at works, or f.o.b. at West coast ports. There is a better tone this week for steel rails, and prices are recovering their lost position, being quoted at £6 5s. per ton at works. Iron ore is selling at 14s. to 16s. at the mines. There is a good demand for Spanish ore, which is being imported in considerable parcels.

On Wednesday, the 15th inst., Miss Smith, daughter of Mr. J. T. Smith, president of the Iron and Steel Institute, was married to Mr. Ernest Trubshaw, managing director of the Llanelly Tin-plate Works. The ceremony was the cause of much rejoicing in Barrow, where the bride's father occupies the important position of managing director of the Barrow Iron and Steel Company. The presents were both numerous and costly.

Iron shipbuilders are moderately employed; but new contracts are not being booked to keep up the activity which has characterised this industry for the past few months, and in some of the departments a slack time is not unlikely. Other industries are in receipt of a fair number of orders. The coal trade is in a good condition.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

THE weather seems to get summer-like in its mildness, with the usual result of causing the demand for house coal to be still further diminished. Prices, however, are not lower than at last quotations. In fact, coalowners say they would prefer to close several of their pits to selling their commodity at less than present rates. Iron in South Yorkshire is a little more briskly called for, but the trade is not quite so brisk as in North Notts and North Derbyshire.

In the Bessemer and crucible steel departments there is still much activity, with no signs of any cessation. The file, cutlery, and edge tool makers have good orders in hand for the Australian and other colonies, and the makers of garden and agricultural machines and implements are full of work, owing to the exceptionally fine weather causing operations to be unusually early. Lawn mowers and similar goods are in particularly brisk demand.

The duties leviable upon Sheffield goods on entering France remain unaltered until the 15th of May next, to which date the terms of the Anglo-French Treaty have been extended. After that date the changes which will operate under "the most favoured nation clause treaty" will come into effect. Then the duties upon English goods will be in accordance with the terms laid down in the most favourable of the existing treaties which other countries have with France. In the Franco-Italian Treaty of 1881, knives for arts and trades entering Italy—wooden handles—are subject to a duty of 16f.; tools and instruments for art, trade, and agriculture, scythes and scobles, 10f.; iron in mass, 2f.; iron rods more than five millimetres in diameter, 4f. 62c.; rods less than five millimetres in diameter, 8f.; tinned and coppered lead and zinc, 10f. 75c. In cutlery the duties will be, per 100 kilos: common knives, 15 per cent.; butchers' knives, tailors' scissors, 125f.; common razors, 250f.; others, 15 per cent. *ad valorem*; fine kinds, 600f.

A remarkable chain for shipbuilding purposes has just been completed for Earle's Shipbuilding and Engineering Company, Limited, Hull, by Messrs. Joseph Mitchell and Company, engineers and machine makers, Exchange Works, Egerton-street, Sheffield. The chain is intended for lifting boilers and other heavy machinery into and out of vessels. Wrought iron has usually been employed in the construction of chains for shipbuilding purposes, but recent accidents have turned attention to steel as more trustworthy and durable. The chain referred to is made of Siemens "open hearth" steel, weighs 4½ tons, and is calculated to sustain a weight of 60 tons. It is 180 yards long, and consists of over 3200 links, held together by upwards of 850 steel pins. It is undoubtedly the largest chain of its kind ever produced, and is noteworthy as the beginning of a new industry in steel.

Earle's Company, I hear, is very well off for orders at present, having orders on their books for seven new ships. The Steel Company of Scotland and other companies usually compete very keenly with the Sheffield steel manufacturers for shipbuilding orders from the Hull and north-east district.

Several very heavy crank shafts for ocean-going steamers have recently been constructed in Sheffield. One, for the Servia, I have already noticed; another for the Arania—building by Messrs. Thompson on the Clyde—is 52 tons in weight. There are also several good orders in hand for steel linings for guns, which, when completed, will weigh 60 tons. There seems no disposition on the part of our naval or military authorities to follow the lead of Italy in 100-ton guns.

Messrs. Wm. Jessop and Sons' dividend is always awaited with interest in manufacturing circles. Their works, the principal of which are at Brightside, are among the largest and oldest ones in the trade; and their business in the finest crucible steels extends over the whole world. At the annual meeting, to be held on the 29th inst., the directors will recommend the payment of a further dividend of 40s. per share, which, with the 15s. per share paid in October, will make 55s. per share for the year. The shares being £50—£30 paid up—this dividend is equal to £9 3s. 4d. per cent. per annum. Last year's dividend was £6 13s. 4d.; and in previous years 5 per cent. per annum.

The Hammond Electric Light and Power Supply Company, Limited, report to the Chesterfield Corporation that they are now able to carry out their contract in an efficient manner, and that in a few days the borough will be illuminated by a system of incandescent lighting, on a scale which has never hitherto been attempted in this country.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

THE improved tone which was observed to have taken possession of the iron trade a week since still prevails at Middlesbrough. On Tuesday there was more firmness as to the present, and more confidence as to the future, than has been previously noticeable at any preceding market this year. A considerable number of sales took place, and at better prices. The quotations for No. 3 g.m.b. were 43s. to 43s. 6d., which is a clear advance of 1s. per ton. Forge iron was the usual 1s. less. Exports both from Middlesbrough and Glasgow have been so far very good. From Middlesbrough, up to Monday night, 44,224 tons of pig had been shipped; and some anticipate that the figures for the whole month will reach 100,000 tons. The heavy draw on private stocks, in order to supply consumers and shippers, is making a certain amount of scarcity, and several cases of detention of ships have been reported. The associated ironmasters, fortified by this state of things, and finding that the minimum of £4 2s. 6d. fixed by them last week was subsequently freely given, have taken courage, and have now raised their minimum to 43s. 6d. Warrants have not yet risen in value proportionately, but no doubt they will do so whenever iron begins to be largely taken out of store. Last week there was a decrease of 1610 tons in Connal's stocks.

The finished iron trade continues steady at previous prices. Not much buying has taken place for some time, and what transactions have been reported have mostly been in second-hand lots held by merchants. These have been parted with in some cases at 5s. per ton below makers' prices.

The steel rail trade is rather flat in consequence of the large quantities now being turned out, and the consequent severe competition among producers for orders. Founders still complain that their trade is dull and prices unremunerative.

The coal trade is quiet, and except in the case of steam coal, which is rather eagerly sought after, there is no change worthy of notice.

In the general engineering trade there is more activity. A large contract for the India Government, represented by Mr. M. Rendel, C.E., has found its way into the Cleveland district. A portion, including a number of pontoons, has been placed with the Tees Side Iron and Engine Works Company; and the remainder, including a large caisson, with Messrs. Head, Wrightson, and Co., of Stockton. The bulk of the wrought iron will in the one case be supplied by Messrs. Fox, Head, and Co., and in the other by the Bousefield Iron Company.

A somewhat alarming colliery accident took place on Tuesday, whereby the lives of 122 men were seriously endangered, and they actually were locked up in the pit for some hours. The scene of the accident was the Lumley pit, near Fence-houses. It appears that the beam of the winding engine suddenly split longitudinally from end to end, a splinter striking the winding drum and stopping it, when four full and four empty cages were passing through the shaft. The men were released by resorting to another shaft called the "Peel" shaft, half-a-mile distant. They were there hauled out, three at a time, in a "sinker's kibble." Two men and two boys working in the five-quarter seam, above the block in the main shaft, were released by letting down a sling, in which they took their seats one by one, and which was then hauled up by a horse pulling at a rope passing over a temporary sheave and thence down to the sling. Surely these poor colliers seem to be within an inch of their lives, even when they are deemed to be in perfect safety.

The will of the late Mr. Alfred Kitching, of Darlington, a director of the North-Eastern Railway, has been proved. His total personal property was affirmed to be under £344,018. Besides this, he leaves nine landed estates. His personal property includes shares in the firms of Fry, Janson, and Co., Charles Janson and

Co., and the North Ditchburn Coal Company. He leaves to his widow his Elmfield house and estate and £3000 per annum for life, and the remainder of his property and the reversion of the above he distributes between his three sons. This is subject, however, to legacies to certain benevolent institutions, amounting in all to £500.

The Scotch ironmasters, who were so very shy and cautious when restriction of output was first proposed to them, seem now to be quite in love with that expedient. They have been making overtures to their Cleveland competitors to reduce yet another 7½ per cent., making a total of 20 per cent. It is not thought, however, that the proposition will be entertained now that the market seems inclined to advance without it.

Mr. Joseph Whitwell Pease, M.P., has accepted the office of arbitrator in the matter of the claim of the Northern ironworkers for a further advance of 7½ per cent. on their wages. It is expected that the arguments for and against will be heard about the first week in April.

The workmen at the Newport rolling mills, Middlesbrough, have again been balloting upon the question whether or not they should join the Board of Arbitration. On two former occasions they decided in the negative; but this time they have decided in the affirmative by a large majority. Consequently the firm have formally applied for admission to the board.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

The Scotch iron market, which has been in a drooping condition for a series of weeks, has at length manifested a decided improvement. It was expected that shipments, which were very good during the past two months of the year owing to the open weather, would show unsatisfactorily in the present month. On the contrary, however, they have gone on increasing, and the past week's exports of pig iron are about the largest recorded since the year began, amounting to fully 13,000 tons. It is true that the American demand has lately slackened, but this has been more than made up by the reception of very good orders from Germany. The deliveries of pig iron into store here have for the time ceased, and the very large export business being done at Middlesbrough has also had a very good effect, while the reduction in the bank rate has induced some fresh speculation in warrants. All these various causes have tended to bring about a healthier tone in the market, and warrants have been steadily improving in price. Rumours have been current to the effect that an effort was about to be made still further to restrict the output of pig iron to the extent of an additional 7½ per cent. There is, however, I am assured, little likelihood of this being done at present. The market, in the meantime, is more promising, and there are difficulties in the way of further restriction, which would go far to neutralise any benefits that might accrue therefrom.

Business was done in the warrant market on Friday morning at from 48s. 4½d. to 48s. 10½d. cash, and from 48s. 7½d. to 49s. one month. In the afternoon transactions were effected at 48s. 9d. to 48s. 4½d. cash, and 49s. to 48s. 7½d. one month. On Monday the market was firm, with business at 48s. 3d. to 48s. 7½d., and on Tuesday the quotations were in the forenoon 48s. 10½d. to 48s. 9d., whilst in the afternoon the tone of the market was strong, with a large business, at from 48s. 10d. to 49s. 1d. cash, and 49s. 1½d. to 49s. 4d. one month. Business was done on Wednesday between 49s. 6d. and 48s. 11½d. cash and 49s. 10½d. to 49s. 3d. one month. To-day—Thursday—the market was easier, with business at 49s. 1d. cash and 49s. 4d. at one month, to 48s. 10½d. cash and 49s. 1½d. one month.

The improvement in the warrant market has had a good effect upon business so far as sales of makers' iron are concerned. Makers report that they are doing a good business, that prices all round are firmer, and that in some cases considerable advances may be reported. The quotations are as follow:—Gartsherrie, f.o.b. at Glasgow, per ton, No. 1, 58s. 6d.; No. 3, 51s.; Coltness, 59s. 6d. and 53s.; Langloan, 59s. 7d., and 53s. 6d.; Summerlee, 57s. 6d. and 50s.; Calder, 57s. 6d. and 51s. 6d.; Carnbroe, 53s. and 50s.; Clyde, 51s. and 49s.; Monkland, 49s. 6d. and 47s. 6d.; Quarter, ditto; Govan at Broomielaw, 50s. 6d. and 48s.; Shotts at Leith, 59s. and 53s. 6d.; Carron, at Grangemouth, 50s. 6d. (specially selected, 55s.) and 49s. 6d.; Kinneil, at Bo'ness, 49s. and 47s. 6d.; Glengarnock, at Ardrossan, 53s. and 50s. 6d.; Eglinton, 49s. 6d. and 47s.; Dalmellington, 49s. and 48s.

The shipments of Scotch pig iron to date amount in the aggregate to 105,251 tons, as compared with 90,733 at the same date in 1881, 145,561 in 1880, and 89,229 in 1879. There is a comparative increase to date of 6165 tons in the imports of Cleveland pig iron into Scotland.

In previous communications I have noticed that the malleable iron trade has lacked that briskness which has for a considerable time characterised it. The dulness in the trade is now becoming more pronounced, manufacturers generally showing some anxiety as to the future. So far there has been no general reduction in prices, but I am assured that orders can be placed at from 5s. to 10s. per ton under the former prices.

So far as orders for the shipbuilding trade are concerned the steel works are well situated, but the inquiry for rails in this quarter seems to have slightly fallen off, most of the orders of importance lately in the market having been secured by English makers. There is also less inquiry apparently for steel manufactures from the United States, and as a consequence the values of hematite are receding.

The coal trade continues to suffer from overproduction, and, although a large business has been done of late, complaints are general that the trade is unremunerative, and that some relief is very desirable, either in the way of restricting the output, or reducing the cost of production. As to how this relief ought to be obtained the colliery owners are not agreed. They have had repeated meetings with reference to the subject, and have adjourned the consideration of the matter until the end of the present month. As is natural, the miners are opposed to having their wages reduced, and profess that they are willing to aid the employers in the matter of restriction; but it is doubtful if the Unions have sufficient influence to bring about concerted action in the matter. The shipments of coals, taking them as a whole for Scotland generally, have not been so satisfactory during the past week on account mainly of stormy weather interfering with navigation. The prices at the ports are nominally without alteration. Mr. Ralph Moore, one of her Majesty's inspectors of mines in Scotland, states that the output of coals during the past year in the eastern district of Scotland over which he has the oversight has amounted to 14,148,880 tons as compared with 12,019,443 in 1880.

A meeting of the Clyde Coal Company, Limited, was held a few days ago in Glasgow under the presidency of Mr. W. D. Gillies, when resolutions were adopted affirming the expediency of winding up the present company with a view to its undertakings being transferred to a new company to be under the same name. Mr. Andrew Dixon, of Glasgow, and Mr. Patrick Turnbull, of Edinburgh, were appointed liquidators to wind up the affairs of the old company, with powers to enter into an arrangement for transferring its business and property to the new company. The chairman stated that for at least four years they had paid away about £22,000 in interest. This had greatly impeded their operations and prevented the successful prosecution of their business. The proposals now made for the establishment of a new company had in view the getting rid of this burden, and he hoped that the arrangement would be carried into effect.

The Clyde shipbuilders have agreed to give the shipwrights an advance of ½d. per hour on their present rate of pay, dating from the 20th current.

The shipments of gunpowder from the Clyde during February amounted to 80,000 lb., valued at £1600, all of which went to Australia. This quantity is 54,000 lb. below the exports of the corresponding month of last year. While the foreign business in gunpowder seems to be rather declining, there is a considerable increase in the demand for dynamite and other explosives.

The Russian warship, the Peter the Great, has now left the Clyde for Cronstadt, after having received extensive repairs and been supplied with new engines and boilers by the firm of Messrs. John Elder and Co.

WALES & ADJOINING COUNTIES.

(*From our own Correspondent.*)

The battle of the sliding scales is one of the events to which we shall have to look forward. I do not expect a thorough settled condition until this is brought about. The sliding scale of the Associated Coalowners is based on good, sound principles, assuring the colliers of a fair participation in the market rates, especially as they go up the scale. Other scales are based on the assumption that low or moderate prices will reign, whereas it is thoroughly well understood that with a lessening area of No. 3 Rhondda and 4ft. steam the tendency of prices for best coals will in future be up.

The Ocean Colliery scale is good in some respects; but after all that of the Association is better, and it is a great pity that an understanding could not be brought about whereby one scale should govern the whole of South Wales. There was an important meeting in the Rhondda Valley this week, to discuss certain matters appertaining to the Ocean scale, and it was decided that unless several suggested alterations be made, notice shall be given for the discontinuance of the scale at the end of six months.

Another battle is also pending, that of the docks; and still another—that of the railways. The opposition to the new Bute Docks Bill is finally split up into parties; but a stout fight is apprehended. Petitions are numerous. In the three railway and dock contests fifty counsel have been secured. The Marquis withdraws his opposition to the Taff Vale Bill.

The Rhondda Tramway scheme has been legalised, and may be regarded as the first important opposition to the Taff Company. Still the Taff Company cares little about its passenger traffic, and it is tolerably well known that a lessened passenger service would enable it to do more justice to the enormous coal traffic that is now carried down the line. During the past week the coal output has been well sustained, and 150,000 tons have been sent away to foreign destinations. Perhaps the least active of the ports was Newport, which sent off only 20,000 tons, Swansea figured for 26,000, and Cardiff 103,000 tons.

Prices have not drooped, though strong efforts have been made. Owners are, however, too well sold to be troubled much by the slight fluctuations we have had.

The Graigola Company, Swansea, have secured an important railway contract. Trade at Swansea continues good in all but tin-plate. Patent fuel is well kept up, but coal prices are slightly weak.

I am sorry not to be enabled to record an improvement in tin-plate. One bad feature is that holders of shares in various companies are showing an eagerness to get rid of them. This does not speak well for the hopefulness in the future of the trade.

Nixon's Navigation Company, Limited, is one of the new companies announced of late. The purchase includes the collieries, mines, land, buildings, and other properties of the firm of Nixon, Taylor, and Cory, and the consideration is £631,800, payable by the allotment of 7800 shares, each credited with £81 as paid up. The company was registered on the 7th inst., with a capital of £780,000, in £100 shares. Mr. Nixon figures for 2340 shares; Mr. Taylor, 780; Wm. and C. Croy, 390 each; and various residents in London, Ryde, Romsey, Berks, &c., complete the list, including two widow ladies.

The men continue on strike at the Gnoll Colliery, Heath. They claim 5 per cent. advance.

The rumour has again been revived that an effort is being made to get the Marquis of Bute to sell the docks. This is scarcely possible when he is at the same time intent upon an important enlargement. Yet should the result of the coming application for powers be adverse I do not know what might not happen. I hope to be able in my next to announce a satisfactory settlement concerning Cyfarthfa, and to give a date when the works will resume operations.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

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

Applications for Letters Patent.

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

7th March, 1882.

1084. Wheels, R. H. Brandon.—(*A. Cottran, Naples.*)
1085. Electro-magnets, W. Thompson.—(*G. Smith, U.S.*)
1086. Furnaces, A. Mellor, Nottingham.
1097. Felting Hats, R. Wallwork, Manchester.
1088. Coppers, &c., G. Inskip & J. Mackenzie, London.
1089. Steel, J. Gjers, Middlesbrough-on-Tees.
1090. Weaving, E. O. Taylor & T. Brierley, Marsden.
1091. Looms, D. Bailey, Lockwood.
1092. Knitting Machines, T. Priestley, Bradford.
1093. Marking Lawn Tennis Courts, R. W. Ralph and W. S. Underhill, Newport.
1094. Sockets, &c., E. H. Johnson, London.
1095. Filter Presses, W. G. Strype, Wicklow.
1069. Actuating Capstans, W. L. Williams, London.
1097. Joints, &c., T. A. Bickley, Birmingham.
1099. Velocipedes, J. M. Taylor, Seer-green, and G. Wethered, Maidenhead.
1099. Cut-off Valve Gear, A. W. L. Reddie.—(*J. Swann and F. R. Fennessy, U.S.*)
1100. Pianofortes, J. Ainsworth, Brinscall.
1101. Metallic Packing, G. Holcroft, Manchester, and J. Grundy, Ashton-under-Lyne.
1102. Looms, C. H. Clegg and A. Hoyle, Littleborough.
1103. Carding Engines, A. Holden, Gorton.
1104. Lasting Boots, W. R. Lake.—(*G. Copeland, U.S.*)
1105. Chains, W. Penman, Gateshead-on-Tyne.
1106. Preventing the Shifting of Cargo, W. R. Lake.—(*E. H. Farrar, New Orleans, U.S.*)
1107. Preparing the Fibre of the Cotton Plant, F. Wheaton, Brooklyn, U.S.
1108. Safety Pins, W. R. Lake.—(*J. Jenkins, U.S.*)
1109. Fixing Metal on Roofs, T. Helliwell, Brighouse.
1110. Reaping Machines, H. R. Allen.—(*Mr. Cochran, Indianapolis, U.S.*)
1111. Reaping Machines, H. Allen, Indianapolis, U.S.

8th March, 1882.

1112. Protecting Harbours, J. Shields, Perth, N.B.
1113. Stench Traps, R. Pearson, Kingston-upon-Hull.
1114. Lamps, W. Skaife, London.
1115. Water as a Motive Power, F. Pool, London.
1116. Socks or Valves, A. Gutensohn, London.
1117. Napped Hats, G. Atherton.—(*G. Yule, U.S.*)
1118. Pickers, G. Burslem, Stockport.
1119. Combing Wool, T. H. Whorton and F. Farrar, Bradford.
1120. Hoists, T. L. Hall, Manchester.
1121. Separating Solid and Liquid Bodies, H. J. Smith, Glasgow.
1122. China Articles, R. Boote, Burslem.
1123. Paper, J. H. Annandale, Midlothian.
1124. Preventing Racing in Steam Engines, J. Holt, Mossley.
1125. Suspension Beds, F. Lebacq, Bruxelles.
1126. Engine Indicators, H. J. Haddan.—(*G. H. Crosby, Massachusetts, U.S.*)
1127. Treatment of Flesh, J. Imray.—(*F. Artimini, Florence, U.S.*)
1128. Controlling the Flow of Water, J. Rawson, Balsall Heath.
1129. Steering Vessels, W. Pepper, Kingston-upon-Hull.
1130. Propelling Vehicles, G. F. Redfern.—(*P. Collamure, Boston, U.S.*)
1131. Mats, E. Smith, City-road, London.
1132. Earthenware Tubes, G. Smith, Bradford.
1133. Stoppers, A. Clark.—(*G. D. Dows, Boston, U.S.*)
1134. Railway Signalling, T. Gaddes, London.
1135. Brakes, H. N. Kivell, Bideford.
1136. Electric Telegraphs, S. Pitt.—(*H. C. Mance, Kurracher, India.*)
1137. Telegraphic Apparatus, W. H. Davies and F. H. W. Higgins, Cornhill, London.

9th March, 1882.

1138. Transmission of Power, J. Thomson, Glasgow.
1139. Dynamo Machines, T. J. Handford.—(*T. A. Edison, New Jersey, U.S.*)
1140. Wagons, W. Hornsby & R. Edwards, Grantham.
1141. Carding Machinery, J. Dobson, Galashiels.
1142. Regulating the Generative Capacity of Dynamo Machines, T. J. Handford.—(*T. A. Edison, Menlo Park, U.S.*)
1143. Spring Hinges, E. P. Phillips, London.
1144. Atmospheric Burners, R. H. Wylde, Leeds.
1145. Motive Apparatus, S. Wilding.—(*J. Caso, Paris.*)
1146. Pianoforte Actions, A. Squire, London.
1147. Attaching Wheels to Axles, J. Mackay, Liverpool.
1148. Cut Nails, J. Maynes, Manchester.
1149. Valves, A. W. Harrison, Abergavenny.
1150. Holding Lawn Tennis Nets, J. Osmond, Kent.
1151. Cash Counters, C. D. Abel.—(*F. Witte, Berlin.*)
1152. Reaping Machines, J. S. Macgregor, Edinburgh, and G. Redfearn, Berwick-on-Tweed.
1153. Substitute for Insulating, M. Zingler, London.
1154. Rotary Engine, J. Bowie and T. Wrigley, London, and D. Dossett, Leyton.

10th March, 1882.

1155. Coffee Jugs, E. Jones, Birmingham.
1156. Soda, &c., J. Mactear, Glasgow.
1157. Spindles, R. B. Thomson, Dundee.
1158. Penholders, G. R. Hughes and T. Carwardine, Hampstead, London.
1159. Dressing Stuffs, A. C. Henderson.—(*V. Cheviet, Lyon, France.*)
1160. Pencils, J. D. Sprague, Upper Norwood.
1161. Making Stencils, J. D. Sprague, Upper Norwood.
1162. Electric Currents, W. R. Lake.—(*H. S. Maxim, Brooklyn, U.S.*)
1163. Electric Lighting, W. Lake.—(*E. Weston, U.S.*)
1164. Protecting Graves, J. Walters, Kingston.
1165. Cleansing Tubes, T. Marshall, East Greenwich.
1166. Printing Surfaces, J. J. Sachs, Sunbury.
1167. Gas, G. C. Trewby.—(*O. A. L. Pihl, Norway.*)
1168. Portable Railways, J. C. Mewburn.—(*G. Fender, Buenos Ayres.*)
1169. Fire-arms, P. T. Godsal, Windsor.
1170. Floating Anchors, W. M. Bullivant, London.
1171. Burning Carbon, A. Graham, Camberwell.
1172. Electric Lamps, J. Wauthier, London.
1173. Secondary Batteries, J. H. Johnson.—(*A. de Méritens, Paris.*)
1174. Regulating Electricity, J. S. Williams, London.
1175. Roofing Materials, E. B. Edwards, Liverpool.
1176. Spoon, T. F. D. Heap and J. Rettie, London.
1177. Telephones, J. D. Husbands, London.
1178. Heating, A. M. Clark.—(*P. & E. Dupoully, Paris.*)
1179. Dyeing, A. M. Clark.—(*J. Hanson, U.S.*)

11th March, 1882.

1180. Dress, O. Y. Rhodes, Leeds.
1181. Pruning, &c., J. Ridal, Crosspool.
1182. Bottling Aerated Waters, J. T. Hayes, Walthamstow.
1183. Corkscrew, G. W. von Nawrocki.—(*R. Hessel, Berlin.*)
1184. Rice, G. P. Witt, London.
1185. Clarifying Syrup, S. Pitt.—(*G. A. Drummond, Montreal, U.S.*)
1186. Boots, &c., W. E. Gedge.—(*L. Dourdet, France.*)
1187. Slide Valves, W. Jones, Manchester.
1188. Drying Grain, J. Walworth, Bradford.
1189. Purifying Coal Gas, W. Watson, jun., Addingham, near Leeds.
1190. Scraping Cane, W. R. Lake.—(*F. Raymond, U.S.*)
1191. Dynamo Machines. T. J. Handford.—(*T. A. Edison, Menlo Park, U.S.*)
1192. Folding, &c., W. R. Lake.—(*E. J. Toof, U.S.*)
1193. Breaking Stone, W. R. Lake.—(*T. Blake, U.S.*)
1194. Ruffling, &c., W. R. Lake.—(*E. J. Toof, U.S.*)
1195. Electric Circuits, W. P. Thompson.—(*M. H. Kerner, New York, U.S.*)
1196. Car Couplings, J. Carmalt.—(*M. Thurber, U.S.*)
1197. Decorticating Rice, A. M. Clark.—(*G. D. Dennis, jun., Nantes, France.*)
1198. Fountain Pens, W. E. Kay, Farnworth.

13th March, 1882.

1199. Electric Lamp, R. Kennedy, Glasgow.
1200. Mincing Machines, F. Des Vœux.—(*R. Huebner, Berlin.*)
1201. Dynamo-electric Machines, R. Matthews, Hyde.
1202. Boilers, H. J. Haddan.—(*W. F. Harris and G. Farr, U.S.*)
1203. Hats, H. J. Haddan.—(*E. Manginot, France.*)
1204. Saving Life at Sea, H. J. Haddan.—(*P. Malherbe, France.*)
1205. Feeding Boilers, C. W. Wardle, Leeds.
1206. Strainers, R. Laurie, Darley Paper Mills.
1207. Giving Alarm, C. B. Wood, Liverpool.
1208. Saccharine Compounds, H. H. Lake.—(*E. Wilhelm, U.S.*)
1209. Small-arms, W. M. Scott, Birmingham.
1210. Knife-cleaning, R. Bishop & W. Down, London.
1211. Electric Currents, H. E. Newton.—(*A. I. Gravier, Paris.*)
1212. Gas, A. W. L. Reddie.—(*E. Bouilliez, Paris.*)
1213. Fire-grates, R. Wright, Richmond.
1214. Furnaces, H. H. Lake.—(*C. Olson, U.S.*)
1215. Looms, J. Leeming, F. Leeming, and R. Wilkinson, Bradford.

Inventions Protected for Six Months on Deposit of Complete Specifications.

1064. Sowing, &c., Manure, H. A. Bonneville, Cannon-street, London.—A communication from L. A. Couteau, Léonville, France.—*6th March*, 1882.
1108. Safety Pins, W. R. Lake, Southampton-buildings, London.—A communication from J. Jenkins, New Jersey, U.S.—*7th March*, 1882.

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

900. Skiving Boot Uppers, W. Douglas, Bristol.—*7th March*, 1879.
999. Malting, H. Simon, St. Peter's-square, Manchester.—*13th March*, 1879.
1030. Railway Wheels, W. Stroudley, Brighton.—*15th March*, 1879.
1211. Speed Indicator, W. Stroudley, Brighton.—*27th March*, 1879.
1536. Piston Rod Packing, A. M. Clark, London.—*18th April*, 1879.
906. Spinning Cotton, W. Turner, Bradford.—*7th March*, 1879.
1180. Button Fastenings, H. J. Haddan, London.—*25th March*, 1879.
975. Button-hole Machines, F. Simmons, London.—*12th March*, 1879.
1103. Capsules, C. Cheswright, London.—*19th March*, 1879.
1126. Capsules, R. T. Dossett, London.—*20th March*, 1879.
1424. Wire Ropes, W. H. Harfield, London.—*9th April*, 1879.
944. Textile Materials, W. R. Lake, London.—*10th March*, 1879.
989. Gas, J. Cort, Lower Bland-street, London.—*13th March*, 1879.
1004. Printing Machinery, J. Cope, London.—*13th March*, 1879.
1015. Galvanic Batteries, T. J. Howell, London.—*14th March*, 1879.
964. Hydraulic Apparatus, C. Pieper, Berlin.—*11th March*, 1879.
980. Working Brakes, R. D. Sanders, Birmingham.—*12th March*, 1879.
984. Cast Iron Ware, E. C. Quinby and E. Baldwin, Stourport.—*12th March*, 1879.
995. Lubricators, E. Meanock, Mossley.—*13th March*, 1879.
1011. Stoves, S. C. Davidson, Belfast.—*14th March*, 1879.
1248. Regulating Speed of Engines, B. Hunt, London.—*28th March*, 1879.

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

842. Metal Dies, W. R. Lake, London.—*6th March*, 1875.
854. Cranked Shafts, E. Clarke, Lincoln.—*8th March*, 1875.
1082. Spinning, T. J. Smith, Fleet-street, London.—*24th March*, 1875.
1294. Colouring Pile Fabrics, J. Worrall, Manchester.—*9th April*, 1875.
862. Valves, W. Mann and S. Owens, London.—*9th March*, 1875.
1024. Steam Cultivating Machinery, J. Howard and E. T. Bousfield, Bedford.—*19th March*, 1875.
909. Capstans, W. H. Harfield, London.—*11th March*, 1875.
910. Hoisting, W. H. Harfield, London.—*11th March*, 1875.
911. Capstans, W. H. Harfield, London.—*11th March*, 1875.
924. Shunting, E. T. Hughes, London.—*12th March*, 1875.
1017. Cabin Fittings, E. P. Alexander, London.—*19th March*, 1875.
935. Tin Plate, J. Richards and D. Williams, Pontypool, and T. W. Matthews and T. P. Leather, Salford.—*13th March*, 1875.
941. Reducing Flocks, &c., B. Rhodes, T. B. Rhodes, and J. R. Stoney, Armley.—*13th March*, 1875.

Notices of Intention to Proceed with Applications.

Last day for filing opposition 31st March, 1882.

4782. Machinery for Sewing Sails, E. H. Smith, New York, U.S.—*1st November*, 1881.
4834. Attaching Horses to Vehicles, H. Dickinson, Huddersfield.—*4th November*, 1881.
4835. Spring Safety Hooks, J. Carter, Salford.—*4th November*, 1881.
4837. Extinguishing Fire, W. E. Fitzmaurice, Tipperary.—*4th November*, 1881.
4841. Pianoforte Actions, G. H. Brockbank, London.—*4th November*, 1881.
4844. Cleansing Fibrous Substances, T. H. Cobley, Dunstable, and G. Tidcombe, jun., Watford.—*4th November*, 1881.
4851. Electromotive Engine, D. T. Piot, London.—*5th November*, 1881.
4858. Fire-bars, F. Erskine, Manchester.—*7th November*, 1881.
4864. Steam Generators, C. D. Abel, London.—A communication from H. Schulte.—*7th November*, 1881.
4865. Forks of Bicycles, S. Armstrong, Birmingham.—*7th November*, 1881.
4869. Packing for Steam Joints, J. R. Williams and H. Dansey, London.—*7th November*, 1881.
4873. Small Fire-arms, E. James, Birmingham.—*7th November*, 1881.
4877. Pickling Steel, T. H. Cobley, Dunstable, and C. Monkton, Harefield.—*8th November*, 1881.
4884. Transmitting Motion, D. Young, London.—A com. from E. Brosser.—*8th November*, 1881.
4902. Bridges, Aqueducts, &c., J. F. Smith, Leicester.—*9th November*, 1881.

4903. BOOTS and SHOES, H. Dickson, Leicester.—*9th November*, 1881.
4905. TRANSMISSION of SOUNDS, W. C. Barney, London. —*9th November*, 1881.
4919. NECKTIES, C. B. Ketley, Smethwick.—*9th November*, 1881.
4921. RAISING WATER, W. Tasker, Andover.—*9th November*, 1881.
4931. FLANGING EDGES of BOILERS, J. Lyall, Govan.—*10th November*, 1881.
4937. SPRING HINGES, F. R. Baker, Birmingham.—*10th November*, 1881.
4952. PACKING CASES for BOTTLES, G. Robson, Liverpool.—*12th November*, 1881.
5008. CORRUGATED TUBES, S. Fox, Leeds.—*15th November*, 1881.
5009. MOULDING STEEL, S. Fox and J. Whitley, Leeds. —*15th November*, 1881.
5025. ELEVATORS and HOISTS, H. Garland, Liverpool. —*16th November*, 1881.
5169. REGULATING SPEED of ENGINES, W. W. Girdwood, London.—*26th November*, 1881.
5184. KNOBS, E. W. Buller, Birmingham.—*28th November*, 1881.
5203. PRINTING FABRICS, J. Kerr and J. Haworth, Church.—*29th November*, 1881.
5357. GRINDING CORN, W. L. Wise, London.—A communication from A. and A. Mariotte and E. Boffy.— —*7th December*, 1881.
5398. TUBES of MEDICAL SYRINGES, T. and W. J. Nicholls, London.—*9th December*, 1881.
5586. COLOURING MATTERS, F. Wirth, Germany.—A com from E. Oehler.—*21st December*, 1881.
5654. RIFLING GUN BARRELS, P. Mauser, Germany.—*25th December*, 1881.
35. TWO-WHEEL CARRIAGES, J. Marston, Birmingham. —*3rd January*, 1882.
120. STORING ELECTRICAL ENERGY, J. Liardet, Brockley, & T. Donnithorne, London.—*9th January*, 1882.
433. CYANOGEN COMPOUNDS, L. Mond, Northwick.—*28th January*, 1882.
476. CIRCULAR SLIDE VALVES, W. C. Church, Brixton. —*31st January*, 1882.
478. DISINTEGRATING JUTE, H. J. Haddan, London.—A communication from A. Angell and W. Cunningham.—*31st January*, 1882.
485. TAPS for BEER BARRELS, W. Rose, Halesowen.—*31st January*, 1882.
563. ARC ELECTRIC LAMPS, A. J. Jarman, London.—*6th February*, 1882.
611. ORNAMENTAL CAPSULES, E. Belmer, London.—*8th February*, 1882.
648. MUSICAL INSTRUMENTS USING PIPES, H. Haddan, London.—Com. from W. Abbot.—*10th February*, 1882.
670. SHIRTS, C. Tighe, London—*11th February*, 1882.
697. HORSESHOES, G. Collier, Newcastle-upon-Tyne, and W. Armes, Norwich.—*13th February*, 1882.
736. PROPELLING TORPEDOES, J. Johnson, London.—A communication from W., A., M., and W. Johnston, New York, U.S.—*15th February*, 1882.
738. PROTECTING BOTTLES, J. Ferguson, Ashton Keynes. —*15th February*, 1882.
785. TREATING TEXTILE FABRICS, J. C. Hutcheson and J. J. Dobbie, Glasgow.—*18th February*, 1882.
815. RIVETTING APPARATUS, F. J. Rowan, Glasgow.—*20th February*, 1882.
839. RATCHET BRACES, S. Gardner, Adderbury.—*21st February*, 1882.
902. ASBESTOS FABRICS, H. J. Haddan, London.—A com. from T. Trivier.—*24th February*, 1882.
1013. LEAD TRAPS, A. M. Clark, London.—A com. from E. Blatchford and C. Gates.—*2nd March*, 1882.
1064. MACHINE for SOWING, H. Bonneville, London.—Com. from L. A. Couteau.—*6th March*, 1882.

Last day for filing opposition, 4th April, 1882.

4874. MOULDING PLOUGHS, F. Wolff, Denmark.—A com. from J. Jensen.—*8th November*, 1881.
4887. AERIAL NAVIGATION, E. Edwards, London.—A com. from J. de Souza.—*8th November*, 1881.
4888. SULPHURIC ACID, T. Richters, Breslau.—*8th November*, 1881.
4894. KNITTING MACHINES, W. Harrison, Manchester. —*8th November*, 1881.
4900. EXCAVATING, J. W. H. James, London.—*9th November*, 1881.
4907. GENERATION of WATER GAS, P. Jensen, London. —A communication from European Water-gas Company.—*9th November*, 1881.
4917. BICYCLES, &c., L. E. Broadbent, London.—*9th November*, 1881.
4924. IMPRESSIONS for PRINTING, J. A. Márquez, South America.—*10th November*, 1881.
4932. GOVERNING TRAMWAY ENGINES, T. Hunt, Fairfield.—*10th November*, 1881.
4934. TUNE-PLAYING TOPS, M. A. Weir, London.—*10th November*, 1881.
4944. MIXTURE YARNS, W. Blackburn, Cleckheaton.—*11th November*, 1881.
4945. HAND-RAKES, W. R. Lake, London.—A communication from O. Bergstorm.—*11th November*, 1881.
4950. COLLAPSIBLE BASKET, H. S. Bale, London.—*11th November*, 1881.
4951. WASHING MACHINES, A. Fortune, Keighley.—*12th November*, 1881.
4956. VELOCIPEDES, R. H. Lea and G. Singer, Coventry. —*12th November*, 1881.
4960. CLEANING CARPETS, C. D. Abel, London.—A communication from J. Zacherl.—*12th November*, 1881.
4963. BAKERS' OVENS, J. L. Hancock, London.—*12th November*, 1881.
4967. CAMERA OBSCURA, A. Pumphrey, Birmingham.—*12th November*, 1881.
4970. PHOTOGRAPHIC CAMERAS, A. M. Clark, London. —A com. from E. Engelbert.—*12th November*, 1881.
4971. GAS-STOVES, C. W. Torr, Birmingham.—*12th November*, 1881.
4972. METALLIC FASTENERS, W. F. Lotz, London.—A communication from G. McGill.—*14th November*, 1881.
5000. MERCURIAL AIR PUMPS, C. H. Stearn, Newcastle-on-Tyne.—*15th November*, 1881.
5010. PNEUMATIC MACHINERY, B. W. Hart, London.—*15th November*, 1881.
5163. TWO-WHEEL CARRIAGES, J. M. Stuart, London. —*26th November*, 1881.
5286. ELECTRIC LIGHT, A. R. Sennett, Worthing.—*3rd December*, 1881.
5317. TUNNELLING, T. English, Hawley.—*5th December*, 1881.
5348. DISTILLING GLYCERINE, W. Clark, London.—A com. from F. Armandy.—*7th December*, 1881.
5366. SEPARATING NICKEL from ORES, W. Galbraith, Sheffield.—*8th December*, 1881.
5566. ELECTRICAL CURRENTS, A. Millar, Glasgow.—*20th December*, 1881.
5593. DYNAMO-ELECTRIC MACHINES, L. S. Powell, London.—A communication from J. Gerard-Lescuyer.—*21st December*, 1881.
5624. NAILS, J. W. Summers, Stalybridge.—*23rd December*, 1881.
5660. ELECTRIC LAMPS, L. S. Powell, London.—A communication from J. Gérard.—*24th December*, 1881.
5734. BINDING SHEETS of PAPER, W. F. Lotz, London. —Com. from G. McGill.—*31st December*, 1881.
121. STOVES, A. C. Engert, Bromley-by-Bow.—*9th January*, 1882.
122. SHEARS for SHEARING SHEEP, W. Smith, Sheffield. —*10th January*, 1882.
324. KITCHEN RANGES, H. M. Ashley, Knottingley.—*23rd January*, 1882.
359. ELECTRIC LAMPS, J. N. Aronson, London.—*24th January*, 1882.
364. TABLETS, W. Carter, Buckhurst Hill.—*24th January*, 1882.
397. GAS ENGINES, C. Emmett, Leeds.—*26th January*, 1882.
413. PROTECTING ROOFS, B. L. Thomson, London.—*27th January*, 1882.
440. ABSTRACTING AMMONIA, G. Neilson, Summerlee. —*28th January*, 1882.
624. DRAW-BAR APPARATUS, S. J. Humble and J. Walker, Derby.—*9th February*, 1882.
661. TELEPHONIC EXCHANGE, H. H. Eldred, London.—A com. from T. Doolittle.—*11th February*, 1882.
676. SUGAR, C. Scheibler, Berlin.—*10th February*, 1882.
730. MEASURING ELECTRICAL CURRENT, C. A. Faure, London.—*15th February*, 1882.
749. TELEPHONIC EXCHANGE, G. L. Anders, London.— —*16th February*, 1882.
795. WHITE PIGMENT, H. Knight, Liverpool.—*18th February*, 1882.
818. REAPING MACHINES, W. P. Thompson, London.—A communication from F. Cochrane and J. Mothershead.—*20th February*, 1882.
873. SELF-COCKING FIRE-ARMS, J. Dickson and A. G. Murray, Edinburgh.—*23rd February*, 1882.
911. BRICKS, J. Parker, Kilmarnock.—*25th February*, 1882.
917. REFLECTORS, H. J. Haddan, London.—A communication from W. Wheeler.—*27th February*, 1882.
945. SADDLE BARS, J. L. Reed, Watford.—*27th February*, 1882.
1025. LOCK-NUTS, W. R. Lake, London.—A communication from W. H. Paige.—*3rd March*, 1882.

Patents Sealed.

(*List of Patent Letters which passed the Great Seal on the 10th March*, 1882.)

932. LOOMS for WEAVING, T. Hanson, Bradford.—*4th March*, 1881.
3746. CONSUMING COAL, E. Kaulbach, London.—*27th August*, 1881.
3833. VALVES, A. E. Lucas, London.—*3rd September*, 1881.
3870. TOILET CABINET, E. R. Johnson, London.—*6th September*, 1881.
3938. FRAMES for WASHING-MACHINES, A. Shaw, Lockwood.—*12th September*, 1881.
3939. WORM GEARING, A. Shaw, Lockwood.—*12th September*, 1881.
3950. PREPARING HEELS for BOOTS, W. Morgan-Brown, London.—*13th September*, 1881.
3957. GAS REGULATOR, W. T. Sugg, London.—*13th September*, 1881.
3958. REFINING STARCH SUGAR, P. Jensen, London.—*13th September*, 1881.
3959. REFINING STARCH SUGAR, P. Jensen, London.— —*13th September*, 1881.
3961. DESTROYING NOXIOUS GASES, R. H. Reeves, Parkhurst.—*14th September*, 1881.
3965. LAMP BURNERS, J. S. Fairfax, London.—*14th September*, 1881.
3967. LAMPS for CARRIAGES, J. G. Ellis, London.—*14th September*, 1881.
3972. STOVES, S. C. Davidson, Belfast.—*14th September*, 1881.
3976. ELECTRIC ARC LAMPS, P. Jensen, London.—*14th September*, 1881.
3978. CHURN, W. Rainbow, Luton.—*15th September*, 1881.
3980. PARLOUR RACE-COURSE, J. Maxfield, London.— —*15th September*, 1881.
3981. ABDOMINAL BELT, H. Willington, London.—*15th September*, 1881.
4003. IRON and STEEL WHEELS, W. Somers, Halesown. —*16th September*, 1881.
4006. SAWING MACHINERY, F. Myers, London.—*16th September*, 1881.
4012. PULLEY BLOCKS, T. H. Ward and E. Howl, Tipton.—*17th September*, 1881.
4049. SECURING PICKS, T. Trussell, Nottingham.—*20th September*, 1881.
4053. REVOLVING HEELS for BOOTS, W. Brown and W. Peover, London.—*20th September*, 1881.
4055. COMBINATION FURNITURE, F. and W. Parker, London.—*20th September*, 1881.
4063. HAIR-PINS, A. M. Clark, Chancery-lane, London. —*21st September*, 1881.
4085. MOULDING CLAY, C. H. Murray, Southwark.—*22nd September*, 1881.
4088. TREATMENT of SEWAGE, H. E. Newton, London. —*22nd September*, 1881.
4095. CHROMATIC PRINTING, H. H. Lake, London.—*22nd September*, 1881.
4112. PRINTING COLOURS on FIBRES, J. W. Stringer, Bradford.—*23rd September*, 1881.
4124. OPERATING SIGNALS, H. J. Haddan, Kensington. —*24th September*, 1881.
4127. FIRE-ALARM WIRE, B. J. B. Mills, London.—*24th September*, 1881.
4128. DISTRIBUTING TRANSMISSION of ELECTRICAL POWER, J. Imray, London.—*24th September*, 1881.
4203. VESSEL for HEATING LIQUIDS, J. T. Goudie, Glasgow.—*29th September*, 1881.
4219. SECURING KNOBS to SPINDLES, J. Hill, London. —*30th September*, 1881.
4246. PURIFYING HOPS, A. Walker, Edinburgh.—*1st October*, 1881.
4297. ASPHALTE APPARATUS, B. D. Healey, Brighouse. —*4th October*, 1881.
4427. PIPE JOINTS, E. G. Mawbey, Market Harborough. —*11th October*, 1881.
4431. TABLES for SEWING, H. E. Newton, London.—*11th October*, 1881.
4524. COLLECTING DUST, F. W. Borland, Flixecourt.—*17th October*, 1881.
4547. WATER-TIGHT DOORS, E. Crompton and J. T. Cochran.—*18th October*, 1881.
4590. CHIMNEY FLUES, F. Wirth, Germany.—*20th October*, 1881.
4598. WATER-CLOSETS, G. Pitt, Sutton.—*20th October*, 1881.
4634. FIRE-PROOFING, A. M. Clark, London.—*22nd October*, 1881.
4696. JOINTS of PIPES, J. A. Eaton, London.—*27th October*, 1881.
5029. PRODUCTION of FELTS, W. L. Wise, London.—*16th November*, 1881.
5050. AUTOMATICALLY RECEIVING SIGNALS, F. Francis and C. Donovan, London.—*8th November*, 1881.
5310. PURIFYING ALKALINE SOLUTIONS, E. Carey, H. Gaskell, and F. Hurter, Widnes.—*5th December*, 1881.
5427. COLOURING MATTERS, J. A. Dixon, Glasgow.—*12th December*, 1881.
5498. SPRING-PACKING for PISTONS, W. Lockwood, Sheffield.—*15th December*, 1881.
5530. STERN-POSTS of STEAM VESSELS, E. Hayes, Stony Stratford.—*17th December*, 1881.
5532. SOLVENTS, D. O. Francke, Sweden.—*17th December*, 1881.
5556. TRAMWAYS, R. S. Cunningham, C. A. F. Vinkeles-Houssart, & W. May, London.—*19th December*, 1881.
5575. TRAMWAY LOCOMOTIVES, J. and J. Quick, London.—*20th December*, 1881.
5577. ELECTRIC TELEGRAPHS, J. Anderson and B. Smith, London.—*20th December*, 1881.
5689. ATTACHING PAPER in MUSICAL INSTRUMENTS, W. R. Lake, London.—*27th December*, 1881.
223. PUMPING LIQUIDS, A. M. Clark, London.—*16th January*, 1882.
266. ATTRITION MILL, S. Pitt, Sutton.—*19th January*, 1882.
270. RIVETS, H. J. Haddan, London.—*19th January*, 1882.

(*List of Letters Patent which passed the Great Seal on the 14th March*, 1882.)

3543. STEAM ENGINES, E. A. Brydges, Upton.—*16th August*, 1881.
3979. COVERINGS for TRAM-CARS, E. H. Grey, London. —*15th September*, 1881.
3999. MEAT EXTRACT, L. A. Groth, London.—*16th September*, 1881.
4007. CARRYING LIQUIDS, G. White, Wilden.—*17th September*, 1881.
4008. ROCK-BORING, M. Macdermott and W. Glover, London.—*17th September*, 1881.
4014. MOUNTING COTTON, H. Greg, Bolton.—*17th September*, 1881.
4017. ELECTRIC LAMPS, S. Hallett, London.—*17th September*, 1881.
4028. WATCH CASES, F. Wirth, Germany.—*19th September*, 1881.
4045. ROWING BOATS, J. H. Clasper, Oxford.—*20th September*, 1881.
4056. WET SPINNING FRAMES, J. Erskine, Strabane.—*20th September*, 1881.
4058. ELECTRICAL CABLES, H. H. Lake, London.—*20th September*, 1881.
4081. SAFETY VALVES, J. Challender, Manchester.—*22nd September*, 1881.
4113. TUNNELLING, J. D. Brunton, London.—*23rd September*, 1881.
4137. OBTAINING MOTIVE POWER, R. Watson, Glasgow. —*26th September*, 1881.
4146. ARTIFICIAL BAIT, G. Burt, Birmingham.—*26th September*, 1881.
4164. CHRONOGRAPHS, W. H. Douglas, Stourbridge.—*27th September*, 1881.
4189. STEAM WINCHES, E. Latham, Birkenhead.—*29th September*, 1881.
4279. PRINTING MACHINES, H. Jullien, Belgium.—*3rd October*, 1881.
4471. TROWELS, T. Tyzack, Sheffield.—*13th October*, 1881.
4646. BOTTLES for LIQUIDS, C. M. Warner, London.—*24th October*, 1881.
4695. UTILISING ELECTRIC CIRCUITS, W. F. Barrett, Monkstown.—*27th October*, 1881.
5102. LEAD-HOLDERS, J. H. Johnson, London.—*22nd November*, 1881.
5513. COILED WIRE, J. Hodson, St. Helens.—*16th December*, 1881.
5564. REVOLVING FIRE-ARMS, W. Stringfellow, Mistley. —*20th December*, 1881.
5721. HYDRAULIC LIFTS, J. S. Stevens and C. G. Major, Battersea.—*30th December*, 1881.
5725. LINOLEUM, M. B. Nairn, Kirkcaldy.—*30th December*, 1881.
53. MINING COAL, W. P. Thompson, London.—*5th January*, 1882.
61. STEAM PRESSURE ENGINES, J. James and W. Wardrop, London.—*5th January*, 1882.

List of Specifications published during the week ending March 11th, 1882.

1412,* 4d.; 3039, 6d.; 3111, 2d.; 3152, 4d.; 3167, 6d.; 3178, 8d.; 3181, 10d.; 3186, 6d.; 3209, 6d.; 3217, 6d.; 3218, 10d.; 3221, 8d.; 3238, 6d.; 3246, 6d.; 3247, 6d.; 3254, 6d.; 3255, 6d.; 3261, 6d.; 3264, 6d.; 3268, 6d.; 3274, 10d.; 3282, 4d.; 3294, 8d.; 3299, 6d.; 3302, 6d.; 3309, 1s. 6d.; 3313, 6d.; 3318, 6d.; 3324, 6d.; 3334, 6d.; 3340, 6d.; 3375, 6d.; 3380, 6d.; 3383, 6d.; 3397, 4d.; 3409, 6d.; 3411, 2d.; 3412, 2d.; 3414, 2d.; 3415, 2d.; 3417, 2d.; 3419, 2d.; 3420, 2d.; 3429, 2d.; 3433, 2d.; 3435, 2d.; 3437, 2d.; 3440, 2d.; 3442, 4d.; 3443, 4d.; 3449, 2d.; 3450, 2d.; 3455, 2d.; 3456, 2d.; 3458, 2d.; 3459, 2d.; 3466, 4d.; 3467, 2d.; 3470, 2d.; 3471, 2d.; 3479, 2d.; 3482, 2d.; 3484, 2d.; 3489, 2d.; 3492, 2d.; 3494, 2d.; 3498, 2d.; 3499, 2d.; 3500, 2d.; 3501, 2d.; 3504, 4d.; 3505, 2d.; 3506, 2d.; 3510, 2d.; 3311, 2d.; 3560, 4d.; 4544, 6d.; 4556, 6d.; 4563, 6d.; 4671, 2d.; 4726, 4d.; 4733, 6d.; 4946, 6d.; 5137, 10d.; 5166, 4d.; 5265, 4d.; 5602, 4d.

*** 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.

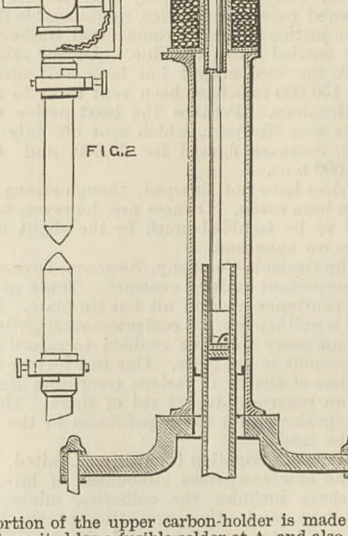
Prepared by ourselves expressly for THE ENGINEER *at the office of Her Majesty's Commissioners of Patents.*

3039. MECHANICALLY PLAYING PIANOS, ORGANS, &c., *H. E. Newton, London.—11th July*, 1881.—(*A communication from C. Gavioli, Paris.*) 6*d.*

A strip of perforated material is made to travel under the ends of levers pivotted to a fixed rail and caused to bear on the perforated strip by springs, so as to be forced down into the perforations. The other ends of the levers bear against rods pendent from balanced valves in a wind chest above and supplied with compressed air from bellows. When the valves are raised they allow the compressed air to pass from the wind chest into a series of channels which conduct it to pneumatic levers, by which the keys of the instrument are actuated.

3049. IMPROVEMENTS IN ELECTRIC LAMPS, *F. W. Haddan, London.*—(*A communication from L. G. Woolley, Mendon, Mich., U.S.*)—*12th July*, 1881. 6*d.*

In this lamp the regulation of the carbons is effected by the helix and rod attached to the upper carbon-holder shown in section in Fig. 1. The parts are made to work in glycerine to insure steadiness. According as the core is attracted down or up, so the upper carbon is moved. When it is attracted in an upward direction, the elevator catches hold of the inside of the carbon-holder and raises it vertically upward, preventing its binding upon its guides. The



lower portion of the upper carbon-holder is made in two parts united by a fusible solder at A, and also by an insulated chain, Fig. 2. Should the holder become heated from any cause, the solder will melt, and the upper carbon drop on one side, thus breaking the circuit, the portion broken away being held by the insulated chain.

3111. EXHIBITION OF GOODS, &c., *J. M. and J. A. Elstob, London.—16th July*, 1881.—(*Not proceeded with.*) 2*d.*

This consists of an endless band to be wound from one roller on to another, and from which the goods are suspended, mirrors being arranged so as to multiply the reflection of same.

3152. STORING AND SUPPLYING HEAT, *F. W. Webb, J. Reddrop, and M. H. Foye, Crewe.—20th July*, 1881. 4*d.*

This relates to improvements on patent No. 4180, A.D. 1879, in which the latent heat of the fusion of crystallised acetate of soda is used for heating purposes, and it consists in placing acetate of soda and water in foot-warmers made of metallic cases, and suitable means are provided to agitate the materials so as to prevent the formation during the cooling of the liquefied acetate of soda into a pasty condition.

3167. PERFORATING CHEQUES, &c., *R. Donkin, London.—20th July*, 1881. 6*d.*

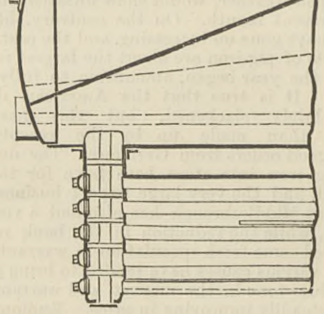
A series of perforating rods are arranged together in a block, each moving independently, but all kept elevated by a plate and spring, and a set of punches are so combined with the perforating rods as to form the device required to be made through the cheque.

3178. LOOMS, *T. Taylor, Derby.—21st July*, 1881. 8*d.*

This relates to the method of and apparatus for securing the rubber threads in woven elastic fabrics, and also to self-acting motions for letting off the warps in looms, and it consists in the employment of perforated plates, so that the rubber threads pass through the perforations, and these plates produce a motion worked by tappets or cams at given intervals, by which the rubber threads pass over one another and allow at intervals another thread of rubber, cotton, or other material to pass through them. The lock thread warp, when not of rubber, is worked with an improved letting-off motion, the warps being fixed in a cratch. Under the warps are two rods attached to a cratch parallel with the warp beam. The warp is strung under the bottom rod and over the topcastle, round a pulley stock, and back again over the topcastle. It is then conveyed forward through the back slay harness and front slay to the cloth. A tension weight is hung on the pulley stock. A strap has one end attached to the top rod in the cratch and the other to a counterweight, and the strap is lapped over the warp beam, the counterweight and tension weight being connected by a string.

3181. WATER TUBE BOILERS, *F. C. Glaser, Berlin.—21st July*, 1881.—(*A communication from H. Heine, Berlin.*) 10*d.*

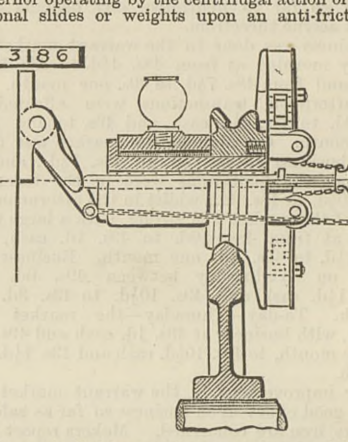
This relates, First, to the construction of the end chambers or water chambers for water tube boilers as regards the distribution of the water tubes and of the stays securing the outside plate of the chamber against the tube sheet of the same, this distribution of the water tubes and the stays being such that each water tube, or the hand-hole giving access to this tube,



is held only by two stays or fixed points; Secondly, to an inclined plate in the upper part of water tube boilers, which is placed over the outlet of the front chamber. Other improvements are described.

3186. SPEED GOVERNORS, *M. Havelock, Newcastle-upon-Tyne.—21st July*, 1881. 6*d.*

This consists in the construction and application of a governor operating by the centrifugal action of anti-frictional slides or weights upon an anti-frictional



spindle, controlled by a spring or springs, and keyed to a shaft revolving either in a fixed or movable bearing.

3208. PREPARING COTTON, &c., FOR SPINNING, *J. Higgins and T. S. Whitworth, Salford.—22nd July*, 1881. 6*d.*

This relates, First, to an arrangement for imparting a rising and falling motion to the copping rails of slubbing and roving frames, whereby the usual racks and pinions are dispensed with; Secondly, to arrangements for dispensing with the weights used for counterbalancing the copping rails, by forming the rail in two parts which counterbalance each other, one ascending while the other is descending; Thirdly, to the mode of imparting motion to the bobbin-shaft of slubbing and roving frames, having the copping rail made in two parts as described: Fourthly, to the method of mounting the bevel wheels upon the spindles of slubbing and roving frames; Fifthly, to making the tube for supporting the spindles and the footstep on which the spindles rest in one piece; and Fifthly, to the method of guiding and supporting such tubes when made in one piece with the footsteps.

3217. CATCHES OR FASTENINGS FOR BRACELETS, &c., *E. P. Wells, London.—23rd July*, 1881. 6*d.*

A round headed T-shaped stud is fixed to one end of the bracelet, and in the other are pivotted two levers with hooks at one end to engage the stud, and pins at the other end to press the levers inwards. A spring between the levers tends to keep the hooks engaged with the stud.

3218. REGISTERING AUTOMATICALLY THE TRAVEL OF A LOCOMOTIVE, &c., IN MOTION, AS WELL AS ITS PERIOD OF REST, *R. H. Brandon, Paris.—23rd July*, 1881.—(*A communication from L. Pouget, Montpellier, France.*) 10*d.*

A sheet of paper divided longitudinally and vertically by parallel lines is rolled on a cylinder, to which rotary motion is imparted by a clockwork mechanism, while at the same time it is caused to traverse in the direction of its axis by means of a screw. A series of punches operated by a wheel running in contact with the line of rails causes a series of marks to be registered on the sheet of paper.

3221. SCOURING, DYEING, AND WASHING PILE FABRICS, *J. Worrall, Salford, and J. Kershaw, Halifax.—23rd July*, 1881. 8*d.*

A machine suitable for operating upon light pile fabrics consists of a tank at the base carrying the framework, supporting a series of, say, four rotary beaters mounted one over the other, with a shallow segment-shaped vessel below each, into which the beater dips. Two inclined side plates are continued from each vessel, so as to form a continuation rising to the height of the beater, a space being left between the sides of the vessel and the lower edges of the plates for the passage of the cloth, which passes from one beater to the other over rollers. The scouring liquid is supplied to the top vessel and passes from one to the other, finally entering the tank at the bottom.

3238. ELECTRIC CONTACT FOR ELECTRIC CLOCKS, &c., *B. J. B. Mills, London.—25th July,* 1881.—(*A communication from G. Leclanché, Paris.*) 6*d.*

This invention relates to the use of mercury to obtain contact. The contacts are multiple and successive, and are produced in an hermetically closed space.

3455. ELECTRIC LIGHTING, *W. E. Hubble, London. —9th August,* 1881.—(*A communication from A. F. W. Partz, Philadelphia, U.S.*)—(*Not proceeded with.*) 2*d.*

The invention is designed to light large spaces by large arc lights and reflectors.

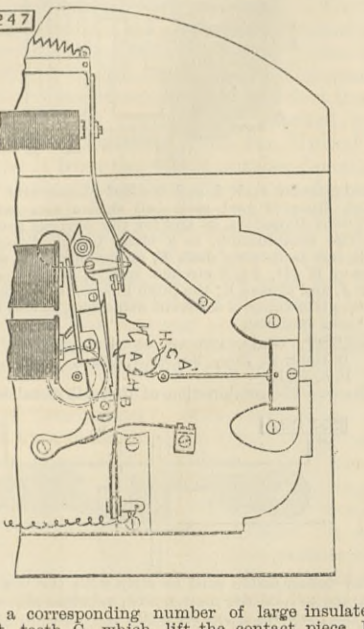
3246. PUMPS, *H. J. Haddan, Kensington.—25th July,* 1881.—(*A communication from L. Maneng, France.*) 6*d.*

This relates to valveless pumps, and consists of a cylinder with four ports and a piston with a circular spiral groove, a crank to turn the piston, and a screw and nut, which in combination with the groove give to the revolving piston a to-and-fro motion.

3247. SELF-ACTING ELECTRIC CLOCKS, *F. T. Reid, Exeter, and J. U. Valentine, Teignmouth.—25th July,* 1881. 6*d.*

A wheel A of ivory or other insulating material carries platinum points H H connected to a brass axis A^1, and revolving with the wheel of the clock train.

3247



A has a corresponding number of large insulated ratchet teeth G, which lift the contact piece B, causing the completion of an electric circuit, which partially winds up the clock and sets a relay to work, actuating the dials.

3255. WATERPROOF SLEEPING BED FOR BIVOUACKING, &c., *B. Genn, Ely.—26th July,* 1881. 6*d.*

The exterior of the bed is made of mackintosh or other light waterproof material, and is lined with flannel, the body of the sleeper being introduced within it. The head of the bed is made up of a light bamboo frame covered with waterproof material, so as to form a hood to keep off moisture from the head. The whole packs up into a small compass.

3261. MAKING THE GLAZING OF GLAZED STRUCTURES IMPERVIOUS TO DUST, AIR, AND WATER, *T. W. Helliwell, Brighouse, Yorkshire.—26th July,* 1881. 6*d.*

This consists in rendering glazed structures dust, air, and waterproof, and to provide for the removal of water caused by condensation, and consists in inserting between the overlapping edges of sheets of glass a bar, either solid or hollow, of glass, zinc, or other suitable material. In combination with such bar a piece of packing composed of india-rubber or other suitable material is employed, so that when between the glass it will expand laterally, and so fill up the space and effectually exclude air, dust, or water. The bottom laps of the glass will thus be apart, and so form a channel for the removal of water caused by condensation.

3264. BARREL-MAKING MACHINERY, *H. J. Haddan, Kensington.—26th July,* 1881.—(*A communication from W. Stewart, Guelph, Canada.*) 6*d.*

This consists of a cylindrical frame supported on a spindle by arms arranged to fold down to allow the cylinder to collapse, and the barrel formed to be withdrawn. An open frame in two halves, and curved to fit the barrel, is arranged to carry the spindle supporting the cylinder, and also the machinery for imparting a rotary movement to the cylinder, and to a series of endless belts arranged to feed the staves on to the cylinder. Special cutting knives and saws are also driven upon the frame, and arranged to cut off the ends of the staves, and form the recess for holding the heads within the barrel.

3268. BREECH-LOADING FIRE-ARMS, *H. A. Dufrené, Paris.—26th July,* 1881.—(*A communication from J. Sugan-Jame, Lugas, France.*) 6*d.*

This relates to improvements on fire-arms constructed on "Gras" system, and consists of a cylinder to receive a spiral spring, and formed with a swell guiding the movable breech during the working, pressing the spiral spring, and giving a fixed position to the apparatus during firing. A fixed extractor allows the empty cartridge case to be withdrawn after firing. A closing piece serves as the needle or striker, and carries the cocking and safety bents.

3282. CAOUTCHOUC SHOES, *S. Pitt, Sutton.—26th July,* 1881.—(*A communication from A. Hutchinson and Co., Paris.*) 4*d.*

The object is to produce a foot covering resembling a Chinaman's shoe in form, and it consists of an inner sole of india-rubber and fibre attached to the form, then a lining of knitted fabric is pasted on to the inner sole, and to this a felt sole is applied.

3294. AN ELECTRICAL MUSICAL INSTRUMENT, *W. F. Schmoële and A. Mols, Antwerp, Belgium.—27th July,* 1881. 8*d.*

This invention is a combination of pneumatic and electro-magnetic apparatus to be applied to a piano, so that the piano may either be played by the keyboard of the apparatus, or the latter may be played as a reed instrument alone, or the music of the piano may be combined with that of the reed instrument. The pneumatic portion of the apparatus provides the motive power, the electro-magnetic portion times and regulates its application. The passage of the current is regulated by a sheet of perforated paper which constitutes the music, and which is drawn forward by rollers at a regulated speed. A series of metallic fingers underlies a metal cylinder connected with a battery, and the perforated paper is made to pass between them. When a finger coincides with a perforation, contact takes place and the current flows to a series of electro-magnets, which instantly raise the pneumatic levers to operate a series of strikers, whereby the keys of the piano are actuated. Means for effecting a gradation of tone, for accentuating particular notes, &c., are also described. The specification is accompanied by detailed drawings of the apparatus.

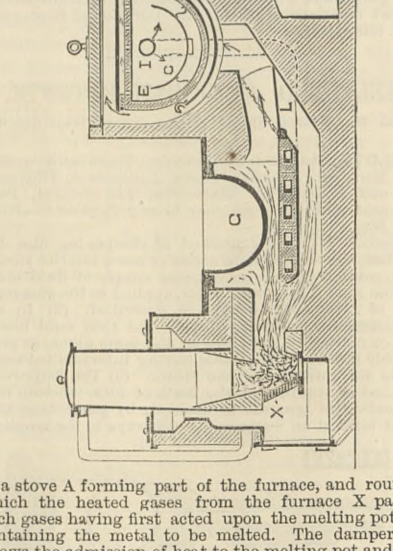
3299. FLOATING CRANES, *W. Hunter, London.—28th July,* 1881. 6*d.*

On a float or vessel of sufficient width of beam to form a steady base is mounted a turntable in a central position, and carrying the whole of the crane gear and shear legs set at the required inclination. The turntable also carries a counterpoise, which can be traversed by an engine provided for the purpose, and fitted with screw gearing for moving it to or from the centre of the turntable, so as to counterbalance the weight being raised, and to be shifted as the turntable revolves. Twin screws driven by engines serve to propel the vessel or float.

3302. FURNACES FOR STEREOTYPING, &c., *C. Pieper, Berlin.—28th July,* 1881.—(*A communication from A. Faber, Magdeburg, Germany.*) 6*d.*

This relates to furnaces for heating the metal and drying the matrices. The matrix is made of layers of paper pasted together by paste consisting of starch, glue, glycerine, or vaseline, ground chalk, and water, so as to render them flexible when dried. The matrix when formed in the usual way is removed from the types and placed with the impressed side down in a cradle of perforated sheet iron or wire gauze C, which is then introduced in the muffle or retort E, and placed

3302



in a stove A forming part of the furnace, and round which the heated gases from the furnace X pass, such gases having first acted upon the melting pot G containing the metal to be melted. The damper L allows the admission of heat to the melting pot and to the drying chamber to be regulated as required. An air current is made to traverse the retort E by pipe I, so as to carry off the vapours from the matrix, and thus facilitate the drying operation.

3309. LASTING THE UPPERS OF BOOTS OR SHOES, &c., *H. H. Lake, London.—28th July,* 1881.—(*A communication from G. W. Copeland, Malden, Mass.*) 1*s.* 6*d.*

This relates to an improved method of and apparatus for lasting the uppers of boots, and also mechanism for making tack-carrying strips, and it consists of apparatus for making "Copeland" tack strips; apparatus for driving tacks from such strips by hand in the process of lasting an upper, and for other purposes; apparatus for driving tacks from the tack-strips by power; and an improved method of lasting, consisting in fitting the upper to the last in any desirable way, and folding the edge upon the surface of the insole, and then in fastening the edge so folded by a gang or group of fastenings driven simultaneously or in rapid succession.

3313. FIRE-ARMS, *W. E. Gedge, London.—29th July* 1881.—(*A communication from M. Haufmann, Brussels.*) 6*d.*

This relates particularly to a locking device for fastening the barrel to the breech of a revolver. The top of the breech has a slot to receive the end of a bar forming a continuation of the rear end of the barrel, and through which a hole is formed, a spring bolt in the slot in the top of the breech engaging with such hole.

3318. FURNACES, *W. H. Poole, Bolton.—30th July,* 1881. 6*d.*

This relates to the furnace bars of steam boilers, and consists in arranging them preferably in two sets, supported by a back and front dead plate and a central bearer, each set consisting of a number of fixed and rocking bars placed alternately. Each bar consists of a long rib, having along the upper edges a number of projections or teeth on each side, the projections on the contiguous bars interlocking so as to leave an air space between them of a serrated or zig-zag form. The locking bars have arms connected to a lever, by means of which they can be moved to and fro when required.

3324. APPARATUS FOR CLEANSING THE INTERIOR SURFACES OF TAPER OR CONICAL TUBES IN STEAM BOILERS, *E. Lofts and H. J. Barker, Cherryhinton. —30th July,* 1881. 6*d.*

The apparatus consists of a hollow metal bar A with an inner bar B, which can slide freely up and down therein. To the bottom of the bar A is fitted and fixed a circular metal plate C. This plate is provided on its

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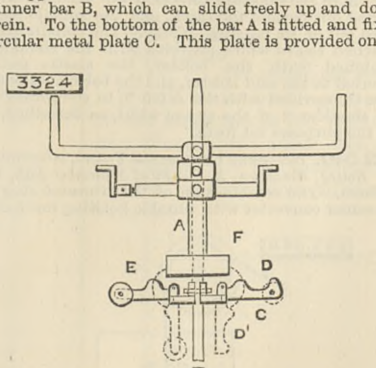


upper face with four or more pairs of metal bearings E projecting upwards. Within each of these pairs of bearings E is pivotted a projecting scraper D. The raised or projecting parts of the scrapers at D^1 are intended to press against and be pressed by an elastic disc F or by a spring.

3334. WIRE FENCING, &c., *W. J. Smith, Inverness.—2nd August,* 1881. 6*d.*

This relates, First, to the means of securing the horizontal wires to the vertical supports or droppers employed to support the wires between the standards, and consists in forming the droppers of metal rods of oval, angular, or other section, in combination with fasteners, such as single or double metal links, so that by passing the droppers through the loops of the fasteners on the wires and partially rotating the same, a wedging action will be produced and the wire securely held. The Second part relates to the standards, and consists in forming the base of a screw form to facilitate its introduction into the earth, the upright being secured to the base by wedges, and being capable of adjustment.

3340. FELTING HATS, &c., *H. A. Bonneville, Paris.—2nd August,* 1881.—(*A communication from W. A. Baglin and J. Gray, Brooklyn, U.S.*)—(*Complete.*) 6*d.*

This consists in a new method of felting hat bodies by placing said hat bodies into perforated elastic felting tubes, and exposing these tubes to a repeated squeezing and rolling action; also in an apparatus composed of a squeezing drum which revolves in a suitable case, a tank situated beneath such case, and communicating with it through openings in the top, and one or more felting tubes.

3375. TRAPS FOR WATER-CLOSETS, BATHS, &c., *C. Parker, Amberley.—4th August,* 1881. 6*d.*

This consists of two machines on one bed plate for casting lead traps in two pieces, having only one seam or joint, and which are soldered together, making a complete trap with a flange outside for fixing.

3380. IMPROVEMENTS IN APPARATUS FOR DETECTING AND RECORDING THE PASSAGE OR STOPPAGE OF AN ELECTRIC CURRENT THROUGH A CONDUCTOR, &c., *W. P. Thompson, Liverpool and London.—4th August,* 1881.—(*A communication from J. A. Pel, Liege, Belguim.*) 6*d.*

This consists of a registering clock applicable to telephone lines, &c. The action is as follows:—The clock is set going at the correct time, that is with the marker opposite the correct time on the dial. So long as the telephone remains unused the dial, which is constructed of paper, remains unmarked, but directly the circuit is made or broken, the armature of an electro-magnet actuates a steel spring armed with a sharp point, and causes it to mark the dial, showing the hour and day when the circuit was used. The dial circumference is divided into twelve sections of one hour each, and the pricker is caused to move from the centre to the circumference slightly at the end of each twelve hours, so that the record of each hour and day are kept separate.

3383. LAVATORIES, *J. Shanks, Barrhead, N.B.—4th August,* 1881. 6*d.*

The lavatory is intended to be fixed against a vertical wall, and is made with an upper cistern for clean water and a lower receptacle for used water. The basin is hinged at a level between the two water vessels, so that it can be turned up when not in use. A part of the basin extends beyond the axis and has two passages formed in it, the lower one serving to convey the used water to the lower vessel when the basin is turned up, and the upper one is for conveying clean water to the basin.

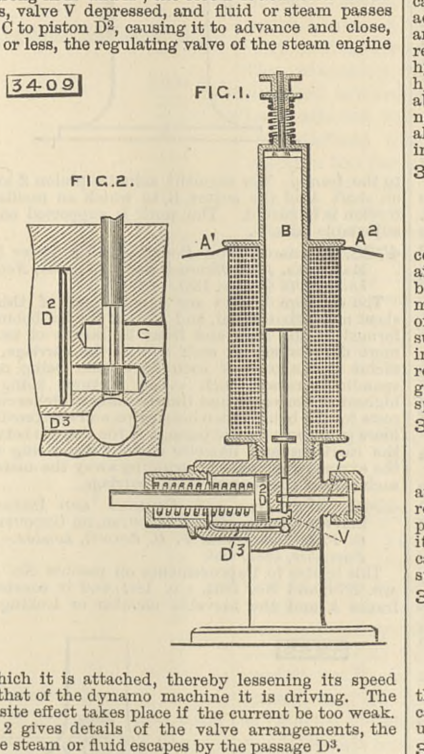
3397. MANUFACTURE OF KNITTED FABRICS FOR SCOTCH BONNETS, &c., *W. and T. Wild, Stewarton, N.B.—5th August,* 1881.—(*Not proceeded with.*) 4*d.*

According to one modification a single horizontal needle bar is used consisting of an iron plate with a brass plate fixed to its inner side, and formed with vertical grooves for the needles and their holders. The needles are placed vertically with their hook points and latches directed inwards, and their carriers are made to operate as usual when being depressed in succession as the knitting action takes place along the row of needles. The needles are raised by a horizontal raising bar acting on the carriers, and the needle bar has a vertical movement to allow the loops of yarn to get under the latches.

3409. AN IMPROVED METHOD AND APPARATUS FOR REGULATING THE DYNAMICAL PRODUCTION OF ELECTRICITY, *G. Westinghouse, jun., London.—6th August,* 1881. 6*d.*

The inventor uses the electricity itself to operate an electrical governor, as illustrated in the figure. A^1 and A^2 represent the circuits. Should the current be too strong in A^1 and A^2, the core B is attracted downwards, valve V depressed, and fluid or steam passes from C to piston D^2, causing it to advance and close, more or less, the regulating valve of the steam engine

3409



to which it is attached, thereby lessening its speed and that of the dynamo machine it is driving. The opposite effect takes place if the current be too weak. Fig. 2 gives details of the valve arrangements, the waste steam or fluid escapes by the passage D^3.

3411. ALIMENTARY MATERIAL FOR BEVFRAGES, *G. W. Kincaid, Chelsea.—6th August,* 1881.—(*Not proceeded with.*) 2*d.*

Malt prepared from barley or other cereal is crushed, ground and soaked in syrup, and then dried first by a gentle heat and then roasted and ground. The material produced, either alone or with other materials, may be subjected to infusion.

3412. AN IMPROVED FLUID TO BE USED IN GALVANIC BATTERIES, *T. Coad, London.—6th August,* 1881.—(*Not proceeded with.*) 2*d.*

The fluid used is a hot saturated solution of nitric acid, bichromate of potash, and nitrate of potash, to which is added one-fourth part sulphuric acid, and the solution allowed to cool.

3414. THROTTLE VALVES, *R. D. Napier, Glasgow.—6th August,* 1881.—(*Not proceeded with.*) 2*d.*

The object is to construct throttle valves capable of being moved with very little power, and to insure their responding quickly and easily to speed governors exerting moderate force. An elliptical disc is placed in the steam passage and is fixed on its spindle, so that the axis of the latter is at a slight distance outside the plane of the disc's surface on the side of the valve on which the pressure acts. The valve spindle is supported in bearings fitted with antifriction rollers.

3415. UTILISATION OF GASEOUS PRODUCTS OF COMBUSTION, *P. M. Justice, London.—6th August,* 1881. —(*A communication from F. Osann, Dusseldorf.*) —(*Not proceeded with.*) 2*d.*

This consists in the utilisation of the combustible gases produced when carbonaceous matter is decomposed or treated by air in suitable apparatus for the production of motive power.

3417. STANDS OR FRAMES FOR WINE AND SPIRIT BOTTLES, &c., *J. Middleton, Birmingham.—6th August,* 1881.—(*Not proceeded with.*) 2*d.*

This relates to the use of tubular telescopic pillars at each end of the frame, which are bent over so as to form arches fitting over the stoppers and serving to prevent the removal of the bottles.

3419. FEEDING BOTTLES, *H. G. Wells, Liverpool.—8th August,* 1881.—(*Not proceeded with.*) 2*d.*

The object is to prevent air entering the tube when the child stops sucking, and it consists in introducing three valves in the tube.

3420. FASTENING FOR WEARING APPAREL, &c., *A. W. Adams, Southampton.—8th August,* 1881.—(*Not proceeded with.*) 2*d.*

A stud is rivetted to a flexible metal plate, and a second plate has a small orifice to spring over the stud on pressure being applied.

3429. CASES FOR STATIONERY, &c., *E. G. Brewer, London.—8th August,* 1881.—(*A communication from F. R. Grumel, Paris.*)—(*Not proceeded with.*) 2*d.*

The article is composed of two parts of card or other suitable material united by a back piece of flexible material to form a hinge, the whole being covered with mole or other skin. The case thus formed is intended to hold stationery, and is provided with tablets and a small box containing pens, pencils, and ink.

3433. APPLYING LUBRICANTS TO FRICTION SURFACES, *A. Hugot, Paris.—8th August,* 1881.—(*Not proceeded with.*) 2*d.*

The lubricant is placed in a vessel screwed to the part to be lubricated, the upper part having a stuffing-box for the passage of a tube capable of adjustment, and to the lower end of which a ball valve with a spindle is attached, the lower end of such spindle entering a socket in the lower part so as to act as a guide, while the upper end projects into the tube and is secured by a pin free to slide in slots. The tube is pierced laterally to allow the lubricant to flow into the vessel, and to its upper end a funnel is fitted. A screw plug at top of tube serves to close the lateral openings, and an air tube leads into the lubricating vessel.

3435. AN IMPROVEMENT IN ELECTRIC LAMPS OPERATING BY INCANDESCENCE, *F. Wright, London.—8th August,* 1881.—(*Not proceeded with.*) 2*d.*

This relates to a method of clamping the carbons and conductors by means of a block of carbon, without the use of cement.

3437. INCANDESCENT ELECTRIC LAMPS, *F. Wright, London.—8th August,* 1881.—(*Not proceeded with.*) 2*d.*

The fibre selected for the incandescent material was that used in making "bass" brooms. The fibre was carbonised and treated in hydrocarbon vapour.

3440. FASTENINGS FOR BANDS, BELTS, &c., *H. Halladay, Birmingham.—8th August,* 1881.—(*Not proceeded with.*) 2*d.*

This consists in making one part of the fastening adjustable on the band.

3442. LIQUID ROUGE, *C. D. Abel, London.—9th August,* 1881.—(*A communication from M. A. A. L. Lade, Berlin.*) 4*d.*

The object is to produce a liquid rouge that will leave the pores of the skin free, and which will only come off with warm soap and water, and it consists of distilled water heated to from 85 deg. to 105 deg. Fah., and to it is added a small quantity of eosin, and when cool about 20 parts by weight of glycerine are added, and intimately mixed 750 parts of alcohol or other suitable antiseptic liquid being then added, and the whole scented with some essential oil.

3443. ABSORBING AND UTILISING THE SULPHUROUS ACID CONTAINED IN GASES FROM FURNACES AND CALCINING KILNS, *C. D. Abel, London.—9th August,* 1881.—(*A communication from H. Precht, Stassfurt, Germany.*) 4*d.*

This consists in the use of hydrate of magnesia and carbonate of magnesia for the absorption of sulphurous acid from the gases of furnaces and calcining kilns, and the regeneration of the magnesia by heating to redness the sulphite of magnesia; also in the use of hydrate of alumina, or of a mixture of this with hydrate of magnesia or carbonate of magnesia for absorbing the sulphurous acid from the gases of furnaces and calcining kilns, and the regeneration of the alumina or admixture thereof with magnesia by heating the sulphites to redness.

3449. GLOSSING MACHINE, *A. J. Boult, London.—9th August,* 1881.—(*A communication from C. G. Haubold, jun., Chemnitz, Germany.*)—(*Not proceeded with.*) 2*d.*

Three rollers are arranged one over the other, the central one being hollow and heated by steam or hot air. An endless band passes round the bottom roller between it and the middle one, embracing rather more than half of it, between the middle and top ones, partly round the top one, and over an outside supplementary roller. The central roller is driven independently of the lowest, and preferably at a different speed, the lowest one being driven by friction gearing, so arranged as to be capable of varying the speed at pleasure.

3450. GOVERNOR FOR GAS MOTOR ENGINES, *F. W. Crossley, Manchester, and H. P. Holt, Leeds.—9th August,* 1881.—(*Not proceeded with.*) 2*d.*

The air inlet has a check valve with a stem at right angles to and nearly touching a blade connected to the rod of the gas supply valve, such blade having a lateral play, and terminating in a knife edge presenting itself to the notched end of an arm reciprocated by a cam, so as to open the gas supply valve by its forward stroke.

3456. IMPROVED ELECTRICAL APPARATUS FOR LIGHTING AND OTHER PURPOSES, *W. R. Lake, London.—9th August,* 1881.—(*A communication from A. L. Arey, Cleveland, Ohio, U.S.*)—(*Not proceeded with.*) 2*d.*

This relates to devices for reducing the resistance of the generating machine, and for regulating the carbons of arc lamps so as to avoid flickering and unsteadiness of the light.

3458. SYPHON TRAP, *D. Emptage, Margate.—10th August,* 1881.—(*Not proceeded with.*) 2*d.*

The object is to combine the advantages of an ordinary S and an ordinary P trap, and it consists of a trap partly of S form, but instead of continuing the outlet branch downwards in a straight line, it is curved outward from the top bend.

3459. STOPPERING BOTTLES, &c., *C. D. Abel, London.—10th August,* 1881.—(*A communication from B Lew, Berlin.*)—(*Not proceeded with.*) 2*d.*

A screw thread is formed in the bottle neck, and at the bottom is a flat or conical shoulder. The stopper has a screwed stem, and carries at the bottom a disc of cork or other material to fit the shoulder in the neck of the bottle.

3466. BREECH-LOADING GUNS, *F. M. Robertson, Croydon, and J. Joyce, Edmonton.—10th August,* 1881.—(*Not proceeded with.*) 4*d.*

This relates to improvements in the locking, extracting, and breech mechanism of breech-loading guns, and of a snap action for securing the back strap or "fore end" of the gun to the barrel, the improvements being specially applicable to hammerless guns used for sporting purposes.

3467. WEATHER-PROOF PAINT OR VARNISH, *O. Wolff, Dresden.—10th August,* 1881.—(*A communication from E. R. Berger, near Dresden.*)—(*Not proceeded with.*) 2*d.*

This consists in adding silicates which have been calcined to the oil colours employed as paint, and in employing burnt colours alone in order to attain any requisite shade of colour.

3470. PLOUGHS, *R. W. U'ren, Devon.—10th August,* 1881.—(*Not proceeded with.*) 2*d.*

This relates, First, to the construction of "shares" in which the mould-board has in combination a couple of wheels, one at the point and one at the rear, so that a cutting action into the ground by the leading wheel shall induce the point of the share to enter and follow the cut to the desired depth, the rear of the share, and also the rear wheel, following to bring the whole of the ploughing portion to a level under the weight of an adjustable frame by which the plough share is carried. The Second part relates to fitting two, three, or other number of such fore and aft-wheeled shares in the same line on the adjustable frame.

3471. SPRING MATTRESSES, SPRING BED-BOTTOMS, &c., *E. Lloyd, Bracebridge, and H. J. Rust, Sheffield.—11th August*, 1881.—(*Not proceeded with.*) 2*d.*

This consists of endless elastic spring steel bands fitted to a frame preferably adjustable, and either independent of or fixed to its support, or the support may be made adjustable so as to tighten the endless bands.

3479. SAFETY APPLIANCES FOR RAILWAY ROLLING STOCK, *R. Pickwell, Hull.—11th August*, 1881.—(*Not proceeded with.*) 2*d.*

This relates to means for simultaneously opening or closing all the carriage doors of a train.

3482. LAMPS, *W. Spence, London.—11th August*, 1881. —(*A communication from A. Rinklake and C. Bohn, Braunschweig, Germany.*)—(*Not proceeded with.*) 2*d.*

The object is to prevent volatile oils from soaking through the joints of lamps, and it consists in applying an elastic ring round the metallic ring of the oil vase, such elastic ring being pressed down to the joint by a screw cap.

3484. BOTTLES AND JARS, AND STOPPERS FOR SAME, *C. M. Taylor.—11th August*, 1881.—(*Not proceeded with.*) 2*d.*

A screw thread is formed in the neck of the bottle, and the stopper is formed with a correspondingly screwed stem, and has a disc of cork, which when the stopper is screwed home closes the mouth of the bottle hermetically.

3489. AXLE CAPS OF VEHICLES, *J. Crowther, Manchester.—12th August*, 1881.—(*Not proceeded with.*) 2*d.*

This consists in drilling a hole in the cap through which lubricant can be supplied to the axle, such hole being fitted with a valve to prevent the lubricant running out again, and also to prevent the entrance of dust.

3492. REFLECTORS, *W. Taylor, Birmingham.—12th August*, 1881.—(*Not proceeded with.*) 2*d.*

The reflector is made of copper, brass, or steel, and is then coated with white metal capable of receiving a high polish and resisting corrosion.

3494. SUPPORTS AND FASTENINGS FOR CURTAINS OR BLINDS, &c., *J. D. Richards and J. Fairhurst, Sheffield.—12th August*, 1881.—(*Not proceeded with.*) 2*d.*

This relates to the use of brackets and rods to keep the blinds stretched tight.

3498. EXTRACTING PHOSPHATE OF LIME FROM GREY CHALK OR PHOSPHATE OF CHALK, *H. J. Haddan, Kensington.—12th August*, 1881.—(*A communication from C. Meurice, Belgium.*)—(*Not proceeded with.*) 2*d.*

The chalk is ground by stones, and a current of air then acts on the powder, and assorts it according to its density.

3499. LOADING AND UNLOADING APPARATUS, *H. J. Haddan, Kensington.—12th August*, 1881.—(*A communication from J. Cornier, France.*)—(*Not proceeded with.*) 2*d.*

This relates to cranes, and consists in providing the end of the jib with a toothed wheel with which gears a rack forming part of a ladder carrying a scoop or gripper at its lower end.

3500. SLEEPERS, *H. J. Haddan, Kensington.—12th August*, 1881.—(*A communication from P. Paquet and G. Guidon, Lyons.*)—(*Not proceeded with.*) 2*d.*

The sleeper consists of an iron T plate bent at the extremities and fixed on an iron T sleeper piece of the same length. The extremities of the plate and sleeper are placed under the ballast, and to the plate two inner and two outer cramps are fitted to hold the rails.

3501. BENDING AND SHAPING MACHINES, *H. J. Haddan, Kensington.—12th August*, 1881.—(*A communication from C. H. Gillot, France.*)—(*Not proceeded with.*) 2*d.*

The machine has two parallel plates united by two screws, one having a hand-wheel and the other a nut, the two serving to vary the distance between the plates. A curved knife or tool pivotted to one of the screws, and having a handle at the opposite end, operates between the plates, the working face of the knife being shaped to suit the work.

3504. POLYCHROMATIC PRINTING, &c., *J. R. Meiké, London.—12th August*, 1881.—(*A communication from F. C. Hoesch, Nürnberg, Bavaria.*) 4*d.*

This relates to the production of coloured pictures, and is especially applicable where the agency of light is employed in producing the picture, and also to a method of ascertaining the kind and proportion of colours required.

3505. TABLE FORKS, *A. Greenaway, Surrey.—12th August*, 1881.—(*Not proceeded with.*) 2*d.*

So as to reduce the cost of manufacture, and at the same time make lighter forks, grooves are formed in the prongs extending from the shoulder to near the tip.

3506. APPARATUS OR BAG SKIP FOR DEPOSITING CONCRETE IN DEEP WATER, &c., *R. Aytoun, Aberdeen.—12th August*, 1881.—(*Not proceeded with.*) 2*d.*

The skip may be made of canvas rendered watertight, and is kept closed by its own weight when full, and opens so as to empty itself when the skip rests on the ground.

3510. HORIZONTAL PRESSES, *C. Humfrey, Chester.—12th August*, 1881. 2*d.*

This consists in suspending the plates, mats, load, &c., from above by chains, ropes, or rods, instead of resting them on the horizontal tie-rods of the press, by which means all the friction of the plates, &c., against the tie-rods is avoided, and a far more uniform pressure obtained.

3511. TREATING PARAFFINE SCALE, &c., *L. Hislop, Chester.—12th August*, 1881. 2*d.*

The object is to treat paraffine scale and like substances so as to obtain a purer and much clearer product, and it consists in pressing the paraffine scale under water or other suitable liquid kept at a temperature within a few degrees of the melting point of the substance, the liquid being constantly agitated, preferably by means of air.

3560. UTILISING RESIDUES OF MANUFACTURE OF SULPHURIC ACID, *W. Weldon, Surrey.—16th August*, 1881. 4*d.*

This consists, First, in treating copper-extractors' residual liquors by a solution of chloride of calcium, whereby the liquor is decomposed with formation of insoluble sulphate of calcium. The mixture is thrown on a filter and allowed to drain, the sulphate of calcium being washed and used for industrial purposes, while the liquor separated can be used to precipitate sulphur from yellow liquors. The Second part consists in adding either lime or oxide of iron to the liquor separated in the first operation, and then treating yellow liquors by the resulting mixture of oxide of iron with solution containing chloride of iron.

4544. MANUFACTURE, TREATMENT, AND APPLICATION TO VARIOUS PURPOSES OF HYPONITRIC ANHYDRIDE, &c., *E. Turpin, Paris.—18th October*, 1881.—(*Complete.*) 6*d.*

This relates, First, to the manufacture of peroxide of nitrogen or hyponitric anhydride; Secondly, to mixing it with sulphuret of carbon in suitable quantities which produces substances capable of giving light and heat or constituting explosive compounds, as the case may be; Thirdly, to the apparatus for utilising the properties of such mixtures; Fourthly, to the application of peroxide of nitrogen or hyponitric anhydride to the manufacture of various chemical products; Fifthly, to the application of peroxide of nitrogen or hyponitric anhydride to the artificial production of cold.

4556. SELF-LUBRICATING JOURNAL OR AXLE BEARINGS OR BOXES AND LUBRICATING DEVICES, *P. M. Justice, London.—18th October*, 1881.—(*A communication from L. Bastet, Brooklyn, U.S.*) 6*d.*

Ground plumbago and phosphate of lime are well mixed and made into a paste, with the addition of a solution of caustic silicate of potash or soda, and then moulded to suit the journal or axle, after which it is dried or hardened by heat. The bearing thus formed

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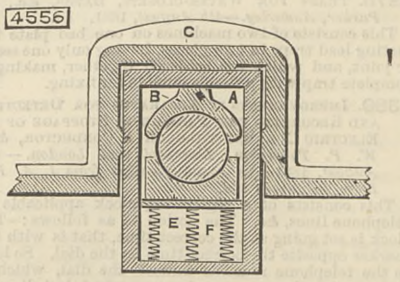

is saturated by immersion for half an hour in a mixture of melted tallow and crude paraffine at about 220 deg. Fah. In the drawing A is the axle on which the load is carried by the ordinary bearing B and saddle C. E is the self lubricating bearing pressed up against the axle by springs F.

4563. HOLDERS OR RECEPTACLES, *H. J. Haddan, Kensington.—19th October*, 1881.—(*A communication from W. H. Miles, jun., New York.*)—(*Complete.*) 6*d.*

This relates to devices for holding brushes of various kinds, and consists of springs made to grip the bristles and prevent the back of the brushes from being worn as they are inserted or withdrawn from the holder.

4671. RINGS FOR SPINNING FRAMES, *W. R. Lake, London.—25th October*, 1881.—(*A communication from J. Y. Anthony, Taunton, and W. K. Evans, Beverley, Mass.*)—(*Complete.*) 2*d.*

This consists in forming spinning frame rings of porcelain or glazed earthenware, turned true on a wheel or in a lathe before being baked and glazed.

4726. METAL-DRESSING MACHINE, HAVING AN OSCILLATING CUTTING TOOL, *R. H. Brandon, Paris.—28th October*, 1881.—(*A communication from H. Pieper, Liege, Belgium.*)—(*Complete.*) 4*d.*

On the driving pulley P is fixed a disc Q with a groove, in which works a slide S connected by rod W with a toothed segment T, the axis of which is secured

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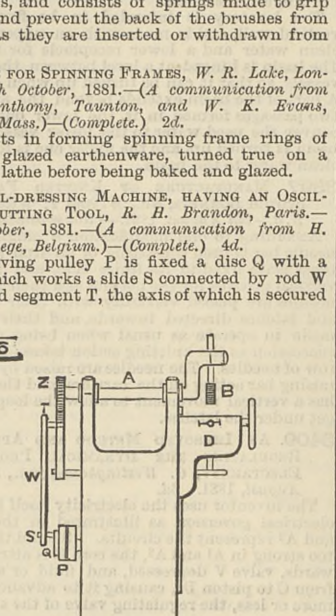

to the frame. The segment actuates pinion Z keyed on shaft A of the cutter B, to which an oscillating motion is imparted. The work is supported on the adjustable table D.

4733. CARRIAGES FOR BOBBIN-NET OR TWIST LACE MACHINES, *J. R. Hancock and W. Smith, Nottingham.—29th October*, 1881. 6*d.*

The carriage blanks are punched out of thinner sheet metal than usual, and a cover for the bobbin is formed at the back and front by means of two or more depressions on each side of the carriage, the metal at the back of each depression being correspondingly raised, such raised portions being the highest at the verge, and thus forming a thicker rest or rests for the bobbin than heretofore, and also providing more gate room for the passage of the threads between the carriages, and likewise entirely dispensing with the expensive process of grinding away the metal on each side of the bottom of the carriage.

4946. APPARATUS FOR READILY AND INSTANTLY SLIPPING, RELEASING, DETACHING, OR UNCOUPLING, *C. F. C. Morris and F. H. Bennett, London.—11th November*, 1881. 6*d.*

This relates to improvements on patents No. 1389, A.D. 1879, and No. 1265, A.D. 1881, and it consists of frame A and the movable member or locking and

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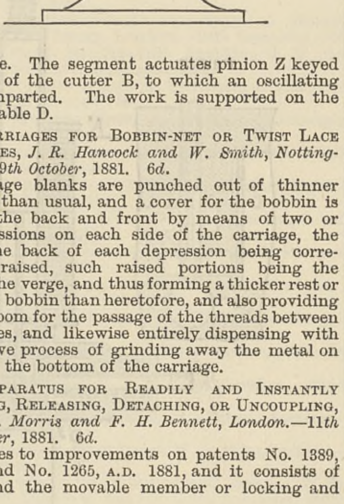

unlocking part B pivotted at C. The frame A is recessed to receive the part B, the upper end of which has a hole D drilled through it to receive the end of spring bolt E.

5137. AIR COMPRESSING AND PUMPING APPARATUS, *A. M. Clark, London.—24th November*, 1881.—(*A communication from C. W. Cooper, Brooklyn, U.S.*) —(*Complete.*) 10*d.*

This relates to improvements on patent No. 4386, A.D 1881, and consists in means to avoid the use of reversing valves at the pumping apparatus, and to utilise the expansive force of the air while it is in the act of exhausting from the pump chambers to the lower pressure pipes.

5166. SEWING MACHINES, *H. J. Haddan, Kensington.—26th November*, 1881.—(*A communication from D. A. Porter and T. H. White, Cleveland, U.S.*)—(*Complete.*) 4*d.*

This consists in the combination with the main horizontal driving shaft of a sewing machine of a crank upon such shaft, to which two levers are attached, one adapted to rotate the feed shaft by the interposition of a radius bar, while the other communicates a vibratory motion to the shuttle-bar.

5265. SCREWS. *W. R. Lake, London.—1st December*, 1881.—(*A communication from the American Screw Company, Providence, U.S.*)—(*Complete.*) 4*d.*

The head of the screw is formed with a continuous rim B, a portion of the head being countersunk, and

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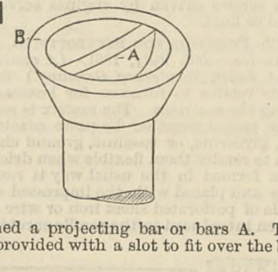

across it is formed a projecting bar or bars A. The screw-driver is provided with a slot to fit over the bar or bars.

5602. FILES, *A. M. Clark, London.—21st December*, 1881.—(*A communication from M. A. Howell, jun., Chicago, U.S.*)—(*Complete.*) 4*d.*

This relates to the manufacture of files by a process combining the decarburisation of cast iron blanks for the purpose of softening and cutting, with the subsequent recarburisation for the purpose of hardening and tempering.

SELECTED AMERICAN PATENTS.

From the United States' Patent Office Official Gazette.

262,979. ART OF SHARPENING FILES AND OTHER SIMILARLY-TOOTHED TOOLS, *Benjamin C. Tilghman and Jeremiah E. Mathewson, Philadelphia, Pa.; said Mathewson assignor to said Tilghman.—Filed May 12th*, 1879.

Claim.—(1) In the method of sharpening files described, the employment of one or more interior steam jets, combined with an exterior supply of fluid mud or fine sand mixed with water, applied to the sharpening of files, substantially as described. (2) In an apparatus for producing a wide and thin sand blast, one or more thin apertures in the same plane, or preferably a row of small holes having intervals between them for introducing the steam. (3) The improved method of sharpening the teeth of files, wherein the formation of grooves is avoided, by presenting the sand blast at an acute angle sideways to the longitu-

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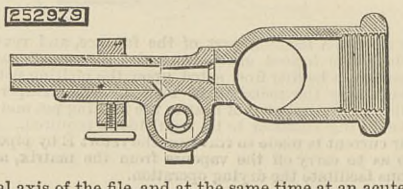

dinal axis of the file, and at the same time at an acute angle to the horizontal plane of the teeth thereof, substantially as specified. (4) In sharpening files by the sand blast, the method of sharpening two adjacent sides simultaneously, which consists in presenting the file to a thin sand blast of a width greater than that of the file and at the angle, substantially as described. (5) A feeler to test the progress of the sharpening during the operation. (6) The combination of a conical mud vessel with the suction pipe of a sand blast apparatus.

253,025. SPINDLE FOR SPINNING FRAMES, *Rimmon C. Fay, Milford, assignor to George Draper and Sons, Hopedale, Mass.—Filed July 29th*, 1881.

Brief.—The bolster bearing for the spindle is surrounded by an elastic packing, and the supporting tube is provided with a catch that engages a shoulder within the whirl sleeve to prevent the spindle from rising when the bobbin is doffed. When the spindle is tipped backward in doffing the shoulder is carried under the catch and cannot rise; but by tipping the

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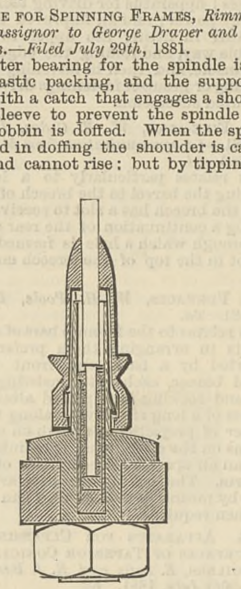

spindle in the opposite direction the shoulder will be carried out beyond the catch, and the spindle may be lifted out of its bearing. *Claim.*—The spindle and its attached sleeve whirl, provided with the shoulder 2, combined with the bolster, the elastic packing external to the said bolster, and the bolster supporting tube C, provided with the catch 3, to co-operate with the shoulder 2 of the sleeve whirl, as described, and for the purposes set forth.

253,049. BESSEMER CONVERTER PLANT, *Alexander L. Holley, Brooklyn, N.Y.—Filed September 24th*, 1881.

Claim.—The combination of the trunnion ring of a Bessemer converter with suitable hoisting mechanism

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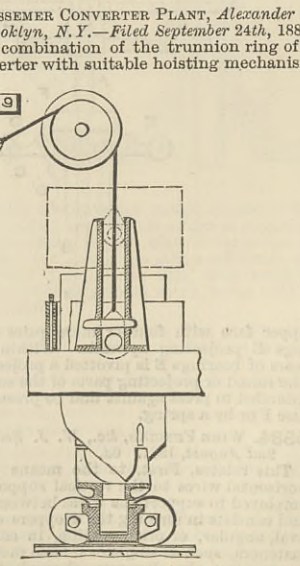

for lifting the trunnion ring, and with a converter shell detachable from the trunnion ring, and with a car and lift under the converter, the combination being for the purpose of lifting the trunnion ring off the shell, so that the shell may be removed laterally and a repaired shell may be placed in the trunnion ring in the manner described.

253,189. DIFFERENTIAL CHAIN BLOCK, *Joseph D. Davies, Bond Hill, Ohio.—Filed November 14th*, 1881.

Claim.—(1) The combination, in a chain block, of a driving shaft operating a pinion composed of two members, one of which engages with a fixed circular rack, while the other member gears with the hoisting sheave, the pitch lines of said rack and sheave rim being of different diameters, for the purpose specified. (2) The combination, in a chain block, of driving shaft E, arm G, pinion H H^1, fixed circular rack I, and toothed sheave rim J, the pitch lines of said rack and sheave rim being of different diameters, for the purpose specified. (3) The combination, in a chain block, of driving shaft E, arms G G^1, pinions H H^1 P P^1

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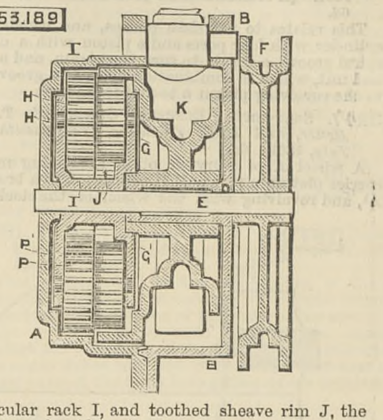

fixed circular rack I, and toothed sheave rim J, the pitch lines of said rack and sheave rim being of different diameters, as and for the purpose specified. (4) The combination, in a chain block, of housings A B, box D, driving shaft E, master wheel F, arm G, pinion H H^1, fixed circular rack I, toothed sheave rim J, and sheave K, the pitch lines of said rack and sheave rim being of different diameters, as and for the purpose specified.

253,227. MANUFACTURE OF ZINC-COATED WIRE, *William E. Rice, Worcester, Mass.—Filed August 15th*, 1881.

Claim.—The combination of the coil of asbestos or

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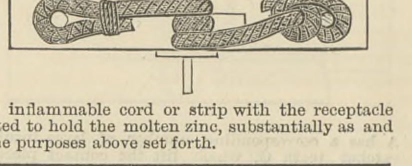

other inflammable cord or strip with the receptacle adapted to hold the molten zinc, substantially as and for the purposes above set forth.

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