THE ELECTRICAL TRANSMISSION OF POWER.

By PROFESSOR OLIVER J. LODGE.

No. II.

Summary of last article.—It will be useful, first of all, to collect together here the most important equations established in the article last week, removing them from a mass of work which, though necessary, is of less practical importance than the results obtained by means of it. Remember that we are dealing at present with two simple series-dynamos connected by a wire with perfect insulation, and that the suffix 1 denotes the sending machine, the suffix 2 the receiving machine. Then, for the net power applied to the sending machine we found

$$P_1 = (\rho_1 + r_1)\,C^2 = E_1\,C\,; \quad . \quad . \quad (4)$$

for the efficiency of the sending machine,

$$f_1 = \frac{e_1}{E_1} = \frac{r_1}{r_1 + \rho_1}\,; \quad . \quad . \quad . \quad (5)$$

for the gross power obtained from the receiving machine,

$$p_2 = (r_2 - \rho_2)\,C^2 = E_2\,C\,; \quad . \quad . \quad (10)$$

for the efficiency of the receiving machine,

$$f_2 = \frac{E_2}{e_2} = \frac{r_2 - \rho_2}{r_2}\,; \quad . \quad . \quad . \quad (12)$$

for the resistance of the line wire,

$$R = r_1 - r_2\,; \quad . \quad . \quad . \quad . \quad . \quad (13)$$

and for the efficiency of the whole arrangement,

$$F = \frac{E_2}{E_1} = \frac{r_2 - \rho_2}{R + r_2 + \rho_1}. \quad . \quad . \quad (16)$$

To these we will now add the perfectly obvious relation

$$C = \frac{E_1 - E_2}{\rho_1 + R + \rho_2}\,; \quad . \quad . \quad . \quad (19)$$

and this, combined with (10), gives us the following expression for the available power at the receiving end of the line:—

$$p_2 = \frac{E_1\,E_2 - E_2^2}{R + \rho_1 + \rho_2}. \quad . \quad . \quad . \quad (20)$$

This last equation gives us the important information that the useful power depends on the difference between E_1 and E_2, and that to get much power we must have this difference large. But (16) informs us that in order to get high efficiency it is necessary for the ratio of E_2 to E_1 to be as near unity as possible. The two demands are therefore to some extent inconsistent, and a little difficulty is often experienced in understanding this point.

Observe that if E_2 is nearly equal to E_1, the current (19) will be very small, and there will be very little waste; but there will also be very little power anywhere, either at the receiving or sending end. By having $E_2 = E_1$, therefore, we can transmit power with exceeding economy, but we can transmit precious little of it. This, of course, is not much good, and we must effect a compromise, aiming to get the difference $E_1 - E_2$ as large as possible, and at the same time the ratio $\frac{E_2}{E_1}$ as near unity as possible. The only way to do these two apparently contradictory things is to make both E_1 and E_2 very large. The difference of two very large quantities may be considerable, although their ratio may be nearly unity. Thus, if the electro-motive force of a sending machine could be made 100,000 volts, and of the receiving machine 90,000, there would be an efficiency of 90 per cent., and yet a difference of 10,000 volts ready to urge the current and perform work. With such forces as this, a large amount of power might be transmitted to absurd distances with great economy.

Thus a common telegraph wire from London to Inverness would have a resistance of less than 10,000 ohms, while the resistance of the wire on the two machines might be assumed to be at the most about the same amount; hence with the above electromotive forces half an Ampère of current would flow round the circuit, and the transmitted work would be 45,000 Watts, or 60-horse power, with only 10 per cent. of waste. The sparking distance of such a wire would, however, be about an inch, and hence no earth-connected body must ever approach anywhere near the wire while in action.

The theory of the matter is simple enough, and it is the same with water power. In order to transmit power economically with either water or electricity, we must have them each at high pressure. The stronger the current permitted to flow, the more waste heat will be produced by the frictional resistance. All this was pointed out some years ago, for the first time so far as I know, by Dr. Siemens.

Highest available power at receiving end with a given electro-motive force at the sending.—The limit of electro-motive force possible in practice is determined mainly by the defective insulation of the leading wire R, which may cause the loss of efficiency by leakage to be too great. But at present we are assuming perfect insulation, so the only limit is in the speed and construction of the sending machine, that is, in the possible electro-motive force E_1. If this is given, it is evident from (20) that p_2 is a maximum when $E_2 = \frac{1}{2}\,E_1$; that is, when the efficiency is $\frac{1}{2}$.

The same thing may be also clearly seen if we combine (16) and (20), writing—

$$\text{Useful power} = p_2 = \frac{E_1^2\,F\,(1 - F)}{R + \rho_1 + \rho_2}. \quad . \quad . \quad . \quad (20^1)$$

which shows at once that for given machines and line wire and a given sending electro-motive force, most power is obtained at the receiving end when $F = \frac{1}{2}$; that is, when the efficiency is 50 per cent. This highest available power being $\frac{\frac{1}{4}\,E_1^2}{R + \rho_1 + \rho_2}$.

It does not follow that this is the condition of things to be aimed at; 50 per cent. is a very low efficiency for a perfectly insulated line, and by running the receiving machine faster less waste will occur; but also less power will be obtained for use. One ought not to work the receiving dynamo; therefore, so as to obtain from it a maximum of power, we ought to let it run fast and leave a reserve of power, which we can call upon if the necessity should arise, but which we only fully call upon with the knowledge that we are then wasting half the total power. The waste power is entirely applied to the production of heat in the wires of the machines and in the line wire, in the proportion of their respective resistances;

that is, $R\ C^2$ in the line;
$\rho_1\ C^2$ in the sending machine;
$\rho_2\ C^2$ in the receiving machine;

the total waste being

$$\frac{(E_1 - E_2)^2}{R + \rho_1 + \rho_2} = \frac{E_1^2\,(1 - F)^2}{R + \rho_1 + \rho_2} = p_2\,\frac{1 - F}{F}$$

Problem.—Required a given amount of power (p_2) at the receiving end, what is the least sufficient electro-motive force of the sending machine which will transmit it through a given line wire with given machines? Also, what is the EMF which will transmit it with a specified efficiency?

By equation (20^1) we see that for E_1 to be as small as possible F must equal $\frac{1}{2}$, and hence by (20) the very least $E_1 = 2\,\sqrt{p_2\,(R + \rho_1 + \rho_2)}$.

Mr. Thomas H. Blakesley pointed this out in a letter to the *Electrician* of the 18th November, 1882. But the above value of E_1 will only give an effeciency of 50 per cent.: if one aims at a higher efficiency F, we must use a higher electro-motive force, and to transmit p_2 with a specified efficiency F, the least sufficient

$$E_1 = \sqrt{\left(\frac{p_2\,(R + \rho_1 + \rho_2)}{F\,(1 - F)}\right)}.$$

As an example, take the case just imagined, where the line wire and machines have a combined resistance of 20,000 ohms, and where we will say 60-horse power, or 45,000 Watts, is required to be transmitted.

To transmit it with an efficiency of 90 per cent. the least E_1 comes out 100,000 volts. But to transmit it with an absolute minimum of electro-motive force—that is, with an efficiency of 50 per cent., only 60,000 volts is necessary. But observe that in this case a power of 120 horse is required at the sending station, while in the former case 66⅔-horse power is sufficient. So there is no question as to which is the most economical if the higher electro-motive force can be obtained, and *if the insulation of the line is perfect.*

Theory of a uniformly leaky line wire.—Now that we have perceived the immediate connection between economy and high electro-motive force, it is useless to go on supposing that the line wire is perfectly insulated and that there is no leakage; for no long line wire can be constructed which does not leak considerably at the very high electro-motive forces which have been indicated as desirable; and it becomes a question at what point the loss by defective insulation will more than overbalance the gain by high electro-motive force.

The conduction resistance of the line wire being R, let its insulation resistance be S, ohms. The insulation resistance of every ohm of the wire will evidently be greater than that of the whole, and if everything is uniform over the whole length of the wire—the simplest hypothesis—the insulation resistance of each ohm will be S R. Hence, if we consider an element of the wire, of resistance $d\,R$, its insulation resistance will be $\frac{S\,R}{d\,R}$. Let e be the potential of the element above that of the ground, and let $d\,e$ be the difference of potential between its extremities. Then we shall have for the main current flowing through the element along the wire

$$C = \frac{d\,e}{d\,R},$$

and for the leak current flowing from the element to the earth

$$d\,C = \frac{e\,d\,R}{S\,R}.$$

Combining the two we get the equation,

$$S\,R\,C\,d\,C = e\,d\,e\,;$$

or, in other words,

$$S\,R\,C^2 = e^2 + \text{a constant.}$$

The potential at the sending end of the wire we will suppose is e_1 and at the receiving end e_2, while the current supplied to the wire is C_1 and that received from it is C_2; thus we have—

$$S\,R\,(C_1^2 - C_2^2) = e_1^2 - e_2^2. \quad . \quad (21)$$

We can also write down the current at any point of the wire in terms of the potential there, thus—

$$C^2 = C_1^2 - \frac{e_1^2 - e^2}{S\,R},$$

and substituting this in $d\,R = \frac{d\,e}{C}$ and integrating, we get—

$$\sqrt{\left(\frac{R}{S}\right)} = \log\frac{e_1 + C_1\,\sqrt{R\,S}}{e_2 + C_2\,\sqrt{R\,S}} = \log\frac{e_2 - C_2\,\sqrt{R\,S}}{e_1 - C^-\,\sqrt{R\,S}} \quad (22)$$

Combining (21) and (22), we arrive at expressions for the strength of the current at either end of the wire in terms of the electro-motive forces, viz. :—

$$\sqrt{R\,S}\cdot C_1 = \frac{e_1}{\tanh\sqrt{\frac{R}{S}}} - \frac{e_2}{\sinh\sqrt{\frac{R}{S}}},$$

or

$$C_1 = \frac{e_1\cosh\sqrt{\frac{R}{S}} - e_2}{\sqrt{R\,S}\,\sinh\sqrt{\frac{R}{S}}}\,; \quad . \quad . \quad (23)$$

and

$$\sqrt{R\,S}\cdot C_2 = \frac{e_1}{\sinh\sqrt{\frac{R}{S}}} - \frac{e_2}{\tanh\sqrt{\frac{R}{S}}},$$

or

$$C_2 = \frac{e_1 - e_2\cosh\sqrt{\frac{R}{S}}}{\sqrt{R\,S}\,\sinh\sqrt{\frac{R}{S}}}. \quad . \quad . \quad (24)$$

Now the efficiency of the wire, viz., the ratio between the power of its current at the receiving end to that at the sending end, a quantity which I formerly called f, is no longer $\frac{e_2}{e_1}$, as it was when there was no leakage, but is $\frac{e_2\,C_2}{e_1\,C_1}$; or, in other words,

$$f = \frac{e_1\,e_2 - e_2^2\cosh\sqrt{\frac{R}{S}}}{e_1^2\cosh\sqrt{\frac{R}{S}} - e_1\,e_2}\,; \quad . \quad . \quad . \quad (25)$$

and the total efficiency of the whole arrangement, viz., $F = f_1\,f\,f_2$ (compare 16), is

$$F = \frac{E_2}{E_1}\cdot\frac{e_1 - e_2\cosh\sqrt{\frac{R}{S}}}{e_1\cosh\sqrt{\frac{R}{S}} - e_2}. \quad . \quad . \quad (26)$$

We may express this wholly in terms of the small e's by remembering that

$$\frac{E_2}{E_1} = \frac{e_2 - \rho_2\,C_2}{e_1 + \rho_1\,C_1}$$

$$= \frac{e_2\left(\rho_2\cosh\sqrt{\frac{R}{S}} + \sqrt{R\,S}\,\sinh\sqrt{\frac{R}{S}}\right) - e_1\,\rho_2}{e_1\left(\rho_1\cosh\sqrt{\frac{R}{S}} + \sqrt{R\,S}\,\sinh\sqrt{\frac{R}{S}}\right) - e_2\,\rho_1}\,; \quad (27)$$

or again we may write everything in terms of the big E's, which for many purposes is the most convenient. The expressions, however, are rather long, and we will introduce two abbreviations,

writing c for $\cosh\sqrt{\frac{R}{S}}$; and s for $\frac{1}{\sqrt{R\,S}}\sinh\sqrt{\frac{R}{S}}$.

The expression for the total efficiency is now

$$F = \frac{E_2}{E_1}\cdot\frac{E_1 - E_2\,(c + \rho_1\,s)}{E_1\,(c + \rho_2\,s) - E_2} \quad . \quad . \quad (28)$$

this being obtained by substituting in equations (23) and (24) the values of the small e in terms of the big, viz., $e_1 = E_1 - \rho_1\,c_1$, and $e_2 = E_2 + \rho_2\,c_2$, and then combining the two equations.

The expression for the strength of the current at either end of the line may also be recorded in the same way, viz.

$$C_1 = \frac{E_1\,(c + \rho_2\,s) - E_2}{(R\,S + \rho_1\,\rho_2)\,s + (\rho_1 + \rho_2)\,c} \quad . \quad (29)$$

and

$$C_2 = \frac{E_1 - E_2\,(c + \rho_1\,s)}{(R\,S + \rho_1\,\rho_2)\,s + (\rho_1 + \rho_2)\,c} \quad . \quad (30)$$

the denominators being the same.

The power obtained at the receiving end of the line may also be written down—

$$p_2 = E_2\,C_2 = \frac{E_1\,E_2 - E_2^2\,(c + \rho_1\,s)}{(R\,S + \rho_1\,\rho_2)\,s + (\rho_1 + \rho_2)\,c} \quad . \quad (31)$$

The present article has been rather more mathematical than I expected; but the full consideration of an imperfectly insulated wire was not likely to be extremely simple. It will be observed that all equations referring to either machine separately are equally valid whether the line wire be perfectly insulated or not; thus the first twelve equations in last fortnight's article remain unaffected by the leak; but all the equations after (12) are modified, as has now been shown.

The modified form of equation (13) has not yet been written down. Let us write it now. Observe that the current splits into two portions, one going through R and r_2 as before, the other leaking to earth through the resistance S; hence a simple, though somewhat inexact, way of dealing with the matter is to treat it as a case of simple divided circuit and to write

$$r_1 = \frac{S\,(R + r_2)}{S + R + r_2}. \quad . \quad . \quad . \quad (32)$$

Any of these equations may be checked by making $S = \infty$, that is, by making the line perfectly insulated, in which case they ought to reduce to the simple equations of last article. It may be useful to indicate the corresponding equations—

(25)	becomes	(15)
(26) and (28)	become	(16)
(29) and (30)	become	(19)
(31)	becomes	(20)
and (32)	becomes	(13)

The functions which I have had to use, viz., sinh and cosh, are unfortunately not familiar to most people, though there is no reason why they should not be, for they occur in physics just as frequently as sine and cosine and are every bit as simple to work with, perhaps simpler.

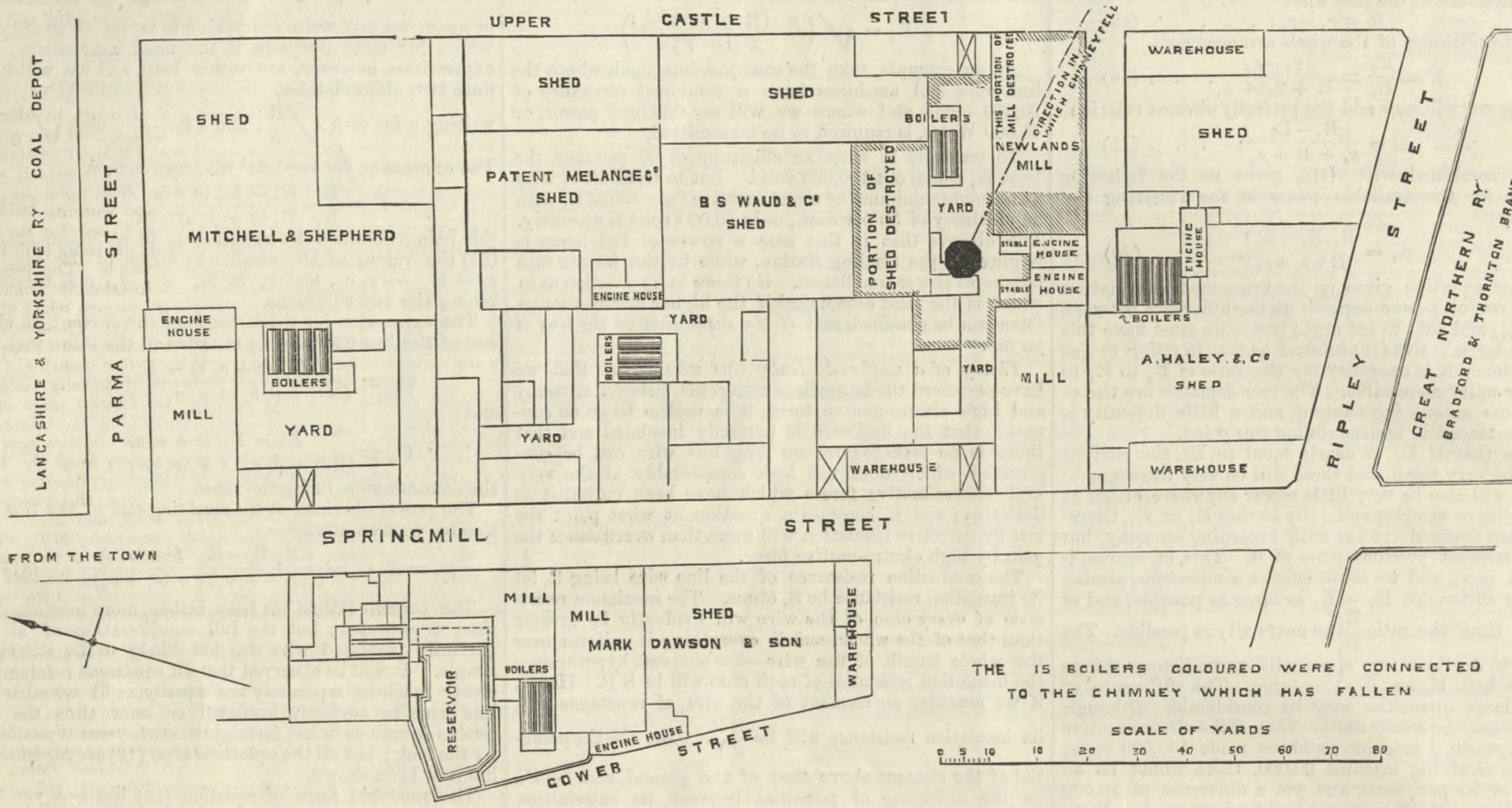
I will, in the next article, explain all that it is for our present purpose needful to know about them; but meanwhile I must beg my readers to correct a mistake made in the last article—page 59—viz., to change the tan, which occurs immediately after the little diagram in the middle column, into tanh.

Next time I will go into a few practical problems and numerical examples in the light of our present knowledge; and especially will apply our results to the very interesting experiment of M. Marcel Despretz, who has transmitted half a horse-power from Miesbach to Munich, a distance of forty miles, by means of an ordinary telegraph wire of 1000 ohms resistance, and with a reasonable efficiency.

THE FALL OF A CHIMNEY IN BRADFORD.

THE catastrophe which occurred at the Newland Mill on the 28th of December was one of the most appalling which it has ever fallen to our lot to record. A chimney of 240ft. high fell with a terrible crash upon an adjoining mill, in which a number of men, women, and children were resting during breakfast hour, no fewer than fifty-four of whom were killed instantaneously or have since died. A protracted and exhaustive investigation, which commenced immediately after the accident, and only terminated on Wednesday, the 31st of January, was held by Mr. Hutchinson, the borough coroner, the Home Office being represented by Lieut.-Col. Seddon, R.E. During the enquiry, which was necessarily somewhat of a technical character, a large amount of evidence was brought forward, relative to the construction of the chimney and its foundations. The chimney, which will be seen in the engraving below to be entirely surrounded by buildings, was erected in 1862 by Sir Henry Ripley.

The first point for consideration was necessarily the nature of the foundation upon which the chimney was to stand, for it was well known that the district upon which the mills have been built had been worked for coal about thirty years previous to 1862. It was not in the first instance thought necessary to employ competent professional assistance, and, indeed, judging from the evidence given at the inquiry, it would appear that in Bradford and the neighbourhood it is the practice to allow contractors to frame their own specification, or to proceed without any written specification at all. In this instance it was alleged that from first to last there never had been a specification of any kind, the contractor simply undertaking to erect a chimney similar to that at Bowling Dye Works. On an examination of the ground being made, an old shaft was found; and this incident finally decided the exact position of the chimney. At the bottom of the shaft were found two headings—one witness said there were three. Whatever the number was, the headings were packed with dry rubble to a distance of about twelve yards



FALL OF A CHIMNEY AT BRADFORD.

all round the centre shaft. The packing was commenced at the farther end, and carried backward towards the shaft; and the dry rubble was then grouted with liquid lime concrete, which was stated by witnesses who had been on the work to have penetrated through almost the entire mass of rubble work. An excavation was made of 40ft. deep and 30ft. square, the centre being the old shaft. Five pits were then carried down to the bottom of the workings underneath, one in the centre of 9ft. in diameter, and one at each angle of the square of 6ft. diameter. These pits were next filled with concrete, and the bottom of the excavation was levelled and also filled to a depth of 2ft. 6in. with concrete. Upon this bed, which was 30ft. square, was laid the first course of stone. This was 28ft. square and 12in. deep. The stones were said to have been faced and well laid in mortar. The next course was similar, but was only 26ft. square. The whole was made perfectly level and the superstructure then commenced. The outside form of the chimney was an octagon, measuring 24ft. from side to side, with sunk panels 6in. deep, and the flue was circular, 9ft. in diameter. Up to a height of 33ft. the flue was lined with 9in. fire-bricks, and outside this lining, with an intervening space of 3in., was a second lining of 9in. of ordinary red brick. From where the fire-brick stopped, the red brick flue was carried up for a thickness of 18in. to 115ft., and the remainder of the length was 14in. in thickness. The outside masonry was composed of squared stone, and the cavity between the back of this stone and the brick flue was filled in with hearting of rough rubble. It was stated that a sufficient number of through stones had been built into the work to tie the face work into the hearting; but an examination of the ruins did not bear out this part of the evidence as fully as might have been expected. The work was commenced in July, 1862, and carried on until the following December, when about 40 yards had been built; operations were then stopped, and the masonry was covered over to protect it from the weather. At the end of the following February the work was resumed and carried on until June, when it reached a height of 210ft. above the foundation. It was then found that the chimney was considerably out of perpendicular in the upper part of its length, and a "Steeple Jack" was sent for to Manchester, to advise upon matters and apply a remedy. He first cut out a course of 7in. stones at the side opposite to the direction in which the chimney leaned, and at a height of 54ft. from the foundation, wedging up the masonry as he cut, and then introduced a new course of stone of ½in. less depth than the course which he had removed. The wedges being removed, this operation brought the upper part of the shaft about 18in. nearer to its proper position; but as this was not sufficient to make it quite perpendicular, a second cut was made which had the desired effect. After this it was discovered that the masonry bulged somewhat above where the cuts had been put in, and the angle quoins became displaced. This defect there was no difficulty in remedying, at least so far as the appearance of the chimney was concerned; and after the work had been done, about 24ft. were added to the height of the structure. It may here be remarked, that one of the witnesses who had been engaged on the work made an important statement at the coroner's inquiry, to the effect that when the chimney was being straightened a loud noise was heard, which he thought arose from the through stones being broken across by the descent of the outer shell. The work was completed by the following November, having been altogether a year and four months in hand. In the year 1866 it was noticed that the outer shell of the chimney had cracked near to where it had been cut, but there do not appear to have been any symptoms calculated to cause apprehension from that date until about a month before the accident occurred. It is true there were cracks in the masonry wide enough to admit a man's fist, and in which birds had built their nests, but this did not seem to cause any alarm. Whether familiarity with defective structures of this kind made those who were interested in the property incautious we cannot say; but there is no resisting the conclusion that the necessary precautions were not taken when the work began to show urgent signs of failure, which it did immediately before Christmas last. The owners of the property appear to have been anxious to avoid all risk of accident; but there seems to have been a tendency all round to hope against hope that no accident would take place. Four days before the fall of the chimney the outer shell bulged about 50ft. from the base, and a part of it was removed. Scaffolding was put up round the base; but a large portion of the shell fell and broke through it, and it was while further preparations were being made for rebuilding the outer shell that the chimney collapsed. There had been very heavy rain and a strong wind for a day or two, and during the night before the accident occurred; and having regard to the weakened condition in which the chimney was then in, it is almost a marvel that it did not fall before. When falling, the chimney did not measure its full length along the ground. It appears to have first given way by bulging some distance from the base; and as the whole structure descended vertically, the upper portion fell in a mass across the buildings, as shown upon the plan above.

There is no difficulty in discovering a cause or causes for the failure of the chimney at Newland Mill. So far as the evidence goes, reasonable care seems to have been taken in the preparation of the foundations, which were of a difficult character. If five columns of concrete were constructed under the chimney and resting on the floor of the coal workings, there was ample support for the dead weight of a chimney of the height of that which fell. Indeed, an examination of the foundations as they now exist does not appear to reveal any defect that could be said to conduce to the accident. The level of the masonry was not absolutely true from one side to the other; but the lowest point was at the side most remote from the direction in which the chimney settled. The mode of constructing the chimney was from the first defective. It was composed of three classes of work, all differing in quality, without anything like sufficient bond to keep the three separate shells in such proximate contact as to enable one to support the others. It was admitted that the hearting at the best was not better than the most ordinary rough rubble, and some of the facing stones, it was stated in evidence, were not as large, nor by any means as fully squared, as they should have been. Nor can this be wondered at, seeing that the work was carried out without a specification of any kind; and this work of a kind that would have demanded the most conscientious and unremitting care from a resident clerk of works. Had the masonry been the most perfect of its kind it would have required a large proportion of through stones to band the different shells one to the other, and should besides have had through courses at short intervals of tooled ashlar, composed of large stones, and reaching from the flue to the outer face—a mode of construction which is frequently followed in the erection of the piers of high bridges.

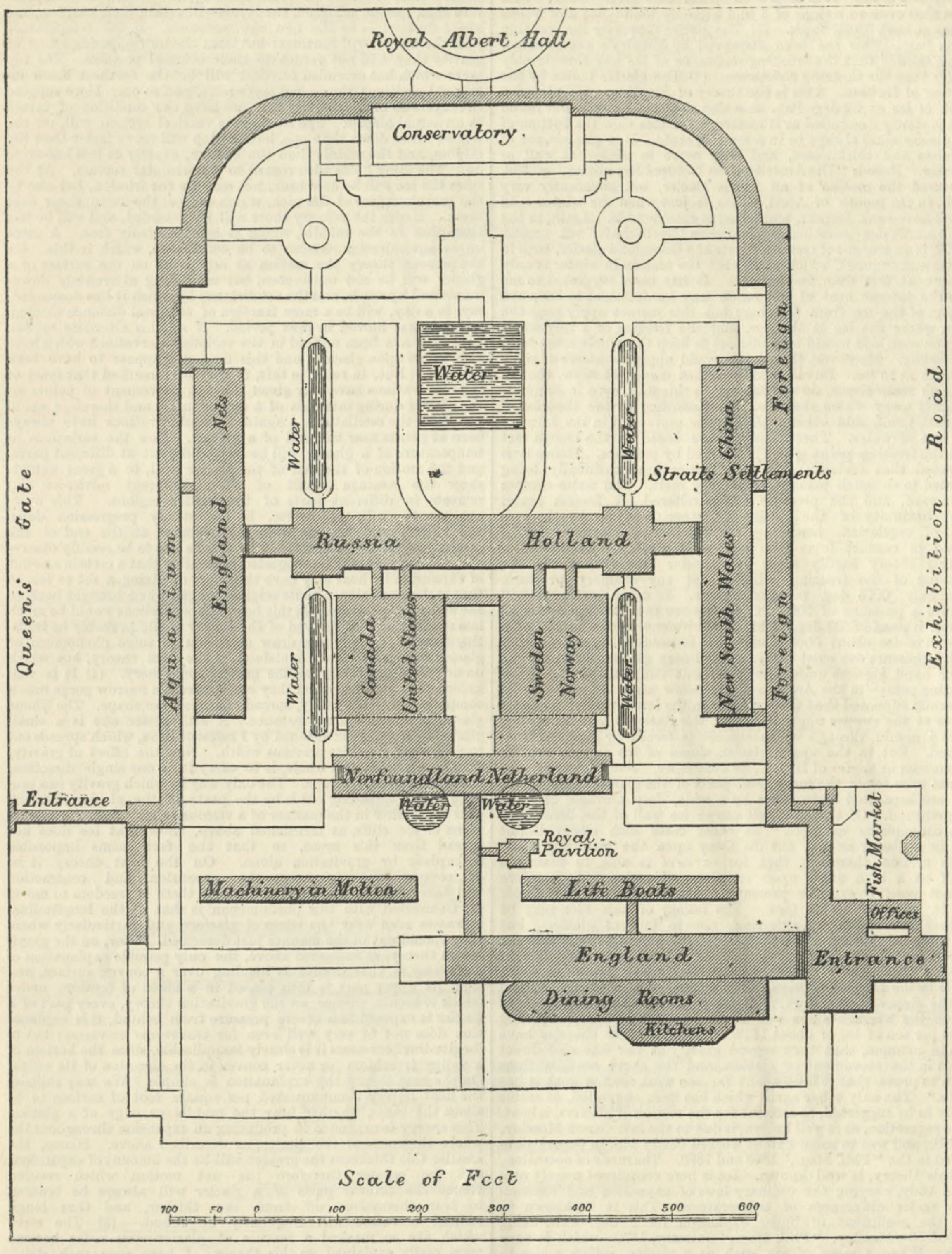
If there is one operation more likely to destroy the cohesion of a chimney of this kind than another, it certainly is cutting out the courses to straighten it. The inevitable effect of such a process is to separate the outer and inner shells one from the other, and completely to destroy any homogeneousness which the structure may have formerly had.

INSTITUTION OF MECHANICAL ENGINEERS.

At the recent annual meeting of the Institution of Mechanical Engineers it was announced by the president, Mr. Westmacott, that the summer meeting would be held this year in Belgium, the council having accepted a cordial invitation to that effect, which had come from the Association of Engineers belonging to the school at Liége. It is understood that the date of the meeting will be the last week in July, so as to anticipate the period when managers and partners in Belgium disperse in search of health and relaxation. Though this date is somewhat early for London engineers, it is well suited to those in the country, and on the whole is probably the best that could be chosen. While the chief part of the week will be spent at Liége, it is understood that the programme includes a long day spent at Antwerp and possibly also visits to other places, such as Verviers and Ghent. In accepting this invitation, the council of the Institution have to some extent taken a new departure. It is true that on two previous occasions Paris has been the locality of the summer meeting; but this was due to the attraction of the great exhibitions which have been held in that capital, in 1867 and in 1878, so that the circumstances were peculiar. It is the first time that the Institution has decided to betake itself to a foreign manufacturing district, in order to see it in its ordinary working-day dress, apart from any special attraction, and to learn what is to be learnt from the inspection of its works, whether of manufacture or construction. We think, however, that the council have done well in sanctioning this innovation, if innovation it be. The time is long past when English engineers could declare that nothing was to be learnt from foreigners. For more than a generation we have been teaching foreigners how to work in almost every department of industry, and it must be confessed that in some cases at least they have bettered the instruction. All unprejudiced Englishmen will now admit that there are some trades in which, from various circumstances of position, &c., our foreign brethren have achieved some superiority, and as to which we perhaps stand in the position of pupils; while in those where it is certain that our supremacy is retained, there will always be points worth noting in their processes and their practice. An Englishman who, with these principles in view, seizes the occasion to visit the industrial establishments in Belgium, will find much to interest, and not a little to instruct him. Doubtless there will be many who will not be backward in profiting by the opportunity.

Liége itself occupies the unique position of being an ancient and picturesque city—not so long ago a quasi-independent capital—which is, at the same time, situated among, and indeed actually over, some of the richest coal measures existing within our globe. The very name for pit coal in the French tongue—*houille*—is said to owe its origin to a certain smith, Hullos, of Plainevaux, who about A.D. 1190 dug coal out of the sloping crests which on either side of Liége guard and limit the picturesque valley of the Meuse. While cropping out on these heights,

THE FISHERIES EXHIBITION, SOUTH KENSINGTON.



the coal measures dip deeply under the floor of the valley, where they are found in those curious undulations and plications which are so characteristic of the Belgian coal-fields. The working of coal under such conditions cannot fail to present many points of interest; and this interest is deepened by the excessive amount of fire-damp met with in these seams, the terrible effects of which are witnessed in the records of many disastrous explosions. At present no light whatever, except a Mueseler safety lamp, is allowed to exist in these mines, and all possible precautions are taken as to working and ventilation, even to increasing the speed of the ventilator in proportion as the mercury falls in the barometer. Collieries of still greater interest than those close around Liége are to be found at Hasard, Gosson, and elsewhere.

It may be said that these are matters for the mining rather than the mechanical engineer; but objects of interest above ground, whether for the engineer or the metallurgist, are also to be found in abundance. The world-renowned works at Seraing are in themselves sufficient to absorb the attention of the visitors for a day at least. We have nothing comparable with it in England, as regards the number of industries which are carried on in one place and under one management, and the vast scale on which they are all conducted. Palmer's works at Jarrow may, perhaps, be cited; but there the finished product is practically of one class only, viz., steam shipping. The works of Sir Wm. Armstrong, Mitchell, and Co., will, perhaps, be a closer parallel, when their proposed steel works are in operation; but even then the different departments will be at a considerable distance from each other. At Seraing we have collieries, blast furnaces, steel works, rail and bar mills, plate mills, tire mills, forges, foundries, engine works, boiler works, and bridge works, all going on side by side within the same enclosure; while the productions of the engine works include locomotives, marine engines, pumping and winding engines, air compressors, mining machinery, and general engineering work. In fact, with the exception of machine tools and steel castings, it is difficult to find any branch of an engineer's business which is not somehow represented. The government of this colossal establishment is another matter of interest. It is often said that in England that limited companies are a mistake, because individual freedom, and the feeling that all is at stake, is a necessary stimulus to successful exertion. The Seraing works, however, have been managed by a limited company since the death of John Cockerill in 1840; and whereas at that date the number of workmen employed did not exceed 2200, there are now 11,000 at work in the different departments. Whether the control of a board is more suited to the genius of the Belgian than of the British nation we will not attempt to decide; but at least we may see that at Seraing has been solved the problem of combining under one direction several different works, all of first-class dimensions, and so obtaining the advantages due to high prestige, vast capital, and powerful financial resources, without at the same time losing that feeling of individual responsibility which is essential to success in industrial enterprises at the present day.

Nor are there wanting other establishments which may compete with Seraing in interest, though they cannot do so in extent and importance. The rolling mills, &c., of Ougrée, midway between Seraing and Liége, are celebrated for their tires and axles, and also for the production of those rolled girders whose appearance in England has so often caused a wail over the horrors of foreign competition. The machine works of the Société de la Meuse, in Liége itself, are well worth a visit, as are the gun-making works in which Liége asserts itself as the Continental rival of Birmingham. In four or five different spots, but all in the neighbourhood, are to be found the various works of the famous Vieille Montagne Zinc Manufacturing Company. Here the members will witness a metallurgical process unknown in England, and yet of great importance. The production of sugar from beetroot is another manufacture, with which scarcely any English engineer is acquainted, but which, in its points of similarity and divergence from the ordinary process with sugar cane, offers much that is of interest to many. Unfortunately, this industry is only carried on during the cold months, so that it cannot be seen in operation; but it is to be hoped that some notice of it will be brought before the members. Going a little further afield, the textile industries—chiefly cloth and velvet—of Verviers and Gileppe will claim the attention of all, but especially of Lancashire engineers; whilst the glass works of Charleroi, the cutlery works of Namur, the lace works of Malines, &c., are all within easy distance.

We have hitherto supposed the meeting to have its centre at Liége, and, indeed, it is fitting that this should be so, since Liége is the place from which the invitation has proceeded, and is the undoubted commercial capital of the country. But there are many other towns in which engineers will find plenty to interest them, independently of the architectural and archæological treasures with which they are plentifully endowed. Especially is this true of Antwerp, which Belgian enterprise is rapidly converting into the most important port of the Continent, and which is already no unworthy rival of London or Liverpool in the extent and magnificence of its dock accommodation. One work in progress here should certainly be inspected by all who visit Belgium this year, since by the following summer it will probably be complete. We allude to the great quay wall which is now being built along the whole course of the Scheldt, from one side of the town to the other. This wall is being built between high and low water, some distance in front of the existing wharves, but neither by means of fixed coffer-dams, like the Thames Embankment, nor by sinking huge masses of masonry previously prepared, like the North Wall at Dublin. A huge frame, called a *batardeau*, acting as an annular coffer-dam, is placed round each length of wall, until it has been raised to high-water level, and is then removed to be used for the next length as required. We can testify to the mechanical interest attaching to the details of this piece of harbour engineering, which is progressing with rapidity and economy towards a complete success; and we are glad, therefore, to learn that a visit to Antwerp will probably form part of the varied programme which the Belgian friends of the Institution are preparing, and which will no doubt warrant us in our assurance that the members have before them the prospect of a highly successful and enjoyable meeting.

THE FISHERIES EXHIBITION.

THE buildings specially constructed at South Kensington for this Exhibition are so far completed that a good idea may now be gathered of the very large and comprehensive character the Exhibition is expected to take. We give herewith a block plan to scale of the buildings, which are built upon the grounds of the Horticultural Society, the plan also showing the arcades already in existence, some of which were used for the Smoke Abatement Exhibition. Extensive tanks are being built in these supplemental to those shown in the grounds. The proposal to hold a great International Fishery Exhibition in London was made before, but was strengthened by the success which attended exhibitions in Berlin, Norwich, and Edinburgh. These exhibitions were the means of bringing valuable inventions before the public, and of suggesting improvements in important branches of fishing and maritime industry. They were also financially successful, a fact of importance as showing the public interest taken in them. There were surpluses ranging from £1400 to £2000. The Berlin Exhibition was only open ten weeks; in that time it was visited by 483,000 people. It is proposed to keep the London Exhibition open for six months. A preliminary meeting was held in the Fishmongers' Hall in July, 1881, when the Fishmongers' Company gave £500 to the prize fund, and £2000 to the guarantee fund, and appointed Mr. Birkbeck, M.P., who had acted as chairman of the Norwich Exhibition, to the chairmanship of the Executive Committee. Sir Phillip Cunliffe Owen has assisted with his advice as to the construction of the building, which is under the immediate superintendence of General Scott, C.B., Mr. G. Bennison being architect.

The Exhibition building stands on twenty-three acres of ground in the Horticultural Gardens, and is in this respect unfortunately a long distance from the centre of London. The grounds of the Exhibition open into the Albert Hall, as shown in the accompanying plan of the whole. In the open spaces of the Gardens there will be fountains, large tanks containing various descriptions of live sea and fresh-water fish, full-sized fishing boats, models of lifeboats, including steam lifeboats, full-sized fish markets, and refrigerating vans for the conveyance of fish. The covered space is over 300,000 square feet. To give some idea of the magnitude of the undertaking, we may mention that on the building in which the Exhibition is to be held the committee have already authorised an expenditure of £20,000. They have a guarantee fund of £22,000. America is spending £10,000 on her exhibits; and, looking to the long list of foreign countries that are competing, at least £100,000 will be spent in what they are sending us. America, Canada, Newfoundland, Norway, Sweden, the Netherlands, and Belgium have applied for an average of 10,000 square feet each for their exhibits; while China, Japan, India, Chili, and New South Wales take together 30,000 square feet. This will leave plenty of room in the covered space for home products, and for foreign countries that have not yet sent in their applications. From the United States we may hope to learn a good deal about the artificial propagation of deep-sea fish. Canada and Newfoundland, as British fishing grounds, are second to none. They possess a fishing-coast of over 4000 miles, and produce £5,000,000 a year, and employ 90,000 men and boys. An important fish trade has recently sprung up with the West Coast of America. The canned fish trade with the Pacific has risen from 4000 cases in 1866 to 928,000 cases in 1882. The total amount of salmon exported from the same quarter is 45,000,000 lb. On this account much interest will be attached to the exhibits from the Far West. In a part of the building set aside for the purpose—or in specially-erected buildings in the grounds—will be shown in active operation the process of curing fish. Scotland, Germany, and Holland are the chief competitors in this section, and foreigners assert that they have something to teach us in this department. The amount of fish annually consumed in London is upwards of 130,000 tons, equal to 1000 bullocks daily during the 313 working days of the year, and representing 90 lb. of fish for every man, woman, and child in the metropolis. The committee have secured the co-operation of the managers of the School of Cookery at South Kensington, who have undertaken to cook and present in the cheapest and most palatable form at breakfasts and luncheons, to be served in the Exhibition, dishes of what are considered the inferior fishes. This is necessary, as although, taking all the year round, the average prices at Billingsgate of haddock, sprats, cod, herring, coal fish, plaice, ling, and hake represent only about 2d. per lb., the second-class fish are not much known by the middle and upper classes in London. By presenting them in a dainty form, it is hoped to show that they are not inferior to fish that command exorbitant prices, and this will benefit alike the London fish consumer and the fisherman on the coast.

Amongst other things attention will be specially directed to the utilisation of fish offal, which is often sold at 1s. to 1s. 6d. a barrel for manure. The utilisation of fish offal is attracting considerable attention in Norway, and Mr. R. W. Duff, M.P., in a recent lecture on the coming Exhibition stated that a grant was voted last year by the Norwegian Parliament to Mr. Sahlstorm, C.E., to carry on experiments in the utilisation of fish offal.

It may be here mentioned that exhibitors of inventions are protected under Act. 33 and 34 Vict. chap. 27. The Board of Trade having certified that the Exhibition is calculated to promote British industry and prove beneficial to the industrial classes of her Majesty's subjects, inventors, within six months of the time of the opening of the Exhibition, will be entitled to apply for letters patent. The secretary, after legal advice, has prepared a circular on the subject. The committee offer liberal prizes on various subjects, some of an engineering or mechanical character, as announced in THE ENGINEER of the 15th September, 1882. For instance, Essay No. V., for which prize of £100 is offered, is on "Improved Fishery Harbours—the principle on which they should be Constructed, and the principle the State should adopt in encouraging Harbour Accommodation for Fishery Purposes." Mr. Duff is of opinion that money properly laid out in harbours should come under the head of reproductive expenditure. Take the case of Fraserburgh, £100,000 was borrowed at 3¼ per cent. In ten years the number of boats fishing from Fraserburgh was doubled, while in the same time the harbour revenue and the value of the exports were nearly trebled.

By the plan we give on p. 99, it will be seen that very large areas are taken by foreign nations, Russia, only a few days ago, deciding to take 10,000 square feet. The new buildings are very light wood structures, the principals being 50ft. in span, and built up of three thicknesses of deal boards, the two outer boards being ¾in., and the inner board 1¼in. by 9in. deep. These thicknesses are, however, only nominal, as four of the ¾in. boards are cut from a 3in. deal and two 1¼in. boards and a ½in. board are also cut from a 3in. deal. The principals are of the same form as those already existing in the well-known entrance from Exhibition-road. They are very light, of good appearance, and cheap. There seems to be every prospect of the Exhibition being very interesting to the public generally, and not a little so to engineers.

ON THE CAUSES OF GLACIER-MOTION.

By WALTER R. BROWNE, M. Inst. C.E., late Fellow Trin. Coll., Cambridge.*

THE question of the causes which produce the movement of glaciers, which was at one time so eagerly discussed, would appear to have slumbered for the last ten years. This cannot be said to arise from the fact that a perfectly satisfactory theory has been developed, and recognised as such by all inquirers. The ambiguous allusion to the subject in Sir John Lubbock's presidential address to the British Association is an evidence that such certainty has not been attained. It is, indeed, generally supposed that the fact of the melting point of ice being lowered by pressure is somehow at the root of the matter; but a full explanation of the origin of this pressure in the case of glaciers, and of the mechanical features of the problem, has yet to be given. I may, therefore, be pardoned if I draw attention to a different solution, proposed not by myself, but by one of the greatest of English mathematicians. My apology for doing so is that I approach the question as an engineer, not as a physicist; and that it is in its essence, as will be shown immediately, a mechanical rather than a physical problem. The following are leading facts of glacier-motion which must be accounted for by any valid theory on the subject:—(1) The phenomena of the movement of a glacier are simply those of a solid body in a state of flow. (2) The present glaciers of Switzerland or Norway, which are the only ones which have been critically examined, are mere shrunken fragments of the glaciers of the great ice age. To take one instance, the present glacier of the Rhone is about six miles long, and, perhaps, 500ft. deep; but the old glacier of the Rhone, which abutted against the Jura, was 120 miles long, and must have been 2000ft. to 3000ft. deep. The movement of such glaciers as this must also be accounted for in any satisfactory theory. (3) The glaciers of the present day are not confined to the temperate region; they are found in much larger numbers and of much greater size in the Arctic regions. (4) Both in the temperate and in the Arctic regions glaciers move in winter as well as in summer, and by night as well as by day. That a glacier is in a state of flow was first proved by Forbes, and has since been confirmed by the measurements of Tyndall and others. Whilst the whole mass moves downwards, the top moves faster than the bottom and the sides than the middle; the upper layers must, therefore, be continually shearing over the lower, and the medial over the lateral. A glacier, being a body in a state of flow, must move under the influence of forces powerful enough to overcome its resistance, and so produce this condition. The general phenomena of the motion of a glacier are exactly reproduced when a viscous body moves through a channel under the influence of its own weight. We have, therefore, to inquire whether the shearing resistance of ice is sufficiently low to enable us to regard a glacier as a viscous mass. The only experiments known to me on the shearing resistance of ice are those of Moseley—"Phil. Mag.," January, 1870. He found that with pressures from 100 lb. to 110 lb. per square inch, cylinders of ice sheared slowly across the two planes in contact, sliding over each other without losing continuity. The distance sheared through was about ⅝in. in half an hour. A load of 119 lb. per square inch was sufficient to shear through a cylinder of 1½in. in diameter in two to three minutes. From these experiments it would appear that the lowest shearing stress which will cause ice to flow is about 100 lb. per square inch; but sufficient time was not allowed in the experiments to make this a matter of certainty. There is another way in which the shearing resistance of ice may be tested. In the case of a block of ice of vertical sides, gravity of course produces a shearing resistance along all planes passing through the base. Let h be the height of such a block in feet, and consider the shearing force due to gravity on any square foot of a plane making an angle θ with the vertical. The shearing force is given by—

$$\frac{\dfrac{wh \times h \tan.\theta}{2} \times \cos.\theta}{h \sec.\theta} = \frac{wh}{2} \sin.\theta \cos.\theta.$$

This expression is a maximum when $\theta = 45$ deg., and its value is then— $\frac{wh}{4}$.

What is the greatest height at which a vertical cliff of ice will stand? I am not able to state this precisely, but it is very considerable. Mr. Whymper mentions crevasses in South America 300ft. deep. Cliffs of fully that height have been seen standing out of water in the case of icebergs, and as so small a part of an iceberg projects above water, these cliffs probably extend below to a considerable depth. Taking, however, only 300ft. for the value of h, or for the maximum height of an ice cliff, this would give about 30 lb. per square inch as the lowest shearing force upon a plane of ice which would cause it to assume the condition of flow. Let us now suppose a glacier of thickness a, lying upon a slope whose inclination to the horizontal is β: then the force, per square foot, tending to shear the ice at its junction with the slope, is clearly $a w \sin.\beta$. Supposing $\sin.\beta$ to equal ¼, and that the shearing resistance is 30 lb. per square inch, we get a = about 290. Hence we may say that a glacier lying on a slope of 1 in 4 will not move at all under its own weight, unless it be at least 300ft. thick, and that if it be more than this, the upper 300ft. will move as one solid mass, the part below alone representing the conditions of flow. It is needless to say that there are hundreds of glaciers which are less than 300ft. thick, and which at no part of their course have a slope anything approaching 1 in 4. We have now to show that the theories generally propounded for glacier action are all of them negatived by some of the foregoing considerations. These theories may be stated as follows:—(1) The glacier simply slides over its bed as a solid body. This is negatived by the fact that some parts move faster than others. (2) The glacier flows under the action of its own weight, exactly as a viscous body flows. This is the theory of Forbes. It is disproved by the facts given above, which show that even on a slope of 1 in 4 a glacier would not flow unless it was at least 300ft. thick. (3) The glacier moves by the crushing of its base. This has been disproved by Moseley's experiments, which showed that the crushing resistance of ice was considerably higher than the shearing resistance. (4) The glacier moves by the melting of its base. This is the theory of Hopkins. He placed a block of ice at 32 deg. Fah. on a slab at a small angle, and found that it slowly descended as it melted. On this view the bottom of the glacier must always be in a melting state. But glaciers are of all sizes and thicknesses, and they move in winter as well as summer. Bessels "Die Amerikanisch Nordpol Expedition," p. 398, measured the motion of an Arctic glacier, not apparently very thick, in the month of April, which is just when the winter cold would have sunk deepest, and found it considerable. Again, in the "Zeitschrift des deutschen Geologischen Gesellschaft," vol. xxxiii., p. 693, is an account of measurements of a Greenland glacier, both in winter and summer, which show that the motion in winter is only 20 per cent. less than in summer. It has been suggested to me that the interior heat of the earth may be sufficient to keep the bottom of the ice from freezing; but this cannot apply near the sides, where the ice is shallow, and the freezing of a very small strip on each side would be sufficient to keep the whole mass from descending. Moreover, this cause would apply to masses of snow as much as to ice. But it is known that masses of snow, though lying on steep slopes, do not descend in this way, even in summer, but melt away where they lie. (5) According to the theories of Tyndall, Croll, and others, the glacier moves not in the form of ice, but of water. These theories are based on the known fact that the freezing point of ice is lowered by pressure. Hence it is supposed that certain parts of a glacier are continually being exposed to so much pressure that they melt. The water escapes downward, and the pressure being relieved, it freezes again. The continuity of the glacier is further kept up by the process of regelation, according to which two pieces of ice if placed in contact form into one solid mass. The advocates of this theory hardly seem to consider how very small the lowering of the freezing point is for any ordinary pressure. It is only ·0075 deg. per atmosphere. In other words, it will require a pressure of 2000 lb. per square inch to liquefy ice at 31 deg. instead of 32 deg. This is equivalent to the weight of a column of ice about 5000ft. high. It is needless to ask whether such a pressure can exist within an ordinary glacier, while on the other hand glaciers undoubtedly move at temperatures far below freezing point—in the Arctic regions below zero. It seems to be generally supposed that the pressure in the lower part of a glacier is due to the steeper upper portions; the glacier channel is spoken of as a mould, through which the ice is forced by pressure from behind. But in the upper glacier, slopes of ice or *névé* are not uncommon at angles of 30 deg., or even more. Such slopes usually do not even touch the more level parts of the glacier below them, but are separated from them by a wide, deep crevasse called a Bergschrund. Of this the well-known ice wall of the Strahlpick is a conspicuous example. In other cases such slopes do not end in a glacier at all, but die away upon the mountain side. It is certain, therefore, that ice or *névé* is able to maintain itself at a high angle upon its slope of rocks, and therefore cannot possibly exercise pressure upon the parts of the glacier far in advance of its foot. The fallacy of this idea may be further illustrated by referring, not to modern glaciers, but to those of the great ice age. Can we suppose that the pressure of the snows about the sources of the Rhone was sufficient to drive that glacier down the valley to Martigny, round a sharp angle to the Lake of Geneva, through the bed of that lake, and on to the slopes of the Jura, a distance of more than 100 miles, in which the average slope was about 1 in 200, giving a propelling force per ton of ice of about 11 lb. only? All these theories have this in common, that they regard gravity as the sole and direct agent in the movement of glaciers, and the above considerations seem to prove that it is an agent far too weak for the work it has to do.* The only other agent which has been suggested, or seems likely to be suggested, to account for the motion of glaciers, is heat. This suggestion, as is well known, is due to the late Canon Moseley, F.R.S., and was to some extent worked out by him in papers published in the "Phil. Mag.," 1869 and 1870. The mode of operation, on this theory, is well known. Ice is here considered merely as a solid body, obeying the ordinary laws of expansion and contraction under differences of temperature. This it is known to do, the coefficient of linear expansion for 1 deg. Fah. being ·00002856—Moseley, "Phil. Mag.," January, 1870—which is very high. When a mass of ice, such as a glacier, suffers a rise in temperature, either through conduction or radiation, it will expand; this expansion will take place mainly in the direction where movement is easiest, that is, down the valley. If from any cause the temperature falls, the glacier will again contract; but since the expansion is assisted by gravity whilst the contraction is opposed by it, the latter will be somewhat less in amount than the former, and when the ice has returned to its original temperature its centre of gravity will have moved a certain small distance down the valley. By such alternate expansions and contractions the glacier moves gradually from the top to the bottom of its course. That variations of temperature do take place in a glacier cannot be doubted, whatever be the condition in which it lies. This granted, the fact that it should move in the way described appears to me no more surprising than that the sheets of lead on which Canon Moseley made his well-experiments did so move; and that the motion thus produced is of the character which answers to all the facts of the case, so far as they are at present known, can, I believe, be established.

The controversy occasioned by Canon Moseley's articles was unfortunately terminated by his illness and death before the matter had been fully cleared up. The main objections urged to his theory were two. The first was that a glacier is not one continuous body, as assumed by Canon Moseley in his mathematical investigation, but is broken up into many parts by crevasses. But, in the first place, the assumption above mentioned is merely one of convenience, and not in the least necessary to the theory. A detached piece of ice would move in the same way as a glacier, or as the sheet of lead did in Canon Moseley's experiments. Secondly, if a glacier is anywhere divided in its whole thickness by a crevasse, this is absolutely fatal to the gravitation theories, since there can be no pressure between the portions above and below this division. The only possible explanation of crevasses, on these theories, is that they are due to the glacier bending over a convex part of its bed. In that case the bottom half will be in compression, and only the top half in tension, so that the crevasse cannot possibly extend more than half way through the thickness. The second objection was that the conductivity of ice is low. Hence the effect of the heat would be confined to the layers near the surface, and could not account for the motion of the glacier as a whole. This objection does not seem to be confirmed by careful reflection upon the way in which such forces act. Let us suppose a glacier 100ft. deep, of which each successive foot expands and contracts alike throughout, but adheres with a definite shearing resistance to the layers above and below. Let there be a rise in temperature, which does not extend beyond the uppermost 10ft. This layer will expand, and if it were free would expand to the full amount due to the increase in temperature. But its lower surface is not free. In expanding it will, therefore, drag the next layer after it, or, in other words, will cause it to expand also. The amount of expansion, however, will not be so great, because there will be a certain shearing extension at the plane of division between the two. The second layer will similarly cause an expansion in the third, and so on to the bottom. In consequence, the energy which would all have been exerted on the top layer, had that been free, will be distributed over the whole of the layers; and the extension of the top layers will of course be much smaller than it otherwise would have been. Should the temperature then remain constant, the layers will retain their position, and adapt themselves to the new circumstances. If the temperature falls the layers will contract; but from the now opposing effect of gravity they will not return to their original position. The top layer which has extended furthest will be the furthest below its original position; the second layer next, and so on. If we suppose the layers to be indefinitely thin, we have the condition of things in an actual glacier. The ice in any vertical section will, on the whole, move down the slope, but the top will move faster than the middle, and the middle than the bottom, exactly as it is known to do. The same holds with regard to a horizontal section. At the sides the ice will be held back, not only by the friction, but also by the protuberances of the rock, which compel the ice to shear over them. Hence the velocity there will be retarded, and will be less than that in the middle, which is comparatively free. A more important objection remains to be considered, which is this. On the present theory the motion at any point on the surface of a glacier will be not continuous, but oscillating alternately downwards and upwards, and the net distance by which it has descended, say, in a day, will be a mere fraction of the total distance through which it has moved in that period. If so, this alternate motion ought to have been noticed in the various observations which have been made upon glaciers, and this does not appear to have been the case. But, in reply to this, it may be remarked that most of the observations have only given the net movement of points on the glacier during intervals of a day or more, and therefore would not show the oscillations. Again, such observations have always been at points near the end of a glacier. Now the variations in temperature of a glacier will be very different at different parts, and the motion of the end of the glacier will, to a great extent, show the average result of these different advances and retreats in different parts of the higher regions. This average result will, of course, be a steady progression down the valley, and the oscillatory movement at the end of the glacier may be so much masked by this as not to be readily observable. Lastly, it may be suggested as possible that a certain amount of expansion by heat may have the effect of giving a set to ice, so that it does not return to its original length when brought back to the same temperature. It this be so the oscillations would be much less marked, and at the end of the glacier would probably be indistinguishable. I may now draw attention to some phenomena of glacier action, which are explained by the heat theory, but which do not seem explicable on the gravitation theory. (1) It is well known that glaciers, when they emerge from a narrow gorge into a comparatively wide valley, spread out into a fan shape. The Rhone glacier is a well-known instance. A still better one is a small glacier in Norway, mentioned by Professor Sexa, which spreads out to five or six times its previous width. Now the effect of gravity, acting on a mass as a whole, is to carry it in one single direction, that of the steepest slope. The only way in which gravity can produce such a spreading out is by the parts of the glacier shearing over each other in the manner of a viscous solid. But the phenomena of ice cliffs, as mentioned above, show that ice does not spread from this cause, so that the fact seems impossible to explain by gravitation alone. On the heat theory it is, of course, perfectly easy; the expansion and contraction will take place in all directions where there is freedom to move. (2) Connected with this phenomenon is that of the longitudinal crevasses seen near the edges of glaciers, and particularly where they spread out in the manner just described. Now, on the gravitation theory, as remarked above, the only possible explanation of a crevasse is that the ice is bending over a convex surface, and that its upper part is thus placed in a state of tension, under which it breaks. Since, on the gravitation theory, every part of a glacier is exposed to a severe pressure from behind, this explanation does not fit very well even for transverse crevasses; but to longitudinal crevasses it is clearly inapplicable, since the bottom of a valley is seldom or never convex in the direction of its width. On the heat theory the explanation is simple. We may suppose the heat energy communicated per square foot of surface to be about the same, whether near the middle or edge of a glacier. This energy is expended in producing an expansion throughout the whole thickness of the glacier, as described above. Hence, the smaller this thickness the greater will be the amount of expansion, and the greater therefore the net motion which results. Hence the thinner parts of a glacier will always be tending to tear themselves off from the thicker, and thus longitudinal crevasses will frequently be found. (3) The striæ which are so marked a feature of glacier-worn rocks become more easily explained on this theory. I have seen such striæ, even in the hard hypersthene of Skye, which were a considerable fraction of an inch in depth. When we consider the enormous force necessary to plough out such a furrow in hard rock, it is almost impossible to believe that it was done by the simple passage over it, once for all, of a stone imbedded in the ice. If, however, the stone descended by a series of oscillations, so that it passed many times over the same spot, this difficulty is greatly lessened. (4) In conclusion, I may point out that the advocates of the gravitation theory are bound to explain what becomes of the heat energy which is poured into a glacier. When the sun is shining this radiant energy is always very large, although the temperature of the air may be low. In such cases the glacier does not melt; it is perfectly clear that it must expand, as any other solid must expand under the action of heat. If so, it seems unreasonable not to hold that the gradual descent by alternate expansion and contraction must follow, as it is known to follow in the case of other materials. On the subject of the motion of Arctic ice, Dr. Rae, F.R.S., has kindly permitted the publication of the following particulars:—"When in Greenland, in the autumn of 1866, I was ice-bound at the head of one of the fiords, and slept a couple of nights at an Eskimo's house. A glacier about half a mile distant was then in full activity, the movement of which might, I believe, have been as visible to the eye as it certainly was audible to the ear. My own idea is that Arctic glaciers must have a downward motion more or less during the whole year, summer and winter. I believe the alternations of heat and cold—or, I should rather say, of temperature—would of itself cause motion, especially near the upper surface. We know that ice 2ft. or 3ft. or more thick contracts very considerably in a few hours by a sudden fall of 15 deg. or 20 deg. of temperature. I have found cracks in Lake Winnipeg 3ft. or 4ft. wide, formed by this cause during a single night, almost stopping our sledge journey. This gap soon freezes up. Then the weather gets milder, the ice expands, and with the new additional formation is too large for the lake, and is forced up into ridges. This process goes on at every 'cold snap,'* alternating with milder weather. Now supposing a glacier for 10ft. or more of its depth contracts by cold, as lake ice is known to do, it will get a series of cracks probably in its longest axis, say from inland seaward; the first snow-drift will fill up these cracks or some of them, and this filling up will to some extent perform the same office as the freezing of the cracks in the lakes. The longitudinal extent of the glacier will be increased. A snowstorm always brings milder weather, which would expand the glacier, but as this expansion would naturally tend downhill, instead of up, the whole motion would be downwards. But even if the cracks I mention did not take place, the contraction by cold would pull the ice downhill, not up, whilst the expansion by increase of temperature would tend to push the glacier downhill, so that these opposite actions would produce similar effects in moving the glacier, or such part of it as could be acted upon by external temperature, downwards. I may also add that when a crack, however slight, is formed by contraction, the cold is admitted into the body of the glacier, and increases the contracting power or influences."

* From the "Proceedings" of the Royal Society, No. 222, 1882.

* Another evidence against pressure from behind as a cause of motion is furnished by the very small size of many glaciers. Some of these, notably those of the class called "glaciers remaniés," are only a few hundred yards long, and cannot be many feet deep.

* "Cold snap," an American term meaning a rather sudden increase of cold.

THE ST. GOTHARD TUNNEL.—COMPRESSORS AND DRILL.

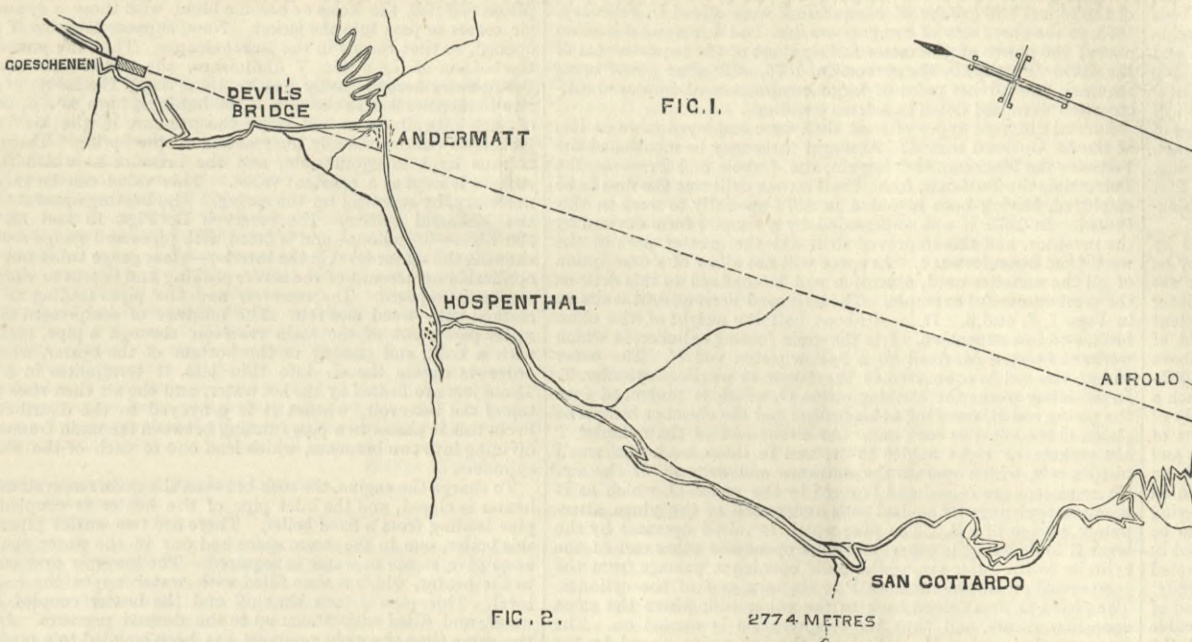


FIG. 1.

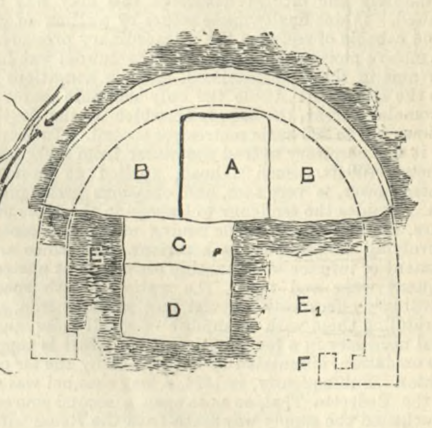


FIG. 3.

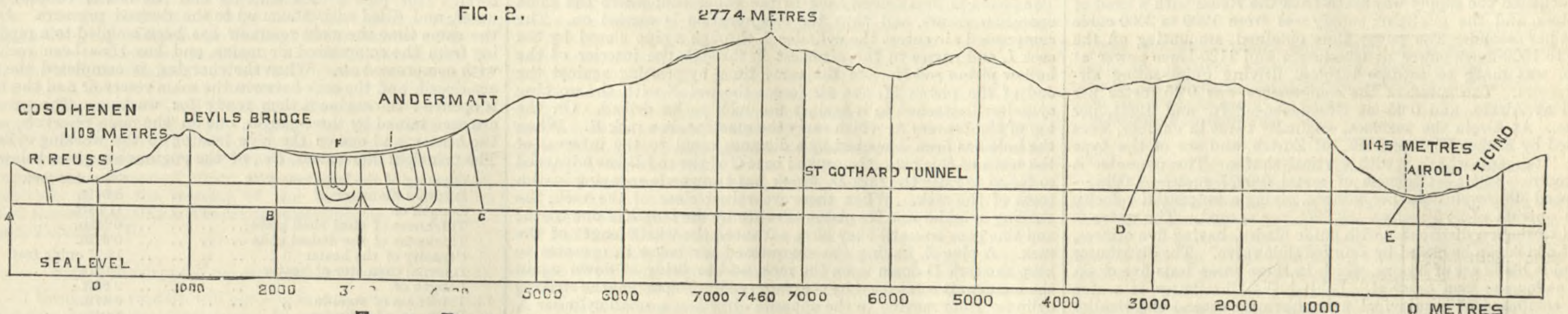


FIG. 2.

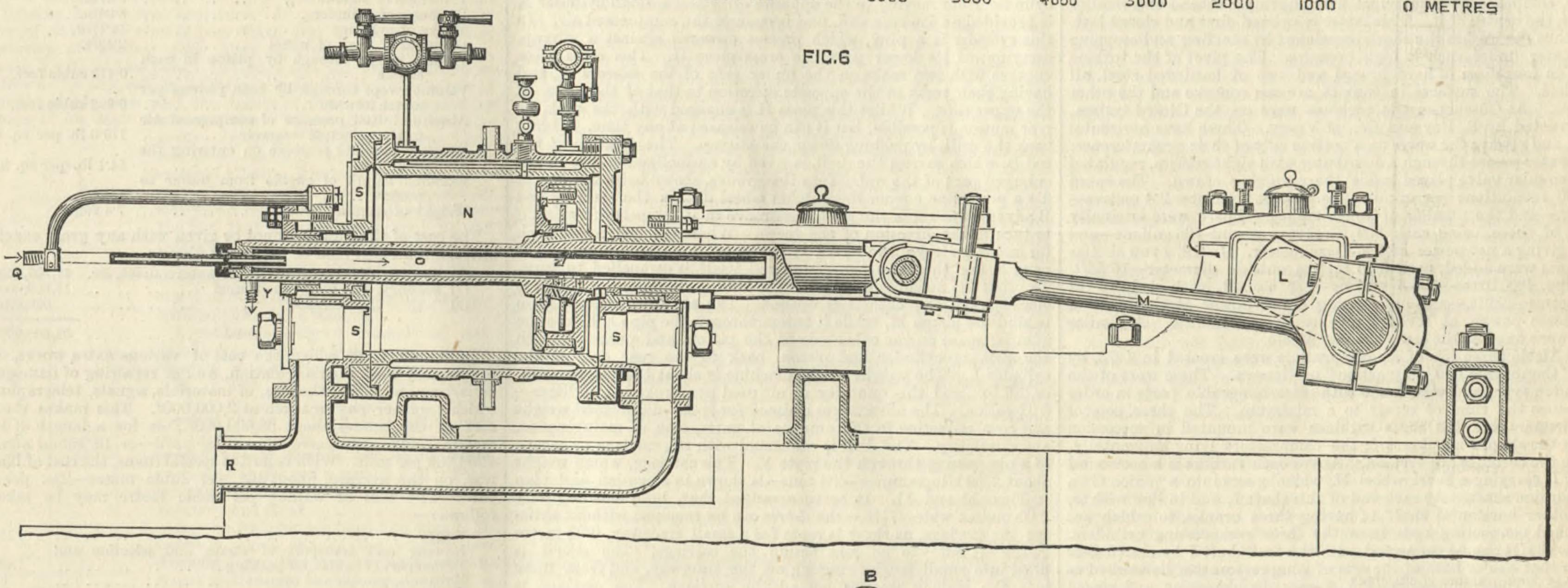


FIG. 6

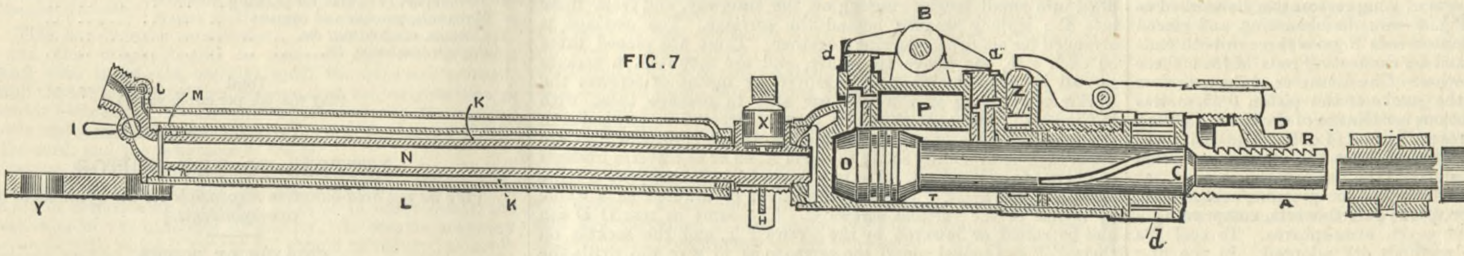


FIG. 7

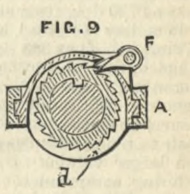


FIG. 9

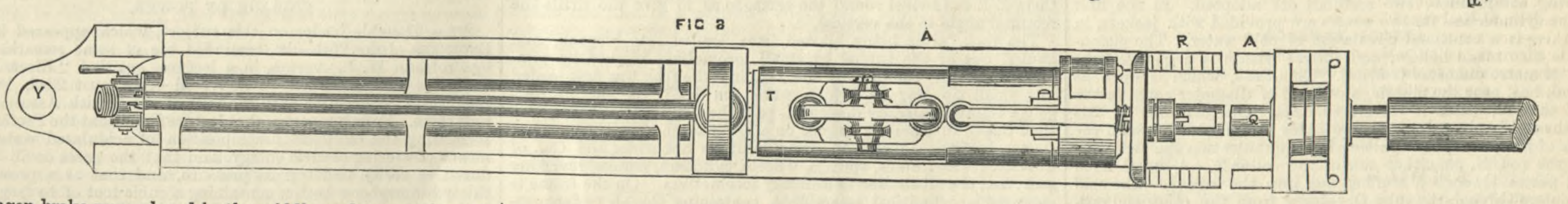


FIG. 8

two-wagon brake were placed in the middle, and two at the end, each loaded with 10 tons, was started on the Vienna Verbindungsbahn and driven with the ordinary goods train speed along the horizontal and down the incline of 1:38. A stoppage was made on the latter with the two two-wagon brakes without the application of the tender brake. The engine and tender were then uncoupled and the train held in position, first by the two, and afterwards by the middle brake alone. On the engine being again coupled up, three attempts were made to overcome the power of the brakes; at the second the train was dragged about a yard, and at the third a coupling screw gave way.

Two pairs of wagons have been running for two and a-half years on the Südbahn, and fifteen pairs for more than a year without requiring the least repair, and the Direction have decided not only to apply them to all new trucks, but also to any that come into the shops for big repairs. The brakes have also been adopted by the Nordbahn, Rudolfs Bahn, and Dux Bodenbacher Bahn, in Austria; by the Chemin de fer du Nord in France; and by the Russian Südwestbahn.

We are informed that the prime cost of adjustment to wagons already fitted with the ordinary spindle brake, so that it can be used either as a two or one-wagon brake, is about £17, and the weight of the parts 200 lb. If applied as a group brake, the cost of fitting up two wagons amounts to about £20, and the weight of the parts to 220 lb. The number of brakesmen is reduced by one-half, and the saving effected thereby will be seen from the following calculation:—With a rolling stock of 500 pairs of running goods wagons, at least 100 brakesmen can be dispensed with, equal to a yearly saving of £75 × 100, or £7500, or capitalised at 5 per cent. to a capital fund of £150,000; whereas the prime cost of fitting 500 pairs of wagons with the Hardy group brake amounts only to £10,000. A similar saving in working expenses is also effected by the use of the two-wagon brake in mixed trains.

THE ST. GOTHARD TUNNEL.*

By HERR E. WENDELSTEIN, of LUCERNE.

THIS paper was intended to give a brief sketch of the methods employed in constructing and working the St. Gothard tunnel. A plan of the railway from Fluelen to Biasca is given in Fig 1, and a section of the tunnel, with the overlying rocks, is given in Fig 2.

The tunnel forms a straight line in plan, Fig. 1, having a total length of about nine and a-quarter miles between the northern portal at Göschenen and the southern portal at Airolo. The former is at a height of 1109 metres above the sea—about 3640ft.—and the latter of 1145 metres—about 3760ft. From the northern portal the line rises with a gradient of 0·5 per cent.—1 in 200—to a point 7801 metres within the tunnel—about 4·9 miles—and then falls towards the southern portal with a gradient beginning at 0·05 per cent., then changing to 0·2 per cent., and ending at 0·1 per cent. The trigonometrical and other methods by which the centre line of the tunnel was originally fixed, and adhered to during construction, will not here be entered upon. The construction of the long tunnel having been decided on, and the actual trace laid out, a contract was entered into with Messrs. Favre and Co., of Geneva, for the completion of the work. In this contract it was provided that the tunnel should be completed within eight years. This time is much shorter than that occupied in the case of the Mont Cenis Tunnel, but that was blasted by gunpowder instead of dynamite, and the boring machines had also been much improved in the interval. As a matter of fact, the time occupied was about nine and a-quarter years of continuous labour day and night, the work having been commenced in the summer of 1872, and completed towards the end of 1881.

The actual method of piercing the tunnel is shown by the section, Fig. 3, and is known as the Belgian method. A heading A was first driven at the top of the tunnel, 2·5 metres broad and 2·5 metres high—8·20ft. Side widenings B B were then made on either side of this heading, so as to complete the whole arch of the tunnel, which was then lined with brickwork. A bottom cut was then made in the floor, extending to the bottom of the tunnel, but lying almost wholly on one side of the centre line. This was made in two cuts C and D, and when this was completed, an abutment was still left on each side, one of them much wider than the other. The narrower one was then cleared out and the side wall put in, but the wider was merely cleared away so far as to allow the laying of a single line of rails; the clearing away of the remainder, and the building of the second wall, being reserved for some later period when a double line should be made necessary by the increase of the traffic. This, however, was so large, from the period of opening, that this second line is already being laid. A drain F is cut at the corner. The rocks passed through by the tunnel have been described as follows by the official geologist, Dr. Stapff, taking them in order from the north end. (1) The "Finsteraar horn Massiv," A B, Fig. 2, which is granitic gneiss, very hard and compact, and extends for about one-seventh of the distance. (2) The "Ursern Mulle" B C, which is gneiss, rich in mica, with intervening quartzose and greenish layers. There was some amount of water in this rock. (3) The "Gothard Massif" of pure

* Institution of Mechanical Engineers.

gneiss, C D, the beds intersecting the axis of the tunnel at a high angle, and occupying about one-half the total length. (4) The "Tessin Mulde" D E, which is mica schist, occupying one-fifth of the length at the southern end. This rock varied much, and yielded a good deal of water. The whole of the rock lay in beds nearly at right angles to the axis of the tunnel, and was favourable both for boring and blasting; except the granite, No. 1 above, and a length of about 380 yards of serpentine, situated about 5300 yards from the north entrance; these proved very hard. There was also, about 2800 yards from the north entrance, a length of about 85 yards, F, Fig. 2, where the gneiss changed into a species of china clay. This became known, during the making of the tunnel, as the "pressure-length," and gave great trouble by collapsing. Unfortunately the critical nature of this clay was not at first recognised. It was finally made secure by walling of great thickness and capable of resisting the extraordinary pressure.

The motive power at both ends of the tunnel was furnished by the streams in the neighbourhood, but the conditions were by no means the same. At Airolo the only available source at first was the Tremola torrent, the supply of which in the depth of winter sometimes fell to 200 cubic metres per second. To obtain sufficient power it was necessary to lead the water from a vertical height of 181 metres—594ft. Such a head, applied to quantities above 200-horse power, is very rare, and occasions great practical difficulties. Besides the tendency to leakage in the pipes under such a pressure, the high speed of the issuing water, and consequently of the revolving turbines, forms a serious evil; since any want of adjustment or inferior workmanship causes great unsteadiness and consequent wear and tear. The water at such speeds has an extraordinary effect both on cast and wrought iron, and even on steel, riddling them with a number of small holes, and rendering renewal necessary in a few months. This effect is supposed to be due to oxidation, stimulated by impact and by the air contained in the water. Subsequently, in 1874, a long channel was constructed from the Bedretta Thal, so as to open a second source of supply. At Göschenen the supply was taken from the Reuss with a head of 93 metres, and the minimum supply was from 1200 to 2000 cubic metres per second. The power thus obtained, amounting on the whole to 1500-horse power at Göschenen and 1120-horse power at Airolo, was made to actuate turbines driving quick-acting air-compressors. The speed of the compressors was 0·45 metre per second at Airolo, and 0·65 at Göschenen—88ft. and 128ft. per minute. At Airolo the turbines, originally three in number, were supplied by Escher Wyss and Co., of Zurich, and are of the type called "tangent wheels" with vertical shafts. The diameter is 1·20 metre—3·94ft.—thickness of metal 0·0277 metre—1·09in.—and speed 390 revolutions per minute, giving a tangential velocity at the outside of 24·5 metres—80·38ft. per second. The water is passed through a distributor with guide blades, having five orifices, any of which can be closed by a curved slide valve. The distributor and guide blade are of bronze, which in these cases lasts five or six times as long as iron or steel. Behind the distributor is a stop valve, composed of a principal valve having a second and smaller one in the centre of it. This latter is opened first and closed last, and thus diminishes the shock occasioned by starting and stopping the water under such a high pressure. The pivot of the turbine rests on four discs of hard bronze and two of hardened steel, all polished. The surfaces in contact are one concave and the other convex. At Göschenen the turbines were on the Girard system, constructed by B. Roy and Co., of Vevey. These have horizontal axes, and receive the water on a portion only of their circumference. The water passes through a distributor with eight orifices, regulated by a circular valve placed inside the revolving crown. The speed is 160 revolutions per minute, the outside diameter 2·4 metres—7·87ft.—and the number of vanes eighty. There were originally three of these, using each 800 litres per second—66 gallons—and each giving a net power of 250-horse power. In 1876 two similar turbines were added, each 5·05 metres outside diameter—16·56ft.—using 480 litres—105·6 gallons—per second, with a head of 73 metres—239ft.—and each giving a net power at the shaft of 325-horse power, at seventy revolutions per minute. A similar pair were fixed at the same time at Airolo.

At Airolo three sets of air compressors were erected in 1873, by the "Compagnie de Construction" of Geneva. These were of the Colladon type, and were made with interchangeable parts in order to reduce the time of repair to a minimum. The three sets of compressors and the three turbines were mounted in succession along the shop, Figs. 4 and 5, the compressors lying horizontally, while the turbines are vertical. Above each turbine is a horizontal shaft I, carrying a bevel wheel H, which gears into a pinion C on the turbine shaft. At each end of this shaft I, and in line with it, is another horizontal shaft L, having three cranks, to which are attached connecting rods from the three compressing cylinders. These shafts can be connected with the first shaft I by clutch gear V, so that one or both of the sets of compressors can be worked as desired. The compressors—Fig. 6—are double-acting, and placed parallel to each other. The piston-rods N pass through both ends of the cylinders, and are worked by connecting rods M from three cranks at 120 deg. from each other. The diameter of the cylinders is 0·46 metres (18·11in.), and the stroke of the piston 0·45 metres (17·72in.), which at 390 revolutions per minute of the turbine gives a mean piston speed of 1·35 metres per second (4·43ft). The position of the cranks gives a uniform motion without the employment of a governor. With this arrangement the four turbines may, at pleasure, be concentrated on three sets of compressors, compressing the air to nine atmospheres, or spread over five sets, compressing a much larger volume to six or seven atmospheres. To cool the air during compression, two methods are adopted. In the first place the cylinder and its two covers are provided with jackets, in which there is a continual circulation of cold water. The piston-rod N is also made hollow, and carries within it a copper tube O O, 0·04 metre diameter (1·57in.). This tube, which is open at each end, has, near the middle, a collar Z of diameter equal to the bore of the rod, which it therefore closes. On each side of this collar the rod is pierced with three holes communicating with the interior of the piston, thus putting in communication the air spaces within the rod N, on either side of the collar Z. A small fixed tube Q passes through a stuffing box into the tube O. The cold water enters through the tube Q, returns from the other end outside the tube O, passes through the interior of the piston to get from one side to the other of the collar Z, and returns to the pipe Y, whence it is conducted away through a flexible hose. By this means the surfaces in contact with the compressed air, both inside and out, are kept always cool, whatever the speed, and if the air be dry no other cooling arrangement is necessary. Secondly, there are two spray injectors fixed at each end of the cylinder. The water for these is filtered first through a sand filter M, Fig. 5, and then through a wire sieve N. The object of this filtration is to get rid of the fine granite silt found in Alpine water, and so to prevent the wear of the packings, &c. The filtered water arrives at the compressors through the pipes V, passes through the air vessel E, is compressed by the pump D attached to the cross-head, and forced as fine spray into the cylinder. The volume of injected water is less than $\frac{1}{100}$ part of the air compressed in the same period. It passes with the compressed air through the exhaust valve S and through the pipes T, to the large reservoirs shown in Fig. 4, where the water is deposited. The air compressed in the tube T forms a species of spring, which at each stroke gives back to the cylinder almost all the energy lost in compressing it. The compressors at Göschenen are similar in arrangement to those at Airolo, and have the same method of cooling the piston and cylinder. They were made by Messrs. B. Roy and Co., of Vevey. The turbines make 160 revolutions, and the driving shaft 80 revolutions per minute, the diameter of the cylinder is 0·42 metre (16·5in.), and the stroke 0·65 metre (25·6in.). Each set of three compressors will compress 4 cubic metres (141 cubic feet) per minute to eight atmospheres total. The piston packing is formed of two bronze rings, with a space between them, which is filled with water admitted through a hole from the inside of the piston. This water forms a liquid packing, and at the same times cools the walls of the cylinder during the stroke. Some of it also escapes past the rings, and entering the cylinder takes the place of the spray in cooling the compressed air; for this purpose it is raised to a higher pressure when necessary by a special pump. At each end of the tunnel two groups of compressors were added in February, 1875, to the three sets of compressors first laid down and described above; the power of the latter falling short of the requirements of the work. Finally, in the summer of 1876, still larger power being required, two further pairs of large compressors of improved construction were laid down in a fresh building.

Several different types of rock drill were employed more or less at the St. Gothard tunnel. Amongst these may be mentioned the Ferroux, the Mackean and Seguin, the Dubois and François, the Turrettini, the Burleigh, &c. The Ferroux drill was the first to be employed, having been invented in 1873 specially to work in this tunnel. In 1875 it was superseded by a simpler form devised by the inventor, and this improved drill did the greater part of the work from henceforward. As space will not allow of a description of all the varieties used, attention will be confined to this drill as the most successful example. The improved Ferroux drill is shown in Figs. 7, 8, and 9. It is of about half the weight of the older form, and less expensive. L is the main feeding cylinder, in which works the piston M, fixed to a hollow piston rod N. The outer end of this rod is connected to the larger or working cylinder T. In the latter works the striking piston O, which is prolonged into the piston rod B, carrying at its further end the chisel or bit. The piston O is conical at each end. At either end of the cylinder T are sockets at right angles to it, and in these work the small pistons *a a*, which operate the entrance and exhaust of the air. These pistons are raised and lowered by the piston O, which as it reciprocates brings its conical ends under each of the plugs alternately, and so lifts it. The plug which is raised operates by the lever B to depress the other, and thus opens the other end of the cylinder to the outer air, whilst itself opening a passage from the compressed air in the chamber P to its own end of the cylinder. The piston is thus driven back to the other end, where the same operation recurs, and thus the reciprocation is carried on. The compressed air enters the cylinder L through a pipe closed by the cock I, and passes to the air chest P through the interior of the hollow piston rod N. At the same time, by pressing against the end of the piston M, the air forces the rod N with the working cylinder T attached to it against the rock to be drilled. On the top of the bearers A, which carry the machine, is a rack R. When the hole has been deepened by a distance equal to the interval of the teeth of this rack, the conical base C of the rod B has advanced so far as to raise the fork D, which has two pawls engaging in the teeth of the rack. When these are raised clear of the rack, the striking cylinder and its piston advance by the length of one tooth; and this goes on until they have advanced the whole length of the rack. A plug Z, having the compressed air below it, operates to keep the fork D down upon the rack, and to bring it down again the moment it is released by the piston rod. To prevent the striking cylinder from moving in the opposite direction, a small cylinder X is provided at the rear end, and is open to the compressed air. In this cylinder is a plug, which presses upwards against a stirrup, carrying, at its lower part, the cross piece H. This cross piece engages with two racks on the under side of the bearers A, and having their teeth in the opposite direction to that of the racks on the upper side. Whilst this piece H is engaged with the rack, no rear motion is possible, but it can be released at any time, to bring back the drill, by pushing down the stirrup. The rotation of the rod B, which carries the drill, is given by an inclined groove in the enlarged part of the rod. Into this groove, shown in section Fig. 5, fits a projection *c* from the ratchet wheel *d*. As the striking rod B advances towards the rock, the groove in it compels the wheel *d* to turn in the direction of the teeth. When the rod comes back for another stroke, the wheel is prevented from returning by the pawl F, and therefore the piston rod itself is compelled to turn. To bring the machine back when the hole is finished, the cock I is closed when the cock J is opened. The air then escapes from behind the piston M, while it enters through the pipe K K into the annular space on the other side of the piston, and pushes it, with the striking cylinder and piston, back to the rear end of the cylinder L. The weight of the machine is about 180 kilogrammes, or 397 lb., and the quantity of air used per stroke is 1·40 litres—0·31 gallon. The advantages claimed for it are diminished weight and cost, reduction in the number of parts, ease of maintenance, and durability. The drill is connected with the carriage by means of a pin passing through the plate Y. This carriage, which weighs about 2400 kilogrammes—2·4 tons—is shown in elevation and plan in Figs. 10 and 11. It is so arranged that, in a heading only 2·60 metres wide—7½ft.—the *débris* can be removed without shifting the carriage, as there is room for a small tramway, 0·30 metre gauge—11·8in.—to be laid beside the carriage. The *débris* is filled into small trucks running on the tramway, and from these into the tipping wagons behind the carriage. The carriage is arranged for six drills working together. These are placed three on each side, one above the other, and are mounted in sockets carried by arms which can be moved by means of screws; the workmen standing at the side are able to manage these with facility. In order that the drills may be directed to any point in the face and at any angle, the sockets at the front end A A are made capable of sliding along the arm B, so as to traverse inwards or outwards as required. The movement is given by screws S lying parallel to the arms. The arms are raised or lowered as a whole by means of the vertical screws C. The arms in rear D D can also be raised or lowered by the screws T T, and the sockets on them E E can swivel round the arms, so as to give the drills the required angle to the vertical.

The rock, after being blasted, was loaded into wagons, and hauled out of the tunnel by small locomotives worked by compressed air. At the face of the heading the rock was first loaded into small tip wagons, which were run back, on the narrow-gauge tramway already described, past the drilling machines, and then tipped into ballast wagons on a lower level. The locomotives, shown in Figs. 13 and 14, were built by Schneider and Co., of Creusot. The frames, springs, wheels, cylinders, cranks, reversing gear, &c., are all similar to ordinary locomotives. On the frame is mounted a cylindrical reservoir A containing the air under pressure. This pressure, of course, diminishes during the journey. From the reservoir the air passes through an automatic distributor R, where it is expanded down to the cylinder pressure, which is always kept the same. Between the distributor and the cylinders it passes through a small reservoir B, which acts as a heater, and at the same time prevents shocks to the valves when the engine is started or stopped. The pressure in the main reservoir A is only limited by the power of the air compressors and the tightness of the joints in the pipes. In practice it reached 14 atmospheres—208 lb. per square inch. By a special arrangement the compressors could be supplied with air already compressed at 7 atmospheres, at times when the efficiency would have been too low, if compressing direct to 14 atmospheres. The distributor R, shown enlarged in Fig. 15, is composed of a cylinder A A, communicating by a pipe Z with the main reservoir, and partly surrounded by a jacket B B. This jacket is filled with the partially expanded air, which can pass into it through two series of holes *a a* and *b b*. From the jacket it passes to the cylinders through the pipe Y. At the end of the cylinder next to the holes *b b* there is a solid cover; the other end communicates with the atmosphere. Within the cylinder works a piston rod X, carrying two pistons. Of these, the upper one H is of the ordinary form, but the lower V is prolonged into a trunk C pierced with holes *e e*. The stroke is such that the front of the piston V never covers the holes *b b*, so that the end of the cylinder below the piston is always in communication with the jacket. The outer end of the piston rod carries a plate K, and a spiral spring N holds this plate apart from another plate L whose distance from the cylinder can be regulated by turning the screw M. This plate L being fixed, the spring tends to keep the piston V at the end of its stroke, and so to keep the holes *e e* opposite the holes *a a*, as shown in Fig. 15. If compressed air now enters through the pipe Z, it passes through these holes into the jacket B. But at the same time, its pressure being greater than the atmosphere, it tends to push the piston H upwards against the pressure of the spring; and if its pressure be greater than the total resistance, the pistons and piston rod rise, the holes *e e* become blind with those *a a*, and the air ceases to pass into the jacket. Now, suppose the pipe Y to be opened, so that the air in the jacket escapes. Then the pressure on the bottom of the piston V diminishes, the piston descends, and the holes *e e* become partly open to those *a a*. The result of these two tendencies is that the area of the holes *e e*, open to *a a*, is kept of such magnitude as will cause the pressure of the air in the jackets to balance exactly the reaction of the spring. The piston is thus kept in equilibrium, and the pressure at which the air escapes is kept at a constant value. This value can be varied, if necessary, by screwing up the spring. The heating apparatus is on the Mekarski system. The reservoir B, Figs. 13 and 14, holds 390 litres—86 gallons—and is fitted with pipes and gauge cocks for showing the water level in the interior—glass gauge tubes not being applicable on account of the severe shaking and shocks to which the engine is exposed. The reservoir and the pipes leading to it are clothed with wood and felt. The mixture of compressed air and water passes out of the main reservoir through a pipe, furnished with a cock, and passing to the bottom of the heater, where, in order to divide the air into thin jets, it terminates in a rose. These jets are heated by the hot water, and the air then rises to the top of the reservoir, whence it is conveyed to the distributor R. From this it passes to a pipe running between the main frames, and dividing into two branches, which lead one to each of the working cylinders.

To charge the engine, the cock between the main reservoir and the heater is closed, and the inlet pipe of the heater is coupled to a pipe leading from a fixed boiler. There are two outlet pipes from this boiler, one in the steam space and one in the water space, so as to give steam or water as required. The lower is first coupled to the heater, which is then filled with water up to the required level. This pipe is then shut off and the heater coupled to the other, and filled with steam up to the desired pressure. During the same time the main reservoir has been coupled to a pipe leading from the compressed air mains, and has thus been recharged with compressed air. When the charging is completed the inlets are closed, and the cock between the main reservoir and the heater is opened: the engine is then ready for working. The pressures are ascertained by three gauges, one on the main reservoir, one on the heater, and one on the pipe leading to the working cylinders. The principal dimensions, &c., of the engines are given below:—

Capacity of the large reservoir	268 cubic feet.
Internal diameter of ,, ...	5·58ft.
Length of ,, ...	11·64ft.
Thickness of steel shell plate	0·59in.
Thickness of the dished ends	0·67in.
Capacity of the heater	13·77 cubic feet.
Internal diameter of heater	2·62ft.
Length of ,, ...	2·89ft.
Thickness of steel in ,, ...	0·47in.
Diameter of cylinder	8·03in.
Stroke of cylinder	14·17in.
Diameter of tread of wheel	2·49ft.
Volume swept through by piston in each stroke	0·413 cubic feet.
Volume swept through by both pistons per metre forward	0·692 cubic feet.
Absolute initial pressure of compressed air in the principal reservoir	170·6 lb. per sq. in.
Constant absolute pressure on entering the cylinders	54·1 lb. per sq. in.
Extreme length of engine from buffer to buffer	16·40ft.
Weight of engine (about)	7·4 tons.

The cost of the tunnel cannot be given with any great exactness, but the total cost man be taken as follows:—

(1) Blasting of tunnel, making of watercourses, &c.	41,700,000f.
(2) Masonry, &c., inside the tunnel	13,300,000f.
(3) ,, ,, outside ,, ...	600,000f.
Total	55,600,000f.

To this must be added the cost of various extra works, of the preliminary work of triangulation, &c., of repairing of damages, of ballasting and laying the line, of materials, signals, telegraphs, &c., which together may be taken at 2,000,000f. This makes the total cost of the tunnel about 58,000,000f., or for a length of 14,890 metres 3900f. per metre—£140 per yard—or in round numbers, £250,000 per mile. With regard to special items, the cost of blasting was, on the average, about 46f. per cubic metre—28s. per cubic yard. The cost of walling per cubic metre may be taken as follows:—

Wages	13f.
Hewing and transport of stone, and selection and transport of rubble for packing	48f.
Hydraulic mortar and cement	6f.
Centres, scaffolding, &c.	3f.
Superintendence, &c...	6f.
Total	76f.

(Say 45s. 6d. per cubic yard.)

LETTERS TO THE EDITOR.

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

STORAGE OF POWER.

SIR,—The able leader on this subject, which appeared in THE ENGINEER of the 26th ult., reminded me of some remarks made by Professor W. E. Ayrton, in a lecture, entitled "Electricity as a Motive Power," which he delivered on August 23rd, 1879, at Sheffield, in connection with the visit of the British Association to that town. From a report of that lecture I find that the Professor, in suggesting the electrical decomposition of acidulated water as a means of storing electric energy, said that the gases could be produced as easily under great pressure, and that at a pressure of thirty atmospheres bottles containing a cubic foot of hydrogen and half a cubic foot of oxygen would supply energy nearly equal to 60-horse power developed for one hour, or 1-horse power for two days and a-half. As this seems very favourable as regards the quantity of gas required, I should like to know if it has ever been ascertained what percentage of the power required to drive the dynamos would be re-developed by the oxy-hydrogen gas engine.

If the cost and the waste be not excessive, this means of storing power might often be found convenient. Besides the great need there exists for portable motive power as a substitute for that of animals, the main difficulty connected with the utilisation of tides is the want of an economical method of storing a large amount of energy, and thus rendering the power derivable from that great but intermittent source constant. ARTHUR OATES.

February 6th.

STEAM ON TRAMWAYS.

SIR,—My attention has only just been called to the recent correspondence in your journal with reference to the economical working of steam tramways, and in order to remove the misapprehension existing in the minds of some of your readers, I hasten to inform you that from my practical knowledge on the subject, extending over some two or three years, and having reference to several successful lines in this country, I can affirm most positively that steam traction is much more economical than horse traction.

The favourable results shown in the working of the Stockton and Darlington tramways—in which case, I observe, the cost averages about 2½d. per mile—have also been secured on the Rhineland steam tramway—Leiden to Kutwyll—for which I acted as managing director.

The engines in use on these lines are of Messrs. Merryweather's construction, and the average of $2\frac{1}{2}$d. per mile includes coal, oil, wages, and ordinary running repairs and renewals.

I am collecting fuller details regarding the working cost, and will address to you another communication embodying the figures ascertained. P. CRANS.

The Hague, February 6th.

SIR,—I notice on page 91 of your last issue a letter from Messrs. Marple and Co., giving a statement of the expenditure on No. 3 engine working on the Wigan tramway, the result of which they state as 3·75d. per mile. From my experience, extending over some years, I am led to think this estimate too low, and that 5d. per mile is much nearer the correct cost. I notice that the driver's wages are taken at 30s. per week of seven days, and as tramway engines generally work for sixteen hours per day, the wages of the man would be $3\frac{1}{2}$d. per hour. I submit that this is only one-half of what ought to be paid to a properly skilled driver, and that locomotives in public streets should not be driven by other than well skilled and intelligent men. I notice further that the experiment has been made during the lightest months of the year, viz., from February to October. The expenses and liability to accident would be much greater during the other three months. No allowance is made for rent, taxes, office expenses, superintendence, insurance, gas and oil for lighting, files, and tools, and the many other items constituting what we may call the trade expenses. I feel sure that if all these matters be taken account of the estimate will exceed rather than fall short of 5d. per mile.

HENRY HUGHES.

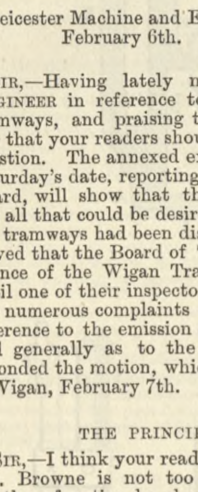
Leicester Machine and Engine Company,
February 6th.

SIR,—Having lately noticed two or three letters in THE ENGINEER in reference to the engines now working the Wigan tramways, and praising their superior qualities, I think it only fair that your readers should be acquainted with both sides of the question. The annexed extract from the *Wigan Observer*, of last Saturday's date, reporting the proceedings of the Pemberton Local Board, will show that the working of the Wilkinson engine is not all that could be desired. After the subject of the working of the tramways had been discussed by the members, "Mr. Shortrede moved that the Board of Trade be memorialised not to renew the licence of the Wigan Tramways Company for the use of steam until one of their inspectors had communicated to the Board as to the numerous complaints of the inhabitants of the district with reference to the emission of steam and smoke from the engines, and generally as to the working of the same.—Mr. Widdows seconded the motion, which was carried unanimously." A. B.

Wigan, February 7th.

THE PRINCIPLES OF MODERN PHYSICS.

SIR,—I think your readers will agree with me when I say that Mr. Browne is not too courteous. If my arguments are not worthy of notice, he should pass them over in silence. If they are worthy of notice, then they deserve full consideration. However, I will let this pass. Indeed, I feel too much obliged to Mr. Browne for suggesting Attwood's machine as an example of the truth of his view and the falsity of mine, to feel vexed by the tone of his last communication. *Quem Deus vult perdere prius dementat.* If Mr. Browne had searched carefully he could not have selected a better illustration of the accuracy of my views than is supplied by Attwood's machine; indeed, I gather from the fact that he selected it, that he can possess but a superficial knowledge of what that machine does and of what it is intended to teach; in no other way can I understand why he should arm me with so powerful a weapon.



I enclose a diagram sketch of Attwood's machine. It will be seen that it consists of nothing but a stand some 10ft. or 12ft. high, at the top of which is a very light and accurately-turned grooved pulley E, the axis of which rests on friction wheels. Over the pulley is passed a very flexible silk cord, which carries at either end a weight A B. These weights are carefully adjusted to exactly balance each other.

In the framing are fixed two pins D D, between which one of the weights can descend; on the top of this weight, when pulled up to the top, is laid a bar C. This bar disturbs equilibrium, to use conventional language, and the weight begins to descend, and will continue to descend with increasing velocity until the pins are reached. These stop the bar C from further descent, and the weights then go on without it—one rising, the other falling, the velocity diminishing very slowly under the influence of pulley friction, the force required to flex the cord, and the resistance of the air.

Now, let us see what this machine is intended to do. It was devised towards the close of the last century by Mr. Attwood, in order to aid in determining the value of g, or in other words, the numerical value of the influence of gravity. It became necessary that the speed with which a weight fell should be reduced as much as possible in order, among other things, that time should be available for observing the behaviour and velocity of the falling weight. There are but two ways of reducing the rate of fall, and these consist in, first, reducing the influence of gravity on a given mass; secondly, augmenting the mass of a body without at the same time augmenting the influence of gravity. The first object could only be attained by removing the mass to a great distance from the earth, which was out of the question, although experiments have been made on the tops of high mountains, where, of course, bodies weigh less than they do at the surface, and in very deep mines, where they weigh more. The second plan alone was available, and it was carried out in Attwood's machine. We have in this two weights A and B, say each weighing 1 lb.; but these weights balance each other, and may for the required purpose be said to have no weight, though they do possess mass. Now, the velocity which can be imparted in a given time to any mass varies directly as the force. Thus, for example, if the force of gravity were doubled—that is to say, if everything weighed twice as much as it does—the quantity of matter in it—mass—remaining unaltered, the value of g would be doubled, and falling bodies would fall twice as fast as they do now. If, on the contrary, the action of gravity were reduced to, say, one-tenth of what it is now, then would the rate of falling be one-tenth what it is now, and so on. Now, in Attwood's machine we have a mass represented by our two pound weights, and if we add to them a bar weighing, say, one-tenth of a pound, we shall then have a mass equivalent to 2·1 lb., while we shall then have a gravitating force only equal to $\frac{1}{21}$ of that normal to such a mass. Therefore, the rate at which the weights will move, the one ascending and the other, with the bar, descending, will only be $\frac{1}{21}$ of the rate at which the little bar alone, or either or both of the weights alone, would descend.

It will be seen that in all this there is nothing whatever to indicate that there is a greater pull—as Mr. Browne would have the readers of THE ENGINEER believe—on one end of the rope or silk line than there is on the other. It is, indeed, impossible to see how this could be; for the friction of the pulley is almost infinitesimal, and the two pound weights simply balance each other. As for the little bar that is entirely in the hands, so to speak, of gravity, and the whole action of the three weights is homogeneous and precisely the same in every respect as if we dealt with a single mass, on which the influence of gravity was reduced to $\frac{1}{21}$ of its normal power. The impulse of the little weight is accurately divided between the two weights A and B hanging on the cord. One-half that impulse is expended in accelerating A, the other half is expended in accelerating B. The resistance of A to acceleration upwards is precisely the same as the resistance of B to acceleration downwards. Mr. Browne cannot dispute this. Again, the weights A and B are identically the same by the conditions of the question. Consequently, we have precisely the same forces operating at each side G F of the string, and the resistance is, as I have said, exactly equal to the motive force. The influence of the small weight, as Mr. Browne will, I have no doubt, see on reflection, is by no means confined to either A or B, but is divided between the two. I venture to ask Mr. Browne what he imagines takes place when the bar is removed by coming in contact with the pins D? While the bar was on, he asserts that there was a greater pull on one end of the line than there was on the other. On its removal the strain was, I presume, equalised. Would it be possible to prove this by any conceivable form of apparatus?

At the risk of trespassing too far on your patience, permit me to put this question in another aspect:—

Let us suppose that the pull at one end of the line was 1·1 lb., at the other end 1 lb. only.

Now the whole force of acceleration we have seen to be concentrated in the 0·1 lb.; consequently, if this be the case, acceleration is produced wholly by the action of the 0·1 on A only, and as B received none of its influence, we find that it has been accelerated without the exercise of any force on it, which is absurd.

But let us suppose that B offered no resistance to the accelerating force due to the bar D. Then we find that a force was expended, and yet did not overcome a resistance, which is also an absurdity.

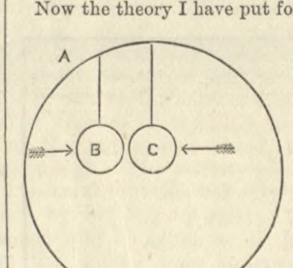
Let us suppose that there is some resistance which is less than the force, and let us call this x and the force y; then as x does not equal y there must be a balance left over, which we may call z, but z is a force, which we find expended upon nothing, which is also an absurdity.

In one word, the case admits of but one solution, namely, the string simply establishes continuity in a convenient form between the two masses, which are to be regarded as one. If these masses did not offer a resistance by virtue of their inertia—to use once more conventional terms—the little weight would fall at the normal rate of 16ft. in the first second; but they do offer resistance, and the velocity is retarded; but they both offer precisely the same resistance, and one-half the pull of the bar is, as I have explained, expended directly on one, and the other half is expended indirectly through the medium of the cord on the other or A, and the resistances to be overcome, and consequently the strains at each end of the cord, are the same; and if Mr. Browne will try the experiment, and will insert the most delicate spring balances he can get into the line at opposite sides of the pulley, he will find that these balances will register the same strain. If he asks me why is motion produced under such conditions, I reply that it is due to the direct contact with the bar C of some form of matter already in motion; and this is the cause of what is commonly known as the attraction of gravitation.

It may, perhaps, be worth while to point out that Mr. Browne stands almost, if not entirely, alone. I am not aware that he has the support of a single authority, save on one point. Boscovich held a theory about the non-existence of matter and the existence of force centres somewhat like Mr. Browne's. Now my views are simply those held by almost every great authority who has written on the subject. Mr. Browne has read Mr. Stallo's book, and he will find in it the names of such men as Newton, Leibnitz, Bernoulli, Euler, Secchi—in short, of almost everyone who has written on the physics of the universe. They one and all have held the views which I have endeavoured to prove to be correct, and I have insisted on the accuracy of these views, because there has come into existence a class of teachers and a type of treatises which are utterly inimical to all progress. The idea of matter being capable of exerting of itself attraction or repulsion bars the road to all inquiry, and Mr. Browne knows, if he dared admit so much, that the greatest thinkers that have ever lived have rejected as absurd the idea of attraction. In his "Foundations of Mechanics" he has attempted to gloss over the expression of Newton's views on this subject, in ignorance, no doubt, of what Newton really did write. In his third letter to Bentley, Newton writes, "That gravity should be innate, inherent, and essential to matter, so that one body may act upon another at a distance through a vacuum, without the mediation of anything else by and through which that action may be conveyed from one to another, is to me so great an absurdity, that I believe no man who has in philosophical matters a competent faculty of thinking can ever fall into it." From this we can gather what estimate Newton would have formed of Mr. Browne's "faculty of thinking."

I may, perhaps, be pardoned if I take up a little more space by calling attention to an admirable paper by Professor Oliver Lodge "On the Ether and its Functions," now being published in *Nature*; and I do this, first, because in it Mr. Browne's views are referred to in not very flattering terms; and because, in the second place, by abandoning all the absurd notions about attraction, repulsion, and action at a distance which have so long disgraced science, Professor Lodge has arrived at something really like a consistent theory of the cause of gravitation. In THE ENGINEER for July 9th, 1880, I gave an attempted solution of the same problem, and it will be seen that my theory and that of Professor Lodge harmonise very closely. Professor Lodge writes: "Let us think"—of the ether—"simply and solely of a continuous frictionless medium possessing inertia, and the vagueness of the notion will be nothing more than is proper in the present state of our knowledge. We have to try and realise the idea of a perfectly continuous, subtle, incompressible substance pervading all space and penetrating between the molecules of all ordinary matter, which are imbedded in it and connected with one another by its means, and we must regard it as the one universal medium by which all actions between bodies are carried on." In another place Professor Lodge writes: "Gravitation is explainable by differences of pressure in the medium caused by some action between it and matter not yet understood."

Now the theory I have put forward is this: Let us suppose that we have in a vessel, of which the circle A is supposed to be a cross section, two bodies, B and C, freely suspended. Let the vessel be filled with some homogeneous fluid as, for example, steam. Now let it further be supposed that these balls B and C are kept cold, then the steam will rapidly condense on their surfaces. The result will be a rush of steam from all directions toward them. I have shown but two of these rushes by the arrows. The steam between the two will be in the condition of the ass between two bundles of hay, and will rush with much less force towards the surfaces than will the molecules outside denoted by the arrows. The force of the currents denoted by the arrows will therefore be much greater than that of the current between the two, and the balls will be driven together, and the closer they get the less will be the energy of the fluid between them. Now, if we could see this take place in an invisible medium like steam we should say the balls attracted each other if we did not know better; but, in Professor Lodge's words, we have here "differences of pressure in a medium," only we do understand the cause of the difference in the case of steam, but we do not yet know the cause in the case of gravity. But we have a very precise illustration of it in the case of magnetism, in which the currents shown by the arrows in my sketch are in one sense actually set up by a steel bar.



As to the cause of motion, Professor Lodge's views and mine are precisely identical, namely, that the thing moved must not only be pushed by something already in motion, but pushed behind, or, in the words of Newton, all force is not merely *vis impressa* but *vis à tergo*. Φ. Π.

London, February 3rd.

THE MANCHESTER SHIP CANAL.

SIR,—In pursuance of the scheme advocated in a letter in THE ENGINEER of the 26th ult., I desire to lay before you approximate calculations which show, I think, conclusively the advantage, from that point of view most appreciated by the public—the monetary one—of the land cut from Garston to Runcorn in lieu of the river scheme.

Engineers acquainted with the cost of work will see that, although the actual nature of the work is necessarily to some extent hypothetical, the prices err on the side favourable to the adaptation of the present river to ocean steamer navigation; and those attached to the canal project are in excess rather than otherwise. It is, of course, very difficult to estimate the cost of the former, but I believe the following is a very moderate computation:—

River Scheme.

	£	s.	d.
51,321,600 cubic yards dredging and removal to suitable place, at 3s...	7,698,240	0	0
1,408,000 cubic yards training walls, at 6s.	422,400	0	0
Entrance, Liverpool end, say	25,000	0	0
	8,145,640	0	0

Garston-Runcorn Canal Scheme.

	£	s.	d.
763 acres land, at £350..	267,050	0	0
22,795,000 cubic yards excavation, at 1s. 6d. ..	1,709,625	0	0
720,000 square yards pitching, at 6s.	216,000	0	0
Entrance, Garston end, say	25,000	0	0
No. 2 bridges and approaches for local traffic ..	50,000	0	0
	2,267,675	0	0
Deduct:			
337 acres agricultural land restored, at £150 ..	50,550	0	0
	2,217,125	0	0

Thus the river route will entail an initial expenditure of nearly six millions sterling more than the land cut. It will require far greater maintenance outlay, and it will be longer than the latter by about $2\frac{1}{2}$ miles. J. GLOVER.

Birkdale, February 7th.

PREVENTION OF SCALE IN STEAM BOILERS.

SIR,—In THE ENGINEER of 2nd inst. you inserted two letters on the above subject which disputed the accuracy of our statement. Your correspondents appear only partially to understand the matter. They say what is perfectly true as regards the effect of caustic soda on water containing iron in solution. But they apparently are not aware or entirely ignore the fact that caustic soda when used in steam boilers causes corrosion—that is to say, there is a constant eating away of the iron. This iron in solution remains inside the boiler suspended in the water, and is eventually precipitated by the daily introduction of fresh caustic soda. The caustic soda is thus most certainly wasting away the boiler plates.

Your correspondent Mr. Duggan has learned from us for the first time that caustic soda passes along with the steam into the engine. As he seems unable to understand this, we must explain it. Perhaps he has never heard anything about priming of boilers. The reduction of pressure causes ebullition of the water, which produces a splashing or a kind of spray somewhere below the point from which the steam is drawn, and this is carried along with the ascending current of steam. Thus, not only the water impregnated with caustic soda, but also any foreign matter that may happen to be at the broken surface of the water, is carried into the steam pipe and thence into the cylinder, &c. &c. This is a simple "mechanical" process. The little chemical knowledge for which the gentleman who signs himself "An Engineer" gives us credit, is not only sufficient to meet our own wants, but leaves us plenty to spare for our customers.

As we are not desirous of advertising our boiler fluid by continuing this correspondence, if he will communicate with us direct we shall be glad to furnish him with any further information he may require. THE DISINCRUSTANT MARSEILLAIS COMPANY.

Manchester, February 7th.

HARD AND SOFT DRINKING WATERS.

SIR,—In your paper of the 26th ult. it states that the water supplied by certain companies in London is reported unfit to drink, though you object to the report. I should be pleased to know whether the water softened by the lime process is injurious to health, or not. The softened water is very useful to manufacturers, but I doubt whether it is good for the people who are compelled to drink it. A friend of mine had some water from Southend analysed some years ago; the analyst said it was unfit to drink, the hardness being 2 by Clark's scale. The waters in Lancashire and some parts of Yorkshire are very soft, and are, I believe, surface waters. These waters are, in my opinion, the cause of the rapid decay of the teeth of the people who are compelled to drink them. I should therefore be pleased to hear whether the softened water would have the same injurious effect on the people as the naturally soft waters. C. J. L.

February 6th.

[Lime softened water may be drunk with perfect impunity.—ED. E.]

RAILWAY SPEEDS.

SIR,—Your correspondent, Mr. C. M. Tucker, is quite in error as to the distance from Trent to Normanton; consequently his calculation of the speeds of the trains is incorrect. I have before me the Midland Company's "Distance Table," from which I find that the exact distance between Normanton and Trent, by the shortest route, *viâ* Staveley, is 65 miles 19 chains—not 74 miles, as stated by Mr. Tucker. The up and down day Scotch Expresses run *viâ* the short route, and do not enter Sheffield. The 10.35 a.m. train from St. Pancras is booked to leave Trent at 1.17, and arrive at Normanton at 2.40; therefore it runs 65 miles 19 chains in 1 hour 23 minutes, or an average speed of a little over 47 miles an hour—not 52. CLEMENT E. STRETTON.

Saxe-Coburg-street, Leicester, February 6th.

RAILWAY NEGLIGENCE.

SIR,—I have just been forced to despatch the following telegram to the Ordinance Committee, and to the Agent-General of New South Wales:—"My two steel shot which left Sheffield on 3rd inst., stick in London in transit; experiment on Monday therefore impossible." I need hardly say the above telegram means loss, confusion, and disappointment. If in my small way such troubles occur, what must be the loss and annoyance of those engaged in large business transactions? EDWARD PALLISER.

Erith, February 8th.

BRASS IN PRESENCE OF CARBONIC ACID acts, on the whole, in a manner analogous to copper. With access of air free from carbonic acid, it is strongly attacked by sal ammoniac solution, only slightly by chloride of magnesium, alkaline chlorides, caustic soda, and lime water, and not at all by distilled water, sulphate of potassa, saltpetre, and carbonate of soda. Perceptible quantities of metal are dissolved by sal ammoniac and chloride of magnesium, and traces of it by caustic soda and lime water. In the presence of carbonic acid and air, it is acted on most violently by sal ammoniac, very strongly by chloride of magnesium and alkaline chlorides; less by distilled water and carbonate of potassa and saltpetre. All the solutions dissolved perceptible quantities of the metal.

TUNNELLING MACHINERY, ST. GOTHARD RAILWAY.

(*For description see page 103.*)

FIG. 4

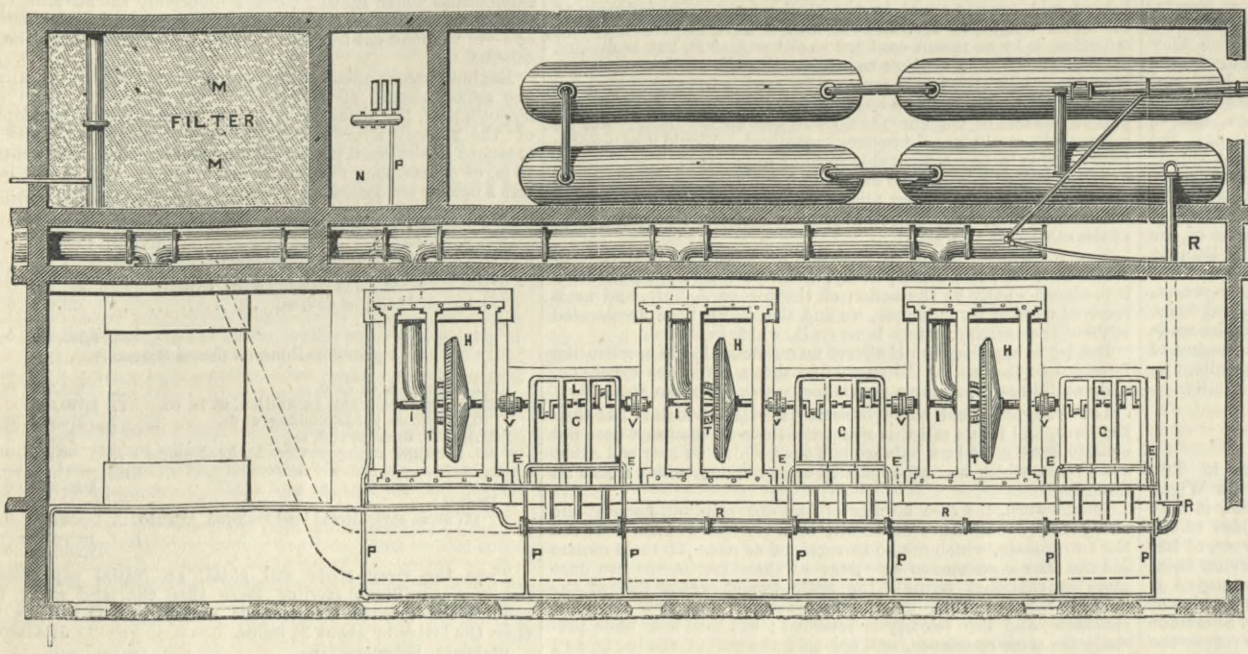


FIG. 15

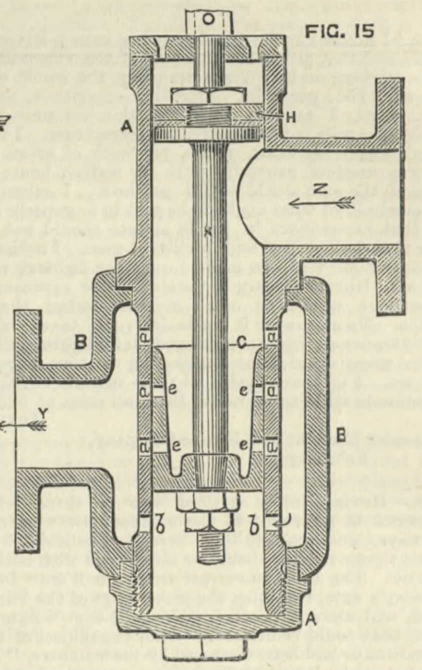


FIG. 5

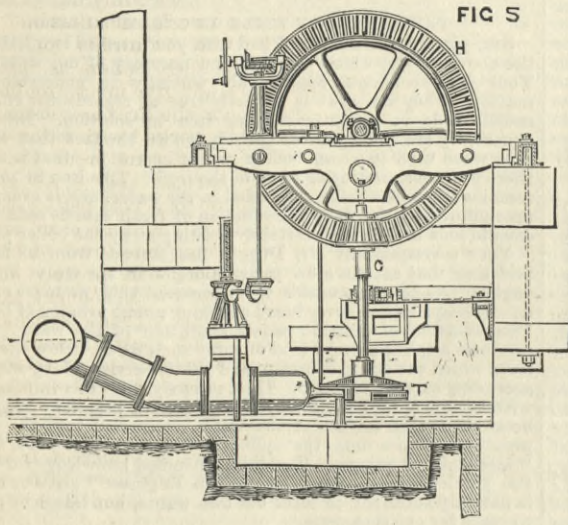


FIG. 12

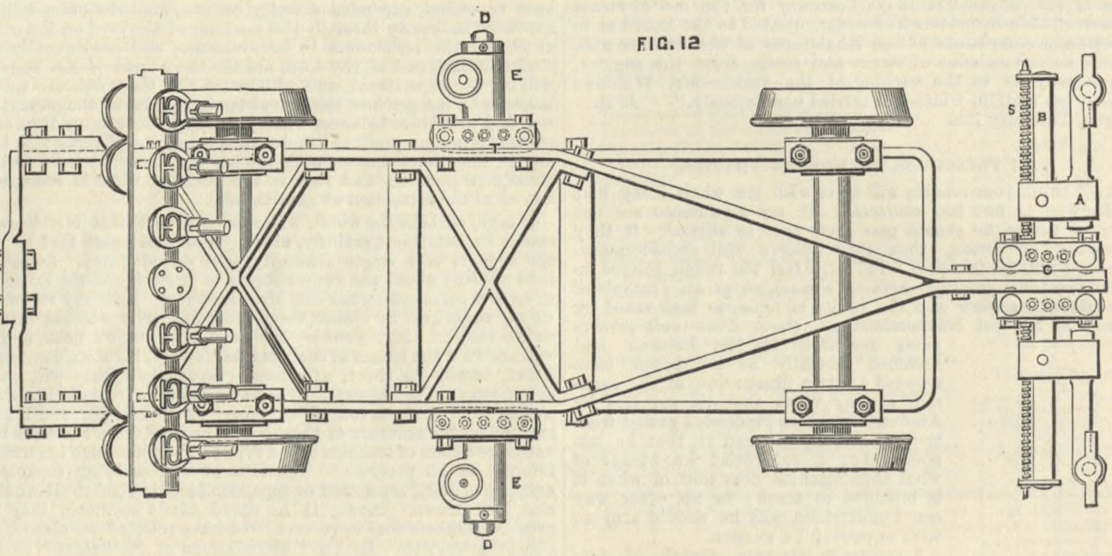


FIG. 10

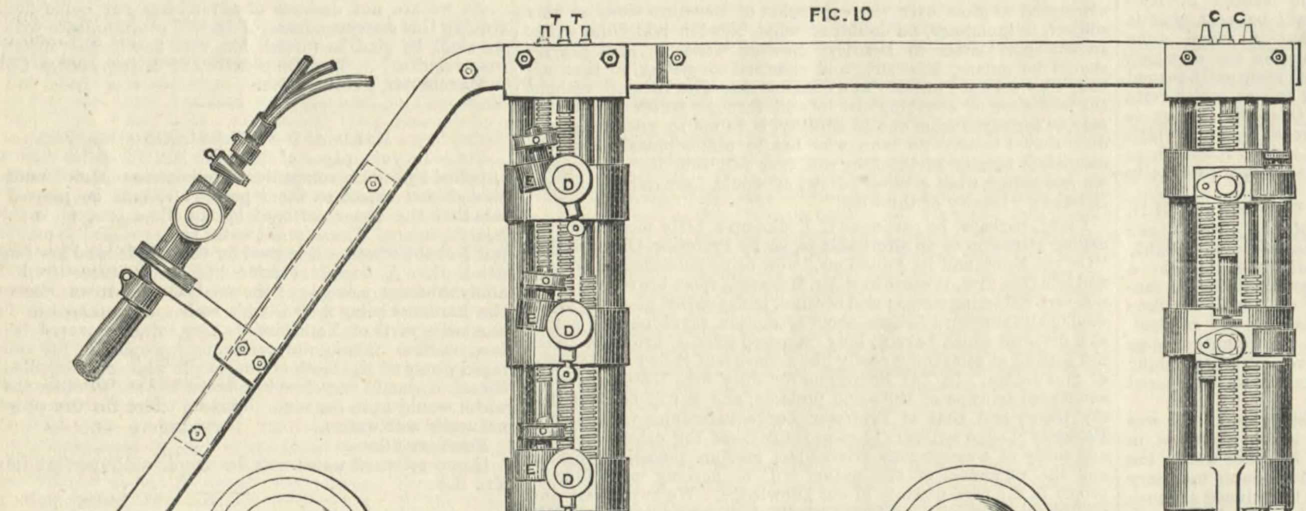


FIG. 11

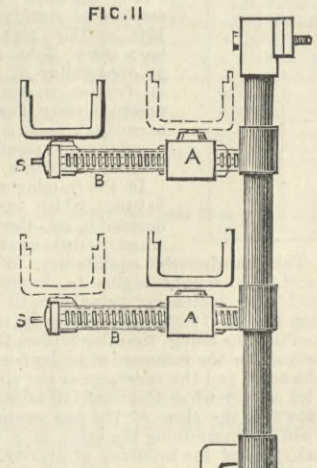


FIG. 14

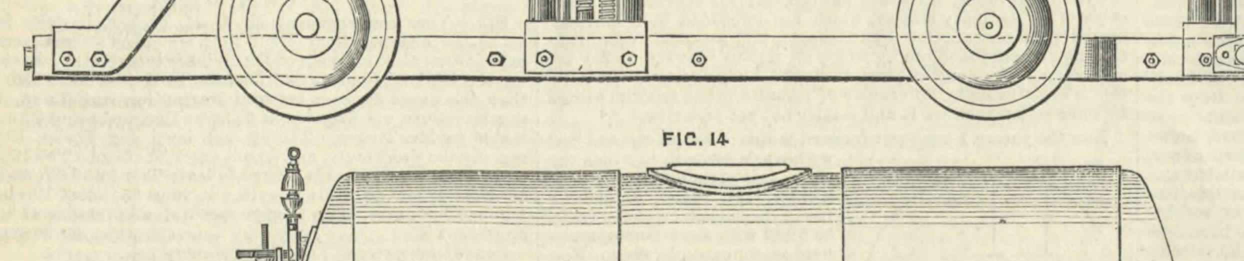
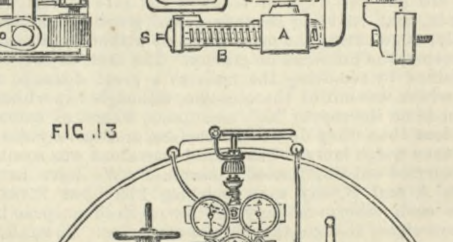


FIG. 13



FOREIGN AGENTS FOR THE SALE OF THE ENGINEER.

PARIS.—Madame BOYVEAU, *Rue de la Banque.*
BERLIN.—ASHER and Co., 5, *Unter den Linden.*
VIENNA.—Messrs. GEROLD and Co., *Booksellers.*
LEIPSIC.—A. TWIETMEYER, *Bookseller.*
NEW YORK.—THE WILLMER and ROGERS NEWS COMPANY, 31, *Beekman-street.*

TO CORRESPONDENTS.

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

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

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

SUGAR FROM MEALIES (N. N.).—*Your letter has been forwarded to enquirers in ordinary course.*

PREPARING GANISTER.—*A letter to correspondent "F. L." awaits his application for it in our publisher's office.*

D. G.—*Enquire of Messrs. Manlove, Alliott, Fryer, and Co., Nottingham, and of Mr. Lewis Olrick*, 27, *Leadenhall-street, E.C.*

BUBBENHALL.—*What would be your definition of "going round" an object? In questions of the kind it is necessary that the same meaning should attach to the same terms both in question and answer.*

BLAST FURNACE ECONOMY.—*We are requested to state that Mr. Cochrane has drawn attention to the dissociation of carbonic acid at high temperatures, the first enunciation of which proposition has been attributed in our pages to Mr. I. L. Bell.*

A. W.—*Small gas-fired boilers are not unlike other vertical boilers. They are generally made with very shallow fire-boxes, and a large number of tubes of small diameter, say ½in., inside. The gas is burned in six, eight, or more Bunsen burners. You will find gas expensive fuel for a* 10-*horse boiler. As to your second question, the efficiency of a good existing boiler could not possibly be doubled, or nearly doubled, by any conceivable methods of firing.*

HOBNAIL PLATE PATTERNS.

(*To the Editor of The Engineer.*)

SIR,—Can any of your readers oblige us with the name of the maker of plate patterns for the manufacture of hobnails—cast malleable? We have looked over the last few years' ENGINEER for the advertisement which we are informed once appeared of this, and cannot find it. T. AND S.

Bristol, February 3rd.

THE FORTH BRIDGE.

(*To the Editor of The Engineer.*)

SIR,—Noticing that you mention in your impression of the 2nd February that the Steel Company of Scotland has the contract for supplying the Forth Bridge steel, I beg to say this is so far correct that they have the greater portion; my company having to send 12,000 tons of plates. D. CAMPBELL.

The Landore Siemens Steel Company, Limited, Westminster-chambers, Victoria-street, London, S.W., February 6th.

DEANE'S STEAM PUMP.

(*To the Editor of The Engineer.*)

SIR,—We are obliged by the notice of Deane's pumping engine, but regret that you have inadvertently—misled, we think, by a word in the description—given us the credit of the manufacture of the engine. Perhaps you would kindly state in your next issue that the engine was built in the United States by the Deane Steam Pump Company, Holyoke, Mass., and that we are the sole makers of the Deane steam pump, under licence from the patentees, in the United Kingdom. The condensing apparatus is made under Deane's patent.

J. E. HODGKIN, Managing Director,
The Pulsometer Engineering Company, Limited.

Nine Elms Ironworks, London, S.W., February 2nd.

DISCHARGE OF SEWAGE.

(*To the Editor of The Engineer.*)

SIR,—Will any correspondent kindly say what is the formula for calculating the discharge of sewage from a pipe 24in. diameter emptying into a river, the invert being level with the bed of the stream? The height of the water in the river varies from 1ft. to 3ft. above the top of the pipe. The sewer has a gradient of 1 in 800 for two miles, and is nearly half-full generally at that point. Am I right in assuming that the gradient has been reduced to 1 in 1148 when the river is 3ft. above the top of sewer outlet? What are the best authorities to consult on these matters to enable me to ascertain the quantity flowing under all conditions of the river, and of the sewer? H. B.

Southport, February 3rd.

[Our correspondent's letter raises a more important question than appears at first sight. If he refers to Neville's "Tables," or to Jackson's "Hydraulic Manual," he can at once find the means of calculating the discharge of clean water through a clean pipe. But there is reason to believe that the formula will not apply with strict accuracy to sewage more or less foul, flowing in pipes also foul, and any of our readers who can give as the result of experience the proportion which the actual discharge of sewage through a pipe which has been some months in use bears to the discharge through a clean pipe, will do some service.—ED. E.]

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MEETINGS NEXT WEEK.

THE INSTITUTION OF CIVIL ENGINEERS.—Tuesday, Feb. 13th, at 8 p.m.: Ordinary meeting. Paper to be read with a view to discussion, "The Design and Construction of Repairing Slipways for Ships," by Mr. Thomas Bell Lightfoot, M. Inst. C.E. Thursday, Feb. 15th, at 8 p.m.: Special meeting. First lecture, "On the Applications of Electricity," "The Progress of Telegraphy," by Mr. W. H. Preece, F.R.S., M. Inst. C.E.

CHEMICAL SOCIETY.—Thursday, Feb. 15th, at 8 p.m.: Paper to be read, "On Some Derivatives of Diphenylene-ketone-oxide," by Mr. A. G. Perkin.

SOCIETY OF ARTS.—Monday, Feb. 12th, at 8 p.m.: Cantor Lectures, "Solid and Liquid Illuminating Agents," by Mr. Leopold Field, F.C.S., A.S.T.E. Lecture III.—Colza, olive, whale, sperm, and fish oils. Mineral oils. Lamps—the argand, moderator, duplex, and Silber methods. Flashing points. Government restrictions. Wednesday, Feb. 14th, at 8 p.m.: Eleventh ordinary meeting, "The Society of Arts Patent Bill, and some Points in American Patent Law and Practice bearing thereon," by Sir Frederick Bramwell, F.R.S. Mr. Richard E. Webster, Q.C., will preside. Friday, Feb. 16th, at 8 p.m.: Indian Section, "Overland Commercial Communication between India and China, *viâ* Assam," by Mr. Charles H. Lepper. Sir Rutherford Alcock, K.C.B., will preside.

THE ENGINEER.

FEBRUARY 9, 1883.

THE POLYPHEMUS.

IN THE ENGINEER for Sept. 24th, 1880, will be found a full description and an illustration of the torpedo ram Polyphemus. This vessel is unique, and in the strictest sense of the word an experiment. The nation is indebted for her to Admiral Sir George Sartorius. Sir George has been the persistent advocate of rams pure and simple; and up to the present at least, the Polyphemus is nothing but a ram, unless she is also a failure. She carries no guns, save a couple for saluting and signalling purposes, and relies altogether for her power of offence and defence on her speed, her ram, and her torpedoes. She is fitted with special appliances for discharging torpedoes under water from her bows and her sides; and up to the present moment nothing but disappointment has attended every effort made to use these last. The torpedoes fired from the bow ports have at all events been got away from the ship; but as much cannot be said of those discharged from her broadside. They are expelled from tubes 9ft. below the water-line. A fish torpedo is about 18ft. long. The Polyphemus has attained a speed of seventeen knots an hour, and the moment the torpedo shows its nose outside of the hull it is deflected by the apparent current running alongside the ship, and is thereupon jammed in the tube. If it can be got clear of this, it is only with its screw blades broken and its stern or tail twisted that the luckless torpedo gets off; and it is not curious that the short course which it then describes is erratic in the extreme. To prevent this action, a steel plate 16in. wide and 25ft. long has been pushed out from the ship's side, and under the lee of this the torpedo is discharged; but hitherto the resistance of the water has proved too much, and the steel bar, standing like an oar blade in the water, has been bent, and the torpedo has stuck half in and half out of the ship. The Polyphemus is coming round from Portsmouth to Chatham to have new boilers put in, and renewed attempts will then be made to fit her with some apparatus which will allow of the discharge of broadside torpedoes when she is running at full speed; but we confess we see little reason for expecting that success will be attained. Even though the torpedo is discharged, the course which it will take must be, to say the least, doubtful. Up to the present the targets aimed at, even at distances of 200 and 300 yards only, the ship steaming at 8 knots or less, appeared to be specially avoided by the torpedoes, which sometimes turned round on the ship, and now and then hastily sought a bed in the mud.

It is now officially announced that the locomotive type boilers in the ship are a total failure. They are to be removed and replaced by ordinary cylindrical multitubular boilers of the ordinary kind. It has not been officially announced, however, that the ship will have to be cut to pieces in order to get the old boilers out and the new ones in. We believe that it has not been decided whether the old boilers will be dropped through her bottom while the ship is in dry dock, or whether her decks and upper works will be cut away to let them be hoisted out; but we know that the former method of removal and substitution would be the better of the two. The Polyphemus is armoured all over her turtle-shaped deck with plates or tiles of Whitworth steel, in a way which we have already illustrated. To get these tiles off will be no easy matter; and they could not be taken off and replaced without racking the whole structure underneath. To cut a great aperture in her bottom will be a simple matter, although, we may add, one not unattended with expense. If we could only be certain that the new boilers would do very much better than the old, we could regard the whole proceeding with more satisfaction; but no opportunity has been afforded to engineers other than those in service of the Admiralty, who know nothing at all practically about locomotive boilers, to express an opinion. All that is known on the subject outside a very small circle is, that the engines of the ship have not been able to drive her at the anticipated speed, because they did not get steam enough. The velocity actually attained by the ship was 17½ knots, but this was only maintained for very short periods by bottling up steam; and her best regular performance may be taken as 15 knots, which was obtained when the boilers were in good humour, and did not prime very heavily. The ship is 240ft. long, 40ft. beam, and 18ft. 9in. deep. Her displacement is about 2620 tons, and it is calculated that with 5000-horse power she can be propelled at 17 knots. She has twin screws, and two pairs of compound horizontal direct-acting engines, with cylinders 38in. and 64in. diameter, and 39in. stroke. Her boilers are, as we have said, of the locomotive type, ten in number, arranged athwartships on each side of a longitudinal bulkhead, in two groups of three boilers and two boilers. The uptakes all lead into one fixed chimney. We do not know what power has been developed by her engines, nor is it likely any one will until questions are asked in the House of Commons by and by; but it is easy to see that to augment her speed from 15 knots to 18 knots, which speed it is hoped she will reach, the power of the engines must be nearly doubled. Let us suppose, for example, that she steams at 15 knots with 3375-horse power, which, probably, is not far from the truth. Then to go at 18 knots, she will require at least 5832-horse power, and probably considerably over 6000. It is really not easy to see how a difference so great can exist between locomotive boilers, which are notoriously good steam-makers, and the ordinary type of boiler. Indeed, it seems to us that unless the substitution is accompanied by a large increase in heating and grate surface, the results must be disappointing; but such an increase will entail a very great augmentation in the weight of the generators, and how this is to be provided for no one seems disposed to explain. A locomotive boiler with water, capable of working up to 500-horse power, need not weigh more than 10 tons at the outside. About half this will suffice in torpedo boat boilers, but an ordinary tubular boiler and water to develope as much will weigh at least 20 tons. If we suppose that the locomotive boilers worked up to only half their anticipated power, they were still doing as much as an equal weight of ordinary boilers; and to obtain the full power required the weight of the new boilers must be nearly, if not quite, doubled. This appears to us to be a very serious consideration in the case of a comparatively little ship like the Polyphemus, in which there is already hardly room to turn round. It will, no doubt, be urged that the new boilers being worked under forced draught conditions, will prove far more efficient than boilers of the same type worked in the ordinary way; but this is pure surmise. The locomotive boilers failed first because they primed, and secondly because the tubes leaked persistently. But we know that on railways the same class of boiler does not leak and does not prime; but the boilers of the Polyphemus were not designed by a railway engineer, but at the Admiralty, and by men who, however clever in their own paths, have no practical knowledge of locomotive boilers. We do not know why it is considered that the new boilers will certainly do better. That cylindrical multitubular boilers work well at sea under ordinary conditions is true; but the Admiralty and its advisers appear to forget that even such boilers as these frequently prove persistent primers, and give much trouble, the priming only beginning as soon as the fires are pushed. In the Polyphemus the boilers will be worked with a forced draught under conditions entirely different from those which obtain in the mercantile marine; and to assume that they will, when burning 60 lb. or so of coal per square foot of grate per hour, work as quietly and give as dry steam as they would do when burning one-third of the quantity, is simply to jump to a conclusion entirely unwarranted by experiment. We do not for a moment say that it is impossible for the new boilers to work satisfactorily; but we do say that there is no special reason to think that they will, and there is a great deal of reason to think that they will not. We believe that locomotive type boilers might have been designed and constructed which would have given perfect satisfaction; but there are so-called locomotive boilers which are so different from the railway boiler in proportion, that they have little or nothing in common. The differences may seem slight to the uninitiated, but those who understand the subject will know that it is on apparent trifles that the true locomotive boiler depends for success; and it is, we think, much to be regretted that railway engineers were not asked their opinions before an enormous expense was incurred in carrying out an experiment.

THE TRANSMISSION OF POWER BY ELECTRICITY.

A PRIVATE exhibition has taken place this week in Paris of the transmission of power by the system of M. Marcel Deprez, the well-known electrician who has for some time past proclaimed his ability and readiness to convey, by an ordinary telegraph wire, considerable power to long distances. At the Electric Exhibition of Paris his invention, in its then shape, attracted some attention; and at Munich, in 1882, he developed a force of 1·13-horse power in a dynamo machine by means of a turbine, and claimed that he had delivered an effective force of 0·433-horse power at a distance of 57 kilos. The failure of some trifling accessories hindered the complete success of his ideas, but since then he has made many improvements in detail, and asserts that he is now ready, by his system, to transmit a force even as great as 5000-horse power, a distance of many hundreds of miles, along a conductor of moderate size, with a loss of only one-half the initial power imparted to the apparatus. For moderate powers, up to 50-horses, an ordinary telegraph wire is to suffice; and even for greater force, an iron rod not more than 3in. in diameter. Some influential capitalists have assisted M. Deprez up to the present time, and his scheme being considered ripe for further development, he invited an influential group of engineers and others to witness a complete demonstration in Paris, on Saturday last. The gale in the Channel the preceding day delayed the arrival of the English visitors, and the exhibition took place, therefore, on the Monday and Tuesday of this week.

The Northern Railway Company had placed at the disposal of M. Duprez a sufficient space in its workshops in the Rue Poissonière, as well as the necessary motive force from a line of shafting. Here were gathered together a considerable number of gentlemen interested, from various points of view, in the proceedings. Of electricians there was the party of M. Deprez; but Mr. Preece, of the English Post-office, who was expected, did not arrive. Colonel Beaumont, who has had so much experience in compressed air motors, was present, and Mr. Ewing Matheson, who has given special attention to various methods of transmitting and distributing power. Mr. R. Tennant, a director of the Great Northern Railway, had gone over with the purpose of seeing the value of the system for use in England and the Colonies; and with a view to its immediate application to a specific case, some gentlemen attended who represented the owners of the water-power of the Perte du Rhone at Bellegarde. There, notwithstanding the vast power available, the turbines already erected and illustrated in our columns are not remunerative, because there are not sufficient users in the immediate vicinity, and the advantages afforded are not enough to induce the erection of factories in a locality not otherwise suitable. If, however, the power could be delivered without inordinate loss in the city of Lyons, only fifty miles distant, it would be utilised by the manufacturers there at a price which, while much cheaper than the steam-power now available, would be remunerative to the promoters.

The trial in Paris has not proved so effective as was hoped, and the English visitors, at all events, would not have came so far if they had known its limited extent. M. Deprez has been before the world so long, and has already made so many experiments, that a complete demonstration might on this occasion have been expected; but the experiment was imperfect. A Gramme dynamo machine, capable of developing about 10-horse power, was driven by a belt from a countershaft; but on the dynamometer which was interposed the readings were irregular and uncertain. The current from the dynamo was taken by an ordinary iron telegraph wire, of 4 millimetres diameter, to Bourget, a station on the Northern Railway, and thence back again to the workshop, a distance altogether of about 20 kilometres, and the return conductor was then connected to a second dynamo machine, which had a makeshift friction brake or dynamometer, applied to a small pulley of about 14in. diameter on its spindle. As far as could be measured by this somewhat rude appliance, a power of about 1-horse power was delivered from an original force of about 3-horse power, and on increasing the speed of the driving shaft, and therefore the power given to the first dynamo, the result was raised to 3-horse power, but beyond this the machine seemed unable to go, as with the increased speed one of the small wires on the first dynamo fused. M. Deprez, though about to improve his testing apparatus, in no way acknowledges any failure, and asserts that he has already demonstrated, from an electrician's point of view, the correctness of his assertions. But while engineers and electricians will gladly welcome any new discoveries that may be made, they cannot acknowledge that M. Deprez has yet given any effectively valuable ideas in the direction he is aiming at. The system is, as is well known, that of obtaining high tension electricity by the use of much finer wires on the dynamo machines than are usual. Although by this means a great power can be transmitted through a conductor of small diameter, it is difficult to maintain sufficient insulation and prevent the wires from heating and fusing. M. Deprez announces that he has overcome these difficulties by improvements duly recorded in patent specifications not yet published. These can be considered when they are printed; but till then we must take leave to dispute the claim to a success which would, indeed, be revolutionary if achieved. To render power practically available and commercially successful, the mode of transmitting it must be simple and regular; and a mere laboratory experiment on a small scale and for a limited time is not sufficient to prove that great force can be regularly and for a long period transmitted with a sufficient margin of safety to ensure against stoppages which would entirely neutralise its value to users. We understand that, in addition to the patents about to be published, M. Deprez has others, not so far advanced, specially directed to the transmission of large powers of 1000-horses and upwards. These will be read with great interest, and there is no fear that any really useful invention will fail to be appreciated. The utilisation of cheap water-power, hitherto neglected because remote, is of vast importance; but there will always have to be set against the saving effected the capital expenditure in developing, transmitting, distributing, and applying the force so derived. These expenses would probably be prohibitory in countries where fuel as a competitive power is cheap. Even if it were attempted to utilise refuse coal as fuel at the mines and to transmit the force so obtained, the competition of cheaply-carried coal would not easily be overcome.

M. Marcel Deprez does not lack appreciation from his countrymen. On Tuesday, the second day of the trial, many distinguished personages were present, among others, M. de Freycinet, M. de Lesseps, several Deputies and Senators, the Italian Ambassador, and others. It is to be hoped that with such influential supporters there will be no difficulty in making a test on the large scale, and in the exact manner which the subject warrants. Engineers and others in this country will be prompt to appreciate any really useful improvements. As to the principles involved in the transmission of power by electricity we need say nothing here, as the whole subject is being dealt with in our pages by Professor Lodge.

THE PURITY OF DRINKING WATER.

If the teachings of ages of experience of the satisfactory character of river water for drinking purposes had needed any confirmation, and if the persistent denunciation of the Thames water in the reports supplied by Dr. Frankland to the Registrar-General needed any further refutation than it has received during the past few years, it was supplied in the paper by Mr. W. Anderson on the Antwerp Waterworks, read before the Institution of Civil Engineers, and the discussion which followed it last week. The paper described the new works by which Antwerp is supplied by water from the river Nethe. This river flows in a south-westerly direction, and at about two miles below Waelhem—a village eleven miles from Antwerp—it joins the Dyle, on which Malines is situated, and another stream called the Senne, and with them forms the Rupel, which falls into the Escaut about ten miles above Antwerp. All these rivers are tidal, and the water intake is placed at Waelhem where the tidal range is 13ft. 6in. In order, on the one hand, to avoid taking in the polluted waters of the Rupel carried past Waelhem on the flood tide, and, on the other, the waters of the Nethe, contaminated at low water by the towns situated above the intake, the authorities decreed that the water should not be taken into the settling ponds before three hours after high-water; and that the level of the bottom of the intake culvert should not be lower than 4ft. above datum, or 4in. above low-water. Now, it is not necessary to enter here into any consideration of the extent to which this water would be polluted by the towns above the intake, or the effect of the reversal or stoppage of the flow of the water by the tides. It is sufficient to say that in this country it would be looked upon as water of at least very doubtful quality even after the most perfect filtration, while it need hardly be said that arguments which could support Dr. Frankland's condemnation of the Thames as a supply for London, would place the Nethe out of the list of sources of supply to be considered for one moment by Antwerp. The Antwerp authorities, however, thought it sufficiently good for the supply of the city after ordinary sand filtration; but in the paper it is admitted by the author that "owing to its peaty origin, and the muddy nature of the banks between which it flowed, it was considerably coloured, was permeated by a very fine mud, which could not be removed either by subsidence or by ordinary filtration, and had a disagreeable taste." Judging from the origin and description of this water, it might have been expected that the analyst for the reports of the Registrar-General, would, after what he has said of the Thames water, have been almost unable to find words which would have described its unfitness for drinking purposes; the writer, however, of the greater part of the sixth Report of the Rivers Pollution Commission, finds in this water no "previous sewage or animal contamination" of which he made so much in the said sixth report, and which he found in dreadful quantities in the water supplied by every one of the companies to the London water drinkers. Dr. Frankland made analyses of the waters of the Nethe before and after subsidence for twenty-three and a-half hours, and after filtration. After mere subsidence for the above-named time this remarkably obliging water became almost or quite harmless; and whatever it may have contained before, it had, according to Dr. Frankland, no previous sewage contamination after this very simple process. The total solid matters had dropped to 21 per 100,000, the organic carbon to 0·633, the organic nitrogen to 0·219, the ammonia to ·028, the nitrogen as nitrates and nitrites to 0, and the total combined nitrogen to 0·242, or in other words, 100,000 lb. of the water contained 21 lb. of solids, mostly in solution, 0·623 lb. of carbon, and 0·219 lb. of nitrogen, the proportion of nitrogen to carbon being 1 to 2·84, and thus, says the report of Dr. Frankland, this water "is exceedingly impure, being still turbid and loaded with an unusually large proportion of highly nitrogenous organic matter," and "very unpalatable." After filtration, however, "from being muddy, unpalatable, coloured, and much polluted, the water of the Nethe was rendered colourless, bright, palatable, and fit for dietetic and all domestic purposes." The question will naturally be asked, "By what magic is this miraculous transformation effected?" The answer is, the spongy iron with which the Antwerp filter beds are provided; and upon the remarkable purifying qualities of spongy iron Dr. Frankland is pinning his faith. Another question, however, will be asked, namely, How does sand filtered Thames water compare with the water from the Antwerp filters, which is described in such terms of absolute perfection? To show this we will quote from the report to the Registrar-General for November. The water supplied during that month by the Chelsea Company, which is Thames water, contained of organic carbon 0·178 lb. in 100,000 lb. of water, 0·029 lb. of organic nitrogen, 0·154 lb. nitrogen as nitrates and nitrites, and total combined nitrogen 0·183 lb. Organic carbon and organic nitrogen were both less than in the Antwerp water after filtration, the total combined nitrogen but 13-100ths of one part more. In other words, the Chelsea Thames water contained these impurities in such enormous quantities that one would have to drink 250 tons of the water to consume 1 lb. of organic carbon, 244 tons of water to consume 1 lb. of combined nitrogen, 287 tons to consume 1 lb. of nitrogen in the form of nitrates and nitrites, and 1539 tons to consume 1 lb. of organic nitrogen. These quantities of water are sufficiently large to warrant a water drinker in feeling tolerably safe with Thames water as supplied by the Chelsea Company, so long as these impurities are fairly uniformly disseminated throughout every ton of water he may drink; and the question now arises; if the Antwerp water, giving the analysis referred to after filtration, is entitled to Dr. Frankland's glowing encomiums, where is the ground for declaiming against Thames water in general? and again, to what pitch of perfection might not Thames water arrive if filtered through spongy iron? As to the harmful nature of the large quantities of organic nitrogenous matter which make a water dangerous, it is mentioned by Dr. J. W. Mallet, F.R.S., in a recent report on the subject, that in two of the waters subjected to examination by him—waters believed to be of a highly dangerous character—the amount of organic matter as detected by analysis, was so small, that if the whole of the carbon and nitrogen present had existed as strychnine, it would be necessary to drink half a gallon of the water at once in order to take such an average dose as might be prescribed medicinally. The probability of the products of putrefactive change being so much more poisonous than the strongest of our recognised poisons, is spoken of as difficult of belief.

There is, however, a magic word which we have not yet touched—bacteria. These are found in Thames water; "that one error fills it with faults." But all waters contain bacteria and their germs; even the three times distilled water, absolutely pure to the analytical microscopical chemical mind, is found to contain bacteria after slight exposure to the air we breathe, though it may be sealed up in tubes cleansed with the utmost care in the chemist's laboratory. What, then, must be the densely bacteria populated state of an ordinary drinking, and not a laboratory glass of water poured from a water bottle which has been standing on a table a few hours in the summer time. It is either dreadful to think of, or bacteria must be rather harmless creatures. But science overcomes most things. It found bacteria. Another branch of it has now found the means of killing them, though heat and cold and sulphuric acid only amuse them. Spongy iron, Dr. Frankland says, "is absolutely fatal to bacteria and their germs." Here is comfort; but to be safe or free from this living organism, we must take the water straight from the spongy iron filter. As, however, this cannot be done, we must be content to consume as few bacteria as possible.

Seriously, it seems that spongy iron has not only remarkable filtering properties, but it does somehow kill animal organisms; and we only wish to point out here that the Thames water, as it leaves the mains, may be looked upon as a perfectly satisfactory potable water.

ELECTRICITY IN GOLD MINING.

Among other uses to which electrical currents are applied, the purification of mercury seems to be likely to take a very important place; a place so important, indeed, that the subject deserves considerable attention. The results obtained are not only singular and striking, but they are to a certain extent still unexplained. That is to say, particular effects are produced, but precisely why and how has not yet been settled. In order to make what follows intelligible, it will be necessary, in the first place, to say something concerning the modern commercial system of gold mining as distinguished from the finding of nuggets and the washing of river sands. Gold is found in almost all countries in greater or less quantity. The principal supply is obtained, however, from quartz "reefs." Through some of these reefs the gold is disseminated in veins, visible to the eye. In other cases it appears as nodules or nuggets; but for the most part it exists in a state of extreme subdivision in the quartz rock. To obtain it the rock is broken to a fine powder in stamp mills; this powder is then sprinkled on inclined wooden tables, some 15ft. long and 3ft. wide, down which a stream of water flows continuously. At intervals, across the table, depressions or troughs are provided, in which mercury is put to a depth of ½in. or so. As the water and gold-bearing quartz powder run down the table or "riffle," they pass over the surface of the mercury in the troughs. The mercury seizes the gold *in transitu*. After a time the mercury becomes saturated with gold, about 3 oz. of gold being in practice sufficient to saturate 75 lb. of mercury. The mercury is then drawn off and "retorted;" that is to say, it is heated in special stills, and evaporated like so much water; the mercury vapour or fumes being condensed and used over again in the form of mercury, much as the feed-water in a surface condensing engine is used and re-used. At the bottom of the retort when the mercury has evaporated is found a button of gold, or rather of gold and a very little mercury. This button is then treated with nitric acid, and a number having been collected, they are melted in a crucible and cast into ingots. There is a certain loss by waste of mercury at every retorting, which is made up by fresh supplies.

Now if the miner had nothing but clean quartz and gold to deal with he would have no trouble in carrying out this process; but he seldom meets with conditions so favourable. Indeed the quartz is constantly found impregnated with sulphides of arsenic and other metals, and these are found to "sicken" the mercury in the troughs in the riffle. The surface of the mercury must be absolutely bright and clean, or it will not take up the gold. To illustrate our meaning, let us suppose that the riffle troughs were filled with melted tin. Copper and tin have a considerable affinity for each other, and if bright copper filings were permitted to pass over the surface of the tin they would sink and alloy with that metal. If, however, the tin were coated with oxide, it will be clear to any of our readers who has used a soldering bit, or tinned a piece of brass or copper, that the filings would pass away down the riffle untouched by the tin. The arsenic and other impurities found with the quartz have an analogous effect. They adhere to and foul the surface of the mercury, and amalgamation becomes impossible. The moment fouling or "sickening" takes place the riffle becomes useless, and the mercury must be all drawn off and retorted. Nor is this sickening a tedious process. It can be effected in half a minute. Thus two or three drops of oil from a bearing will instantly sicken twenty or thirty pounds of mercury. The practical effect of all this is that there are very rich quartz reefs which cannot be worked, because there is no known method of getting the gold out of the ore. We may cite one case in which there are no less than 42 oz. of gold to the ton, but the quartz is so "foul" that it cannot be worked. Thus, then, we have an ore worth £126 per ton, which as it happens, could be mined and treated for about £4 per ton, and which is entirely valueless, all attempts to work it having hitherto failed. A great many cases might be cited in which promising mines have entirely collapsed for this reason. A laboratory analysis of the ore has shown that it is rich in gold, carrying perhaps 5 oz. or 6 oz. to the ton, but owing to the sickening of the mercury the most that can be got out will be a couple of pennyweights perhaps—hardly enough to pay for the working.

We need hardly say that chemists and others have for years attempted to hit on some expedient for cleaning "sick" mercury without retorting, and the result can be attained in two ways. Thus, a small quantity of sodium added to the metal restores its power of amalgamating with gold, owing, no doubt, to the remarkable power which sodium possesses of making metals alloy. Thus, if a little sodium amalgam be rubbed on a bit of hoop iron, the iron may be dissolved in a pot of melted zinc. The mercury can also be cleaned by blowing chlorine gas through it. Neither plan has, however, met with much practical success. Sodium is not easily obtained in sufficient quantities, and it is not a very nice thing to carry up country to wild and out-of-the-way districts. There are obvious troubles again connected with the use of chlorine, and so neither have, as we have said, met with much, if any favour from practical gold miners.

Some months ago Mr. Richard Barker, of Norfolk-street, a member of the Geological Society, discovered—for we cannot say invented—a very curious phenomenon, namely, that if mercury be used as a cathode, while a copper or other metallic electrode is immersed in water covering the mercury, the mercury will immediately begin to expel any impurities which it contains, except metals. This principle he has applied to the purification of mercury in gold riffles, and with remarkable success. The invention—for the discovery referred to above had to be reduced to a practical form, in the shape of suitable apparatus—has been taken up by the Electro-Amalgamator Company, and a riffle has now been at work in Southwark for some little time. This riffle consists of a wooden trough, about 3ft. wide, and 12ft. or 14ft. long, with the usual mercury troughs across it. Along one side of the trough run two iron bars, one of which forms one side of an electric circuit, while the other forms the other. Rods of iron dip into all the mercury troughs, and put the mercury on the negative or return side of the circuit; similar rods are connected with bars, one of which lies across the riffle over each mercury trough, and from this bar, strips of copper about 1in. wide and 8in. long extend and lie horizontally over the mercury, which is thus under, so to speak, a huge comb, the teeth of which are about 8in. apart. The distance between the mercury and comb teeth is about one-fourth of an inch, and so long as the riffle is dry no current can pass. Close to the riffle is a very simple and inexpensive dynamo, wound for quantity only, with very coarse wire. Over each comb is fixed a small roller or axis of wood in which are stuck pegs, which pegs dip into the mercury between the comb teeth. The dynamo is driven by a small gas engine, and the pegged rollers are caused to revolve at the same time, the pegs agitating the surface of the mercury. The ground quartz, and a full stream of water descend the riffle from the top as already explained, and the water flowing over the mercury and touching the comb teeth, contact is at once made, and a current flows from the whole lower surface of each comb tooth through the water to the mercury. The effect produced is magical. No matter how "sick" or foul the mercury is, the moment the current is turned on, the impurities fly from the space below the comb tooth, and collect in narrow ridges in the intervening spaces, from which they are washed away by the current of water, and the surface of the mercury at once becomes as bright as silver. We have seen quartz used, heavily charged with sulphur and arsenic from sulphur pyrites. One shovelful of this stuff sufficed to sicken all the mercury in the riffle, and the mercury was brought back to condition in less than one minute after the current was turned on. With the current flowing, the mercury could not be made sick. One experiment which we witnessed showed in a startling way the effect produced by the passage of the current. Four or five pounds of clean mercury being put into a china bowl, some oil was added, and the whole beaten up with a stick to a species of ointment, a process which occupied five or six minutes. A sovereign dropped into this mixture of oil and mercury came out untouched by the mercury. For all purposes of amalgamation the mercury was useless, and must remain so until retorted. The bowl was now nearly filled with water, and the end of a negative wire from a battery was plunged into the metal and oil, while the positive wire was just dipped into the water, which stood two or three inches deep. The moment contact was made with the water the oil began to rise in streams from the mercury, which could be seen collecting itself into little drops, two or three of which would coalesce. In about three minutes the whole of the oil had come to the surface of the water, and the mercury lay pure and bright at the bottom of the bowl.

We are unable to explain to what this action is due, nor are we aware that any chemist or electrician is in a better position to supply information. There are two or three theories at the service of our readers, all more or less—principally less—satisfactory. According to one of these the impurities on the surface of the mercury, or mixed with it, become electrified, and are repelled by the mercury, because they are not metallic. According to another, the molecules of mercury are polarised, and, changing their relations to each other, expel all foreign bodies. Another theory attributes the action to the formation of nascent hydrogen, which acts chemically on the impurities; and this theory finds confirmation in the fact that pure water acts more effectively than any other liquid, the addition of any other liquid to the water, or of any substance soluble in it, apparently weakening the action of the current. It is a noteworthy fact that if the poles be changed, the cathode or negative end of the wire being in the water, while the anode or positive wire is in the mercury, the action is very trifling. If both ends are plunged in the mercury there is no action whatever. If a quantity of sickened or "floured" mercury be put into a large iron pan, and covered with water, experiments may be carried out which demonstrate the action of the current very clearly. Taking the positive insulated wire in the hand, an inch or so of the wire being left bare, while the other wire is plunged in the mercury, we can cause the impurities on the surface of the mercury to go in any direction we choose. They always fly away when the positive wire is pointed at them, just as dust will go before a blast from the nozzle of a pair of bellows. Indeed, it requires small exertion of the imagination to believe that a current of air proceeds from the end of the wire, and brushes the dirt before it. It has, we may add, long been known that the passing of a current of electricity through mercury tended to clean it, but the action was too feeble to be of any importance, and, so far as can be seen, the whole virtue of the Barker system resides in the use of water on the top of the mercury. As to the importance of the invention our readers can judge for themselves. It is to be hoped that a really satisfactory explanation of the action of the current will be forthcoming ere long.

BERTHS IN OCEAN STEAMERS.

For some time past complaints have appeared in the daily press from several correspondents who are tolerably unanimous in finding fault with the sleeping accommodation provided in the great ocean steamers of the present day. Up to a comparatively recent period the saloons of such vessels were long and narrow, berths or state rooms opening off them at each side. As ships increased in size a modification was introduced, and the dining saloon was extended until it became as wide as the ship, and the state rooms were then all arranged either forward or aft of the saloon, or, in some cases, both forward and aft. In this way what is commonly known as the music room was obtained above the saloon, this being usually a deck house, with a large portion of the floor removed, the space being fenced with a handsome rail. The deck house is surrounded with seats, and a piano is fixed at one end and an organ at the other. This room makes an exceedingly pleasant lounge, and that the entire system of construction is popular appears to be proved by the circumstance that it is now adopted by all the principal shipowners—the Paramatta, the latest addition to the Peninsular and Oriental Company's fleet, supplying an excellent example. It would appear, however, that not a few persons fancy that the widening of the saloon has reduced the berthing accommodation, and that in consequence passengers are crowded inconveniently; and it is furthermore urged that if less money were expended in painting and decorating, every individual first-class passenger would have a separate state room to him or herself. It is worth while to consider how far these complaints are the legitimate utterances of wronged voyagers, or the querulous grumbles of sybarites offended by ruffled rose leaves.

The business of the owners of ocean-going passenger steamships is to make their passengers as comfortable as possible. Competition in this class of traffic is so keen, that no company can afford to run boats which passengers go on board of with regret, and leave with delight. The experience of the captains of these vessels, with all manner of men and women, is very large and very varied, and it is at least reasonable to assume that they keep their employers posted up concerning what passengers do and do not like. Now, besides carrying passengers pleasantly, the ship-owning company has to carry as many as possible; because the ships cannot be run for nothing on the one hand, and, on the other, the number of passengers who would pay double fares for double accommodation is extremely small. Furthermore it is well in all ships, and it is absolutely essential in ships going to the tropics, that each state-room, or berth, should have a port opening in the side of the ship. In no other way can adequate ventilation be secured. Again, it is necessary, in order that a sufficient number of passengers may be berthed, that they must sleep in two stories, so to speak; that is to say, that one berth must be over the other. The consequence is that each cabin must be shared by two, three, or four inmates. That such a sharing of accommodation may be very unpleasant to some people in its consequences, and extremely distasteful to others, is of course certain. No one, we suppose, asserts that an arrangement by which one extremely small bedchamber is shared by two, three, or even four individuals, utter strangers to each other, is commendable. But this is not the point. The question is, can any better scheme be adopted? and we reply at once—as, indeed, do most shipowners—of course a better plan can be adopted; a state room can be assigned to each individual. If, however, we are asked, Can a better accommodation be supplied at the present price? we must reply in the negative. Let us suppose, for example, that there are fifty first-class state rooms on board the Indian-bound steamer Hotterevernuggar. These rooms have each three berths instead of four, which is the latest and probably the best system for India bound steamers, and the cost of a passage is £90. It is clear that the total first-class passenger receipts can be, under the circumstances, 90 × 3 × 50 = £13,500; but if each state room had but one occupant, then the receipts of the company would be 50 × 90 = £4500 only; and those who ask that no state room shall have more than one occupant virtually ask the owners of the Hotterevernuggar to give up £9000 per voyage. The other alternative is that the passengers should each pay 3 × 90 = £270 for a passage. Experience proves that even the most devoted admirer of nocturnal isolation would resolutely decline to purchase his coveted luxury at this price; nor would it be possible to split the difference satisfactorily. The owners of the Hotterevernuggar would make nothing out of their fifty passengers, and the fifty passengers would grumble at the exorbitant price they paid for the state rooms. No alternative remains but to augment the number of state rooms. There are two ways in which this may be done; one is to make each room smaller, the same deck space being occupied, in which case only two may be in each room instead of three, or by carrying this system a step further, only one berth may be put into each cabin; the other is to give up more deck space. As regards the first plan, it is difficult to see how it could be carried fully into practice, unless, indeed, the berths were so arranged that they could be drawn forward into passages, their occupants put into them, and the berths pushed back, the berths acting like so many drawers in a bureau. In no other way could two state rooms be made out of one of those now in use. Seven feet long and 9ft. wide is a good sized state room; the berths take off 2ft. from the 9ft. If this 9ft. were subdivided, there would be left, after 2ft. of berth was deducted, a floor space of 2ft. 6in. We fancy the enjoyment the semi-isolated passenger would take in stowing away his effects in this space. The more carefully each scheme is considered, the more evident does it become that the only possible solution of the difficulty lies in providing more state rooms. But as we have seen in the case of even so fine a ship as the Hotterevernuggar, no fewer than 150 state rooms would be needed instead of fifty, and the question is where are they to be put, so that each may have a port-hole in the ship's side. With the berths put fore and aft, allowing 7ft. for the length of each state room, and seventy-five state rooms at each side, we should have a length of 75 × 7 = 525 of ship occupied by cabins. But the Hottenevernuggar is only 465ft. long over all. If the cabins are arranged on two decks they will still take up a length of 263ft., which is quite out of the question. Of course, if the cabins are doubled on each other, so that one set of state rooms opens only on the saloon and the other on the sea, plenty of cabins may be got, everything else being sacrificed. But we fancy that most of those who had inside state rooms would begin to complain pretty loudly long before the Red Sea was reached.

We are by no means an advocate of crowded state rooms. It would be better in every way that each passenger should have a state room to himself. But, in plain terms, the thing cannot be done at the money. Being on board ship is, after all, not quite like being on shore; and a good many persons should never set foot in a steamer. Even the isolated state room would not bring matters up to the level of a first-rate hotel. There is such a thing as holy-stoning decks, and ashes have to be hoisted overboard; and there are gales, and heavy seas, and the noise of the engines and vibrations of the screw; and lights have to be put out early, and there are insect plagues to contend against. After all has been done that can be done to make passengers happy, and to smooth their rose leaves for them, a certain amount of roughing it has to be incurred; and it is hardly fair to the shipowner and the naval architect to complain that they will not consider the comfort of passengers for whom they have really done all that can be humanly accomplished under the fixed conditions.

TIN-PLATES IN THE UNITED STATES.

A CONTROVERSY of some importance has been carried on ever since last midsummer in reference to the trade in tin-plates in the United States. The immediate object of the movement is, and has been, to bring pressure on the Legislature at Washington to procure higher customs dues on importations of foreign tin-plates. It is well known that in the course of the last twelve or fifteen years a new branch of industry has developed in the preparation and preservation of canned fruit, meat, soup, and fish. The demand for tin boxes has, from one year to another, outstripped the supply of the raw material, and British tin-plates have served to satisfy the existing deficiency. It is well to observe that British importations have by no means tended to make an inroad on American industry, inasmuch as no exertions on the part of manufacturers have been manifested to supplant British tin-plates. The tin cans could not, therefore, by reason of an insufficient supply, be made without having recourse to the foreign material. In fact, the belief prevailed that difficulties, probably more or less of a technical nature, had arisen which rendered either impracticable or unprofitable the production of tin-plates in factories of the American Union. Serious attempts are now being made to dispel this belief. A small number of manufacturers has apparently overcome alleged difficulties, and obtained lately a footing in the home market for tin-plates. It has been reported that a prejudice exists in favour of British plate for this reason: The trustworthiness and the degree of perfection of the quality of the imported article served as a sure guarantee to the preserver of canned fruit and other goods. On the other hand, trials with cans of home-made materials might expose the canning establishments to serious risks and ultimate losses in money and reputation. The confidence in the durability and perfection of British plates had taken deep root. The cans had been exposed to climatic influences and other vicissitudes—stored often for lengthy periods in wholesale or retail warehouses before the fruit, &c., would reach the consumer. Whether or not this cause of objection was founded on fact or fiction, remained, of course, an open question. We are now told that perseverance and courage have enabled American manufacturers of tin-plates to take steps seriously to compete in a near future with importers of tin-plates from this country. Much feeling of indignation was created by the apparent inanity of tin-plate makers. It was held that the article ought to be produced at home, at any risk or sacrifice. Last year's report of the American Iron and Steel Association gave opinions on the subject in unmeasured terms, designating the inactivity of plate makers as humiliating, and even more.

A general outcry for protection has been the outcome of the movement. Home manufacture must be favoured by an increase in the present tariff rate, in order to limit importations of foreign goods. In support of the alleged grievances, an association, known as the Metropolitan Industrial League, has recently published a list of names, comprising owners and managers of canning factories, as well as merchants and others who have dealt in and used tin-plates of American origin. They join in a chorus of enthusiasm by means of certificates purporting to show that perfection of domestic produce has now been attained. It is said that American tin-plates which the firms have bought and used are in most cases equal in quality and finish to most of the good brands of terne plates of English make.

We have before us a printed copy of certificates of more than a dozen American firms who eulogise, with satisfaction, various brands, especially the plates which are produced by the United States Iron and Tin-plate Company at Pittsburgh. The immediate object in view is, of course, the desire to promote agitation, and to urge the legislative body now assembled at Washington to abolish the old existing tariff rate, which, since 1864, has been maintained at 15 per cent. *ad valorem*, and to substitute a new rate on all imported tin-plates, equal to 2⅜ cents per lb., or 60 per cent. *ad valorem*. The party who advocate the introduction of an increased rate of duty contend that during a series of years the Customs authorities have acted in error by wrongly interpreting the section referring to tin in the Act of 1864. They allege that in the section referred to an error of punctuation has been made; most probably by the clerk who engrossed that part of the Act. If the comma which is inserted after the word *plates* be omitted, and a comma placed after the word *iron*, the true meaning of the Act would unquestionably be that tin-plates as well as the iron must be galvanised or coated with any metal by electricity or otherwise. The opinion has prevailed all the time that the Custom House authorities, acting under instructions emanating from the Treasury, has erroneously admitted tin-plates under the clause providing for "tin, in sheets or plates," and under which clause should only be admitted "sheets or plates of pure tin." Pig, or block tin, being a raw material, not produced within the territory of the United States, stood always on the free list. What is known commercially as "tin-plates," it is held, should be taxed under the following clause, *i.e.*, amending it in these words: "All plates and sheets of iron or steel, or taggers iron, coated with tin or lead, or with a mixture or a component part by the dipping or mixing processes, now known as tin-plates, terne plates, and taggers tin, and by whatever names hereafter called, $2\frac{3}{4}$ (two and three-quarter) cents per pound." Describing the article thus, more aptly, the belief is favoured that the original framers of the Bill had intended to levy the duty as described. But the mistake committed by the engrossing clerk had compelled the Treasury department to confine itself to the interpretation of the Act, and to leave it to Congress to correct, if necessary, the mistake. It is added that the labour and expense in the reduction of pig tin into sheets or plates is very small, and therefore a duty of 15 per cent. *ad valorem* is and was deemed adequate. Moreover, at present, articles of pure tin can barely be considered as of commercial importance. On the other hand, the consumption of ordinary tin-plates has increased enormously. Four million boxes of tin-plates, it is alleged, have been consumed last year in the United States, on the whole of which supply the country depended on imports from England. The fact is pointedly alluded to that, in 1860, there were about 100 rolls making sheet iron for tin-plate purposes, while in 1881 the number of factories had increased to about 400 trains of rolls, employing in round numbers 30,000 hands. Time must show whether or not the American tin-plate makers can successfully compete with British production. The importance of this branch of industry is known to all and needs here no elucidation. Nevertheless, the foregoing may be well worth a very serious consideration when we reflect how largely capital and labour are in this country engaged in the manufacture of tin-plates. The consumption in the United States of America has so much increased that the British export has for years absorbed 75 per cent. of the quantity shipped. In other words, while, during a period of fourteen years, the British tin-plate works have shipped a quantity of 1,615,463 tons to the United States of America, the export to all other countries has not exceeded, during the same space of time, 565,788 tons. These figures comprise the period 1869 to the 31st December, 882.

A METAL BALLOON.

THE *Neue Freie Presse* of Vienna recently described an invention of Count Buonaccorsi di Pistoja, which had been subjected to a minute examination and to experimental demonstrations on the part of the Austrian Society of Architects and Engineers. This project is founded on the use of metal for the purpose indicated, and is noteworthy from the fact that instead of flexible material wanting in durability, it introduces a stronger substance capable of supporting technical manipulation. Thus the construction of balloons is said to be brought within the range of principles hitherto inapplicable to that purpose, and the chances of aerial navigation becoming an accomplished fact are, it is considered, materially enhanced by means of this invention. The balloon is adapted for being filled by gas, but is likewise planned with a view to steam being employed in its propulsion. The body of the balloon is in the shape of a fish laid on its side, and is composed of aluminium and strengthened with steel ribs. This form is supposed to cause the least possible resistance of the air during forward motion, and to act in some degree as a parachute. The sheets of aluminium are described as being of dimensions hitherto unknown, being in some cases 39in. wide, and varying in thickness from ·039 of an inch to one-tenth of that. The results obtained are said to indicate that the construction of large bodies out of aluminium is quite practicable. The tests made of its resistance against tearing showed that it was stronger in this respect than taffetas silk, although not exceeding that material in weight on account of the extreme thinness of the plates. The second portion of the balloon is the framework which surrounds the middle portion of the body, which is divided into three parts. This framework is intended to contain the machinery and the apparatus for propulsion, as well as the aeronaut. Experiments proved that hammered and tempered cast steel, while possessing enormous strength and being ornamental in appearance, was of a lower degree of specific gravity than other substances which were suggested, and which were also in other respects less suitable. The construction of the framework is said to be simple in plan, and to resemble in some respects the best models of bridge building. The third and most important portion of the machine is the motive apparatus. This consists of ten large screws, four of these effecting the horizontal progression of the balloon, and six its motion in an upward direction. The combination of the balloon is said to be so designed that the entire weight of all the separate parts and of the aeronauts is balanced by the force of the gas within about 220 lb. This remainder of 220 lb. absolute weight is overcome by the action of the apparatus for upward motion, and thus ascending motion is rendered possible by this mechanical force. This principle allows of successive rising and falling by the increased or diminished action of the screws. These screws are constructed upon a principle which Count Buonaccorsi had already patented in connection with steamships, but with the needful alterations required for the purpose of aerial navigation. The extreme lightness of this type of screw, and the relatively small quantity of steam which it requires, are said to make it applicable beyond all others to the purpose indicated. According to the preliminary calculations made, a speed of about eleven yards per second would be obtainable with the nominal horse-power of the machine—10-horse power—the radius of the screws being supposed to be 6·56ft. The tests made were with screws of half this radius. A combination of three screws—the central one worked direct from the machine, and the others made to rotate by the transmission of force—was the object of much approval, and when the outer screws, or all the screws of each group were put in motion, the apparatus is stated to have risen in an upright position, which was not the case when one or both of the outer screws of each group were not allowed to work. The steam engine used is peculiar in its construction. It consists of an upright tubular boiler, which in some points resembles that of Dupuis, but with the distinction that the boiler takes in at once the entire quantity of water which is required. The furnace is placed in the centre, and the tubes go upwards and downwards. The superheated steam formed in the upper part of the boiler is transmitted directly and without loss of heat to the engine immediately adjoining. In commenting upon the general character of the invention, the *Neue Freie Presse* remarks that it has certain points which indicate the possibility of its general application sooner or later. Attention is called to the fact that the weight of the motor is about 12 cwt. or 14 cwt., thus representing about $1\frac{1}{4}$ cwt. per horse-power. This limit has, it is said, nothing essentially impracticable about it, inasmuch as marine engines have long been constructed in which a minimum weight of about 2 cwt. per horse-power has been arrived at in cases where lightness and power were essential requirements. In conclusion, it is stated that Count Buonaccorsi's invention has, for the reason just alluded to, more elements of sterling merit about it than many of the modern theories as to aerial locomotion, which are based on motors being constructed which only weigh 13 lb. to 15 lb. per horse-power.

CONTINUOUS BRAKES ON THE PRUSSIAN STATE RAILWAYS.

EXTENSIVE experiments with so-called continuous brakes for locomotives and passenger cars have been made on the Prussian State Railways for several years, the results of which may be of general interest. They commenced with those made near Guntershausen in the year 1877, which, however, did not give results sufficiently conclusive to decide finally as to the system to be selected. After different systems had been employed for several years it became known that the Prussian States Railways seemed disposed to select a uniform system. For this purpose the Guntershausen experiments were repeated in the summer, 1881, on the Halensee-Dreilinden line near Berlin. All systems to be examined were then used in regular service of the express and mail trains on the Berlin-Breslau line from the 15th October, 1881, till 1st April, 1882. The competitive systems were: (1) Heberlein System, automatic friction brake; (2) Westinghouse System, automatic air compression brakes; (3) Carpenter System, automatic air compression brakes; (4) Steel System, automatic air compression brakes; (5) Sanders System, automatic vacuum brake; (6) Smith-Hardy System, continuous, but not automatic vacuum brake; (7) the ordinary hand spindle brake System. With the exception of the last-named, they are all patented in Germany. The patentees were present during the Guntershausen experiments, while those at Halensee-Dreilinden were made without their presence. After the termination of the experiments and the tabulation of their results, the representatives of all the Prussian State railways were called together by the Minister of Public Works to submit their views and propositions as to the selection of the system to be adopted, according to the *Anzeiger zum Centralblatt der Bauverwaltung*. Besides other questions, the following were also submitted to the assembly:—"Is a greater safety in the service to be obtained by the introduction of a continuous brake, that is to say, of a brake which allows the driver to work all the brakes of the whole train, consequently also those of the cars, from his place?" This question has been answered in the affirmative by the representatives of all the Royal Railways. Nevertheless, the results of the experiments lately made with the old hand spindle brake on the Halensee-Dreilinden line were nearly as favourable as some of the continuous brakes. It must, however, be mentioned at the same time, that those brakes were during the experiments handled by experienced men, selected from the mechanics of the Halensee workshops. In expectation of the signals, those men worked the brake powerfully and quickly. It is, however, not to be supposed that in the ordinary service the brakes could be made use of so rapidly. But it is precisely the quick working of all the brakes of the train by the driver which makes the use of the continuous brakes so valuable, whether they are automatic or not. It is this condition which makes them especially preferable to hand brakes. Another question which has been submitted was: "Which system of continuous brakes seems most likely to answer, without being exposed to the danger of discontinuing its application, if once carried out and in use?" The Assembly answered this question by declaring that all the systems could be carried out; but that they are not all alike good as regards safety and quickness of action, maintenance and attendance, as well as in regard to the number of times of the brake not acting, having become out of order. The introduction above all of a uniform and simple system was, therefore, required for the main lines. The action of the different brakes on gradients was also considered, as well as the question whether the continuous brake to be introduced should also be automatic at the same time. The Assembly unanimously decided that the brake should be at the same time automatic, and considered it necessary for all systems to have a special brake attendant—a mechanic—to superintend the brake and to undertake its warming, oiling, &c. It was at the same time decided that the Smith-Hardy vacuum brake which is not automatic, but is, nevertheless, by preference used on the Berlin town line, and highly valued for its simplicity, is not suitable for main lines. The Assembly finally selected the Carpenter brake for the use of the express trains of the States lines and those railways under States supervision, by a majority of two-thirds. It seems that the Minister of Public Works has approved of the decision of the assembly, and sanctioned a contract for the supply of those brakes, which have also to be adapted to all foreign passenger cars—so-called course cars—running in the express trains of the Prussian States lines. It has further to be mentioned that for the rolling stock of secondary lines the Heberlein brake has been accepted, and in the mixed trains of those lines, on account of the goods cars, it does not seem that any other system of continuous brakes would be practically applicable.

A SIGNAL LAMP LID THE CAUSE OF A COLLISION.

A COLLISION due to a curious cause occurred on the Furness Railway on the 13th of November last, at Pennington Block Station. From the evidence it appears that the signalman at Pennington left his cabin about 2.42 p.m. to light the lamp of his up distant-signal, this being the most convenient time for him to leave his cabin. After lighting the distant-signal he omitted to shut down the lid of the lamp before he pulled it back to its proper place on the signal-post, and he returned to his cabin about 2.58 p.m., switching his station again into the block circuit, and then found that he could not work his up distant-signal. He had telegraphed to Lindal east and Ulverston cabins when he switched out and when he switched his station in. The goods train ran past Pennington up distant-signal, which showed a white light, but it was pulled up at the home-signal, which was at danger, as Ulverstone yard was occupied by another goods train, so that the signalman at Ulverston could not give line clear to Pennington, when he was first asked to do so from that cabin. The signalman at Pennington, on finding that his up distant-signal would not work, switched out his station a second time, and left his cabin to go and see what was the matter; but he appears to have forgotten to notify to the signalmen on duty at Lindal east and at Ulverston, that he had switched out his station, when he did so this second time. The consequence of this omission to notify the second switching out at Pennington was, that the men at Lindal and at Ulverston were placed in direct communication with each other, without either of them knowing it, and whilst the Ulverston signalman thought that he was giving line clear to Pennington, he was really giving line clear to Lindal, and the Lindal signalman was telegraphing to the Ulverston signalman for line clear for the passenger train, when he supposed that he was telegraphing to the Pennington signalman; the result was, that when Ulverston yard was clear, and the signalman there intended to telegraph that the goods train, which was stopped at Pennington, might come on, he really telegraphed to Lindal that the line was clear, and the passenger train, which had been checked there by the signals in consequence of Pennington not being clear, obtained the "Clear" signal and the passenger train was allowed to go on, while the goods train was standing at Pennington. When the passenger train approached Pennington the up distant-signal was still at "All right," as it could not rise to danger owing to the spectacle of the back-light catching the open lid of the lamp. The passenger train passed this signal, and as it ran round the curve the driver caught sight of the goods train, which he stated was then only about 60 yards in front of his engine. Steam was shut off at the time as the train was descending the incline. The driver at once reversed, whistled for the guard's brake, opened the sand-pipes, the fireman applied the tender-brake, and the speed of the train was reduced to about four miles an hour before it struck the brake-van of the goods train. In his report to the Board of Trade on the accident, Colonel Rich necessarily attributes the collision to the neglect of the Pennington signalman, in not shutting down the lid of the lamp, and by his omitting to notify to the signalman on duty at Lindal east and at Ulverston cabins when he switched his station out of the circuit the second time, about 3.15 p.m. Colonel Rich also observes, if the passenger train had been fitted with continuous brakes under the control of the servants in charge of the train, the collision, which appears to have been very slight, would probably have been prevented.

LITERATURE.

Memoir of Augustus De Morgan. By his wife, SOPHIA ELIZABETH DE MORGAN. With Selections from his Letters. London: Longmans, Green and Co. 1882.

THE life of this excellent man, which has at length appeared, is written by his wife, and is a book of more than ordinary interest. Augustus De Morgan was born in the year 1806, at Madura, in the Madras Presidency. His father, Lieutenant-Colonel De Morgan, held several staff appointments, and died at St. Helena, in 1816. The whole book teems with descriptions of his very active life, and we cannot do better than plunge at once into those phases of his career which are most characteristic. On page 100 we read: "All *cram* he held in the most sovereign contempt. I remember, during the last week of his course which preceded an annual college examination, his abruptly addressing his class as follows: 'I notice that many of you have left off working my examples this week. I know perfectly well what you are doing; *you are cramming for the examination.* But I will set you such a paper as shall make *all your cram* of no use.'"

An account is given of the Mathematical Society, which was established in the year 1817, in Crispin-street, Spitalfields, mainly composed of working men, the condition of membership being that each member should have his pipe, his pot, and his problem. De Morgan was hard pressed to take the presidency of the Astronomical Society, but nothing would induce him, and the letters which passed between Sir John Herschel and himself are given, and are well worth reading. He was on many occasions very earnestly begged to take it, but he refused; for, while working harder than ever, if possible, as secretary, to keep up the character and usefulness of the society, his old reasons were still in force. He always feared the love of rank and money finding its way among the honest, useful workers who had hitherto composed it. He held up the example of the Royal Society as one in some ways to be avoided, and "resisted every measure that would tend to bring in the sort of influence which had fettered its scientific work during the last century. His commentary on the Royal Society's history in times past is given in the 'Budget of Paradoxes,' as well as some allusion to the fact of his never having sought for membership." But we are under the impression that men are not supposed to seek election, and that all things pertaining to the election of any person as Fellow of that Society are done by some members who consider that person fit for election. The person himself must not move in the matter.

Apropos of the enormous variety of subjects on which a young man was required to answer questions in science examinations, without reference to any special ability, he points out how stultifying and confusing it is even to the brain which could receive them all without damage to physical health. In illustration of this reckless and fruitless waste of mental effort he prepared the following "Cambridge examination":—

Q. What is knowledge? A. A thing to be examined in. —Q. What is the instrument of knowledge? A. A good grinding tutor.—Q. What is the end of knowledge? A. A place in the civil service, the army, the navy, &c.—Q. What must those do who would show knowledge? A. Get up subjects and write them out.—Q. What is getting up a subject? A. Learning to write it out.—Q. What is writing out a subject? A. Showing that you have got it up.

On p. 202 is a letter to Dean Peacock on his marriage, in which he very amusingly demonstrated the difficulty he felt respecting the lady's name at the instant of the ceremony. In a letter to Captain Smyth, in 1848, he wrote:—"Airy gave us a very good telegraph lecture. I mean *on* telegraph not by telegraph. But time may come when we shall sit down in our own house and hear him lecture from Greenwich." Mrs. De Morgan adds the note:—"I do not suppose the writer had the smallest conception of the wonderful literalness with which his predictions would be fulfilled. It must be remembered that the telephone was not even dreamed of thirty-three years ago."

In 1856 De Morgan took an active part in the scheme for introducing a decimal system in weights, measures, and coins. In a letter of this time he speaks of Dr. Bowring, afterwards Sir John Bowring: "What an ardent creature he is! He seems to me as if he lived on live birds." In the same year he writes to a friend about a new musical instrument which he proposed to construct, and to call the "Electro-magnetic Whack-row-de-dow." In a letter to Dr. Whewell, dated the same year, he tells a good story, which is as follows:—"A little before 1830 Biot was at Rome, conversing with the chief Inquisitor, who said, "You men of science think that the Inquisition is opposed to scientific statements, which is quite untrue." "Then," said Biot, "I suppose the professor at the Sapienza College may teach the motion of the earth?" The

THE INSTITUTION OF CIVIL ENGINEERS.

MILD STEEL FOR THE FIRE-BOXES OF LOCOMOTIVE ENGINES IN THE UNITED STATES OF AMERICA.

At the ordinary meeting on the 30th of January, Mr. Brunlees, president, in the chair, a paper on the above subject was read by Mr. John Fernie, M. Inst. C.E.

It was stated in the paper that the use of mild steel for the fire-boxes of locomotive engines was now general in the United States. Although large numbers of the outer shells of the boilers were still made of iron plates, this was simply to effect a saving of expense, and many railroad companies had the boilers wholly of steel. Iron plates were first used as a substitute for copper, owing to the rapidity with which the anthracite coal wore away the soft copper. When sound the iron plates gave better results, but the weldings were frequently unsound; they were apt to blister, and the plates were subject to crack near the fire-bars. Steel fire-boxes, the plates being a nearly pure compound of iron and carbon, were used for the Pennsylvania Railway engines eleven years ago. Since then excellent steel for this purpose had been made by the Siemens-Martin open-hearth process in many places in the United States. The mode of manufacture of this steel was briefly described, as it differed from English practice. The specification for boiler and fire-box steel last given out by the Pennsylvania Railroad Company was quoted. The author next proceeded to state that in the cities of the United States, all steam boilers for stationary engines were placed under municipal regulations, whereby a proper registration and inspection were instituted at a small cost to the user. In Philadelphia about 4000 boilers were tested once a year, and a licence was given by the inspector to use the boiler for one year, at the pressure it was considered fit to sustain. The formulas, under which the calculations were made, were stated, and the tests employed. The highest test was when a boiler plate, from which a portion was cut off lengthwise, showed a ductility of 20 per cent. upon a measured length of twelve thicknesses of the plate, and when cold would bend to 180 deg. over a diameter equal to two thicknesses of the plate, or when cut crosswise would bend cold to 90 deg. over a diameter equal to five thicknesses of the plate. In every steam vessel navigating the lakes, rivers, and seas of the United States, and sailing under its flag, a complete system of inspection during manufacture, and an examination of boilers when made, was maintained by the Government, and all boiler plates had to be branded with the maker's name, and with the tensile strength of the plate per square inch. Makers of boiler plates were pecuniarily liable for any failure of the material if it occurred at a lower strain than that at which it was branded. Officers for examining and testing the materials and work done were appointed, and the question seemed to be much better understood and practised in the United States than in England. With respect to locomotive engines, which were in one city one day, and in another on the next, and which might constantly be moved out of one State into another, there could be no municipal or Government control, but there was a healthy public opinion on the subject, and heavy damages would be obtained against any company whose boilers exploded from neglect, or from the use of bad material. In America, it was stated, railroad engineers were not hampered by Government control. There was no necessity to urge railway companies to adopt improvements. Inventions were quickly examined, tested, and rejected or adopted. Hence the march of improvement was more rapid than in Great Britain. The author then proceeded to describe, first, the English type of locomotive fire-box, and afterwards the various new forms of American fire-boxes. In the former the strains set up by the greater expansion of the inner box over the outer, from the higher temperature, were aggravated from the material being of copper, which expanded more than iron under equal increments of temperature. Greater stress was thrown upon the stays, and by the use of copper and brass tubes a galvanic action was established in locomotive boilers, which speedily destroyed the iron plates. The author illustrated the American type by two examples of boilers and fire-boxes in use on the Pennsylvania Railroad, and he pointed out in how far they approached the conditions of what he held to be a perfect fire-box of the old and well-known form. The requirements for a fire-box of this kind were, that the plates forming the outer and inner boxes should be of similar metal, that as the metal of the inner box must always expand more than the outer, it should be thin enough to bend or spring between the spaces where it was held by the round stays; that to compensate for the extra expansion, the heavy roof-beam stays should be done away with, that there should be a number of water tubes through the body of the fire-box, that the fire-bars should also be water tubes, that the areas of the fire-box and grate should be large, and that the materials of construction should be cheap and easily obtainable. The author demonstrated that in these respects the American was far in advance of the English type of locomotive boiler. With regard to cost he showed that as steel fire-boxes were only half the weight of copper ones, and as the price per ton of the former metal was about one-third of the latter, the actual cost of steel fire-boxes was from one-fifth to one-sixth the price of copper ones, although the cost of workmanship would be a little more in working steel.

CONTINUOUS BRAKES ON THE PRUSSIAN SECONDARY RAILWAYS.—In specifying recently for sixty-four passenger carriages and fifteen combined Post-office and guard's vans for the Prussian Eastern Railway, the Royal Direction at Bromberg specially lay down as a condition that every vehicle is to be fitted with a Heberlein brake. As will be seen in another part of our present impression, the Heberlein brake has now been definitely adopted by the German Government for all the so-called "subordinate lines," and for the mixed trains, as being the only system of continuous brake which admits of vehicles without any special fittings being coupled into the trains without in any way interfering with the automatic qualities of the brakes, or with the engine drivers' and guards' control over them. The question as to which system of brakes is to be used for ordinary passenger trains is still undecided, the Carpenter compressed air brake having, however, been selected for an application to about 100 locomotives and 500 carriages, for the through express service.

RAILWAY CARRIAGE OF AGRICULTURAL IMPLEMENTS AND CASTINGS.—It will be remembered that a deputation from the Agricultural Engineers' Association recently waited upon the Railway Goods Managers, at the Railway Clearing-house, for the purpose of bringing before them serious alterations imposed by the new classifications for 1883, and the prejudicial effects likely to follow, if they should be persisted in. A reply has been received from the secretary of the Clearing-house, who writes:—"I am requested to inform you that at meetings of the Committee of Goods Managers, specially convened for the purpose, and held here on the 25th and 31st ultimo, the views and suggestions of the deputation of members of the Agricultural Engineers' Association, which were explained at the meeting held here on Thursday last, have been very carefully considered, and that it has been determined that, when articles charged under either of the following heads, viz.;—'Agricultural machines and implements—except steam engines, steam ploughs, steam plough vans, and thrashing machines, in lots of two tons or above, and iron harrows; ditto in ton lots; light castings not otherwise enumerated;' are carried at owners' risk, and if damaged in transit they shall be returned free, and that the articles sent to replace them shall be carried free also, provided that the damaged article be returned one within week from date of being tendered—by advice or otherwise—to consignee, and that the whole transaction be completed within two months. This arrangement to apply as from 1st January, 1883. In communicating this decision, I am desired to point out that the revision of the classification has in some cases effected reductions, as well as in other cases advances, and that the railway companies hope that, taken as a whole—with the concession respecting free carriage above set out—it will be considered satisfactory."

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

(*From our own Correspondent.*)

THE drop in "marked" iron declared last week by two or three of the leading firms has not been followed by any other reductions, nor are any looked for. Yet the market continues unsettled, and new business is restricted.

Messrs. John Knight and Co., Cookley Ironworks, have issued the following:—"We notice that one or two makers are reducing the price of bar iron 10s. per ton, but we regret that we cannot follow them until raw material generally is reduced. The moment we are in a position to make you any concession you shall hear from us." This firm was amongst the houses which last October advanced prices 10s. In bars Messrs. Knight rank in the same category as Messrs. John Bradley and Co., who it is understood also decline to make any change. But Messrs. Bradley declared no change last October, their bars having previously been as now £8.

The 10s. drop leaves the Earl of Dudley's list, which is 12s. 6d. per ton higher than any other firm:—Rounds, lowest quality, £8 2s. 6d.; single best, £9 10s.; double best, £11; and treble best, £13. Rivet and T iron is: Single best, £10 10s.; double best, £12; treble best, £14. T iron of lowest quality is £9 2s. 6d.; angles, not exceeding eight united inches, and hoops and strips from 14 to 19 w.g. are: Lowest quality, £8 12s. 6d.; single best, £10; double best, £11 10s.; and treble best, £13 10s. Strips and hoops of 20 w.g., ⅞in., are £1 per ton additional as to each of the qualities, and of ¾in. £2 per ton additional.

William Barrows and Sons' new prices are:—Ordinary bars, rounds, squares, and flats, £7 10s.; best bars, £9; and best best bars, £10; best chain and best scrap bars are also £9; and double best ditto, £10. Plating bars are £8 to £9 10s., according to quality; best angle, T, and rivet iron, £9 10s.; double best ditto, £10 10s.; double best charcoal bars, £16; ordinary plates, £9; best boiler plates, £10; double best, £11; and treble best, £12. Extra treble best plates are £15, and best charcoal ditto, £19 5s. Sheets to 20 w.g. are £9; 21 to 24 w.g., £10 10s.; 25 to 27 w.g., £12; best charcoal sheets, £10 5s. per ton extra. Strip, fender, and plough plates are £9, and best ditto £10 10s. Hoops from 14 to 18 w.g., are £8, and best ditto £9 10s. Best matched slit rods are £9 10s., and second best £8 15s. Double best charcoal slit horse-nail rods are £16 10s., and double best rolled ditto £18.

Messrs. Hingley and Sons' altered bar quotations are:—Netherton crown best, £7 10s.; best rivet iron, £8; best best bars, £8 10s.; double best plating iron, £9; and treble best, £9 10s. Angle and T-iron, up to eight united inches and not exceeding 25ft. long, is: Angle iron, 10s. per ton above the price of bars; and T-iron, 20s. per ton extra.

E. T. Wright and Sons, Wolverhampton, quote:—Monmoor best boiler plates, £9; sheets, £8 10s.; bars, £7 5s.; and hoops, £7 15s. The Wright qualities of this firm are 10s. per ton lower, as usual.

Merchants are pressing makers of medium and common finished iron for easier rates. But vendors continue firmly to resist the pressure, which they stigmatise as unreasonable; and it is satisfactory that orders are still arriving from London for makers who have declared to buyers that they "shall not give way one penny." Medium quality bars are £6 15s.; common bars, £6; hoops, £6 10s. to £7; sheets, singles, £7 15s. easy; and doubles, £8 10s.

Alderman Avery, president of the Mill and Forge Wages' Board, awards to-day—Thursday—that under the sliding scale, which comes into operation in April, puddlers' wages shall be 9d. per ton in excess of 1s. for each pound sterling in the ascertained net average selling price of iron. The scale is to continue in operation for six months certain, and there is a minimum attached of 7s. 3d. per ton for puddlers.

Best thin sheet-makers and makers of tin-plates report pretty favourably of the demand. Prices are unchanged with, however, a tendency towards firmness in tin plates.

The demand for pigs is improved, and some all-mine makers are stating this week their intention of blowing out if there is not an early revival; 65s. remains their quotation. Hematites are 65s. to 67s. 6d. nominal; native part-mine pigs, 50s.; and cinder sorts 40s. upwards. Sales of foreign pigs tame; Derbyshires, 47s. 6d. upwards delivered at stations, and Lincolnshire 50s.

Some big sales of ironstone are announced. Northampton ores are 6s. to 6s. 2d. delivered; Forest of Dean are nominal at 14s. 6d. at stations.

Anvils and vices are in good demand at the chief makers, though new orders are scarcely so numerous as a couple of months ago. The business with the United States is not an average, and this circumstance is attributed by makers to the unrest regarding the tariff duties. With Australia and Canada and some parts of Europe, however, a big trade is doing. The home demand is fair, and the principal manufacturers are fully employed.

The examination in Wolverhampton of twelve candidates for mine managers' certificates has resulted in the examiners recommending the Home-office to grant certificates to five.

The office of Inspector of Mines for South Staffordshire, East Worcestershire, and Cannock Chase is vacant, through the death of Mr. James Philip Baker, late of Wolverhampton. Mr. Baker had filled the office since its creation at the passing of the Mines Regulation Act.

At Wednesbury on Tuesday a coroner's jury returned a verdict of "manslaughter" against Benjamin Banks, colliery engineman, in connection with the recent fatal rope breakage accident at the Willingsworth Colliery.

The chairman of the South Staffordshire Mines Drainage Commissioners, at a meeting of that body on Wednesday, complained loudly of the great difficulty which the Commissioners experienced in collecting their rates from colliery owners. At the same meeting a drainage rate of 1d. per ton on all minerals raised throughout the area covered by the Act during the past half-year was levied, and formal sanction was given to loans amounting to £30,000, borrowed upon the security of the Tipton mines drainage rates.

The South Staffordshire and East Worcestershire Traders' Council have decided to make an appeal to the trade organisations throughout the country for funds to enable the Anti-Truck League to stamp the truck system out of the district. Money is needed to support those who gave evidence on the subject, for they lose their employment directly they become witnesses.

The report of the Birmingham Improvement Committee relating to the scheme under the Artisans' Act shows that the deficiency of revenue during the past year was £18,858, being an excess of £3858 over the estimated deficiency.

Hanley, North Stafford, has been fixed upon as the place for the next annual conference of the Federation of Miners for the Midland counties, which is to be held on March 6th.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—The continued unsatisfactory condition of the iron trade is tending towards a general feeling of depression throughout the market, and there appears to be a growing want of confidence in the future. There has been no material giving way in prices during the week, but the business doing has been exceedingly small, and although makers nominally maintain their quotations, it is not that there is actual firmness in the market, but because they have found that repeated concessions have been practically useless so far as stimulating buying is concerned.

An exceedingly dull tone prevailed throughout the Manchester iron market on Tuesday, and I could hear of no orders of any weight stirring. For Lancashire pig iron a few inquiries were reported at low prices, but local makers, who are fairly supplied with orders for the present, show no anxiety to do business in the existing depressed state of the market. Their quoted rates remain at 46s. 6d. to 47s. less 2½ for forge and foundry qualities delivered equal to Manchester, but even on the basis of these figures they are not free sellers, and they are practically doing little or nothing so far as booking new orders is concerned. In district brands a few sales of Lincolnshire foundry are reported, but otherwise business is excessively quiet. For delivery into the Manchester district quotations remain at 45s. 10d. to 47s. 10d. for Lincolnshire forge and foundry, and 48s. 6d. to 50s. for Derbyshire less 2½ per cent.

The manufactured iron trade is in a very depressed condition. Although the recently announced reductions in South Staffordshire had already been discounted so far as this district is concerned, they have had the effect of still further unsettling the market, and buyers, where they put forward inquiries, offer prices far below those quoted by makers. Quotations for delivery into the Manchester district remain nominally on the basis of £6 7s. 6d. to £6 10s. per ton, but there has been exceedingly little business doing, and there is so much underselling to secure orders that if the market could be really tested, £6 5s. would probably be found to be a very general figure at which orders would be taken. Shipping inquiries continue only moderate, and I hear that the low freights now obtainable at London are tending to divert the Indian trade from Liverpool. A new opening for merchant iron is, however, coming into view, and I hear of fair inquiries for shipment to Africa.

The members of the Manchester Association of Employers, Foremen and Draughtsmen, held their 27th annual dinner on Saturday, at the Queen's Hotel, under the presidency of the Mayor, Alderman Hopkinson, and about 100 gentlemen sat down. Amongst a number of friends present were Colonel Shaw, the American Consul; the borough engineers of Manchester and Salford, Messrs. J. Allison and A. Jacob; the resident engineers of the London and North-Western and the Manchester, Sheffield, and Lincolnshire Railway Companies, Messrs. W. B. Worthington and C. Sacre; and Mr. F. Wiswall, the engineer of the Bridgewater Navigation Company. The Mayor, in proposing prosperity to the Association, said it had already achieved great success, which he hoped would simply be the prelude to still greater progress in the future. Such associations, with the larger organisations of the Civil and Mechanical Engineers, had a most important influence upon the varied industrial undertakings of the country. In former years secrecy was the order of the day with regard to all mechanical and trade operations, but the engineers of England had changed all this. There was now a free interchange of ideas, and a readiness to show methods of manufacture. There had been a rapid development of trade in connection with iron and steel and other allied industries since the establishment of these institutions that had not been known before, and this he attributed in large measure to the rapid development of new processes, which had been largely helped forward by the ready means of inter-communication afforded by the various associations throughout the country. The chairman also urged the importance in the present day of a mechanical training, which he said was becoming increasingly necessary to the civil engineer whilst in the conduct of naval and military operations. The possession of mechanical knowledge was now indispensable. Subsequent speakers also touched upon the importance of a mechanical training, Mr. A. Jacob urging that if a man wished to make his mark as an engineer, a workshop training was almost a necessity in the present day. The importance of increased technical knowledge amongst the workmen was also introduced, and Mr. John Craven stated that with regard to Manchester, they had in hand a scheme of technical education in connection with the Mechanics' Institute, whereby a thoroughly efficient technical school would be established, furnished with looms, spinning machinery, mechanical tools, and other appliances, which would enable a boy, before he had actually left school, to learn something of the branch of trade he intended to follow.

Mr. Joseph Dickinson, H.M. Chief Inspector of Mines, introduced to the members of the Manchester Geological Society at their meeting on Tuesday an improvement in safety lamps and a system of testing the lamps before supplying them to the men, which he considered of considerable importance. The improvement in the lamp has been introduced into the Mueseler type by Mr. J. S. Green, of the Celynen Colliery, Abercarn. Mr. Green had found that under certain conditions gas continued to burn underneath the disc or horizontal gauze after the flame on the horizontal wick had discontinued burning, and to prevent this he had affixed a small projection of tin to the tube, and this had proved effectual. With the addition of a shield to the lamp about 2in. in depth around the bottom at the top of the gauze, and resting on the top ring over the glass, Mr. Green considered that the lamp was rendered unexplodable under all probable conditions. As an additional safeguard every lamp before it was handed to the workmen was tested by means of a suitable apparatus in an explosive mixture of air and gas.

There is very little material change in the condition of the coal trade. A moderate demand is kept up, and although there has in some cases been a little easing down in prices since the commencement of the month, there has been no general reduction of list rates. At the pit mouth prices average about 9s. 6d. to 10s. for best coals; 7s. 6d. to 8s. for seconds; 6s. to 7s. for common; 4s. 6d. to 5s. for burgy; and 3s. 6d. to 4s. for good slack, with common sorts in some cases as low as 3s. per ton.

There has been rather more doing for shipment, although there are still many complaints of a scarcity of orders. Delivered at the high level, Liverpool, or at the Garston Docks, Lancashire, steam coal ranges from 7s. 6d. up to 8s. per ton, according to quality.

In a partial manner the restriction of the output is being carried out in this district. Except that the colliery proprietors, as I pointed out last week, are not inclined to keep the day men on full time, whilst the colliers are only working a portion of the day, there is no disposition to take any general action. In some cases the pits have only been run four and a-half days, and it is not improbable many of them will only be kept open four days in the week, but the general feeling is that the matter will rectify itself.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

THE Cleveland iron trade is still in a very unsatisfactory condition. Scarcely any business is being done, and prices continue to fall. The returns for last month show that stocks have increased over 26,000 tons, a fact which has no doubt had a depressing effect upon the trade. At the market held at Middlesbrough on Tuesday last, several small lots of No. 3 g.m.b. were offered for prompt f.o.b. delivery by merchants at as low a figure as 41s. 6d. per ton; but few purchasers were found. Producers showed more disposition to sell than they have done for some time. Some of them were willing to take 42s. per ton for No. 3 g.m.b., but the principal smelters, who are not in urgent need of fresh orders, quoted 42s. 6d. per ton.

The stock of Cleveland iron in Messrs. Connal and Co.'s Middlesbrough stores continues to decrease. On Monday last the quantity was 87,647 tons, being 2799 tons less than on the previous Monday.

During the month of January there were shipped from Middlesbrough, 56,841 tons of pig iron and 21,376 tons of manufactured iron and steel. In the corresponding period of last year the quantities exported were—pig iron, 71,458 tons, and manufactured iron and steel 29,143 tons. The principal items in last month's exports of pig iron were as follows:—Scotland, 22,640 tons; France, 9465 tons; Belgium, 5545 tons; Germany, 5045 tons; Spain, 2283 tons; and Italy, 2640 tons. It will be noticed that the quantity sent to Germany is still comparatively small. In some months of last year 25,000 to 30,000 tons were sent thither. It is probable that larger quantities will now be required by that country, and if so, the market ought to be helped somewhat thereby.

The Cleveland Ironmasters' returns for January were issued on Saturday last. They show that there are 121 blast furnaces at work, 85 of which are producing Cleveland iron and 36 hematite and basic iron. The output of Cleveland iron in the whole district amounted to 156,293 tons, being 697 less than in December. The make of hematite and basic iron was 76,036 tons, or an increase of 3546 tons on the make of the previous month. The total production of iron of all kinds was 232,329 tons.

The iron in makers' stocks at the end of January amounted to 169,215 tons, being an increase of 43,229 tons. In the makers' and warrants stores, however, the stocks decreased, the quantity being 97,294 tons, or 16,406 tons less than at the end of December. The net increase in stocks is therefore 26,823 tons.

Business is again very stagnant in the finished iron trade, and prices have fallen since the last report. Ship plates are now to be had at £6 5s. to £6 10s. per ton, shipbuilding angles at £5 2s. 6d. to £5 7s. 6d., and common bars at £5 15s. per ton, all f.o.t. at works, less 2½ per cent. Puddled bars are £3 15s. per ton net at works. One of the plate mills and some puddling furnaces have again temporarily been put into operation at the Skerne Ironworks, Darlington.

The miners of Northumberland have been balloting on the wages question, and have decided to appoint a committee to negotiate with the masters for the purpose of fixing on a new sliding scale. It will be remembered that the sliding scale under which they have been working lapsed a short time ago.

The directors of the Consett Iron Company, Limited, have resolved to pay an interim dividend of 12s. 6d. per share on February 15th, to all members registered on their books on the 5th of the same month. A dividend of 1s. per share will be paid to the members of the Consett Spanish Ore Company, Limited, on the same date.

The directors of the North-Eastern Railway Company have decided to lengthen and deepen their docks at Middlesbrough, and to enlarge and improve the entrance from the river. It is estimated that the works contemplated will cost something like £250,000.

The fourteenth annual meeting of the Board of Arbitration was held in the Central Hall, at Darlington, on Wednesday, the 31st ult. Mr. W. Whitwell presided, and there was a full attendance of employers and operative representatives. The secretary reported that there were 20 firms belonging to the Board, and 10,438 operative subscribers. The working expenses for the past year have been exceedingly heavy, owing to there having been no less than fourteen meetings, which cost, on an average, £40 on each occasion. A long discussion took place on the new rules, which are being framed with a view to improve the working of the Board, and to reduce the expense of administration. The meeting was adjourned till Thursday, the 8th inst. Among other discussions, one took place on the payment of operative delegates for time lost in attending meetings and in adjusting disputes at their respective works. The financial statement showed that as much as £873 6s. 8d. had been paid during the past year under this head. The employer representatives had only received £260 9s. 9d. on the same account. As the employers and operatives contribute equally to the funds of the Board, it is clear that the excess of the former over the latter amount, or, say, three-fourths of the operative delegates' payments, is contributed solely by the employers. Many of the latter feel this to be an abuse not contemplated originally, nor justified at any time by the rules of the Board, but which has sprung up through a weak administration. They cannot see why these delegates should be paid mainly by the employers' side, and in such a way as to prevent financial control by the operative officers; and so as to make it the interest of a designing delegate continually to promote and keep alive disputes, for the prevention and determination of which he alone holds office. The existence of serious abuse will be still more easily understood when it is noticed that the representation and settlement of disputes at one works—viz., the Wear Rolling Mills—cost £84 15s., whilst Consett, employing three or four times the number of men, cost only £79 7s. 6d! and Jarrow, employing an equal number, cost only £16 15s.! The ironworkers generally are as indignant as the employers at these disclosures.

THE SHEFFIELD DISTRICT.

(*From Our Own Correspondent.*)

THERE is at present every prospect of another crisis in the coal trade of South and West Yorkshire, the bone of contention being the policy of restriction. The West Yorkshire coalowners have flatly refused to meet a deputation on the subject, or even to consider the question any further. The South Yorkshire coalowners, while emphatically declining to entertain the proposal to restrict the output of coal on the basis laid down in Mr. Pickard's circular, offered to meet the men and explain the reasons why they had come to this decision. Mr. Pickard has re-printed both the replies, and forwarded them to the miners' delegates, along with a distinct "pronouncement" of his own. He gathered from the employers' answer that they are thoroughly satisfied with the profit they are now making, "and that they in no way seek to improve matters except by the old style of dragging more work out of the workman for less money." Mr. Pickard says it now rests with the miners whether or not they will continue glutting the market, "thereby giving either to the public, coal merchant, or the coalowners, ten shillings per week of the colliers' hard-earned money;" and in conclusion he states that each colliery and pits-head of men "must" send deputations to the colliery offices before next Monday "to ask if the owners are willing to agree to restrict, as agreed upon at the conference on 22nd January last, and whether a pithead notice seeking for the altered mode of work, or an individual notice, will be required." A further conference of Yorkshire miners is fixed for Monday at Barnsley.

Mr. Pickard, I have reason to know, has misunderstood the reply of the South Yorkshire coalowners. While they distinctly declined to entertain the question of restriction, they expressly stated their willingness to explain to the men their reasons for this action, and they, of course, meant by that to meet the deputation appointed by the colliers. It was no part of their intention to adopt the plan of each colliery owner explaining to his own men. No great harm was done by the misunderstanding, as no amount of palaver between the delegates and the colliery owners would have changed the opinions of the two parties. Still, I expect if certain negotiations which are now proceeding between the Colliery Owners' Association and the Barnsley Association come to anything, an interview will take place at Sheffield, on Friday, the 9th inst.

Another effort is to be made to resuscitate the Northfield Iron and Tire Company at Rotherham. The business has been carried on by the liquidator, Mr. G. Walter Knox, for nearly two years. The capital is to be £50,000, in £10 shares, the actual purchase-money being £39,755 9s. 6d.

Makers of agricultural machinery and implements report that, in spite of the recent heavy rains, there is a larger trade than during the corresponding period of last year. For cutlery and general goods the inquiry from the farming districts has of late been very slight.

For guns, plates, and railway material, there is a good demand, though no large orders for steel rails have recently been received. Though the iron trade is generally languid, one or two of the local firms are fully employed; steel, in the finer qualities, is in brisk request on foreign and colonial account.

At Dronfield another week's grace has been granted. The men employed at the steel works had received notices expiring on the 10th, but these notices have been withdrawn and work will be continued till the 17th, by which time it is hoped all orders will have been cleared off, and arrangements completed for the exodus to Workington. The old firm, Messrs. Wilson, Cammell, and Co., are to invite the workmen and their friends at tea, concert, and ball, as a kind of valedictory entertainment.

The file-cutters, forgers, and grinders have declined to concede the 10 per cent. reduction requested by the employers, holding that the present condition of trade does not call for any such reduction. The employers say they have not been able to increase their price-lists since the advance of 10 per cent. was conceded last May, and that trade has declined ever since the advance was given. There are some 2000 men and 600 women and boys in the File-cutters' Union, 400 men in the Forgers' Union, 250 in the Grinders' Union, and 200 in the Hardeners' Union.

The razor-makers are agitating for an advance of 10 per cent. in wages, which the employers will probably concede. The razor trade has been very brisk, especially for America, for a long time, but it is now rather easier.

Mr. A. Alexander, who has been assistant managing director of the Cyclops Works—Messrs. Charles Cammell and Co., Limited—for ten years, was on Wednesday presented with a testimonial of the value of over £160, on the occasion of his retirement from that position. The testimonial included a valuable gold watch and chain, with compass, pendant, &c., value £50, for himself; a gold watch and chain for Mrs. Alexander; silver plate; a number of books; and an album containing the portraits of the managers. Mr. G. F. Longden was secretary, Mr. G. B. Wood treasurer, and Mr. Weinger cashier of the Testimonial Fund, and there was also a committee composed of the heads of departments. The presentation was made by Mr. Sykes, the "father" of the Cyclops establishment, in the presence of Mr. George Wilson, the chairman; Mr. H. E. Watson, director; and Mr. S. Jackson, a former director. Mr. Alexander, who is well known and respected in the iron and steel circles of England, made a very able reply.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

FOR several days the Glasgow warrant market had been gradually improving up till Monday, when business was done at 47s. 8d. On Tuesday, however, the quotations suddenly dropped, and on inquiring the cause, it was discovered that a large quantity of warrants had been thrown upon the market in the forenoon, and had, as is usual in such cases, to be disposed of at gradually lessening rates. The expectation was that purchases of iron for consumption to a considerable amount would be made this week; but as the quotations have again given way, the probability is that buyers will be inclined to wait a few days, to see whether a further decline will take place. The shipping demand for pig iron is only moderate, but there is a rather better feeling in the continental trade, and the home department is so well employed that it is reasonable to expect there will be an improvement in the trade generally here before long. The stock of pig iron in Messrs. Connal and Co.'s stores continues to decrease. Three additional furnaces have been put in blast since the date of last report, there being now 110 in operation, as compared with 106 at the same date in 1882.

Business was done on Friday forenoon in the warrant market at 47s. 6d. to 47s. 8d. cash, and in the afternoon at 47s. 7½d. to 47s. 8d. cash. On Monday transactions were effected at 47s. 6d. to 47s. 8d. The business done on Tuesday forenoon was at 47s. 6½d. to 47s. 4d., while 47s. 3½d. cash was quoted the same afternoon. The market was irregular on Wednesday, with transactions between 47s. 2d. and 47s. 4½d. cash. To-day—Thursday—business was done between 47s. 3½d. and 47s. 5d. cash, and at 47s. 8½d. one month.

Makers' prices are a shade easier as follows:—Gartsherrie, f.o.b., at Glasgow, per ton, No. 1, 63s. 6d.; No. 3, 54s.; Coltness, 66s. 6d. and 55s. 6d.; Langloan, 65s. 6d. and 55s. 6d.; Summerlee, 62s. 6d. and 52s. 6d.; Chapelhall, 63s. and 53s.; Calder, 63s. and 51s. 6d.; Carnbroe, 56s. and 50s. 6d.; Clyde, 52s. 6d. and 50s. 6d.; Monkland, 49s. 3d. and 47s. 9d.; Quarter, 48s. 9d. and 47s. 3d.; Govan, at Broomielaw, 49s. 3d. and 47s. 6d.; Shotts, at Leith, 65s. 6d. and 56s.; Carron, at Grangemouth, 53s. (specially selected, 57s. 6d.) and 52s.; Kinneil, at Bo'ness, 49s. 6d. and 48s. 6d.; Glengarnock, at Ardrossan, 56s. and 50s. 6d.; Eglinton, 50s. 3d. and 48s.; Dalmellington, 50s. 6d and 50s.

In various departments of the iron industry purchasers who have been delaying their orders until prices of manufactured iron should be reduced as a consequence of the decline in the values of pig iron are now expected to do business. They cannot withhold their demands much longer, as some of them are pretty short of supplies. The prices of manufactured iron are nominally unchanged, but for good orders satisfactory terms would not be very difficult to arrange at present. The past week's shipments of iron manufactures from Glasgow included £6600 worth of machinery, £2100 sewing machines, and £30,000 other iron and steel manufactures, exclusive of pig iron.

There is a brisk inquiry for coals in Lanarkshire, and the shipping demand at Glasgow is quite active. The coalmasters, who bore patiently with the total obstruction of their business during the period of the Caledonian Railway strike, are now complaining most bitterly of the utterly inadequate facilities afforded them for the transmission of coals to the vessel's side. So great is the dissatisfaction, indeed, that unless the railways can be prevailed upon to furnish a better supply of locomotives and trucks, an appeal will be made to the Railway Commissioners. The officials have apparently got so accustomed to complaints of this nature that they pay less attention to them than they used to do, and collieries are kept partially idle and vessels kept waiting in the harbours because it is impossible to get wagons to transmit the coals. This state of things is all the more remarkable when it is remembered that on both sides of the Firth of Forth at present the shipping trade in coals is slack, and the demands upon the railway companies therefore smaller than usual. The inland demand for coals is good, and the prices without alteration. At Glasgow the quotations f.o.b. are for main coals, 7s. 3d. to 7s. 6d. per ton; ell, 7s. 6d. to 8s.; splint, 7s. 6d. to 8s.; and steam, 8s. to 9s.

The colliery owners of Fifeshire have, in consequence of the dulness in the coal trade, intimated that they will reduce the miners' wages 8 per cent., or about 4½d. per day. At a meeting of the Executive Board of the Fife and Clackmannan Miners' Association the subject has been considered, and resolutions adopted to the effect that in their opinion the condition of the trade and its immediate prospects do not warrant the reduction. They also determined to solicit a conference with the employers' representatives to discuss the whole question.

It is stated that at the solicitation of the Clyde Coal Company, Mr. Hamilton, of Dalziel, M.P., has consented for an easy immediate payment to relieve the company of their lease of the minerals of Jerviston, near Motherwell. They have been paying a heavy annual rent under this lease, while unable to extract any of the minerals.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

THERE is to be a sale of all the plant at Penydarran Works, and this will end the history of a once flourishing ironworks. In the days of the Homfrays, and of Alderman Thompson, large fortunes were made there, but with the sale of the minerals to the Dowlais Company, the place was rendered worthless to any successor. Mr. Fothergill expended a little money afterwards in trying to revive the decaying fortunes of the place, but fruitlessly.

Dock extensions at Newport—Alexandra—were inaugurated last week by Sir George Elliott. I shall refer to these further, and also to the Cardiff Dock extensions, as soon as a practical beginning is made. I rather anticipate a withdrawal of the Barry scheme. The Cardiff Corporation has now taken decisive action with the view of acting as mediators between the promoters and the Marquis of Bute and Taff Vale Company.

The iron and coal trades are brisk, more active indeed than we generally get them at this time of the year. Prices are tolerably firm in both cases, except under special circumstances. In iron I note larger quantities going down the Taff Vale and other lines from Dowlais, and this week large consignments left the ports for the colonies.

Fifty coke ovens on the Coppeé principle were started at the Great Western Colliery, Rhondda, on Monday, and the first batch turned out exceedingly well. These ovens are now becoming general in Wales. At Blaina a cluster of thirty-seven is being built. The coal at Blaina—bituminous—is admirably adapted for coking, and the coke turned out is of the first excellence.

Wales is evidently going in for steel with vigour. Blaenavon, Tredegar, Rhymney, and Dowlais are in good going order, and by July Blaina will be in readiness, and Cyfarthfa will soon follow suit.

The Cyfarthfa and Dowlais colliers have formed a union for mutual protection. It was intended to have the aid of the Plymouth colliers also, but this has not been carried out. A few days ago an important delegate meeting was held by the old union, and it was resolved to agitate for an alteration of existing arangements at Dowlais in the method adopted of paying wages.

Messrs. Neville and Co. have decided to cease working the Glynea Colliery, and a month's notice has been given.

An explosion took place in the Coedcae Colliery last week, and five men were injured. It is supposed to have been due to leaving a door open, whereby gas was brought in contact with a naked light.

At Mr. Chamberlain's visit to Swansea last week, the projected harbour of refuge at Swansea was brought under his notice, and though he did not commit himself to a support of this scheme, he gave the meeting to understand that no obstacles would be brought against it by his department.

The house coal collieries of the Forest of Dean are depressed.

The report of the directors to the first ordinary meeting of the Rhondda and Swansea Bay directorate has been given, and they report the acceptance of a contract for the formation of the line, and a confident hope was expressed that some portion will be ready by the summer. At the conclusion of the general meeting a Wharncliffe meeting will be held, when various projects will be submitted:—First, a proposal to extend the railway to the new docks, Swansea, and to the Briton Ferry Dock sidings; also to discuss feasibility of a short line, in conjunction with the Great Western.

I have no good news of the tin-plate industry. Coke and patent fuel are in good healthy condition. Cardiff has been a sufferer by the storms. Many vessels remain unheard of, and are thought to have foundered. One of these traded between Cardiff and Ireland.

Patent fuel is looking up, and is especially brisk at Swansea, where the weekly shipments have steadily increased from 2000 and 3000 to close upon 8000 tons.

SOUTH KENSINGTON MUSEUM.—Visitors during the week ending Feb. 3rd, 1883:—On Monday, Tuesday, and Saturday, free, from 10 a.m. to 10 p.m., Museum, 10,868; mercantile marine, Indian section, and other collections, 3552. On Wednesday, Thursday, and Friday, admission 6d., from 10 a.m. to 4 p.m., Museum, 1509; mercantile marine, Indian section, and other collections, 245. Total, 16,174. Average of corresponding week in former years, 13,146. Total from the opening of the Museum, 21,679,241.

LIVERPOOL ENGINEERING SOCIETY.—The second meeting of the session was held on Wednesday, the 31st inst., at the Royal Institution, Colquitt-street, Mr. H. Bramall, M.I.C.E., president. in the chair, when a paper, entitled "Graphical Investigation of Stresses," was read by Mr. H. T. Turner. The author divided his paper into three parts—Firstly, economy as a fundamental principle in designing; the desirability of simpler methods of calculation; the origin of "graphic statics" applied to the investigation of framed structures. Secondly, the method applied to "roof trusses;" description of Mr. Bow's system; examples of oblique forces, &c.; application to "deficient frames." Thirdly, investigation of stresses in bridge girders, subject to rolling loads; method by bending moments and shears; accuracy attainable and comparison with analytical methods.

NAVAL ENGINEER APPOINTMENTS.—The following appointments have been made at the Admiralty:—Henry Scott, chief engineer, additional, to the Pembroke, for service in the Dolphin; Henry Bembow, chief engineer, to the Antelope, vice Spring, whose time has expired; William A. Harvey, chief engineer, to the Dido; James Leighton, engineer, additional, to the Pembroke, for service in the Wanderer, vice Scott; William G. Parsons, engineer, to the Seahorse, vice Leighton; Cornelius H. Steward, engineer, to the Dido; Samuel Aston, engineer, to the Hercules, vice Steward; William C. Hilder, engineer, additional, to the Terror, vice Taylor; Thomas Agnew, engineer, to the Valiant, for service in the Imogene, vice Hilder; David E. Smith, engineer, additional, to the Vernon, for service in the Vesuvius, vice Runnells, whose time has expired; William Rabbidge, engineer, additional, to the Asia, vice Soper; Frederick Worth, to the Jumna, vice Rabbidge; and Edward J. Rutter, assistant engineer, to the Valiant, vice Agnew.

FROME SEWERAGE.—In November last the Frome Local Board advertised for reports and plans for the sewerage and sewage disposal of their district, and offered premiums for those which, in their opinion, were first and second in order of merit. Twelve schemes were submitted, and these have been under the consideration of a committee of the whole Board, who have held several protracted meetings during the past month, with the result that the first prize of £20 was unanimously awarded to the scheme submitted under the motto of "*Palmam qui meruit ferat,*" the second prize of £10 being given to "*Presto.*" The first prize also entitles the author to be appointed engineer for the execution of the works. At the meeting of the Board, held on Friday, the 2nd inst., the envelopes containing the names of the successful competitors were opened, when it was found that the first prize had been obtained by Mr. Henry Tomlison, M.I.C.E., of Cambridge and Westminster, and the second prize by Messrs. Dudley and De'Salis, of Westminster. The envelopes containing the names of the unsuccessful competitors were not opened. The Board also decided to take steps to carry out the scheme adopted at their next meeting.

THE BLOCK SYSTEM AND THE NORTH BRITISH RAILWAY.—In concluding a report on the collision which occurred on the 13th of December, at Foulford sidings, near Cowdenheath station, on the North British Railway, when a passenger train from Dunfermline to Kinross came into collision with the tail of a mineral train from Townhill to Burntisland, and five passengers and the guard of the passenger train were injured, and three of the passengers seriously hurt, Major Marindin says:—"I had occasion, when reporting upon a very bad accident which occurred at Tayport on 25th November, 1881, to call attention to the fact that not one single mile of the North British Fifeshire lines was worked upon the block system, except some short lengths of recent construction which could not be opened without it; no extension of block-working has been made in Fifeshire. Under these circumstances it is hardly too much to say that the responsibility for any fatal accident which may occur from the want of such a system of working should properly fall, not upon the servants of the company, who have, somehow or other, to work a crowded traffic under rules quite unfitted for such a state of things, and a strict adherence to which would certainly cause great delay and many complaints; not upon the officers of the company charged with the conduct of this traffic, who would be glad to see the line provided with appliances for safe working; but upon the directors of the company, who, in spite of warning after warning, have chosen to leave these lines in a state which, considering the amount of traffic upon them, is without a parallel upon any system in Great Britain."

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.

30th January, 1883.

489. STOVES, J. A. B. Bennett, King's Heath, and J. Herd and B. F. Walker, Edgbaston.
490. SECURING WADS in CARTRIDGES, H. J. Haddan.—(*F. Seibold, New York, U.S.*)
491. COPPER, &c., TUBES, T. B. Sharp, Smethwick.
492. TREATING WOVEN FABRICS, E. Jones, Dumbarton.
493. WINDING THREAD upon SPOOLS, &c., J. P. Kerr and T. Law, Paisley.
494. SKATES, E. K. Dutton.—(*J. Sieper, Prussia.*)
495. DRESSING FLOUR, W. P. Thompson.—(*L. W. Pruss, Minneapolis, U.S.*)
496. REDUCING GRAIN, W. P. Thompson.—(*W. D. Gray and E. P. Allis, Milwaukee, U.S.*)
497. LIGNEOUS COMPOUND, C. D. Abel.—(*B. Harruss, Böhlen, Germany.*)
498. CULTIVATING SOIL, J. Cooke, Richmond.
499. AIR and GAS MOTORS, G. W. Weatherhogg, Wandsworth.
500. RAISING SUNKEN SHIPS, G. S. Dodman, Liverpool.
501. UTILISING ELECTRIC LAMPS for STAGE PURPOSES, J. G. Sanderson, Salford.
502. VICES, A. W. L. Reddie.—(*H. Schofield, U.S.*)
503. SPINNING MACHINERY, J. Tatham, Rochdale.
504. ADJUSTING the FOCUS of LENSES, E. Marlow, Birmingham.
505. ATTACHMENTS for BRACKETS, &c., J. H. Norrington, Harlesden.
506. OPERATING the PROPELLING, &c., APPLIANCES of VESSELS, E. P. Alexander.—(*J. Frasier, Searcy, U.S.*)
507. FISHING-RODS, R. Anderson, Edinburgh.
508. PRIMARY VOLTAIC BATTERIES, G. André, Dorking.
509. ETCHING, E. Nienstaedt, Berlin.
510. CUTTING-UP PLASTIC, &c., SUBSTANCES, J. H. Johnson.—(*J. G. Baker, Philadelphia, U.S.*)
511. RADIATORS for HEATING, L. W. Leeds, London.
512. AUTOMATIC FEED APPARATUS for STEAM BOILERS, C. F. Trinks, Helmstedt.
513. PACKING MIXTURES, &c., W. R. Lake.—(*T. C. Taylor, Philadelphia, U.S.*)
514. GASBURNERS, J. Rettie, London.
515. DIGGING, &c., LAND, E. Cobham, Stevenage.
516. BUILDING ARCHES and DOMES, W. R. Lake.—(*T. J. Lovegrove, Philadelphia, U.S.*)

31st January, 1883.

517. FILING and BINDING LETTERS, &c., J. M. Delany, Manchester.
518. VESSELS, &c., for AERIAL NAVIGATION, W. R. Lake.—(*E. F. Falconnet, Nashville, U.S.*)
519. GAS, A. Jay and C. Hook, Kingswood Hill.
520. ELECTRIC LAMPS, A. Kryszat, Moscow.
521. TRAINING the HUMAN VOICE to PRODUCE MUSICAL SOUNDS, J. W. Lea, London.
522. DESICCATED EGG, H. J. Allison.—(*P. Cooper and C. A. La Mont, New York, U.S.*)
523. FOLDING BEDS or BEDSTEADS, A. Hodgson, London.
524. HARVESTING MACHINES, B. Samuelson and W. G. Manwaring.—(*The Marsh Binder Manufacturing Company, Sycamore, U.S.*)
525. EXHIBITING GOODS, F. McIlvenna, Manchester.
526. ELECTRICAL COMMUNICATION on RAILWAY TRAINS, R. W. Vining, Liverpool.
527. SHUTTLES for SEWING MACHINES, H. J. Haddan.—(*E. Capitaine, Berlin.*)
528. HOSE CONNECTIONS, H. J. Haddan.—(*E. F. Gilbert, New York, U.S.*)
529. DINNER PLATE and COVER, R. Jordan, Barton-under-Needwood.
530. LUBRICATING CERTAIN PARTS of MACHINERY, E. B. Petrie and W. A. Entwistle, Rochdale.
531. DRAIN TILES, M. Benson.—(*J. Lynch, U.S.*)
532. TERRA-COTTA TILES, &c., M. Benson.—(*J. Lynch, Washington, U.S.*)
533. KNITTING MACHINES, H. B. Barlow.—(*O. Cazeneuve, Montrejeau, France.*)
534. STANDS for HOLDING VESSELS CONTAINING MILK, &c., F. A. Colley and J. Wingfield, Sheffield.
535. ELECTRIC MOTORS, &c., S. Pitt.—(*F. B. Crocker, C. G. Curtis, and S. S. Wheeler, New York, U.S.*)
536. DRIVING GEAR of BICYCLES, &c., R. H. Froude and J. Jenner, London.
537. BUTTONS, &c., J. Imray.—(*W. Pilkington, Quebec.*)
538. CABLE STOPPERS, A. M. Clark.—(*J. B. Lynch, U.S.*)
539. DRIVING TRAM, &c., CARS by ELECTRICITY, M. R. Ward, London.

1st February, 1883.

540. DISTILLING, &c., OILS, N. Henderson, Broxburn.
541. COALING STEAMSHIPS, S. Plimsoll, London.
542. BREECH-LOADING SMALL-ARMS, H. Webley, Birmingham.
543. METAL PRINTING, &c., D. Appleton, Manchester.
544. AUTOMATIC FLUSHING and ANTISEPTIC TANK, F. J. Austin, Hounslow.
545. BRAKES, M. Williams, Cardiff.
546. LAMPS, S. Williams, Camborne.
547. WATER GAUGES, J. Dewrance, London.
548. SEWING MACHINES, W. E. Gedge.—(*E. Kohler, U.S.*)
549. ELECTRIC BRUSHES, &c., M. McMullin, London.
550. SPRING HASP or CLIP, C. Mohr, Birmingham.
551. ARTIFICIAL HARD and SOFT INDIA-RUBBER and GUTTA-PERCHA, W. H. Harrison, London.
552. FURNACES, H., W., and J. Martin, Coatbridge.
553. OBTAINING PRODUCTS from COAL, &c., by DISTILLATION, H. L. Pattinson, jun., Felling.
554. COKE OVENS, H. Simon.—(*F. Carves, France.*)
555. ELECTRICAL CONDUCTORS, J. Imray.—(*The Société Anonyme des Cables Electriques, Paris.*)
556. VARIABLE EXPANSION GEAR, T. English, Hawley.
557. CLEANSING or WASHING CEREALS, &c., C. D. Abel.—(*Dr. L. M. R. von Markhof, Vienna.*)
558. MARINE BOILERS, C. H. Ziese, Elbing.
559. DYNAMO-ELECTRIC MACHINES, W. P. Thompson.—(*J. A. I. Craig, Montreal.*)
560. SUGAR, A. J. Boult.—(*J. P. Porry, Fort de France.*)
561. LOOMS, A. J. Boult.—(*F. Rabache, France.*)
562. WATER-LEVEL REGULATORS, J. H. Johnson.—(*P. Gauchot and the Société Volpp Schwarz et Cie., Paris.*)
563. ORGANS, &c., J. B. Hamilton, Hammersmith.
564. BRAKE APPARATUS, W. R. Lake.—(*H. Marneffe, Liége, Belgium.*)
565. METALLIC BEDSTEADS, H. Ferrer, Balsall Heath.
566. PROJECTILES for ORDNANCE, A. Longsdon.—(*A. Krupp, Essen, Germany.*)
567. PREVENTING the FREEZING of WATER in CHEMICAL FIRE-ENGINES, W. Blakely, Bournemouth.
568. APPARATUS for SUPPLYING WATER to CHEMICAL FIRE-ENGINES, W. Blakely, Bournemouth.
569. TRICYCLES, W. Blakely, Bournemouth.
570. BREECH-LOADING FIRE-ARMS, W. Blakely, Bournemouth.
571. RUDDERS, W. Blakely, Bournemouth.
572. HOLDING or SECURING the GLOBES on LAMP BURNERS, W. Blakely, Bournemouth.

2nd February, 1883.

573. SHARPENING PICKS, &c., R. Walton and F. A. Stansfield, Rawtenstall.
574. TRICYCLES, A. Burdess, Coventry.
575. SHIPS' SLEEPING BERTHS, W. R. Lake.—(*The Huston Ships' Berth Company, Incorporated, Boston, U.S.*)
576. WINDOW SASHES, D. F. W. Quayle, Castletown.
577. PURE SPIRITS of WINE, M. Bauer.—(*J. A. Stelzner, Saxony.*)
578. SAWING STONE, &c., P. Gay, Paris.
579. PADDLE-WHEEL FLOATS, J. Stewart, Blackwall.
580. BREAKING MACHINE to REMOVE SURPLUS DRESSING from FABRICS, C. Garnier, Lyons.
581. SLOTTING MACHINES, H. J. Haddan.—(*L. J. Knowles, Massachusetts, U.S.*)
582. COUPLING, J. H. Vidal, Sunderland.
583. LOCKING NUTS upon their SCREW BOLTS, G. A. Walker, Danes Hill.
584. CRUCIBLES, &c., H. L. Doulton, London.
585. CIGARETTES, W. H. Beck.—(*E. Abadie, Paris.*)
586. TREATING BRINE, E. P. Alexander.—(*A. Braconnier, Paris.*)
587. OXIDISING AGENT, E Potter & W. Higgin, Bolton.
588. BORING DRILLS, A. A. Patterson, Nunhead.

3rd February, 1883.

589. COMBUSTIBLE GAS, W. Crossley, Glasgow.
590. FURNACES, J. P. Cotiart, Havana.
591. HORIZONTAL STEAM BOILERS, A. Sharpe, Lincoln.
592. GALVANIC BATTERIES, P. R. de F. d'Humy, London.
593. TREATING COAL TAR, &c., E. Sonstadt, Cheshunt.
594. TELEPHONES, G. H. Bassano, A. E. Slater, and F. T. Hollins, Derby.
595. BLEACHING, J. B. Thompson, New Cross.
596. PRESSURE REGULATORS for GAS, J. Imray.—(*H. Giroud, Paris.*)
597. DIRECT-ACTING HYDRAULIC MACHINES, R. H. Tweddell, London, and J. Platt and J. Fielding, Gloucester.
598. GALVANIC BATTERIES, H Thame, Battersea.
599. WATER-CLOSETS, &c., S. S. Hellyer, London.
600. COOKING STOVES, T. Fletcher, Warrington.
601. INDICATORS for STEAM and other ENGINES, A. Budenberg.—(*C. F. Budenberg, Germany.*)
602. HOLDING NECKTIES in POSITION, E. Wise, Belvedere.
603. COMMUNICATING APPARATUS, W. Darby, Margate.

5th February, 1883.

604. RAILWAYS, E. N. Molesworth-Hepworth, Manchester.
605. RAISING, &c., LIQUIDS, J. Cross & G. Wells, Widnes.
606. LETTING-OFF APPARATUS for LOOMS, J. Schofield and J. E. Bentley. Littleborough.
607. BEATERS for THRASHING MACHINES, R. and F. Garrett, Suffolk, and J. D. Ellis, Sheffield.
608. REMOVING the SUPERFLUOUS GLAZE OFF ENAMELLED BRICKS, &c., T. Cliffe, Huddersfield.
609. UMBRELLA, &c., COVERS, M. Hyam, London.
610. LIGHTING by GAS, F. A. L. de Gruyter, Amsterdam.
611. MOTIVE POWER, A. E. Edwards, London.
612. COVERED WIRE, W. Halkyard, Rhode Island, U.S.
613. CRUTCHES, &c., H. J. Haddan.—(*G. Thürzò, Vienna.*)
614. ELECTRIC GENERATORS, J. Fleming, Hampstead.
615. CLOSING, &c., CURTAINS, T. Webster, Edinburgh.
616. GLOBES for CANDLES, J. B. Goodwin, London.
617. BREECH-LOADING FIRE-ARMS, E. A. Brydges.—(*C. Garbe, Berlin, Germany.*)
618. METAL FOIL, F. Wirth.—(*F. Haenle, Munich.*)
619. HINGES, G. W. von Nawrocki.—(*O. Ludewig, Stettin.*)
620. PROTECTING PLANTS, &c., from INSECTS, J. Walker, Leeds.
621. FINING MALT LIQUORS, R. Dean, Fulham.
622. PERCUSSION CAPS, T. Nordenfelt, London.
623. MEASURING, &c., CURRENTS OF ELECTRICITY, P. Cardew, Chatham.
624. ELECTRO-MOTORS, W. R. Lake.—(*A. Skene, Vienna, and F. Kühmaier, Presburg.*)
625. SUBSTITUTE for LEATHER, &c., W. L. Wise.—(*E. Bauer, Vienna.*)
626. SELF-ACTING OR FOUNTAIN PENS, J. Ridge, Enfield.
627. COUPLING APPARATUS, J. J. Purnell, London.
628. DYNAMO-ELECTRIC MACHINE, R. W. Munro.—(*A. E. Swannikoff, Paris.*)
629. VOLTAIC BATTERIES, R. Larchin.—(*L. Hartmann, St. Petersburg.*)
630. PORTABLE SAW, N. W. Wallace, Clifton.
631. ELECTRIC-LIGHTING APPARATUS, A. M. Clark.—(*N. de Kabath, Paris.*)

Inventions Protected for Six Months on Deposit of Complete Specifications.

487. SEWING MACHINES, R. H. Brandon, Paris.—A communication from the Morley Sewing Machine Company, Boston.—*29th January*, 1883.
506. PROPELLING and STEERING APPARATUS, E. P. Alexander, London.—A communication from J. Frazier, Searcy, U.S.—*30th January*, 1883.
516. BUILDING, &c., ARCHES and DOMES, W. R. Lake, London.—A communication from T. J. Lovegrove, Philadelphia, U.S.—*30th January*, 1883.
535. ELECTRO-MOTORS, &c., S. Pitt, Sutton.—A communication from F. B. Crocker, C. G. Curtis, and S. S. Wheeler, New York, U.S.—*31st January*, 1883.
564. BRAKE APPARATUS, W. R. Lake, London.—A communication from H. Marneffe, Liège, Belgium.—*1st February*, 1883.
575. SHIPS' SLEEPING BERTHS, W. R. Lake, London.—A communication from the Huston Ships' Berth Co., Incorporated, Boston, U.S.—*2nd February*, 1883.

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

419. FUSTIANS and CORDS, W. Wilcock and D. Greenwood. Pecket Well.—*30th January*, 1880.
441. AMMONIA, C. Kesseler, Berlin.—*31st January*, 1880.
755. APPLYING ELASTIC PADS to ARTICLES of VERTU, &c., J. Vernon, Newton Stewart.—*20th February*, 1880.
417. PRODUCING IMPRESSIONS on LEATHER SKINS, F. Burc, Paris.—*30th January*, 1880.
465. WASHING MACHINES, T. Woolfall, Blackburn.—*3rd February*, 1880.
471. TELEPHONIC APPARATUS, H. H. Lake, London.—*3rd February*, 1880.
708. ALIMENTARY PRODUCTS, A. M. Clark, London.—*17th February*, 1880.
1308. LUBRICATING APPARATUS, A. M. Clark, London.—*30th March*, 1880.
455. LAMPS, T. H. Blamires, Huddersfield.—*2nd February*, 1880.
172. BEDSTEADS or COT BEDS, W. Morgan-Brown, London.—*3rd February*, 1880.
486. RAILWAY CARRIAGES, &c., J. MacLachlan, Glasgow.—*4th February*, 1880.
862. STAVES for BARRELS, W. Morgan-Brown, London.—*27th February*, 1880.
507. EXTRACTING GOLD, &c., from ORES, J. H. Johnson, London.—*5th February*, 1880.
530. HARVESTING MACHINES, B. Samuelson, Banbury.—*6th February*, 1880.
548. IRON and STEEL, J. Gjers, Middlesbrough-on-Tees.—*7th February*, 1880.
608. PURIFYING ALKALINE SOLUTIONS, E. Carey, H. Gaskell, & F. Hurter, Widnes.—*11th February*, 1880.
617. PULVERISING APPARATUS, F. W. Michell, Redruth, and T. Tregoning, Camborne.—*12th February*, 1880.

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

387. PRODUCING HEAT and LIGHT, A. M. Clark, London.—*31st January*, 1876.
444. PULVERISING ORES, &c., A. M. Clark, London.—*3rd February*, 1876.
442. JACKS, &c., of JACQUARD APPARATUS, J. Broadhead, Shay Clough.—*3rd February*, 1876.
717. DYEING, &c., TEXTILE FABRICS, J. Chadwick, Chadderton.—*21st February*, 1876.

Notices of Intention to Proceed with Applications.

(*Last day for filing opposition, 23rd February*, 1883.)

4447. TREATING BARK, &c., W. M. Riddell, London.—*19th September*, 1882.
4629. TRICYCLES and VELOCIPEDES, A. Gibbs, Birmingham.—*29th September*, 1882.
4631. CRANK for BICYCLES, &c., F. G. Kinnaird, London.—*29th September*, 1882.
4638. STEAM GENERATORS &c., W. P. Thompson, London.—A communication from M. M. Monsanto, B. Odio, and F. Perozo.—*29th September*, 1882.
4649. ORNAMENTAL FRILLINGS, C. Jackson, Nottingham.—*30th September*, 1882.
4651. ARTIFICIAL LIGHT APPARATUS for PHOTOGRAPHING, J. Y. McLellan, Glasgow.—*30th September*, 1882.
4703. REFRIGERATORS, P. Jensen, London.—A communication from C. Klein.—*3rd October*, 1882.
4712. ELECTRIC BELLS and ALARM CLOCKS, B. W. Webb, H. P. F. Jensen, and J. Jensen, London.—*3rd October*, 1882.
4730. CHIMING CLOCKS, W. R. Lake, London.—A communication from J. Lindauer.—*4th October*, 1882.
4731. CONNECTING SPINDLES to LOCKS and LATCHES, &c., J. Drewitt, London.—*4th October*, 1882.
4732. LUMINOUS PAINTS or COLOURS, H. J. Haddan, London.—Com. from G. Schatte.—*4th October*, 1882.
4737. FOUNTAIN PENHOLDERS, F. F. Benvenuti, Swansea.—*5th October*, 1882.
4759. MEASURING FLUIDS, W. and C. W. B. Hamer, Cheshire.—*6th October*, 1882.
4780. ELECTRIC LAMPS, S. F. Walker and F. G. Olliver, Cardiff.—*7th October*, 1882.
4802. HOLES of CASKS or BARRELS, W. H. Beach, Woodfield, Stafford.—*9th October*, 1882.
4830. FUSES for PROJECTILES, A. Noble, Newcastle-upon-Tyne.—*11th October*, 1882.
4831. MACHINE GUNS, &c., A. Noble, Newcastle-upon-Tyne.—*11th October*, 1882.
4917. WEATHERPROOF EXPLOSIVE COMPOUNDS, &c., P. Jensen, London.—A communication from J. Schulhof.—*16th October*, 1882.
4929. FRICTION CLUTCHES, &c., D. Frisbie, New Haven.—*17th October*, 1882.
5052. RADIAL AXLE-BOXES, F. W. Webb, Crewe.—*24th October*, 1882.
5184. MEASURING, &c., POWER TRANSMITTED by DRIVING BELTS, C. V. Boys, Wing, near Oakham.—*31st October*, 1882.
5189. CLEANING, &c., DRIED FRUITS, D. Fox and A. Wheeler, Darlington.—*31st October*, 1882.
5278. TELEGRAPH WIRES, G. E. Vaughan, London.—A communication from S. Trott and F. A. Hamilton.—*4th November*, 1882.
5343. GILL STOVES, C. J. Henderson, Edinburgh.—*9th November*, 1882.
5925. MINERS' SAFETY LAMPS, W. Morgan, Pontypridd.—*12th December*, 1882.
5991. TRICYCLES, &c., O. Pihlfeldt, Coatham, Redcar.—*15th December*, 1882.
6204. VELOCIPEDES or HAND-CARS, W. P. Thompson, Liverpool—A communication from S. H. Walz.—*28th December*, 1882.
6225. GLASS BOTTLES, J. S. Davison, Sunderland.—*30th December*, 1882.
6239. UMBRELLAS and PARASOLS, L. Engel, London.—*30th December*, 1882.
38. VESSELS for HOLDING LIQUIDS, G. A. J. Schott, Bradford.—*2nd January*, 1883.
48. SAFETY GEAR for STARTING, &c., ENGINES, J. Musgrave and R. Gregory, jun., Bolton.—*3rd January*, 1883.
57. LUBRICATORS, T. Duff, Upton.—*4th January*, 1883.
75. OILING CRANK PINS, W. P. Thompson, Liverpool.—Com. from C. H. Parshall.—*5th January*, 1883.
78. ELECTRIC FIRE ALARM APPARATUS, W. C. Gordon, London.—*5th January*, 1883.
424. DITCHING MACHINES, R. Fowler, Leeds.—Com. from H. Carter and W. Rennie.—*25th January*, 1883.
487. SEWING MACHINES, R. H. Brandon, Paris.—A communication from the Morley Sewing Machine Company.—*29th January*, 1883.

(*Last day for filing opposition, 27th February*, 1883.)

4658. PURIFYING ALCOHOL, A. J. Boult, London.—Com. from G. Fleury.—*30th September*, 1882.
4670. IMPARTING a GLOSSY APPEARANCE to BOOTS, &c., E. and A. Wright, London.—*2nd October*, 1882.
4674. COUPLING for RAILWAY VEHICLES, R. Stone, Bristol.—*2nd October*, 1882.
4676. INCANDESCENT ELECTRIC LAMPS, J. F. Phillips, London.—A communication from C. H. F. Müller.—*2nd October*, 1882.
4682. LOOMS for WEAVING, J. H. Pickels, Burnley.—*2nd October*, 1882.
4698. TRICYCLES, H. C. Bull, Liverpool.—*3rd October*, 1882.
4707. STAND for SUPPORTING BICYCLES, &c., G. E. Vaughan and J. Walton, West Bromwich.—*3rd October*, 1882.
4718. ELECTRIC RAILWAYS, J. Hopkinson, London.—*4th October*, 1882.
4724. ELASTIC FABRICS, W. R. Lake, London.—A communication from F. A. Ball.—*4th October*, 1882.
4726. DOOR LOCK, &c., CHECKS, W. A. Barlow, London.—A communication from F. W. Boldt and P. C. A. Vogel.—*4th October*, 1882.
4729. TRICYCLES, &c., E. Brown, Birmingham.—*4th October*, 1882.
4740. CALL APPARATUS for TELEPHONE LINES, M. Benson, London.—A communication from J. P. Stabler.—*5th October*, 1882.
4765. ELECTRICAL APPARATUS for PROPELLING BOATS, A. Reckenzaun, Leytonstone.—*6th October*, 1882.
4769. TREATING CERTAIN CARBONACEOUS MINERALS for OBTAINING OIL, &c., A. Neilson and A. C. Thomson, Renfrew, N.B.—*7th October*, 1882.
4774. BOILER, H. C. Bull, Liverpool.—*7th October*, 1882.
4782. ELEVATORS, W. S. Brice, Liverpool.—*7th October*, 1882.
4803. GEARING for BICYCLES, &c., W. Britain, jun., London.—*9th October*, 1882.
4807. SELF-LEVELLING SLEEPING BERTHS, W. R. Lake, London.—A communication from J. H. Milligan.—*9th October*, 1882.
4814. MOULDERS' NAILS, &c., W. Motherwell, Glasgow.—*10th October*, 1882.
4822. PRINTING MACHINES, J. E. Dawson, London.—Com. from W. P. Kidder.—*10th October*, 1882.
4838. EMPLOYING the MUSCULAR FORCE of MAN, B. J. B. Mills, London.—A communication from L. Bellefonds.—*11th October*, 1882.
4841. BALANCE VALVE, W. Teague, jun., Pool.—*11th October*, 1882.
4843. LOOMS for WEAVING, J. W. Holmes, Preston.—*11th October*, 1882.
4848. BOTTLES, E. P. Hawkins, London.—*12th October*, 1882.
4890. FLUID PUMPING, &c., APPARATUS, B. W. Davis, London.—*14th October*, 1882.
5080. WATCHES, W. Clark, London.—A communication from J. W. Bell.—*24th October*, 1882.
5202. TUBES, G. Little, Oldham.—*1st November*, 1882.
5380. VALVES and COCKS, F. P. and E. J. Preston, J. T. Prestige, A. T. Cornish, and W. A. Simmons, Deptford.—*11th November*, 1882.
5417. BOLTS and NUTS, R. Howarth, Wolverhampton.—*14th November*, 1882.
5591. TREATING VEGETABLE, &c., MATTER, G. and J. E. Tolson, Dewsbury.—*24th November*, 1882.
5753. PREPARATION of WARPS of JUTE, &c., D. R. and G. Malcolm, jun., Dundee.—*2nd December*, 1882.
6090. LEGGINGS, F. W. Hemming, London.—*20th December*, 1882.
6103. ADMINISTERING MEDICINE to ANIMALS, P. Fonnereau and W. Fielding, London.—*21st December*, 1882.
6104. COCKS or VALVES, G. Teideman, London.—*21st December*, 1882.
6105. ELECTRIC METERS, F. H. Varley and J. R. Shearer, London.—*21st December*, 1882.
21. GAS MOTOR ENGINES, J. R. Woodhead, Leeds.—*1st January*, 1883.
62. POINTS, &c., for TRAMWAYS, A. H. Rowan, London.—*4th January*, 1883.
103. PRODUCING DESIGNS, &c., on GLASS, D. Reich, Berlin.—*8th January*, 1883.
105. REGULATING the SUPPLY of GAS, &c., J. Lewis, London.—*8th January*, 1883.
136. GOVERNORS for STEAM, &c., ENGINES, J. M. Paxman, Colchester.—*10th January*, 1883.
160. LOOMS for WEAVING, G. A. Shiers and A. Wright, Oldham.—*11th January*, 1883.
215. BREECH-LOADING CANNON, R. H. Brandon, Paris.—Com. from B. B. Hotchkiss.—*13th January*, 1883.
325. WOOD SCREWS, H. H. Lake, London.—A communication from the Harvey Screw Company, Incorporated.—*19th January*, 1883.
358. SHIPS' SLEEPING BERTHS, H. H. Lake, London.—A communication from the Huston Ships' Berth Company, Incorporated.—*22nd January*, 1883.
380. PRINTING, &c., MACHINERY, W. R. Lake, London.—A communication from H. P. Feister and R. M. Hunter.—*23rd January*, 1883.
535. ELECTRIC MOTORS, &c., S. Pitt, Sutton.—A communication from F. B. Crocker, C. G. Curtis, and S. S. Wheeler.—*31st January*, 1883.

Patents Sealed.

(*List of Letters Patent which passed the Great Seal on the 2nd February*, 1883.)

3694. WAGON or LURRY, E. Hollingworth, Dobcross.—*3rd August*, 1882.
3719. FOLDING SEATS, W. H. Avis, Polegate.—*4th August*, 1882.
3722. MECHANICAL BUTTON, A. Combault and W. T. Taylor, London.—*4th August*, 1882.
3728. CARRIAGES, U. Scott, London.—*5th August*, 1882.
3730. REGULATING the SPEED of BICYCLES, &c., J. G. Horsey and T. Bell, London.—*5th August*, 1882.
3734. CONVEYING, &c., GRAIN, L. E. Mansfield, Paris.—*5th August*, 1882.
3735. REDUCING or PULVERISING MINERALS, R. J. Junnack, Helston.—*5th August*, 1882.
3739. ROTARY ENGINES, J. G. Jones, London.—*5th August*, 1882.
3744. PAINTING, &c., WOVEN FABRICS, D. Guille, London.—*5th August*, 1882.
3745. REGULATING the FLOW of GASES and LIQUIDS, R. Macintyre, London.—*5th August*, 1882.
3747. SPRINGS, G. H. Slack, Manchester.—*5th August*, 1882.
3750. DENTAL PLATES, &c., J. H. Gartrell, Penzance.—*5th August*, 1882.
3757. LIGHT-EMITTING CONDUCTORS, R. Werdermann, London.—*5th August*, 1882.
3758. VENTILATING RAILWAY CARRIAGES, &c., A. R. and J. W. Harding, Leeds.—*7th August*, 1882.
3759. PERFORATING CHEQUES, P. Jensen, London.—*7th August*, 1882.
3764. PERMANENT WAY for RAILWAYS, J. Dickson, jun., Seaforth.—*8th August*, 1882.
3770. PREPARING LEAD, L. Epstein, London.—*8th August*, 1882.
3776. COKE, J. Wood, Flockton, near Wakefield.—*8th August*, 1882.
3778. WASHING MACHINE, C. C. Greenway, London.—*8th August*, 1882.
3784. GENERATORS, J. Noble, Middlesbrough-on-Tees.—*9th August*, 1882.
3785. REGULATING APPARATUS for STEAM ENGINES, H. Davey, Headingly, near Leeds.—*9th August*, 1882.
3787. GENERATING ELASTIC FLUID UNDER PRESSURE, H. Davey, Headingly, near Leeds.—*9th August*, 1882.
3807. CONVEYING STEEL INGOTS in a HEATED STATE, J. Riley, Glasgow.—*10th August*, 1882.
3848. STEAM ENGINES, I. Beck, Sheffield.—*12th August*, 1882.
3849. PARALLEL VICES, W. M. MacBrair, Sheffield.—*12th August*, 1882.
3863. DEODORISING, &c., HUMAN EXCRETA, R. Nicholls, London.—*12th August*, 1882.
3875. TREATING COTTON, &c., E. de Pass, London.—*14th August*, 1882.
3879. TYPE-SETTING, &c., MACHINES, E. W. Brackelsberg, Prussia.—*14th August*, 1882.
4007. CONTINUOUS CENTRIFUGAL MACHINES, F. Wirth, Germany.—*21st August*, 1882.
4079. SECONDARY BATTERIES, L. H. M. Somzée, Brussels.—*25th August*, 1882.
4213. LOADING and UNLOADING VESSELS, A. M. Clark, London.—*5th September*, 1882.
4288. GOVERNING APPARATUS for STEAM VESSELS, J. Dewrance and E. Wimshurst, London.—*8th September*, 1882.
4340. KNITTING MACHINERY, S. Lowe, and J. W. Lamb, Nottingham.—*12th September*, 1882.
4341. KNITTING MACHINERY, J. W. Lamb and E. Attenborough, Nottingham.—*12th September*, 1882.
4402. SUPPLY and WASTE VALVES for BATHS, &c., S. S. Hellyer, London.—*15th September*, 1882.
4487. TREATING PHOSPHORITES, J. Imray, London.—*20th September*, 1882.
4567. OBTAINING MECHANICAL EFFECT by ELECTRICAL ENERGY, E. L. Voice, London.—*26th September*, 1882.
4683. AXLES for VEHICLES, W. Clark, London.—*2nd October*, 1882.
4745. GRAIN DRYERS, A. M. Clark, London.—*5th October*, 1882.
4908. CORKING, &c., BOTTLES, A. Macdonell, Newry, Ireland.—*16th October*, 1882.
5075. MANUFACTURE of COKES, &c., P. Jensen, London.—*24th October*, 1882.
5125. DOOR CHECKS or GOVERNORS, A. J. Boult, London.—*27th October*, 1882.
5287. UMBRELLA and PARASOL FRAMES, S. Scherer, London.—*6th November*, 1882.
5443. CIGARETTES, J. Clarkson, Apperley Bridge.—*15th November*, 1882.
5501. SELF-ACTING BUCKETS, &c., G. M. Kay and J. Lowrie, London.—*18th November*, 1882.
5535. METALLIC PACKINGS, A. M. Clark, London.—*21st November*, 1882.
5550. CENTRE VALVES, R. Dempster, jun., Elland.—*22nd November*, 1882.
5639. COUPLING, &c., RAILWAY VEHICLES, W. and L. Younghusband and T. Hudson, Darlington.—*27th November*, 1882.
5659. ORNAMENTAL SHEARING of PILED FABRICS, C. D. Abel, London.—*28th November*, 1882.
5717. DISTILLATION of COAL, G. E. Davis, Manchester.—*30th November*, 1882.

(*List of Letters Patent which passed the Great Seal on the 6th February*, 1883.)

773. KNITTING MACHINES, J. Poole, Bradford.—*17th February*, 1882
3768. LAMPS, H. Cullabine, Sheffield.—*8th August*, 1882.
3769. DETAILS of SEWING MACHINES, H. Gardner, London.—*8th August*, 1882.
3771. MINING MACHINES, W. R. Lake, London.—*8th August*, 1882.
3775. BRICKS, &c., J. C. Bloomfield and J. McGurn, Ireland.—*8th August*, 1882.
3780. ROTARY ENGINES, A. Kissam, London.—*9th August*, 1882.
3788. SEWING MACHINES, J. Imray, London.—*9th August*, 1882.
3789. OXIDISING ALCOHOLS, &c., E. A. Brydges, London.—*9th August*, 1882.
3792. PRODUCING DISTILLATES from KIMMERIDGE SHALE, E. K. Mitting, Rye.—*9th August*, 1882.
3793. DOOR-MAT and SCRAPER COMBINED, J. S. Willway, Bristol.—*9th August*, 1882.
3794. LIDS of FUEL ECONOMISERS, E. Green, Wakefield.—*9th August*, 1882.
3798. POLES and STAKES, W. A. Barlow, London.—*9th August*, 1882.
3800. BOXES, P. Jensen, London.—*9th August*, 1882.
3803. TELEPHONIC APPARATUS, S. P. Thompson, Bristol.—*9th August*, 1882.
3804. TIME-PIECES, W. Morgan-Brown, London.—*10th August*, 1882.
3811. CLEANING WINDOWS, C. H. Southall, Leeds.—*10th August*, 1882.
3819. GAS ENGINES, J. McGillivray, Glasgow.—*10th August*, 1882.
3821. ELECTRIC LAMPS, F. Mori, Leeds.—*10th August* 1882.
3822. BATTERIES for STORING ELECTRICITY, F. Mori, Leeds.—*10th August*, 1882.
3827. COMPRESSING, &c., AIR, C. W. Harding, King's Lynn.—*10th August*, 1882.
3828. CAST IRON LINING for the WALLS of FURNACES W. H. Beck, London.—*10th August*, 1882.

3833. COMBING FIBRES, G. Little, J. Green, and J. Fletcher, Oldham, and T. C. Eastwood, Bradford.—11th August, 1882.
3841. ARM-PIT DRESS SHIELDS, W. R. Lake, London.—11th August, 1882.
3847. LAMPS, W. H. Bulpitt, Birmingham.—12th August, 1882.
3855. PNEUMATIC SIGNALLING APPARATUS, G. Porter, London.—12th August, 1882.
3858. TREATING SOLUTIONS used for PURIFYING COPPER ORES, &c., D. Watson, Manchester.—12th August, 1882.
3859. FACING POINTS for TRAMWAYS, H. Scott, Liverpool.—12th August, 1882.
3884. BOOTS and SHOES, W. Morgan-Brown, London.—15th August, 1882.
3885. CAR WHEELS for TRAMWAYS, &c., W. Morgan-Brown, London.—15th August, 1882.
3887. AXLES, &c., J. Mackay, Liverpool.—15th August, 1882.
3938. WASHING, &c., GAS, S. Holman, London, and C. Hunt, Birmingham.—17th August, 1882.
3952. GAS STOVES, J. F. C. Norman and A. H. P. S. Wortley, London.—18th August, 1882.
3970. SPINNING, &c., TOBACCO, D. and J. Macdonald, Glasgow.—19th August, 1882.
3977. AMMONIA, D. Urquhart, London.—19th August, 1882.
4008. INDICATING the POSITION of SUNKEN SHIPS, W. R. Lake.—21st August, 1882.
4060. PAINTING, &c., W. H. R. Toye, London.—24th August, 1882.
4072. FILTERING APPARATUS, J. F. C. Farquhar and W. Oldham, London.—25th August, 1882.
4161. FILE for HOLDING PAPERS, P. Lawrence, London.—31st August, 1882.
4163. FILTERS, A. M. Clark, London.—31st August, 1882.
4182. SHIPPING COAL, &c., P. J. Messent, Tynemouth.—1st September, 1882.
4210. DISCHARGING BILGE WATER from the HOLDS of VESSELS, A. M. Clark, London.—4th September, 1882.
4262. PURIFYING GAS, W. W. Box, Crayford.—7th September, 1882.
4265. WASHING APPARATUS, W. B. Nation, London.—7th September, 1882.
4458. CARBON CONDUCTORS for ELECTRIC LAMPS, W. R. Lake, London.—19th September, 1882.
4520. BUTTON-HOLE ATTACHMENT for SEWING MACHINES, I. Nasch, London.—22nd September, 1882.
5103. VELOCIPEDES, &c., G. H. C. Hughes, Birmingham.—26th October, 1882.
5112. SEPARATING GLYCERINE from FATTY MATTERS, J. Imray, London.—27th October, 1882.
5409. ELECTRIC LIGHTING, J. Muirhead and T. M. Collet, London.—13th November, 1882.
5499. RAILWAY SLEEPERS, W. E. Pedley, Old Brompton.—18th November, 1882.
5504. INCANDESCENT ELECTRIC LAMPS, A. Swan, Gateshead.—20th November, 1882.
5505. COCOA and CHOCOLATE, S. P. Wilding, London.—20th November, 1882.
5546. COOLING APPARATUS, S. P. Wilding, London.—22nd November, 1882.
5566. EXHAUSTING the BULBS of INCANDESCENT ELECTRIC LAMPS, &c., N. K. Cherrill, Paris.—22nd November, 1882.
5645. PRIMARY VOLTAIC BATTERIES, G. G. André, Dorking.—28th November, 1882.
5654. HOLDERS for OPERA GLASSES, A. J. Boult, London.—28th November, 1882.
5655. PNEUMATIC GRAIN ELEVATORS, A. J. Boult, London.—28th November, 1882.
5667. CUTTING and REDUCING TUBES, S. Goodby, sen., Wolverhampton.—29th November, 1882.
5703. SEWING MACHINES, M. Gandy, Liverpool.—30th November, 1882.
5727. TRANSFERRING &c., RAILWAY WAGONS, G. Taylor, Penarth.—1st December, 1882.
5807. METALLIC INLAID WORK, A. M. Clark, London.—5th December, 1882.
5916. LOOMS for WEAVING, W. Adam, Kidderminster.—11th December, 1882.

List of Specifications published during the week ending February 3rd, 1883.

84, 6d.; 85, 1s. 4d.; 2670, 6d.; 2671, 8d.; 2727, 6d.; 2775, 4d.; 2776, 6d.; 2781, 6d.; 2789, 1s. 2d.; 2795, 6d.; 2804, 6d.; 2830, 8d.; 2834, 8d.; 2840, 6d.; 2841, 6d.; 2846, 8d.; 2848, 1s.; 2849, 6d.; 2852, 6d.; 2855, 6d.; 2856, 6d.; 2857, 6d.; 2858, 6d.; 2863, 6d.; 2865, 4d.; 2868, 6d.; 2870, 6d.; 2878, 6d.; 2883, 6d.; 2887, 10d.; 2889, 10d.; 2890, 6d.; 2893, 6d.; 2894, 6d.; 2896, 6d.; 2897, 6d.; 2900, 6d.; 2901, 6d.; 2904, 6d.; 2906, 6d.; 2907, 6d.; 2908, 2d.; 2912, 6d.; 2913, 6d.; 2914, 6d.; 2915, 6d.; 2916, 6d.; 2917, 4d.; 2918, 4d.; 2920, 6d.; 2925, 2d.; 2926, 6d.; 2927, 6d.; 2928, 6d.; 2930, 2d.; 2931, 6d.; 2934, 6d.; 2938, 6d.; 2941, 4d.; 2942, 4d.; 2944, 6d.; 2945, 4d.; 2949, 6d.; 2950, 8d.; 2953, 6d.; 2955, 6d.; 2958, 6d.; 2959, 2d.; 2960, 6d.; 2962, 2d.; 2964, 4d.; 2967, 6d.; 2968, 6d.; 2969, 2d.; 2970, 6d.; 2972, 6d.; 2974, 2d.; 2975, 2d.; 2976, 2d.; 2977, 6d.; 2978, 2d.; 2979, 6d.; 2981, 4d.; 2982, 2d.; 2983, 4d.; 2984, 8d.; 2986, 2d.; 2989, 2d.; 2991, 2d.; 2994, 2d.; 2995, 4d.; 2996, 2d.; 2999, 2d.; 3001, 4d.; 3002, 8d.; 3003, 4d.; 3004, 6d.; 3005, 2d.; 3006, 2d.; 3009, 6d.; 3012, 2d.; 3013, 2d.; 3014, 2d.; 3015, 6d.; 3022, 2d.; 3026, 6d.; 3028, 2d.; 3030, 6d.; 3031, 2d.; 3033, 2d.; 3035, 2d.; 3038, 2d.; 3040, 2d.; 3043, 2d.; 3050, 2d.; 3051, 2d.; 3052, 2d.; 3053, 10d.; 3055, 4d.; 3058, 4d.; 3059, 2d.; 3063, 4d.; 3069, 2d.; 3071, 2d.; 3072, 2d.; 3073, 2d.; 3074, 4d.; 3077, 2d.; 3079, 2d.; 3082, 2d.; 3084, 2d.; 3085, 6d.; 3086, 2d.; 3096, 2d.; 3104, 2d.; 3105, 6d.; 3107, 4d.; 3109, 2d.; 3272, 4d.; 3791, 6d.; 3942, 6d.; 4073, 6d.; 4992, 4d.; 5062, 8d.; 5165, 4d.; 5223, 6d.

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

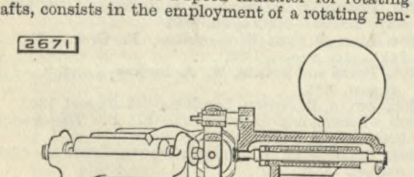
ABSTRACTS OF SPECIFICATIONS.

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

2671. CENTRIFUGAL GOVERNORS FOR REGULATING STEAM ENGINES, &c., *W. P. Thompson, Liverpool.—7th June*, 1882.—(*A communication from J. Selwig, Brunswick.*)—(*Complete.*) 8d.

The construction of the governor shown in the drawing in plan for regulating motors, also applicable for the construction of a speed indicator for rotating shafts, consists in the employment of a rotating pendulum oscillating in a circular path, and in which the moment of the centrifugal force is proportional to the sine of the angle which the pendulum arm (the normal let-fall from the centre of gravity of the pendulum upon its axis), or a line drawn through the point of suspension of the pendulum in its plane of oscillation, and inclined to it at any angle, makes with a plane parallel to the axis of rotation passing through the axis of the pendulum.

2671



2670. PLUGS FOR CONNECTING SERVICE PIPES TO WATER AND OTHER MAINS, *C. J. T. Haussen, Prussia.—7th June*, 1882. 6d.

This consists in the employment and mode of application of hollow plugs or nipples for connecting service pipes to water and other mains under low fluid pressure, or under ordinary or considerable fluid pressure, said plugs or nipples containing a material easily soluble by a solvent such as water applied from the side towards the service pipe, and for ordinary or considerable pressure provided on the side towards the main with a thin protecting crust of material not soluble, or not quickly soluble by the fluid in the main.

2727. CONSTRUCTION AND MODE OF WORKING APPARATUS WHEREIN STEAM IS GENERATED TO ACTUATE MOTIVE POWER ENGINES, *H. Aydon, near Hounslow, and E. Field, Westminster.—10th June*, 1882. 6d.

This consists in the combined use of three chambers, viz., a No. 1 chamber, wherein combustion of fuel takes place under pressure; a No. 2 chamber, wherein steam is generated; and a No. 3 chamber, wherein products of combustion from No. 1 chamber are washed prior to becoming mixed with steam that has been generated in No. 2 chamber.

2775. SAFETY APPARATUS FOR OPENING MINERAL WATER BOTTLES, *D. C. Berthod, London.—13th June*, 1882.—(*Not proceeded with.*) 4d.

This consists of a long piece of metal to cover the upper part of the bottle, with a rod inside to work up and down for pushing the stopper of the bottle in and a spring to push the rod up again.

2776. IMPROVEMENTS IN MANUFACTURING CARBONS APPLICABLE FOR ELECTRIC CANDLES, &c., *F. H. Varley, Mildmay-grove.—13th June*, 1882. 6d.

The inventor constructs carbon rods as follows:—A string or rope is made of some vegetable fibre by twisting in the usual way. It is then stretched and submitted to the action of caustic alkali at a high temperature. It is subsequently washed and dried. It is next submitted to the action of sulphuric acid, and again washed and dried. After this it is immersed in a hot solution of petroleum or other hydrocarbon until saturated, when it is placed in a retort. This retort is provided with an inlet and outlet channel for a stream of coal or other gas, which is caused to flow through the retort. The rods are removed from the retort whilst warm, and immersed in the petroleum, afterwards being returned to the retort, and this process is continued until they are of the required solidity.

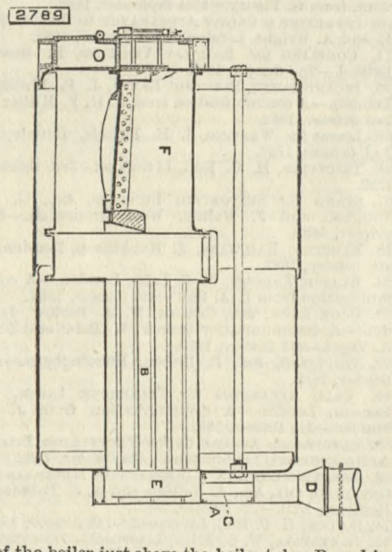
2781. IMPROVEMENTS IN ELECTRIC LIGHTING APPARATUS, *W. R. Lake, London.—13th June*, 1882.—(*A communication from C. F. de la Roche, Paris.*) 6d.

This relates to a simple form of arc lamp, in which the carbons abut against a ring or other stop, the feed movement being produced by means of springs or counterweights. No other mechanism is used.

2789. SUPPLYING AIR TO FURNACES OF STEAM BOILERS, &c., *J. Howden, Glasgow.—14th June*, 1882. 1s. 2d.

The principal object is to supply the air required for the combustion in the furnaces of steam boilers in an improved manner, and so as to diminish the waste of heat, which ordinarily takes place, whilst, as applied to marine boilers, the stokeholes are ventilated and kept cool. The drawing shows the arrangement as applied to a small tubular boiler. The air from a blowing apparatus enters the case A at the smoke-box end of the boiler just above the boiler tubes B, and in which are a number of vertical tubes C through which the fire gases pass to the uptake D, there being below the case A and tubes C a chamber E through which the fire gases pass from the tubes B to the vertical air-heating tubes C. A space surrounds the side and the under part of the smoke-box, and communicates with the case A at the side furthest from the air inlet, and the air passes by two pipes to the furnace E.

2789



2795. LOOMS FOR WEAVING, *T. Knowles, Blackburn.—14th June*, 1882. 6d.

This relates, First, to the method of mounting the finger or pawl upon the rocking lever, which actuates the catch wheel and attendant mechanism employed to rotate the taking-up beam or roller. Secondly, to the arrangement of mounting or pivotting the "swell."

2804. AN IMPROVED METHOD OF AND MEANS FOR EMPLOYING ELECTRICITY FOR TELEGRAPHIC AND TELEPHONIC PURPOSES, *W. R. Lake, London.—14th June*, 1882.—(*A communication from F. van Rysselberge, Schaerbeck, Belgium.*) 6d.

This relates to the employment of two parallel conductors or two conductors, one of which surrounds or envelopes the other, both being insulated from one another and from surrounding bodies. One end of the first conductor is in communication with the transmitter, the other end being insulated, and one end of the second conductor is connected to the receiver, its other end being also insulated.

2834. WATER-CLOSETS, &c., *A. M. Clark, London.—15th June*, 1882.—(*A communication from J. J. B. Frey, New York.*) 8d.

The objects sought to be attained are, a more thorough ventilation of water-closets, a more perfect immunity against odours resulting from sewer air or from ordinary use of said closets, the providing of an overflow alike for the bowl or basin and for the valve chamber of the closet.

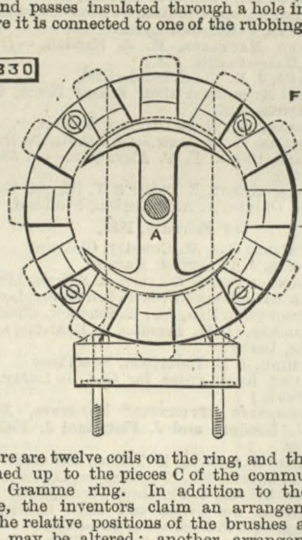
2841. STEAM BOILERS, *A. D. Barclay, Kilmarnock.—16th June*, 1882. 6d.

This relates to the construction or arrangement of the parts of steam boilers with an annular flue space or fire-box formed between a central and an annular water space, such annular flue being fitted with rows of radial water tubes.

2830. IMPROVEMENTS IN THE CONSTRUCTION AND GOVERNMENT OF ELECTRO-MOTORS, &c., *Professors W. E. Ayrton and J. Perry, Finsbury.—15th June*, 1882. 8d.

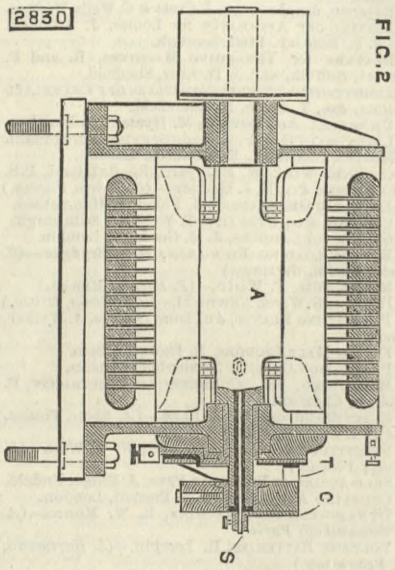
One form of the invention is shown in Figs. 1 and 2. A is a rotating field magnet formed of soft iron or other material and wound with wire in coils, which are nearly parallel to the axis. This rotates inside a Pacinotti ring. In the present case one end of the wire on the bobbin is fastened to the iron, and the other end passes insulated through a hole in spindle S, where it is connected to one of the rubbing brushes

2830 FIG. 1.



T. There are twelve coils on the ring, and their rods are joined up to the pieces C of the commutator as in the Gramme ring. In addition to the above machine, the inventors claim an arrangement by which the relative positions of the brushes and field magnet may be altered; another arrangement by means of which the relative positions of the commutator and the Pacinotti ring may be altered; the regulation of a motor by continually introducing or taking out of the circuit a resistance, or shunting the current

2830 FIG. 2

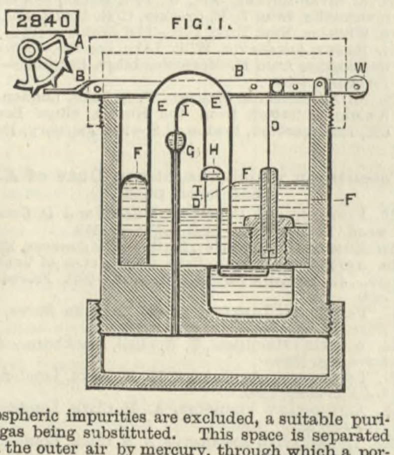


past the machine or any portion of it periodically in such a way that a governor, like an ordinary steam engine governor, alters the fractional part of the whole periodic time during which introduction of the resistance or the shunting occurs; the use of a magneto-electric and dynamo-electric motor, coupled or geared together, for obtaining constant speed, &c. &c.

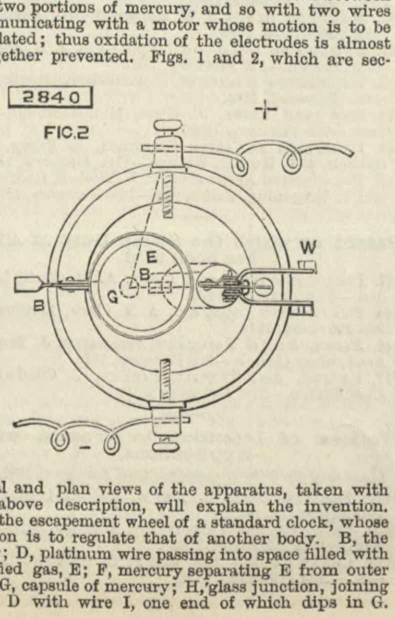
2840. APPARATUS FOR THE MEASUREMENT AND REGULATION OF VELOCITY, *H. S. Hele Shaw, Bristol.—16th June*, 1882. 6d.

According to this invention the moving body, whose motion is to regulate that of another, imparts impulses to one end of a lever or frame, the other end of which communicates with a space from which oxygen and atmospheric impurities are excluded, a suitable purified gas being substituted. This space is separated from the outer air by mercury, through which a portion of the lever or frame, or a wire attached thereto, passes, and in which it works without appreciable friction. In the isolated space, but insulated from the mercury below, is a capsule of mercury, in which the wire attached to the lever dips at every impulse, and thus establishes electrical communication between the two portions of mercury, and so with two wires communicating with a motor whose motion is to be regulated; thus oxidation of the electrodes is almost altogether prevented. Figs. 1 and 2, which are sectional and plan views of the apparatus, taken with the above description, will explain the invention. A is the escapement wheel of a standard clock, whose motion is to regulate that of another body. B, the lever; D, platinum wire passing into space filled with purified gas, E; F, mercury separating E from outer air; G, capsule of mercury; H, glass junction, joining wire D with wire I, one end of which dips in G.

2840 FIG. 1.



2840 FIG. 2



When B is depressed by A, wire I dips into the mercury below E, and the circuit is completed; B is raised after each impulse by weights W W.

2846. RAILWAY BRAKE APPARATUS, *E. Foakes, Cardiff.—16th June*, 1882. 8d.

The inventor claims on a railway vehicle the combination of the brakes, consisting of the toggle joints and shoes or blocks, with the longitudinal rods or bars arranged to be pushed or pulled by the adjacent vehicle, and act on the said brake through the medium of suitable apparatus or mechanism.

2848. STEAM PUMPING ENGINES, &c., *T. H. Ward Tipton.—16th June*, 1882. 1s.

This relates, First, to stop regulating or throttle valves and valves of a like kind; Secondly, to the means for packing the piston rods; Thirdly, to the valves of pump cylinders; Fourthly, to a mode of actuating equilibrium slide valves; Fifthly, to the condenser and feed-water heater.

2849. PRESSES FOR EXPRESSING OILS OR LIQUIDS FROM SEEDS, &c., *J. H. Johnson, London.—16th June*, 1882.—(*A communication from P. D. and E. D. Brenot, Paris.*) 6d.

This consists partly in the employment of a cage with hinged walls or sides, which move outwards spontaneously by reaction when it is desired to remove the cakes.

2852. MACHINERY FOR WEAVING SACKS, PILLOW CASES, &c., *W., A., A., A., E., and J. Briggs, Whitworth.—16th June*, 1882. 6d.

This consists partly in the combination with an endless pattern surface of a tappet or tappets put, by the action of the said pattern surface, in and out of gear with one or more of the jack rods to cause the top and bottom warps to be woven together at the proper places to form the closure of the tubular article.

2855. ADJUSTING RAILWAY CARRIAGE DOORS, &c., *S. A. Say, Peckham.—16th June*, 1882. 6d.

This consists partly in the manufacture and use of adjustable door jambs.

2856. METEOROLOGICAL INDICATING AND AIR TESTING INSTRUMENTS, *F. H. F. Engel, Hamburg.—16th June*, 1882.—(*A communication from W. Klinkerfues, Gottingen.*) 6d.

This relates to an instrument for ascertaining relative moisture and corresponding dew point of the air, by means of one indicating hand, moved by the alterations in length of an hygroscopic hair string, which hand points or shows to scales divided in degrees.

2857. INJECTORS, *A. H. Smith, Nottingham.—17th June*, 1882. 6d.

Each injector is constructed with an outer case provided with two inlets and one outlet; one inlet admits steam and is provided interiorly with either a fixed cone, or a cone capable of adjustment opposite the fixed or loose cone. Inside is a second fixed or loose cone, and at one side of such cone within the case is a port or overflow way provided with a stop valve and hand wheel. The position of the port or overflow way varies according to the position the injector will occupy when at work. Outside the first-named fixed or adjustable cone is a spindle or stop valve for the admission of steam. The second inlet is provided with a dial valve or cock to adjust the supply of water.

2858. SAFETY SADDLE BARS, *R. S. Garden, Piccadilly.—17th June*, 1882. 6d.

This relates partly to the method of converting a saddle bar of the ordinary construction into a safety saddle bar, which in times of emergency can freely escape, together with its stirrup leather and stirrup iron, from all connection with the saddle-tree.

2863. APPARATUS FOR CHECKING AMOUNT OF MONEY ON TRAM-CARS, &c., *H. R. Landon and G. L. Dezille, London.—17th June*, 1882. 6d.

This consists in checking apparatus of the combination, with the supply rollers, of feed rollers and serrator, with or without a bell, all operated by means of an external knob or crank, the turning of which first raises the serrator, and then feeds and cuts the strip of paper.

2865. RAILWAY CAR WHEELS, *H. A. Bonneville, London.—17th June*, 1882.—(*A communication from E. B. Meatyard, U.S.*)—(*Complete.*) 4d.

This consists, First, in making the body or web of the wheel of two thin pressed metallic discs—thickened at the hub—which extend from the axle to the tire, curved and slit or slotted radially, so that when forced on the axle and rivetted to the tire they may constitute a cushion between the axle and the tire; Secondly, in making the tire or rim with an internal annular stem of such shape as will best preserve its circular form.

2868. APPARATUS FOR CUTTING OR SHAPING STONE, *J. Thomas, Bangor.—17th June*, 1882. 6d.

This consists, First, in the use of a weighty hammer driven by any suitable means; Secondly, of a die or anvil against or upon which the stone is placed when struck; and Thirdly, peculiarly formed tools varying with the kind of stone operated upon, and very largely according to the kind of work to be done.

2870. CALORIC ENGINE, *A. M. Clark, London.—17th June*, 1882.—(*A communication from J. Schweizer, Switzerland.*) 6d.

This engine is based on the employment of a partial vacuum, produced by the expansion of air at atmospheric pressure, by the heat of a gas flame, jet of steam or other fluid, or by a current of hot air, and its subsequent cooling in a closed chamber.

2878. DRY CENTRE VALVES FOR WORKING GAS PURIFIERS, *E. M. Simpson, London.—17th June*, 1882.—(*A communication from F. Weck, Berlin.*) 6d.

In a common case is constructed a central arrangement of a number of disc valves, the number of which will depend upon that of the purifiers which are to be connected therewith. These valves in a certain manner partly communicate with one another and are partly shut off from each other.

2883. AUTOMATIC LUBRICATING APPARATUS, &c., *E. A. Brydges, Berlin.—19th June*, 1882.—(*A communication from F. Tovote, Hanover.*) 6d.

In one arrangement a hollow piston provided with a hollow spindle is employed, which said spindle is guided in the lid of the receptacle so as to regulate the consumption of consistent fat or grease or other lubricant, whereby the hollow piston is filled or partially filled with shot, pieces of lead, or other suitable material.

2887. COUNTING OR CHECKING APPARATUS, &c., *F. Peterson and J. H. R. Dinsmore, Liverpool.—19th June*, 1882. 10d.

This relates to an apparatus in which an endless band is employed for displaying the numbers.

2889. MACHINERY FOR THE STAGES OF THEATRES, *C. D. Abel, London.—19th June*, 1882.—(*A communication from R. Gwinner, J. Kautsky, C. Dengg and F. Roth, Vienna.*) 10d.

The stage is divided into four sections in a direction parallel with the proscenium, each of which sections consists preferably of three iron bearers for the reception of the scene carriages, at the side of which is a trap, and then two other bearers for the reception of the trap slides. Each of the said sections is supported by columns carried by the plungers of hydraulic cylinders. The said bearers are not fixed to the columns but fit with sockets thereon.

2890. LOCOMOTIVE ENGINES AND VEHICLES FOR TRAMWAYS, &c., *G. Allan and R. E. Dickinson, Sheffield.—19th June*, 1882. 6d.

The inventors claim, First, the combined construction and arrangement of steam boiler for tram cars, consisting of a double tubular boiler with central fire-box, from which the fire tubes pass transversely from the car to smoke boxes on either side thereof: Secondly, the method of rendering exhaust steam invisible by causing it to pass into tubes or vessels situated in the fire-box of the steam boiler, from which tubes or vessels it issues into or over the fire, in order to escape then into the atmosphere; Thirdly, the construction of apparatus for admitting exhaust steam directly into or on to the fire; Fourthly, the construction of apparatus for causing the brakes of vehicles to be applied automatically, wherein the centrifugal force of weights in overcoming the force of springs acting in opposition thereto causes screwed shafts to be turned, by means of which revolving blocks are brought into frictional contact with a drum, the rotation of which causes the brake blocks to be applied.

2893. PREPARATION AND FITTING OF ARTIFICIAL TEETH, *E. Reading, London.—19th June*, 1882.—(*A communication from D. H. Buttner, New York.*) 6*d*.

This relates to a method and apparatus for fitting an artificial crown to the natural root of the tooth.

2894. MANUFACTURE OF CLOTH AND LOOMS THEREFOR, *T. Isherwood, Rhode Island, U.S.—19th June*, 1882. 6*d*.

This comprises the method of and means for interweaving and firmly uniting strengthening strips with the cloth by means of interlying warp threads, and separate shuttles for laying the weft for the strips and the weft for the cloth in such a manner that cloth is produced having strengthening strips interwoven with the cloth at intervals, so that such cloth is made thicker and stronger where these strips occur than at the spaces between such strips.

2896. IMPROVEMENTS IN SHUNTS OR SWITCHES FOR PROTECTING TELEGRAPHIC INSTRUMENTS FROM EXCESSIVELY POWERFUL CURRENTS, &c., *C. T. Howard, Providence, Rhode Island, U.S.—19th June*, 1882. 6*d*.

This invention comprises a switch placed in proximity to a plate connected with the ground and a movable bridge, whereby the circuit can be disconnected from the instrument, and a portion of any abnormally powerful current automatically carried to the ground, whether the connection is made with the instrument or not.

2897. RAILWAY BRAKES, *W. R. Lake, London.—19th June*, 1882.—(*A communication from J. Woods, Melbourne.*) 6*d*.

This consists in lifting and supporting the weighted levers by means of fluid pressure, whereby the brake blocks are taken off and held from the wheels.

2900. PROMOTING COMBUSTION IN FURNACES, *A. M. Clark, London.—19th June*, 1882.—(*A communication from T. Brennan, W. G. Munn, W. J. Duncan, W. A. Meriwether, and C. G. Davidson, Louisville, U.S.*) 6*d*.

Instead of using air in combination with steam, the inventors exclude all air possible and cause an artificial draught by the use of pipes formed with openings, which pass the steam in straight and in diagonal lines across and above the fire, and also use in connection with the steam a small or suitable quantity of petroleum or other cheap oil fed into the steam supply by adjustable self-oilers.

2901. PRODUCING A CONTINUOUS CURRENT OF AIR, &c., *L. Edwards, London.—19th June*, 1882.—(*A communication from E. Vigreux, Bois-Guillaume, France.*) 6*d*.

This consists in the combination of a revolving conical cylinder, helical passages, inlet and outlet passages, and case with movable cover.

2904. CONSTRUCTION OF TAPS AND VALVES, *J. Nixon, Oldham.—20th June*, 1882. 6*d*.

This relates to "screw-down" taps and valves, and consists in the construction of the plug which closes the central aperture, and in the method of its attachment to the screwed spindle.

2906. REEL APPLIANCES FOR REAPING MACHINES, *T. Culpin, London.—20th June*, 1882. 6*d*.

The object is an arrangement of reel appliances of reaping machines, whereby the blade or blades is or are caused to descend vertically, or nearly so, into the heads or ears of the grain and carry or push the straws on to and over the platform without beating against the heads, the blade or blades retaining their vertical position while travelling over the platform, and on rising again, to clear and to prevent the scattering of the cut grain.

2907. IMPROVEMENTS IN ELECTRIC TELEPHONY, *J. G. Lorrain, Westminster.—20th June*, 1882.—(*A communication from A. Dunand, Paris.*) 6*d*.

This relates to the employment of a condenser Y in combination with a battery, both arranged in the circuit of the secondary wire of an induction coil, as the receiving telephone; a microphone or other transmitter, with its battery, being arranged in circuit with the primary wire of the said coil.

2908. DRYING APPARATUS FOR PUBLIC WASHING-HOUSES, &c., *W. Combe, Glasgow.—20th June*, 1882.—(*Void.*) 2*d*.

This relates to an apparatus in which a current of warm air is driven or drawn through for the purpose of drying the clothes contained therein.

2912. APPARATUS FOR THE REGULATION OF ELECTRIC CURRENTS, *S. H. Emmens, Argyll-street, Middlesex.—20th June*, 1882. 6*d*.

This relates to the conversion of currents of varying quantity and intensity into currents of uniform steadiness. This is accomplished by interposing between the generator and the service circuit two or more sets of secondary batteries, so arranged that while one set is being charged by the generator, another is being discharged by the service circuit, and *vice versâ* alternately. To accomplish this automatically, the inventor causes a worm wheel actuated by gearing connected with the engine to set in motion two discs, which are made to revolve in opposite directions. These discs are each divided into two insulated halves, and are furnished with two sets of central conducting rings; one set of these rings are connected to one set of the insulated halves, and the lead and return wires of the service circuit, whilst the other set are connected to the other set of insulated halves, and the lead and return wires of the dynamo. The batteries have stationary poles furnished with suitable brushes, whereby electrical contact may be maintained with the revolving discs. By this means at every half revolution of the discs the batteries exchange circuits, and are alternately charged by the dynamo and discharged through the circuit.

2913. IMPROVEMENTS IN SECONDARY BATTERIES, *S. H. Emmens, Argyll-street, Middlesex.—20th June*, 1882. 6*d*.

The inventor constructs his electrodes of short spiral cylinders of sheet lead superposed one on the other, and separating each pair from the other by an insulating diaphragm. To expedite the formation of his battery he uses an electrolyte consisting of a solution of acetate, nitrate, or other salt of lead, and then passes a strong current through it.

2915. HOISTING GEAR, *W. J. Brewer, London.—20th June*, 1882. 6*d*.

This consists in a lifting block of the combination of geared wheels, power rope pulleys, lifting tackle, and lifting drums, used differentially or otherwise, to produce variations in power and speed.

2916. CHILDREN'S COTS, *G. W. Moore, London.—20th June*, 1882. 6*d*.

This relates, First, to means for preventing all possibility of the child creeping or falling out; and Secondly, in constructing the stands for the cots.

2918. OBTAINING FERROCYANIDE OF IRON AND AMMONIA FROM THE PRODUCTS OF THE MANUFACTURE OF COAL GAS, *S. Pitt, Sutton.—20th June*, 1882.—(*A communication from H. Bower, Philadelphia.*) 4*d*.

This consists in the addition of iron or a salt of iron to ammoniacal liquor, without, however, adding acids to said liquor, whereby a considerable portion of the cyanides are converted into ferro-cyanide of ammonia, in such form as to be susceptible of being thereafter utilised in the manufacture of ammonia and of ferro-cyanide of iron (Prussian blue), by treatment with lime, distillation, and the addition either of acid and a salt of iron or of an alkali or alkaline salt.

2914. IMPROVEMENTS IN ELECTRIC LAMPS, &c., *S. H. Emmens, Argyll-street, London.—20th June*, 1882. 6*d*.

This relates to the regulation of arc lamps. One method of carrying out the invention is shown in the accompanying illustration. The carbon holders are

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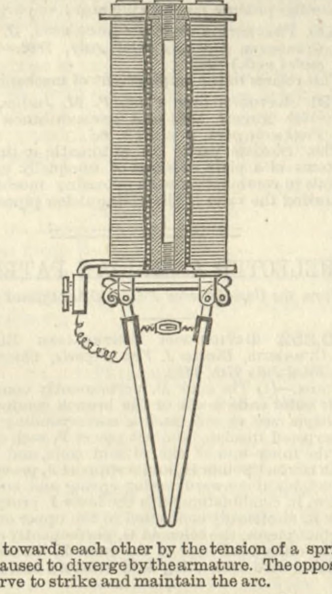


inclined towards each other by the tension of a spring, and are caused to diverge by the armature. The opposing forces serve to strike and maintain the arc.

2917. IMPROVEMENTS IN DYNAMO-ELECTRIC MACHINES, &c., *T. Parker, Coalbrookdale, Salop, and P. B. Elwell, Wolverhampton.—20th June*, 1882.—(*Not proceeded with.*) 2*d*.

This relates to the construction of armatures, so as to reduce the useless portion of the inductor as much as possible. The inventors make their armature of square or oblong longitudinal section, similar to the rim of a fly-wheel, so that the two sides of the rim, and also the face, can be embraced by the field magnets. Other improvements are also described.

2920. APPARATUS FOR CLEANING AND REMOVING THE SKINS FROM POTATOES, *C. L. Hancock, Dudley.—20th June*, 1882. 6*d*.

This relates to an apparatus in which the potatoes are cleaned by the scrubbing action of a vertically rotating brush, and the skin removed by a combined rolling, rubbing, and scraping motion against a punctured interior or vessel's lining, the jagged or roughened edges of apertures projecting towards the brush, so as to remove the skin in fine particles.

2925. MANUFACTURE OF LEATHER FROM CLIPPINGS AND WASTE PIECES, *E. G. Brewer, London.—20th June*, 1882.—(*A communication from A. Levy, Paris.*)—(*Not proceeded with.*) 2*d*.

This relates to the treatment of the clippings with gum and subjecting them to great pressure.

2926. COOKING RANGES AND STOVES, *A. K. Robinson, Leeds.—20th June*, 1882. 6*d*.

This relates to an improved construction of bonnet or fire cover applied to closed fire ranges.

2927. IMPROVED MACHINE OR APPARATUS FOR RAISING WATER FOR IRRIGATION, &c., *W. R. Lake, London.—20th June*, 1882.—(*A communication from F. A. Grunow and H. Meyer, U.S.*) 6*d*.

This relates to a pump in which a wheel provided with angular blades rotates.

2928. MULE SPINNING MACHINES, *S. Mock, Rhode Island, U.S.—20th June*, 1882. 6*d*.

The invention consists in providing a mule spinning machine with mechanism, which, when the mule carriage moves in to the roller beam, will automatically wipe the said mule carriage and the spindles, and remove all the loose fibre and waste from the portion of floor traversed by the said mule carriage.

2930. TREATMENT OF COKE OVEN GASES FOR THE UTILISATION OF THEIR CONSTITUENTS, *J. Imray, London.—20th June*, 1882.—(*A communication from G. S. Page, Stanley, U.S.*)—(*Not proceeded with.*) 2*d*.

The invention relates to the treatment of the combustible gases given off in the coking of coal, culm, or slack in ovens, for the purpose of separating therefrom and utilising the condensible constituents, such as tar and ammonia, while the permanent gases are stored and used for heating or illuminating purposes.

2931. UMBRELLAS, PARASOLS, AND SUNSHADES, *B. J. B. Mills, London.—20th June*, 1882.—(*A communication from J. A. Dupuy, Lyons.*) 6*d*.

This consists in constructing the sticks of umbrellas, &c., with capability of being shortened or contracted, when required, to the length of the covering, by causing the two parts of the stick to enter one into the other, and by the sliding of the top notch towards the point, with various methods of fastening the same in position.

2934. IMPROVED MEANS OF SUSPENDING OR MOUNTING ELECTROLIERS, &c., *A. W. Brewtnall, Warrington.—20th June*, 1882. 6*d*.

The object of this invention is to enable the principle of the ball-and-socket joint to be applied to the suspension of electroliers. It consists in constructing the ball and likewise its socket in segments, zones, or other parts of metal, separated from one another by segments of insulating material, the metallic segments of the socket corresponding to similar segments of the ball, and in contact therewith over a sufficient extent of surface, to permit of the free motion of the ball in its socket without breaking the electrical connection between the corresponding segments.

2938. ACTIONS OF PIANOFORTES, *J. Mallinson, Selby.—20th June*, 1882. 6*d*.

This relates to the construction and employment of pianoforte actions made with metal wires, having coils and curved ends to fit over and act on the hammer butts.

2941. WHEEL, *J. S. Ayrton, Stoke-upon-Trent, and T. Floyd, Westminster.—21st June*, 1882. 4*d*.

The invention consists in forming the body portion of the wheel separate and distinct from the outer or peripheral portion.

2942. BIER, *C. D. Goldie, St. Ives.—21st June*, 1882. 4*d*.

The bier consists of a strong frame, which is placed on wheels, and which is fitted with one or two flaps kept in position by a bolt or bolts. From the frame rise two or more supports, and on these rests a strong rod, fitted with two or more reels capable of containing a sufficient quantity of web or other material.

2944. CARTS, WAGONS, &c., *W. March, London.—21st June*, 1882. 6*d*.

A revolving brush, operated on by one of the hind wheels, is placed under a wagon and sweeps into an elevator the slop or other material requiring removal. The elevator consists of endless chains of steel bands with buckets attached, and revolving on pulleys inside a base, and is driven by the hind wheel or by a pulley attached to the intermediate brushing machine.

2945. IMPROVEMENTS IN PLATES FOR SECONDARY OR STORAGE BATTERIES, *C. Sorley, Rosoman-street, London.—21st June*, 1882. 4*d*.

This relates to the grooving of the plates of secondary batteries, so that the ridges between the grooves terminate in thin edges, rough toothed or plain.

2949. BOXES MADE OF CARDBOARD, &c., *M. D. Wood, Stafford, and E. P. Smyth, Shepherd's Bush.—21st June*, 1882. 6*d*.

This relates to boxes each made of two pieces of cardboard or similar material, one of which pieces forms the bottom or body of the box, while the other piece forms the lid thereof.

2950. MACHINERY FOR NAILING THE HEELS ON BOOTS AND SHOES, *W. R. Lake, London.—21st June*, 1882.—(*A communication from F. F. Raymond, Newton, U.S.*) 8*d*.

This consists partly in the combination of a jack for holding the boot or shoe, a group of awls, and a group of drivers having a straight horizontal movement on a crosshead adapted to be vertically reciprocated.

2953. MANUFACTURE OF BOOTS, *P. Lehany, London.—21st June*, 1882. 6*d*.

The object is the manufacture of a boot which shall possess the advantage of a combined boot and gaiter, which shall be water-tight, and which can be easily and expeditiously put on and taken off.

2955. TREATING NITROGENOUS MATTERS TO OBTAIN USEFUL PRODUCTS, &c., *J. C. Mewburn.—21st June*, 1882.—(*A communication from L. Fouque, Paris.*) 6*d*.

The process is characterised by the employment of electric currents to replace the action of fermentation in certain of these matters, and to give to the others certain elements of which they are deficient.

2958. VALVES OR COCKS, *T. Penn, London.—21st June*, 1882. 6*d*.

This consists partly in forming the part which closes and opens the inlet (that is to say, the valve proper) in two parts.

2959. LOOMS, *R. Illingworth, Blackburn.—22nd June*, 1882.—(*Not proceeded with.*) 2*d*.

This relates to arrangements for weighting the warp beam.

2960. MACHINERY FOR THE MANUFACTURE OF NAILS, *J. W. Summers, Staleybridge.—22nd June*, 1882. 6*d*.

This consists principally in causing the tube or barrel through which the clamp carrying the plate or strip of metal passes, to have an intermittent rotary motion in one direction imparted to it by means of a star wheel and a train of gearing from a shaft beneath, which shaft is actuated in its turn by the main driving pulley of the machine.

2962. IMPROVEMENTS IN INCANDESCENT ELECTRIC LIGHT LAMPS, *M. Volk, Brighton.—22nd June*, 1882.—(*Not proceeded with.*) 2*d*.

This relates to a switch appliance attached to the lamp holder, by means of which the current can be turned into the lamp or not at will.

2964. VELOCIPEDES OR TRICYCLES, *W. Morgan-Brown, London.—22nd June*, 1882.—(*A communication from F. White, Westboro', U.S.*) 4*d*.

The invention is embodied in a velocipede or tricycle which is propelled by a lever operated by the body and arms of the occupant with a movement somewhat similar to that of rowing.

2967. SHOE AND OTHER SIMILAR FASTENERS, *H. J. Haddan, Kensington.—22nd June*, 1882.—(*A communication from H. J. Dieler, St. Paul, U.S.*) 6*d*.

This consists partly of a fastening device consisting of two leaves hinged or otherwise loosely connected, one of which is adapted to be secured to the shoe, &c., while the other is provided with means for its removable attachment to the overlapping piece of the shoe, &c., and means for locking the two leaves in close contact—for instance, a hooked catch.

2968. PROPELLING VESSELS, *W. L. Cowie, Borneo.—22nd June*, 1882. 6*d*.

For propelling a vessel the inventor employs vertical propeller blades similar in form to knife blades, which are mounted at the exterior of the sides of the vessel, and caused to reciprocate to and from a horizontal direction in a line with the length of the vessel, and they are caused to be set edgewise when moving in the direction that the vessel is to be propelled, and at right angles to the line of the vessel's movement when moving in the contrary direction.

2969. COMPOSITION FOR PREVENTING AND REMOVING SEDIMENT, &c., IN STEAM BOILERS, &c., *E. Edwards, London.—22nd June*, 1882.—(*A communication from J. Vernanchet, Paris.*) 2*d*.

The composition consists of salt of alum, salt of soda, and sea-salt, intimately mixed together in combination with a sufficient quantity of glue.

2970. TREATING SEWAGE, &c., *E. Edwards, London.—22nd June*, 1882.—(*A communication from L. de Soulages, Paris.*) 6*d*.

This relates to a method of treating in closed vessels and by a dry process all nitrogenous liquid or solid substances, in order to convert them into manure mainly of carbon, all the offensive exhalations being avoided which are ordinarily produced in such processes, the whole of the nitrogen being preserved, the small quantity of air present being decomposed and its nitrogen retained, and the ammoniacal salts being fixed in the manure by the absorbent action of the carbon.

2972. HAT FORMING UMBRELLA OR PARASOL, *A. Gros and C. Salbreux, France.—22nd June*, 1882. 6*d*.

A number of ribs or stretchers are covered with a suitable material and connected with an arrangement of mechanism secured to the brim of the hat. The working of this mechanism causes the ribs to extend beyond or withdraw over or under the hat brim.

2974. IMPROVEMENTS IN THE METHOD OF PRODUCING THE ELECTRIC LIGHT, *O. G. Pritchard, Penge.—22nd June*, 1882.—(*Not proceeded with.*) 2*d*.

The inventor combines with the electric arc a gas flame forming a sort of path for the arc; a constant stream of finely divided carbon is supplied to the arc so as to impart by its incandescence the desired intensity of light. Tubular electrodes of platinum or other metal are used, the one forming a gas burner and the other a feed tube for the finely divided carbon.

2975. FIRE-ARMS, *B. Burton, London.—23rd June*, 1882.—(*Not proceeded with.*) 2*d*.

This relates to a means of converting breech-loading arms of any description into a magazine gun.

2976. HANDLES FOR JUGS, MUGS, TEAPOTS, &c., *J. Grundy, New Bristol, U.S.—23rd June*, 1882.—(*Not proceeded with.*) 2*d*.

This relates to improvements in handles for jugs, &c., whereby the same are rendered detachable.

2977. APPARATUS FOR SUPPLYING WATER TO STEAM BOILERS, *E. de Pass, London.—23rd June*, 1882.—(*A communication from La Société Volpp, Schwarz, and Cie., Paris.*) 6*d*.

This consists of a float and valve supply apparatus fixed on or in connection with the boiler with which it is in communication by means of a steam and a water pipe.

2978. APPARATUS FOR THE MANUFACTURE OF GAS, *G. W. and E. H. Stevenson, Westminster.—23rd June*, 1882.—(*Not proceeded with.*) 2*d*.

This refers to the construction of apparatus whereby the carbonisation of coal, cannel, or other suitable material for the production of gas may be carried out continuously and without the necessity for so frequently opening the retort for the introduction of the coal or withdrawal of the coke.

2979. BALL AND SOCKET JOINTS, *H. J. Haddan, Kensington—23rd June*, 1882.—(*A communication from O. C. White, U.S.*) 6*d*.

This relates to the combination of a ball made contractile or in sections, with a contractile socket piece provided with means of contracting or clamping it upon the ball.

2981. PURIFICATION OF GAS AND MANUFACTURE OF A FERTILISING COMPOUND, *J. Duke, Glastonbury.—23rd June*, 1882. 4*d*.

This relates to the use of mono-calcic phosphate for the purification of gas, and to the manufacture of a valuable fertilising agent as the result of such process of purification.

2982. APPARATUS FOR OBTAINING MOTIVE POWER, *J. G. Parker, Plymouth—23rd June*, 1882.—(*Not proceeded with.*) 2*d*.

The object is to obtain motive power by the rise and fall of the tide.

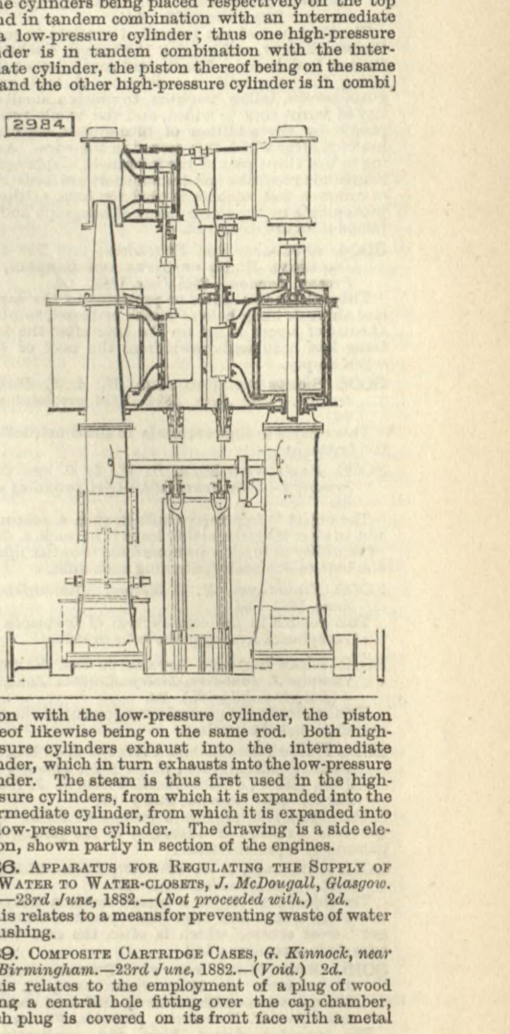
2983. MANUFACTURE OF TROWELS, *A. Reaney, Sheffield.—23rd June*, 1882. 4*d*.

This consists in forming the complete tangs of a hollow or tubular shape, from the steel plate or blade, by means of swages, dies, or other mechanical equivalents instead of by forging them solid.

2984. MARINE STEAM ENGINES, *G. Rodger, Barrow-in-Furness.—23rd June*, 1882. 8*d*.

The inventor uses two high-pressure cylinders, each of the cylinders being placed respectively on the top of and in tandem combination with an intermediate and a low-pressure cylinder; thus one high-pressure cylinder is in tandem combination with the intermediate cylinder, the piston thereof being on the same rod, and the other high-pressure cylinder is in combi-

2984



nation with the low-pressure cylinder, the piston thereof likewise being on the same rod. Both high-pressure cylinders exhaust into the intermediate cylinder, which in turn exhausts into the low-pressure cylinder. The steam is thus first used in the high-pressure cylinders, from which it is expanded into the intermediate cylinder, from which it is expanded into the low-pressure cylinder. The drawing is a side elevation, shown partly in section of the engines.

2986. APPARATUS FOR REGULATING THE SUPPLY OF WATER TO WATER-CLOSETS, *J. McDougall, Glasgow.—23rd June*, 1882.—(*Not proceeded with.*) 2*d*.

This relates to a means for preventing waste of water in flushing.

2989. COMPOSITE CARTRIDGE CASES, *G. Kinnock, near Birmingham.—23rd June*, 1882.—(*Void.*) 2*d*.

This relates to the employment of a plug of wood having a central hole fitting over the cap chamber, which plug is covered on its front face with a metal disc.

2991. EXTRACTING COLOURING MATTER AND JUICES FROM WOOD, *J. H. Johnson, London.—23rd June*, 1882.—(*A communication from E. Pereire, Paris.*)—(*Not proceeded with.*) 2*d*.

This consists essentially in submitting the materials to the action of steam or other heated vapour, preferably in an apparatus similar to the apparatus ordinarily employed for impregnating wood with preserving matter or fluid.

2994. ASH RECEIVER, *R. and S. Jackson, Broadbottom.—24th June*, 1882.—(*Not proceeded with.*) 2*d*.

The invention consists in constructing an ash receiver, consisting of a box of plate iron or other suitable material fitting into the ash-hole or pit beneath the grid or grating, and provided with a handle, by means of which, when the grid or grating is removed, it can be drawn out, lifting out all the ashes with it.

2995. SOLUTION FOR BREWING, *E. R. Moritz, London.—24th June*, 1882. 4*d*.

This consists in the employment in the brewing of beer of a solution containing phosphate of magnesia, the result of the reaction of phosphate of soda or chloride of magnesium, the precipitate being dissolved by means of sulphurous acid.

2996. APPARATUS FOR BOLTING, SIFTING, AND CLEANING MEAL, FLOUR, &c., *S. Bruce, Dublin.—24th June*, 1882.—(*Not proceeded with.*) 2*d*.

This relates to improvements in the general construction of the apparatus.

2999. APPARATUS FOR RAISING WEIGHTS, *E. Edwards, London.—24th June*, 1882.—(*A communication from V. Cassin, Sauveterre, France.*)—(*Not proceeded with.*) 2*d*.

This relates to improvements in the ordinary "jack" used for lifting weights, in which a toothed rack, by which the weight to be lifted is supported, is actuated by a corresponding toothed pinion worked by a handle.

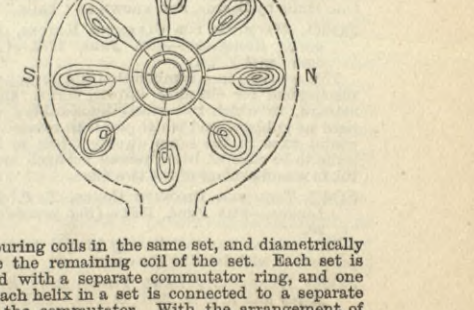
3001. CORSETS AND STAYS, *C. L. Reynolds, Landport.—24th June*, 1882. 4*d*.

This relates to the application of a lateral independent band or bands to the external surface.

3002. IMPROVEMENTS IN DYNAMO-ELECTRIC MACHINES, *P. Jensen, London.—24th June*, 1882.—(*A communication from D. A. Schuyler and F. G. Waterhouse, New York.*) 8*d*.

This relates to a novel arrangement of armature coils, &c. The coils are divided into sets of four, those in each set being disposed symmetrically with relation to one another in such a way that each coil of a set is placed at an angle of ninety degrees from its two

3002



neighbouring coils in the same set, and diametrically opposite the remaining coil of the set. Each set is provided with a separate commutator ring, and one end of each helix in a set is connected to a separate plate of the commutator. With the arrangement of field of force poles employed, diametrically opposite bobbins would be connected to diametrically opposite segments. The remaining ends of the coils are connected or in permanent electrical connection with one another. Commutator brushes are so applied that each bobbin is connected to the brush during its movement from one neutral point to the other. Excellent results have been obtained by keeping the coil connected through approximately 135 deg. of revolution as it passes from one neutral point to the other. The armature coils may consist of any desired number of bobbins capable of division by the factor 4. The figure illustrates the manner of dividing and connecting the bobbins to one another and to the commutator. Other improvements are described and claimed.

3003 Improved Construction of Telephonic or Sound Conducting Wires, &c., also in Compounds for Insulating same, and in Transmitter and Receiver Diaphragms, &c., *A. Wilkinson, Peckham, Surrey.—24th June, 1882.* 4d.

The First part of the invention consists in making the wire hollow, and passing it through a solution of tin and lead mixed. The Second part relates to insulating the wire with a compound of india-rubber, gutta-percha, tallow, naphtha, to which a small quantity of burnt cork is added, and the whole rendered plastic by the addition of bituminous matter and heating, after which it is served in the wire. According to the Third part of the invention, diaphragms for telephonic receivers and transmitters are constructed of common felt such as is used for hats. Other improvements in the construction of telegraph and telephone lines are described.

3004. Apparatus for Protecting the Tap Holes and Shive Holes of Casks and Barrels, *L. J. Prosser, London.—24th June, 1882.* 6d.

This relates to a shield or protector to the tap hole and shive or bung hole of a cask or barrel, to obviate the use of a cork to fill up the hole after the tap or bung has been withdrawn from the cask or barrel when empty.

3005. Sights for Fire-arms, *W. A. F. Blakeney, London.—24th June, 1882.—(Not proceeded with.)* 2d.

This relates to improvements in the construction of the foresight.

3006. Preserving Milk, *H. W. L. O. von Roden, Hamburg.—24th June, 1882.—(Not proceeded with.)* 2d.

The object is to preserve milk in such a manner as not to alter its taste, and to leave it in such a degree of liquidity as to allow its immediate use after opening the bottles or vessels containing such milk.

3009. Fireplaces, *W. S. Morton, Edinburgh.—26th June, 1882.* 6d.

This relates to the construction of fireplaces with fuel receptacles formed in the hobs or sides.

3012. Steam Steering Apparatus for Navigable Vessels, *J. Saunders, Liverpool.—26th June, 1882.—(Not proceeded with.)* 2d.

This relates to the general arrangement of the steam cylinders and the gearing.

3013. Fixing Photographic Pictures upon Earthenware, Porcelain, &c., *H. H. Lake, London.—26th June, 1882.—(A communication from E. J. Irlande, Paris.)—(Not proceeded with.)* 2d.

The object is to provide a process of fixing which prevents a change or alteration of the photographic pictures or representations.

3014. Tricycles, *T. F. Marriott, Leeds.—26th June, 1882.—(Not proceeded with.)* 2d.

The object is to enable a person using a tricycle to move the cranks and alter their position when they get "cross centre," which is often the case when a tricycle is ascending a hill.

3015. Edge Mills for the Pulverisation or Granulation of Hard Substances, *B. J. B. Mills, London.—26th January, 1883.—(A communication from F. Wanneveich, Grenoble, France.)* 6d.

The inventor claims, First, the application of several runners turning upon concentric paths around the same vertical shaft; Secondly, the successive passage of the substances from one to the other of these paths, either by their natural fall, or by mechanical means, such as guides or collectors, of form suitable to the various cases.

3022. Manufacture of India-rubber Tires, &c., *A. J. Wyley and B. Collins, Manchester.—27th June, 1882.—(Not proceeded with.)* 2d.

The object is to reduce the cost of the mould and of the labour in the manufacture of india-rubber tires.

3026. Blow-pipe Lamp, *J. T. Garrett, Camberwell.—27th June, 1882.* 6d.

The firing tool consists of a combined blow-pipe and lamp, carried by a suitable handle, air being conveyed to the blow-pipe by a tube from the mouth of the operator, or from a suitable bellows or fan.

3028. Forming Temporary Partitions in Class-rooms, &c., *J. W. Cook, London.—27th June, 1882.—(Not proceeded with.)* 2d.

According to one part of the invention it consists in hinging to the backs of the forms or seats, flaps composed of wood or other suitable material.

3030. Floating Lights, *C. D. Abel, London.—27th June, 1882.—(A communication from L. A. Brasseur, Brussels.)* 6d.

The oscillation of a floating buoy or vessel, or the movements of the waves relative thereto, are utilised for producing, by means of a magneto or dynamo-electric machine within the life-buoy, electric currents that serve to produce light either by incandescence of a conductor, or by means of "Geissler" tubes.

3031. Apparatus for Utilising the Power Required to Stop Tramway Cars, &c., for Restarting the same, or as an Instantaneous Brake, *F. J. Prince, Peckham.—27th June, 1882.—(Not proceeded with.)* 2d.

This relates to the employment of bevel wheel gearing, on suitable cross shafts or spindles, with connecting and disconnecting clutches operated through the intervention of suitable bars, rods, or levers.

3033. Carbons for Incandescent Electrical Illuminations, *F. S. Isaac, Queen's-gate-gardens, Middlesex.—27th June, 1882.—(A communication from Sir J. Vogel, whilst on his voyage to Australia.)* 2d.

This relates to the manufacture of carbons for incandescent lamps from the fibre of what is known as Rubus Australis, Parsona, Lygodium, or Supple Jack.

3035. Photographic Cameras, *G. Hare, London.—27th June, 1882.—(Not proceeded with.)* 2d.

This relates to the construction of the camera so as to render it compact and light.

3038. Stable Fittings, *D. McGill, Peckham.—27th June, 1882.—(Not proceeded with.)* 2d.

This relates to appliances for the division of stables into stalls by boards, and known as "bails."

3040. Machines for Cleaning Knives, *R. Wallwork, Manchester.—28th June, 1882.—(Not proceeded with.)* 2d.

This consists in a combination and arrangement of mechanism for cleaning knives, forks, and other articles, in which two small india-rubber discs are used as rubbers, and which are both rotated on horizontal axes in the same direction face to face, the knife to be cleaned being passed between and across the face and centres of the two discs.

3043. Tool for Drawing Corks, *T. P. Wymond, London.—28th June, 1882.—(Not proceeded with.)* 2d.

This relates to a tool having hinged barbs for the purpose of withdrawing the corks.

3050. Handles of Lawn Tennis Bats, &c., *C. W. Meiter and R. C. B. Moth, London.—28th June, 1882.—(Not proceeded with.)* 2d.

The handles are roughened by means of serrations pointing in opposite directions.

3051. Glass Melting Furnaces, *L. Le Breton-Mount, Melbourne.—28th June, 1882.—(Not proceeded with.)* 2d.

This relates to the means or apparatus for feeding or supplying "batch" or cullet to glass-melting furnaces.

3052. Machinery for Preparing Cotton, &c., *S. Lord and J. Kaberry, Rochdale.—28th June, 1882.—(Not proceeded with.)* 2d.

This consists in the employment of ring travellers and short light spindles or sheds, which latter carry the bobbins whereon the yarn is wound.

3053. Breech-loading Small-arms, *T. W. Webley and T. Brain, Birmingham.—28th June, 1882.* 10d.

This consists, First, in the construction and combination of parts for actuating the top bolt of drop-down guns in which the barrels are fastened down by top and bottom bolts, the top bolt taking into the prolonged rib between the barrels, and the bottom bolt taking into the lump on the underside of the barrels. Secondly, in the construction and combination of parts for fastening down the barrels on the prolonged rib of drop-down guns provided with top hand levers; Thirdly, in improvements in cocking the internal hammers of drop-down guns, and in lock mechanism of the said guns.

3055. Manufacture of Cartridges, *H. E. Newton, London.—28th June, 1882.—(A communication from La Société Anonyme Dynamite-Nobel, Isleton, Switzerland.)* 4d.

This consists in manufacturing cartridges, whereby the explosive is entirely enclosed in a fatty body, and is thus completely protected from the deleterious action of the humidity of the atmosphere.

3058. Rollers, &c., for Transferring and Printing, *E. C. Hancock, Worcester.—28th June, 1882.—(A communication from Dr. W. Grüne, Berlin.)* 4d.

This consists in manufacturing rollers or films from a compound of (advantageously) glue and glycerine, and then tanning the same by the action of tannic, pyrogallic or similar acids or tanning materials, whereby a tough and durable non-grained surface is obtained.

3059. Preventing or Diminishing the Force of Explosions in Coal Mines, *G. W. von Nawrocki, Berlin.—28th June, 1882.—(A communication from R. Jacobi, Zeitz, Germany.)—(Not proceeded with.)* 2d.

The timber used in the mine is impregnated with a solution of salt.

3063. Refining, Purifying, or Clarifying Saccharine Substances, &c., *D. MacEachran, Greenock.—29th June, 1882.* 4d.

The First part consists in the employment of manganese oxides, or other compounds of manganese such as salts of manganese, either alone or mixed with other refining or purifying agents. Another part consists in employing a settling tank or an equivalent vessel into which saccharine or other liquid charged with wood-charcoal, manganese, or other purifying agent, is run prior to being passed into the filter press or bag filters.

3069. Looms, *C. Catlow, Burnley.—29th June, 1882.—(Not proceeded with.)* 2d.

This relates to improved combination of mechanism for operating the healds; to improved combination of mechanism for holding the cloth roller or cloth beam, and to an improved construction of reed dents.

3071. Hoops for Bulge Barrels, *W. Downs, Liverpool.—29th June, 1882.—(Not proceeded with.)* 2d.

The two ends of the hoop are bound to the body of hoop, where the two overlap, by means of tin or other metal bands.

3072. Manufacture of Hydrosulphite of Soda, *G. W. von Nawrocki, Berlin.—29th June, 1882.—(A communication from the Verein Chemischer Fabriken, Mannheim, Germany.)* 2d.

The inventor claims the reaction of sulphate of soda on tank waste, with the co-operation of water, heat, and atmospheric air.

3073. Improvements in Electric Railways, &c., *H. Binko, Finsbury Park, Middlesex.—29th June, 1882.—(Not proceeded with.)* 2d.

This relates to the better collection of the current supplied to the dynamo machine used to propel or haul, as the case may be, and also to means for avoiding the shock experienced on disconnecting the current from such dynamo machine.

3074. Treatment of Hops, *W. G. Forster, Streatham Common.—29th June, 1882.* 4d.

This consists, First, in the treatment of the fresh hops to separate the flavouring matter or essential oil; Secondly, the treatment of hops to separate from them the bittering matter or lupuline, and the keeping or resinous matter, and the preparation by which these matters are rendered readily soluble; Thirdly, the further treatment of hops from which the essential oil, the lupuline, and the resinous matter have been extracted, to separate the tannin and prepare the same for use.

3077. Apparatus for Sharpening Saws, *C. P. Martin, London.—29th June, 1882.—(A communication from E. Vallangin, Paris.)—(Not proceeded with.)* 2d.

This relates to the employment of a circular cutter.

3079. Improvements in Electric Lamps, *J. H. Johnson, Lincoln's-inn-fields.—30th June, 1882.—(A communication from L. Bardon, Paris.—(Not proceeded with.)* 2d.

This relates to the regulation of arc lamps, and its object is to cause the upper carbon to descend slowly when the arc is lengthened, instead of suddenly, as is the case in many lamps.

3082. Boilers for Heating and Circulating Water, *S. Newbold and S. Thornley, Liverpool.—30th June, 1882.—(Not proceeded with.)* 2d.

This relates to improvements in general construction of boilers for greenhouses, &c.

3084. Machine whereby Potatoes or other Roots can be Separated into Sizes Required, *S. Copeland, Beverley, Yorks.—20th June, 1882.—(Not proceeded with.)* 2d.

This relates to the employment of a rotating cylinder or barrel, the outside being constructed with different meshes for sorting the potatoes.

3085. Excavating Earth for Sinking Tubing, *W. E. Gedge, London.—30th June, 1882.—(A communication from C. H. Leach, Baltimore, U.S.)* 6d.

This consists in an apparatus for sinking tubing, of a pipe having an upwardly opening valve and formed at its lower end to cut or disintegrate the soil, an exterior pipe arranged to follow the first in its descent, and means for reciprocating the central pipe.

3086. Printing or Stamping Ink, *F. Wirth, Frankfort.—30th June, 1882.—(A communication from G. Schmidt, near Frankfort.)* 2d.

This relates to the manufacture of inks by the admixture of peroxide or other black or dark oxide of manganese with linseed oil, varnish, or other vehicle.

3099. Preparation of Carbon Filaments, *A. R. Leask and F. P. Smith, London.—30th June, 1882.—(Not proceeded with.)* 2d.

This relates to the improvements in the appliances or apparatus to be employed in the "flashing" process.

3104. Picker Arms for Power Looms, *W. Alexander, Dundee.—1st July, 1882.—(Not proceeded with.)* 2d.

The object is to render that end of the arm through which the picking bolt or thong passes more durable than at present.

3107. Improvements in Secondary Batteries, *C. H. Cathcart, Sutton, Surrey.—1st July, 1882.* 4d.

This relates to improvements on patent No. 2068, 2nd May, 1882, granted to the present inventor and C. B. G. Cole. The improvements consist in forming the positive plate of perforated zinc corrugated or bent into various shapes. The plate is first well amalgamated with mercury and then covered with electrolytically-deposited pure zinc, the whole being again amalgamated with mercury. The negative plate is lead amalgamated with mercury and electrolytically oxidised.

3105. Agricultural Elevators, *R., J., and H. Wilder, Wallingford.—1st July, 1882.* 6d.

This relates to apparatus for elevating hay, straw, or similar produce for stacking and like purposes.

3109. Prevention of Boat Accidents, *H. O. A. E. Grünbaum, Stratford.—1st July, 1882.—(Not proceeded with.)* 2d.

This relates to the employment of mechanical oars.

3791. Extinguishing Fire, *P. M. Justice, London.—9th August, 1882.—(A communication from V. Vankeerberghen, Brussels.)* 6d.

This consists partly in automatic extinguishing systems of a plate or sheet of unequally expanding metals in combination with releasing mechanism for operating the valve of the extinguisher pipes.

SELECTED AMERICAN PATENTS.

From the United States' Patent Office Official Gazette.

270,352. Device for Controlling Electrical Currents, *Charles J. Van Depoele, Chicago, Ill.—Filed July 27th, 1882.*

Claim.—(1) The coils B, permanently connected at their outer ends to one of the branch conductors of a multiple arc circuit, and a corresponding series of superposed insulated contact pieces F, each connected to the inner end of one of said coils, and provided with contact points H, and a support J, provided with adjustable downward acting spring and suitable set screw, in combination with the lever I, provided with link R, electrically connected to the upper one of said contact pieces, the solenoid G, permanently connected to the other conductor of the branch, the core L, and suitable wire connecting said solenoid and lever, and

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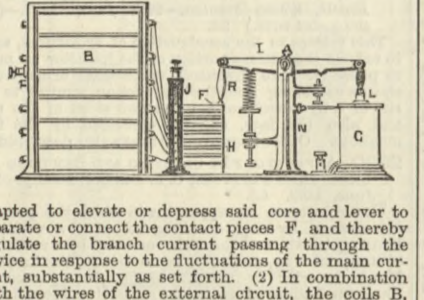

adapted to elevate or depress said core and lever to separate or connect the contact pieces F, and thereby regulate the branch current passing through the device in response to the fluctuations of the main current, substantially as set forth. (2) In combination with the wires of the external circuit, the coils B, contact pieces F, and support J, the solenoid G, standard N, lever I, core L, and suitable connecting wires, all located in and forming part of a branch of a main circuit, an adjustable stop, a regulating tension spring connected to the stop and the said lever I, and suitable adjusting screw, substantially as shown and described.

270,392. Bottle for Containing Aerated Liquids, *Hiram Codd, London, and Dan Rylands, Barnsley, County of York, England.—Filed 7th September, 1882.*

Brief.—Opening the valve relieves the pressure of gas upon the stopper and it falls inward, thus unstoppering the bottle. *Claim.*— (1) A bottle constructed substantially as described, to adapt it to be closed by an internal stopper, and having a valved

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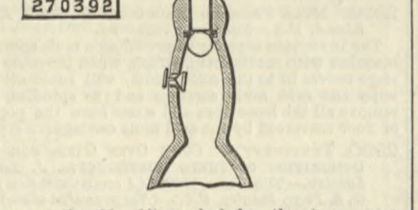

opening at the side of its neck, below the stopper seat, substantially as and for the purpose hereinbefore set forth. (2) The combination, substantially as hereinbefore set forth, of the bottle, the internal stopper, and the opening in the neck provided with a valve, for the purpose described.

270,491. Electric Light, *H. A. Seymour, Washington, D.C.—Filed June 1st, 1882.*

Claim.—(1) The combination, with the carbons of an electric light, of blocks of refractory material, against which the carbons rest, or which serve to support the adjacent ends of the carbons, and devices for automatically separating the blocks by the action of the current, substantially as set forth. (2) The com-

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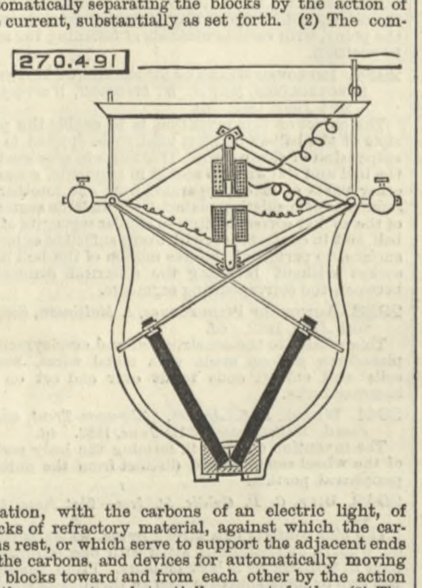

bination, with the carbons of an electric light, of blocks of refractory material, against which the carbons rest, or which serve to support the adjacent ends of the carbons, and devices for automatically moving the blocks toward and from each other by the action of the current, substantially as set forth. (3) The combination, with the carbons of an electric light, of blocks for limiting the lengthwise movement of the carbons, and devices for automatically varying the distance between the adjacent ends of the carbons, substantially as set forth. (4) The combination, with the carbons of an electric light, of blocks for limiting the feed of the carbons, a solenoid in the main circuit for separating the blocks, and a solenoid in a shunt-circuit for causing the blocks to approach each other, substantially as set forth. (5) The combination, with the carbon, of an electric light and blocks of refractory material for supporting the adjacent ends of the carbons, of arms having said refractory blocks removably secured to the adjacent ends thereof, and electro-magnets for automatically regulating the distance between the end of the carbons, substantially as set forth. (6) The combination, with the carbons of an electric light, of separate blocks of refractory material for supporting the adjacent ends of the carbons, said blocks being cut away to form an opening on their lower sides, and devices for automatically varying the distance between the ends of the carbons, substantially as set forth.

270,528. Air Brake Pressure Regulator, *George Westinghouse, jun., Pittsburg, Pa.—Filed November 23rd, 1882.*

Claim.—(1) A pressure regulator having a cock P, in combination with a brake cylinder, substantially as set forth. (2) In combination with an auxiliary brake cylinder, a spring diaphragm and a valve or equivalent spring valve, having air ports leading, one to the air-escape port of the brake cylinder, one to the open air

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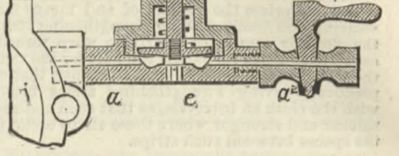

when the diaphragm is raised or the spring valve is unseated, and the third opening through a cock P, to the open air, substantially as set forth. (3) The combination, in an automatic fluid pressure brake apparatus, of a brake cylinder, a triple valve, and a pressure regulator connected to the air-escape port leading from the brake cylinder through the triple valve, substantially as set forth. (4) A brake pressure regulator having in combination a spring diaphragm, *a*, *a²*, and *c*, and cock P, substantially as set forth.

270,552. Compound Steam Engine, *David N. Melvin, Linoleumville, N.Y.—Filed June 24th, 1882.*

Claim.—(1) In a trunk engine, the combination, with the main piston and trunk piston, of the two packings and the outer packing, as and for the purposes herein specified. (2) In a trunk engine, the

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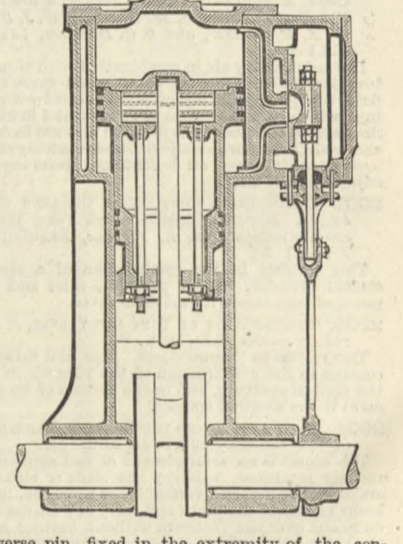

transverse pin, fixed in the extremity of the connecting rod, in combination with the adjustable brasses, set screw, and jam nut, arranged to be operated from the front end of the trunk, as and for the purposes herein specified.

CONTENTS.

Holland has 1450 kilometres of railways. In 1838 there were two companies—the Dutch Company, running trains from Rotterdam to the Hague, Harlem, and Amsterdam, and the Dutch-Rhenish line, from the German frontier towns to the principal cities of Holland.