THE CALCULATION OF CONTINUOUS GIRDERS.

BY MAX AM ENDE.

No. II.

The continuous girder of uniform section.—Let A B, Fig. 7, be one of an indefinite number of spans of a continuous girder of uniform section, and let P be a single load placed at the distance a from A. The ordinates of the triangle A P B, Fig. 8, represent the—positive—moments of the load P, and the effect of the continuity of the girder is a negative moment M_1 over A, decreasing uniformly towards B, where it is = 0, and a negative moment M_2 over B decreasing in the same manner towards A. The moment at any point between A and B is therefore the sum of the three ordinates at that point, or the ordinate of the crosslined surface, Fig. 8.

Fig 7.

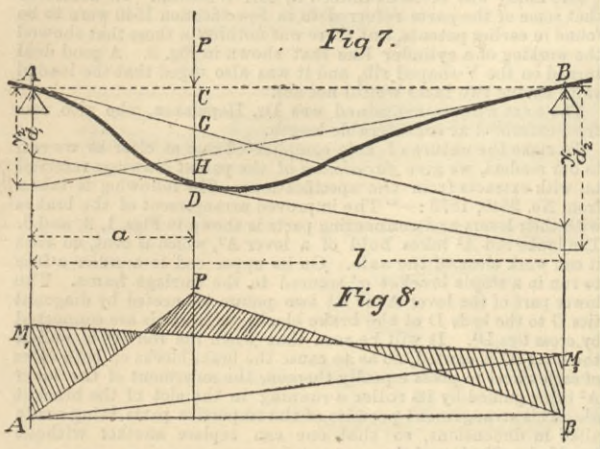


Fig 8.

In Fig. 7, A D B represents in an exaggerated manner the elastic line of the beam A B, under the influence of the load P and the moments M_1 and M_2. Tangents are drawn to it at A, D, and B, which cut off from the end verticals the pieces d_1, d_2, y_1, y_2. Between these and the moments M_1 and M_2 exist certain relations, the statement of which is the object of the present investigation. Following our plan of regarding any convenient part of a girder as a cantilever, we take the piece A D and consider it first rigidly fixed at A when the deflection of its end is $\overline{GD}$, and then at D when the deflection of its end is d_1. In the same manner we take the piece B D and consider it fixed first at B and then at D, when the deflections are $\overline{DH}$ and d_2 respectively. But as we shall finally require expressions for y_1 and y_2, we note some geometrical relations between them and the deflections, viz.:

$$\overline{GD} = \overline{CD} - \frac{a}{l} y_1$$

$$\overline{HD} = \overline{CD} - \frac{l-a}{l} y_2$$

$$\overline{CD} = \frac{a}{l} d_2 + \frac{l-a}{l} d_1$$

from which :—

$$\left.\begin{aligned} y_1 &= d_2 + \frac{l-a}{a} d_1 - \frac{l}{a}\overline{GD} \\ y_2 &= \frac{a}{l-a} d_2 + d_1 - \frac{l}{l-a}\overline{HD} \end{aligned}\right\} \quad . \quad . \quad . \quad (16)$$

Deflection $\overline{GD}$: Cantilever fixed at A and free at D; moment at a point at the distance x from D is :—

$$+\frac{l-a}{l} P (a-x) - \frac{l-a+x}{l} M_1 - \frac{a-x}{l} M_2$$

From the diagram we can see that $\overline{GD}$ is increased by all negative moments, *i.e.*, those which produce an upward convexity, and diminished by all positive moments, therefore we write :—

$$-\overline{GD} = \frac{1}{EJ}\int_0^a \left[+\frac{l-a}{l} P (a-x) - \frac{l-a+x}{l} M_1 - \frac{a-x}{l} M_2\right] x\,dx$$

$$\overline{GD} = \frac{a^3}{6EJl}\left[(a-l)P + \frac{3l-a}{a} M_1 + M_2\right]$$

Deflection $\overline{HD}$: Cantilever fixed at B and free at D; moment at a point x from D :—

$$+\frac{a}{l} P (l-a-x) - \frac{a+x}{l} M_2 - \frac{l-a-x}{l} M_1$$

Then :—

$$-\overline{HD} = \frac{1}{EJ}\int_0^{l-a} \left[+\frac{a}{l} P (l-a-x) - \frac{a+x}{l} M_2 - \frac{l-a-x}{l} M_1\right] x\,dx$$

$$\overline{HD} = \frac{(l-a)^3}{6EJl}\left(-aP + M_1 + \frac{2l+a}{l-a} M_2\right)$$

Deflection d_1 : Cantilever fixed at D and free at A; moment at a point x from A :—

$$+\frac{l-a}{a} P x - \frac{l-x}{l} M_1 - \frac{x}{l} M_2$$

Then :—

$$+d_1 = \frac{1}{EJ}\int_0^a \left[+\frac{l-a}{a} P x - \frac{l-x}{l} M_1 - \frac{x}{l} M_2\right] x\,dx$$

$$d_1 = \frac{a^3}{6EJl}\left[2(l-a)P - \frac{3l-2a}{a} M_1 - 2M_2\right]$$

Deflection d_2 : Cantilever fixed at D and free at B; moment at a point x from B :—

$$+\frac{a}{l} P x - \frac{x}{l} M_1 - \frac{l-x}{l} M_2$$

$$+d_2 = \frac{1}{EJ}\int_0^{l-a} \left[+\frac{a}{l} P x - \frac{x}{l} M_1 - \frac{l-x}{l} M_2\right] x\,dx$$

$$d_2 = \frac{(l-a)^3}{6EJl}\left[2aP - 2M_1 - \frac{l+2a}{l-a} M_2\right]$$

Putting these values for G D, H D, d_1, and d_2 into equations (16), we obtain, after some reductions :—

$$\left.\begin{aligned} y_1 &= \frac{1}{6EJ}\left[a(l-a)(2l-a)P - 2l^2 M_1 - l^2 M_2\right] \\ y_2 &= \frac{1}{6EJ}\left[a(l-a)(l+a)P - l^2 M_1 - 2l^2 M_2\right] \end{aligned}\right\} \quad (17)$$

If, instead of the single load P at the distance a from A, several loads at different distances a act upon the girder, the two first members of equations (17) have to be written :—

$$\Sigma\, a(l-a)(2l-a)P \text{ and } \Sigma\, a(l-a)(l+a)P$$

respectively; and if in these latter expressions $p\,da$ is put for P, where p is a uniformly distributed load per unit of length, they change into—

$$\int a(l-a)(2l-a)p\,da \text{ and } \int a(l-a)(l+a)p\,da.$$

Integrating between 0 and l for the special case of p being distributed over the whole span, they further change both into $\frac{l^4}{4}p$, and the equations (17) are written as follows :—

$$\left.\begin{aligned} y_1 &= \frac{l^2}{6EJ}\left[\frac{pl^2}{4} - 2M_1 - M_2\right] \\ y_2 &= \frac{l^2}{6EJ}\left[\frac{pl^2}{4} - M_1 - 2M_2\right] \end{aligned}\right\} \quad . \quad . \quad (18)$$

In this form they were first stated by Clapeyron, and still are commonly used for the calculation of continuous girder bridges. The two equations (17) or (18) contain together four unknown quantities. For a continuous girder of n spans we should have, therefore, 2 n equations with 4 n unknown quantities. But the tangents $\frac{y}{l}$, as well as the moments M, are common to the two spans adjoining each intermediate support, and as there are $n-1$ such supports, the number of unknown quantities is reduced to $4n - 2(n-1) = 2n+2$. Further, if the girder is rigidly fixed at the two ends, the two tangents $\frac{y}{l}$ at these points are known, or if it can turn freely on the ends, the moments at these points are = 0. In both cases the number of unknown quantities is reduced to 2 n, and as there are 2 n equations, they can be calculated. If any support is artificially, or, by being elastic, raised or lowered, the amount of movement is simply to be added to or deducted from those pieces y which are affected by that movement.

It may be observed that for the special case where $y_1 = y_2 = 0$, *i.e.*, for the case of a horizontal beam rigidly fixed at its ends, equations (17) will give :

$$M_1 = \frac{a}{l^2}(l-a)^2 P$$

$$M_2 = \frac{a^2}{l^2}(l-a) P,$$

and equations (18) would give—

$$M_1 = M_2 = \frac{pl^2}{12}.$$

From the former two we further find that M_1 becomes a maximum if

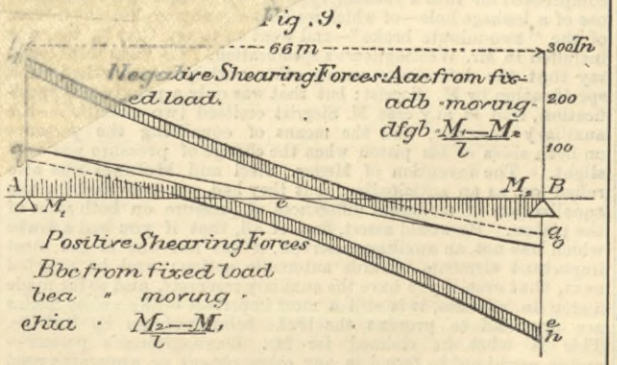
$$\frac{d}{da}\frac{a}{l^2}(l-a)^2 P = 0, \text{ or } a = \tfrac{1}{3}l$$

and M_2 becomes a maximum if

$$\frac{d}{da}\frac{a^2}{l^2}(l-a) P = 0, \text{ or } a = \tfrac{2}{3}l.$$

The shearing force at any point between A and B from the moment M_1 is $-\frac{M_1}{l}$, and from the moment M_2 it is $+\frac{M_2}{l}$, or from both together $\frac{M_2 - M_1}{l}$. The shearing force from the load P at a point at a distance x from A is $-\frac{P(l-x)}{l}$ if $x < a$ and $+\frac{Pa}{l}$ if $x > a$. These are the same shearing forces as those acting in a single girder; for the continuous girder the value of $\frac{M_2 - M_1}{l}$ has only to be added. If a distributed load p per unit of length moves over the girder, it is known from the treatment of the single girder that the greatest positive shearing force at a point x from A, is $p\frac{x^2}{2l}$, and the greatest negative shearing force is $p\frac{(l-x)^2}{2l}$. The shearing force from an equally distributed load q per unit of length is $q\left(x - \frac{l}{2}\right)$.

Fig. 9.



The latter expression is represented by the ordinates of the straight line $a\,c\,b$ in Fig. 9, measured from A B, l being = 66 and $q = 2{\cdot}9$; the former two expressions are represented by the ordinates of the two parabolas $d\,b$ and $a\,e$ measured from $a\,c\,b$, p being = 5. The two ordinates together at any point would be the maximum shearing force in a single girder. Considering now, for example, this girder to be the second span of a continuous girder of four spans, viz.: 56m., 66m., 66m., 56m., it would be necessary to add to the ordinates already determined the values of $\frac{M_1 - M_2}{l}$; but as these are not constant, but varying according to the position of the moving load, not only in the span A B, but also on the other spans, it would be necessary to calculate $\frac{M_1 - M_2}{l}$ for a series of positions of the load, having regard to such positions of the load in the other spans as make those values maxima. In most practical cases a sufficient approximation will be attained if only those values of $\frac{M_1 - M_2}{l}$ are calculated which correspond to the two extreme positions of the load on span A B, viz., to $x = o$ and $x = l$, and if the intermediate values are assumed to vary in the proportion of x. The ordinates of the curves $f\,g$—measured from $d\,b$—and $h\,i$—measured from $a\,e$—which indicate these values, are taken from the calculation of a bridge of the dimensions given above.

Example 6.—Let A B and B C be two adjoining spans of a continuous beam of uniform section, resting on $n+1$ supports, at distances $l_1\ l_2 \ldots\ldots l_a\ l_b \ldots\ldots l_n$; let $M_a\ M_b\ M_c$ be moments over A B C produced by the action of a moment at one end of the beam. Then the moment at any point in A B at the distance x from A is

$$M_a\frac{l_a - x}{l_a} + M_b\frac{x}{l_a},$$

and the moment at any point in C B at the distance x from C is

$$M_c\frac{l_b - x}{l_b} + M_b\frac{x}{l_b}.$$

We now imagine the elastic line of the beam to be drawn, and draw a tangent to it at B, which cuts off the distances d_a and d_c on the verticals through A and C. Considering, then, A B as a cantilever fixed at B, we have

$$EJ\,d_a = \int_0^{l_a} M_a\frac{l_a - x}{l_a}\,x\,dx + \int_0^{l_a} M_b\frac{x^2}{l}\,dx =$$

$$\frac{1}{6}(M_a l_a^2 + 2M_b l_a^2);$$

and considering C B as a cantilever fixed at B, we have, in the same manner,

$$EJ\,d_c = -\frac{1}{6}(M_c l_b^2 + 2M_b l_b^2);$$

and since

$$d_a = d_c\frac{l_a}{l_b},$$

$$M_a l_a^2 + 2M_b l_a^2 = (-2M_b l_b^2 - M_c l_b^2)\frac{l_a}{l_b}$$

$$M_a l_a^2 = -2M_b(l_a^2 + l_a l_b) - M_c l_a l_b.$$

Accordingly, we write :

$$M_1 l_1^2 = -2M_2(l_1^2 + l_1 l_2) - M_3 l_1 l_2$$
$$M_2 l_2^2 = -2M_3(l_2^2 + l_2 l_3) - M_4 l_2 l_3$$
$$\vdots \qquad \vdots \qquad \vdots$$
$$M_{n-1} l_{n-1}^2 = -2M_n(l_{n-1}^2 + l_{n-1} l_n) - M_{n+1} l_{n-1} l_n.$$

If the beam can turn freely over the first support so that $M_1 = 0$, and if all the spans are $= l$, we find :

$M_3 = -4M_2$; $M_4 = -3\frac{3}{4}M_3$; $M_5 = -3\frac{11}{15}M_4$; $M_6 = -3\frac{11}{30}M_5$; $M_7 = -3\frac{23}{209}M_6$, &c.

In each span, therefore, is a point at a distance of $\frac{1}{5}l$ to about $\frac{1}{4}\frac{1}{7}l$ from the left, where the moment is = 0, or where the moment which may have been there previously is not altered by the action of a moment at the right-hand end of the beam; and there is another point in each span in a nearly symmetrical position, in consequence of a moment acting at the left-hand support. These points are called *fixed points.*

LEGAL INTELLIGENCE.

JUDICIAL COMMITTEE OF THE PRIVY COUNCIL.

(*Present*—Lord FITZGERALD, Sir BARNES PEACOCK, Sir ROBERT COLLIER, Sir RICHARD COUCH, *and* Sir ARTHUR HOBHOUSE.)

CHILDS' PATENT.

THIS was a petition by Major James Childs, late of the 3rd Battalion Royal Fusiliers, of Cedar Lea, Clapham Common, for the prolongation of the term of letters patent granted to him on the 7th of December, 1869, in respect of improvements in the manufacture of bread and biscuits.

Mr. ASTON, Q.C., Mr. E. CARPMAEL, and Mr. R. R. HARRIS were counsel for the petitioner; the ATTORNEY-GENERAL and Mr. R. S. Wright for the Crown.

The petition stated that the invention in question had relation to improvements in the manufacture of aërated bread, and was based on the system first proposed and invented by Dr. Dauglish. In that system the carbonic acid gas used in the aërated bread-making was forced into water in much the same way as in making ordinary soda-water, and the water so charged was then mixed with the dough. But in order to make the water absorb a sufficient quantity of the gas great pressure was necessary, which not only required very costly machinery, but when the dough was released from the vessel in which it was mixed, as it had to be in order to be formed into loaves, the gas, instead of rising gradually and producing a series of air chambers or vesicles in the dough, and thus making it to rise or become light, had a tendency to burst these vesicles and allow the mass to continue heavy and dough-like. Again, it was found that the starch in the flour remained quite unconverted. Starch in that condition absorbed and retained a large percentage of water, which rendered it necessary to employ a very high and unusual temperature to bake the bread, otherwise it became what is known as "cold" or "sad." A third objection, and one which arose from the same cause, was that aerated bread was extremely difficult to toast, and when toasted the result was not satisfactory. These objections proved fatal to the commercial success of Dr. Dauglish's system, and although at first the operations of some of the licensees of Dr. Dauglish, and the companies, of which there were several started to work his invention, gave promise of yielding a good return to those who had invested time and money in them, yet in the result, owing mainly to these objections and the losses occasioned to the persons and companies who endeavoured to use the invention, all persons who had taken out licences had ceased to work out the aërated bread process at the time the petitioner made his invention, and all the companies had suspended operations, except the Aërated Bread Company, Limited, in which concern Major Childs was a large shareholder. According to the inventor, the patent provided that, in place of water, a fermented liquid should be placed in the condenser, which was then charged with gas. By that means the serious defect caused by the bursting of the numerous small vesicles, resulting in the bread being heavy, was obviated. All the different parts of the process conduced to the conversion of the starch in the dough into dextrine, whereby the bread could be more perfectly baked and rendered more palatable

and nutritious. The process, also, had the advantage of largely reducing the cost of production. It was claimed for the invention that by it aërated bread was manufactured with perfect regularity and certainty—waste and deterioration being entirely avoided, and the most perfect cleanliness secured, as in every step of the manufacture machinery was substituted for hand labour, and the flour passed from the sack into the baked loaf without being once touched by the hand, the whole process of mixing the flour and kneading the dough being completed in half an hour, instead of ten to twelve hours, as in the ordinary process. The aërated bread thus made was highly nutritious, and more easy of digestion than ordinary bread, the gluten being preserved, and the bread was free from the ferment or leaven which was necessarily present in other bread, and proved in many cases injurious to health. Not only was great economy in the manufacture of aërated bread effected by the improvements of the petitioner, but the system was so greatly improved that it could be put in practice by bakers in a small way of business with the expenditure of a small amount of capital for plant. Down to 1873 Major Childs failed in his endeavour to get his invention fairly worked, but in that year he became chairman of the Aërated Bread Company, Limited, and lent them the patent so long as he remained in that capacity. It was not till 1881 that a large central manufactory was started in London for the making of the bread, which since that time had been gaining in public favour. Owing to these causes and others, the petitioner asserted that he had not hitherto received any adequate remuneration from his invention, but that now that the patent was becoming better understood and recognised, he had reasonable grounds, if the term were prolonged, that he would at length receive commensurate return for his invention, and the time and trouble and outlay expended upon it.

Major Childs, the petitioner, was called in support of his application, and was examined as to the profits he had made through the invention. He received a salary of £600 a year as chairman and managing director of the company, which was now paying 8 per cent. He held 12,000 shares in the concern.

Sir Frederick Abel, C.B., consulting chemist to the War-office, and President of the Society of Chemical Industry, was called, and spoke highly of the merits of the invention as obviating the defects which existed in the ordinary way of making bread by hand. It produced pure nutritious bread.

Mr. R. S. Wright, on the part of the Crown, said he was instructed to say that, after the evidence of Sir F. Abel, he should not dispute that the invention was a meritorious one. The real question was whether the patentee had been sufficiently remunerated, and on this point the learned counsel estimated the profit made by the inventor, including the rise in the value of his shores, to amount to between £20,000 and £30,000.

Their Lordships, in giving judgment, said they were satisfied that the invention was one of considerable merit. The remaining question was whether the patentee had been sufficiently remunerated. Upon that point their lordships had some difficulty. The petitioner certainly appeared to have made during the last few years some profit, and an increasing profit, but the accounts were not so clear as they might be. Their lordships had come to the conclusion that, considering the merits of the invention, the patentee had not been sufficiently remunerated, and they would, therefore, humbly advise her Majesty to grant a prolongation of the patent for five years. They did not think the Crown had such interest in the patent as to require the insertion of the usual saving clauses.

HIGH COURT OF JUSTICE.—QUEEN'S BENCH DIVISION.

Before Mr. Justice Denman *and a Special Jury.*

WESTINGHOUSE *v.* THE LANCASHIRE AND YORKSHIRE RAILWAY COMPANY.

On Monday this important patent case commenced. The counsel for the plaintiff are the Solicitor-General, Q.C., Mr. Aston, Q.C., Mr. Horace Davey, Q.C., and Mr. Chadwyck Healey. The counsel for the defendants are Mr. Webster, Q.C. and Mr. Moulton. A great deal of interest is taken in this case by railway men, and the locomotive superintendents of all the leading lines almost without exception were in Court. Among the expert witnesses to be called may be named Sir F. J. Bramwell, Mr. Cowper, Dr. Hopkinson, Dr. Pole, Mr. Imray, &c.

The action is brought against the Lancashire and Yorkshire Railway Company by Mr. George Westinghouse, who asserts that the railway company is using an automatic vacuum brake, which is an infringement of the Westinghouse automatic brake in two principal respects, namely, as regards the use of a "heavy valve," through which the reservoir under each carriage is "charged," and by means of which compensation can be made for accidental leakage in the train pipe, and, secondly, as regards the arrangement of "rigging," that is of the levers and trusses by which the brake blocks are actually applied to the wheels of the train.

The defendants plead that their apparatus does not infringe the plaintiff's patents, and that the plaintiff's patents are void by anticipation. To make what follows intelligible it will be well to state here that under the existing law if any one claim in a patent is proved to be invalid, all the other claims fall to the ground with it. Thus it is only necessary for the defendants to prove that one of Mr. Westinghouse's claims is bad, to vitiate the particular patent granted for that and other claims.

The pleadings having been opened by Mr. Chadwyck Healey,

The Solicitor-General addressed the Court for the plaintiff in an able speech which occupied nearly two hours in the delivery. He began by explaining to the jury what was the original position of the brake question before continuous brakes came into use, pointing out that the stoppage of a train as far as brakes were concerned, depended on a brake on the engine or tender, and another on the guard's van, or vans. He then went on to explain the conditions which a good brake should fulfil, such as automatic action, promptness, applicability to the whole train, and so on. He said much, indeed, necessary to instruct a jury, which we need not repeat here, for to do so would only be to tell our readers what they are quite familiar with already. On one point he dwelt at some length. In the working out of an automatic system it is necessary to take precautions to prevent the brake from going on when it is not wanted. The jury would see that unless this danger were guarded against we might have a very improved brake system, yet a very imperfect one. Of course, if we create a system which allows of an automatic action we must take care that it does not act of itself when we do not want it to act, and great care must be taken that the brake does not go on when it is not wanted. The reason why he insisted on this point is, that to prevent an automatic brake from going on of itself as a result of leakage in the train pipe, &c., a valve or its equivalent must be provided; and it is alleged that the valve used by the Lancashire and Yorkshire Railway Company for the purpose is similar to that used by the plaintiff with the same object. Concerning this valve a great deal, it will be seen, was said. The Solicitor-General next proceeded to explain that Mr. Westinghouse had given perfection to his brake by a series of steps, and by a great many steps. A great many patents had been taken out for one improvement after another, as is always the case. Probably the more excellent a system the greater the number of improvements. Consequently, many patents had been taken out by Mr. Westinghouse. But he would not have to trouble the jury with many of these, because his anxiety would be to make this case as clear and simple as he possibly could. He would state that when this action was commenced against the defendants a number of infringements were charged of a number of patents. At that time they were not aware of exactly what the defendants were doing, although they knew, and in some respects they were satisfied, that their patents were being infringed, yet the exact facts as to what they were doing were not within the knowledge of the plaintiff. However, a complete inspection was procured of all the defendants were doing, and the result of that inspection was to satisfy the plaintiff that as regards some of the suggestions of infringements which were in the first instance made, although they had believed them to be going on, they were not going on, and therefore, of course these were abandoned; and as regards the others, to avoid complicating the case and prolonging its length, it was deemed more expedient in the interests of both parties not to go into them. Therefore, in the present action the question was reduced to a question in regard to two patents, viz., patent No. 3840 of 1873, and No. 1540 of 1874, dated respectively 25th of November and 1st of May. Although the patent first in order of date was that of November, 1873, he thought it would add to the simplicity of the case if he took the later patent first. He then proceeded to describe the main system of Westinghouse, and although this system is quite familiar to most railway men, it may be worth while to enable such of our readers as are not versed in brakes to understand this case, to explain what the system is, and this we do nearly in the words of the Solicitor-General. Mr. Westinghouse fits to the engine a compressing pump and a reservoir. The air passes under pressure from this reservoir into a pipe which runs from one end of the train to the other, and is known as the train pipe. Under each carriage, and in connection with this train pipe, is fixed a small reservoir, which becomes filled with compressed air from the train pipe. This is known as the auxiliary reservoir. There is also provided a cylinder in which a piston works, and the rod of this piston is attached to the brake rigging, and puts the brake on or takes it off. The Solicitor-General used a section model to illustrate this.

In order that the reservoir may be filled a passage is provided in the piston, and in this is placed a valve, the use of which forms one of the questions to be decided by this action. So long as the pressure in the train pipe and in the auxiliary reservoir is the same, the brakes are not applied to the wheels. If, now, the pressure in the train pipe is reduced the piston is no longer in equilibrium, and the excess pressure of the air in the auxiliary reservoir forces the brakes against the wheels. This diminution of pressure in the train pipe may be brought about in four ways. First, by opening a tap on the engine; secondly, by opening a tap in a guards' van; thirdly, by the giving way of the train pipe, or of one of the sections of hose by which its lengths are coupled up, as, for example, when a train is broken in two by the failure of a draw-bar; and, lastly, by leakage in the train pipe, its joints or couplings. If the last were not provided for, as it is simply impossible to make the joints quite air-tight, the brake would "leak on" when the train had run a few miles. To guard against this the valve is used. This valve remains off its seat while the difference in pressure between the train pipe and the auxiliary reservoir is small, and the result is that it is impossible for the pressure to be greater on one side of the piston than the other as a result of moderate leakage. If, however, there is a sudden and considerable escape of air from the train pipe, then the force of the rush of air is sufficient to close the valve on to its seat, and prevent the further equalisation of pressure on both sides of the piston, and so the brakes are applied. It will be seen that this valve is essential to any automatic brake, unless, indeed, its equivalent, a small hole, is used; but in this case, the auxiliary reservoir will empty itself by degrees, and the brake will after a time come off. Such a brake is in use on one railway, and is known as the "two-minute" brake, because it leaks off in about that time. When a valve is used the brake will remain on for an indefinite time. It will be understood, then, that by the use of the valve in question, called by the plaintiffs a "heavy valve," the brakes cannot be put on by leakage alone. There must first be a sudden and considerable difference created between the pressure on the train pipe and that in the auxiliary reservoir.

So far we have dealt entirely with pressure brakes, but it will be seen, and the Solicitor-General carefully explained to the jury, that all that applies to this system, if worked with compressed air, applies equally to it if a vacuum be employed, only everything will be reversed. The auxiliary reservoirs will be partially exhausted, instead of being filled with condensed air. The same of the train pipes. In order to put the brakes on we admit air to the train pipe instead of letting it out, and the air may be admitted in four ways, namely, by taps on the engines and in the guards' vans, by breakage of the apparatus, or by leakage into the train pipe; and to guard against the effects of this it is necessary or expedient to employ a valve, which remains off its seat until there is a sudden difference of pressure caused. Thus it will be seen that all that applies to the well-known Westinghouse pressure brake may apply equally to a vacuum brake, such as that used by the defendants. Indeed, the Solicitor-General pointed out that Mr. Westinghouse has distinctly claimed the use of a vacuum. For he says in the specification under the patent of 1874, "In what has preceded I have described the nature of my improvements as applied to brake apparatus worked by the pressure of a fluid, as, for example, compressed air, when such pressure exceeds that of the external atmosphere. The improvements which I have described are, however, applicable, with various obvious modifications, in cases where the power is communicated throughout the train by the exhaustion of the air." The jury could see—pointed out the Solicitor-General—that there was no sort of difference in principle or even in substantial detail between working this system with compressed air greater than the force of the atmosphere by forcing it in and then letting it out, and by creating a condition of things in which the air is exhausted, and more or less of a vacuum is created, and then air is let in. They would see further that Mr. Westinghouse distinctly in his specification claimed the combination which is the essence of the invention, as applied to both these systems, the pressure and the vacuum.

Having sufficiently explained the Westinghouse brake, the Solicitor-General proceeded to show what the defendants do; nominally they were the railway company, really the Vacuum Brake Company. This company had in its apparatus all the parts of the Westinghouse brake, the cylinder, the auxiliary reservoir, &c. It had also a valve of such a sort that if there is only a slight difference of pressure air can pass round it. In all respects it was precisely Mr. Westinghouse's invention, with the obvious modification, which he pointed out, required for turning the compressed air into a vacuum system. He then referred to the use of a leakage hole—of which we have already spoken in the case of the "two-minute brake"—and went on to say that it, too, was included in Mr. Westinghouse's specification. He then went on to say that the defendants, among other anticipations, relied on a specification by M. Siegrist; but that was only a provisional specification, and in any case M. Siegrist omitted two essentials—the auxiliary reservoir, and the means of equalising the pressure on both sides of his piston when the change of pressure was only slight. The invention of Messrs. Steel and McInnes was also relied on as an anticipation; but they had not provided for the equalisation of moderate differences of pressure on both sides of the piston. He would assert, first of all, that if you had a brake which has not an auxiliary reservoir, it has not one of the most important elements towards automatic action; and he asserted next, that even if you have the auxiliary reservoir, and so far made a step in advance, it is still a most imperfect brake unless means are provided to prevent the brake being put on by leakage. This is what he claimed for Mr. Westinghouse's patent—and it could not be found in any other patent or apparatus used by any one else. He might add that about 50,000 Westinghouse brakes had been fitted to carriages and about 10,000 to engines. The defendants, he understood, were going to say, "even if we grant that this invention of yours is new and that we have infringed it, and therefore are *prima fâcie* liable, we will take your patent and show quite apart from that being very new and being infringed, you patented certain other things; we will show that these are old, and therefore the patent is bad," and in respect of each of these pleas are adduced a great number of patents. He would be prepared to meet such objections as they arose. He next came to the matter of the patent No. 3840, 1873. Complaint was made of the infringement of two of the clauses—the second and fourth. The first of these is for the use of a loaded valve in the manner described. As, however, there are some doubts as to whether the defendants did infringe on this claim, plaintiff had come to the conclusion to abandon action on this point, and would they confine themselves to the fourth clause, namely, the "combination of the guided brake levers A^2 with the diagonal and cross ties G and D^1, and the brake beds D arranged and operating substantially as herein described." This claim refers to what is known as "brake rigging," namely, the system of levers by which the blocks are applied with an equally distributed pressure against all the wheels of a coach. The Solicitor-General explained to the jury at great length, and by the aid of models, what he claimed as the invention of the plaintiff, and the infringement of the defendant.

Mr. John Imray was the first witness sworn. He was examined by Mr. Chadwyck Healey, and gave evidence in favour of the plaintiff. It would be impossible within the limits at our command to give his evidence, which extended over the greater part of two days, *in extenso*. It must for the present suffice to say that he regarded the brake of the defendant as identical with that of the plaintiff.

Mr. Imray was cross-examined by Mr. Webster. He admitted that some of the parts referred to in Specification 1540 were to be found in earlier patents, but there was nothing in these that showed the working of a cylinder like that shown in Fig. 3. A good deal turned on the V-shaped rib, and it was also urged that the loaded valve having two faces would not act.

The next witness examined was Dr. Hopkinson, who also was cross-examined at considerable length.

To make the nature of this complicated case as clear as we can to our readers, we give *fac-similes* of the patent drawings referred to, with extracts from the specifications. The following is taken from No. 3840, 1873:—"The improved arrangement of the brakes with their levers and connecting parts is shown in Figs. 1, 2, and 3. The brake rod A^1 takes hold of a lever A^2, which is bent, so that it can work clear of the axle. On its upper end is a roller *a* free to run in a staple bracket a^1 secured to the carriage frame. The lower part of the lever A^2 is at two points connected by diagonal ties G to the beds D of the brake blocks, which beds are connected by cross ties D^1. It will be seen that when the rod A^1 is pulled the lever A^2 is canted, so as to cause the brake blocks on both sides of each wheel to press equally thereon, the movement of the lever A^2 being guided by its roller *a* running in the slot of the bracket a^1. This arrangement permits of the respective parts being made alike in dimensions, so that one can replace another without trouble in adjustment."

The claim alleged to be infringed is the 4th, and runs as follows:—"The combination of the guided brake levers A^2 with the diagonal and cross ties G and D^1 and the brake beds D, arranged and operating substantially as herein described in reference to the figures on the accompanying drawings."

As regards patent 1540, of 1874, infringement is alleged as regards Fig. 3. The specification runs as follows, as far as refers to this engraving, with which alone we have to do.

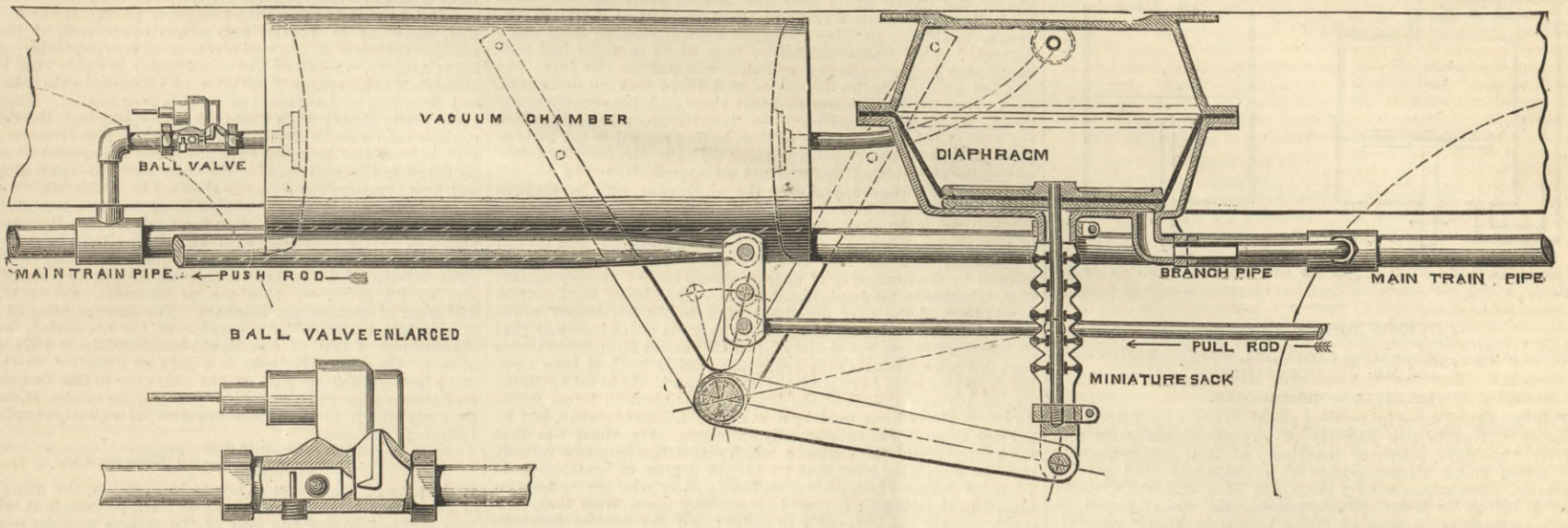
"According to another of my present improvements I connect one end of the brake cylinder to the communicating pipes, and the other end to the auxiliary reservoir, applying to the brake piston and its rod suitable packing, and providing against the waste of fluid by leakage when the brakes are off. The piston of the brake cylinder is made with an annular V-shaped rib upon one face of it, which rib, when the piston is at the extreme of its stroke, the brakes being then off, seats against a ring of caoutchouc or other yielding packing fixed on the cylinder cover, and thereby prevents any escape of fluid from the cylinder round the piston rod while the brakes are inert. It is obvious that the rib may be formed on the cylinder cover and the packing fixed on the face of the piston. For packing the piston rod a cup leather may be employed. I prefer, however, instead of passing the piston rod through a stuffing-box, to provide at the end of the main brake cylinder, and with its axis in the same line, a cylinder of smaller diameter fitted with a piston fixed on the main piston rod, such piston being packed with a cup leather. To prevent the brakes from being put on when it is not required, I arrange in a branch from the communicating pipe to the auxiliary reservoir, or in the brake piston, an escape valve of the kind described in the specification to the patent, No. 3840, of 1873, referred to above—that is to say, a valve in a case with a seating above and below, the valve being loaded with an adjustable weight or spring, so that when the pressure on its lower face is moderately increased it merely rises and permits fluid to pass it and issue by the opposite opening; but when the pressure on its lower face is suddenly or considerably increased the valve is so far raised in opposition to the weight or spring as to close the opposite opening. By the use of such a valve on a slight or gradual reduction of pressure in the pipes fluid can pass from the auxiliary reservoir to these pipes, and the pressure on both sides of the brake piston being thus equalised the brakes remain off; but on the pressure in the pipes being suddenly or considerably reduced the valve is closed against the upper seat, and the brake piston being subjected to the excess of pressure subsisting in the auxiliary reservoir is moved so as to put on the brakes. Fig. 3 represents a brake cylinder arranged as described above. The main piston F has an elastic facing *f*, which being pressed against a V-shaped rib on the cylinder cover prevents leakage. The pipe C branches from the pipes communicating through the train, and the pipe G communicates with the auxiliary reservoir on the brake carriage. It will be seen that while the pressure in the pipe C is equal to that in G, or nearly so, the piston F is kept in the position shown in Fig. 3, the brakes then being off. But if the pressure in C be suddenly reduced, then the pressure in the auxiliary reservoir, communicated through G, forces back the piston, and causes the brakes to be put on. On again charging the pipe C the piston being forced forward takes off the brakes. A passage *b* leading to an escape valve B permits the passage of air from the auxiliary reservoir when the pressure therein slightly exceeds that in the pipe C; but on the pressure in the latter being suddenly reduced for the purpose of applying the brakes the valve B closes. By this arrangement the auxiliary reservoirs can be charged directly from the pipe C past the cup leather of the brake piston, or through a valve or small hole provided in that piston, the brakes being kept off by the pressure acting on the small piston of the rod. But when the pressure in the pipes is suddenly reduced the greater pressure subsisting in the auxiliary reservoir moves the piston and causes the brakes to be put on. On again charging the pipes the pressure on both sides of the main piston becoming equalised, the pressure on the small piston will cause the brakes to be taken off and the main piston to seat its rib against the packing on the cylinder cover, so as to make a tight joint against leakage."

The claims of the specification run:—"(1) The use, in combination with the pipes for communicating the fluid pressure and with the triple valve box and escape valve, of a four-way cock, whereby the fluid pressure can be made to work the brakes either directly from the communicating pipes or from the auxiliary reservoirs, or whereby the whole brake apparatus of a carriage or carriages can be cut off from communication, substantially as herein described. (2) The method of constructing and working a brake cylinder, substantially as herein described in reference to Fig. 3 on Sheet 1 of the accompanying drawings. (3) The use, for coupling on a train the pipes communicating fluid pressure for operating brakes or signals, of couplings constructed substantially as herein described in reference to Figs. 4, 5, 6, 7, and 8 on Sheet 1 of the accompanying drawings. (4) The use of brake gear consisting of two cam-shaped or excentric segments connected to a vertical brake cylinder and pivotted on side rods which are jointed to the rod of the brake piston and to the brake rods, the said gear constructed and operating substantially as herein described in reference to Figs. 9, 10, 11, and 12 on Sheet 2 of the accompanying drawings. (5) The use for working the brakes of a pair of wheels of a lever, one arm of which is moved by the brake rod, and the other arm is jointed to a truss connecting the two brakes, the fulcrum of the lever being supported by a truss from the carriage frame, substantially as herein described in reference to Figs. 13 and 14, on Sheet

2 of the accompanying drawings." We have already said that if it can be shown that one portion of a patent is invalid, the whole is invalid. The defendants allege that the fourth claim given above and several of the others are invalid. The engraving, Fig. 11, No. 1540, illustrates it. The specification says :

"In the specifications above referred to were described means of hanging and fitting the brake blocks, and arranging their connections to the brake pistons in such manner as to equalise or proportion the pressure on the different wheels, to take up slack due to wear or looseness of joints, and to render the advance of the brake blocks towards the wheels rapid in the first instance, and more slow and gradual as they came to bear on the wheels. Part of my present invention relates to improvements in the arrangement of the brake cylinder and their connections to the brakes, so as to retain the results mentioned above in a more simple and effectual manner, and to dispense with springs for taking off the brakes. For this purpose I place the brake cylinder in a vertical position, with its piston-rod projecting upwards, and carrying a crosshead from which two side rods extend downwards, one on each side of the cylinder. To these side rods are jointed the brake rods, extending towards the brake blocks of the wheels in each direction, and on each of the side rods is jointed an excentric or cam-shaped segment, which is also connected by a rod to the cylinder bottom, or to the framing of the carriage above it. The curved edges of piston. When this arrangement is applied to work the brakes of several pairs of wheels, the brake rods, instead of being jointed directly to the side rods, are jointed to the ends of equal armed levers or sway beams, pivotted on those side rods, so that each brake rod is subjected to an equal strain. Or when it is desired that one pair of the brake blocks should be pressed with greater or less force against their wheels than another pair—as in the case where one pair of wheels carries a greater or less load than another pair—the arms of the sway beams are respectively proportioned so as to give to each rod the desired proportion of strain. The brake rods extending from the side rods or sway beam are at their farther ends hung by radius bars from the carriage framing. The beds on which the brake blocks are fitted are likewise hung by separate radius rods from the carriage frame, the beds being jointed to their hanging rods by pins at the lower end of the beds. These beds have on their back edges slotted holes in which engage T heads at the ends of the brake rods, so that when these rods are moved the brake blocks are moved with them. For removing a brake it is only necessary to take out the pin by which the bed is jointed to its hanger, and to disengage the slotted hole of the bed from the T head of the rod which remains suspended by its own hanger. Fig. 9 represents respectively a side view of the under framing of a carriage with the brake gear arranged in this manner, and Figs. 11 and 12 represent respectively a side view and an end view of this brake gear to an enlarged scale. L are the vertical brake cylinders, one on each side of the carriage; *l* are the side rods jointed to the piston rods at their upper ends, and to the brake rods M at their lower ends. On each side rod is mounted an excentric or cam-shaped segment N connected by a rod *n* to the cylinder bottom, the peripheries of the segments N touching each other. When the piston in the cylinder L is raised the side rods *l* are also raised, whereby the segments N are caused to roll on each other, expanding the side rods owing to their excentricity, and thereby causing the brake blocks O to be pressed against the wheels. When the pistons in the cylinders L are relieved of pressure, the weight of them and of the side rods, segments, and brake rods cause them to descend, and thereby to take off the brakes. The cam faces of the segments N may obviously be so formed as to give a considerable travel with little force to the brake rods in the first part of their stroke before the brakes reach the wheels, and then to give them a short travel with increased force while the blocks are being pressed on the wheels. The brake rods M are hung by radius bars *m* from the carriage frame, and the beds O on which the brake blocks are fitted are hung by separate radius rods *o* jointed to the lower parts of the beds. When the above described arrangement of brake gear is employed the communicating pipe C, triple valve box P, with its four-way cock and the auxiliary reservoir R, may be conveniently arranged with the necessary branch pipes, as shown."

The brake alleged by the plaintiff to be an infringement as fitted on the Lancashire and Yorkshire Railway is shown in the accompanying engraving, and is thus described by the Vacuum Brake Company :—"By means of a small ejector placed upon the engine, the air is drawn out of the main train pipe from the bottom side of diaphragm through the branch pipe, and also from the top of diaphragm through the vacuum chamber and ball valve, so that in running, a vacuum of 20in. to 24in. is maintained throughout the system. The brake is operated by a valve in connection with the main train pipe, which is opened by the driver or guard, allowing air to flow to the bottom side of diaphragm, thereby applying the brakes, the top side and vacuum chamber maintaining the vacuum through the action of the ball valve, which closes immediately air is admitted to the train pipe. In the event of a train parting, the 'Universal' hose couplings will without damage



VACUUM BRAKE, LANCASHIRE AND YORKSHIRE RAILWAY.

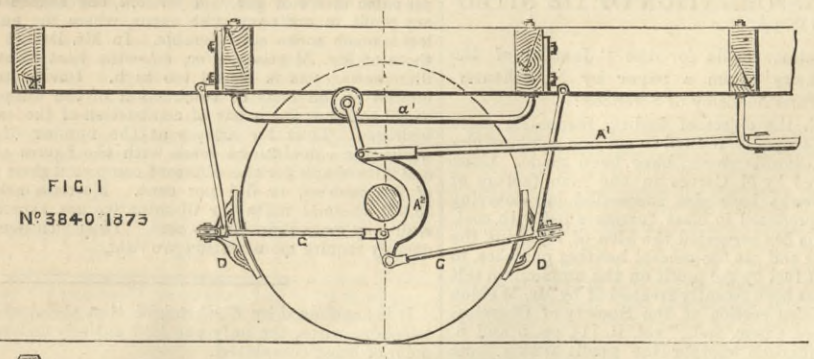


FIG. 1
Nº 3840 1873

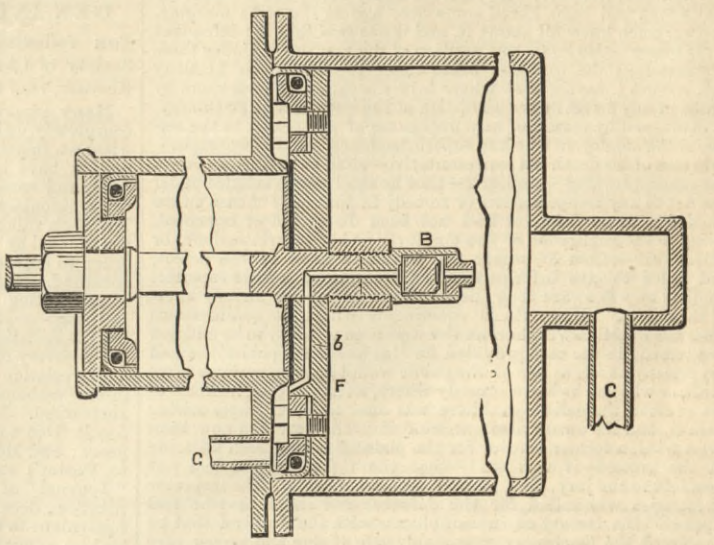


FIG. 3
Nº 1540. 1874

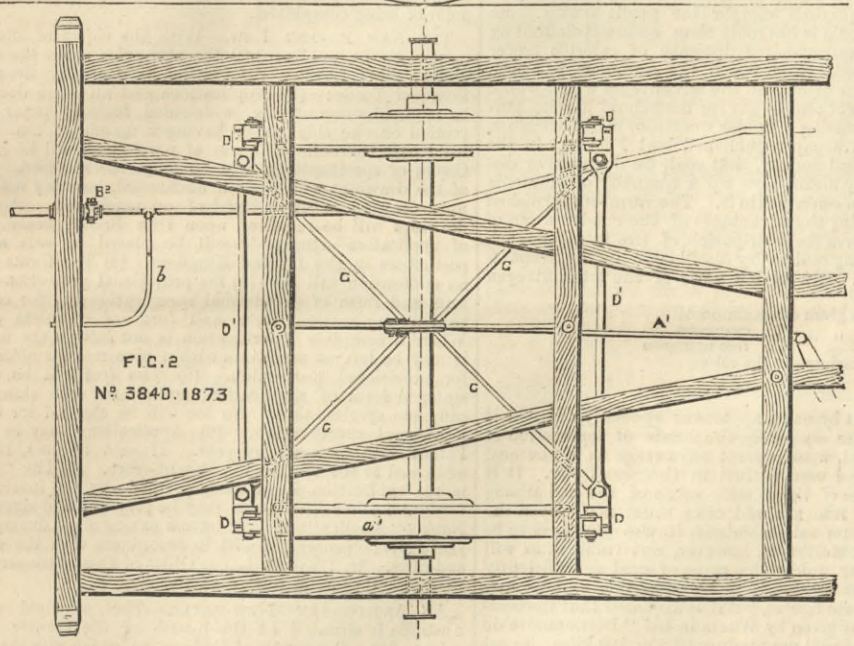


FIG. 2
Nº 3840. 1873

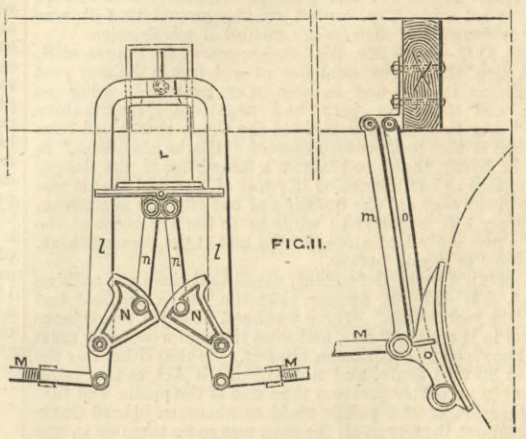


FIG. 11.

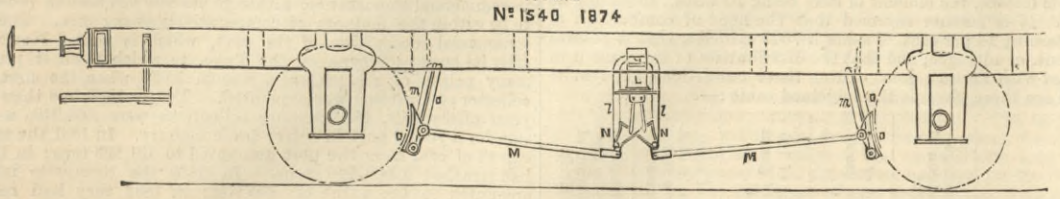
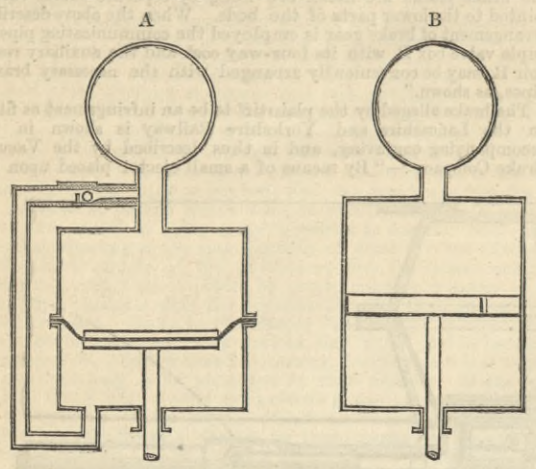


FIG. 9
Nº 1540 1874

the two segments are always in contact, and their excentricity is such, that as the piston-rod with its crosshead and side rods is raised by the action of the fluid pressure, the segments rolling on each other cause the side rods to separate more and more, and so to move the brake rods jointed to them, and put on the brakes. The curvature of the segments is preferably made such that during the first part of the movement of the piston, the separation of the side rods and the consequent movement of the brake blocks is rapid, while as the piston continues to ascend, the separation of the side rods and movement of the brakes become more slow and gradual. When the piston is relieved of pressure, its weight, with the weight of the crosshead and side rods, causes it to ascend and take off the brakes. The cylinder thus arranged is preferably made with a hollow, containing oil, on its lower cover, so that every time the piston descends to the bottom, its edge dips into the oil, whereby the cylinder is lubricated on the subsequent ascent of the

become detached, and the brakes immediately apply themselves. To release them, when the engine is detached from the train, the ball valve—by means of a small cord placed on either side of the carriage—is opened, which admits air to the vacuum chamber and top side of a diaphragm, thus restoring the equilibrium on both sides of diaphragm, under which conditions the brakes fall off by gravity. The flexible diaphragms, hose pipe connections, and miniature sacks, are made of the best rubber, and coated with a material which effectually resists oil and grease. A dummy is provided for the rear coupling. In simplicity, efficiency, and durability, this brake is unequalled by any other system, there being no parts exposed to friction, or requiring lubrication." For the purpose of argument, the defendants' system was reduced to a diagram form, shown in the accompanying sketch A. Another alleged infringement, in which the valve is replaced by a small hole or passage in the piston, is shown by the accompanying sketch

B. We have engraved the small equalising, or so-called "Heavy" ball valve, to an enlarged scale. Its action will be readily understood. While leakage is taking place it remains off its seat against the



pin stop; when the brak is put on the valve is blown on to its seat.

QUEEN'S BENCH DIVISION.

(*Sittings in Banc, before* Lord Coleridge, Mr. Justice Stephen, and Mr. Justice Mathew.)

MITCHELL *v.* HOLDSWORTH.

This case raised some interesting questions under the Employers' Liability Act as to the liability of owners, especially for any defects in the ways, plant, or machinery of their premises, and it had arisen under circumstances of a remarkable and painful character. The action was by the widow of a workman who had been killed under these circumstances. He was employed at working a machine, a part of which played backwards and forwards, and placed in a position so near a wall that the passages by which it could be passed were only 11in. or 12in. wide, and in going to borrow a key he wanted to work the machinery he had to pass the machinery, and he did so at a spot where the space between it and the wall was only 11in., so that even if he compressed himself to the utmost he could scarcely clear the machinery, and, in fact, he did not do so, and being caught by it, was in a moment drawn in and forced into a small space and instantly crushed to death. It appeared that there were two other passages at which he might possibly have passed; but which however, it was said, were almost as dangerous—one allowing only 12in. between the wall and the manchinery, and the other allowing no more than the one in question. It appeared also that part of the machinery projected over into the narrow opening, and a witness said this was dangerous. The machine, however, was in its ordinary state, and it appeared that a man had been killed some time ago at the same machine. The workmen knew all about it, and it was said that the defendant —the owner—also knew the position of the machine. Under these circumstances the question arose under the Employers' Liability Act, section 1, saying that where injury is caused to a workman by reason of any defect in the condition of the ways, works, machinery, or plant, and by reason of any negligence of any person in the service of the employers who has superintendence, &c., the workman—or in case of his death his representative—shall be entitled as one of the public, provided—section 2—that he shall not be entitled under the Act to any compensation or remedy in that class of case unless the defect arose from, or had not been discovered or remedied, owing to the negligence of the employer or his superintendent, or unless—sub-section 3—where the workman knew of the defect, and failed to give information to the employer or some superior, "unless he was aware that the employer or superior already knew of the defect." Upon these enactments with these qualifications arose the question whether, as the workman was only to be entitled to a remedy in the case provided for "as one of the public" he had any remedy at all, as one of the public would have no business there at all, or whether he had a remedy where, as in this case, he knew of the cause of the defect—a remedy where was one, and the danger arising from it, and the owner also knew of it. The case had now been twice tried, a former verdict for the plaintiff having been set aside on the ground—it was said—that the right question had not been left to the jury, and it had been tried again. The inspector of factories was called for the defence, and stated that he had "passed" the factory as in compliance with the Act, and that he considered the machinery reasonably safe if due and proper care were used in passing, though an engineer on the other side thought it dangerous, and the jury found that the owner knew of the danger. The defence on the part of the owner was that the disaster had occurred through the man's own fault, as the machine moved slowly, and there was time to pass it without being caught, and that at all events he knew of the danger. The Judge thought there was evidence of a defect in the way, though not in the machinery, and left it to the jury whether, on the whole, the workman—as one whom familiarity might naturally render the less conscious of danger—had been to blame for want of care. The jury in the result found for the plaintiff for £160. This was an application to set aside the verdict on the ground that it was against the evidence, and also on the ground of misdirection.

Mr. Wills, Q.C.—with Mr. Waugh—appeared for the plaintiff, and argued that there was evidence of a defect in the way past the machine, as it was not in any way protected—being so dangerous; and that the jury had negatived "contributory negligence." As to this he reminded the Court that it had been held long ago in the well-known case of "Clarke *v.* Holmes," in the Court of Error, that the plaintiff's knowledge of the danger was not sufficient to bar his action in point of law, and that it was only a fact in the case on the question of contributory negligence, which the jury had negatived; while as to the negligence of the defendant, a man's life had already been lost at the same machine, and it remained as it was before.

Mr. Channell, for the defendant, urged that there was nothing in the point, as it did not appear that the former accident had arisen from the same cause. There was here, he urged, no evidence of a "defect in the ways," &c., and even if there were so, it must have been known to the workman himself. So that either way the accident was his own fault, and not within the Act, as the workman was put in no better position than one of the public, and that in such a case one of the public could not recover. [Lord Coleridge pointed out that even if the man was to be taken as in the same position as one of the public, yet he had been invited and induced by the defendant to work upon his premises and about this machinery.] But still he knew all about it and was able to guard against it. It was true that the jury had negatived negligence in the man, but that was upon a very loose and incorrect direction upon that point, that he might have been by use and familiarity made careless of the danger. Still if it existed it must have been known to him, and the accident was in any view his own fault.

The arguments occupied a great part of yesterday, and at its conclusion,

The Court took time until Tuesday to consider their decision, and then pronounced it in favour of the plaintiff.

Lord Coleridge, in giving judgment to that effect, said some very interesting questions were raised in the case, on which it was not necessary to decide. For he put his decision on the short ground, so forcibly put by Mr. Wills, that this was an action grounded on negligence; that there was evidence of negligence; and that the jury negatived "contributory negligence" of the man himself. That injury had resulted from the negligence there could be no question. And if it had been an ordinary case there could have been no doubt upon it at all that the defendant would have been liable. Before the passing of the Act he would not have been liable — not upon the ground that he had not been negligent, but upon the ground that his negligence, by reason of judicial decision, did not give the workman an action against him, on account of the relation subsisting between them. But that exceptional state of the law — which had been created by judicial decisions of not very ancient date — had been taken away by the Act, which said, in effect, that the workman should have the same right of action against the employer for his negligence that one of the public would have had, neither more nor less, as if he had not been the servant of the defendant. Therefore the action would lie, and then the question was, whether there was a defence? That was a question of fact, whether there had been negligence in the workman, and that was put to the jury, and decided by them in his favour, so that there was no defence on that ground. Then it was said that there had been misdirection by the Judge as to what would be "contributory negligence" in the man, but he was not sure of that, having regard to the facts of the case, but he was disposed to think that the direction was substantially right. But this was not an appeal from the Judge's direction; it was an appeal upon the whole case, and he thought that it had been rightly decided for the plaintiff.

Mr. Justice Stephen said he was of the same opinion. A defect in the common law, he said, had been amended by the Act of Parliament, and the law, as thus amended, was that a person injured by the negligence of another should have a remedy against him, whether in his employment or not. That being so, the action would lie, and the only question was as to "contributory negligence" of the workman, of which the only evidence here was that he had knowledge, but the jury found that under the circumstances that did not constitute such negligence, and if he had been upon the jury he should have given the same finding. As to the summing up, it perhaps described the law on the subject in terms which would not have been used by a writer of a legal treatise, but he did not think it was substantially erroneous. Its effect was that the negligence of the workman which disentitles him to a remedy must be something more than that slight degree of inattention to a known danger which persons ordinarily show who are well accustomed to the danger; it must be something more than that, how much more it was impossible to define; and the precise language used was of no consequence, nor could the jury have been misled by it.

Mr. Justice Mathew was of the same opinion. The judgment was quite right, and must therefore be affirmed.

Mr. Channell asked for leave to appeal, but

Lord Coleridge said, with the concurrence of the other judges, why should this plaintiff be hung up for another year?

Mr. Channell said it was a decision of very wide application.

Lord Coleridge: That is true; but it rests on clear grounds, and there are no sufficient grounds for allowing an appeal.

ON THE DESTRUCTIVE DISTILLATION OF COAL, AND TRANSFORMATION OF ITS NITROGEN INTO AMMONIA.

The following is an abstract made for the "Journal of the Society of Chemical Industry" from a paper by M. Scheurer-Kestner, read before the Paris Academy of Sciences:—

Many experiments, with the object of finding means for more completely utilising the nitrogen contained in certain combustibles without impairing their calorific power, have been made. Good results have been achieved by M. Carvés in the manufacture of coke, and some English works have also succeeded in recovering the ammoniacal vapours produced in blast furnaces fed with coal. The high value of ammonia has suggested the idea of replacing the use of coal by that of coke and gas for general heating purposes, in order to reduce the cost of fuel by the profit on the ammonium salt obtained. This subject has been recently treated of by Mr. Weldon at a meeting of the London section of the Society of Chemical Industry—see "Journ. Soc. Chem. Ind.," vol. ii. [1], pp. 5 and 6. Still it remains an open question whether the profit arising from the recovery of the ammonia is not more than counterbalanced by a depreciation due to a corresponding decrease of calorific power in the carbonaceous material from which the ammonia has been abstracted. Mr. Davis has calculated the advantages which would result from a substitution of coal by gas for household heating purposes; and Morrison, discussing a similar question, called attention to Foster's statement in a paper published last February in the "Journal" of the Chemical Society, that coal, on destructive distillation, does not by any means give up a quantity of ammonia equivalent to the nitrogen contained in it. The numbers furnished by him admit of calculating the advantages of the condensation of the ammonia, since he gives the distribution of the nitrogen, such as takes place on subjecting coal to dry distillation in the preparation of illuminating gas. Out of 100 parts of the total nitrogen contained in the coal—

14·5	are given off	as ammonia
1·5	,, ,,	cyanogen
35·5	,, ,,	free nitrogen
49 0	remaining in the coke	
100·00		

The author considers that by using apparatus specially adapted it would be possible to utilise separately the heats of combustion of the gas and coke produced, with as great advantage as if the coal itself had been burnt and used as fuel in the usual way. It is obvious that the decrease of the calorific value of the coal arising from its transformation into gas and coke must not exceed the profit from the ammonium salts obtained, if the process is to be really profitable. This condition is, however, not fulfilled, as will be seen from the following, unless the price of coal is sufficiently low. As far as at present known, it is only possible to base any calculations on approximate figures, but it is assumed that the composition of coal gas is that given by Wurtz in his "Dictionnaire de Chimie." The amount of coal gas produced from 100 kilos. of coal is 28 cubic metres, the amount of coke being 70 kilos., including 20 of ashes. It is further assumed that the heat of combustion of coal containing 14 per cent. of ashes is 7500 calories, that it retains 1½ per cent. of nitrogen, and that the distribution of the same is in agreement with Foster's data. Given these conditions, the results obtained are those given in the subjoined table:—

	Percentage composition of gas.	Weight of one litre of gas at 0°.	Weight of 100 litres of gas at 0°.	Heat of combustion in cals. Favre and Silbermann.	Calories generated by the combustion of 100 litres.
Ethylene	3·8	1·254	4·765	11,858	56·503
Marsh gas	32·8	0·716	23·485	13,063	306·784
Carbonic oxide ..	12·9	1·254	16·176	2,403	38·870
Carbonic acid ..	0·3	1·977	0·573	—	—
Hydrogen	50·3	0·08958	4·496	34,600	155·561
	100·00		49·495		557·718

Hence 100 litres of illuminating gas generate on combustion 557·718 calories, and 1 kilo. would consequently develope

$$\left(\frac{557{\cdot}718\times1000}{49{\cdot}495}\right)=112{\cdot}68 \text{ calories.}$$

Now, since 1 kilo. of coal produces 280 litres, or 138·586 grms., of gas, it follows that the gas from 1 kilo. of coal would, on combustion, develope 1561·587 calories, *i.e.*,

$$\left(138{\cdot}586\times\frac{112{\cdot}68 \text{ calories}}{100}\right).$$

The same kilo. of coal would produce 700 grms. of coke, containing about 560 grms. of pure coke, of which the heat of combustion is 8080 calories, and 560 grms. of such pure coke, on combustion, would generate 452·4 calories, *i.e.*, (0·560 × 8080). Hence 1 kilo. of coal transformed into coke and gas loses 1415 calories, or 19·3 per cent. of its calorific value, *i.e.*, [7500 calories − (4524 + 1561) = 1415]. It now remains to be ascertained whether the ammonia that has been condensed during the distillation of the coal represents a value sufficient to compensate for the diminished value of the coal as a fuel, as well as to afford a margin of profit. It has been seen that, according to Foster, only about one-seventh of the total nitrogen contained in the coal is converted into ammonia. According to Armour, one ton of Broomhill coal only yields 9·060 kilos. of ammonium sulphate, or 2·200 kilos. of nitrogen, in the coke ovens, and according to Jameson the yield is even smaller. These data agree pretty closely with those of Foster, although the figures in one case refer to coke ovens, and in the other to gas retorts. However, Armour and Jameson have not stated the amount of nitrogen contained in the coal used in the coke ovens to which they refer, and hence assumption must be resorted to on this head in making any deductions. It would appear from the numbers given that coal never produces more than from two to three-thousandths of ammonia. It is admitted with Mr. Forster that 14 per cent. of its nitrogen is transformed into ammonia. According to the data given before, 1 kilo. of coal containing 15 grms. of nitrogen will give up 2·1 grms. of this gas as ammonia, corresponding to 8·55 grms. of ammonium sulphate. The average price of 1 kilo. of this salt being 0·5f., the value of the ammonium sulphate obtained from 1 kilo. of coal would be 0·004275f., or 4·27f. per ton of coal. Consequently there is a gain of 0·004275f. on one side, and a loss of 1415 calories on the other; or in other words, since coal commands a price of 22·65f. per ton, the condensation of the ammonia affords no advantage whatever, as is clearly seen from the following calculation:—

$$\frac{7500 \text{ cal.}\times 0{\cdot}004275}{1415 \text{ cal.}}=0{\cdot}02265 \text{ per kilo.}$$

If the price of coal sinks as low as 15f. per ton, the manufacture of ammonium salt affords a profit of 1·44f. per ton, from which we have still to subtract the cost of the process, in order to get the next margin:—

$$\frac{1415 \text{ cals.}\times 15\text{f.}}{1000}\times 7500=0{\cdot}00283.$$

$$0{\cdot}00427-0{\cdot}00283=0{\cdot}00144.$$

These results are by far lower than would be expected after such a modification in the heating materials, unless the price of fuel is very low; for the lower it is the less considerable is the loss represented by the 1415 calories which have not been utilised. It is probable that the cost attending the transformation of the coal into coke and gas would not even admit of a profitable working of this process, in case fuel was as cheap as 10f. per ton. In fact, the advantage gained by the manufacture of ammonium salts would only average as much as 4f. per ton of coal, or hardly 1·5 centime per cubic metre of gas. *A fortiori*, one cannot expect to realise any profit in ordinary coke ovens, where the number of calories lost is much more considerable. In Mr. Davis's calculations and those of Mr. Morrison—*loc. cit.*—the heat of combustion of the illuminating gas is found too high. Davis, instead of availing himself of the heat of combustion of the compound bodies, has added together the heats of combustion of the carbon and of the hydrogen. Thus he arrives at the number of 12,233 calories, whilst the calculations made with the figures obtained by Favre and Silbermann for the different compound gases show a difference of 783 calories, or 6·4 per cent. Morrison arbitrarily assumes 18,000 thermal units for illuminating gas, exceeding thereby the reality by more than 40 per cent. The conclusions derived consequently require modification *pro ratâ*.

It is announced by *L'Electricité* that the doubling of the Paris telephone wires, the only one laid entirely underground, is on the point of being completed.

The New Patent Law.—With the object of affording information to the public until the new rules under the Act are completed, the following information is issued by direction of the Board of Trade:—(1) Applications and all other documents will be required upon strong, wide-ruled foolscap paper, written or printed on one side only, having a margin of 2in. on the left-hand part thereof. The use of parchment will be discontinued. Copies of specifications will no longer be required. (2) The size of the drawings will remain unchanged, but they will be required upon drawing paper instead of on parchment. A copy of the drawings will be required upon thin Bristol board. (3) Forms of application—stamped—will be placed on sale at the chief post-offices in the United Kingdom. (4) The forms required for an application will be—(*a*) for provisional protection—application form and form of provisional specification; (*b*) for complete protection—application form and form of complete specification. Where a complete specification is not left in the first instance, it may be left at any time within nine months after application for provisional protection. (5) The fees will be £1 for each stamped form of application, and £3 for each stamped form of complete specification. No fee will be charged for the form for provisional specification. (6) Applications may be left at the Patent-office or sent by post. If sent by post, they must be addressed to the Controller, Patent-office. (7) The "declaration" in the application form must be made by the inventor or inventors. All other documents may be prepared and signed by agents. Note.—"Applications" for letters patent made during the present year must be proceeded with in accordance with the existing laws and rules.—H. Reader Lack, Office of Commissioners of Patents, 25, Southampton-buildings, Chancery-lane.

An Antipodean Newcastle.—The principal coal-port of Australia is situated at the mouth of the Hunter River, about seventy-five miles north of Sydney, to which city it stands second in commercial importance, although its rise has been so recent as to be within the memory of comparatively young men. The first commercial recognition of the port, which is named Newcastle, after its busy prototype on the Tyne, to which town it presents many points of resemblance, was in 1846, when the first sub-collector of Customs was appointed. Yet, in 1882, less than forty years afterwards, the customs collections were £68,249, a large sum for a young port in a free-trade country. In 1891 the annual export of coal from the port amounted to 131,263 tons; in 1882 it had reached 1,080,446 tons. In 1862 the Newcastle imports amounted to the value of £35,932; in 1882 they had reached £632,073; the exports during the same year being valued at £618,586. The progress of the port is further illustrated by the fact that the cost of the various harbour works, including breakwaters, wharfs, cranes, dredging and dredging plant, has been little short of £700,000. In this is included between 300ft. and 400ft. of continous wharfage, on which are erected seven steam cranes, and noble works at Bullock Island, where a mile of wharfage has been constructed, and on which are erected eight hydraulic cranes, six of them capable of lifting 15 tons each, and two 25 tons each. Seven million tons of silt have been lifted from the harbour and thrown into the sea. A great natural obstruction known as the "Horseshoe" has been dredged away, and where there was formerly at low tide but a depth of 10ft. of water there is now 21ft. There are also 23ft. of water across the harbour over a sand bank formerly dry at low water. The advantages of these improvements are shown by the circumstance of 50,000 tons of shipping being at one time, last year, safely moored in the port, into which the noblest vessels may come and anchor with perfect safety.

RAILWAY MATTERS.

THE project of a direct railway from Tashkend to the Caspian is now under authoritative consideration.

THE French Societé des Chemins de fer Economiques has lately accepted some low tenders for 8000 tons of 40 lb. rails for small gauge lines, to be made in the department of Allier.

AT the Roadmaster's office a few days since, a report of material used was received with this indorsement :—"Charge to Mrs. Lane's account." Investigation proved that miscellaneous account was intended.

ON the 3rd inst. the Whitby and Loftus branch of the North-Eastern Railway was opened. The new line is sixteen miles long. When the Scarborough and Whitby Railway is completed a continuous line of coast railway between Hull and Berwick will have been formed.

AN imperial ukase dated from Gatchina, November 22nd, authorises the Minister of Finance to borrow 50,000,000 of roubles in gold by the issue of perpetual rentes to enable the Exchequer to pay the State Bank the 50,000,000 due under the ukase of 1881, and for the expenses of railway construction.

THE Pacific Railway has reached the foot of the Rocky Mountains, and work will shortly be stopped for the winter, during which twelve exploring parties will be at work to locate some definite route of passage through the mountains. There are now in Canada nearly 9000 miles of railway in operation.

THE owners of the railroad up Green Mountain on the Mt. Desert in Maine, U.S., propose building an electric railroad for summer pleasure travel on the island from Bar Harbour to Eagle Lake, where connection will be made with the steamboat running across the lake to the terminus of the Green Mountain Road. The distance is three miles.

THE manufacturers of Coventry continue to agitate against the increased rates which the railway companies have intimated they shall in future charge upon the carriage of cycles. It would appear that one reason which the companies assign for their action is that some manufacturers have been in the habit of breaking the spirit of the rule which allowed bicycles packed in parts to be conveyed at a less rate than whole bicycles.

IT appears from the report of the New South Wales Commissioner of Railways for 1882 that, during the year, the earnings amounted to £1,698,863, and the working expenditure to £934,635. The lines open for traffic yielded 5·14 per cent. on the capital expended in the construction. At the close of the year 1268 miles of line were open for traffic, and 504 miles were in course of construction. The total expenditure for construction on all the lines in the colony was £16,776,642.

THE Railway Commission appointed to investigate the management of the passenger traffic of the Queensland railways have recommended that a board be appointed to supervise the management and construction of railways, and to see that safety, convenience, and the interests of the public are duly regarded. The commission have also recommended that appointments to the railway service should be vested in a board. An inquiry into the management of the freight traffic is strongly advised.

NOMINALLY an American car load is 20,000 lb. It is also 70 barrels of salt, 70 of lime, 90 of flour, 60 of whisky, 200 sacks of flour, 6 cords of soft wood, 18 or 20 head of cattle, 50 or 60 head of hogs, 90 or 100 head of sheep, 9000ft. of solid boards, 17,000ft. of siding, 13,000ft. of flooring, 40,000 shingles, one-half less green lumber, one-tenth less of joist, scantling, and other large timbers, 340 bushels of wheat, 400 of barley, 400 of corn, 680 of oats, 300 of flaxseed, 366 of apples, 340 of Irish potatoes, 300 of sweet potatoes, 1000 bushels of bran.

A PECULIAR signal arrangement is being put on the track by the Philadelphia and Reading Railroad Company, near Bound Brook, at the point where that railroad crosses the Lehigh Valley-road. The *National Car Builder* says, when a train strikes a point 2700ft. from the crossing of the two roads an electric bell is set in motion, and if an engineer persists in running, notwithstanding that a danger signal is displayed, the crossing tender can use an automatic arrangement by which the train may be run on a siding that leads into a field and be ditched.

THE railway from Liege to Maestricht, says a Belgian paper, has obtained permission to put on its track, between Liege and Vise, small trains, made up of cars, of the tramway pattern. These trains stop between stations, and thus are a great convenience for the small villages along the route. They are much appreciated, and, not the least striking fact, the railway company adopted this system in order to prevent the establishment of any competing tramway line. This says, the *Railroad Gazette*, is an idea that perhaps might be advantageously adopted by some lines in our own country.

IN a paper on "Compressed Air Locomotives for Mines," published in the "Génie Civil," M. Edmond Boca claims for them the following advantage over chain haulage :—(1) Greater simplicity of installation, owing to the suppression of pulleys, rollers, and guides. (2) The dispensing of a double line of way and a special road for workmen. (3) Their capability of serving several galleries, of being easily transported from one working place to another, and of avoiding the risk of stoppage. (4) The facility of apportioning the power to the work, while the driver always has his engine under command.

THERE is a fiction that engines on the Metropolitan Railway are not as other engines, and that they never leave the rails. Board of Trade reports tend to destroy this fiction, and to show that rigid wheel base and sharp curves are as evidently the cause of derailment on the subterranean as on other lines. Colonel Yolland has written a report on the accident which occurred on the 3rd October, between Farringdon-street and Aldersgate-street, when the four leading bogie wheels of a Metropolitan District engine mounted the rails, and ran for a distance of about thirty-eight yards off the rails before the train was stopped. No damage was done to the engine or carriages in the train or to the permanent way, and no complaints have been received from any of the passengers in the train. A precisely similar accident occurred on the 10th May last, at the same spot, to a Metropolitan District Railway Company's passenger train, and it was then recommended that the Metropolitan Railway Company should insert check-rails on all their lines on curves having a radius of ten chains or less, and not permit such curved lines to be laid tight to gauge. Since this second accident in the same place in one year, check rails have been put in.

THE net amount which will have to be handed over by the Post-office for distribution among the railways at the close of the half-year for parcel post work will be about £100,000 for the five months' operations, being at the rate of nearly £250,000 a year. The equivalent in dividend upon the ordinary stock of the railways is about 2s. per cent. per annum, and it comes in as a net receipt—that is to say, there is no set-off or deduction by way of working expenses. There are no available means at present of allocating this sum between the companies; but having regard to all known circumstances, the *Railway News* says, the positions of the principal companies will be found pretty accurately set forth in the following figures:—Great Eastern, 5 per cent. of total sum; Great Northern, 5 per cent.; Great Western, 12 per cent.; Lancashire and Yorkshire, 4 per cent.; London and Brighton, 4 per cent.; London and Chatham, 3 per cent.; London and North-Western, 15 per cent.; London and South-Western, 5 per cent.; Manchester, Sheffield, and Lincoln, 4 per cent.; Midland, 9 per cent.; North-Eastern, 7 per cent.; North Staffordshire, 2 per cent.; South-Eastern, 5 per cent. The basis of apportionment is mainly on the passenger train figures for the past year.

NOTES AND MEMORANDA.

WITHOUT reckoning the collisions, 611 steamships and 2363 sailing vessels were lost or damaged on our coast in 1881-82.

THE trusses of the old part of the roof of the Basilica of St. Paul, at Rome were framed in 816, and were sound and good in 1814, 1000 years later. These trusses are of fir. The timber work of the external domes of the Church of St. Mark, at Venice, is more than 840 years old, and is still in a good state. Sound logs are dug out of bogs where they have lain for an indefinite period.

THE loss of life on our coasts in the year 1881-82, collision cases included, was as follows:—East Coast of England, 289; South Coast, 129; West Coasts of England and Scotland, and East Coast of Ireland, 286; North Coast of Scotland, 82; East Coast of Scotland, 239; other parts of the coast, 72; total, 1097. It will thus be seen that the greatest loss of life happened, as usual, on the East Coast of England.

THE copper lodes in New South Wales were first opened about twenty-five years ago, the most important mine at present being the Great Cobar Mine, which is also the most distant from the seaboard, being 497 miles west of Sydney. The quantity of ore already smelted at this mine is 69,118 tons, producing 9182 tons of fine copper. In 1881, 21,552 tons of ore were smelted, producing 2568 tons of copper. The lode occurs in Silurian slates; it varies in width up to 100ft.

EXCLUDING foreign ships and collision cases, 198 of the disasters which happened to ships on or near our coasts in 1881-82 happened to nearly new ships, and 400 to ships from 3 to 7 years of age. Then there were 502 to ships from 7 to 14 years old, and 919 to ships from 15 to 30 years old. Then follow 4337 old ships from 30 to 50 years old. After passing the service of half a century, we come to the very old ships, viz., 40 between 50 and 60 years old, 26 from 60 to 70, 16 from 70 to 80, 5 from 80 to 90, 7 from 90 to 100, and 3 upwards of 100 years old, while the ages of 70 are unknown.

WHILE Mr. Preece has found that there is no difference in the conducting power of lightning rods of various forms, *Wieders Annalen* says: Holtz has concluded that solid steel bars do not form so good permanent magnets as tubes, because the core acts as an armature joining the two poles. In experimenting to test his hypothesis, he magnetised rods and tubes to saturation, and found that the magnetism of the tube showed an excess of more than 50 per cent. After waiting six months, he subjected the same magnets to new tests, in order to find which retained the magnetism best. He found that the magnetism of the solid was to that of the hollow magnets, in one case as 1 : 2·5, in another as 1 : 2·9.

THE distances, often many miles, through which gas is transmitted before reaching an engine, are such that, with any other means of distributing power, they would considerably enhance the cost of the power. But in the case of gas, it does not appear that these distances are at all a matter of consideration. Professor Osborne Reynolds thus explains this:—It takes about ten cubic feet of gas to develope 1,000,000 foot-pounds in a gas engine, whereas of air compressed in the ordinary way it would require something like 140 cubic feet to yield the same power. Hence the comparative cost of transmission is the cost of transmitting ten cubic feet of gas against that of 140 cubic feet of compressed air, and these would be about as one to twenty-five; so, as a means of distributing energy, gas is twenty-five times more efficient than compressed air.

M. HEDDEBAULT has discovered a method of preparing soluble wool from tissues in which wool and cotton are combined. When subject to a current of superheated steam, under a pressure of five atmospheres, the *Scientific American* says, the wool melts and falls to the bottom of the pan, leaving the cotton, linen, and other vegetable fibres clean and in a condition suitable for paper making. The melted wool is afterward evaporated to dryness, when it becomes completely soluble in water, and is called azotine. The increased value of the rags is sufficient to cover the whole cost of the operation, so that the azotine is produced without cost. It contains all its nitrogen, in a soluble condition, and can, therefore, be compared to dry blood, which is worth, 2·50 francs per kilogramme of nitrogen. M. Ladureau regards this discovery as one of great interest for agriculture and mechanical industry.

IN a paper on "Coal Gas and Gas Engines," by F. Fischer—Dingl. Polyt. Jour. 249, 178—the author analysed the gas employed in driving a six-horse Otto engine, and found its composition to be as follows:—Benzene, 0·69; propylene, 0·37; ethylene, 2·11; methane, 37·55; hydrogen, 46·27; carbonic oxide, 11·19; carbon dioxide, 0·81; nitrogen, 1·01; oxygen, trace; total, 100·00. With the engine running at a low speed the gaseous mixture, after explosion, contained 2·4 per cent. CO_2 and 17·2 per cent. O; at high speed, after explosion, 6·5 per cent. CO_2 and 9·9 per cent. O, the temperature being 400 deg. C. It is therefore evident that the quantity of air taken in by this machine is from two to four times the volume necessary for complete combustion; and further, that gaseous mixtures much poorer in combustible constituents than ordinary coal gas may be used in place of the latter.

A PAPER appears in the *Journal de Physique* by M. J. Jamin on the "Critical Point of Liquefiable Gases," in which he discusses a new theory. He says :—"I believe that gases are liquefiable at all temperatures when the pressure is sufficient." Describing Cagniard de la Tour's experiment, he says: "According to known laws, the quantity of vapour above the liquid increases very rapidly, its density increasing at the same rate as its weight without known limit. Again, the remaining portion of the liquid expands at an increasing rate until it passes that of the gas (Thilorier); it is clear, then, by the effect of these inverse variations, that at last a limiting temperature must be reached when the liquid and the vapour must have the same weight for the same volume. At this point they are inseparable; the vapour does not rise nor the liquid fall, and the surface of the liquid disappears." Thus the critical point is the temperature when a liquid and its saturated vapour have the same density. From the experiments of Cagniard de la Tour he deduces that at the critical point a liquid has no latent heat, and in summing up he says: "At the critical point there is no difference between a liquid and its vapour, neither in tension, nor density, nor thermal constitution, nor appearance, nor any property by which they can be distinguished."

THE injurious influence of hydrochloric acid in the titration of solutions containing ferrous salts by means of Margueritte's process, was first pointed out by Löwenthal and Lenssen. The importance of the method has led Fresenius and others to search for means of obviating the disturbing action of the hydrochloric acid. Some time ago there appeared in the *Berichte* of the Berlin Chemical Society a paper on the same subject by Clemens Zimmermann. He recommended an addition of manganese sulphate to the hydrochloric acid solution. This method has been tried by Krutwig and Cocheteux in many determinations of iron ores, and they have obtained accurate results, so that they can recommend the use of manganese sulphate. It seems remarkable, however, that determinations which they had formerly made had likewise given figures analytically correct. They believed that the cause of this was that they dissolved the iron ore in the smallest possible quantity of hydrochloric acid, about 10 c.c. to 0·1 gramme of ore, adding then 400 c.c. of water and about 30 c.c. of sulphuric acid. Special experiments seem to justify this supposition. The use of sulphuric acid keeps down the discrepancies in the results, so that there is no objection to the use of Margueritte's process in presence of hydrochloric acid if the following precautions are observed :—(1) If possible, dissolve the ore in very little sulphuric acid; (2) reduce by means of zinc in the hydrochloric acid solution; (3) add a quantity of sulphuric acid twice as great as that of the hydrochloric acid; (4) dilute the solution to about 300 c.c.; (5) when the titration is carried out use the permanganate in a dilute state.

MISCELLANEA.

A CONVENTION providing for the laying of new submarine telegraph cables between Greece and other countries has been signed by the Government and the Eastern Telegraph Company.

IN addition to the diaries to which we referred last week we have to mention "The City Diary," the twenty-first annual issue of which has reached us. The diary is arranged for one week to a page, handy in size, interleaved with blotting paper, and is published at the *City Press* office.

AT the Swiss Congress recently summoned to discuss the subject of the Patent Law, resolutions were passed, by 110 votes to 52, recommending the Government to adopt some measure for the protection of inventions. No opposition was offered to the introduction of a "Trade Marks" law.

THE New British Iron Company, the old-established ironmaking firm whose "Lion" brand of best Staffordshire iron is so well known, was last week converted into a limited company, the shareholders of which are, however, the same as before, it being intended, we believe, to fully maintain its privacy.

AT the Court Opera at Vienna tiny incandescent lamps, suspended by fine swinging wires, give the effect of swarms of fireflies flitting about a tropical forest. By switches the current is turned of and on at the pleasure of the operator, and the effect, as the artificial fireflies flash and dance in mid-air, is said to have been electrical in other than a literal sense.

THE November return of the Cleveland Ironmasters' Association shows the following as one month's make of pig iron, namely, 154,000 tons of Cleveland iron and 74,000 tons of other kinds; a total of 228,000 tons, or 10,000 tons less than in October. There are 118 furnaces blowing, 84 of which are making Cleveland pig iron. Stocks decreased 21,800 tons in November.

AT the meeting on 9th November of the Société d'Encouragement, Paris, M. Simon called attention to a recent decision of the French Government, by which it was forbidden to take notes of patents. This decision bears all the harder on inventors and patent agents because only abstracts are published of French patents, and then only two or three years after they are granted.

A USEFUL little table for the pocket-book, compiled by Mr. E. J. C. Welch and published by Messrs. E. and F. N. Spon, gives the weights of copper conductors for electrical currents, from one to 500 ampères, the weight of copper being proportioned to the current to be conveyed, so that the ratio to its heat generating effect in the conductor and the external or cooling surface of the conductor itself is constant.

A NEW screw steamer of 500 tons, built and engined for peculiarly different purposes by Messrs. W. Simons and Co., was launched on the 3rd inst., complete from their works at Renfrew. This vessel is named Batman, and is the sixth steamer this firm have constructed for the Melbourne Harbour Commissioners. It is intended for the double purpose of a powerful hopper steamer and gunboat, and is fitted to carry a 5-ton rifled gun.

THE classification adopted in the Calcutta International Exhibition is the following:—Section A, fine arts; section B, education and application of liberal arts; section C, health; section D, furniture and other objects for the use or decoration of dwelling-houses and other buildings; section E, fabrics, including apparel, toilet requisites, and other objects of personal wear or use; section F, raw products and manufactures from products not included in other sections; section G, machinery and implements, means of transport, appliances and processes used in the common arts and industries, including models and designe; section H, food products; section I, agriculture and horticulture; section K, ethnology, archæology, and natural history.

THE third ironclad, the Help in Need, corvette, built for the Chinese Government, has been launched at Stettin. She has a water-line length of 72 metres, a breadth of 10·5 metres, and a depth of 7·20 metres, while her greatest draught of water when fully equipped will be 4·8 metres. The two bi-cylindrical compound engines, each driving a screw, have together an indicated horse-power of 2800, and ought to give the vessel a speed of fifteen knots an hour. The displacement of the finished ship will be 2355 tons. Her armament will comprise two turret Krupp cannon of 21 centimetres, another Krupp gun of 15 centimetres, four torpedo guns, and six Hotchkiss cannon. The vessel will be manned by a crew of 180 officers and men.

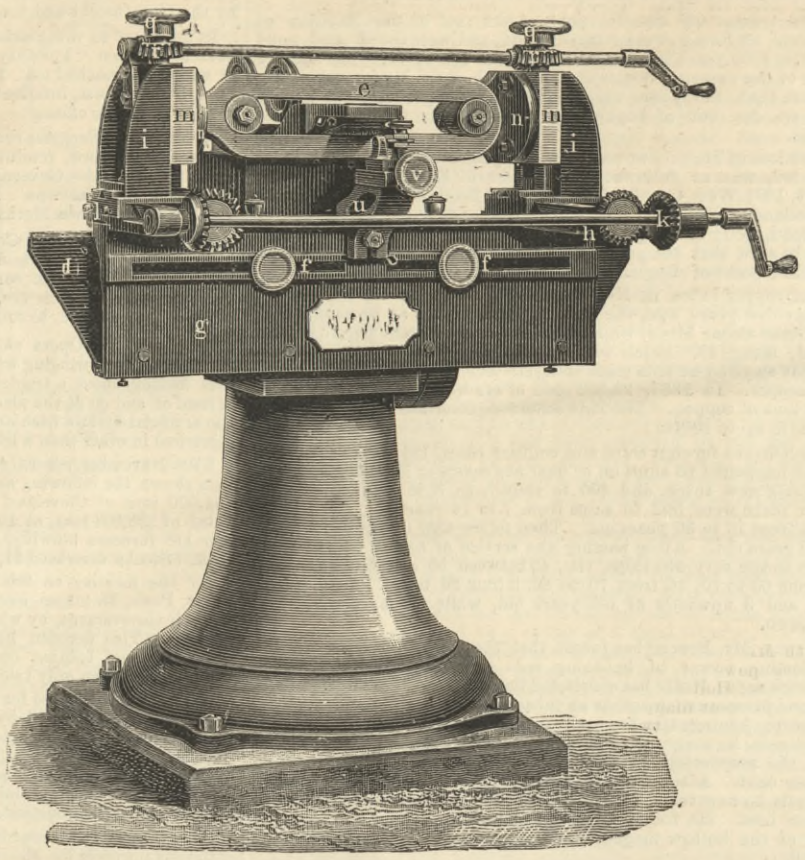
THE death is announced of Mr. Joseph Mitchell, C.E, in his eighty-first year. Mr. Mitchell was trained under Telford, and at an early age was appointed engineer to the Commissioners of Highland Roads and Bridges, and afterwards engineer to the Fishery Board. He had much to do with the most important engineering works carried out in the Highlands during a period extending over half a century. He surveyed and carried out the first line opened in the Highlands—that between Inverness and Nairn—while the Highland railway system, the railway between Inverness and Bonar Bridge, and part of the Sutherland line, were carried out by him. Deceased was a resident of Inverness, but two months left for London, where he died a few days ago.

A TRIAL has been made by the Consolidated Electric Company with an accumulator used to light up a carriage of Mr. A. de Rothschild's. A test journey from Halton to Tring Station and back was made again on Sunday evening. The light is under the command of the occupant of the carriage, who can light or extinguish either of the lamps. An incandescent light is placed in each of the ordinary outside carriage lamps, and one arranged with a small bracket and globe inside. The current is supplied from five cells, containing six metal plates in each, which can be re-charged without disturbing the arrangements by simply connecting two wires. The whole being contained in a small mahogany case, weighing a little over 1 cwt., can be easily removed from the carriage if necessary.

FOR storing of wind power in sand the Oil City, Pennsylvania, *Blizzard*, states that one Townsend has six arastras running to their full capacity, and four more will be started up in a few days. The arastras are placed in a little sandy flat, where only sufficient water for drinking purposes and to moisten the ore operated upon is to be obtained. The arastras are actually operated by sand, which drives a large overshot wheel. A windmill runs a belt containing a large number of buckets, and these carry the sand up to a large tank, just as grain elevators carry wheat in a flouring mill. A stream of sand being let out upon the over-shot wheel, it revolves just as it would under the weight of a stream of water, and the arastras move steadily on at their work. When there is much wind, sand is stored up for use when calm prevails so the arastras are never idle.

THE *Scientific American* gives the following from a practical man :—"I have a wagon of which, six years ago, the fellies shrank so that the tires became loose. I gave it a good coat of hot oil, and every year since it has had a coat of oil or paint, sometimes both. The tires are tight yet, and they have not been set for eight or years nine. Many farmers think that as soon as wagon fellies begin to shrink they must go at once to a blacksmith's shop and get the tire set. Instead of doing that which is often a damage to the wheels, causing them to dish, if they will get some linseed oil and heat it boiling hot and give the fellies all the oil they can take, it will fill them up to their usual size and tighten to keep them from shrinking, and also to keep out the water. If you do not wish to go to the trouble of mixing paint, you can heat the oil and tie a rag to a stick and swab them over as long as they will take oil. A brush is more convenient to use, but a swab will answer. It is quite a saving of time and money to look after the woodwork of farm machinery. Alternate wetting and drying injures and causes the best wood soon to decay and lose its strength unless kept well painted. It pays to keep a little oil on hand to oil fork handles, rakes, neck yokes, whippletrees, and any of the small tools on the farm that are more or less exposed."

EMERY MACHINE FOR POLISHING LINKS.



For the purpose of facilitating, and at the same time executing with greater speed and accuracy, the tedious and troublesome job of surfacing and finishing the reversing links of locomotives, Messrs. S. Oppenheim and Co., of Hainholz, near Hanover, have constructed the machine we illustrate. By means of this machine links can be finished after having been hardened, without the risk of in any way changing their temper, an advantage which will be much appreciated. Moreover, the surfaces are perfectly smooth and straight, offering none of the slight unevenness which hand labour unavoidably produces, and which so considerably increases the wear, that frequently these links have to be softened, refaced, and again hardened, by which latter operation it is not an unfrequent occurrence that the links break or warp. The link to be ground is firmly secured upon two pins, which are fixed to rotary brackets *n* in such a manner that the inside surface to be operated upon is exactly parallel to the reciprocating table *g*. The two standards *i*, to which the brackets *n* are bolted, can be readily brought close together or pushed further apart, according to the size of the piece to be ground. For the purpose of vertically adjusting the link when in position, little hand wheels *q* are provided at the top of the standards *i*, which raise or lower the slides *m*; when both are required to be raised or lowered simultaneously, the worm and wheel motion *r* is put in operation. The length of travel of the table *g* is regulated by lugs adjustable by means of the little hand wheel *f*, which lugs reverse the position of open and crossed belts upon the fixed pulley. To move both the standards *i* simultaneously a coupled bevel wheel arrangement *k* is provided, by means of which any parts which may have been left in the corners can be brought within reach of the emery disc. As soon as one surface is finished the brackets *n* are each slacked from their supports, turned 180 deg. and fixed again, when the surface now offered to the action of the grinding disc must be exactly parallel to the former. The emery disc is guided on a double cone in a long bearing, so as to ensure perfect running, and is driven by means of a catgut guided over pulleys placed above and below the conical spindle, so as to obviate any side pressure being exerted on the emery disc spindle. The change for a new emery disc is a very easy matter, and does not necessitate removal of the spindle. A little tool-holder carrying a diamond roughing tool is fixed on the table *g*, by means of which tool the emery wheel can be readily roughened while at work. This machine is being introduced here by Messrs. Müller, Uhlich, and Co., King William-street, E.C.

BORLAND'S INJECTOR.

The accompanying engravings illustrate a new injector, the invention of Mr. Severin Borland. The improvements consist partly in its internal arrangement, which admits of its being taken to pieces for cleaning in a few seconds, without disturbing the joints; and partly in the proportions of the nozzles, which are entirely new, and give to the jet a power which, we are informed, ensures certainty of action and rapid delivery. Figs. 1 and 2 of our engravings represent the exterior elevation and the section of the injector as made to work without lift, while Figs. 3 and 4 show the construction of the lifting injector. It has no internal moving parts, regulation being effected by means of the water cock, or, in the case of the lifting injector, partly by the steam inlet valve shown at Fig. 4. We are told that experience proves that no amount of vibration will "shake it off," and it is thus, Mr. Borland—who was works manager for Messrs. Sharp, Stewart, and Co.—says, specially adapted for locomotive work of all kinds. The various branches are diametrically opposite to one another, so that the injector is universal; and in the lifting pattern, where the addition of a third side branch is necessary, an ingenious, because very simple, arrangement allows the branch to be swivelled round and locked in any position. Thus both classes can be fixed in any convenient position without special branches. The injectors are very small and made entirely of gun-metal, and are turned and polished bright all over. The joints are ordinary unions, ground so as to be steam-tight without packing, and the injectors are easily fixed by any workman, and, owing to their small size, they in most cases require no stay. The injectors are made by Mr. Severin Borland, of Manchester.

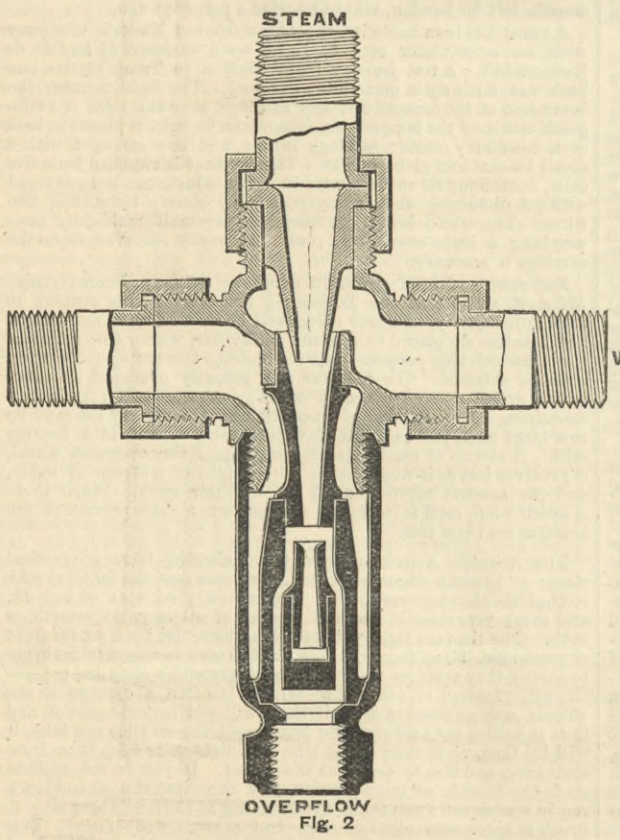


Fig. 2

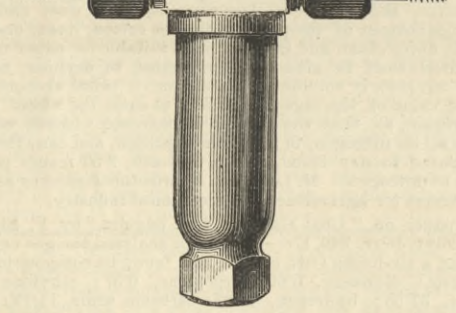


Fig.

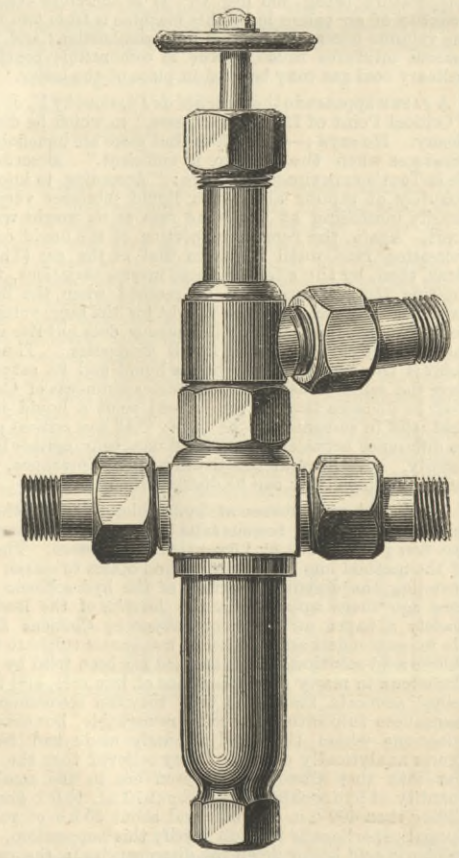


Fig. 3

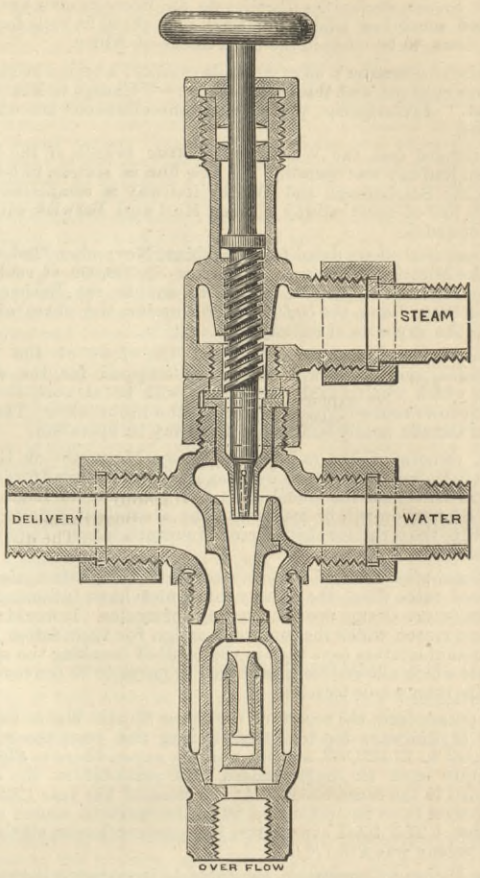
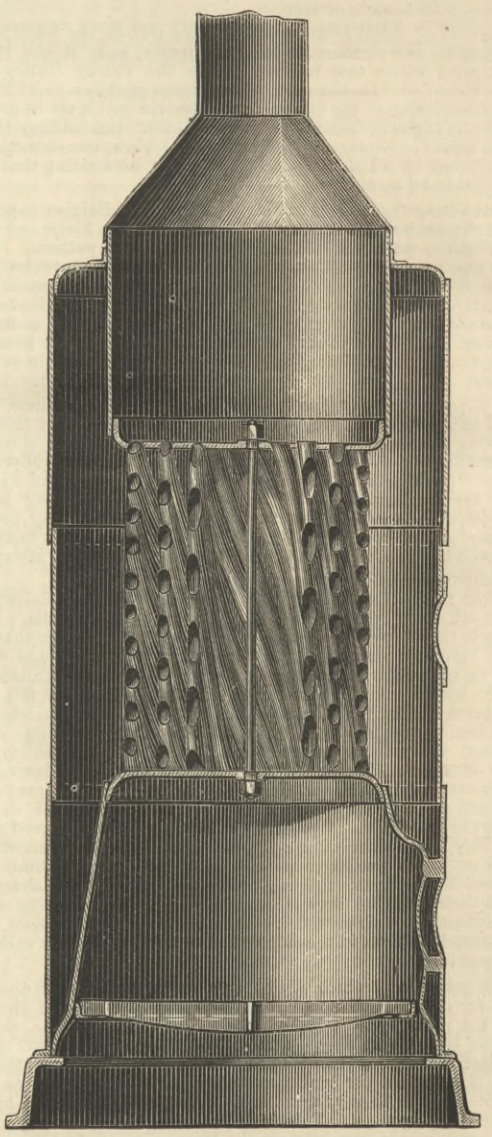


Fig. 4

ARMER'S VERTICAL BOILER.

The boiler illustrated by the engraving below is made by Messrs. J. and E. Hall, of Dartford, under Mr. Armer's patent. The object of the design is to obtain in a vertical boiler the greatest possible efficiency in the tube heating surfaces. For this purpose the tubes have a helical twist given them, which does not influence the facility for cleaning, while it causes greater impingement of the gases against the tube walls, and gives more freedom for expansion and contraction than straight tubes. It is a very simple boiler, and from our engraving its construction and merits will be gathered without further explanation.



Naval Engineer Appointments.—The following appointments have been made at the Admiralty:—Henry W. White, chief engineer, additional, to the Pembroke, for service in the Warspite; and Henry G. Bourke, chief engineer, to the Osprey, vice Fraser; and William Annam, engineer, additional, to the Terror, vice Fellowes.

AYR HARBOUR SLIPWAY HAULING MACHINERY.

MESSRS. J. AND A. TAYLOR, AYR, ENGINEERS.

(*For description see page* 450.

fig.1

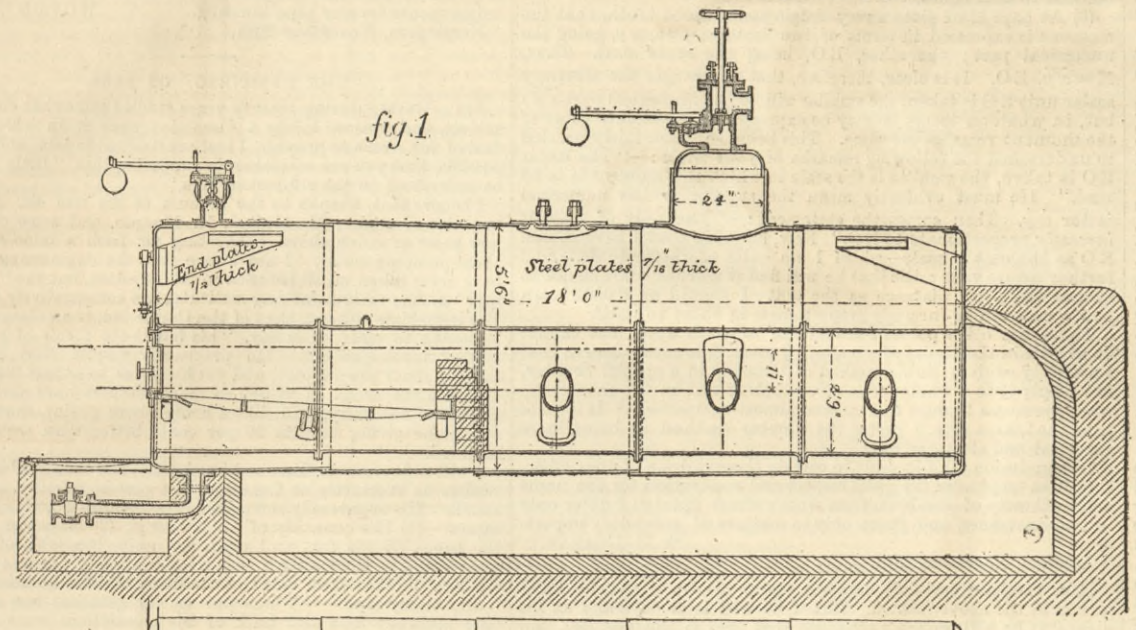


fig.2.

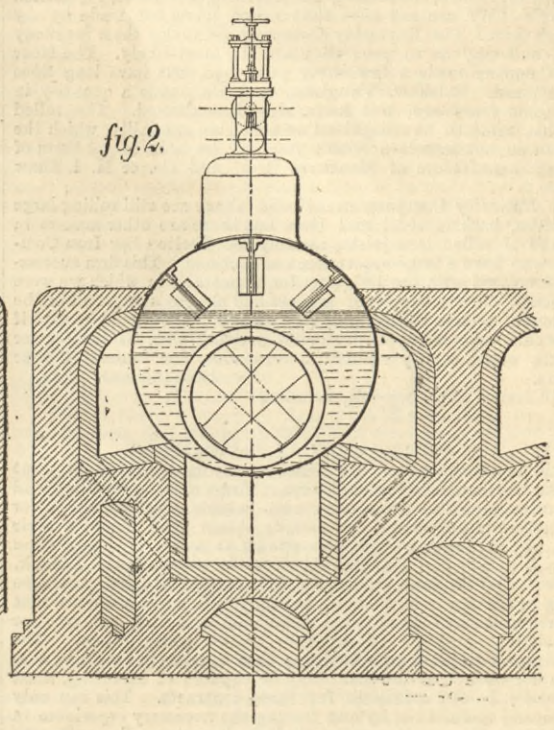


fig.3.

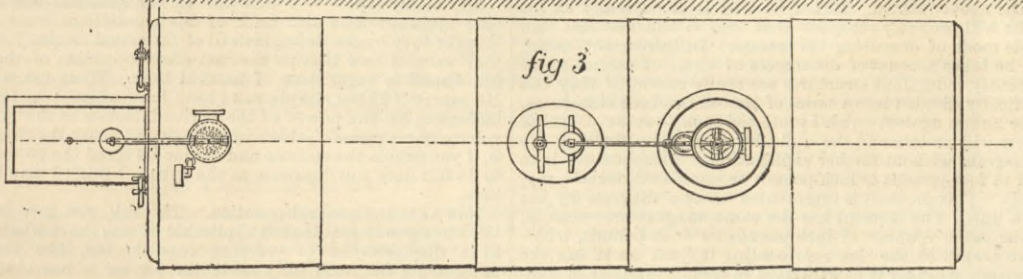


fig.4.

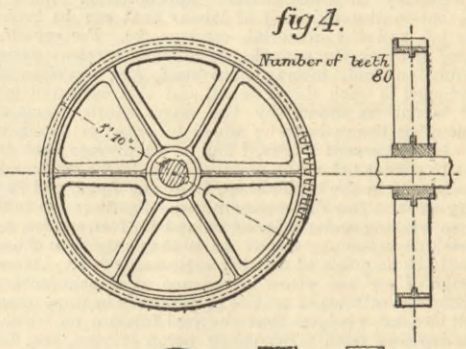


fig.5.

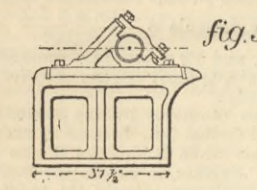


fig.6.

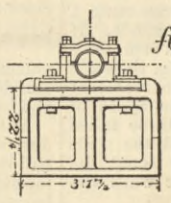
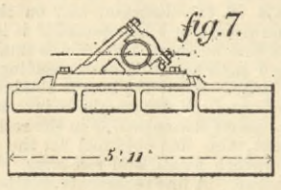
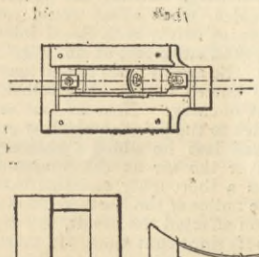
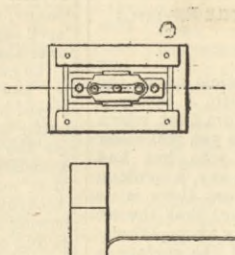
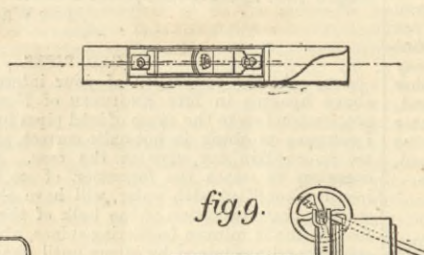


fig.7.









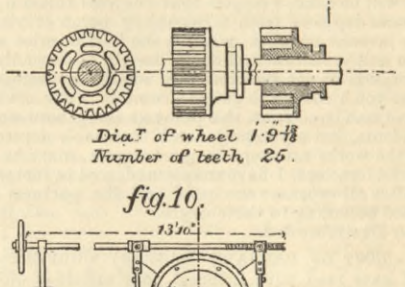


fig.8.

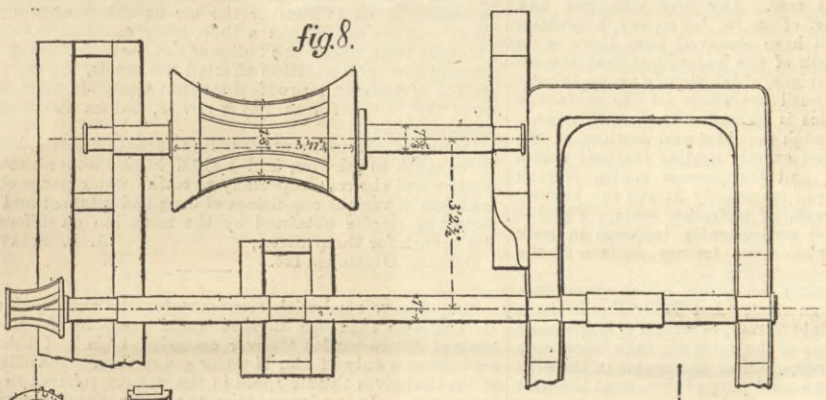


fig.9.

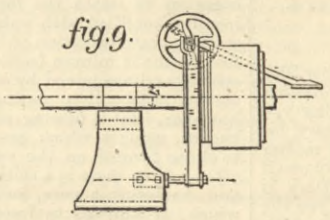
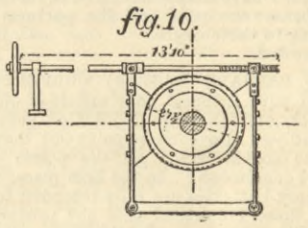


fig.10.



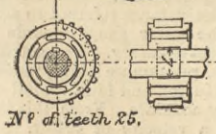


fig.11.

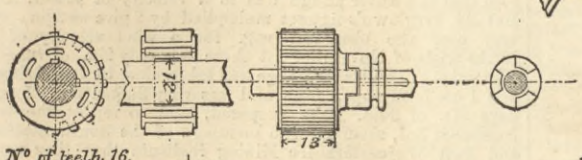


fig.12.

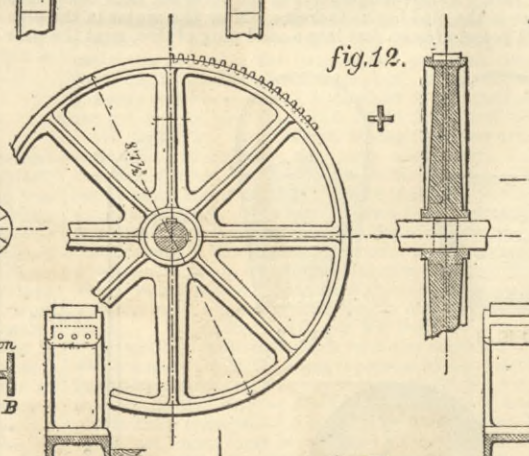


fig.13.

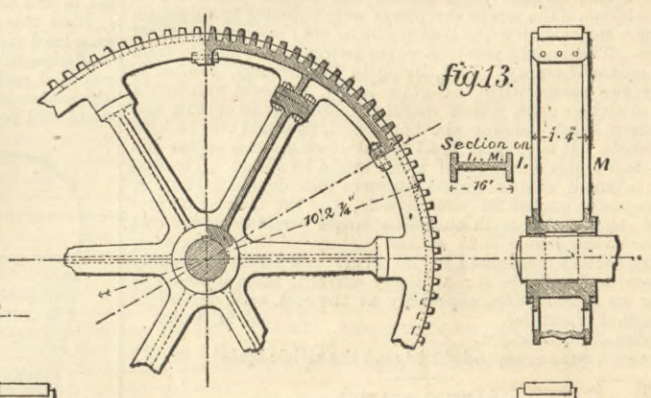


fig.14.

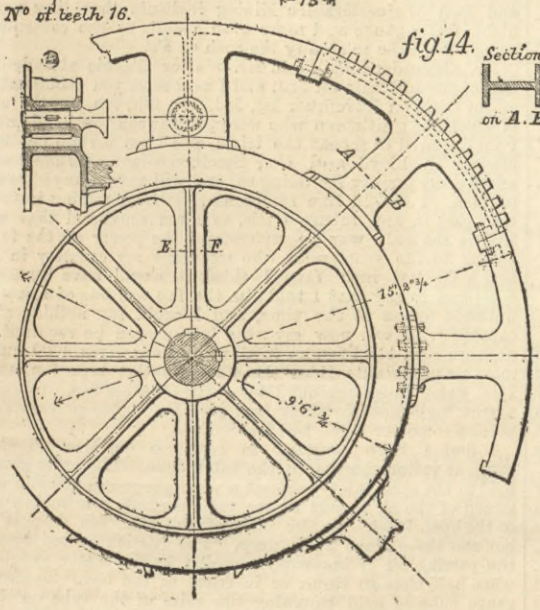


fig.15.

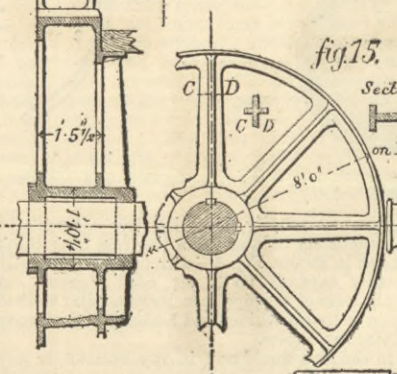
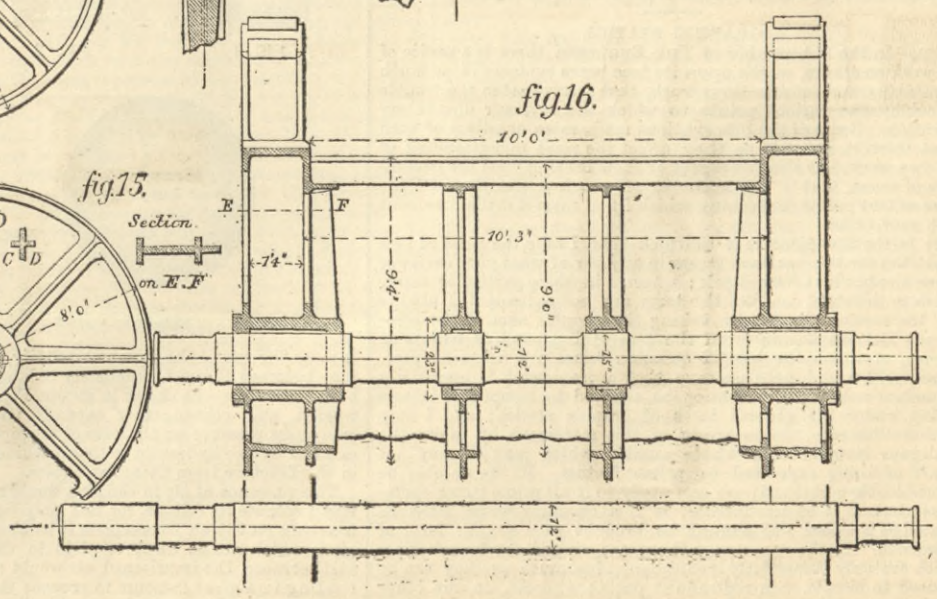


fig.16.



LETTERS TO THE EDITOR.

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

ROLLED JOISTS.

Sir,—Our attention has only now been directed to your issue of April 13th, 1883, containing the following statement, *re* "Rolled Joists:"—"We are not sure that rolled joists are made by any English firm. The Butterley Company did make them for many years, and may do so yet: they are the most likely. The Moor Iron Company made a few some years ago, but have long since discontinued. Bolckow, Vaughan, and Co. made a quantity in steel some years ago, but have also discontinued. The rolled joist has come to be recognised as a Belgian speciality, which the English do not interfere with; you will be able to get them of Belgian manufacture of Measures Bros. and Co. or M. I. Shaw and Co."

The Butterley Company mentioned above are still rolling large quantities, both in steel and iron, but there are other makers in England of rolled iron joists, notably the Shelton Bar Iron Company, who have a large assortment of sections. This firm successfully competed with the Belgians for a contract, in which we were interested, for the supply of girders and channels required in the erection of a large station roof in England. We should be glad if you would take an opportunity of noticing this, as the former remarks would convey rather an erroneous idea to many of your readers.

Bolling and Lowe.

2, Lawrence Pountney-hill, London,
November 29th.

DEPRECIATION IN FACTORIES.

Sir,—In your last issue Mr. Price opens up a subject of great interest to manufacturing engineers. Firms of long standing and reputation, and also firms who own patents and specialities for which there is a demand, can usually obtain good prices for their work, and no doubt are able to write off at a rate of depreciation that will satisfy Mr. Matheson's scientific calculations. I think, however, that my contemporaries who are not fortunate enough to belong to the above-mentioned category will agree with me that the first necessity is to obtain a livelihood, and that our rate for depreciation must be subordinate to this consideration. The most important point in a business that consists in obtaining contracts for work that the firm may be capable of executing, must necessarily be the estimates for these contracts. This can only be properly undertaken by one having the necessary experience in executing work of a generally similar character. For such estimates it is necessary to know what "appropriation" must be added to the bare estimated cost of labour that can be booked direct to the job, and the material, carriage, &c. For myself, I take at the end of every six months, or other convenient period, the expenditure on fuel, management staff, &c., including the repairs apportioned to each department, and this compared with the cost of labour as shown by the wages sheets, forms the "appropriation," or the ratio to be added in order to obtain the actual cost. In my present works, I find on an average that this ratio is about 15 per cent. for the erecting shop, 25 for the foundry and pattern shop, 40 in the boiler shop, 60 at the forge, and 75 in the machinery work. The difference in these figures is due to the number of men working under a foreman, and the fuel, repairs, &c., required in each department; but of course they vary from time to time, and would be no guide to another engineering firm. I merely give an average of my ten years' experience as a manufacturer. Having obtained the estimated cost of a given work by these means, I think it will be acknowledged that the real fulcrum on which a firm's success depends, from a pecuniary point of view, are, first, if you are in want of work, what is the lowest price at which you can tender and yet allow sufficient margin? Secondly, if you are not too anxious to get the contract, what is the highest price that would give you a chance to get the work? Your readers will say that I have wandered from the point at issue between your other correspondents, but my experience is that one's depreciation fund, provided the works are kept in good repair, must be subordinate to the considerations I have mentioned, and in fact should be the balance after all expenses are paid and the partners fed, housed, and clothed according to their degree.

C. R. Parkes.

London, December 3rd.

COST OF PRIMARY BATTERY CURRENTS.

Sir,—I have read with interest your article of November 30th on the above subject, and have no doubt that your calculations are correct. But will you allow me to point out that I think you have not taken into consideration all the points necessary for arriving at a correct conclusion? In the first place, it is a matter of course that primary batteries are only intended for very small installations. For these I contend that the primary battery is much cheaper than the dynamo. In the case quoted by you the battery of sixteen cells is stated to supply eighteen five-candle lamps at a cost of 2¼d. per hour for the whole. According to your calculation, if the necessary power were supplied by a dynamo driven by a steam engine the cost would be only one-fourteenth of that sum. This is only possible where power can be laid on from a public source of supply. If I, living in the country, wanted to light say two rooms with the glow lights, I should purchase a battery of sixteen cells, which might perhaps cost £8 or £10, and my eighteen lights burning six hours a night would cost 1s. 1½d. for the whole. It is obvious that to put down a steam engine and dynamo to do this amount of work would be absurd. The coal burnt in a small engine would be more than double the 2·25 lb. per horse-power quoted in your article, and the interest on first cost, and depreciation with engineers' wages would bring the cost up to more than double that of the battery. I think, therefore, that if the battery mentioned in the *Times* is a simple one, easily kept clean, and reliable for a steady current, there is plenty of room for its introduction, especially as the cost, as advertised, is less than that of candles.

F. M. Eden.

Kettering, December 3rd.

[May we ask our correspondent to read the article again?—Ed. E.]

GRAPHIC STATICS.

Sir,—In the last number of The Engineer there is a notice of my work on statics, which upon its face bears evidence of so much painstaking and conscientious work, that I have taken the trouble to look up the various points to which the reviewer directs my attention. Some of the observations made raise questions of such great interest, not only as they affect the right understanding of my own work, but also in respect of their bearing upon the general laws of stress, that I beg leave to offer a few remarks upon the more salient points concerning which I find myself in disagreement with your critic.

(1) In the first place it is affirmed that I take the *mean* of two quantities for the resultant stress in any bar of what your reviewer terms a redundant framework; whereas in these particular cases, which in the strict sense of the term are not redundant, I always find the resultant stress by taking the *graphic sum* of the component stresses arising from the several independent trusses or frames, of which the bar in question forms a constituent part. Moreover, I would here observe that a framework is essentially redundant only when it cannot be reduced to component trusses falling under the general laws of graphic statics; and I may further illustrate the meaning of this statement by taking the analogous instance of a whole number which may or may not admit of being expressed in prime factors. If the number be reducible, then obviously we can apply to it all prime factor operations; but if it be irreducible, it is a quantity which must be treated as a whole, and cannot be brought to a simpler form of expression. In the same way there are certain framework types which are only apparently redundant, insomuch as they can be reduced to simple, non-redundant parts; whereas, on the other hand, there are to be found types which are essentially redundant in the sense that they defy all our attempts to separate them into component, non-redundant trusses. This latter class I consider to be imperfect, and avoid all mention of them in my work.

(2) It is observed that "in example, Fig. 23, at page 27, the joint, *l k j* M, is missed out." This remark, which applies only to the description, might lead some of your readers to imagine that this joint had been casually omitted in Fig. 27; whereas, as a matter of fact and observation, its reciprocal is clearly and identically marked in that figure.

(3) At page 178 I state a very simple and obvious truth, that the moment is expressed in terms of two factors; one, $x\,y$, being the numerical part; the other, E O, being the scale unit. Thus, $M = \overline{x\,y}$. E O. It is clear, therefore, that the larger the arbitrary scalar unit E O is taken, the smaller will be the numerical part $\overline{x\,y}$; but, in whatever terms it may be expressed, the absolute value of the moment remains the same. This being so, I am fairly puzzled to understand the following remarks of your critic:—"The larger E O is taken, the smaller is the scale to which the moment is to be read." He must evidently mean the smaller is the numerical factor $\overline{x\,y}$. Then comes the statement:—"The unit of scale is *inversely* proportionate to E O." Now, knowing that I have chosen E O as the unit of scale—which I am quite at liberty to do, and I further assure your critic that he will find it a great convenience to assume the polar distance as the unit—I should be glad to learn how a unit can be *inversely* proportionate in value to itself.

There are other points I should like to touch upon, but cannot do so within the limits of a letter. I must, however, observe that I not only explain Bow's method of lettering in a special chapter, but apply it to a whole series of examples; and in the chapter on wind pressures I adopt this method almost exclusively. It is quite true that, as a rule, I prefer the number method as being more practical and elastic in use.

In conclusion, and in reply to certain observations of your critic, I wish to emphasise my great respect and veneration for the name and authority of Rankine, from whose whose opinion I differ only in two instances, and there only in matters of secondary importance.

R. H. Graham.

London, November 28th.

[Mr. Graham certainly does not *say* in his book that he takes means in the above fashion. But if he will look carefully at his diagrams he will probably recognise that this is the accurate and most simple mode of describing his process. In taking the mean, of course, he takes account of differences of sign. I cannot agree that apparently redundant structures are really not so if they can be geometrically divided into a series of non-redundant structures. It is a false notion against which I protested in my review. I think your readers will understand the difficulty about the scale of the moment diagram without further explanation. The moment is to be read off in foot-pounds or inch-pounds or some such terms—say, inch-pounds. This moment is represented on the diagram by the length of a line. The moment has the same magnitude—that is, contains the same number of inch-pounds or foot-pounds, whatever be the length of the line representing it, just as it has the same magnitude whether it be expressed in inch-pounds or in foot-pounds. The length of the line representing it depends on the scale of the diagram, *i.e.*, on the length of line representing 1 inch-pound or 1 foot-pound if it is to be read in foot-pounds. If the line be short, the scale is small—that is, the length representing 1 inch-pound is correspondingly short. If it be long, the scale is large. Now, the length obtained on the diagram to represent any one of the moments is inversely proportional to the length of the polar distance E O in the reciprocal figure. If E O be taken great, the line obtained for the moment is short, and the scale therefore small, and *vice versa*. There is no mystery about the matter. A line represents inch-pounds to a *small scale* when the length that means 1 *inch-pound is short*.

The Writer of the Review.]

LEAD PIPES.

Sir,—At the conclusion of your interesting article under the above heading in The Engineer of November 16th, a theory is propounded as to the cause of lead pipes bursting from frost, which I venture to think is not quite correct, and I hope you will allow me to explain my view of the case. Any one who has had occasion to watch the formation of ice in, let us say, a common iron bucket filled with water, will have observed that there is no sudden transformation of the bulk of the water, but that the ice first forms in minute feathering spines, which slowly arrange themselves, and are joined by others until the whole of the surface is covered, and a thin coating of ice is formed. During this time, however, heat is passing off through the sides and bottom of the bucket, against which are formed exactly similar feathery spines to those formed on the surface, and the process continues until after a time there is a thick layer of ice exactly fitting the bucket, and enclosing a core, so to speak, of unfrozen water—Fig. 1—which, if allowed to freeze, and consequently increase in bulk about 8 per cent., will ultimately raise the former surface of the ice in the bucket somewhat as shown in Fig. 2.

Now this is, in my opinion, exactly the action which takes place in a lead pipe when it bursts from frost. Let B C—Fig. 3—be a lead pipe filled with water in a state of rest, of which C is the most exposed part. As the temperature of the outer air falls below zero the water in the pipe begins to freeze. Now the water in the pipe at C will become frozen first into a solid plug of ice, next the part

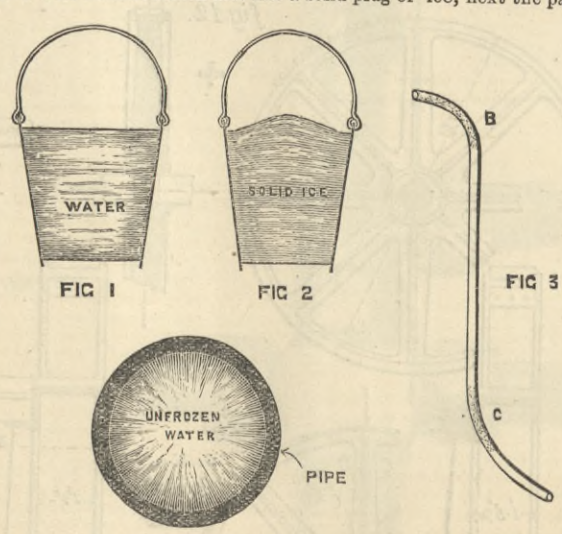


FIG 1 FIG 2 FIG 3

FIG 4

B near the top of the pipe will solidify, thus leaving a length of pipe between B and C practically isolated from the rest containing half-formed ice—as shown in section Fig. 4—which, as it gradually freezes, and consequently expands its 8 per cent., exerts an enormous pressure on the sides of the pipe, precisely similar to that exerted by the hydraulic testing machine, and hence the similarity in the fracture from these two causes.

The presence of air in the pipe would not, in my opinion, in any way promote its failure, for not only would the same force which is acting on the air to compress it be also acting on the sides of the pipe, which are as likely to yield to the one as the other, but, furthermore, the imprisoned air would act as an elastic cushion, tending in a great measure to prevent the pipe from bursting, and the more air present the less likelihood would there be of its doing so; and as a matter of fact I have effectually cured pipes which used regularly to burst nearly every frost, by inserting a short "dead end," so arranged as to be constantly full of air, and thus provide space for the water to expand into during the process of freezing.

I would further remark that although it is quite true, that taking the bulk of a unit of water at 4 deg. Cent. as 1·00000, it only expands as water to 1·000122 at 0 deg. Cent., yet as ice it suddenly increases to 1·0825 at the same temperature, which is in itself, I consider, ample excuse for any pipe bursting.

Wilfrid Stokes.

Kensington, November 20th.

THE EFFICIENCY OF FANS.

Sir,—Having during twenty years studied somewhat closely this subject, and noticed lately a discussion upon it, in which a good deal of fog seems to prevail, I feel constrained to join, and show, if possible, that you are mistaken in supposing that "little seems to be understood on the subject of fans."

I believe that, thanks to the labours of the late Mr. Atkinson, inspector of mines; M. Guibal, M. Murgue, and some others, we now know as much about exhausting air from a mine as we do about pumping water. I am aware that the engineering journals have never taken much interest in the question, but the "Proceedings" of the various mining institutes are comparatively full of it. The immediate subject, that of the Capell fan, is an absurdity from beginning to end. You say, "his fan is the result of no mathematical investigation." He practically admits that he knows nothing about the subject, and yet he seems to expect that he can drop into the arena in which so many workers have toiled for a quarter of a century, and, like a heaven-born genius, show at once a machine giving results 30 per cent. better than anything yet achieved.

I will endeavour to dismiss him shortly, and then put before your readers as succinctly as I can how the general question at present stands. His apparently remarkable results arise from the following causes:—(1) His quantity of air is wrong; (2) his water gauge is the same; (3) his fan and pipes are quite incapable of showing what would be the result if such a description of fan was put upon a mine; and it is upon this last condition that the question turns.

Mr. Allday says:—"When put to the practical test it was at once apparent that the bulk of his calculations were what he thought they ought to be, instead of the actual results." Of course they were; I saw that in the first announcements of them. But Mr. Capell is regardless of natural laws. What can we expect? He says:—"These simple rules have been adopted by the mining institutes; (3) the power of the engine increases as the cube of the volume of air passed, which in the new fan is not the case." That is, if you double the volume and double its speed the power required to do this does not increase as the cube. I think I may leave him here.

Now as to the general question. The rule you give for finding the horse power required is applicable if you have what is known as a displacement or varying capacity fan, like the Struve or Lemielle fan, and only move the air out of one chamber into another. But when you are dealing with air drawn through the channels of a mine, which in this district are several miles in length, then the proper formula is $\frac{Q \times h \times 5{\cdot}2}{33{,}000}$ where Q = volume, h inches of w.g., and 5·2 weight of a square foot of water lin. deep. To be accurate, Q must be corrected for temperature and barometrical condition.

As to fans, the open fan can never by any possibility equal the duty of a perfect covered Guibal fan, because it wastes the power still in the speed of the air when it delivers it into the resisting medium of atmosphere. Further, it churns the outside air to no purpose. Suppose you submerge entirely the paddle wheel of a steamer, and make it revolve, what effect would you get? Mr. Capell says, "the fan running empty with closed inlet takes more power than when passing 8000 cubic feet at 2in. w.g." I say, just so; he has no doubt read "So fight I: not as one that beateth the air," and he should have known better. M. Guibal did, and he covered his fan to prevent re-entry. Next he put on a movable shutter to adjust the outlet to the point at which by experiment he gets the best results, and last he added a chimney gradually expanding so as to deliver the air at the minimum of speed. These matters are all on a thoroughly scientific basis. In 1866 I brought them under the notice of the Northern Mining Institute, showing how each addition affected the result, and my note-books are full of tests and proofs since that time. It must be remembered that Guibal was not a novice, but an able engineer and mathematician.

I could go into many other points of much interest, but it would be too much to ask you, and I shall hope another time to make matters still clearer—especially as to the water gauge obtainable; the effect of various conditions of drag and volume; and the comparison of results obtained by the same fan on different mines. But enough for the present,

A. L. Steavenson.

Durham, December 1st.

Sir,—I have read with some surprise the statement of Mr. C. H. Treglown that the highest water gauge in the Birmingham trials of November 1st "never exceeded $1\frac{7}{16}$in." I think he has read *one* arm only of the U water gauge glass. The official record of the trial gives the air speed in the instance referred to as 4640ft. per minute. In an open tube the water gauge records the air velocity and air pressure with perfect accuracy. The actual water gauge for a wind velocity of 4299ft. per minute is 2in., for 5472·7ft. per minute is 3in. I quote Dr. Hutton and Lind's wind velocity tables—tables which are singularly accurate. From this it can be seen that the water gauge due to a velocity of 4640ft. is 2·77in. But Mr. Treglown's figures multiplied by 2 give us 2⅞in., which is very near the observed w.g. for a wind velocity of 4640ft. In the trials of November 1st there was only 9in. of tube on the 20in. inlet. The water gauge was taken close to a revolving helical arm I use in my open fans, and was very fluctuating. I agreed to have 6ft. of 20in. tube prepared, and to repeat the trials on November 3rd, assuring the members of the South Staffordshire and East Worcestershire Mining Institute that they would see higher water gauge and more even results as the consequence of using a 6ft. tube to steady the rush of air.

Mr. Alexander Smith and Mr. Walter Glennie attended on behalf of the Institute on 3rd, and I now send you tabulated results of the trials on November 1st, 3rd, 5th, 6th, 7th, for the accuracy of which the gentlemen who were present can vouch. If necessary I am prepared to repeat the trials, and I am certain my licensees, Messrs. H. Lloyd and Co., Steelhouse-lane, Birmingham, will afford every facility for doing so, and will answer any inquiries sent to them. I should like representatives from mining institutes to take part in any future trials, as I am convinced that seeing a trial is the only way to understand the power of the fans. In answer to the gentleman who mentions my courtesy in lending him a 20-blast inch fan, I think it would have been equally courteous to say that I told him the fan was one of a new design, untested by me at the time, and I could say nothing about its capability. I can now give the information he required. Low-pressure 20in. blast fan at 3000 revolutions gives 1000 cubic feet more air per minute than the 40in. Gunther type fan, and gives 18in. water gauge against 11in. of the Gunther fan. Of course the narrow high-pressure blast fans give far higher pressures in proportion to power used, but less volume.

I find I have omitted to reply to question about water gauge at various points in the inlet tube. The water gauge tube held in the open inlet becomes a wind gauge and gives an accurate record of the air speeds at the various points it is held in the tube or the open inlet. In the inlet of the 36in. fan there is a large box and three stays 2½in. deep. The friction caused by these in the passing air is instantly recorded by the water gauge falling when held close to them or in front of the box. So also, if the gauge tube is held touching the sides of the tube on the inlet. Half the tube is affected by the high velocity and half by the low

velocity current due to their friction against the sides of the tube. After the trials on November 1st some observations were made which confirmed this, but they were taken with the fan at low speed, and no counter was used to check observations. The results I have in a letter from the gentleman who took them:—Mid current, w.g., 1ft. 6in.; close to box, 1⅛in.; close to side of tube, rubber tube touching, 1⅞in. On Monday, 5th, one of the gentlemen who experimented with me on the 1st repeated the experiments at the end of 6ft. of tube, when the variations were found to be very slight and the water gauges at all velocities agreeing with the table I send you as taken on November 3rd, showing that the uneven results of November 1st were solely due to the water gauges being taken close to the inlet obstructions which reduced air velocity; and this reduced velocity was accurately recorded by the wind gauge use of the U water gauge. As my observations of water gauges probably extend in the aggregate to thousands of tests, what is matter of course to me is naturally new to those who have not gone into the matter in the same way.

G. M. CAPELL.

Passenham Rectory, Stony Stratford, December 3rd.

WATER GAS.

SIR,—I beg to inform "Verax" that the chief difference between the gas made in the apparatus patented by Mr. Kidd and that used by myself, is in the percentage of hydrogen. Two estimations of the first-named gas, made with the best anthracite obtainable, give 10 and 13·5 per cent. respectively. Two of the last named give 18·7 and 19·3 per cent., one sample being made with average quality anthracite, and the other with small "peas," costing only 3s. 3d. a ton at the pit. All the estimations were made by independent chemists.

In the practical working of the two apparatus there is also a considerable difference. Mr. Kidd ingeniously tried to produce his steam inside the gas generator, but the serious drawback to this arrangement was that if the generator fire were not very carefully attended to there was wet steam, which soon damped down the fire to an unworkable condition. In the apparatus I use I produce the steam in various ways, but all of them are distinct from and independent of the gas generator.

As to the working of gas engines, my experience has been almost exclusively confined to the Otto machines. My statements as to these are perfectly reliable, and can easily be verified. If "Verax" has obtained different results with an Otto or other gas engine of this class, I trust he will favour us with particulars.

J. EMERSON DOWSON.

3, Great Queen-street, Westminster, December 3rd.

SUEZ CANAL QUESTION.

SIR,—Although the Suez Canal question has been well discussed during M. de Lesseps' visit to England, there is one point to which I do not think any reference has been made, and which is the part the compound marine engine has played in the success which has attended the canal. It is really to the state of perfection to which this engine has been brought within the last fourteen or fifteen years that the success the canal has attained is mainly due, and this being the case, it is surprising that no allusion has been made to the subject.

Only for this invention it would have been impossible for any but heavily subsidised mail steamers to have made use of the Suez Canal between England and India; in which case it would have proved as great a failure financially as, fortunately for M. de Lesseps, it happens to be a success. This was well known to every one—to every engineer at least—who made the passage to India overland at the time the construction of the canal was being discussed. M. de Lesseps claims credit for having constructed the canal in the face of opposition. But the opposition he met with was, under the circumstances, fully justified. Besides this, had M. de Lesseps and his company not undertaken the construction of the canal at the time they did, it would have been constructed by England when it was required; that is to say, when her engineers had brought the compound engine to the state of perfection that admitted of long voyages by mercantile steamers being profitably made; and, had it been constructed by England, forced Egyptian labour—or more correctly slave labour—would never have been employed, as was the case during a great part of its construction under M. de Lesseps. Taking these facts alone into consideration, it will be admitted that M. de Lesseps is in no way justified in assuming the bearing he does towards the commercial representatives of Great Britain in regard to the Suez Canal. As one who has passed several times through the Suez Canal, I might perhaps be allowed to express an opinion with regard to the additional accommodation so urgently needed. I think that to widen the present canal in the manner suggested by Sir George Elliot would be the best arrangement. One particular reason why one wide canal would answer better than two narrow ones is the effect the greater body of water it would contain would have in preserving its banks from the heavy wash always caused by large ships when passing through a narrow canal such as the Suez Canal in its present condition. The risk of collisions has been mentioned in advocating the construction of a second narrow canal, but if the present one were twice its present width, and under proper management, there should be no reason to apprehend any inconvenience from this cause, while the time occupied in passing through would not exceed one-third of what is now required.

D. M. R.

December 3rd.

MACHINE RIVETTING.

SIR,—As I hope that your invitation to a discussion on machine rivetting may bring out some useful information on the subject, I venture to give you some brief idea of my own experience in this class of work. In the first place, machine rivetting is of little practical use unless it can be made to pay; and as there are several classes of rivetting machines—such as geared or mechanical rivetters, steam and hydraulic machines—it is important to know which is the best. So far as cheapness goes, there is no doubt that a good mechanical rivetter has distinct advantages over most hydraulic machines. The first cost is far less, the cost of maintenance is less, there is no risk of freezing, and the power is applied in a far more economical way. This last assertion may need explanation. In a hydraulic machine the full pressure of thirty or forty tons is exerted throughout the entire length of the stroke—say 6in. or so—whereas in a mechanical rivetter the full pressure is only exerted during, say, the last inch of the stroke, or while the rivet is actually being closed. A 2-horse power nominal engine will easily work a mechanical rivetter at the rate of ten strokes per minute; but to exert a pressure of thirty tons through a distance of 6in. ten times in a minute requires about 10-horse power net—*i.e.*, without taking into account either friction, leakage, or loss of power in pumping. As regards the pressure really required to close rivets, it is probable that this is generally overestimated. In practice it will be found that a pressure of 15 tons will close rivets of 1in. diameter—which is as far as my experience takes me—with great power and success. This pressure was at first roughly estimated by finding that a powerful rivetter would just, and only just, punch ⅝in. holes in ⅝in. plate, and was afterwards reduced to practice by having a machine made to exert a maximum pressure of 15 tons, which has proved very successful for work up to 1in. diameter.

Coming next to the actual working of the machine, there is much misconception of what can be fairly expected. A machine has no magic power by which bad work can be turned into good; and whoever expects to make up for all previous carelessness in the final operation of rivetting is doomed to disappointment. The best workmanship of any particular kind is always the cheapest in the end. In girder work, for instance, it is important to have a good run for the machine without stoppages. This means few bolts to hold the work together, as little drifting as possible, and no drifting whatever after the girder is slung for rivetting. This, again, can only be attained by care in each and every stage of the work. The plates and angles must be well straightened and free from twist, the holes must be accurately marked and accurately punched, smithwork must fit, butts must be good, and the work must be put together in an intelligent way by competent men. No closing of plates must be left to be done by the machine, if any reasonable speed in rivetting is expected. When these preliminaries are observed, either in girder or boiler work, and rivets of the proper length are used—*i.e.*, long enough to fill the holes and cup, but no more—it is impossible to spoil good work in any mysterious way, either by imparting too great stiffness, or by not humouring rivets that are all of the same quality and are brought out of a furnace at exactly the same heat, still less by bursting the holes to the plate edges, or by forcing the rivets between the plates.

On the other hand, it will be readily understood that if work is carelessly made, with no intelligent system, and with no regard to the final process, when at last it dawns upon the men that the work has to be rivetted, nothing but trouble and disappointment can follow. The long and short of it is, that machine rivetting is a specialty, and unless ihe whole system is intelligently arranged and worked out, a rivetting machine is of little value as a labour-saving appliance.

NEMO.

December 4th.

THE SOUTH STAFFORDSHIRE AND EAST WORCESTERSHIRE INSTITUTE OF MINING ENGINEERS.

A MONTHLY general meeting of the members of this Institute was held at the Mining Museum, Dudley, on Monday last, the 3rd inst. Before the ordinary business the president, Mr. H. Johnson, jun., spoke feelingly of the death of one of the late ex-presidents, Mr. W. North; and Mr. J. Hughes moved that a vote of condolence be conveyed to the family of the deceased, which was carried unanimously.

The discussion upon a paper, entitled "The Depreciation of Colliery Plant," read at a recent meeting by the vice-president, Mr. A. Sopwith, M. Inst. C.E., was opened by the secretary, Mr. Alexander Smith, M. Inst. C.E., reading the following critical notes embodied as a paper:—

Mr. Smith said that he felt considerable hesitation in approaching this subject after the very masterly and exhaustive paper read by their vice-president at a recent meeting; but the question was one of such moment to colliery managers and others interested in mining enterprise, or, in fact, any owners or managers of plant and machinery in general, that scarcely too much can be said upon it, and he therefore thought a few critical notes in the form of a paper from one who has had to deal with the said subject in his professional practice would be acceptable. Mr. Sopwith gives the gist of the whole matter as well and as concisely as it can be stated when he says:—"A perfect and complete system of depreciation for a colliery would mean the absolute determination of the value of the mining stock and plant taken at certain intervals, and also the quantity and value of the coal remaining to be worked; in other words, the difference in value, as shown by complete valuations at certain periods. In order to meet such decreasing value as would be shown by such valuations, it is customary to write off a certain sum annually. Now, if the sum written off be arrived at by a careful consideration of the actual depreciation of the various items, a fair amount of technical skill and knowledge must be devoted to the question; on the other hand, if it be deemed advisable to write off a certain percentage in a general way to cover depreciation, the question is practically robbed of technical interest, and becomes one of a purely financial nature." He perfectly agreed with the vice-president as to the principle he lays down, but would further observe that the absolute determination of the value of the mining stock and plant, taken at certain intervals, is the true and correct system, whilst the writing off a percentage is simply approximate, and unsatisfactory at the best. He must, however, differ with Mr. Sopwith as to this coming within the province of a mining engineer, and for several reasons. He was speaking now of the plant and stock proper, and not of the depreciation of the workings, which cannot be dealt with excepting by or with the assistance of the mining engineer. In the first place a mining engineer has enough to do in a colliery of any proportions in conducting the operations of the mine and properly carrying out the provisions of the Mines' Regulation Act, so as to ensure economy in working and safety to those under his charge; which latter is, of course, the most important consideration. Then, again, to properly value, so as to arrive at the depreciation, requires a special training, and the valuer must be an engineer acquainted with all the details of the several portions of the plant, not simply so as to be able to adapt them to the varying requirements of a colliery, but so that he may as it were reconstruct each separate item such as engines, &c.; and to do this he must have had a mechanical training, which Mr. Craig, M.P., in his recent splendid address at Mason's College, says, "is not essential to a mining engineer." Indeed, he cannot possibly give the time necessary to acquire it; and lastly, whilst upon this portion of the subject, as the dividends or profits can be materially affected by the valuation and depreciation of plant and stocks, it is much more satisfactory that it should be regulated by an independent person. It would be exceedingly interesting and undoubtedly useful to ascertain the lives of the principal items of plant and stock at a number of collieries; but, as Mr. Sopwith stated, the absolute determination of a standard is impracticable; if worked out for one colliery the results would differ from those of another, apart from the complication arising from the differences of construction. Identically the same machinery, doing the same amount of work, will last double the time in one colliery where they have regard to the necessary "stitch in time," that it does in another where things are neglected. After a thorough consideration of the details of the whole question, Mr. Sopwith gives the true solution in these words: "It appears desirable to pay special attention to details, and act in a systematic manner with regard to each item." There is no doubt that every tub must stand on its own bottom, and you can't adapt a general system to the depreciation of colliery plant. "Permit me now," said Mr. Smith, "to give particulars of a system I adopt in connection with the valuation of colliery plant, which accords with the ideas expressed by Mr. Sopwith, and which has grown out of a long experience. I think I am right in saying that upon the Earl of Dudley's estates there are more colliery plants than come under a single proprietary elsewhere in the world, and I am sure there is no more perfect system of book-keeping. To accord with this system annual valuations were started between forty and fifty years ago. I have the books for this period, and have personally made the valuations for nearly twenty years. In each colliery there are several plants, varying from two or three to thirty or forty, and each plant is put down to work a certain area of mine. That area is regulated and registered in the office of his lordship's surveyor, Mr. John Hughes—one of their ex-presidents—and every year a return of the area remaining ungotten at each plant is made to me, and upon it I base the depreciation. A new plant is first credited at cost price, and is depreciated each year as the mine is worked, so as to bring it to removal value at the time the mine is exhausted. Engines, &c., may be worth more or less at this time, in accordance with their condition, whilst buildings are worth only the value of the material you may get from them, and shafts and gateroads are of course worth nothing. Machinery is valued exactly in accordance with its condition, as it may have to be renewed several times during the life of a colliery, or it may be in a good condition at the end. An evil is therefore prevented, which would arise in the former case, were the depreciation treated in a lump, of the colliery not only having to stand the charge of a new engine, say, when renewal is required, but of the loss from its stock of the old one at far more than its actual value. By this system the correct value as near as possible is ascertained year by year, and depreciation properly considered. It is done entirely independent of finance, so that there can be no "cooking;" and I can truly say in regard to the large estate I have mentioned that I have never had the slightest idea whether a colliery was paying or not, and never saw a balance-sheet of any of them in my life. Now, with regard to the question of reserve funds, private proprietors may do as they like, but limited companies are bound to consider and properly deal with them. Whether or not it is wise to reserve a fund for the renewal of corpus is an open question; but "you cannot both eat your cake and have it." Some people prefer to have this portion of the profits for reinvestment, and it does not much matter either way; but it is absolutely necessary to have a wear-and-tear depreciation fund. Shares are a marketable commodity continually trafficed in, and consequently each year's trading and profits should be complete and independent. Portions of the loose plant are renewed and exhausted in a year, and revenue has to stand the brunt of it; but where items are reduced by depreciation in benefitting a year's trading, and such depreciation has to be made good in some future year, it is only fair that the value should be carried forward in reserve. On the other hand, any extension or renewals that are made in a year and are unexhausted, and will benefit a period of years, should not be done out of revenue at the expense of the profits, without being distinctly shown in the published accounts, so that the value of the shares may be increased thereby, as really a shareholder is entitled to all actual profit made in his year. This latter point is one much lost sight of by directors. In this paper I have only dealt with the principles of the subject, as the details are almost inexhaustible.

After an animated discussion in which Mr. Parton, F.G.S., Mr. W. B. Scott, Government inspector, Messrs. Treglown, Farnworth, Sopwith, and Hughes took part, it was resolved to have Mr. Smith's paper printed and circulated amongst the members. The Secretary called attention to an article which appeared in THE ENGINEER November 16th upon the "Efficiency of Fans," and the remarks therein having reference to the Institute. Having read the article and the letters bearing thereon from THE ENGINEER of Friday last, Mr. Smith said they would remember his connection years ago with the scientific press, so that they would take it as with some authority when he assured them the remarks would never have appeared had not the writer received from some good source the information upon which he founded his article. It was very unfortunate that statements contrary to fact had been furnished, and that they should have resulted in remarks disparaging to the Institute. It would be fresh in their minds that every one who had taken part in the trials time after time at the meeting pointed out the discrepancies, and they certainly furnished quite as clear an elucidation of them as the writer of the article. Instead of breaking up without coming to a conclusion, as they knew, a committee was formed who are to test the Capell and other fans with a view to getting satisfactory results, the figures obtained by Mr. Capell having been proved to be unreasonable. Messrs. Treglown, Sopwith, Glennie, Patfield, and others spoke in the same strain.

REPAIRING A SUSPENSION BRIDGE.

THE Suspension bridge, the link between the sister cities, Pittsburgh and Alleghany, which is travelled by hundreds of thousands of people weekly, has been in such a state of commotion, owing to the repairs being made upon it, that people have complained and growled at the inconvenience occasioned, all of which is an injustice to the bridge company in this instance. The work on the bridge is under the care of Mr. F. Collingwood, an old and experienced engineer, sent out by Colonel Roebling.

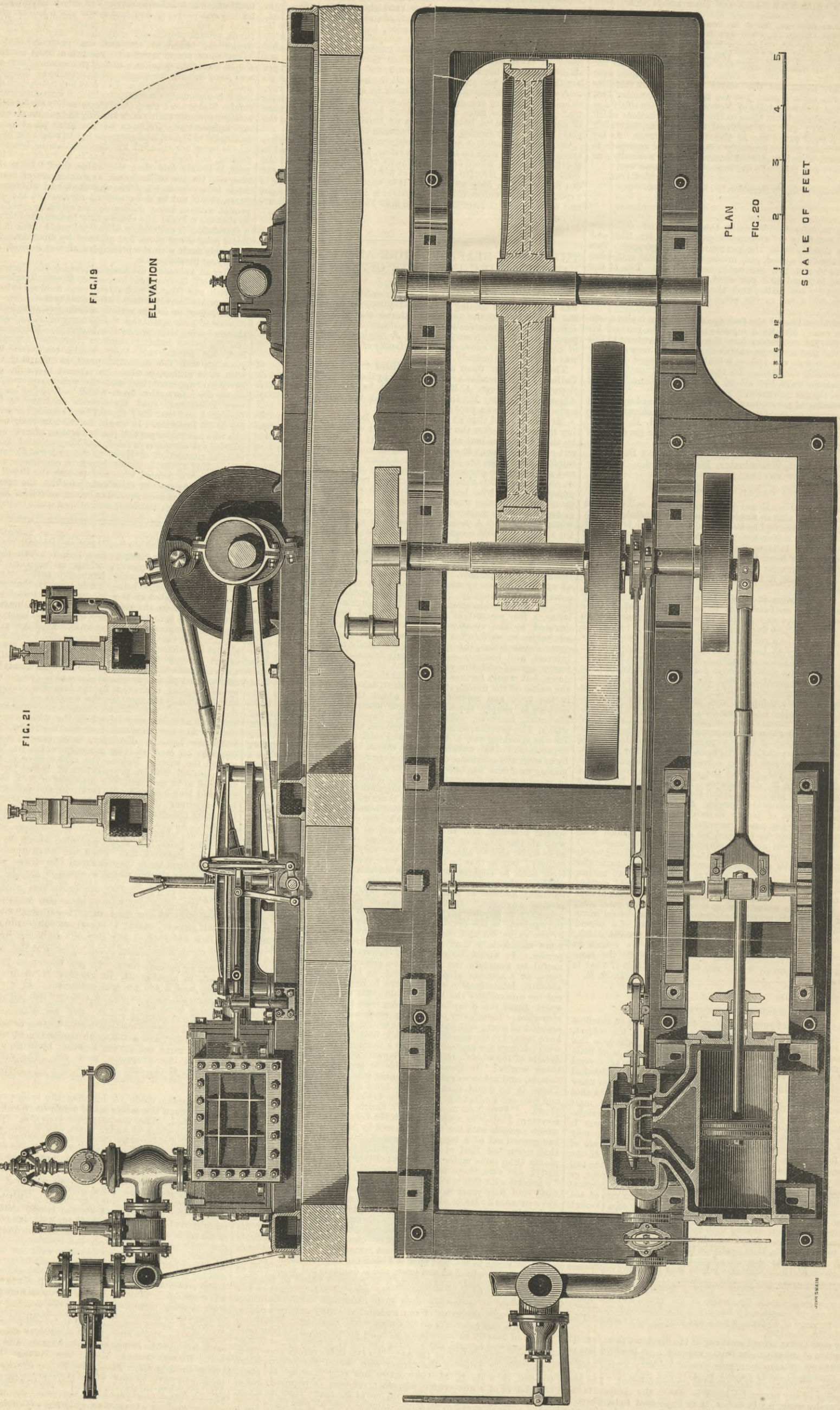
It has been twenty-four years since the bridge was built, and in all that time the moorings of the cables have not been repaired to any extent. Colonel Roebling thought it would be well to examine the wires and see what condition they were in, and it is well that such scrutiny took place, for the bridge was in danger of being ruined by the sagging and even by the breaking of the cables. There have been many changes in the manner of building bridges since this one was put up. These changes are improvemente in every way, both as to the way in which the wires are protected and in the way they are surrounded at the moorings. The large cables, which are 7¼in. in diameter, were closely surrounded at the moorings on each end by masonry which was concreted closely around the wires. Before the cables were so surrounded, they were covered with a preparation of boiled tar. Tar was once supposed to be an admirable protector of iron, but this belief was exploded long ago, and the result in the present case illustrates how injurious it is. The tar gradually, through atmospheric influences, changes into tar water, and this water was rapidly ruining the wire. The water contained chloride, carbonate, and other salts of ammonia, which ate the iron. Some pieces of wire were dotted with little holes, like small-pox pits, where the rust had gnawed away the material, and when the wires were uncovered and a strain put upon them they snapped like straw. Although each of the ⅛in. wires should stand a strain of over 1200 lb., they broke at 200. As soon as this state of affairs was discovered, Mr. Collingwood began to scrape the tar off and carefully overhaul each cable. Whenever a defective piece was found it was cut out and a new piece was spliced in. The splicing was a delicate and difficult piece of work. It is easy enough to join the ends together, but it is not easy to get just the right strain on the new piece. There must be no slack wires in the cable, of course, so each splice is put in with a grip machine and the amount of strain is kept uniform by delicate tests. In one large cable 175 wires had to be spliced, in another 31, in another 71, 5 in another and 31 in another, and 3 are not yet examined. It is very tedious work scraping each wire, as only a few men can work at a time. There are 600 of these wires in the big cables and 200 in the small ones, so that the amount of work can readily be seen. After the wires are scraped they are covered with a coating of linseed oil, which is allowed to dry, and a thorough application of white lead is given. Then the wires are drawn together by bands of small wire 7in. apart and the wrapping goes on. The wrapping consists of wire ⅛in. thick, and it takes 300ft. of this wire to a foot of cable. A coat of ordinary white lead and colouring finishes the work.

One mistake made in building the bridge was in putting the masonry round the cables at the moorings so that they could not be examined. The masonry has been all removed and a brick tunnel built which is water tight, and is provided with iron water shedders and covered by iron plates, which can be lifted when it is necessary to repaint or repair the cables in future. Where the cables pass through the woodwork, holes have been made so that all parts of the big wire can be reached at any time. The building on the lower side of the Pittsburgh end of the bridge has been torn down and a new office of Philadelphia brick is to be built. This was rendered necessary by the fact that half of the foundations of the building rest on the bridge abutment and half on made ground. The latter half sunk so as to cause a large crack in the office wall and make it dangerous. It is exactly the same case with the toll-house on the Pittsburgh side, and it will be replaced. A good deal of stone work on the pier nearest to Allegheny had to be replaced as the sandstone had decayed. The decayed stone was put in the pier in 1834 and was part of the old bridge which was enlarged and built upon when the present bridge was contructed. The nosings of the pier were also renewed. The work is being done entirely by Pittsburgh mechanics under Mr. Collingwood's directions. The cost of the repairs will not be over 10,000 dols. or 15,000 dols., and they will not be completed for a couple of months. Mr. Collingwood says that the flooring needs repairing, but the company has no seasoned wood on hand at present. He says it takes 10 per cent. yearly of the cost of a large bridge to keep it in good condition. None of the repairs were made necessary by the fire of two years ago, strangely enough. The bridge has safely supported a load of 22 tons on one wagon, but the engineers advise the directors to refuse to allow more than 12 ton loads to pass over.—*Pittsburgh Telegraph*.

AYR HARBOUR SLIPWAY HAULING MACHINERY.

MESSRS. J. AND A. TAYLOR, AYR, ENGINEERS.

(For description see page 450.)



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

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PHŒNIX.—*The Earl of Dudley, Round Oak Ironworks, Brierley Hill, Staffordshire, makes the brand you want.*

J. W. H.—*Engines properly made may be run at* 1200*ft. of piston speed per minute. It may, however, be taken as a general rule that* 150 *revolutions per minute is the highest number that any steam engine intended to last a long time and give little trouble should make. The double crank in your engine should have a pin of the same diameter as the shaft bearings at least. The single crank pin may be half their diameter.*

W. H. W. (Haslington).—*The pressure conveyed by your device to the lower ends of the tubes would have no effect whatever in the way you wish. The only effect the whole arrangement would have would be just that of a pair of weights hung from the fork ends, namely, their inertia would help to carry the bicycle over a small obstruction, and as much as their momentum was reduced under the circumstances would the tendency of the rider and the upper part of the machine to throw forward be lessened, but only to this small extent. To carry what is only equivalent to dead weights for this purpose would not be a device which would recommend itself to anyone.*

BLACK VARNISH.

(To the Editor of The Engineer.)

SIR,—Can any reader of THE ENGINEER recommend a black varnish suitable for small machines? I want it to dry hard and glossy. I have tried Brunswick black, but could not get good results without the application of heat. Judson's "black all" failed me too. J. S. C.

Dublin, December 4th.

THE NEW PATENT LAW.

(To the Editor of The Engineer.)

SIR,—I am, I believe in common with many others, much concerned as to communications from abroad under the New Patent Law. Briefly, will communications be received as at present, or will execution abroad and power of attorney, &c., be required from every

FOREIGN APPLICANT.

["Foreign Applicant" and others will be glad to learn that communications from abroad will be allowed as now. We may also inform him that he will have to send a drawing and description both sufficient to show clearly the character of the invention.—ED. E.]

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MEETINGS NEXT WEEK.

THE INSTITUTION OF CIVIL ENGINEERS.—Tuesday, Dec. 11th, at 8 p.m: Ordinary meeting. Paper to be discussed, "On Electrical Conductors," by Mr. William Henry Preece, F.R.S., M. Inst. C.E.

SOCIETY OF TELEGRAPH ENGINEERS AND ELECTRICIANS.—Thursday, Dec. 13th, the annual general meeting will be held for the reception of the annual report and election of council and officers for the ensuing year. The following papers will be read:—(1) "On an Instrument for Measuring the Strength of a Magnetic Field." (2) "On a Method of Calculating the Total Horse-power Expended in a Network of Conductors," such, for instance, as a system of street mains, by Mr. J. E. H. Gordon, B.A., Member.

SOCIETY OF ARTS.—Monday, Dec. 10th, at 8 p.m.: Cantor Lectures, "The Scientific Basis of Cookery," by Mr. W. Mattieu Williams, F.C.S. Lecture II.—The constituents of flesh. The action of heat on albumen, gelatine, fibrin, &c. The juices of flesh and their nutritive value. Exosmosis and endosmosis as operating in the kitchen. Maceration. Caseine. The cookery of cheese and its nutritive value. Milk, butter, and "bosch." Wednesday, Dec. 12th, at 8 p.m.: Fourth ordinary meeting, "The Preparation and Use of Rheea Fibre." by Mr. J. Forbes Watson, M.A., M.D. Major-General Henry Hyde, R.E., will preside.

DEATH.

On the 8th Oct., at Windsor, Victoria, MURDOCK CAMERON, late Engineer, Locomotive Department, S. A. Railway.

THE ENGINEER.

DECEMBER 7, 1883.

THE BOARD OF TRADE AND MERCHANT SHIPPING.

LAST week we considered at some length the first portion of Mr. Chamberlain's circular, and we pointed out, it will be remembered, that a system, not men, must be attacked; that the ocean cargo steamer is not in herself the defective craft that she is presumed to be; and that any plan intended to make the sailor's life safer than it is now must deal with insurance as now practised. Mr. Chamberlain in the concluding portion of his memorandum brings very heavy charges indeed against the existing system of insurance, and he undertakes to show that it may be altogether to the advantage of the shipowner that vessels should be lost. Now we are fully persuaded that the whole system of insurance as now practised is in many respects defective, and that it can be altered for the better; but it appears to us that the President of the Board of Trade has allowed his enthusiasm to run away with him, and that as a consequence he has drawn an impossible picture. If what he tells us is true, then the owners and insurers of ships must be exempt from all the laws of political economy, and the greater the loss the greater the gain, not to one person alone, but all round. As this is after all the most important question raised by Mr. Chamberlain, we shall deal with it here first, and return subsequently to the consideration of one or two other points which deserve notice.

Mr. Chamberlain quotes a statement made by Sir Thomas Farrar before the Unseaworthy Ship Commissioners, which we need not quote in full. It supposes the case of a ship intended to make a voyage to Calcutta and back. If she make this trip successfully, the shipowner will have in hand at the end of the voyage:—Value of ship (£30,000), less deterioration (£500), £29,500; gross freight, £12,000; total, £41,500; from which sum must be deducted the expenses he has paid, viz.:—Cost of provisions, £1000; wages, £1000; coals at starting, £800; coals at Calcutta, £1600; Suez Canal, each way, £1200; port expenses, Calcutta, £300; port expenses, London, starting, £300; port expenses, London, on return, £300; premiums, £1240; total expenses, £7740; deduct, £7740; total in hand at end of voyage, £33,760. In other words, value of ship at end of voyage, £29,500; net freight, £4960; total, £33,760. If, on the other hand, the ship is lost, say, in the Bay of Biscay, going out, the account would stand as follows:—Value of ship at commencement of voyage, £30,000; gross freight insured, £12,000; total, £42,000; from which sum must be deducted the expenses paid, viz.:—Cost of provisions in London, say, £500; wages, one-fourth of voyage, £250; coals at starting, £800; port expenses, London, at starting, £300; premiums, £1240; total expenses, £3090; deduct, £3090; total in hand at termination of adventure, £38,910. Thus, then, by the loss of his ship the owner would make £5150 more than he would have realised had the voyage been completed in safety. For the present we may assume that Sir T. Farrar's statement is quite correct. We find, however, that about £44,000 has in one case gone to the bottom of the sea, and that in the other case it has not. A very little reflection will show that someone must bear this loss, and the ordinary reader will say at once that it falls on the underwriters, and that they are poorer by £44,000 than they were before. But according to Mr. Chamberlain this is not the case; on the contrary, the more ships lost and the larger the sums paid by the underwriters, the more prosperous are these gentlemen. "But how about the underwriter?" says Mr. Chamberlain, "Does he not look after over-insurance and refuse risks so fraught with danger? By no means. *It is the greatest mistake to suppose that underwriters, as a body, have an interest in preventing shipwrecks.* So long as premiums bear a fair proportion to risks, the more the losses the larger the business of insurance. If there were no shipwrecks there would be no underwriting. *But the underwriter has a special interest in over-insurance.*" The italics are ours. Let us examine these statements and see what the whole thing really implies.

It will be seen that according to Mr. Chamberlain the ship loser is not poorer; he is really richer. Let us suppose that the hearts of the underwriters are to be made truly happy, and that the case supposed by Sir Thomas Farrar is multiplied by fifty-fold—instead of one ship and her cargo insured for £42,000, we will have fifty ships insured for £2,100,000, the premiums amounting to £62,000. All these ships are lost in the Bay of Biscay. Out of whose pockets will the £2,100,000 come? It is really difficult to understand how such an enormous loss as this could be a subject of congratulation to underwriters. It may be said that this is an impossible case, but it is only impossible in the sense that so many large ships would not be lost all at once; but whether the losses take place all in one month or during twenty years the result is the same—the underwriters have to pay. According to Mr. Chamberlain, the profits made by underwriting are so great that the loss of a ship is not deplored, but rather the reverse; but these profits are all derived from the shipowners and the freight owners. We may leave the latter on one side for the moment. If the underwriters make a profit, then it is as clear as anything can be that the shipowners not only cannot make a profit out of the wrecks of ships, but that such wrecks must represent a dead loss. To put this in another way, let us suppose that Messrs. Jettison and Average start in business as underwriters. For five years they steadily insure ships, taking, say, £6000 a year. They have no losses. At the beginning of the sixth year one of the ships insured for £25,000 is lost. Messrs. Jettison and Average pay the claim promptly. Is it not quite clear that in this case it is the shipowners and not the underwriters who have lost £25,000—gone to the bottom of the sea? Mr. Chamberlain is too shrewd a man not to see this, but he does not see it clearly and fully. He does not realise the fact that underwriters are, after all, only bankers, so to speak, for the shipowners; but he does partly admit the fact that a man cannot have his loaf and eat it, and that shipowners as a body really gain nothing at all by insuring their ships, and that Sir T. Farrar's statement possesses too limited an application to be of much value. The President of the Board of Trade, says:—"The convenience which shipowners merchants, and underwriters may find in the present sent system may be all very well for them, and yet a loss to the nation. It may spread the liabilities which ought to fall on their shoulders over the backs of the community, but it is not the less a national loss. The tonnage of British ships lost in the year approaches 400,000; that of ships suffering serious casualty approaches 700,000, and there are innumerable smaller casualties besides. What is the cost of this loss—including that of cargoes—to the British public? It is not easy to estimate it with any accuracy, but it must be enormous. At £10 a ton, 400,000 tons of shipping would be worth £4,000,000; at £20, £8,000,000; and cargoes are sometimes more, sometimes less, valuable than the ships themselves. Taking all sea casualties together, it would probably be no exaggeration to put the money loss to the nation at much more than £10,000,000 a year. Have inferior shipowners any right to throw away this amount of national property, even if we put the much more serious loss of life out of the question?" Nothing is more easy than to write about national loss, but a generality of this kind is quite out of place in this connection. How can it be shown that this is a national loss, save in a vague and general sense? If the ships are bad now, can they be worth £10,000,000? Let it be borne in mind that Mr. Chamberlain expressly contends that the loss of a ship is a gain to both the shipowner and the underwriter; but there must be a loss somewhere. "Oh," he writes, "that falls on the nation."

It may be urged that the dishonest and roguish shipowner makes his honest fellows pay for him. We quite see this; but does Mr. Chamberlain imagine that it is not also seen by those most keenly interested, namely, the honest shipowners and the underwriters? Those who best know what underwriting is, what freighting is, and what the whole shipping trade of this country is, do not require us to tell them that the President of the Board of Trade has, to use an American phrase, generalised too much. No underwriters will insure bad ships if they can help it. It is a matter of fact that a captain who has lost his ship from any cause whatever, finds it extremely difficult to get another berth, because underwriters either will not insure a ship at all if commanded by him, or will only do it at extra rates. Again, the underwriters, as a body, have called into existence Lloyd's Registry, and there is a similar institution in Liverpool. Instead of the species of reckless gambling which Mr. Chamberlain appears to think it, underwriting deserves to be ranked almost as one of the exact sciences. We do not deny for a moment that a certain species of gambling is carried on to a limited extent. We do not presume to assert that all underwriters are absolutely immaculate. But we do maintain that the sketch which Mr. Chamberlain has given us of the shipowner and the underwriter who make incredible profits out of absolute losses, is exaggerated and inaccurate. Mr. Chamberlain uses, and very neatly, certain quotations and appliances to illustrate the meaning. We venture to use one ourselves to illustrate our contention. A traveller in France chanced during a night journey with post horses to see only two individuals; a landlord who was drunk, and a market woman who had red hair. He wrote in his diary that in the north of France "all the men are drunkards and all the women have red hair." This picture was very nearly as accurate as Mr. Chamberlain's. According to him all shipowners can make a profit by losing their ships, and many of them succumb to temptation. All the underwriters make a profit out of wrecks, and will underwrite anything. Once more we counsel a little caution on the part of the President of the Board of Trade. Things are not precisely as he would have us believe, and precision on his part is essential to his success. There are beyond all question bad ships, and reckless men, who can do much as they please under the existing law of insurance, and a change is needed; but none will treat this change with more pleasure than men for whom, as a class, Mr. Chamberlain can now hardly say a good word. It is to be regretted too that he makes no sign, gives no indication of what the change in the law ought to be. "Much more," he writes, "might be said on the subject of insurance; on the want in many policies of any sufficient warranty of seaworthness; on the doctrine of abandonment and constructive total loss, under which a shipowner, by proving his ship to be worth £15,000 only, can compel and has compelled the underwriter to pay him £36,000 for her; on the doctrines concerning prepaid freight, under which the shipowner can keep his freight and get rid of all obligation to earn it; on the trial by a jury of cases of unseaworthiness, where a judge who knows little and a jury who know less are set to try questions which ought to be specially reserved for experts. But this is not an essay on the merits of the law of freight, insurance, and liability. It is only an attempt to call attention to the broad features of that law which inevitably encourages shipwreck. For the same reason no attempt is made to show in what way these laws may best be amended. That is a question for statesmen and for experts." Any suggestions which Mr. Chamberlain might make would meet with the careful consideration which they deserve.

Before concluding we wish once more to point out that Mr. Chamberlain has our warmest sympathies. His intentions are eminently meritorious, but his methods are unstatesmanlike. His charges are too sweeping, his deductions too loose, his helplessness to suggest a remedy too obvious. The subject is one of really national importance. Very great mischief may be done by intemperate zeal. No one knows better than Mr. Chamberlain that legislation has, up to the present, proved futile. Unless the utmost caution is now used, further mistakes will be committed, and the making of new shipping laws will be simply waste of time.

GROYNES AT BRIGHTON.

IN our issue for November 23rd last we published a letter addressed to us by Mr. Ellice-Clarke questioning certain remarks we made relative to the works erected under his direction for the protection of the foreshore at Hove. That letter stated that the article containing these remarks had not been read by the writer, and that the information which called forth the former had been received at second hand. Had Mr. Ellice-Clarke read our article, he would have found that the impression he was under that we had stated that all the defences erected by him had been washed away was entirely erroneous. What we wrote was, "The temporary defences erected to protect

the embanked walk of the lower esplanade have wholly disappeared." Only one other remark capable of any possible misinterpretation was that referring to the recent gales, that they had "been disastrous to the works which have so long been in progress." The context would, however, show that we referred to "disaster" only in connection with the proof afforded that these works had failed to fulfil their purpose. The permanent works, we are glad to say, remain uninjured, and it was only those of a temporary character that we named as having been washed away. We take the opportunity afforded by the occasion for this explanation, which is demanded by Mr. Ellice-Clarke's letter referred to, to name one point in connection with these destroyed temporary works which seems to call for remark. With the view of securing the shingle accumulated to the leeward of one of the large masonry groynes, piling had been driven seaward of it, and *at the rear* of this had been spiked planking to retain the beach in position. The result which followed should, we think, have been foreseen. Apparently it had been deemed that the backing of shingle would suffice to enable this planking to withstand the force of the waves; but this was surely expecting too much of so easily mobile a material as shingle. A very short exposure to the broken water forced above, and through the interstices between, the planks, sufficed to dislodge the beach somewhat, and the planking was then left without the least rearward support. But few blows from the waves were, we imagine, sufficient to tear out all the spikes by which it was secured to the piling. Manifestly, we should say, the planks should have been secured to the seaward face of the piling. It is true that in the construction of wooden groynes the reverse course is followed, but in such cases the function of the boarding is not to withstand the force of the sea, which is directed along its face, and is not, as in the case of the destroyed work referred to, exposed to its direct strength. When used in groyning, the function of the boarding is to take the weight of the shingle accumulating to the windward of the groynes, and to fulfil that efficiently, of course the planks should bear against the piles. The reversed demand in the instance of the temporary works should have induced a reversal of the treatment to meet it.

On Friday, November 16th, five days earlier than the date of Mr. Ellice-Clarke's letter, and a week after our latest article on this subject appeared, there occurred at the Hove works an inrush of the sea the character of which was greatly opposed to much that we have written on this subject, and which goes far to support our early contention, when we first commenced writing relative to these works, that it is almost impossible to decide on any course which shall meet every particular phase of action of wind, waves, and currents. The sea on the day named was not particularly high, nor did we observe any particular congregation of natural forces likely to produce abnormal action. And yet a most unforeseen result followed. To the *leeward* of one of the large masonry inclined groynes, the sea ran up with such force that the whole of the ground on which the contractor's workshops had stood during its construction was carried away, and the esplanade breached up to within 4ft. of the green itself. This was, perhaps, nearly the most serious of any of the mishaps which have taken place, and occurring—as we have italicised—to the leeward of the groyne, shows that Mr. Ellice-Clarke's new system of dealing with such constructions is not infallible.

In the letter of that gentleman which has called forth these comments he stated that he considers immunity has only been secured in the instances where he has carried out the groynes at angles more widely divergent from the right angle than the masonry groyne referred to in the preceding paragraph, and he claims perfect success for such instances. We fear that our latest observations do not bear out that claim in its entirety. True it is that to the leeward of such flat groynes—to coin a word seemingly appropriate to them—there has been, and still remains, a considerable accumulation of shingle denoting the absence of scour met with where groynes are carried out at a right angle with the shore line; but this seems to have only been secured by transferring the destructive action to the *windward* face. In every such instance we noticed that the sea had cut deeply into the parade immediately adjoining the root of the groynes on the *windward* side, and we could see but little of the shingle in those positions in which Mr. Ellice-Clarke assures us it has been retained in sufficient quantity to protect the shore. The unexpected in road we have named as having taken place on November 16th on a leeward face is pretty good proof that no system of groynes can be devised which shall be certain of acting effectively in all cases; and it affords ample justification for the decision now arrived at by the Hove Commissioners to abandon further trial of such systems and to fall back upon the sea wall we have recommended from the first. This determination shows that groynes are to be given up because those of the solid wall type are found unsuccessful. Why try to stop the sea instead of checking it?

There is one further point which is raised by this letter. We have before named it to be Sir John Coode's intention to adopt, in the case of the groynes proposed by him for the protection of the sea wall and to be constructed after his designs, the very reverse of the plan which Mr. Ellice-Clarke contends in his letter to be a perfect success. It is evident, therefore, that we have here two practised engineers holding diametrically opposed opinions. Which, we wonder, will prove to have been in the right; or will it eventually turn out that, given the varying conditions of natural forces, they will both be sometimes right and sometimes wrong? Anyway, we cannot now, after what we have seen, place absolute reliance on the system just about to be abandoned, and time alone can show whether its reversal will bring about better results. Meanwhile we hear that tenders for the sea wall were received by the Hove authorities last week; but we have heard the opinion expressed by local professional men that the foundations of the proposed wall do not go down deep enough by at least 5ft. to ensure security. We should say, however, that the long experience of Sir John Coode is not likely to permit an error in a matter of this kind.

THE EFFICIENCY OF FANS.

Mr. Steavenson's letter, which will be found in another page, is a useful contribution to the discussion now going on in our pages, and deserves some comment at our hands. It will be seen, too, that the South Staffordshire Institute of Mining Engineers consider that we have wronged them, and this we regret. Nothing, of course, was further from our intention. Those who have followed the discussion which has taken place in our pages cannot fail to be struck with the extreme vagueness of the various statements made. Mr. Capell's figures are inconsistent with each other, and have, it appears, quite perplexed him. He does not know what to make of them. The South Staffordshire mining engineers have not, so far as we can find out, done anything save advise that further trials should be made. If they have taken further steps in the matter it is without our knowledge. Our correspondents find fault with the Capell fan, but they are not agreed among themselves as to what is wrong about it or the inventor's figures; and now Mr. Steavenson comes on the scene and states that not only is Mr. Capell entirely wrong, but that our method of calculation is of limited application. If Mr. Capell has done nothing else, he has at least succeeded in putting a good many people into a ferment about fans.

For the present we shall not attempt to interfere between the combatants. Indeed it is not easy to find any tangible fact or argument that can be discussed. No one seems to know how much Mr. Capell is wrong. All that we can do in one way is to suggest that some experiments should be carried out by a competent engineer to test the accuracy of Mr. Capell's claims. Mr. Steavenson has, however, made a definite statement concerning our mode of calculation, and on this we have something to say. Mr. Steavenson seems to confound two things, namely, fan resistance and net work done. Now, our mode of calculation has nothing at all to do with resistance; that is to say, it takes no account of loss by friction, or churning the air, or anything of that kind, and we hope to convince Mr. Steavenson that it is applicable to a fan of any possible type, and is not limited as regards its utility to such fans as Struve's, as he would have us believe; nor is it less applicable to suction fans than it is to blowing fans. The work done by a fan consists in putting a body of air previously at rest into motion. The circumstance that this motion results in changing the air in a mine, or in urging combustion on a smith's hearth, in no way affects the phenomena with which we have to deal. The valuable work done by a fan can always be expressed in terms of pounds of air and the velocity of the current in feet per second. The nearer to the fan we collect our data the better for the fan, because sources of error are avoided; and the best place to measure velocity is, no doubt, as near as possible to the tips of the fan-blades in the delivery pipe. But we may measure the velocity anywhere, without doing the fan much injustice, provided we make allowance for the effects of bends and frictional resistance. Under these circumstances we fail to see why Mr. Steavenson would limit the application of our rule, as he wishes to do. The work carried away in the moving air has all been put into it by the steam engine using the fan as an instrument. The work done by the engine may be greatly in excess of that stored up in the air, but it cannot possibly be less; and the nearer this stored-up work is to the power developed by the engine the better is the fan. We must ask Mr. Steavenson, if he does not concede this point, to explain on what data he proposes to estimate the relative value of fans. The formula which he gives is unsatisfactory. Every formula which deals with the pressure of the air going into or leaving the fan must be more or less misleading, because there is no fixed and invariable relation between the pressure and the quantity. Under some conditions, however, pressure is the thing wanted, quantity or volume being of secondary importance. Then efficiency is measured on a different basis, the height of the water gauge being most considered. Thus, for example, two fans are sometimes backed on each other, one fan blowing into the other. The result is, of course, a greatly increased pressure of blast, but there is obviously no increase of volume. For the most part, however, volume or quantity is the thing demanded, and this is especially true of mine fans. Mr. Steavenson, we may here point out, makes a curious mistake in speaking of the Guibal chimney as gradually taking the velocity out of the air and so promoting efficiency. This is not so; chimney or no chimney, the fan has to put a certain quantity of air in motion at a given velocity at the smallest part of the outlet, and this is the place where efficiency is to be measured. The widening of the chimney is useful, but only because it reduces resistance, not because it saves work already stored in the air which would otherwise be wasted. Mr. Steavenson has here confounded a driven fan with a driving fan. Thus, if we take the case of a turbine, the water ought to leave the rotating fans with the smallest possible velocity in order that no work may be carried away in the water; but there is no true analogy between the turbine and the fan, because in the latter case we want to move a body of air, and if the velocity be very small so must be the volume of air, and we should defeat ourselves. It is impossible to make a turbine which will not discharge water with some velocity, and it is equally impossible to make a fan which will do this.

One point deserves notice about the rule we have laid down. It will be seen that the work done on the air varies as v^2. That is to say, if we double the velocity at which the air leaves the fans we double the quantity or volume, but the power required will be—other things being equal—not double, but quadrupled. It may be said that this is not consistent with existing theories, to which we can only reply that the theories are wrong. The formula $\frac{M v^2}{2g} = E$ is indisputably accurate. In dealing with fans nothing is more easy than to make mistakes concerning the weight of air moved, and these mistakes will sometimes show that a fan is more efficient at high speeds than at low, in spite of the formula. We cannot give a better example of the work done by a fan than to suppose a train moving at a moderate velocity along the front of a large grain store; as each wagon comes under a shoot bag of wheat is dropped into it. The wheat had no horizontal motion until it touched the train, its inertia is overcome, and it acquires a velocity of say ten miles an hour. The whole of the work so done remains, in common scientific parlance, in the wheat, as would be quickly found if the train came into collision with another; and the work done in starting the bags represents the energy expended by the engine usefully, the force expended in moving the train overcoming friction, and so on, is waste, and the analogue of this waste is found wherever a fan is used.

THE UNITED STATES CRUISERS.

Our contemporary, the U.S. *Army and Navy Journal* for November 17th says:—"The New York *Sun* learned on Wednesday by way of Washington that the London Engineer had published an article severely reflecting upon our new naval cruisers, from which a short extract was given, this being followed up on Thursday with further extracts. As the article from The Engineer was published in full in the last number of the *Journal*, the *Sun* is a little late with its information. We intended to say something in reply to The Engineer, but have only space now to say that if our engineering talent is so far behind the times as our contemporary would have us believe, it must have deteriorated since the days when we produced the Iroquois, the Merrimac, the Niagara, and later the Wampanoag, vessels which certainly stood very high in the opinion of our foreign brethren when they first made their appearance. We can only bide our time, and trust that the measured mile speed of the Chicago will not fall below that indicated by Mr. Bowles in his admirable paper published by the Naval Institute." We are sorry to find our contemporaries quarelling as to which first reproduced our criticism on the United States cruisers. We would venture to hint that The Engineer is itself actually read in the United States, so that this contest for priority is after all only a fight for the honour of second place. We regret that the *Army and Navy Journal* has not had space to comment on our criticism. As to the ships named we never before heard that they were successful. The Merrimac was a useful makeshift; but it requires considerable audacity or great ignorance of facts to speak of the Wampanoag as a success. May we ask our contemporary to say where she is now and what she has done? It is not yet too late to alter the design of the Chicago, and if the alterations are made Americans will perhaps have reason to thank a journal, which has not hesitated to tell them the truth, rather than the American press, which can see no defect in anything American. We respect patriotism, but this is not patriotism.

TYNE STEAMERS AND THE LOAD LINE.

The action of the Board of Trade in regard to the load-line question applied to steamers loading in the river Tyne has caused of late much discussion. Several steamships which have been loading coal have been detained; coal has been ordered to be taken out. In one or two recent instances the order has been declined by the owners of the vessel, and it has been allowed to sail unquestioned. In another and more recent instance, a steamer went to sea from the Tyne under novel circumstances. The Board of Trade defined a certain load line; the owners demurred to it, and boldly stated that the vessel would be loaded in the river Tyne to a deeper depth. Officials of the Board of Trade inspected the vessel, and though the exact depth to which the vessel was loaded seems to be disputed, yet it seems clearly proved that the vessel left with less freeboard than that fixed by the Board of Trade. It is evident that cases such as these must destroy any influence that the Board has. It is clearly proved that the Board has ordered a load line allowing a certain depth, and that vessels have been suffered to leave, after delay, loaded deeper. If the load line is to be one that allows less freeboard to vessels whose owners contest the question than to those whose owners accept the decision, there will speedily be such a crop of litigation as will upset any load-line rules. Without here expressing any opinion on the exact point at which the load line shall be drawn, or the persons to affix it, or to determine complaints, it must be acknowledged that one of the great needs in regard to the question is that of a consistent method of determining the position, and one that will be adhered to. The detention of a vessel for ten days, and then allowing the vessel to leave with the same cargo, is a step that only needs to be repeated a few times to destroy all the influence that the Board of Trade has with the shipowners.

LITERATURE.

Chemical Percentage Tables and Laboratory Calculation. By C. H. Ridsdale, F.C.S., of Stockton-on-Tees. London: Crosby Lockwood and Co. 1883.

This is a useful little book. "Whilst it is essential that every chemist should thoroughly understand how to do his calculations, it does not follow that he should actually do them *ad nauseam*, and for his benefit I have framed these tables," writes the author in his preface. Part I. consists of tables, showing at a glance the percentage of various substances from the weight of precipitate obtained. Sulphur in barium sulphate, sulphur indicated by copper oxide, silicium in silica, manganese in manganese protosesquioxide, lime in its carbonate, anthracene in anthraquinone, lime in its sulphate, besides a host of other determinations, can all be readily made out. The name of Eggertz in double inverted commas at the top of page 63 will be a puzzle to those who do not already know its signification; those who do may rightly ask why the double inverted commas, and why is the sign of the possessive case omitted? Again, on page 73, we have a heading, "Slag.—Lime," which in the Table of Contents is given "Slag-Lime," which deals with the determination of the percentage of lime in slags. On page 74 we have the heading, "Spiegel, Ferro-Manganese," which subjects are treated of in six lines, while the existence of a paragraph more than double the length of them on the determination of copper is not indicated at all in the heading. These are blemishes which should be set right in another edition.

The tables in the first part of the little book are the most useful portion, and they appear to be very free from error. Such tables require careful editing, or they may lead the chemist terribly astray. It would be well here to

direct the reader's attention to two important errors in one of the tables in the *Anleitung zur quantitativen chemischen Analyse*, of Fresenius, fifth edition, published in 1866. They are to be found in the fourth table of the Appendix, to which many chemists turn at the conclusion of an analysis to calculate the amount of some constituent of each precipitate that has been weighed. On page 987, and in the column with the heading 4, where the amount of pyrophosphate of manganese having been determined, that of the phosphoric acid is required, the number 1·55856 should be 2·55856. On page 989, in the column with the heading 9, where the amount of oxygen in a certain weight of lime is given, the number 1·57143 should read 2·57143. The latter misprint also occurs in two of the English editions of this work, edited by W. Lloyd Bullock, F.C.S., and published, the second edition in 1854, and the third edition in 1860.

Arithmetical Chemistry, or Arithmetical Exercises for Chemical Students. By C. J. WOODWARD, B.Sc., Principal, Chemistry and Physics Department, Birmingham and Midland Institute. Part II. London: Simkpin, Marshall, and Co. 1883.

THE author says in his preface, "I had but little idea of the time and trouble connected with the preparation of this small volume, and I am indeed pleased to see the last sheet through the press." We should almost be disposed to differ from the author as to the accuracy of the title. Such symbols, and the use of them, can surely hardly be described as "arithmetical":—

$$N_h\ M_h\ V^2_h = N_o\ M_o\ V^2_o \quad . \quad . \quad . \quad . \quad . \quad (b)$$

And there are pages to which this remark may be applied. He divides the subject into several heads, such as Laboratory Calculations; Gas Analysis; Density of Molecules, in form of vapour, liquid and solid; Thermo-chemistry; Gaseous Phenomena; Miscellaneous Problems; Answers to Problems; and References to works in which students will find information. On page 6 we read of Cook's *Chemical Philosophy*; this doubtless means Cooke; and on the next page he gives as an exercise the numbers indicating the composition of stilbite, and in the answers to this exercise he gives the formula of stilbite with no oxygen combined either with aluminium or calcium. On page 18, where treating of gas analysis, he speaks of bullets of papier-maché, "which are cast in a bullet-mould, the platinum wire being inserted through a notch cut in the bullet-mould opposite to the hole through which the metal is usually poured in." This is not necessary; the one hole certainly sufficing for the making of the balls according to the method of Bunsen. On page 23 we read of Thomas's analyses of coals for the South Wales Basin, when they were placed in the vacuum of a Sprengel pump—*Quarterly Journal of the Chemical Society*, vol. xxviii. Gay Lussac is the way in which the French chemist is spoken of invariably; we have always seen it written Gay-Lussac. He refers to a supplement of Watts's Dictionary as *Watt's Dic.* iii. sp. 926. This should be *Watts' Dic.* viii., Part II., 926. A specimen of argentiferous copper glance, referred to on page 72, comes from Rudelstadt, not Rudostadt, in Silesia. Among some questions taken from papers set by the Science and Art Department, and set as exercises for the reader, is one given last year, the answer to which he confesses to be incorrect; but he does not give the correction. Had not this one better have been left out altogether? At the end he refers to books in which the student will find information on the subjects treated in the volume. One which he quotes is *Roscoe*, where the word indicates a treatise on Chemistry, by Roscoe and Schorlemmer, in several volumes. There are at least two separate works by Roscoe, and for one of them surely the name should stand.

FOREIGN NOTES.

Galignani, of November 17th, gives particulars in addition to those recently published in these pages about the Panama Canal. The entire excavation, in accordance to the latest estimates, will amount to 100,000,000 cubic metres, instead of the 80,000,000 originally calculated. The earlier estimates proceeded on the assumption that a large part of the excavating would be through hard and thick rock formation. The walls would have been almost vertical where this rock formation existed, and the original estimates were based on this condition. It has since been discovered that the rock formation is not thick enough to form such walls. The excavation must, therefore, be wider, with a consequent increase in cost, but compensation is found for this in the decreased cost of construction. The health of the labourers is much better than was expected in a tropical climate, the worst month in the year showing only 10 per cent. of the whole number employed on the sick list. The workmen, who are negroes from the West Indian Islands, receive from 1·25 to 1·50 dols. a day; they are paid regularly, and treated well in all respects. The whole undertaking is expected to be finished in 1888.

At Nice towards sunset the weather becomes intensely cold in contrast with the warmth of the day, and nearly everyone keeps indoors about the time of the setting of the sun. Consequently six hot-air stoves have been fixed in the International Exhibition building, and the warm air will be distributed by the aid of an engine of 200-horse power. The pavilions in the park will be warmed by another system. After the Exhibition is opened various experiments will be made as to the fire-resisting powers of various fire-proof safes. Still more electric light power is being added, that, by means of night work, the Exhibition may be opened at the time specified.

The great improvements going on in Rome in the pulling down of old buildings and widening of many of the thoroughfares are not being made by the destruction of buildings of historical interest. All these are carefully preserved and brought better into view by the abolition of the slums around them.

An ice-making machine, invented by Professor Raoul Pictet, of Geneva, was on view at the Swiss National Exhibition at Zurich, with sulphurous acid as the refrigerating liquid. With a given quantity of sulphurous acid it is easy to rapidly freeze several times its volume of water, and the apparatus is so constructed that there is little tendency to the destruction of the containing vessels by chemical action; sulphurous acid is more manageable in this respect than liquid ammonia. The latter is best worked at high pressure, say, from 12 to 20 atmospheres, and Professor Pictet's machine is worked at a mean pressure of 2·5 atmospheres. It is also stated to work for six months with a loss of but three kilogrammes of acid. The construction is on the usual principle of reducing the pressure of the liquid by means of steam power, to produce cold, and to condense the evaporated liquid in an adjoining chamber for future use. One of these machines is in use at the skating-rink at Southport, three in Geneva for ice-making, three in Paris, one of them at a chocolate manufactory, two in Naples, one in Xérès to improve the quality of wines, six in Cairo, four in Japan, and one in Chicago, to aid in the potting of preserved articles of food.

In one of the theatres at Rome a thin iron curtain has been placed, to separate the stage from the body of the theatre in case of fire. The curtain is in two parts, one fixed and the other movable. The latter is let down and raised by hydraulic apparatus. While it is falling, a bell is rung continuously by automatic action, as a warning to actors beneath to get out of its way.

Various Italian railway authorities are now meeting in Turin, to consider what railway facilities can be given to exhibitors and others in relation to the International Exhibition of 1884 in that city.

The Swiss lakes are all more or less subject to the influx of sudden gusts of wind, a kind of "wind avalanches," about which more might be learnt were anemometers more numerously used by meteorologists in Alpine valleys and passes. Many years ago, a passenger steamer on the Lake of Wallenstadt was overturned by one of these sudden gusts, and everyone on board drowned. The steamboat was afterwards raised. Only last week, a boat laden with hay was upset in the Lake of Neuchatel by unexpected wind, and the four men in charge saved by the Neuchatel lifeboat manned by eight men, one of whom was a lawyer, M. Monnier. Judges on circuit are paid but a few shillings a day in Switzerland, and lawyers help to save life like ordinary mortals.

The directors of the Manitoba and North-Western Railway have been holding meetings throughout the counties of Russell and Shoal Lake. They ask these municipalities to vote the company a cash bonus, to aid in the construction of the line through their respective localities. The road has now reached Minnedosa, from Portage La Prairie, some seventy-five miles; and it is proposed to extend its construction next summer to Shell River, a distance of 100 miles. These counties are sadly in need of railway facilities to carry the settlers' produce to a market, and as the proposed line runs through the "Fertile Belt," it is sincerely hoped that the necessary funds will be forthcoming.

The question of the construction of the Hudson Bay Railway is again agitating railway circles. 11,000,000 dols. is required to build and equip the road, and it is proposed to hand over the stock to the local Government in trust for the people, and to issue debentures for twenty-one years. A tax is to be levied on the municipalities of the province to meet the interest thereon. It is thought that 4 per cent. bonds on the security of the province can easily be floated in England. The length of the line from Winnipeg to its destination will be 572 miles. Leaving Winnipeg, it will go direct to the Narrows, *viâ* Stonewall, over a prairie section comparatively easy of construction, thence crossing the Saskatchewan at Grand Rapids. The line will hug the west shore of Lake Winnipeg, and at the north-east will diverge in an easterly direction until the first rapids of the Nelson River are reached, thence along the south shore of the Nelson until deep water is reached at its mouth near Hudson Bay. This route presents very few obstacles to rapid construction.

A deputation representing the Amalgamated Hudson Bay Railway Company waited on the local Government recently. The deputation asked the Government to memorialise both the Imperial and Dominion Governments on the necessity of making an exploration of Hudson's Bay Straits to ascertain whether its navigation was feasible, and during what months of the year its dangers would be less from floating ice. The Government promised to memorialise both Governments, and lend all other assistance possible, but they showed it was impossible for them to take any direct interest in the road.

Canadian Pacific Railway contractors are returning from the end of the track west. They report work suspended for the winter, pending a final settlement of the adoption of a pass through the Rockies. It is again reported that there is a doubt as to whether the Kicking-horse or Howse will be adopted. The latter will be at least thirty miles longer, but construction through it will be easier and cheaper than by the former. Grading has now been completed to the summit of the Rocky Mountains, 962 miles west of Winnipeg. Track has been completed eastward from Thunder Bay to Nepigon. The main line of the eastern division is now completed from Montreal to a point about 100 miles west of Lake Nipissing. Thus by the end of this season only 617 miles of main line will remain to be completed, 263 miles of which is west of the summit of the Rockies, and the remainder on the north shore of Lake Superior. Since April, this year the line has been laid west, from Maple Creek to Padmore, and by the 10th of November will reach the summit of the mountains, 60 miles further west, making a total distance of 320 miles of grading and track-laying in a little over seven months. The summit is the highest elevation reached by the track—5300ft. above the sea—and not that of the Rocky Mountains, which is covered with perpetual snow.

The South-Western Colonisation Railway has been sold to the Canadian Pacific Railway, and this line will now be pushed forward through Southern Manitoba with all despatch—not a moment too soon. The settlers in this section of the province are in dire stress, being unable to find a market for their grain, as it does not pay to haul it by teams to the nearest railway station. Many farmers are reported to have thrown up their homesteads in utter disgust, and crossed the international boundary line into the United States. The question of the construction of a branch railway is a matter of most serious moment. Railway communication with the commercial centres must be given if farming is to be made to pay in this country; but the thinly scattered settlements over a vast area render the solution of the problem a difficult matter.

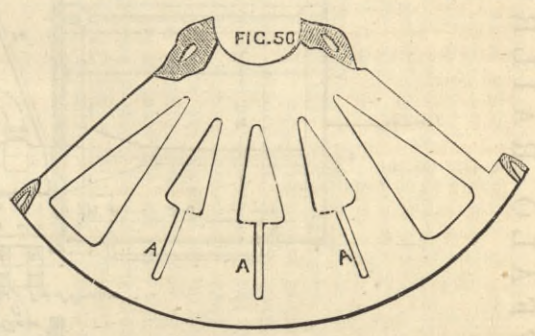
There are two other roads under the course of construction, the Souris and Rocky Mountain and the Rapid City Central. The former, leaving the Canadian Pacific Railway at a point east of Brandon, runs to Rapid City, distance some thirty miles—which section is nearly completed—and thence in a north-westerly direction towards Prince Albert, through Shoal Lake and Russell counties. The latter, also leaving the Canadian Pacific Railway just east of Brandon, takes a more southerly course than the former, leaving Rapid City on its north, and runs through the same counties to Fort Ellice, thence westerly. Neither of these companies has land grants—most necessary subsidies. I do not see myself how they are to be built, or how the promoters expect to earn a dividend.

The Street Railway in Winnipeg is being extended, and tenders are being called for by the Town Council for paving main street with wooden blocks.

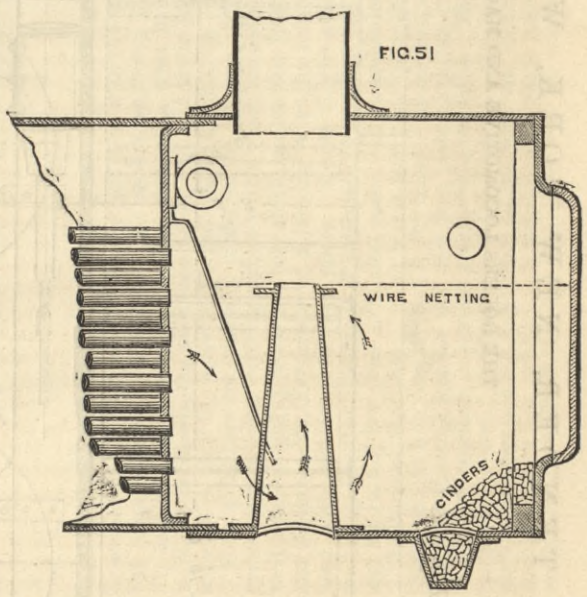
THE CHICAGO RAILWAY EXPOSITION.

No. VIII.

THE heaviest passenger locomotive exhibited was built for a first-class new line, the New York, West Shore and Buffalo Railroad, which runs on the right or western bank of the Hudson to Albany, and *viâ* the large manufacturing towns of Syracuse and Rochester to Buffalo, and is intended to specially compete with the well-known New York Central, running on the other bank of the Hudson. The line is double throughout, and laid with 67 lb. steel rails of Vignoles' section. One-third of the line is level and 80 per cent. is straight, the sharpest curves are 1910ft. radius, and with few exceptions are 2865ft. radius or more. The ruling gradients are 1 in 264 going eastward—the direction of the heaviest traffic—and 1 in 176 going westward. The space between the rails is 7ft. 6in., instead of the 6ft. usual in Great Britain, and the rolling stock can therefore be made correspondingly wider without any risk of loose doors, fouling bridges, &c. The engine is especially interesting to Englishmen, being designed by two English engineers, the late Mr. Howard Fry, and the Mechanical Engineer of the line, Mr. John Player.



Mr. Howard Fry served his pupilage to Mr. J. Cudworth, then Locomotive Superintendent of the South-Eastern Railway, and having held various positions on American railways, was chosen for the post of Superintendent of Motive Power of the line in question a little over a year ago, and had the rare opportunity of specially designing the whole of the rolling stock of the line before a single rail was laid. He was universally regarded as the coming man in his profession, when he was killed in the prime of life and in the execution of his duty by a most lamentable accident on the Chicago and Grand Trunk Railway. The Westinghouse brake hose gave way on a vehicle of the train in which Mr. Fry was travelling, and the brake consequently went on and stopped the train, which was run into by a following freight train while the train men were endeavouring to release or repair the brake. The sleeping-car in which Mr. Fry was travelling was telescoped, and he was barely alive when extricated from the wreck. The kindly terms in which Mr. Fry is universally spoken of is very gratifying to an Englishman, and bear testimony both to Mr. Fry's high qualities, and to the very cordial and friendly feelings which exist among American railway men.



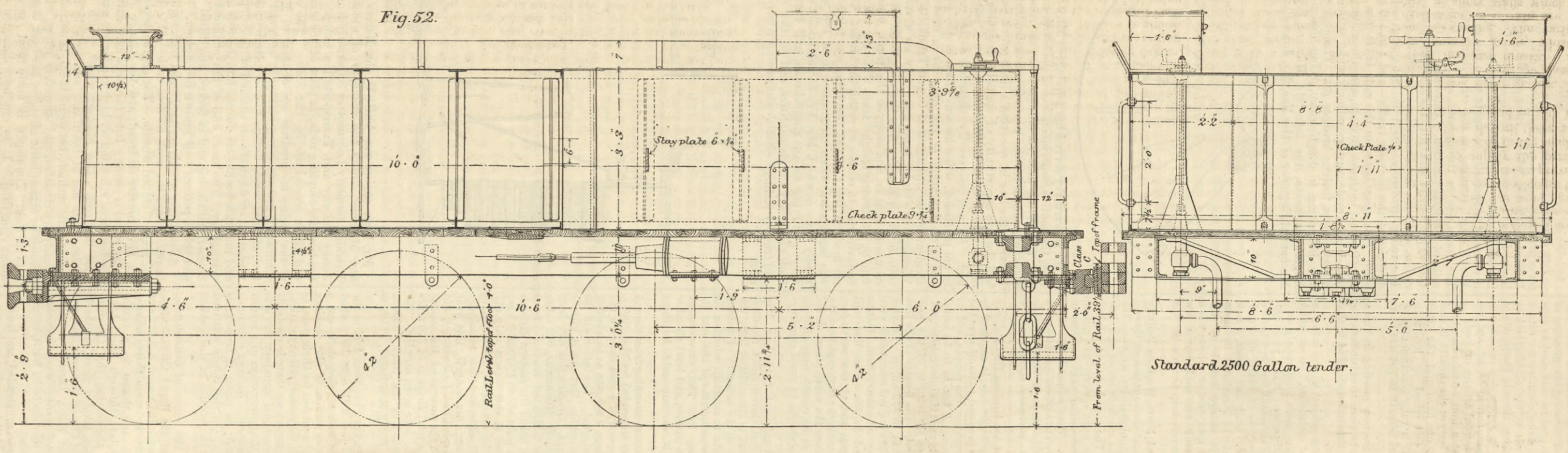
Mr. Fry's engine was built by the Rogers' Locomotive and Machine Works, the manager of which, Mr. John Headden, formerly Locomotive Superintendent of the New Jersey Railway and Transportation Company, first used the bush for coupling rods, in place of the strap and cotter end still in general use in the States. The coupling-rods of the engine in question are of steel of I-section, the channels or grooves being started at each end by a milling tool, and the work finished on a planing machine. The washers fit on a square on the end of the coupling-rod pin, and the brass bushes are forced into the rods and held by a vertical key. The small end of the connecting-rod is also bushed, and the big end is forked and fitted with a block and bolt, a pattern well known in England.

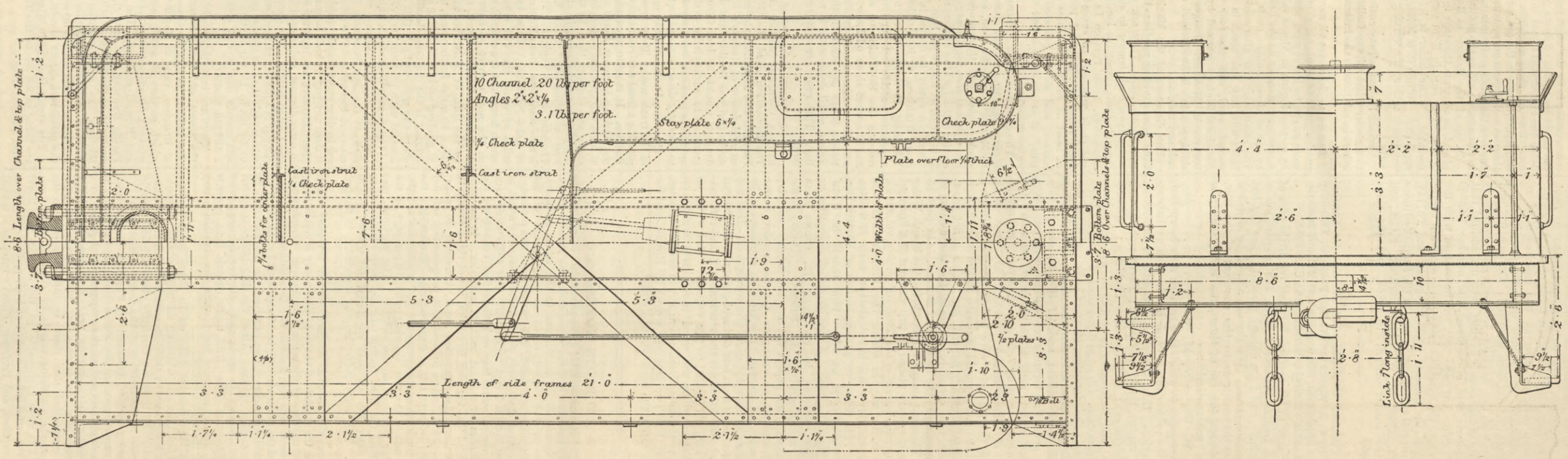
Allen's paper wheels are used under both engine and tender bogies, though the cost, 85 dols. each—£17—is five times the price of chilled wheels. The engine bogie wheels are 2ft. 9in. diameter on tread, and the tender 3ft. 6in. The Allen wheel is coming into favour where easy riding and freedom from vibration at high speeds are more important than first cost. The Mansel wheel, which undoubtedly prolongs the life of both tire and axle by interposing a non-metallic cushion between them, is not adapted to extremely dry climates, and therefore paper, which is little affected by atmospheric changes, has been used as a substitute for teak. The paper is made from rye straw, and is about $\frac{1}{16}$in. thick. It is cut into discs, ten of which are pasted together and subjected to 1000 tons hydraulic pressure. Three of these discs—each composed of ten sheets—

STANDARD TENDER, NEW YORK, WEST SHORE, AND BUFFALO RAILROAD.

THE ROGERS LOCOMOTIVE AND MACHINE WORKS, PATERSON, N.J., ENGINEERS.

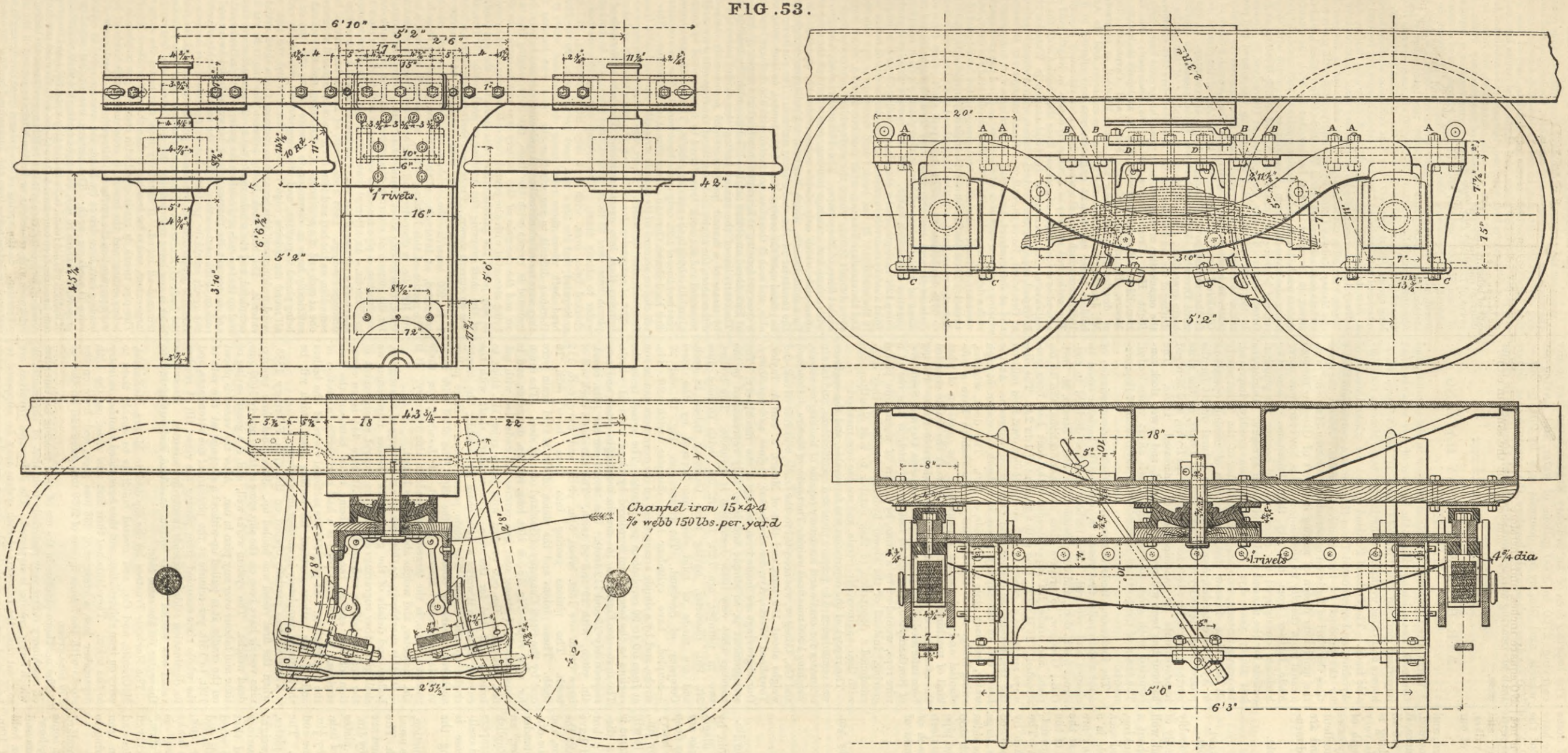
Fig. 52.





STANDARD TENDER BOGIE, NEW YORK, WEST SHORE, AND BUFFALO RAILROAD.

FIG. 53.



are then similarly pasted together and compressed, and finally four of the resultant discs are pasted and pressed together, making an extremely hard and solid wheel centre, 3¾in. thick, or half the combined original thickness of the 120 sheets of paper of which it is composed. The disc is turned to fit the tire and the boss, which are forced on by hydraulic pressure, and held together by wrought iron side plates, bolted through an internal flange on the tire. We hope to describe later on some other wheels of recent invention, which promise to supersede the chilled wheel.

The driving-wheels are 5ft. 8in. diameter on tread, the skeleton being as usual of cast iron, the spokes, rim, and boss being cored out. The axle heads are slightly tapered, and, after being painted over with whitelead, are forced into the wheels with a pressure of about 80 tons by an hydraulic press. The tires are afterwards shrunk on in a manner somewhat different to that usual in England. The axle is supported by a couple of stands, so that the wheels are a few inches off the ground, and the tire is heated in a furnace, drawn out, suspended from a crane, and swung on the wheel, and cooled by means of a perforated pipe or sprinkler. The balance weights are cast solid with the wheels, but a space A A is left between the spokes, as shown in Fig. 51, to allow for shrinkage. Each engine when tried in steam is placed on blocks, the oscillation noted, and lead is run into the spaces A A until the movement is reduced to a minimum.

Four slide bars are generally preferred in America as giving greater support and rubbing surface with a minimum amount of reciprocating weight, while the bars shield one another from dust and cinders. Mr. Fry preferred a two-bar wrought iron cross-head with cast iron rubbing pieces. Messrs. Rogers generally make the four-bar crossheads of a mixture of cast iron and steel, and the bars of low grade mild steel occasionally case-hardened.

The front of the smoke-box is a cast iron plate fastened to a solid wrought iron ring rivetted to the circular smoke-box, a cast iron door shutting against this cast iron plate, as shown on Fig. 52. All the surfaces in contact are faced in the lathe. This arrangement is used very generally in the States, as the cast iron plate is cheaper and not so liable to buckle with the heat as the wrought iron plate, which once warped out of shape cannot be straightened; while, if the cast iron gives way by cracking, it can be patched. The engine is fitted with an extended smoke-box, which resembles that described in our last paper. It is stated that on one line this arrangement has reduced the consumption on passenger engines from 68 lb. to 47 lb. per mile, and on goods engines from 92 lb. to 63 lb., saving 21 lb. and 29 lb. respectively. The deflector plate and large netting do not require so sharp a blast, and the fire is less cut up and fewer sparks are formed. As the bulk of the cinders lodge in the lower front corner of the smoke-box, the netting is not much injured by their impact. Undoubtedly, the best method of preventing sparks is to so proportion the grate area and blast pipe that steam can be kept up without lifting the fire at all, and this seems to be effected by the enormous grate area of the Wootten engine, which is now being tried on various kinds of fuel, and is exciting much interest in America. The figures given above show an almost incredible waste of fuel, probably partly due to the increased back pressure caused by the sharp blast, and partly to the fuel being blown out of the chimney before it is half burnt. This enlargement of the smoke-box is a curious contradiction of English practice where the smoke-box is contracted by firebrick, &c., to improve the steaming powers of an engine. The enlarged cross section of the smoke-box, as compared with the tubes, causes a loss of velocity in the current of hot gases which has to be again given by the blast pipe to force the products of combustion up the chimney, which must be sufficiently restricted in area to prevent the external atmosphere rushing down to supply the partial vacuum in the smoke-box. The loss of the velocity in the smoke-box tends, of course, to permit the sparks to deposit there, and possibly the blast pipe has less effect in lifting and cutting the fire.

Pet cocks are being superseded by glass water gauges, this and other engines exhibited having two sets of gauge glasses, fitted with a safety ball acting when the glass breaks. All the usual steam cocks for injectors, pressure gauge, whistle, Westinghouse pump, &c., lead from one casting. The various coloured discs, &c., denoting the destination of a train are replaced in America by flags mounted on short staffs which fit into suitable stands or sockets on the front buffer beam. These stands serve also to hold a light curved jib crane for lifting the front cylinder or steam chest covers, or taking the weight of the

piston and rod. A somewhat similar crane is used on the London and North-Western Railway for lifting off dome covers. The sand-box and dome of Mr. Fry's engine have cast iron casings of a *quasi* English pattern without the mouldings usual in American practice, but the result is not altogether pleasing to the eye. The engine is fitted with the Westinghouse automatic brake on the tender and driving wheels, and with Richardson's balanced slide valves, which were described and illustrated on page 145 of our issue of August 24th.

The engine and tender are strongly proportioned, and while there is no lack of metal where strength is needed, little expensive workmanship is required. For instance, it will be noticed that the tee irons in the tender tank are all straight, and that no joggling or expensive smithing is required in the angle irons, &c., though the tank is very strongly made and stayed. The superior strength of American cast iron enables it to be used in many cases instead of an expensive forging. Steel castings of excellent quality are now made in many places in America, and are also superseding expensive smithing. The leading dimensions of the engine are as follows :—

Cylinders	18in. dia. by 24in. stroke.
Driving wheels, diameter	5ft. 8in.
Tractive force per lb. average pressure in cylinder	114·4 lb.
Bogie wheels, diameter	2ft. 9in.
Weight in working order	42 tons 13 cwt.
Contents of tender tank	2500 gallons.

The tender, which we illustrate on page is probably the first built in America with a frame composed wholly of iron, and is remarkably strongly proportioned and well designed. The tank is of the horseshoe form without a well,—universal in the States—and is bedded on planking, and held down by six knees rivetted to the tank, and each bolted to the frame by a $\frac{7}{8}$ bolt. The tank manhole is a casting, and the sides, top, and bottom of the tank are stiffened by tee irons placed at 2ft. centres braced at the corners by 5in. by $\frac{1}{4}$in. gusset stays. The hind end of the tank is stiffened by three vertical tee irons, which are not, however, gussetted to the top or bottom plates. The weight of the coal on the flat top of the tank is taken by four vertical cast iron pillars of cruciform section, fastened top and bottom to the tee iron stiffeners. Three large check plates are fastened to these pillars, and to the sides of the tank, to prevent a rush of water when a quick stop is made, and check plates are also placed near the feed pipe strainers. The tank is made in very few plates—sixteen in all—the back being in one plate 11ft. long, and each of the sides in one plate 16ft. 10in. long. The thickness of plates and pitch of rivets, &c., are as under :—

Top and bottom plates	$\frac{1}{4}$in. thick.
Inside leg plates...	$\frac{7}{16}$in. thick.
Sides, ends, and coping plates	$\frac{7}{16}$in. thick.
Angle irons, 4 lb. per ft.	2in. by 2in. by $\frac{5}{16}$in.
Tee irons	4in. by 3in.
Pitch of rivets in angle irons on top ...	1$\frac{1}{4}$in.
Pitch of rivets in angle irons on side ...	1$\frac{1}{4}$in.
Pitch of rivets in angle irons on bottom	1$\frac{1}{4}$in.
Rivets in tee irons and stays	$\frac{1}{4}$in. dia.
Rivets in tank	$\frac{3}{8}$in. dia.
Lap of plates	1$\frac{1}{4}$in.
Shovelling plate...	$\frac{1}{16}$in. thick.
Coping angle iron, wood platform... ...	2in. by 2in. by $\frac{1}{4}$in.

The frame is composed of four longitudinals of 10in. by $\frac{3}{8}$in. by 2$\frac{1}{2}$in. by $\frac{3}{8}$in. channel iron braced together diagonally by two flat plates 6in. by $\frac{1}{2}$in. The headstocks are also of channel iron of the same section, stiffened by deep $\frac{1}{2}$in. plates. The weight is put on the bogies by heavy cross bearers, each composed of two plates 18in. by $\frac{1}{2}$in., with diagonals of the same area in cross section. It will be noticed that the horizontal centre line of the frame is above that of the central buffing and drawgear, a disadvantage common to all American rolling stock ; but apparently, in this case, a little scheming would have enabled the frame to be lowered sufficiently to make the centre lines coincide, thereby strengthening the frame, and enabling much of the heavy draw-gear casting to be dispensed with. In the coupling between engine and tender the draw-link is above the buffing plate or "bumper," an arrangement which is regarded as objectionable in English practice. A wedge between engine and tender bumpers keeps the coupling tight, and prevents rattling and oscillation. The hind draw-gear casting or bull nose is secured by two 1$\frac{5}{8}$in. bolts, thus fully equalling the strength of an English drawbar.

The bogie is also of very simple and strong construction, the frame being in plan in the form of an H, the usual cross frames beyond the wheels being dispensed with. The brake blocks are applied only between the wheels, and are hung from a stout cross frame composed of a 15in. by 4in. channel iron, laid horizontally with vertical $\frac{1}{2}$in. plates rivetted to the flanges, the whole making a species of fish-bellied girder. The whole frame is kept square by $\frac{1}{2}$in. gusset plates, fastened to the channel iron cross frame and main bar frame by 1in. rivets and bolts respectively. The springs are 3ft. span, and are composed of fifteen plates, 3$\frac{1}{2}$in. by $\frac{3}{8}$in. The front tender bogie carries the weight on the centre and the hind bogie on the side bearings immediately above the springs. It will be noticed that the height of the centres can be adjusted by the wood packing. The passenger tenders have 3ft. 6in. wheels, and the goods engines 2ft. 9in. wheels, but the same tank, frame, and bogie centre is used for all classes. The brake blocks are made in two pieces, the cast iron "block" is attached to the brake beam and hanger, and the "shoe," when worn out, can be detached by withdrawing a curved taper pin which passes through lugs on block and shoe and locks them together. The brake beams are plain iron bars, measuring 5in. by 1in. at the centre and tapering to 3$\frac{1}{2}$in. by 1in. at the ends.

The journals each measure 7in. by 3$\frac{3}{4}$in., the standard size adopted by the Master Car Builders' Convention some few years ago for freight and passenger cars. It is, however, proposed to increase this size, the weights of cars and the loads carried being greater. At the Convention held this year at Chicago, Mr. Westinghouse suggested 10in. by 5in. The total journal area supporting the tender is, therefore—multiplying number of journals by diameter and length of each—8 by 7in. by 3$\frac{3}{4}$in. = 210 square inches. The bearing area of an ordinary English main line tender carrying 2700 to 3000 gallons of water, and having six wheels and 9in. by 5in. journals is 6 by 9in. by 5in. = 270 square inches, and therefore the pressure per square inch of bearing surface would be about the same in either case.

AYR HARBOUR SLIPWAY HAULING MACHINERY.

When the Clyde was fordable at Glasgow in the summer, and Greenock was a fishing village, the harbour of Ayr was the most important port on the Firth of Clyde. It had tobacco warehouses and other evidences of having for those times a considerable trade. The Duke of Portland opened the mineral wealth of Ayrshire, and constructed Troon Harbour as a convenient outlet for the products of his extensive coal-fields. About the same time the Earl of Eglinton constructed Ardrossan Harbour, with the ambitious design of making it a port of Glasgow through a canal from the city to the sea-port ; this, however, was never made farther from the city than Johnstone. These two harbours outstripped the older one, and became the principal outlets for the mineral products of North Ayrshire. During the last thirty years Ayr Harbour has been greatly improved. Ex-provost Steele, who has been a member of the Trust nearly all that time, foresaw that, as the area of mining operations in Ayrshire extended, Ayr would be the natural outlet for the products of the valley of the Ayr and the Lugar, as the more northern ports have been for the valley of the Irvine, and he urged improvements in anticipation of increased trade. The harbour has been widened and deepened, and a wet dock constructed, with gates to keep large vessels afloat when loaded. The trade of the port has increased with the march of improvements.

The increasing trade demanded dry-dock accommodation of some sort in order that vessels frequenting the harbour could be cleaned and repaired. The harbour trustees decided to construct a slip dock, and commissioned Mr. John Strain, M. Inst. C.E., Glasgow, to prepare plans and specifications, and to his plans and under his superintendence the dock has been constructed. It is 850ft., long with a gradient of 1 in 24. The slipways are made of concrete with strong chilled cast iron rails on the top, bedded in cement and causewayed between. At the lower end of the slipways there is a depth of water at high water, ordinary state of the tide, of 22ft. The dock, wharves, swing bridge across the entrance, and workshops have a substantial and workmanlike appearance. The question of what kind of machinery should be placed to work the cradle occupied the attention of the trustees for a considerable time. Having been informed of the system adopted by Messrs. Day and Summers, of Southampton, the special feature of which is the use of a wire rope, wound on to a drum, by means of worm and pinion gearing, instead of the slower hydraulic purchase, they commissioned a deputation of their number to visit Southampton with their engineer, Mr. Strain, and see the new method.

The report of the deputation was favourable, and the engineer was commissioned to prepare plans and specifications, and take in estimates for cradle and machinery capable of hauling up vessels, weighing 1200 tons dead weight. The tender of Messrs. J. Copeland and Co., Glasgow, was accepted for the cradle, which is of oak, and weigbs about 150 tons, and that of Messrs. J. and A. Taylor, Townhead Works, Ayr, for the boilers, engines, and machinery. Our engravings are made from tracings of the machinery. The arrangement is so simple and is so fully represented in the tracings that very little description is requisite. The boilers, two in number, are 18ft. by 5ft. 6in., with furnace flues 2ft. 9in. diameter, having three Galloway tubes in each, and are made of mild steel manufactured by the Steel Company of Scotland. The engines—see Fig. 19 and 20 —coupled, have cylinders 15in. diameter, with 2ft. 6in. stroke, and by a simple arrangement on the governors can be run at from 60 to 90 revolutions per minute. The speed from the engines to the large drum is reduced by three train of wheels. The first—see Figs. 12 to 18—are 8in. broad, 2$\frac{3}{4}$in. pitch, and have respectively 25 and 112 teeth. The second pair are 13in. broad, 4in. pitch, with 20 and 96 teeth. The wheels on each end of large drum are 13in. broad, 5$\frac{1}{2}$in. pitch, and have each 112 teeth. The pinions gearing into them have each 16 teeth. These pinions and the pinion of the second train were cast by the Steel Company of Scotland of mild steel. The drum for wire rope—Fig. 18—is 10ft. long, 9ft. 2in. diameter, and is constructed of strong cast iron centres and ends clad with oak 6in. thick, and the oak covered with hemp rope 1in. thick to form a soft bed for the rope. The auxiliary shaft with the curved drum on it works a 1$\frac{1}{2}$in. chain for hauling the empty cradle up and down. The chain passes round a large pulley anchored near the bottom of the slip. The steel wire rope, manufactured by Messrs. Bullivant, of London, on their patent system, is the largest ever made in this country. It is 4in. diameter, and weighs about 7 tons 15 cwt.

Of this machinery we this week give engravings of the engines, boilers, and details of the gearing. In another impression we shall give other engravings showing the general arrangement of the engines, boilers, and machinery. At page 444 is an elevation of one engine, the view being taken between the two engines. On the same page is a half plan partly in section of the two engines. At page 441 are sectional views of the boilers and of the various parts of the hauling gear, which will be shown more completely in another impression.

The dock was partially opened on the 27th February, 1883, when the first vessel was hauled up. Since that time twenty-nine vessels have been on the slip, some of them nearly 1000 tons dead weight. The system works well, and is a great saving of time and labour over any plan in use. After the vessel is placed on the cradle it is pulled up without a stoppage at the rate of 12ft. to 18ft. per minute at the pleasure of the attendants, and the whole time occupied from placing the vessel till it reaches its destination seldom exceeds twenty-five minutes. Recently a vessel was hauled up, its bottom examined, and put again into the water on the same tide.

The Harbour Trustees let the slip dock to Messrs. McKnight, McCreadie, and Co., and erected buildings to enable them to carry on iron shipbuilding, and thus have added another industry to the town. They launched their first new vessel on the 13th September last, a steamer of 236 tons gross, and have on the stocks with the frames up one of 2000 tons gross and another of 350 tons gross.

The northern practice in the use of spur gearing in this class of machinery differs very materially from that of the south, in which screw gearing is employed. The differences involved are so great that the followers of each system may be supposed to have good reasons on their side, though we fail to see how both can be best for the same work. It is, however, a question on which some expression of opinion might be usefully given.

THE MERSEY RAILWAY TUNNEL.*

Amongst the proposals which have from time to time occupied the attention of engineers and capitalists, the bridging and tunnelling of rivers and estuaries, in order to establish direct communication between important towns or districts, have of late years occupied a prominent place, and if practical results have only in one or two instances been attained, this cannot be attributed to any want of belief in the value of such connections, but rather to the inherent difficulties and costliness of the necessary works. The towns of Liverpool and Birkenhead having together a population of some 750,000 persons, bound by the closest ties of commercial interest, and possessing the finest docks and harbours in the world, still remain separated by the river Mersey, a deep tidal stream, some 1300 yards in width; the interchange of traffic amounting annually to about 26,000,000 of passengers and 750,000 tons of goods, being effected by means of steam ferries only. As long ago as 1865 it was felt that this condition of affairs seriously interfered with trade, and several proposals were put forward with a view to meeting the difficulty. A high-level bridge, and a railway tunnel crossing under the Mersey some distance above the towns, were alike considered and set aside, but in the year 1866 the Mersey Railway Company was incorporated, with power to construct a pneumatic railway from Woodside, in Birkenhead, to Church-street, in Liverpool. By a further Act in 1871, the pneumatic system was laid aside and an ordinary railway authorised, the powers being also extended from Woodside to a junction with the joint railway belonging to the London and North-Western and the Great Western Railway Companies, at Green-lane, in Tranmere. In the year 1882 the point of junction was altered and powers taken to extend in Liverpool from Church-street to Waterloo-place, in immediate contiguity with the Central Station of the Cheshire Lines Committee, and by an Act of the present session further capital powers were granted to the company. It was not until December, 1879, that it was found possible to practically begin operations, and although the sinking of the shafts and driving of the heading hereinafter described were then commenced, the organisation of the company upon the present basis, with the Right Hon. Cecil Raikes, M.P., as chairman; the Right Hon. Edward Pleydell Bouverie, F.A.S., as deputy chairman ; and Messrs. Boutcher, Hubbard, Mott, and Cavendish Taylor as directors ; Major Isaac and John Waddell as contractors ; Mr. James Brunlees and the author as engineers, and Mr. Archibald H. Irvine as resident engineer, was only effected in July, 1881, since which time the works have been vigorously prosecuted. The authorised railway is 3 miles 8$\frac{1}{4}$ chains in length, and will extend as a double line of railway from the junction with the joint railways at Tranmere to a terminal station in Waterloo-place, Liverpool, adjoining the Central Station, with intermediate stations at Green-lane, Borough-road, and Hamilton-square in Birkenhead, and at James-street, Liverpool. Operations were commenced by sinking shafts on each side of the river, and just one mile apart, to such a depth, viz., about 180ft. below the level of the quay, as was necessary to ensure the efficient drainage of the lowest part of the tunnel. These shafts were both originally intended to be 15ft. in diameter when lined, but the Birkenhead shaft has been increased to 17ft. 6in. diameter. The Liverpool shaft passes for a short distance through made ground, and then through the red sandstone of the district, which at this point yields a considerable quantity of brackish water. At the bottom there is a pumping sump 12ft. in depth, and a standage heading 33 yards in length to form a safety reservoir in case of any sudden accumulation of water in the workings. It has been found necessary to tub this shaft, and the standage heading, with cast iron tubbing, which involved some difficult fitting, where the shaft widens out for the clack and bucket doors of the pumps. The Birkenhead shaft, also provided with a sump and standage heading, passes through the solid sandstone rock, which only yields any considerable quantity of water for a short distance, which has been tubbed against wedging cribs, the remainder of the shaft being unlined. The shafts could not be placed upon the centre line of the tunnel, no land being available, and each is therefore connected with the drainage heading by a cross cut forming at Liverpool nearly a right angle—97 deg.—and at Birkenhead an obtuse angle—133 deg.—with the heading itself. The centre line of the tunnel having been ranged across the river by means of a transit instrument and permanently marked on either shore, the angles and lengths of the cross-cuts were carefully measured and the work transferred to below ground by means of plumb lines hung in the pumping shafts. These shafts were so crowded that base lines of 12ft. only could be obtained. The lines consisted of fine hard drawn German silver wire $\frac{1}{16}$in. in diameter. This was selected on account of its tensile strength, combined with freedom from corrosion by water. There was a slow motion screw at the point of suspension for adjusting the wires laterally and thereby bringing them into exact position. The bobs at the ends of the plumb lines were 33 lb. in weight, and were hung in buckets of water to steady them. The setting out by this method was checked twice over, with but very little variation, and it is anticipated that the lines will meet very closely. In the Birkenhead shaft, where there were many obstacles, and where it was therefore difficult to see whether the lines were hanging free, they were tested electrically. A galvanometer and battery, being included in circuit with the lines, the bobs hanging free in the air and the one pole of the battery was put to earth, the other being connected with the plumb line. If making earth by contact at any point, the galvanometer was deflected, the wet condition of the shaft ensuring the making of good earth. If free, there was no current shown. From each shaft is being driven a heading or drainage gallery, rising with gradients of 1 in 500 and 1 in 900 towards the middle of the river, and which is connected, at intervals, with the main tunnel by bore-holes. The portion of this heading which is executed by hand is taken out 10ft. 4in. in diameter and lined with brickwork in cement 14ft. thick, thus leaving a net diameter of 8ft. Below the invert, and for the purpose of clearing the water from the brickwork during construction, a pipe trench is cut in the rock to receive pipes 18in. in diameter. An attempt has been made, with some success, to stop back a portion of the water by iron cribs and brickwork in the drainage headings. Cast iron rings, of hollow box section, being some 18in. on the bed and 6in. deep, have been placed at intervals, one at each end of a section of a brick lining, and the rock cut out sufficiently large in diameter to receive them; the ring or crib being placed in position, and standing vertical, was highly wedged all round the outside edge between the crib and the rock with wood wedging until this became so compact that a chisel would not enter it. The brickwork lining between the two cribs was then completed, and the whole made tight. The intention was then to seal up the two ends and confine the water to that particular section, and so prevent its passage along between the brickwork and the rock on to the next section. Were the rock thoroughly impervious the result would be perfect ; but in the case under notice a considerable proportion of the water penetrated through the rock at the back of the cribs. Instead of using cribs, close building in brick is now being resorted to, the rock having been first carefully trimmed all round. If carefully done this baffles the water to a large extent, and is far less costly than the method above described. The pipe trench is made good with concrete put in place in bays before setting, and the invert is constructed with blocks of brickwork prepared on the surface. Altogether 930 lineal yards of this heading have been driven by hand, the average speed at each face being 11 yards per week. The cement was at first mixed in the proportion of three to one, but upon testing the work with the head of water it was not found to be thoroughly watertight, and the proportion has since been increased to two to one with the most satisfactory results. The greatest care is taken to fill any cavities at the back of the brickwork with sandstone or broken bricks in cement of the same proportion. In the spring of the present year arrangements were matured for introducing into the Birkenhead heading the machine

* Paper read before Section G of British Association by Mr. C. Douglas Fox, M.I.C.E.

invented by Colonel Beaumont, R.E., and Captain English, R.E., and which consists of a strong frame some 30ft. long, upon which is fixed an upper bed which carries the machinery. This upper bed can be moved forward by a screw feed on the lower frame, the feed in the sandstone rock being $\frac{3}{16}$in. per revolution, and the speed of the borehead about one and a-half revolutions per minute, being about one-third the speed at which it can be driven in chalk. When some 4ft. 6in. have been cut the action of the feed is reversed, and the weight of the machine being taken by hydraulic jacks, the lower frame is moved forward ready to recommence operations. The radial arms of the borehead are fitted with cutters, or discs of chilled cast iron, which are truncated cones, and which, as they wear, can be slightly turned round, thus exposing a fresh cutting edge without so frequently incurring the delay of replacing the cutters. The borehead is driven by a pair of compressed air engines, having cylinders 12in. in diameter and 18in. stroke, and running at from 80 to 100 revolutions per minute. The compressed air is supplied at a pressure of 35 lb. to 40 lb. per square inch by compressors at the surface, driven by portable engines. This machinery cuts the sandstone rock cleanly and accurately to a diameter of 7ft., delivering in small pieces. The greatest progress hitherto made has been about five yards in twenty-four hours, and twenty-four lineal yards in a week of six working days, and the machine has now driven a total of 260 yards of heading. The rock thus cut is found to yield much less water than when explosives are used, so that it has not been necessary to line this portion of the heading. Only seven men are required to work and tend the machine, which is fitted with an endless strap and buckets to deliver the *débris* into tubs at the tail. The chief difficulties encountered have been the keeping of the machine in true line and level, the dust caused in the drier parts of the rock, and the foggy atmosphere resulting from the use of compressed air, together with certain defects in detail, which are gradually being remedied. Simultaneously with the drainage headings, the main tunnel has been driven forward. The excavation has been throughout in sandstone rock, the roof being generally excellent, and requiring but little support. The rock is very solid and homogeneous, but varies considerably in the quantity of water it yields; thin layers of a white colour being more porous than the rest. The rock under the river on the Liverpool side is remarkably dry. The faces under the river are carried forward by means of a bottom heading, which is first driven by hand in the usual manner, and from this "break ups" are made to the full size of the tunnel—not more than 12ft. lineal of excavation are allowed to be exposed at one time, the brickwork following on as closely as possible. The excavation under the river is 30½ft. wide by 27½ft. high, and being lined with brickwork in cement 2ft. 3in. thick, the internal finished dimensions of the tunnel are 26ft. wide and 23ft. high, recesses for platelayers being placed at intervals. The two inner rings of brick are of Staffordshire blue, the remaining rings of Burnley or other approved red brick, the filling of broken stone or bricks, the whole set in cement, mixed in the proportion of one of cement to two of sharp sand or gravel. Landwards the lining of the tunnel is reduced in thickness to 1ft. 6in. and then to 1ft. 2in. In order to leave the main shafts clear for pumping purposes, the drainage heading is now connected with the main tunnel on the Liverpool side by a staple shaft 9ft. in diameter and 25ft deep, and a similar connection is being made on the Birkenhead side. The underground stations at James-street, Liverpool, and Hamilton-square, Birkenhead, are excavated in the solid rock, which is then lined with brickwork, and are 1000ft. long and 50ft. wide by 30ft. high from the rails. These will be lighted by electricity and approached by hydraulic lifts. For the purpose of keeping the works clear of water extensive pumping plant has been erected at Woodside, Birkenhead, and St. George's Dock, Liverpool, and this has proved most efficient. Owing to the depth of water—90ft.—in the river Mersey, and the high levels of the towns on either side, gradients of 1 in 30 are necessary in order to provide a sufficient distance—the average thickness being 40ft. and the minimum 33ft.—between the bed of the river and the crown of the tunnel. There are four pumping engines, two on the Liverpool and two on the Birkenhead side, of the horizontal type known as compound differential, invented by Mr. Henry Davey, and constructed by Messrs. Hathorn, Davey, and Co., of Leeds. At Liverpool the large engine is capable of raising 288,000 gallons per hour, and the other 96,000 gallons, whilst at Birkenhead the large engine will raise 234,000 gallons, and the small one 96,000, making a total from both sides of 17,136,000 gallons per day. The largest quantity of water met with has been at Birkenhead 180,000 gallons, and at Liverpool 210,000 gallons per hour. On three occasions the engine has suddenly lost its load, and on two of these the valve gear has saved the machinery from injury by interposing a cushion of steam, although the force has been sufficient to shift the engine-bed $\frac{3}{4}$in. on its pillar, and to drive the packing out of the steam pipe joints. There has only been one serious break-down. This occurred at Liverpool on the evening of the 17th of March last. The load was suddenly lost with the No. 1 pump, through the fracture of the bolts in the top length of the spear. The piston returned with great force into the cylinder, thereby breaking the cover between the high and low-pressure cylinders. The valve, in this case, failed to save the engine, probably on account of the fracture occurring near the end of the stroke, and so high up in the spear, the two lifts being coupled together; when the break occurred in the No. 1 lift, the weight of the No. 2 lift was acting with the steam, and helped to aggravate matters; but the accident was chiefly due to the fact that a careless workman had left a nut projecting on the piston, which, instead of having the usual clearance, actually came in contact with the cylinder cover, and consequently fractured it. The engines are connected with the spears of the pumps by quadrants, which were constructed by the Sandycroft Engine Works Company. The dimensions of those on the Liverpool were somewhat larger than on the Birkenhead side, owing to the longer stroke of pumps, viz., 10ft. on that side; but in all other respects their construction is identical. The checks or sides are made of 1in. plate iron, thickened up at the ends and centre where the pins passed through by additional pieces of plate iron. These checks are stayed to the case of the king posts with strong latticing, and in the horizontal portion or levers with stout cast iron distance stays, through which pass 1¼in. bolts. The end pins, to which the main links of the engine and pumps are attached, are 7in. diameter, and the centre shaft or gudgeon 11in. diameter. The length of the king post from centre shaft to engine pin is 15ft., and from centre shaft to pumping pin 15ft. for the Liverpool, and 12ft. for the Birkenhead quadrants. The diagonal stays or tension rods are 3in. at the end and 4in. in the middle, and are provided with straps, gibs, and cotters similar to an engine connecting-rod. This construction enables the rods to be cottered up very securely, and avoids the play or looseness often observed when the diagonals have plain eyes. The weight of each pair of the quadrants with all the fittings in connection with them is about 22 tons. The pumps are ordinary bucket-lift pumps, with spears in the rising main. The chief difficulty has been the necessity of frequent renewal of buckets, owing to the water being full of sand. To provide duplicate power, and to prevent any possible interruption of the works during repairs to the existing machinery, an additional engine and pump is being fixed on each side of the river, and as these are of large size, a more detailed description of them may not be without interest. The pumping engine is of the overhanging beam class, patented by Mr. Barclay on August 30th, 1861, and which was adopted because it does not absorb much ground space, and also on account of the small liability to accident which it possesses. It is of the compound type, having a high and low-pressure cylinder firmly bedded to the foundation. The high-pressure cylinder has a diameter of 36in., and the low-pressure cylinder 55in., the length of their strokes being 10ft. 6in. and 13ft. respectively, both cylinders being double-acting. The balance beam of the engine is placed between the foundation walls. This beam is 19ft. long from rocking centre to centre at pump rods, and 24ft. 6in. long from rocking centre to end, the back end being furnished with a box having sufficient capacity to hold 20 tons of balance weight; its depth is 4ft. 6in., and it is composed of plates of steel 1¼in. thick, securely bound with distant pieces of cast iron. The main beam of the engine is formed of two plates, each 32ft. 6in. between the extreme centres. The vibrating columns are at the back end of the engine. There are two sets of parallel motion, turned and polished bright, one set being required to keep the low-pressure cylinder rod travelling parallel, and the other for the high-pressure cylinder piston rod. There is a large connecting rod, 38ft. 9in. long, between the centres, for joining the point of main beam to point of balance beam. This rod is composed of oak with malleable iron straps, and firmly bolted along its whole length; it is fitted with brass button gibs and cotters at each end. At each side of this rod there is a malleable iron rod, extending from main beam to a cast iron crosshead. This crosshead is placed below the point of balance beam, and to it the pump rods are attached. This arrangement brings the pump rods direct on to the main beam, on which there is but 1$\frac{3}{8}$in. of lateral motion, thus avoiding the large swing at the point of balance beam, and keeping the rods travelling upwards and downwards almost in a direct line—a matter of great importance in pumping machinery like the present, having a stroke of 15ft. The pump rods are made of wood, having four malleable iron plates at each joint. The rods are bolted to malleable iron forks, having tapered ends turned and fitted—one to cast iron crosshead at top end, and one to plunger at bottom end—both held in position by a collar. The plunger pump is of the ordinary kind, having a stroke of 15ft. The plunger is 40in. in diameter, and turned true throughout its entire length, fitted with two malleable iron hoops at top end; the suction and delivery valves are of brass, mounted with strong steel lids, having leather faces, also malleable iron guards, and fishing tackle. The rising main is of sufficient size to allow both valves to be drawn up from the surface, thereby avoiding much trouble and inconvenience during repairs; the working barrel is bored its entire length slightly larger than the plunger; the clack seats are provided with openings 4ft. 6in. and 3ft. 9in., to allow of easy access to the valves; the doors for these openings are of steel; the whole pump is set on two massive cast iron girders, the suction pipe passing up between them. These girders at each end rest on oak, which is bedded to a cast iron sole plate, resting on concrete set in strong cast iron boxes, which are continually in the water. The weight of engine and pumps is 262 tons. The boilers, eleven in number, have been manufactured by Messrs. Daniel Adamson and Co. They are of the Lancashire type, being 28ft. long and 7ft. 6in. diameter, each boiler having two flues 3ft. diameter, and each flue crossed by five conical circulating pipes. They are built for a working pressure of 70 lb. per square inch, and are steel shell boilers. The tunnel is lighted during construction by electric arc lights. The ventilation is at present secured by air compressors, by bratticing, and by the staple shafts connecting the tunnel and heading, but it is intended to erect permanent machinery for the mechanical ventilation of the tunnel.

ENGLISH EXPRESS TRAINS.

THE *Journal of the Statistical Society* for September contains an elaborate paper by Mr. E. Foxwell, on "English Express Trains; their Average Speed, &c., with Notes on Gradients, Long Runs, &c." The author takes great pains to explain his definition of the term "express trains," which he finally classifies thus:—(*a*) The general rule; those which run under ordinary conditions, and attain a journey-speed of 40 and upwards. These are about 85 per cent. of the whole. (*b*) Equally good trains, which, running against exceptional difficulties, only attain, perhaps, a journey-speed as low as 36 or 37. These are about 5 per cent. of the whole. (*c*) Trains which should come under (*a*), but which, through unusually long stoppages or similar causes, only reach a journey-speed of 39. These are about 10 per cent.* of the whole.

He next explains that by "running average" is meant:—The average speed per hour while actually in motion from platform to platform, *i.e.*, the average speed obtained by deducting stoppages. Thus the 9-hour (up) Great Northern "Scotchman" stops 49 minutes on its journey from Edinburgh to King's Cross, and occupies 8 hours 11 minutes in actual motion; its "running average" is therefore 48 miles an hour, or, briefly, "r.a. = 48." The statement for this train will thus appear:—Distance in miles between Edinburgh and King's Cross, 392½; time, 9h. 0m.; journey-speed, 43·6; minutes stopped, 49; running average, 48.

Mr. Foxwell then proceeds to describe in detail the performances of the express trains of the leading English and Scottish railways—in Ireland there are no trains which come under his definition of "express"—giving the times on journey, the journey-speeds, minutes stopped on way, and running averages, with the gradients and other circumstances bearing on these performances. He sums up the results for the United Kingdom, omitting fractions, as follows:—

Extent of system in miles.		Distinct expresses.	Average journey-speed.	Running average.	Express mileage.
1773	North-Western	54 / 28 } 82	40	43	10,400
1260	Midland	66	41	45	8,860
928	Great Northern	48 / 19 } 67	43	46	6,780
907	Great Eastern	34	41	43	3,040
2267	Great Western	18	42	46	2,600
1519	North-Eastern	19	40	43	2,110
290	Manch., Sheffield, & Lincoln	49	43	44	2,318
767	Caledonian	16	40	42	1,155
435	Brighton	13	41	41	1,155
382	South-Eastern	12	41	41	940
329	Glasgow and South-Western	8	41	43	920
796	London and South-Western	3	41	44	890
984	North British	11	39	41	830
153	Chatham and Dover	9	42	43	690
		407	41	44	42,688

A total of 407 express trains, whose average journey-speed is 41·6, and which run 42,680 miles at an average "running average" of 44·3 miles per hour.

If we arrange the companies according to their speed instead of their mileage, the order is:—

	Average r.a.	Miles.		Average r.a.	Miles.
Great Northern	46	6,780	Great Eastern	43	3,040
Great Western	46	†2,600	North-Eastern	43	2,110
Midland	45	8,860	Chatham and Dover.	43	690
Manch. Shef. & Lincoln	44	2,318	Caledonian	42	1,155
London & S.-Western	44	890	South-Eastern	41	940
North-Western	43	10,400	Brighton	41	1,155
Glasgow & S.-Western	43	920	North British	31	825

Express Routes arranged in Order of Difficulty of Gradients, &c.

North British	Great Northern
Caledonian	South-Western
Manch. Sheffield & Lincoln	Great Eastern
Midland	Brighton
Glasgow & South-Western	North-Western
Chatham and Dover	North-Eastern
South-Eastern	Great Western

* 10 per cent. of the number, but not of the mileage, of the whole; for most of this class run short journeys.

† Not reckoning mileage west of Exeter.

Long Runs in England.

	Number of trains.	Average speed,	Running averages.
		miles.	miles.
Midland	104	53	46 (5,512)
North-Western	98	60	45 (5,880)
Great Northern	49	73	50 (3,616)
Great Western	24	56	48 (1,344)
Great Eastern	24	56	42 (1,362)
Brighton	23	45	42 (1,047)
North-Eastern	20	56	44 (1,120)
South-Western	13	47	44 (615)
South-Eastern	12	66	42 (795)
Chatham and Dover	8	63	45 (504)
Caledonian	8	59	45 (476)
Glasgow and South-Western	8	58	44 (468)
Manchester, Sheffield, and Lincoln	8	48	43 (390)
North British	7	60	40 (423)
Total	406	58	45 (23,550)

From this it will be seen that the three great companies run 61 per cent. of the whole express mileage, and 62 per cent. of the whole number of long runs.

THE INSTITUTION OF CIVIL ENGINEERS.

THE NEW EDDYSTONE LIGHTHOUSE.

AT the ordinary meeting on the 27th November, Mr. Brunlees, President, in the chair, the paper read was "On the New Eddystone Lighthouse," by Mr. William Tregarthen Douglass, Assoc. M. Inst. C.E. The necessity for the construction of a new lighthouse on the Eddystone rocks had arisen in consequence of the faulty state of the gneiss rock on which Smeaton's tower was erected, and the frequent eclipsing of the light by heavy seas during stormy weather. The latter defect was of little importance for many years after the erection of Smeaton's lighthouse, when individuality had not been given to coast lights; but with the numerous coast and ship lights now visible on the seas surrounding this country, a reliable distinctive character for every coast light had become a necessity. The tower of the new Eddystone was a concave elliptic frustrum, with a diameter of 37ft. at the bottom, standing on a cylindrical base 44ft. in diameter, and 22ft. high, the upper surface forming a landing platform 2ft. 6in. above high water. The cylindrical base prevented in a great measure the rise of heavy seas to the upper part of the tower, and had the further advantage of affording a convenient landing platform, thus adding considerably to the opportunities of relieving the lighthouse. With the exception of the space occupied by the fresh water tanks, the tower was solid for 25ft. 6in. above high-water spring tides. At the top of the solid portion the wall was 8ft. 6in. thick, diminishing to 2ft. 3in. in the thinnest part of the service room. All the stones were dovetailed, both horizontally and vertically, as at the Wolf Rock Lighthouse. Each stone of the foundation courses was sunk to a depth of not less than 1ft. below the surface of the surrounding rock, and was further secured by two Muntz metal bolts 1¼in. in diameter passing through the stone and 9in. into the rock below, the top and bottom of each stone being fox-wedged. The tower contained nine rooms, the seven uppermost having a diameter of 14ft. and a height of 10ft. These rooms were fitted up for the accommodation of the light-keepers, and the stores necessary for the efficient maintenance of the lights; they were rendered as far as possible fireproof, the floors being of granite covered with slate; the stairs and partitions were of iron, and the windows and shutters of gun-metal. The oil-rooms contained eighteen wrought iron cisterns capable of storing 4300 gallons of oil, and the water-tanks held, when full, 4700 gallons. The masonry consisted of 2171 stones, containing 62,133 cubic feet of granite, or 4668 tons. The focal plane of the upper light was 133ft. above high water, its nautical range was 17½ miles, and in clear weather it overlapped the beam of the electric lights from the Lizard Point. The lantern was of the cylindrical helically-framed type adopted by the Trinity House. The glazing was 2ft. 6in. higher than usual for first-order lights, this addition being necessary to meet the requirements of the special dioptric apparatus. For the white fixed light exhibited from the three lighthouses of Winstanley, Rudyerd, and Smeaton, at the Eddystone the Trinity House determined on substituting, as a distinction, a white double-flashing light at half-minute periods, showing two successive flashes, each of about three and a-half seconds' duration, divided by an eclipse of about three seconds. It was also decided to show from a window in the tower, 40ft. below the flashing light, a sector of white fixed light, to cover the Hand Deeps, a dangerous shoal three and a-half miles north-west from the lighthouse. It was further arranged that a large bell should be sounded during foggy weather, twice in quick succession every half-minute, thus assimilating the character of the sound signal to that of the light. Two bells of 40 cwt. each were mounted at opposite sides of the cornice, in order that a windward bell might be sounded during fog. The optical apparatus for the main light consisted of two superposed tiers of lenticular panels, twelve in each tier. Each lens-panel subtended a horizontal angle at its foci of 30 deg., and a vertical angle of 92 deg., being 47½ deg. above the central plane of the lens and 44½ deg. below it; and was composed of a central lens and thirty-nine annular rings or segments, there being twenty-one above and eighteen below the central lens. The twelve panels in each tier were fitted together so as to form a twelve-sided drum, each lens having its focus in a common centre at a distance of 920 mm. These lenses subtended the largest vertical angle of any yet constructed for coast illumination, the increased angle and consequent additional power being obtained by the adoption of heavy flint glass for the six highest and the three lowest rings of each panel. The light was derived from two six-wick Douglass burners, one being placed in the common foci of each tier of lenses, the illuminant being colza oil. With a clear atmosphere, and the light of the Plymouth Breakwater lighthouse—ten miles distant—distinctly visible, the lower burner only was worked at its minimum intensity of 450 candles, giving an intensity of the flashes of the optical apparatus of 37,800 candles; but whenever the atmosphere was so thick as to impair the visibility of the Breakwater light, the full power of the two burners was put in action, with the aggregate intensity of 1900 candles for the lamps, and an intensity of the optical apparatus of 159,600 candles. This intensity was about 23·3 times greater than that of the fixed light latterly exhibited from Smeaton's tower, and about 3282 times that of the light first exhibited in the tower from tallow candles. The new tower was built at a distance of 130ft. from Smeaton's lighthouse, a large portion of the foundation being laid below the level of low-water spring tides. The estimate for the work was £78,000, and the cost £59,255. The first landing at the rock was made in July, 1878, and the work was carried on until December. Around the foundation of the base of the tower a strong cofferdam of brick and Roman cement was built for getting in the foundations. By June, 1879, the work was sufficiently advanced for the stones to be laid in the lower course, and everything was arranged for H.R.H. the Duke of Edinburgh, Master of Trinity House, who was to be accompanied by H.R.H. the Prince of Wales, to lay the foundation-stone on the 12th of the month; but the weather being stormy, the ceremony was postponed until the 19th of August, when the lowest stone was laid by the Duke of Edinburgh, assisted by the Prince of Wales. On the 17th of July, 1880, the cylindrical base was completed, and the thirty-eighth course by the early part of November. On the 1st of June, 1881, the Duke of Edinburgh, when passing up Channel in H.M.S. Lively, landed at the rock, and laid the last stone of the tower. On the 18th May, 1882, the Duke of Edinburgh completed the work, by lighting the lamps and formally opening the lighthouse. The edifice was thus erected and fitted up within four years of its commencement, and one year under the time

estimated. The whole of the stones, averaging more than 2 tons each, were landed and hoisted direct into the work, from the deck of the steam tender Hercules, by a chain fall working between an iron crane fixed at the centre of the tower, and a steam winch on the deck of the Hercules, which was moored at a distance of 30 fathoms from the rock. The Town Council and inhabitants of Plymouth having expressed a desire that Smeaton's lighthouse should be re-erected on Plymouth Hoe, in lieu of the Trinity House sea-mark thereat, the Trinity House made over to the authorities at Plymouth the lantern and four rooms of the tower. For taking down and shipping Smeaton's masonry the Hercules was moored at 10 fathoms from the rock, and the stones were shipped, after the removal of the lantern, by her steam machinery, by a process exactly the reverse of that by which the stones of the new tower were landed. After the removal of the structure to the floor of the lower room, the entrance doorway and well staircase leading from it to the lower room were filled in with masonry, and an iron mast was fixed at the centre of the top of the frustrum.

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

(*From our own Correspondent.*)

As I last week indicated was not unlikely, the colliers on the west side of Dudley have attempted a strike this week for the 10 per cent. rise. But the attempt was little more than a fiasco. The men found that their brethren in the West Bromwich district would not join them, and recognising that it would be useless for 3000 or 4000 to stand out if the remaining 12,000 or 13,000 continued at work, they went down the pits again on Wednesday morning.

It may, therefore, be assumed that, thanks to the determined attitude exhibited by the masters from the first, we have now seen the last—at any rate for a month or two—of the threatened great strike of colliers in South Staffordshire. The colliers on the Cannock Chase side of the district, however, declare that they intend to have an advance with the new year. The proprietors of the principal collieries thereabouts have this week been semi-officially informed that the men's representatives had agreed to give fourteen days' notice for an advance which should "make their wages equal to those paid to the miners of South Staffordshire and East Worcestershire," the notice to be given on December 15th. The number of men directly affected is 8000. Should any difficulty arise, it is satisfactory that it is likely to be settled without resort to a strike. The further resolution of the men was that their agent should be instructed to "call the Conciliation Board together to discuss the question as early as possible."

The effect of all this upon the iron market in Birmingham to-day —Thursday—and in Wolverhampton yesterday, was to occasion the sheet makers to become somewhat chary of booking forward into next quarter. Certain galvanisers have booked orders for delivery in the New Year which they have not yet covered by purchases of sheets. At the prices at Wolverhampton to-day they offered their orders, they were not always successful in getting them off their hands.

Generally, the report this week of the galvanised corrugated sheet makers is: "Steadiness, with no pressure." They express no apprehension of the effect upon their branch of business of the calamining process. The alloy is at present three times the price of spelter. With prices of galvanised iron at their present level, they urge that there is little or no fear of a successful competing process.

While the list price of marked bars remains at £7 10s. still, excellent bars are to be had at £7. Plating bars and fullered shoe bars rolled by the list houses are quoted at £8; best rivet iron at £8 10s. nominal. Common bars run down to a minimum of £6, at which figure makers declare there is no profit. For both bars and hoops and strips there is a good local demand, but outside buyers are making their orders as light as possible until next year comes in.

Gas strip is in active inquiry at £6 5s. per ton, the tube-makers being all well engaged.

Nail sheets are quoted £6 5s. to £6 10s., according to quality, and most of the mills are active. Singles, for air pipes and the like, are £7 7s. 6d. upwards, but the minimum quotation for galvanising singles is £7 15s.; doubles are £8 to £8 7s. 6d. Throughout the sheet trade the orders are becoming unequally distributed, and the extent of the profits almost equally variable.

Plates are without improvement, and the competition from outside districts is severe. Tank plates are £7 10s. upwards; boiler plates, £8 10s. onwards; best boiler-plates, £10; double best, £11; and treble best, £12; extra qualities run up to as high as £15; common angle iron is £6 10s., and superior sorts, £7 upwards; T and hinge strip iron is procurable at £7 10s.

The tin-plate makers report themselves well employed. Selling prices for I.C. coke are 17s. to 18s., and for charcoals 19s. to 20s. per box.

Few mills and forges in South Staffordshire and East Worcestershire which have been in operation but bid fair to close the year in full average activity.

A meeting of ironmasters was held to-day to consider the advisability of applying to Mr. Cnamberlain to legalise a new standard gauge for sheets, hoops, and other flat metals. The Ironmasters' Association had prepared a proposed gauge by which sheeets $\frac{1}{16}$in. thick should be called No. 16 gauge. It was, however, resolved that the iron trade should adopt the Birmingham wire gauge, and place the letters B.W.G. after quotations.

The pig trade remains dull. Selling as to other than small lots to complete mixtures may be said to have practically ceased for the quarter, at any rate as to those brands for which consumers are prepared to give anything like a fair price. Thorncliffe pigs are quoted 57s. 6d.; Derbyshires, 46s. 3d.; Northamptons, 45s.; native all-mine descriptions, 62s. 6d. to 60s.; hematites nominal at 60s. per ton.

South Wales scrap iron is inquired for at from 55s. to 57s. 6d. per ton delivered.

Gas, steam, and house coal are in large sale. The first named is realising from about 9s. 9d. to 10s. 6d., delivered into the Staffordshire district from other parts of the kingdom. Best house coal is 11s. at local pits. Furnace coal is 10s. down to 9s., and forge coal 7s. down to 6s. per ton at the pits.

Machinery is more than ever being adopted in the nut and bolt trade, and those firms who have of late laid down such mechanical aid express themselves as much gratified with the saving that results as well as the increased expedition. At the Wednesbury Nut and Bolt Works of Mr. J. Edward Blandy, Horsfall's machine has just been put in and is working admirably. The chief recommendation is the economy which it effects. By its operation hexagon nuts, even to the bur, are made without any waste. Hitherto this class of work has been expensive from the large amount of scrap made in producing it, but by the new machine there is no scrap.

Prices are well maintained by the nut and bolt makers, whose association is becoming increasingly strong. But Belgian competition is still severe, even in the home markets. Light cast iron requisites hold their own.

The South American markets show irregularity at date in distribution of orders. India keeps steady, and the experience of the firms who are doing most with the Empire induces a continuance of hopefulness. The Australian demand is prejudiced by heavy stocks in the hands of buyers in that market, and the Cape keeps decidedly bad.

The Council of the Wolverhampton Chamber of Commerce will meet on Friday to determine upon the desirability of sending a deputation to wait upon the President of the Board of Trade upon the new Patents and Trade Marks Registration Act. Special objection is taken to Clauses 105 and 106, which make it penal to represent any article as patented when no patent has been granted, or to use the royal arms without authority. Large stocks of locks and other hardwares have accumulated on manufacturers' shelves which bear these marks, and it is urged that if Clauses 105 and 106 are literally enforced on January 1st serious injury will be inflicted.

At most of the nail warehouses in the Hales Owen, Old Hill, and Cradley Heath districts, the employers have intimated their intention of paying wages in accordance with the prices in the 1879 list, which is equivalent to a rise of 10 per cent. The Bromsgrove masters have also agreed to a similar concession. The demand for the class of forge nails affected is improved.

The agricultural implement department continues to be an interesting section of the annual Christmas Cattle Show in Birmingham. At the exhibition this week in Bingley Hall there were 125 stands, as compared with 117 last year, and 110 in 1881.

The Guarantee Fund for the proposed Fine Art and Industrial Exhibition in Wolverhampton next June now reaches £7000.

At the Mason College, Birmingham, on Monday, Professor Smith, who occupies the chair of engineering, delivered the last of the present series of lectures to working men. It was on "Factors and Margins of Safety to be Allowed in Designing Structures and Machines Built of Metal." The professor dwelt upon the necessity for fully testing, but not for straining, all material used, and for making ample allowances for sudden and continued strains—the weight of snow, wind pressure, and for unexpected increases in the load to be borne by the structure; and for uncertainty as to the quality of material.

The depreciation of colllery plant was discussed by the Institute of Mining Engineers at Dudley on Monday. A paper by the secretary—Mr. A. Smith—advocated an annual inspection and valuation by a skilled valuer. A paper by Mr. A. Sopwith advocated, if possible, a system midway between the arbitrary mode usually adopted and the perfect way suggested by Mr. Smith. The general opinion of the meeting was that the lives of machinery varied so much in different pits that it was impossible to have a hard-and-fast rule.

The scheme for providing a technical school for Coventry progresses. It is felt that no step that has been taken in connection with the trade of the city for many years past can compare with this movement in its possible influence for good upon its manufacturing interests. Handsome donations and subscriptions are still coming in, and the Chamber of Commerce have this week passed a resolution heartily supporting the scheme.

Messrs. Woodward and Grosvenor, carpet manufacturers, of Kidderminster, have been the first to introduce the electric light in the manufacture of carpets. The electricity is generated by the motive-power used to drive the works machinery. The experiment is being watched with much interest.

The miners employed at Earl Granville's North Staffordshire collieries on Wednesday began to work at an increase of 10 per cent. This advance, however, only brings them up to the scale paid at all the other collieries in the district, where the same rate of pay as was in force before the recent unsuccessful twenty-two weeks' strike has now been conceded.

NOTES FROM LANCASHIRE.

(*From our own Correspondents.*)

Manchester.—The crisis in the coal trade has passed over, fortunately without any serious mischief having been done, and much after the manner I have anticipated in previous "Notes." But although the decision come to by the miners' representatives at the Sheffield conference on Tuesday virtually puts an end for the present to the threatened strike and the movement for securing advanced wages, so far as any combined action on the part of the men throughout the various colliery districts is concerned, may be said to have collapsed, it is scarcely probable the agitation will be allowed to drop. In one form or another it is certain to be a source of friction and irritation between employers and employed for some time to come, and it will therefore be of interest to point out impartially and briefly the actual position in which the coalowners and the colliers stand with regard to this question of wages. For this purpose I have very carefully collected statistics as to wages and prices, which can be verified if required, from the leading collieries throughout Lancashire. The chief movement in the recent agitation has been in the West Lancashire districts, and I will first take the average wages that are under the present scale being paid at several of the principal collieries. The highest average is 6s. 3d. to 7s. per collier per day, and the maximum rate in this case is no doubt due to a large proportion of the men being employed in the cannel mines; the other pits average 6s., 6s. 2d., to 6s. 3d., and 6s. 5d. per collier per day; and taking the whole district, it would not be an unfair average to put the men's wages at 6s. per collier per day, with the average weekly earnings for five days—which is the limit to which the men have themselves restricted their labour—at 30s. I may add that the pits would be open for the men to go down the whole six days of the week if they choose, and to this extent they would be enabled to increase their earnings; but this is a process of getting more money which, apparently, does not commend itself to the mind of the collier, and in some cases work is even limited to four and a-half days a week. Apart from the necessary curtailment of their earnings, the men in this matter of restricting the output have scarcely kept good faith with their employers. About two years ago a great outcry was raised for weekly pays, and these were conceded. This concession was estimated by the men themselves as equivalent to an advance of 5 per cent. in wages, and it was granted on the understanding that the miners would work twelve days a fortnight, if there was work for them to do. But this part of the bargain they have seen fit to ignore. Since November, 1881, two advances in wages, each of 10 per cent., have also been conceded to the men, and their wages are now 28·32 per cent. higher than in June, 1870, whilst the average selling price of coal is only $9\frac{6}{10}$d. per ton higher; and, as compared with November, 1881, their wages are 22·26 per cent. higher, whilst the average selling price of coal when they demanded a further advance of 15 per cent. was only $1\frac{2}{10}$d. per ton higher than in November, 1881. It will thus be seen that whilst prices had not shown more than a small fractional improvement, the men were in receipt of wages which had been advanced upwards of 22 per cent. This, then, has been the basis upon which they have striven to set up a claim for a further advance of 15 per cent., and this also is the basis upon which the masters have refused to entertain the demands of the men. As regards the Manchester district, the average rate of wages would not seem to be quite so high; but taking one firm employing 3000 men as an illustration, the average all through, after deducting the stoppages for holidays or other causes, is equal to 25s. 6d. per collier per week. The better class of men, however, earn a higher average than this, and selecting the pay sheets of about 150 of the best men, there was an average of £1 9s. 9d. per man per week upon a month's earnings, the highest average for one set of men being £1 19s. 11d. per week. To this I may just add, as an illustration of the wide difference in the way in which the men work, that in one mine and under similar conditions one set of men had during the past month made an average of £1 17s. 2d. per week, whilst another set had only made £1 2s. 4d. per week. The last advance of wages in the Manchester district was in November, 1882, when simultaneously with an upward movement in prices the men got an advance of 10 per cent. It was then thought that trade was improving, but the advanced prices were not long maintained, and during the ensuing summer they fell to a very low point, but wages remained without alteration. There has since been a recovery, but prices have not yet got back to the point at which they stood when the last advance in wages was made. So far the advantage has been all on the side of the men as regards the rate of wages they have been receiving, and it may be accepted as a definite decision of the employers that until there is a general upward movement in the price of coal there will be no further advance in the rate of wages.

The iron market during the past week has continued without animation in any department, and it is now scarcely probable that any business of weight will be brought forward until after the turn of the year. Nominally prices are without material alteration, but the tendency of the market is in favour of buyers. In pig iron there has been very little business doing. Lancashire makers still hold for 45s. less 2½ for forge and foundry qualities delivered equal to Manchester, and prefer to work on with old contracts rather than press sales at lower prices. For good brands of Lincolnshire iron the leading makers still ask 44s. 10d. for forge and 45s. 10d. for foundry, less 2½ delivered here; buyers, however, do not give these figures, and both Lincolnshire and Derbyshire brands are to be bought at comparatively low prices.

In hematites there has been little or nothing doing, but there are some fairly large steel rail orders in the market, which, when they are placed, will, it is expected, bring buyers into the market for the raw material.

The finished iron trade has been very quiet, and the tendency is to give way a little in price to secure orders. Local and North Staffordshire bars are both to be bought at £6 2s. 6d., hoops at £6 7s. 6d., and sheets at £7 15s. to £7 17s. 6d. per ton delivered into the Manchester district.

In the engineering branches of industry trade is not so bright as it has been, but the complaints I hear the most frequently are not so much of actual scarcity of work as the extremely low prices at which the work has to be taken.

In the coal trade the collapse of the threatened strike has withdrawn the pressure for supplies which, during the last few weeks, has given an appearance of briskness to the market. All classes of fuel have, however, of late been moving off so freely, in anticipation of the stoppage of the pits, that an advance in prices was almost inevitable, and with the commencement of the month this has been pretty general. In the Manchester district, delivered rates for house coal have been put up 10d.; engine classes of fuel, 5d.; and the wharf prices 5d. to 10d. per ton; whilst in the West Lancashire districts pit prices generally have gone up 1s. on round coals and 6d. on engine fuel. The average pit prices are now—11s. for best coals, 8s. 6d. to 9s. for seconds, 7s. 6d. to 8s. for common coals, 5s. to 5s. 6d. for burgy, 4s. to 4s. 6d. for good slack, and about 3s. 6d. for common sorts. Now that the threatened strike is over there has been very little coal sold at the advanced pit prices, and as a considerable portion of the coal bought recently has gone into stock, actual requirements for the present will only be small, so that it is doubtful how far colliery proprietors will be able to maintain the advance.

The shipping trade is only moderate, with good Lancashire steam coal averaging 8s. to 8s. 6d. per ton, delivered at the High Level, Liverpool, or the Garston Docks.

At the meeting of the Manchester Geological Society on Tuesday, Mr. W. Brown exhibited and explained a model of a patent safety catch for wire ripe guides in mine shafts. The invention has for its object the prevention of accidents to pit cages through the breaking of the winding rope. For this purpose two or more levers are placed on each side of the cage on either side of the guide rod. These levers turn on pins secured to the sides of the cage; the ends of the levers nearest the guide rods are provided with hinge joints, from which extend suitable rods having rollers concaved to the diameter of the guide rod, with sides extending outwards, and having flat circular surfaces to ensure an effective grip on the guide rod and inclined planes which are fixed to the sides of the cage. The opposite ends of the levers are each secured by a hinge joint to connecting rods joined together above the cage by the rods to which the link is attached for securing the cage to the winding rope. When the cage is suspended the rollers are drawn away from the guide rods and the inclined planes, the whole weight of the cage being supported upon the connecting rods as well as the pins or centres of the levers, the tie-rod forming the connection between the rope and these centres. In the event, however, of the rope or any of the connections breaking, the whole weight of the cage is thrown upon the centres, causing the suspended ends of the levers to fall and the opposite ends to rise with the rollers into the inclined plane and grip the guide rods, whereby the cage is held, supported by its own weight acting upon the rollers in the inclined planes, thus preventing its fall down the shaft. To ensure that the levers are operated quickly in case of a rope breaking, springs are employed for pressing the levers against the guide rods.

Barrow.—I can hear of no change of any importance having taken place in any direction during the past week in the position of the hematite pig iron market. As I stated last week several firms in this district have commenced to reduce the output of metal, and this has a tendency to keep the stocks, which so far have been very heavy, from accumulating, as the output more nearly represents the deliveries. Few orders of any magnitude are being received by makers either on home or foreign account, and the small business doing seems to be more with a view of supplying immediate wants than with any idea of speculation; but no doubt the near approach of the Christmas holidays is the cause of this. Prices are still at a very low point, and makers find it impossible to realise any profit on these transactions. Buyers still seem inclined to pull down prices, but makers strongly resist this step. Quotations this week have seen no change, No. 1 Bessemer being sold at 48s. per ton net, prompt delivery; No. 2, 47s. 6d.; and No. 3, 47s. per ton. Steel makers are not so well employed as they might be, few orders being booked. There is yet, however, a considerable output from both the rail and merchant departments. Rails this week are quoted at from £4 10s. to £4 15s. per ton net at works. Shipbuilders are but indifferently employed. In one or two yards in the district an attempt is being made to pull down prices, but this is strongly opposed by the men. Iron ore is in great demand at from 9s. to 10s. 6d. per ton net at mines. Coal and coke firmer. Shipping quiet.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

The heavy order for wagons referred to in my last letter has been decided. The Great Northern Railway Company invited tenders for 2000 wagons, and of that number 1000 have been given to Messrs. Craven Bros., Darnall, Sheffield; 500 to Mr. William Stableford, of Leicester, and 500 to the Oldbury Wagon Company. A considerable order for steel rails for a home company is still undecided.

The strike is now abandoned. This important decision was come to at a national conference held at Sheffield on Monday and Tuesday. About 135,000 miners were represented by delegates, who were presided over by Mr. Woods, a Lancashire delegate; Mr. Benjamin Pickard, Mr. J. Frith, and Mr. William Parrott, the secretaries of the Yorkshire Miners' Association, with Mr. E. Cowey, the president, were also present. Of the leading coal-producing counties of England, only Durham and Northumberland were represented. The Lancashire delegates came to the conference with a strong disinclination to adopt extreme measures. In fact, several of them stated that they had so often gone out when Yorkshire remained in that they had resolved this time to see Yorkshire actually on strike before they took this step. For Nottinghamshire it was stated that not 2000 could be depended upon to come out; Derbyshire was also divided, and very discouraging reports were read from South Staffordshire, North Staffordshire, and Cannock Chase. The Yorkshire delegates, with few exceptions, were in favour of advising the men to leave work, and a motion endorsing the previous resolutions in favour of striking for 15 per cent. was proposed and seconded. An amendment in favour of

postponing the subject to the 27th December, in consequence of so many of the districts which had pledged themselves to cease work being now disinclined to do so, was moved and seconded by Barnsley delegates. For the amendment there were twenty-eight votes, while six voted against and six were neutral. The amendment was therefore carried. Practically it means that the strike is altogether abandoned, for it is very improbable indeed that the whole question will be re-opened again on the 27th inst.

At the pit-head conference of Yorkshire miners, held the same afternoon, there was a long and somewhat acrimonious discussion. Of course, a strike to be successful must be universal, and the resolution passed at the general conference in ths morning had destroyed all hope of there being any unanimity on the part of the colliers' delegates even in Yorkshire. Mr. E. Cowey, the president of the Yorkshire Miners' Association, confessed to feeling humiliated at having to beat a retreat; but, along with Mr. Pickard, he felt the hopelessness of engaging in a struggle single-handed. It was accordingly resolved, with two dissentients, "That this conference regrets that the other counties have failed to carry out the Manchester Conference resolutions; we hereby agree that deputations wait upon our employers to withdraw our notices to-morrow, seeing that we are not willing to plunge our district into a strike and fight the battle by ourselves; and we further agree that a conference be held in Barnsley on Saturday, at eleven o'clock, to hear the reports as to how the notices have been withdrawn, and to decide upon our future action." The object of the conference at Barnsley is to see if the coalowners have generally permitted the men to withdraw their notices, and to ascertain if any of the employers had "taken advantage" of miners who had been prominent in the agitation and threatened strike.

Everywhere news of the abandonment of the strike was received as a great relief, not only by the colliers themselves, but by the steel-workers, ironworkers, the general public, and tradespeople in particular. Prices of coal will now go down as rapidly as they rose, and in a short time the coalowners will be compelled to put men on reduced employment—probably three days a week. An immense quantity of fuel has been accumulated in view of the strike. It is stated that the Midland Company alone had 30,000 loaded wagons on their system, and the sidings of every coal-carrying company were literally blocked up last Saturday. On Monday and Tuesday the representatives of many coal companies and merchants were waiting outside the conference-room, in the hope of getting early news of the decision come to by the delegates, and on its becoming known that the strike had been abandoned the news was promptly telegraphed over the kingdom.

The Eclipse Cutlery Works, Sheffield—Messrs. Wheatley Brothers—was destroyed by fire on the morning of the 5th inst. The loss is £4000. Between 300 and 400 men are thrown out of employment. It is not known how the fire originated.

THE NORTH OF ENGLAND.

(From our own Correspondent.)

A SLIGHTLY better feeling was noticeable at the Cleveland iron market, held at Middlesbrough on Tuesday last. The prices which have ruled during the last few days were fully maintained, and there was more disposition to buy on the part of consumers than for some time past. Makers and merchants were thereupon somewhat less anxious to sell. No. 3 g.m.b. was offered by merchants at 37s. per ton, but most makers held out for 3d. to 6d. per ton more than that figure. It is thought that lower rates will not now be quoted—at all events before the holidays—as most producers are fully booked to the end of the year. No. 4 forge iron was on Tuesday offered at 35s. 6d. per ton.

Warrants are in small request, and not above 37s. per ton is obtainable. The stock of Cleveland pig iron in Messrs. Connal's Middlesbrough stores has remained almost stationary for a fortnight. On Monday last the quantity held was 63,593 tons, being 302 tons less than when last reported. At Glasgow the stock on Monday was 584,088 tons, being a reduction of 1399 tons for the week.

The finished iron trade shows little change. Manufacturers have orders which will keep their works going till the end of the year, and are about able to maintain the prices which have ruled for the last month; fresh orders are, however, not readily secured. Ship plates are quoted at £5 17s. 6d. to £6 per ton; angles at £5 12s. 6d., and common bars at £5 15s., all free on trucks at makers' works less 2½ per cent. discount.

The exports of pig iron from the Tees last month were almost unprecedented, amounting as they did to 101,114 tons. This quantity has been exceeded only once in the history of the trade of the district, and then only by about 50 tons. The principal items in last month's shipments are as follows, viz.:—To Scotland, 28,350 tons; to Germany, 17,020 tons; to Wales, 14,097 tons; to Holland, 10,939 tons; and to France, 11,285 tons. The shipments of manufactured iron and steel were also much heavier than they have been for a long time, the quantity being 40,437 tons.

The ironmasters' returns for November were issued on the 3rd inst. They show that there are 118 furnaces at work, 84 producing Cleveland pig iron and 34 making hematite and basic pig. The make of iron of all kinds amounted to 228,050 tons. The total quantity of iron in stock at the end of the month was 220,288 tons, being a reduction of 21,798 tons since October 31st.

It will be remembered that the Durham miners gave notice a short time since to terminate the sliding scale which has regulated their wages for the last two years. This notice expires on December 31st, and it is to be hoped that some arrangements of a not less satisfactory character will succeed it. The men have applied for an advance of 10 per cent., and ask for several other concessions before agreeing to accept any renewal of the sliding scale system. The whole question is under consideration by the owners, who promise a definite reply in the course of a few days.

Messrs. Stevenson, Jaques, and Co., have given notice to leave to about eighty of their miners at Boosebeck, and intend to damp down one of the blast furnaces at their Middlesbrough works, owing to the continued depression of the pig iron trade.

At most of the shipyards at Stockton, Hartlepool, and Middlesbrough notices have been posted up stating that, owing to the depression in trade, reductions must be made in piecework prices and time wages, to take effect in February next. Piecework prices will be reduced 10 to 20 per cent.

In answer to the notice given by the masters connected with the Board of Arbitration for a 5 per cent. reduction, the operatives have sent in counter claims as follows:—"First, substantial advance on present rates; secondly, a minimum rate to be established; thirdly, if any new scale is to be adopted, to be on a more liberal basis than the one now in operation." A meeting of the board is summoned at Darlington on the 5th inst., when the wages question will be fully discussed. An arbitration will no doubt ensue, and the referee will, if possible, be then appointed.

Messrs. Bolckow, Vaughan, and Co., Limited, have given notice to their workmen for a reduction of wages to come into operation with the new year. They claim 10 per cent. off the steel workers and 5 per cent. off mechanics.

It is reported that the ironworkers engaged in the manufactured iron trade intend to propose Mr. C. J. Coleman, the Middlesbrough stipendiary magistrate, as referee in the approaching arbitration for the settlement of their wages. It will be remembered that Mr. Coleman acted recently in a similar capacity between Messrs. Bolckow, Vaughan, and Co. and their men.

It is not likely, however, that the employers will agree to anyone not practically acquainted with their trade.

NOTES FROM SCOTLAND.

(From our own Correspondent.

THE Glasgow iron market has been to some extent affected by the failures that occurred last week in the local iron and shipbuilding trades. It is now believed, however, that the worst regarding these is known, and that other stoppages of importance need not, in the meantime, be apprehended. There has not been very much of consequence doing in the iron market. The transactions have been for the most part of the jobbing description, with the view of securing differences, in the speculative department. As to the legitimate business, the demand for export has materially slackened—a fact which is made clear by the marked diminution in the amount of the shipments. On the other hand, the stocks of pig iron in the warrant stores continue to decrease, the quantity for the past week being over 1200 tons. There are now 101 furnaces in blast, against 114 at the same date last year.

Business was done in the warrant market on Friday up to 44s. 4d. cash. On Monday forenoon transactions took place at 43s. to 44s. 2½d., 44s. 4d. and 44s. 3½d. cash, and 44s. 3½d. to 44s. 5½d. one month; the quotations in the afternoon being 44s. 3d. to 44s. 6½d. cash and 44s. 5½d. to 44s. 8d. one month. Business was done on Tuesday at from 44s. 6d. to 44s. 4½d. cash, and 44s. 8d. to 44s. 6½d. one month. On Wednesday business was done at 44s. 5d. to 44s. 7d. cash and 44s. 6½d. to 44s. 9d. one month. To-day—Thursday—transactions took place at 44s. 7d. to 44s. 6d. cash and 44s. 9d. to 44s. 8½d. one month.

The quotations of makers' iron are again somewhat low, as follows:—Gartsherrie, f.o.b. at Glasgow, per ton, No. 1, 52s.; No. 3, 49s. 6d.; Coltness, 55s. and 51s.; Langloan, 54s. and 51s.; Summerlee, 53s. 6d. and 49s.; Calder, 55s. and 47s. 6d.; Carnbroe, 53s. and 48s.; Clyde, 48s. and 46s.; Monkland, 45s. 9d. and 43s. 6d.; Quarter, 45s. and 43s. 3d.; Govan, at Broomielaw, 45s. 9d. and 43s. 6d.; Shotts, at Leith, 55s. and 52s. 6d.; Carron, at Grangemouth, 49s. (specially selected, 56s. 6d.) and 47s. 6d.; Kinneil, at Bo'ness, 46s. 6d. and 45s. 6d.; Glengarnock, at Ardrossan, 53s. and 45s. 6d.; Eglinton, 46s. 6d. and 43s. 6d.; Dalmellington, 48s. and 47s.

The imports of iron ore from abroad in the past week were smaller than usual, but the quantity being consumed is very considerable.

Operations have just been commenced by the Brandon Iron and Steel Company for the erection of an iron and steel works at the village of Craigneak, near Motherwell. The intention is to proceed with the works as speedily as possible, and it is believed they will employ about 300 men. Messrs. Miller and Co., engineers, Coatbridge, have contracted to supply the necessary engines and machinery. The works will be close to the Caledonian Railway, which will afford every facility for traffic.

The question of the ironworkers' wages at the malleable and rolling mills in Lanarkshire still engages attention. Several weeks ago the pay of the men was reduced in accordance with an award in the North of England, there having been an understanding in force for a long time that, to avoid disputes wages should rise and fall with those across the Border. The men object to the decline on this occasion, because when it took place trade was specially active; but the masters naturally hold to the agreement, because if they had been slack and an advance given in England, they might still have been obliged to increase wages. The necessity for adhering to the rule is all the greater at present, because dull times are in prospect. A meeting of the central executive of the men has been held, and the secretary instructed to give notice to the employers that Monday next will be held as an idle day in all the works affected.

The export trade in manufactured iron and steel materials continues good. In the past week there was despatched from the Clyde general iron manufactures valued at £27,200; steel goods, £9560; sewing machines, £10,200; and machinery, £11,000.

There has been a good business in the shipment of coal at the Clyde ports in the past week, but the coalmasters are again complaining of a scarcity of wagons for conveying coals from the pits to their destinations. The f.o.b. prices at Glasgow are:—Main, 7s. to 7s. 6d. per ton; ell, 8s. 6d. to 9s. 6d.; splint, 7s. 9d. to 8s. 3d.; and steam, 8s. 6d. to 9s. 6d. A better demand having been experienced for dross, the prices for it are rather more firm. Business is comparatively good in Ayrshire; but in the Slamannan and Airdrie districts the masters are reported to be re-considering the wages' question on account of the prices of steam coals not being fully maintained. At Grangemouth the week's export of coals has been 5740 tons, while 5000 tons were despatched from Leith. Business appears to be a shade quieter in Fifeshire, and the failure of the West of Fife Coal Company has produced a bad effect, at least temporarily, on the trade.

There is a fair business in the Scotch mineral oil trade, although prices of ammonia have recovered only to a slight extent.

The wages of ironworkers in the Clyde shipyards were on Monday reduced by 10 per cent., but private meetings have taken place between representatives of the masters and workmen, with the object of having the amount of the reduction somewhat modified, if this should be at all found possible. The failures that were reported last week in the shipbuilding and iron trades of the Clyde are not expected to be followed by others of any moment at present, although there can be little question that many firms have had not a little difficulty in making both ends meet.

WALES & ADJOINING COUNTIES.

(From our own Correspondent.)

THE clearance of Plymouth Works continues, and a rapid dispersion of the plant is being made to all parts of the country. De Bergue's plant, Llandaff, is also cleared away, and only the shell of the works is left. These things following in the track of Penydarran, shows the course of things. In less than two years only the sites of the old industries of Penydarran, Plymouth, Treforest, Gadlys, and Llwydcoed will remain, and, judging from prominent indications, there is little or no likelihood of new works being started on new principles.

A noticeable characteristic of the new ironworks in Wales is economy of process, and even if the iron trade should sink lower than what it now is, Wales could keep its head above water when most of the mills in the North would have to close. I give this as the practical opinion of one who has had the fullest opportunities for forming an opinion, and having visited nearly all the works in England, expresses his strong approval of the manner in which Cyfarthfa is being laid out.

An order for 20,000 tons of rails has been placed in Glamorgan and Monmouth for delivery next year. Yet, confessedly, trade is bad and low quotations fail to bring business. The only briskness shown is in connection with coal, and with railway projects calculated to give easy access to virgin coalfields, I note that the Taff Vale, London and North-Western, and Great Western are already in the field, and the next session promises to be a busy one.

The railway employés of the Taff appear to be more contented. Now that promises of altered hours are made, the Taff Railway Company is simply waiting the completion of its arrangement to do this, but I find that its hours compare very favourably with those of the Midland and the Great Northern especially. The ironworkers have held a meeting this week in advocacy of an arbitration and sliding scale association, and a final meeting at Dowlais is announced. They appear resolved to carry their movement out, and are chiefly impelled by the success of the Coalowners' Association scale, which is working admirably. There is no falling off in the demand for coal, but there is in the quantity exported, on account of the bad weather. A good deal of hampering has taken place at the various ports this week in consequence, and Swansea has been in particular a considerable sufferer. The trade, however, especially in best steam, in all the Rhondda coals and house coals, is good.

Some degree of concern is felt at Swansea as to the results which may attend the lamented death of Sir W. Siemens. It remains to be seen whether the industry associated with his name will continue on its old lines or be modified.

Another great change is coming. On Saturday a petition will be lodged against the Aberdare and Plymouth Company, and the names of the petitioners will command all attention. It has taken a long time to bring matters to this, and the result must awaken a great deal of anxiety.

The humble inventor of the "Billy Fair Play" machine, well known at all the collieries, died this week. He was an ingenious man, and designed other inventions of note.

I am glad to hear that most of the disturbing influences in the Rhondda are being allayed, and the peaceful working of the Welsh valleys is in marked contrast to the North of England. The Clydach doctor question has been settled, and the only little upset at present is at Gelli, where a number of the colliers have been summoned.

I have little to report favourably in connection with tin-plate. Makers busy. New orders scarce.

MR. THOMAS KNOWLES.—The death is announced of Mr. Thomas Knowles, senior member for the borough of Wigan, on the 3rd inst., at his residence, Darnhall-hall, near Winsford, Cheshire. Mr. Knowles was born at Ince, near Wigan, in 1824, and when nine years old began to work in a mine. He attended a night school frequently after fifteen hours' work. He filled most of the offices at the colliery, and when twenty-four years old was appointed manager by the late Mr. Thomas Pearson at his Ince Collieries. Six years later, owing to his business abilities, he was taken into partnership by Mr. Pearson. Ten years ago the works connected with the Dallam Ironworks, Warrington, were amalgamated with the Wigan Collieries, and the concern has since been worked as the Pearson and Knowles Coal and Iron Company, Limited, Mr. Knowles being chairman. In addition to this Mr. Knowles carried on cotton-spinning at Sovereign Mills, Wigan. He was a member of the Wigan Town Council for twenty years, and twice filled the office of mayor. He was a director of the London and Nerth-Western Railway Company and Manchester and Liverpool District Banking Company, a justice of the peace for the county, &c. For two years he occupied the post of president of the Mining Association of Great Britain. He took an active part in the debates on the Employers' Liability Act, but was overcome with his exertions, and a voyage to America with the Duke of Sutherland failed to completely restore him. He was able afterwards to attend to his Parliamentary duties for a time, but was seized with a paralytic stroke.

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.**

27th November, 1883.

5532. WINDING COTTON, &c., H. C. Hill and H. H. Brown, Stalybridge.
5533. BLOCK ICE, H. C. Smith, Richmond.
5534. ASH HOISTS, J. D. Spreckels, San Francisco.
5535. TELEGRAPHIC RELAYS, J. H. Johnson.—(*J. A. Maloney and G. W. Cooper, Washington, U.S.*)
5536. SOLID INK PENCILS, J. Darling, Glasgow.
5537. HEATING AIR, J. Murray, Paisley.
5538. COMPOUND MARINE ENGINES, W. B. Thompson, Dundee.
5539. SUPPLYING ELECTRIC CURRENT, &c., M. Immisch, London.
5540. SECONDARY VOLTAIC BATTERIES, A. Khotinsky, London.
5541. PRODUCING MOTIVE POWER, W. Ross, London.
5542. GAS, A. J. Boult.—(*J. Hanlon, New York, and J. E. Leadley, New Jersey.*)
5543. GAS ENGINES, L. H. Nash, Brooklyn, U.S.
5544. BICARBONATE of SODA, A. M. Clark.—(*La Société Anonyme des Produits Chimiques de l'Est, France.*)
5545. MICROPHONES, F. J. Semal, Belgium.
5546. LATHES, J. A. B. de Castelberg.—(*C. Piquerez, St. Ursanne, Switzerland.*)
5547. ADVERTISING, H. Bonneville.—(*A. Ralu, France.*)
5548. INCANDESCENT ELECTRIC LAMPS, J. C. Mewburn.—(*J. Kahn and I. Bräuer, Vienna.*)
5549. LOOMS for WEAVING, R. Hall and C. Ellis, Bury.
5550. MANURE, J. H. Kidd, Wrexham.
5551. REVERBERATORY GAS FURNACES, W. L. McNair, Golden, Colorado, U.S.)
5552. SIPHON BOTTLE, H. H. Lake.—(*La Société J. Vidie et Fils, Pantin, France.*)
5553. TREATING MIXED FABRICS, S. Pitt.—(*Madame Robert, Iseron, France.*)
5554. MANUFACTURING FABRICS, H. H. Lake.—(*J. B. Edson, Massachusetts, U.S.*)

28th November, 1883.

5555. UMBRELLAS and PARASOLS, J. H. Johnson.—(*J. N. Colby, New London, U.S.*)
5556. DRESSING FLOUR, &c., G. C. Janssen, Hamburg.
5557. OPENING STOPPERED BOTTLES, R. Swales and W. P. Cherry, Hull.
5558. CUTTING and DRESSING MARBLE, &c., W. Burke.—(*Messrs. Puissant Frères, Belgium.*)
5559. LAMPS, G. Wood, Warrington.
5560. TRACTION ENGINES, W. Wilkinson, Wigan.
5561. KNITTING the INNER SELVAGES of DOUBLE PILE FABRICS, S. C. Lister and J. Reixach, Bradford.
5562. GENERATING ELECTRIC CURRENTS, A. B. Cunningham, London.
5563. VENTILATED QUILT, G. Pocknell, Exeter.
5564. REDUCING ORES, A. M. Clark.—(*J. B. O. Thiéblemont, Paris, France.*)

29th November, 1883.

5565. LAUNCHING FISH TORPEDOES, A. Sauvée.—(*J. B. Canet, Paris, France.*)
5566. SHUTTLE TONGUES, W. Carr, Bury.
5567. METALLIC BOSSES for CARRIAGE WHEELS, H. J. Haddan.—(*J. J. Schmidt, Erfurt, Germany.*)
5568. MANUFACTURING BESSEMER METAL, H. D. Pochin, Barnes.
5569. VELOCIPEDES, P. Adie, London.
5570. GAS MOTOR ENGINES, T. M. Williamson, J. Malam, and W. A. Ireland, Southport.
5571. BLOWING GLASS, A. M. Clark.—(*La Société Appert Frères, Paris, France.*)
5572. CASTING STEEL INGOTS, J. H. Poole, Glasgow.
5573. PERAMBULATORS, W. Dawson, Leeds.
5574. BOXES, T. S. Sykes, Liverpool.
5575. TRICYCLES, H. Knight, London.
5576. COATING for PROTECTING BUILDINGS, &c., from HEAT, T. H. Fielding and A. N. Jonsen, Sydney.
5577. MANUFACTURING COKE, &c., A. B. Cowan, Spennymoor.

30th November, 1883.

5578. PAPER CASKS or VESSELS, F. C. Glaser.—(*F. Westphal, Bergisch Gladbach, Prussia.*)
5579. CHECKING the ISSUE of TICKETS, A. Johnson, Birkenhead.
5580. COUPLINGS, C. E. Newill, Rochdale.
5581. FINISHING TEXTILE FABRICS, F. Dehaitre, Paris.
5582. SALICYLIC ACID, T. Kemp, Berlin.
5583. TRICYCLES, T. Humber, Beeston.
5584. ELECTRIC IGNITING APPARATUS, H. J. Haddan.—(*E. Witte, Vienna.*)
5585. FITTING WINDOW SASHES and SASH FRAMES, W. J. Penny, London.
5586. DISENGAGING SHIPS from MOORINGS, G. H. Lewis, Southampton.
5587. WORKING AUDIBLE FOG SIGNALS, J. R. Wigham, Dublin.
5588. CIRCULAR KNITTING MACHINES, W. R. Lake.—(*A. Bonamy, Oise, France.*)
5589. VELOCIPEDES, S. Hall, London.
5590. KNITTING MACHINES, E. Edwards.—(*L. Bosi, Italy.*)
5591. GAUGING SPECIFIC GRAVITIES, &c., J. C. Stevenson, Liverpool.

1st December, 1883.

5592. FILE-WHEEL, E. Dufriche-Miroude, Paris.
5593. OBTAINING INFUSIONS from COFFEE, &c., W. N. Hutchinson, Bideford.
5594. WOOL-WASHING MACHINES, J. Campbell, Bradford.
5595. MANUFACTURING IRON and STEEL, E. Edmunds, Pontnewydd.
5596. VENTILATING APPARATUS, G. Greig, Stonehaven.
5597. HOOP SKIRTS and BUSTLES, M. Rosenstock, New York, U.S.
5598. COMBING, &c., DYED HANKS of YARN, H. A. Crowther and J. Moorhouse, Huddersfield.
5599. STEAM, &c., ENGINES, T. Blamires, Huddersfield.
5600. UTILISING SCORIA, G. F. Redfern.—(*J. Stickle, Denver, Colorado.*)
5601. BICYCLES, J. G. Parker, London.
5602. CONTROLLING RAILWAY SWITCHES, A. M. Clark.—(*Railway Speciality Manufacturing Company, U.S.*)
5603. FOLDING PACKAGES, C. Mace, London.
5604. SHAFT COUPLINGS, L. Sterne, London.

3rd December, 1883.

5605. SODA, W. Weldon, Burstow.
5606. HAULING NETS, G. Souter, Elgin.
5607. SEAMLESS UPPER LEATHER for BOOTS, T. T. Marshall, Jarvis, Ontario.
5608. MECHANICAL VEHICLE, H. Robin, Paris.
5609. DRYING CLOTHING, J. Hawkesworth, Stokeford.
5610. TRICYCLES, W. J. Lloyd, Harborne.
5611. INSULATORS, G. W. Hannam.—(*S. Oakman, U.S.*)
5612. TRICYCLES, E. R. Settle, Coventry.
5613. VELOCIPEDES, W. Wise.—(*F. von Palstring, Saxony.*)
5614. PRESERVING, &c., BEERS, W. Aubert, jun., London.
5615. PORTABLE ELECTRIC LIGHT APPARATUS, H. J. Haddan.—(*J. Beduwé, Liége, Belgium.*)
5616. PRODUCING DESIGNS, &c., in MARBLE, &c., G. Hand-Smith, London.
5617. WHEELS, T. L. Aveling, Rochester.
5618. FASTENERS for CLOTHING, W. P. Thompson.—(*Messrs. De Saint Denis and Co., Paris.*)
5619. TELEGRAPH and TELEPHONE WIRES, A. J. Boult—(*G. Gray, Boston, U.S.*)

5520. Lubricating Mechanism, A. H. Leech and W. Bateson, Wigan.
5521. Laying Wood Pavement, G. W. von Nawrocki.—(*R. Albrecht, Tilsit, Germany*)
5522. Manufacturing Ornamental Articles from Wood Pulp, &c., P. Jensen.—(*A. Andersson, Sweden.*)

Inventions Protected for Six Months on Deposit of Complete Specifications.

5502. Grinding the Treads of Wheels, E. P. Alexander, Southampton-buildings, London.—A communication from A. W. McIntyre, Chicago, U.S.—26*th November*, 1883.
5534. Ash Hoists. J. D. Spreckels, San Francisco.—27*th November*, 1883
5542. Illuminating and Heating Gas, A. J. Boult, High Holborn, London. A communication from J. Hanlow, New York, and J. E. Leadley, Camden, New Jersey.—27*th November*, 1883.
5543. Gas Engines, L. H. Nash, Brooklyn, New York.—27*th November*, 1883
5563. Ventilated Quilt, G. Pocknell, Exeter.—29*th November* 1883.
5565. Launching Fish Torpedoes, A. Sauvée. Parliament-street, Westminster.—A communication from J. B. G. A. Canet, Paris.—29*th November*, 1883.

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

4926. Coppers for Boiling Worts, T. Bloom, Boston.—26*th November*, 1880.
4932. Treating Ores, &c., F. M. Lyte, Putney.—26*th November*, 1880.
4963. Ploughs, J. Howard and E. T. Bousfield, Bedford.—29*th November*, 1880.
4991. Battery of Machine Guns, T. Nordenfelt, London.—30*th November*, 1880.
4965. Heel-stiffeners for Boots, H. Lake, London.—29*th November*, 1880.
5034. Steamships, J. S. White, Isle of Wight.—3*rd December* 1880
5041. Spinning and Doubling Machinery, B. A. Dobson and R. C Tonge Bolton.—3*rd December*, 1880.
4968. Dissolving in Chemical Processes, &c, J. F. N. Macay, London —29*th November*, 1880.
4984. Treating Jute, &c., C. F. Cross, Brentford.—30*th November*, 1880.
5029. Ring Spinning Frames, A. M. Clark, London.—2*nd December*, 1880.
4975. Washing Machines, J. Mitchell, Newcastle-on-Tyne.—30*th November*, 1880.
5021. Driving Gear of Mangles, T. Bradford, London.—2*nd December*, 1880.
5113. Telephones, J. B. Morgan, London.—8*th December*, 1880
5263. Preparing Colouring Matters, J. H. Johnson, London.—15*th December*, 1880.
5001. Printing, Folding, and Cutting Newspapers, P. D. Hedderwick, Glasgow.—1*st December*, 1880.
5025. Cleaning Flues, R. Sutcliffe, Idle.—2*nd December*, 1880.
5036. Preventing Incrustation, A. Jay, near Bristol.—3*rd December*, 1880
5050. Boilers, W. H. Mifin, Manchester, and E Nield, Oldham.—4*th December*, 1880.
5491. Web Printing Machines, J. Foster, Preston.—30*th December*, 1880.

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

4593. Feeding Steam Boilers, C. Pieper, Saxony.—27*th November*, 1876.
4645. Making up Printed Paper into Books, &c., W. Conquest, London —30*th November*, 1876.
4715. Seamless Metal Tubes and Rods, E. H. Waldenström and W. Sumner, Manchester—6*th December*, 1876.
4515. Floating Lights, C. D. Abel, London.—21*st November*, 1876.
4582. Web Printing Machines, J. Foster, Preston.—27*th November*, 1876.
4599. Boots, Shoes, and Clogs, J. Blakey, Leeds.—28*th November*, 1876.
2806. Audible Alarm Signals, N. J. Holmes, London.—10*th August*, 1875.
4614. Stopping Leaks in Boilers, &c., H. Ferguson, Liverpool.—29*th November*, 1876.
4862. Lock Top for Spindles, T. K. Hatterley, Leeds.—15*th December*, 1876.
4765. Electric Telephony, W. Morgan-Brown, London.—9*th December*, 1876.
4674. Brick-making Machinery, H., J., and W. Ward, jun., Leeds —2*nd December*, 1876.
4682. Boring or Working Rock, &c., W. R. Lake, London.—4*th December*, 1876.

Notices of Intention to Proceed with Applications.

(*Last day for filing opposition*, 21*st December*, 1883.)

3515. Bicycles, &c., G. Warwick, Aston.—17*th July*, 1883.
3623. Sheep Shears, T. Birkhead, Sheffield.—24*th July*, 1883.
3628. Velocipedes, M. D. Rucker and J. Winterschladen London.—24*th July*, 1883.
3647. Ventilator Cowls, &c., A. Mechan, Glasgow.—25*th July*, 1883.
3648. Fire-resisting Doors, F. W. E. Braid, London.—25*th July*, 1883.
3649. Facilitating the Changing of Healds in Looms, S. H. Storry and S. D. Rhodes, Huddersfield —25*th July*, 1883.
3656. Automatic Flushing Apparatus, W. B. G Bennett, Portswood.—25*th July*, 1883.
3662. Belt Fasteners, H. Greene, London.—26*th July*, 1883.
3673. Bundle Carriers for Harvesters, W. Cranston, London.—A com. from W. A. Wood.—27*th July*, 1883.
3675. Mats or Floor Coverings, R. Martinez, New York.—27*th July*, 1883.
3676. Enabling Persons to Remain in Rooms filled with Smoke, &c., L. A. Groth, London.—A communication from B. Loeb, jun —27*th July*, 1883.
3677. Making Casks, S. Wright, Fgremont.—27*th July*, 1883.
3679. Smelting and Refining Furnaces, N. Fière, Molenbeck.—27*th July*, 1883.
3681. Sliding Chandeliers, &c., J. Nadal, London.—27*th July*, 1883.
3687. Chairs, F. C. Glaser, Berlin.—A com. from F. W. A. Erdmann and H. Ruperti.—28*th July*, 1883.
3691. Baking Bread, &c., H. J. Haddan, London.—A communication from A. Klucke.—28*th July*, 1883.
3696. Ascertaining the Speed of Vessels. F. H. Engel, London.—A com. from O. Pezoldt.—28*th July*, 1883.
3707. Moulds for Obtaining Impressions Representing Lace Medallions, R. Lanham, London.—28*th July*, 1883.
3719. Screw Hooks, &c., S. W. and J. A. Richards, Birmingham —30*th July*, 1883.
3761. Stair Pads, T. Griffith, Manchester.—1*st August*, 1883.
3795. Life-boats, G. Skelton, Millwall.—3*rd August*, 1883.
3798. Mills for Grinding Paint, T. T. Crook, Bolton—3*rd August*, 1883.
3841. Watch Keys, &c., J. S. Birch, New York.—7*th August*, 1883.
3884. Precipitated Phosphate of Lime, W. Weldon, Burstow.—A communication from E. Lombard.—10*th August*, 1883.
3929. Controlling the Operation of Stretching Machines H. H. Lake, London.—A communication from La Société Anonyme des Teintures et Apprêts de Tarare.—13*th August*, 1883.
4028. Covering Wire with Plastic Material, E. T. Truman, London.—20*th August*, 1883.
4077. Paper-making Apparatus, A. M. Clark, London.—A com. from M. Sembritzki.—22*nd August*, 1883.
4079. Chlorine, W. Weldon, Burstow.—23*rd August*, 1883,
4400. Fixing the Poles of Lawn Tennis Nets, T. B. H. Cochrane, Ryde 14*th September*, 1883.
4434. Hydrometers and Saccharometers, T. Derham, Bolton.—17*th September*, 1883
4677. Grinding Caustic Soda. S. Pitt, Sutton.—A communication from F. P Harned.—2*nd October*, 1883.
4695. Manufacture of Certain Parts of Steam Boilers, J. Tordoff, Leeds.—2*nd October*, 1883.
4933. Horseshoes, &c, T. D. Richardson, North Greenwich.—16*th October*, 1883.
5083. Tobacco Pipes, W. A. Ross, Acton, and H. Lawson, Clapham.—25*th October*, 1883.
5093. Moulding Screw Forms, &c., D. Rylands, Stairfoot.—A com from H. Brooke.—26*th October*, 1883.
5131. Sewing Machines, W. F. Thomas, London.—29*th October*, 1883.
5140. Furnaces, A. G Brookes London.—A communication from L P. French —30*th October*, 1883.
5144. Mounting the Wheels of Railway Carriages, J. E. S. Thornhill, T. Forknall and E. Thornhill, near Manchester —30*th October*, 1883.
5168. Chlorate of Potash, &c, E. K. Muspratt, near Liverpool, and G. Eschellman, Widnes.—31*st October*, 1883.
5183. Chlorate of Soda, E. K. Muspratt, near Liverpool, & G. Eschellmann, Widnes.—31*st October*, 1883.
5522. Grinding the Treads of Railway Wheels, &c., E. P. Alexander London.—A communication from A. W. McIntyre —26*th November*, 1883.
5543. Gas Engines, L. H. Nash, Brooklyn.—27*th November*, 1883.

(*Last day for filing opposition*, 24*th December*, 1883.)

3386. Cutting Sugar-cane into Lengths, J. Thornton, Cleckheaton.—28*th July*, 1883.
3689. Spinning Machinery, T. E. Smith, Keighley.—28*th July*, 1883.
3693. Bottle Stoppers, M. Gill, Huddersfield.—28*th July*, 1883.
3695. Checking Apparatus, D. Dossett, Leyton.—28*th July*. 1883
3698. Station Indicators, S. Ballin, Hamburg.—28*th July*, 1883.
3708. Purification of Gases, A. G. Hendereon and J. A. Kelman, London.—30*th July*, 1883.
3718. Asphalte Apparatus, B. D. Healey, Brighouse.—30*th July*, 1883.
3731. Locks or Dams, W. P. Thompson, Liverpool —A communication from J. du Bois.—31*st July*. 1883.
3732. Carbonising Wood, W. P. Thompson, Liverpool.—A com from J. A. Mathieu.—31*st July*, 1883.
3740. Water-closets, T. W. Helliwell, Brighouse.—31*st July*, 1883.
3742. Regenerative Gas-light ng Apparatus. A. S. Bower, St. Neot's, and T. Thorp, Whitefield —31*st July*, 1883.
3754. Ventilating, &c., Rooms, &c., C. M. Tait, London.—31*st July*, 1883.
3757. Mowing and Reaping Machines, E. Pratt, Uxbridge.—31*st July* 1883.
3758. Coating with Gelat nous Compounds the Drawing Rollers of Spinning Machinery, E. Edwards, London.—A com. from J. Appelt —31*st July* 1883.
3763. Electric Clocks G. M. Herotizky, Hamburg.—1*st August*, 1883.
3765. Supporting Trousers, J. H. Topham, Manchester.—1*st August*, 1883.
3766. Printing, &c., Stamps, &c, J. H. Topham, Manchester.—1*st August*, 1883.
3768. Invalid Couches, W. Dickinson, Manchester.—1*st August*, 1883.
3781. Razors and Razor Sheaths, T. Clarke, Sheffield.—2*nd August*, 1883.
3784. Railway Locomotive Exhaust Apparatus, J. Armstrong, New Swindon —2*nd August*, 1883.
3802. Dobbie Machines for Weaving, P. Burns, Gillis, and R. G. McCrum, Milford.—3*rd August*, 1883.
3833. Bicycles, A. C. Henderson, London —A communication from G. Rothgiesser.—7*th August*, 1883.
3840. Taps or Cocks, S. Defries, London.—7*th August*, 1883.
3844. Chemical Fire-engines, J. Gibbs and D. Fotheringham, Glasgow.—7*th August*, 1883.
3859. Breech-loading Small-arms, W. M. Scott, Birmingham, and C Proctor, Handsworth.—8*th August*, 1883.
3860. Trimming the Edges of Cards for Combing Fibrous Materials, H. H. Lake, London.—A communication from F. G Beaumont.—8*th August*, 1883.
3895. Letter-press Printing Machines, A. Godfrey, New Reddish.—11*th August*, 1883.
3904. Controlling the Feeding Bells of Blast Furnaces, &c., T. Wrightson, Stockton-on-Tees.—11*th August*, 1883.
4021. Bracelets, A. Desbats, London.—20*th August*, 1883
4029. Rendering the Seats of Ships Available as Life-buoys, E. S. Copeman, London.—20*th August*, 1883.
4047. Thrashing Machines, E. Foden, Sandbach.—21*st August*, 1883.
4083. Extracts of Orchal. B. J. B. Mills, London.—A communication from J.-B. Peter.—23*rd August*, 1883.
4282. Asbestos Packed Cocks, J. Dewrance, London.—6*th September*, 1883.
4436. Lasting Boots and Shoes, C. F. Gardner, London A com. from G. McKay.—17*th September*, 1883.
4851. Extracting Precious Metals from their Ores, A. P. Price, London.—11*th October*, 1883.
4890. Boiling Pans, &c, W. Briggs and R. Taylor, Darwen.—13*th October*, 1883.
4953. Speed Indicators, E. J. P. Gallwey, Thirsk.—17*th October*, 1883.
4975. Extracting Precious Metals from their Ores, A. P. Price, London —18*th October*, 1883.
5098. Carrying Military Knapsacks, J. C. Mewburn, London.—Com. from A. Mendel.—27*th October*, 1883.
5103. Electric Gas Lighters, T. and J. Taylor, Oldham.—27*th October*, 1883.
5125. Extracting Precious Metals from their Ores, A. P. Price, London.—29*th October*, 1883.
5127. Electrical Generators, T. J. Handford, London.—A com. from T. A. Edison.—29*th October*, 1883.
5134. Clearing Roads, &c., from Snow, J. Forster, St. Helens.—30*th October*, 1883.
5213. Carpets, T. Tempest-Radford, Kidderminster.—2*nd November*, 1883.
5534. Ash Hoists, J. D. Spreckrels, San Francisco.—27*th November*, 1883.
5565. Tube and Carriage for Launching Fish Torpedoes, A. Sauvée, London.—A communication from J. B. G. A. Canet.—29*th November*, 1883.

Patents Sealed.

(*List of Letters Patent which passed the Great Seal on the* 30*th November*, 1883.)

2521. Coal Derricks, &c., A. Lewsley, London.—21*st May*, 1883.
2731. Motors, R. Anderson, London.—1*st June*, 1883.
2782. Steam Boilers, E. H. Nicholson and W. Mather, Newark-upon-Trent.—1*st June*, 1883.
2753. Firing Gunpowder for Blasting Purposes, C. W. Curtis, London.—2*nd June*, 1883.
2767. Treating Coal, &c., H. Symons, Totnes.—4*th June*, 1883.
2782. Electrical Wire Protectors, J. O. Cottrell, Fanwood, U S.—5*th June*, 1883.
2797. Surveyors' Measuring Tapes, &c., L. P. Cabella, London.—5*th June*, 1883.
2799. Preparing Metal Surfaces for Etching, J. J. Sachs, London.—5*th June*, 1883.
2809. Envelopes or Wrappers, C. Eskrett and W. H Searle, Hull.—6*th June*, 1883.
2813. Breech-loading Small-arms, J. Woodward and F Beesley, London.—6*th June*, 1883.
2826. Lock-catch Plates for Stereotype Plates, T. T. Hodgson, London.—7*th June*, 1883.
2840. Separating Grain, &c., J. H. Gatward, Hitchin.—7*th June*, 1883.
2852. Ships' Sleeping Berths, W. R. Lake, London.—7*th June*, 1883.
2870. Playing Puzzle Games, T. H. Ward, Tipton.—8*th June*, 1883.
2879. Propellers, J. Betteley, London.—9*th June*, 1883.
2921. Roofing Tiles, C. Major, Bridgwater.—12*th June*, 1883
2922. Electric Meters, J. E. H. Gordon, London.—12*th June*. 1883.
2943. Fastening Builders' Scaffolding, W. P. Thompson, London.—13*th June*, 1883.
2970. Disintegrating Rags, C. Pieper, London.—14*th June*. 1883.
2994. Electric Incandescence Lamps, A. M. Clark, London.—15*th June*, 1883.
3093. Extracting Sugar from Molasses, J. H. Johnson, London.—21*st June*, 1883.
3109. Pavements, &c, E. G. Banner, London.—22*nd June*, 1883.
3179. Tricycles, &c, C. Harvey, jun., Yardley, and W. Paddock, Birmingham —26*th June*, 1883.
3201. Heating Water, &c, J. H. Johnson, London.—27*th June*, 1883.
3258. Producing Designs upon Rollers, J. J. Sachs, London.—30*th June*, 1883
3364. Boots and Shoes, I. Drakeford, Northampton.—6*th July*, 1883.
3396. Door Springs, D. and S. Timings, Birmingham.—9*th July* 1883.
3410. India-rubber Springs for Railway Engines, &c., G. Spencer, London —10*th July*, 1883.
3471. Fastenings for the Hames of Horses, &c., F. B. Goodman, Birmingham.—13*th July*, 1883.
3568. Gas Motor Engines, C. T. Wordsworth, Leeds, and H. Lindley, Manchester.—20*th July*, 1883.
3594. Boxes for Parcels Post, R. B. Jackson, London.—21*st July*, 1883.
3817. Grinding Metallic Tubes, &c., C. Harvey, jun., Yardley, and W. Paddock, Birmingham.—4*th August*, 1883.
3939. Railway Couplings, L. Anderson, Paris, U.S.—14*th August*, 1883.
4159. Sewing Machines, H. Grellier, Brixton.—28*th August*, 1883.
4265. Children's Cots, W. F. and W. H. Keep, London.—5*th September*, 1883.
4332. Boots and Shoes, A. Hanniball, London.—10*th September*, 1883.
4439. Roller Mills, J. A. A. Buchholz, Twickenham.—17*th September*, 1883.
4916. Wood Turning Machines, A. J. Boult, London.—16*th October*, 1883.

(*List of Letters Patent which passed the Great Seal on the* 4*th December*, 1883.)

2784. Horse Hoes and Turnip Thinners, F. Mote, Burnham Market —5*th June*, 1883.
2788. Primary Voltaic Batteries, G G. André, Dorking—5*th June*, 1883.
2791. Bending Angle Iron, C. Wicksteed, Kettering.—5*th June*, 1883.
2796. Treating Rags, &c, J. Illingworth, Whitelee.—5*th June*, 1883.
2804. Generating, &c., Electric Currents, A. and T. Gray, Glasgow.—6*th June*, 1883.
2806. Weighting Apparatus for Looms, I. and A. Wallwork, Hurst.—6*th June*, 1883.
2825. Skiving Leather, W. Douglas, Kingswood.—7*th June*, 1883.
2832. Connecting and Disconnecting Electrical Circuits. H. H. Cunynghame, O. E. Woodhouse, and F. L Rawson, London.—7*th June*, 1883.
2836. Substitute for Lithographic Stones, H. J. Haddan, London.—7*th June*, 1883.
2837. Forming Yeast into Cakes, &c., H. J. Haddan, London.—7*th June*, 1883.
2843. Coke and Coke Ovens, H. Hutchinson, London.—7*th June*, 1883.
2844. Rolling Tubes, &c., C. Kellogg, Buffalo, U.S.—7*th June*, 1883.
2860. Looms for Weaving, W. Irving and F. Howarth, Liversedge.—8*th June*, 1883.
2869. Treatment of Milk, G. Lawrence, London.—8*th June*, 1883.
2889. Indicators for Engines, J, G., and J. T. S. Pimbley, near Bolton.—9*th June*, 1883.
2895. Producing Electric Light, W. P. Thompson, Liverpool —9*th June*, 1883.
2908. Regulating the Feed of Roller Mills. T. Inglis and C. Herbert, Edinburgh.—12*th June*, 1883.
2935. Looms for Weaving, R. S. and R. Collinge, Oldham.—13*th June*, 1883.
2942. Spinning Machinery, F. Heslop, Leeds.—13*th June*, 1883.
2946. Consuming Smoke, C. Mace and J. Brewster, Sunderland.—13*th June*, 1883.
2964. Enamelling Moulded Articles, C. D. Abel, London.—14*th June*, 1883.
2965. Storing Electric Energy, F. J. Cheesbrough, Liverpool.—14*th June*, 1883.
2966. Marking the Score at Lawn Tennis, &c., J. H. Wilkinson and G. S. Rogers, Durdham Down.—14*th June*, 1883.
2983. Washing Wool, H. J. Haddan, London.—15*th June*, 1883.
2985. Extinguishing Fires, &c., A. F. Spawn, Oakland, U.S.—15*th June*, 1883.
2986. Tills, J. C. Cox, London.—15*th June*, 1883.
3034. Levelling Instruments, B. J. B. Mills, London.—19*th June*, 1883.
3042. Breech-loading Cannon, S. Pitt, Sutton.—19*th June*, 1883.
3046. Watchmakers' Lathes, A. M. Clark, London.—19*th June*, 1883.
3124. Bottle-filling Machines, C. A. Day, London.—23*rd June*, 1883.
3132. Miners' Safety Lamps, J. Wetter, New Wandsworth.—23*rd June*, 1883.
3150. Tannic Extracts, J. H. Johnson, London.—26*th June*, 1883.
3194. Looms for Weaving, W. Smith, Heywood, and J. Wrigley, Bury.—27*th June*, 1883.
3238. Cartridges, H. E Newton, London.—29*th June*, 1883.
3282. Transporting Boxes of Fish, J. Scott, Granton.—3*rd July*, 1883.
4022. Utilising the Bye Products of Coke, C. and J. Thomson, Glasgow.—20*th August*, 1883.
4054. Universal Joints, W. G. Edmonds, Devonport.—21*st August*, 1883.
4102. Measuring Cloth, J. Farmer, Salford.—24*th August*, 1883.
4118. Brakes for Vehicles, H. Pilkington, Bury.—25*th August*, 1883
4152. Producing Prints, &c., E. de Zuccato, London.—28*th August*, 1883.
4153. Producing Prints, &c., E. de Zuccato, London.—28*th August*, 1883.
4154. Producing Prints, &c, E. de Zuccato, London.—28*th August*, 1883.
4190. Attachment for Tricycles, &c, E. Weidlich and H Mitchell, London.—30*th August*, 1883.
4266. Rollers for Spinning Machines, J. T. Chadwick, Salford, and J. Crossley, Bury.—5*th September*. 1883.
4328. Treadle Looms, C. D. Abel, London.—10*th September*, 1883.
4408. Treatment of Hops, G. F. Redfern, London.—14*th September*, 1883.
4430. Striking Work for Clocks, A. G. Hovde, Norway.—15*th September*, 1883.
4523. Turning Bags after Stitching, W. R. Lake, London.—21*st September*, 1883.
4740. Dampening Apparatus for Lithographic Presses, L. Schmiers, Leipzig.—5*th October*, 1883.
4804. Making Nails, H. J. Haddan, London.—9*th October*, 1883.

List of Specifications published during the week ending December 1st, 1883.

1401, 6d.; 1450, 6d.; 1634, 2d.; 1788, 4d.; 1803, 4d.; 1828, 2d.; 1835, 1s.; 1849, 6d.; 1851, 4d.; 1853, 8d.; 1859, 2d.; 1868, 8d.; 1870, 8d.; 1871, 2d.; 1872, 2d.; 1874, 2d.; 1875, 8d; 1877, 6d; 1880, 2d.; 1881, 2d.; 1882, 2d.; 1884, 2d.; 1885, 2d; 1887, 2d.; 1889, 6d.; 1891, 2d.; 1892, 6d.; 1893, 6d.; 1894, 6d.; 1895, 4d; 1896, 2d; 1897, 2d; 1899, 6d.; 1901, 2d.; 1903, 6d.; 1904, 6d; 1905, 6d.; 1906, 6d.; 1909, 8d.; 1911, 2d.; 1914, 6d.; 1916, 2d.; 1919, 4d.; 1920, 6d.; 1921, 2d.; 1922, 6d; 1923, 8d.; 1924, 6d; 1925, 4d; 1926, 2d.; 1927, 2d.; 1928, 6d.; 1929, 4d.; 1930, 2d; 1931, 8d; 1932, 2d.; 1933, 2d.; 1934, 6d; 1935, 6d.; 1938, 6d.; 1939, 4d; 1940, 2d.; 1941, 2d.; 1942, 6d.; 1943, 4d; 1944, 6d.; 1946, 6d; 1947, 6d.; 1948, 6d.; 1949, 2d; 1950, 2d.; 1251, 2d.; 1953, 6d.; 1954, 6d.; 1955, 2d.; 1958, 6d.; 1959, 2d.; 1961, 4d.; 1962, 8d; 1963, 6d.; 1964, 2d.; 1965, 4d.; 1966, 2d; 1967, 6d; 1968, 6d; 1969, 2d; 1970, 2d.; 1971, 6d.; 1973, 2d.; 1974, 6d.; 1975, 6d.; 1976, 6d; 1979, 2d.; 1980, 6d; 1981, 6d.; 1982, 6d; 1984, 8d.; 1985, 6d.; 1986, 2d.; 1987, 6d.; 1988, 2d.; 1990, 2d.; 1991, 6d.; 1992, 2d.; 1993, 2d.; 1994, 2d; 1995, 4d.; 1996, 2d.; 1998, 4d; 1999, 6d; 2000, 4d.; 2001, 6d; 2002, 6d.; 2003, 4d.; 2008, 6d.; 2009, 4d.; 2010, 6d; 2013, 2d; 2019, 6d.; 2022, 4d.; 2026, 4d.; 2027, 6d.; 2032, 8d.; 2035, 6d.; 2036, 6d.; 2042, 8d; 2043, 2d.; 2045, 6d.; 2049, 4d.; 2053, 6d; 2054, 6d.; 2059, 4d.; 2099, 8d.; 2107, 4d; 2 60, 4d.; 2109, 6d.; 2213, 6d.; 2372, 6d; 2400, 1s. 2d.; 2724, 6d; 2853, 6d.; 3050, 8d.; 3289, 4d.; 3931, 6d.; 3966, 6d.; 4036, 4d.; 4044, 2d.; 4058, 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.*

1401. Manufacture of Top Notches for Umbrellas and Parasols, *W. Milner, Carbrook.*—16*th March*, 1883. 6*d.*

Relates to the general construction of top notches.

1450. Railway Carriage Lamps, &c., *J. H. Johnson, London.*—19*th March*, 1883.—(*A communication from J. Schulke, Paris*) 6*d.*

The circulation of air and gases is so regulated that the internal pressure balances the external pressure, and the temperature of the air and gas supplied to the lamp to support combustion is elevated by the heat of the flame and of the products of combustion.

1634. Game, *J. J. Ridge, Enfield.*—31*st March*, 1883.—(*Provisional protection not allowed.*) 2*d.*

The object is to pass a ball through a hole in a net.

1788. Manufacture of Colouring Matters, *P. J. Meyer, Berlin.*—9*th April*, 1883. 4*d.*

The inventor claims, First, the production of isatin or of products of substitution of isatin from dihalogenised acetic acids or from their amides, ethers and aldehydes on the one hand, and certain amines on the other, by directly fusing them together or by boiling their solutions and treating the product of the interaction with strong acids or bases; Secondly, the transformation of the thus obtained products of substitution of isatin (methylisatin, dimethylisatin, trimethylisatin, their halogenised and alkalised products of substitution and amido and methylamido isatin), into a product of substitution of indigo by reducing the chlorides thereof.

1803. Dynamo-electric Machines, &c., *P. M. Justice, London.*—10*th April*, 1883.—(*A communication from Keegan, Washington, U.S.*)—(*Not proceeded with.*) 4*d.*

This invention relates to a method of relatively closely arranging the poles of both the armature and field magnets; and Secondly, to preventing the production of secondary induced currents in the coils.

1835. Gas Motor Engines, and Applying them to Pumping Purposes, *J. J. Butcher, Newcastle-on-Tyne.*—11*th April*, 1883. 1*s.*

In the drawing which shews one modification A is the piston of the motor cylinder. Round the circum-

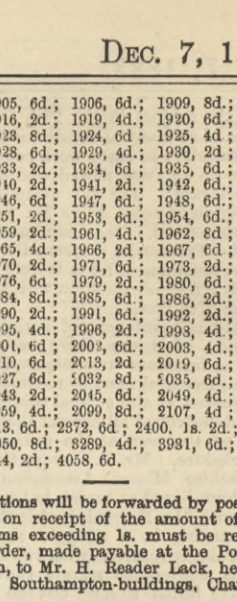


FIG 1

ference of the cylinder liner B the various ports B^1 B^1 are placed, which communicate with the passage B^2 and

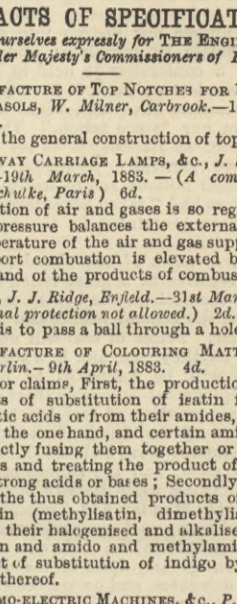
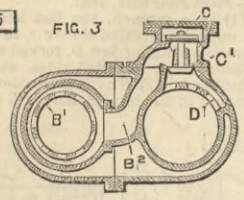


FIG 2

give access to and finish between the valves C C^1. These valves, which open in opposite directions, are rigidly connected together by means of the bolt and

sleeve shown, and the distance between them is equal to the distance between their respective valve seats plus the lift required by the valves. Thus, when one of the valves opens the other acts as a stop to prevent it from lifting too high. The upper valve is larger



than the lower and gives access to the atmosphere, while the lower and smaller valve communicates with the pump cylinder D through the ports D^1 D^1. Several other improvements are described.

1828. WINDING OF THREAD ON THE SHUTTLE BOBBINS OR SPOOLS OF SEWING MACHINES, &c., *J. McHardy, Dollar.*—11*th April*, 1883.—(*Not proceeded with.*) 2*d.*

The object is to enable the bobbins or spools when empty to be rewound or refilled with thread without the necessity of removing the said spools or bobbins from the shuttles.

1841. DEVICE FOR HOLDING A PENCIL OR OTHER INSTRUMENT FOR DESCRIBING CIRCLES, &c., *E Lane, London.*—11*th April*, 1883. 4*d.*

This relates to a device consisting of a sleeve or tubular portion having a pointed leg or limb pivotted thereto, with or without the means for fixing the said leg in any desired position.

1842. PRODUCTION OF AMMONIA OR COMPOUND OF AMMONIA, *R. Tervet, Clippens, N.B.*—12*th April*, 1883. 4*d.*

This consists in passing hydrogen over or through coal or shale in retorts either during the process of distillation, or over or through the coke or ash resulting from the process of distillation.

1843. COMBINED DEFLECTING AND INJECTING EXHAUST ROOF VENTILATOR AND CHIMNEY COWL, *R. Oakley, London.*—12*th April*, 1883. 8*d.*

This relates to the arrangement of deflecting plates.

1844. APPARATUS FOR PREVENTING THE PASSAGE OF WATER DOWN VENTILATING SHAFTS ON SHIPBOARD, &c., *R Oakley, London.*—12*th April*, 1883. 4*d.*

This relates to the employment of a deflecting guard.

1845. VENTILATING STOVE, *R. Oakley, London.*—12*th April*, 1883. 4*d.*

This relates to the arrangement of plates.

1846. APPLIANCES FOR VENTILATING CHURCHES, SCHOOLS, &c., *R. Oakley, London.*—12*th April*, 1883. 6*d.*

This relates to the arrangement of plates.

1847. POLO STICKS, *J. C. Rogers, Paignton.* — 12*th April*, 1883.—(*Not proceeded with*) 2*d.*

The object is to render the sticks less liable to fracture and to obtain lightness

1849. PROJECTILES FOR FIRE-ARMS, &c, *L. A. Groth, London.*—12*th April*, 1883.—(*A communication from Dr. H. Bischoff, Durkheim, and Major Z. d'A. Mieg, Landau.*)—6*d.*

The projectiles are constructed from metallic wolfram, for the purpose of producing low trajectories and greater penetrating power.

1850 STEAM BOILERS, *J. Richards, Clifton Junction, Lancaster.*—12*th April*, 1883.—(*Not proceeded with.* 2*d.*

This relates to that class of boiler in which the fuel is consumed in a gaseous state, and the improvements consist in the method of application of such fuel, and the recovery and utilisation of the heat from the waste gases previous to their passing up the chimney.

1851. MACHINERY FOR CUTTING, PRINTING, AND NUMBERING TICKETS, CARDS AND PAPER, *J. Lewthwaite, Halifax.*—12*th April*, 1883. 4*d.*

This relates to several improvements in the general construction of a machine described in patent No. 308, dated 8th October, 1852.

1852. MANUFACTURE OF SHAG OR PILE FABRICS AND APPARATUS THEREFOR, *H. J. Haddan, London.*—12*th April*, 1883.—(*A communication from F. A. Paretlada, Barcelona*) 6*d.*

This relates to a mechanical process for the manufacture of pile fabrics of various colours and materials, by weaving at the same time two nearly superposed sheets, and forming the nap from threads wound from one or more beams in a direction nearly parallel to the warp, and taken up by the crossings of the weft until they are woven into the two sheets.

1853. SLIDE AND SCREW-CUTTING LATHES, *M. Wadsworth, near Halifax.*—12*th April*, 1883. 8*d.*

This relates, First, to an improved construction of the fast head; Secondly, to an apparatus for lubricating the tail ends of the spindles; Thirdly, to the construction and arrangement of swing plate and change wheels for screw cutting; Fourthly, to a reversible tool-box applicable to various shaped tools; Fifthly, to a self-acting mechanism for stopping and drawing back the cutting tool.

1855. APPARATUS FOR THE MANUFACTURE OR PRODUCTION OF GAS FOR LIGHTING AND HEATING, *G. F. Redfern, London*—12*th April*, 1883.—(*A communication from S. A. Giraudon, Paris*)—(*Not proceeded with.*) 2*d.*

This relates to apparatus for producing or manufacturing gas for lighting and heating purposes by carburetting air, by passing it through volatile oils or hydrocarbons.

1856. COKE OVENS, *R. Dixon, View Crook.*—12*th April*, 1883.—(*Not proceeded with.*) 2*d.*

This relates to the mode or manner of obtaining the bye-products that are given off in the carbonisation of coal in coke ovens.

1858. WICK TRIMMERS, *A. J. Boult, London.*—12*th April*, 1883.—(*A communication from W. C. Seaton, Quebec.*) 6*d.*

This consists chiefly in a spiral, cylindrical, or flat brush capable of being revolved by the hand of the operator within a suitable case, preferably of metal, which has one or more longitudinal slots or openings, through which the wick to be trimmed is admitted to the brush.

1859. APPARATUS FOR REDUCING WOOD TO FIBRES, &c., *A. J. Boult, London.*—12*th April*, 1883.—(*A communication from H. André (fils aine), Le Thor, France*)—(*Not proceeded with.*) 2*d.*

This relates to the general construction of apparatus for reducing wood to fibres in the manufacture of wood tissue and paper, and for similar purposes, and also for decorticating the same.

1861. TRICYCLES AND OTHER VELOCIPEDES, *T. Leigh, Liverpool.*—12*th April*, 1883.—(*Not proceeded with.*) 2*d.*

This relates to the manner of constructing the machines so that they may pass through narrow doorways.

1864. LIFE AND SAFETY BUOY, &c., *G. J. Kirchenpauer and L. H. Philippi, Hamburg.*—12*th April*, 1883. 6*d.*

This consists in floating or submerged structures, of the application of an electric current generated on shore or on board of a ship, and conducted to the floating or submerged structure by means of a cable of suitable length for working an electro-motor which drives the propeller or the signalling device, or both, and for steering the floating or submerged structure, or for one of these purposes alone.

1862. ROAD VEHICLES, AND METHODS AND APPLIANCES FOR PASSENGER AND GOODS TRANSPORT, *W. J. Brewer, London.*—12*th April*, 1883. 6*d.*

This relates to improvements in the construction of the carrying parts or cradles of road vehicles generally, and to a novel construction of goods cart, to be hung or carried upon such cradles, the said cart being applicable as a boat or pontoon for crossing rivers or forming bridges.

1866. PROCESS AND SOLUTION FOR THE TREATMENT OF FLAX, SILK, &c., TO EXTRACT THE GUM THEREFROM, &c., *W. R. Lake, London.*—12*th April*, 1883.—(*A communication from G. M. F. Foret, Paris.*) 4*d.*

This relates to a process for watering or steeping flax at the spinning mill without the application of heat, and for extracting the gum from and facilitating the spinning of silk, wool, hemp, China grass, and other animal or vegetable textile materials, by means of an improved solution.

1867. APPARATUS FOR AUTOMATICALLY GUIDING, OPENING, AND STRETCHING FABRICS, *J. Kerr, Church, Lancaster.*—12*th April*, 1883. 6*d.*

This consists in apparatus for automatically guiding, opening, and stretching fabrics, of the use of an arrangement whereby the swerving of the fabric from its normal path causes an electric circuit to be completed to operate means for retarding or stopping the guiding, opening, or stretching roller or rollers.

1868. ROTARY PUMPS OR MOTORS, *J. H. Johnson, London.*—12*th April*, 1883.—(*A communication from Ba on G. Greindl and L. Poillon, Paris.*) 8*d.*

In rotary pumps constructed according to this invention the suction and delivery orifices may be placed in the same vertical plane on one and the same side of the case or otherwise, and motion is imparted to the pump (by means of a pulley) from the shaft of the cylinder provided with the epicycloidal recess or recesses to the shaft of the drum or cylinder, carrying the wings or blades which alternately enter the said recess or recesses, the motion from one shaft to the other being transmitted by V or angular toothed gearing wheels, in order to avoid the shocks or backlash which are inevitable when ordinary gearing is employed, the work performed by the pump being done by the two drums or cylinders alternately and successively.

1870. APPARATUS FOR UTILISING SOLAR HEAT, *W. L. Wise, London.*—12*th April*, 1883.—(*A communication from La Société Centrale pour l'Utilisation de la Chaleur Solaire, Brevets Mouchot et Abel Pifre, Paris*) 8*d.*

According to this invention a number of separate reflectors or concentrators with vessels or receptacles to be heated are grouped on a common support or frame, each of these reflectors being of moderate size and capable of ready disconnection; whilst the series can be readily adjusted simultaneously, and steam generated in the boilers of the respective reflectors or concentrators, can be conducted therefrom by means of fixed tubes to a steam engine or other apparatus wherein it is to be utilised.

1871. ELECTRIC LAMPS, *A. P. Lundberg, London.*—13*th April*, 1883.—(*Not proceeded with.*) 2*d.*

Attached to the base of an electro-magnet are two side plates carrying suitable sockets, wherein the carbons are inserted obliquely, their points resting on a stop plate. One side plate is fixed and the other, together with the stop plate, is moved by the electro-magnet on the passage of the current.

1872 COMBINED GROOVING PLANE AND PLOUGH, *E. C Bourne, London.*—13*th April*, 1883.—(*Not proceeded with.*) 2*d.*

This consists in fitting a grooving plane with an adjustable expanding cutter which can be regulated to produce any sized groove.

1873. HAND-POWER LIFTS AND HOISTING MACHINERY, *A. Attwood and T. W. Barber, Ulverston.*—13*th April*, 1883. 6*d.*

This relates partly to the arrangement of gearing mounted on adjustable fulcrums on a fixed base plate, allowing a slight rocking movement to throw the brake on and off, and actuated by an endless hand rope and wheel.

1874. BRAKES AND OTHER APPARATUS, &c., *J. C. Stevenson, Liverpool.*—13*th April*, 1883.—(*Not proceeded with.*) 2*d.*

This has for object improvements in or pertaining to brakes and other apparatus, and designed to effect storage and utilisation of force, and has reference to an arrangement of mechanism comprising a cylinder or cylinders and valves so constructed and arranged as to pump or force air or other fluid into a receiver or receivers, and afterwards to give out the force stored up as required.

1875 PREVENTING THE WASTE OR LOSS OF HEAT IN OR FROM PROCESSES OR APPARATUS WHEREIN IT IS GENERATED OR UTILISED, &c., *E. Maw, Liverpool.*—13*th April*, 1883. 8*d.*

This relates partly to the employment of a composite metallic plate composed of two or more sheets or plates of metal with distance pieces between them. Other improvements are described.

1876. ARTIFICIAL FUEL, *E. Goad and T. Chappell, London.*—13*th April*, 1883.—(*Not proceeded with.*) 2*d.*

This relates to the mixture of small coal or slack, breeze, or cinder ashes, chalk, clay, alum and copperas or soda.

1877. APPARATUS FOR MEASURING ELECTRIC CURRENTS, &c., *R E.B. Crompton, London, and G. Kapp, Chelmsford.*—13*th April*, 1883. 6*d.*

The usual spring or permanent magnet in instruments for measuring current are dispensed with, their counteracting force being supplied by electro-magnets excited by the current or part of the current to be measured. The instrument consists of a needle suspended as in a tangent galvanometer and surrounded by a coil of insulated wire wound in a direction at right angles to the plane of oscillation of the needle, and provided with a directing electro-magnet, the opposite poles of which are in a line parallel to the coil and passing through the centre of the needle.

1878. BOGIE TRUCKS FOR RAILWAY LOCOMOTIVES, &c., *W. M. Smith, Taybank.*—13*th April*, 1883. 8*d.*

This relates to the combination of a curved casting, swing beam, and a casting swivelling on the curved casting.

1880. SEWING MACHINES WITH ROTARY HOOKS, *C. Pieper, Berlin.*—13*th April*, 1883.—(*A communication from R. Gritzner, Durlach.*)—(*Not proceeded with*) 2*d.*

The object is to construct these machines in such a manner that the spool for the under thread can be made of considerably larger dimensions than hitherto, and that the casing of the spool rests only upon a point, whereby the passage of the loop of the upper thread is facilitated and rupture of the thread is obviated.

1881. JOINTED KNEE CAP FOR HORSES, *E. Edwards, London.*—13*th April*, 1883.—(*A communication from O. A. Deschamps, St. Valéry en Caux, France.*)—(*Not proceeded with*) 2*d.*

This relates to the construction of a cup-shaped knee cap.

1882. APPARATUS FOR HEATING WATER BY GAS AND RETAINING THE HEAT, *H. Brinsmead, Ipswich.*—13*th April*, 1883.—(*Not proceeded with.*) 2*d.*

A metallic boiler in a casing of wood or other suitable material leaving a space between the boiler and the outside casing, which space is filled with non-conducting material.

1884. MANUFACTURE OF CORRUGATED METAL AND APPARATUS THEREFOR, *G. W. von Nawrocki, Berlin*—13*th April*, 1883.—(*A communication from G. Kammerich, Berlin.*)—(*Not proceeded with.*) 2*d.*

The corrugated sheet metal plates are made in the following manner—that is to say, the flat sheets are caused to pass through a rolling mill in which are arranged as many pairs of rollers one behind another as the number of flutings or corrugations the sheet is required to have. The pairs of rollers form one after another, two flutings at a time.

1885. APPARATUS FOR FACILITATING THE STARTING OF TRAMWAY CARS, &c, *J. E. Dawson and A. C. Bluett, Watford.*—13*th April*, 1883.—(*Not proceeded with.*) 2*d.*

This relates to an apparatus in which only one handle or lever is required for effecting the stopping and starting of the vehicle.

1887. MACHINERY OR APPARATUS FOR MOULDING ARTICLES OF POTTERY OR EARTHENWARE, *S Crowder, Natal.*—13*th April*, 1883.—(*Not proceeded with.*) 2*d.*

The machinery or apparatus is provided with moulds (consisting of parts constituting dies and moulds) of metal of a shape giving between them the form of the article to be produced. The said moulds are hollow, and steam or hot water or hot air is supplied to and caused to circulate through the interiors of the parts of the moulds. Pressure is applied to the parts of the mould to urge them forward on each other to a distance which will leave the clay or plastic material placed between the said parts of the mould of the thickness required for the article being made.

1888. APPARATUS FOR REVERSING, REGULATING, OR CONTROLLING THE MOTION OF PLANING AND OTHER LIKE MACHINES, &c., *P. R. Allen, London.*—13*th April*, 1883. 6*d.*

In carrying out one portion of the invention, the reversing or feed motions are actuated by means of clutches or their equivalents controlled by electro-magnets, which are magnetised by currents of electricity being sent through them at determined times. The period during which these magnets are magnetised is determined by the passage of a style brush roller or its equivalent over a pattern or representation of the object which is being operated upon by the tool.

1889. ELECTRIC CABLES OR CONDUCTORS AND MACHINERY FOR MANUFACTURING THE SAME, *W. R. Lake, London.*—13*th April*, 1883.—(*A communication from W. J. Phillips and G. L. Kitson, Philadelphia, U.S.*) 6*d.*

Relates to the necessary machinery for producing a cable, the wires of which are coated with Burgundy pitch, which is roughened on its outer surface, and wrapped with a covering of asbestos, over which a layer of resin is placed, the whole being afterwards encased in a covering of lead.

1890. APPARATUS FOR SEWING THE SOLES OF BOOTS OR SHOES, AND DESIGNED TO SERVE AS AN ATTACHMENT TO A SEWING MACHINE, *W. R. Lake, London.*—13*th April*, 1883.—(*A communication from J. H. Cutten and L. E. Moore, Boston*) 6*d.*

This relates to an attachment designed to be used on a straight needle wax-thread sewing machine, and by its use such a machine is adapted for sewing the inner sole of a boot or shoe to the upper, or upper and welt.

1891. APPLIANCES FOR PREVENTING THE PASSAGE OF FLAMES FROM ONE STOREY TO ANOTHER, *A. M. Clark, London.*—13*th April*, 1883.—(*A communication from J. McCarroll, New York.*)—(*Not proceeded with*) 2*d.*

The object is to prevent flames from passing from one storey to another in buildings through lift or elevator shafts or wells, and it consists in an elevator well enclosed with wire gauze, whereby the passage of flames into and out of the well is prevented, and provided with spring-closed wire gauze trap doors, closing across the thoroughfare of the well to prevent the passage of flames through the well or shaft.

1892. APPARATUS FOR THE PREPARATION OF AERATED WATERS OR BEVERAGES, *F. Bennett, London.*—13*th April*, 1883. 6*d.*

This relates to an apparatus for preparing aërated waters or beverages, consisting of a gas generator and receptacle for the water or liquid to be aërated, the said parts being arranged and combined so as to communicate and operate to produce the desired result by simply placing the ingredients in their respective receptacles, whether there be used or be not used in combination therewith a gas purifier or washer.

1893. STUD AND EYELET FASTENER, *A. M. Combault, London.*—14*th April*, 1883. 6*d.*

The fastener consists of two parts, viz, a stud having a spherical or flattened spherical head or knob, and an eyelet-hole or socket.

1894. PAVEMENT, *W. Eerry and P. Stuart, Edinburgh.*—14*th April*, 1883 6*d.*

This relates to underground conduits in the paving for the carriage of telegraph, telephone, electric light, or other wires or cables, and consists of corrations, grooves, flutes, or a channel or channels, made in stone or composite blocks or slabs joined together.

1895 GENERATING AND APPLYING ELECTRICITY FOR MEDICINAL OR OTHER PURPOSES, &c., *R. V. Ash, London.*—14*th April*, 1883. 4*d.*

Relates to appliances to be worn upon the body, and consists in attaching to a textile fabric strands of copper surrounded spirally by zinc wire, or other suitable metals, and having open spaces or strands of non-conductors interposed.

1896. SEWING MACHINES FOR THE PRODUCTION OF "FRENCH VEIN" OR HEM STITCH, *J. Heggan, Dromore, Ireland.*—14*th April*, 1883.—(*Not proceeded with.*) 2*d.*

This relates to the arrangement of parts whereby the machine may be run at a greater speed, the wear thereof is reduced, and the use of shuttles is dispensed with.

1897. APPARATUS FOR THE MANUFACTURE OF MORTAR, CONCRETE, AND ARTIFICIAL STONES, *H. J. Haddan, London.*—14*th April*, 1883.—(*A communication from T. F. Leupolt, Zittau*)—(*Not proceeded with*) 2*d.*

This relates to the general construction of the apparatus.

1898. TICKETS FOR RAILWAY AND OTHER PURPOSES, *J. H. Johnson, London.*—14*th April*, 1883.—(*A communication from M. Vezzosi, Paris.*) 6*d.*

The tickets are made so as to form a means of advertising.

1899. TRAP FOR RATS, MICE, WEASELS, &c., *E. Edwards, London.*—14*th April*, 1883.—(*A communication from J. A. H. Mary, Villefranche, France.*) 6*d.*

The trap is made entirely of metal, and consists of two parts, one by which the animal enters the trap and the other in which it is imprisoned and detained.

1900. TEMPERING NEEDLES, FISH-HOOKS, STEEL PENS, &c., *V. Milward, Redditch.*—14*th April*, 1883. 6*d.*

The articles are tempered by causing them to pass over a heated metallic plate or table.

1901 MANUFACTURE OF BOLTS, SPIKES, RIVETS, NAILS, &c, *T. Jeavons, Birmingham.*—14*th April*, 1883.—(*A communication from W. Taylor, Pittsburg, U S*) —(*Not proceeded with*) 2*d.*

This refers to machinery for the manufacture of bolts, spikes, rivets, nails, and other like articles from rods of iron or other metal, the rod being automatically and intermittently fed into the machine and gripped or held while a head is being formed thereon by the action of a heading tool or ram, and the headed length afterwards separated from the rod and pointed.

1902 VALISE OR PAD EQUIPMENT FOR FOOT SOLDIERS, *W. A. F. Blakeney, Glasgow.*—14*th April*, 1883 6*d.*

This relates to a pack or pad equipment adapted to carry separately the dispensable and the indispensable part of a soldier's outfit.

1903. BREECH-LOADING FIRE-ARMS, *E. Harrison and F. Bersley, London.*—14*th April*, 1883. 6*d.*

This refers to improvements in self-cocking breakdown guns, whereby the inventors are enabled to use the power developed in the actions both of opening and closing the gun for the purpose of cocking either lock by either of those actions as described.

1904. LOOMS FOR WEAVING, *T. Singleton, Over Darwen.*—14*th April*, 1883. 6*d.*

This consists of nineteen different improvements in the construction of the looms.

1905. MACHINERY EMPLOYED IN WINDING YARN OR THREAD, *J. Liddell, J. S and S. H. Brierley, and F. W. Hirst and D. Homer, Huddersfield.*—14*th April*, 1883. 6*d.*

The object is to prevent breakages by the employment of mechanism placed between the swift and bobbin which will yield and give way to the drag of the yarn, and when the drag is sufficient the tension thereof will stop the rotation of the bobbin.

1906 STOVES, *J. A. Hanna and T. F. Shillington, Belfast.*—14*th April*, 1883. 6*d.*

One part relates to providing means for the removal of ashes from the stove without causing the dust to rise and spread through the room. Another part relates to providing the stoves with transparent panels or sides through which the light of the fire may be seen.

1907. APPARATUS FOR THE PROTECTION OF FIREMEN IN THE DISCHARGE OF THEIR DUTIES, AND APPLICABLE FOR USE AS A FIRE-ESCAPE, *W. R. Lake, London.*—14*th April*, 1883.—(*A communication from S. Richard, Philadelphia*) 6*d.*

This consists partly in the combination with a carriage, of a frame mounted thereon, supporting a blanket or cloth which covers the exposed side of the said frame and carriage, and a water distributor, arranged at the top of the said frame and adapted for connection with a water supply.

1909. FIRE-ARMS, *H. H. Lake, London.*—14*th April*, 1883.—(*A communication from J. Schuhof, Vienna.*) 8*d.*

The invention comprises a peculiar right or left-handed cartridge-feeding arrangement—according as the cartridge is arranged to be put in the chamber right or left-handed—for converting rifles with bolt breeches, which do not allow of a spoon-shaped cartridge feeder in the breech chamber, into a magazine rifle with a magazine in the stock. It also comprises a new transport rail or rod for the cartridge feeding mechanism, in which the spring teeth hitherto used—by means of which the transport of the cartridge is effected—are made in one piece with the said transport rail. Other improvements are described.

1911. MANUFACTURE OF ELECTRODES FOR ELECTRIC ARC AND INCANDESCENCE LAMPS, *W. Houghton, Paris.*—14*th April*, 1883.—(*Not proceeded with.*) 2*d.*

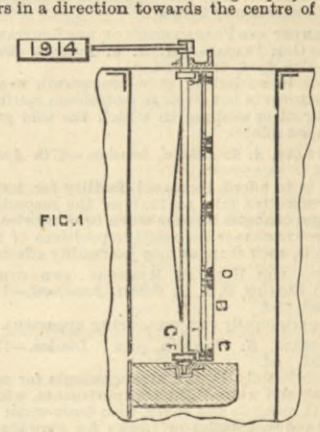
The carbons are made from diamonds, diamondiferous ore, or similar carboniferous substance, ground to a powder and mixed with a suitable vehicle, the desired form being obtained by pressure.

1912. MANUFACTURE OF CARBONATE OF STRONTIA, *W. A. Rowell, Newcastle-on-Tyne.*—14*th April*, 1883. 4*d.*

The inventor claims the manufacture of carbonate of strontia by the combined processes First, the conversion of the sulphate into sulphide by heating it with carbonaceous matter; Secondly, the conversion of the sulphide into chloride by means of chloride of magnesium; and, Thirdly, the conversion of the chloride into carbonate by the action of carbonic acid in the presence of magnesia.

1914. FURNACE BARS AND FIREGRATES, *G. L. Scott, Manchester.*—16*th April*, 1883. 6*d.*

A are the bearer bars which sustain the sections B upon which the fuel rests. On the upper faces of the bars A are formed ridges on which the ends of the grate sections rest, so that spaces C are left for the passage of air between the grate and the bearer bars, whereby overheating of the latter is prevented. On the two inner bars these ridges project beyond the bars in a direction towards the centre of the furnace,



as indicated at D. These projections sustain the centre row of sections. Each section is formed with snugs on its lower surface, these snugs entering between the bearer bars and keeping the section in position sideways. The two pairs of bars A are mounted to slide upon bearers E, and are connected at each end by means of racks F, with which gear rack pinions which are upon a shaft G.

1916. APPLIANCE FOR COOLING OR WARMING MILK, &c., *F. T. Bond, Gloucester.*—16*th April*, 1883.—(*Not proceeded with.*) 2*d.*

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

1919. KNITTING MACHINERY, *H. J. Haddan, London*—16*th April*, 1883.—(*A communication from C. Young, Chicago*)—(*Not proceeded with*) 4*d.*

This relates more particularly to flat-web or reciprocating knitting machines.

1920. ARMOUR-PLATES, *J. W. Spencer and W. Bagshawe, Newcastle on-Tyne.*—16*th April*, 1883. 6*d.*

The inventors claim, First, the manufacture of armour-plates composed of plates of mild steel cast with recesses to receive pieces of chilled iron, and the combination of such steel plates with such chilled iron pieces; Secondly, the combination of steel plates and chilled iron pieces having raised surfaces or projections for deflecting projectiles; Thirdly, the combination of steel plates and chilled iron deflecting pieces, such plates having also raised surfaces or projections cast in them.

1921. APPARATUS FOR EXTINGUISHING FIRES, *F. H. F. Engel, Hamburg*—16*th April*, 1883.—(*A communication from G., T. and W. Leser, Hamburg.*)—(*Not proceeded with.*) 2*d.*

This relates to certain improvements in steam jet fire extinguishing apparatus, and has for its object, in case of fire, to set the apparatus at work automatically.

1922. FORKS FOR AGRICULTURAL AND OTHER PURPOSES, *G. Pichhardt, Hagen, Germany.*—16*th April*, 1883. 6*d.*

This relates to the mode of fixing the prongs of the forks.

1923. SCREW PROPELLERS, *S. W. Snowden, West Hartlepool.*—16*th April*, 1883. 8*d.*

This relates to arrangements in connection with

screw propellers which render it possible to remove and replace the blades without docking the vessel or altering her trim, and without the aid of divers.

1924. Electrical Heating, and Apparatus Connected therewith, *J. S. and R. P. Sellon, London.*—16*th April*, 1883. 6*d*.
Relates to appliances for automatically regulating the supply of current to be transformed into heat, so that the temperature may be maintained approximately constant. For instance, a thermometer may complete the circuit of an electro-magnet, the armature of which inserts resistance into the leading circuit as the temperature rises.

1925. Pulley Blocks and other like Hoisting Apparatus, *T. H. Ward, Tipton.*—16*th April*, 1883. —(*Not proceeded with.*) 2*d*.
The object is to produce a pulley block or like apparatus, which shall be more efficient and compact and less bulky for a given load, and cheaper in cost of production, than such apparatus as hitherto constructed.

1926. Construction of the Walls, Ceilings, Floors, Partitions, Air Shafts, &c, of Buildings for Preventing the Spread of Fire and Admitting Light and Air, *A. M. Clark, London.* —16*th April*, 1883.—(*A communication from J. McCarroll, New York.*)—(*Not proceeded with.*) 2*d*.
The walls, ceilings, floors, partitions, air shafts, or compartments of buildings are composed of two or more thicknesses or layers of wire gauze which are not rendered opaque by mortar, plaster, or any such material, or otherwise, with a view to preventing the occurrence or spread of fire and for the admission of light and air through such walls or partitions.

1927. Manufacture of Tennis Balls, *J. Burbridge, Tottenham.*—16*th April*, 1883.—(*Not proceeded with.*) 2*d*.
The joint in the rubber ball is protected by a cloth covering, and then the join of the cloth is covered with a strip of rubber, and the whole vulcanised.

1928. Hanging Ships' Rubbers, *S. W. Snowden, West Hartlepool.*—16*th April*, 1883. 6*d*.
This relates partly to the employment of india-rubber cushions.

1929. Metallic Springs used in Upholstery, *J. Pring, Sandbach.*—17*th April*, 1883. 4*d*.
This relates to forming a bend or indent in the coil to receive the bent end or extremity of the wire of the spring.

1930. Hinges or Movable Joints, *J. D. Sgrague, Upper Norwood.*—17*th April*, 1883.—(*Not proceeded with.*) 2*d*.
This relates to the construction of hinges or movable joints specially applicable to swing looking-glasses, &c.

1931. Machinery for Sewing and Trimming or Cutting Fabrics, &c., *J. H. Johnson, London.*—17*th April*, 1883.—(*A communication from F. H. Wilcox, New York.*) 8*d*.
This consists, First, in the combination with a sewing machine having a four-motion under feed and trimming attachment therefor, of means for relieving at each descent of the needle the pressure of the presser foot, so that the machine may sew and trim around small circles, such, for example, as the end of glove fingers; Secondly, to certain improvements for automatically receiving the pressure on the pressure foot; Thirdly, to improvements in the trimming attachment. Other improvements are described.

1932. Galvanic Batteries, *C. L. Clark, Manchester.*—17*th April*, 1883. 2*d*.
This consists in using silver oxide as the depolarising agent, and a solution of potassic or sodic hydrate as the exciting fluid, or a solution of any of the alkaline sulphates or chlorides, or of the sulphates or chlorides of the alkaline earths may be used.

1933. Treatment and Preparation of the Substance known as Gum Tragacanth, *A. C. Duncan, Manchester.*—17*th April*, 1883. 2*d*.
This consists in subjecting gum tragacanth to elevated temperatures in hot air or in petroleum spirit or oil, or in other oil or medium in which the said gum tragacanth is not soluble.

1934. Tramways, *A. E. Adlard, London.*—17*th April*, 1883. 6*d*.
The object is to afford increased facility for transposing the respective rails so that as the respective operating edges or angles become worn or otherwise, it may be desired to change the relative positions of the respective rails, such changes may be readily effected.

1935. Vessels for Holding Mineral and other Oils and Liquids, *G. A. J. Schott, Bradford.*—17*th April*, 1883. 6*d*.
This relates principally to a measuring apparatus.

1938. Lifeboats, *N. Hamblin, jun., London.*—17*th April*, 1883. 6*d*.
This consists mainly in the arrangements for self-righting by air and water-tight compartments, which are fitted with manhole and cover, also fresh-water or ballast tanks and receptacles or tanks for stowage of food or other articles.

1939. Boxes or Receptacles for Protecting Articles in Transmission through the Post, &c., *A. G. Speight, London.*—17*th April*, 1883. 4*d*.
This consists of a lining for boxes, or for wrappers, or envelopes.

1940. Saddles for Bicycles, Tricycles, &c., *J. Redpath and F. H. Anderton, Sheffield.*—17*th April*, 1883.—(*Not proceeded with.*) 2*d*.
The object is to construct a saddle to avoid the vibration and shocks consequent upon travelling on rough and broken roads.

1941. Machinery for Indicating the Names of Stations to Passengers in the Carriages or Compartments of Railway Trains, *E. Collier, London.*—17*th April*, 1883.—(*Not proceeded with.*) 2*d*.
This relates to a revolving cylinder on which the names of the stations are marked.

1942. Stoppers or Covers for Bottles, Jars, &c., *N. Thompson, London.*—17*th April*, 1883. 6*d*.
This relates to construction of external stoppers or covers.

1943. Albums, *R. Moser, Berlin.*—17*th April*, 1883. 6*d*.
The object is an improvement in the way in which photographs are inserted into the leaves of albums, and in the manner of securing the same when inserted.

1944. Means for Facilitating the Application and Use of Apparatus for Detecting Leaks in Water or Gas Pipes, *J. J. Tylor, London.*—17*th April*, 1883. 6*d*.
The inventor claims for the purpose of facilitating the use of telephones, microphones, sounding rods, or other sound-conducting or sound-increasing devices for detecting leaks in water or gas pipes, the employment of a hollow sound chamber connected with the pipe or channel through which the water or gas flows, and continued to the surface of the ground or other convenient point.

1946. Machine for Cutting Cloth, *A. J. Boult, London.*—17*th April*, 1883.—(*A communication from G. Hoyer and Co., Germany.*) 6*d*.
This relates to an apparatus whereby fabrics can readily and rapidly be cut into even lengths as is required.

1947. Hand-weaving Devices, *E. Wernicke, Berlin.*—17*th April*, 1883. 6*d*.
This relates to a weaving device to be operated by hand, wherein the "shed" is formed by a single shaft or frame, which has rigid or stretched "healds" or "heddles," the same tool serving for passing the weft thread through the "shed" and for beating it up.

1948. Apparatus Applicable to Lawn Tennis Poles and Stretchers, *J. Mellor, Corwen.*—17*th April*, 1883. 6*d*.
The invention is designed to avoid undue strain on the net, yet always keep it precisely the same height and with a uniform strain upon it.

1949. Unhairing Hides or Skins, *A. Galwey, Upton.* —17*th April*, 1883.—(*A communication from A. Depierre, Brussels.*)—(*Not proceeded with.*) 2*d*.
This relates to the general construction of a machine for unhairing hides or skins.

1950. Pumps for Extinguishing Fire, &c., *E. J. C. Welch, London.*—17*th April*, 1883.—(*Not proceeded with.*) 2*d*.
This relates particularly to the general arrangement of the parts of hand pumps.

1951. Movement of Swing Looking Glasses, &c., *C. I. Bell, Greenwich.*—17*th April*, 1883.—(*Not proceeded with.*) 2*d*.
This relates to the employment of a barrel provided with a spring.

1953. Apparatus for the Manufacture of Bread for Military and other Similar Purposes, &c., *J. H. Johnson, London.*—17*th April*, 1883.—(*A communication from Geneste Hercher, and Co., Paris.*) 6*d*.
This relates to a portable apparatus or combination of appliances for the manufacture of bread, consisting of a vehicle provided with accommodation for men, implements, and every requisite for carrying on the said manufacture, for military and other similar purposes.

1954. Type Cases, *J. H. Johnson, London.*—17*th April*, 1883.—(*A communication from La Société de Typographie par Procédés Rapides, Paris.*) 6*d*.
This consists partly in forming type cases described in specification of letters patent No. 3770, dated 19th September, 1879, in two separate sections, capable of being united, so as to form a complete case.

1955. Manufacture of Certain Descriptions of Door Furniture, *E. V. Bailey, Birmingham.*—18*th April*, 1882.—(*Not proceeded with.*) 2*d*.
This relates to producing roses and collars from sheet metal.

1958. Padding and Oiling Apparatus Used in Printing or Dyeing Woven Fabrics, *C. A. Paterson, Lennoxtown, N.B.*—18*th April*, 1883. 6*d*.
The inventor claims a combination consisting of a liquoring vat fitted with guide rollers to lead the fabric through the roller; also a pair of squeezers to operate on the fabric before entering the liquor, and a second pair of squeezers to operate on the fabric after leaving the liquor, the various parts being constructed or arranged to act on the fabric when in a gathered or rope-like condition.

1959. Surfacing Lithographing Stones, *G. Cochrane, Edinburgh.*—18*th April*, 1883.—(*Not proceeded with.*) 2*d*.
This consists principally in imparting to the stone, and to the plate upon which it is surfaced, an improved combination of motions, whereby truer surfaces are imparted to the stone even after considerable use of the machine.

1961. Slide Valves, *J. F. Johnstone, Belvedere, Kent.* —18*th April*, 1883. 4*d*.
This relates to means for relieving the slide valve from a portion of the pressure upon its back, by connecting the valve with a metallic diaphragm on which also the pressure is exerted.

1962. Ovens or Furnaces for the Manufacture of Coke, &c., *F. C. Glaser, Berlin.*—18*th April*, 1883.—(*A communication from H. Stier, Zwickau.*) 8*d*.
This relates to improved constructions of ovens or furnaces, applicable both for the manufacture of coke and for other similar distilling processes, wherein the heating is effected by means of producer gases, the gas producers, which are placed in front of the ovens, being so arranged that they can be entirely cut off from the ovens in case of their getting out of order, each separate coking chamber being then capable of being used as a gas producer.

1963. Apparatus for Paring the Brims of Silk and Felt Hats after being "Curled" and Set, *L. F. Marsh, Bristol, and J. Cree, near Manchester.*—18*th April*, 1883. 6*d*.
The object is to cut or trim the edges of hat brims mechanically after the brims have been curled and set by hand or by a hat-curling and setting machine.

1964. Producing a Yellow Dye, *G. A. Bang, Leeds.* —18*th April*, 1883.—(*A communication from G. A., E., and R. Dahl, Barmen, Germany.*) 2*d*.
1 part of alpha-naphtha-methyl-ether is warmed to about 90 deg. C., with 4 parts of fuming sulphuric acid (containing 10 to 15 per cent. of anhydrous sulphuric acid) or with 8 parts of sulphuric acid of 66 deg. strength so long that when a sample of the mixture is dissolved in water and warmed with nitric acid it no longer gives any cloudiness or trace of precipitate. When this point is reached the mixture is poured into about 10 parts of ice water, and 2 parts of nitric acid are then gradually added and warmed for some time to about 40 deg. or 50 deg. C. After cooling the mixture solidifies into a crystalline powder, which is compressed. By treatment with potash, a potasssium salt not easily soluble is obtained, thus producing the required dye.

1965. Mechanism in Connection with Oil Lamps, *H. E. Phillipson, Dublin.*—18*th April*, 1883. 4*d*.
This refers to improvements for the purpose of obviating the noise caused by the working of the mechanism or apparatus in lamps used for burning oils without the aid of chimneys or globes.

1966. Apparatus for Raising Steam, Warming Buildings, and Heating Ovens by Gas, *E. Thornton, Bradford.*—18*th April*, 1883.—(*Not proceeded with.*) 2*d*.
This relates to the general construction of the boiler.

1967. Galvanising Sheet Iron and Machinery therefor, *J. Tinn, Bristol.*—18*th April*, 1883. 6*d*.
This relates to the arrangement of the rolls in connection with the bath for galvanising sheet iron, whereby the sheets are delivered having the surfaces uniformly clean and smooth and free from oxidised spelter.

1968. Apparatus for Stopping Collision or other Holes in Ships, &c., *J. B. Wilkie, North Shields.*— —18*th April*, 1883. 6*d*.
This relates to parts forming an apparatus for stopping leaks, consisting of shear legs, a pad with appliances for fixing in position tackle or gear for drawing the pad into close contact with side of ship.

1969. Receptacles for Secondary Batteries or Electrical Accumulators, *G. Binswanger and T. S. Sarney, London.*—18*th April*, 1883.—(*Not proceeded with.*) 2*d*.
These are made from soft wood, the joints being grooved, bevelled, and compressed before being put together, the liquid causing the joints to expand. The wood boards are previously coated with gutta-percha or a similar substance.

1970. Carding Engines, *A. C. Henderson, London.*— —18*th April*, 1883.—(*A communication from L. A. Perin, Paris.*)—(*Not proceeded with.*) 2*d*.
The object of the invention is to card cotton and other fibrous matters, and free them from all impurities, such as burrs, sticks, and so forth, without crushing such matters, and without wasting the wool, which has not hitherto been effected by carding engines.

1971. Apparatus for Automatically Exposing Bodies or Articles to the Action of the Sun's Rays, &c., *W. Cooke, London.*—18*th April*, 1883.—(*A communication from R. Schlototterhoss.*) 6*d*.
The object is to expose materials or bodies, whether solid, flexible, or elastic, more especially material which has been rendered sensitive, such, for instance, as prepared papers, tissues, gelatinous membranes, and such like, to the action of the sun's rays, or other kind of light.

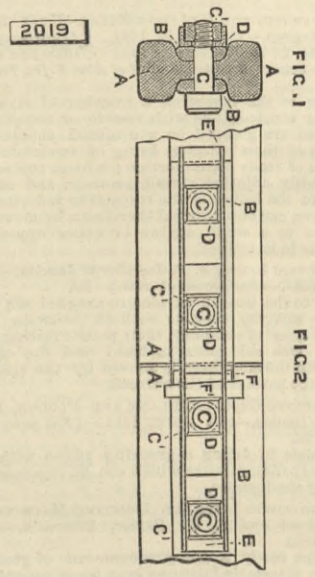
1972. Cartridges and Projectiles for Rifles, *H. Simon, Manchester.*—18*th April*, 1883.—(*A communication from the Schweizirische Industrie Gesellschaft, Neuhausen.*) 6*d*.
This relates, First, to constructing projectiles for rifles of a body of lead enclosed in an outer casing of copper; Secondly, constructing the charge for a cartridge of a single pellet of compressed gunpowder.

1991. Dynamo-electric Machines and Bobbins or Gramme-rings therefor, *W. P. Thompson, Liverpool.*—19*th April*, 1883.—(*A communication from B. Cabella, Milan.*) 6*d*.
The invention essentially consists in making the "non-useful" part of the armature, or that part which is furthest from the existing magnets, of much larger section than the useful part. This is accomplished by building up the armature with suitably formed bars and sheets of copper. The commutator consists of a number of insulated strips joined to one end of the bars, which are longer than the sheets and project at the one end over them.

1992. Engines and Driving Gear for Electric Machines, *R. Brown, Gainsborough.*—19*th April*, 1883.—(*Not proceeded with.*) 2*d*.
The lever of the governor is provided with an adjustable weight, by which means the speed of the engine may be altered, or the engine speed may remain constant and the speed of the electric generator be altered by an arrangement of countershafts and various sized pulleys which are thrown in or out of gear by friction clutches.

1998. Electric Batteries, *B. W. Webb and H. P. F. and J. Jensen, London.*—19*th April*, 1883. 4*d*.
Relates to a "dry" battery, the exciting paste of which is composed of plaster of Paris, chloride of sodium, sal-ammoniac, and yeast. The electrodes are composed of two outer manganese blocks and a central plate of amalgamated zinc.

2019. Apparatus for Locking the Nuts upon the Bolts by which Fish-plates are Secured to Railway Rails, &c, *G. Grover, London.*—20*th April*, 1883. 6*d*.
A A^1 are ends of two rails coupled together in the usual way by fish-plates B B and bolts C C C passed through them. Washers D are placed on the bolts. C^1 C^1 are nuts screwed on to the ends of the bolts and brought to such a position that their sides are horizontal and vertical. E is a locking trough; it has holes in its bottom for the nuts to pass through. Each



hole is a square of a size to allow a nut to pass freely, and on one side of the square is a slim circular notch of a diameter somewhat exceeding that of the washer. This locking trough is passed over the nuts and is slipped endwise, so that the semicircular end of each hole embraces the washer within it. A gib and cotter F F^1 are then passed through holes. These holes are formed in the sides of the trough in such a position that the back of the cotter comes against the side of one of the nuts, thus preventing the trough sliding back.

2039. Fish-plates for Connecting the Rails of Railways, *G. Robson, Newcastle-on-Tyne.* —21*st April*, 1883. 4*d*.
The fish-plates consist of two side pieces, which, at their upper parts, abut against the web of the rail, and their mid-parts are curved to embrace the lower head of the rail, and at their lower parts are formed with depending webs.

2042. Magneto-Electric Machines, Dynamo-Electric Machines, and Electro-motors, *G. Hookham, Birmingham.*—21*st April*, 1883. 8*d*.
The field magnets have V-shaped permanent magnets, a number of which are built up to form a trough, and these are fixed with their angles to the shaft. The magnets of the armature are trough-shaped, the edges of which are about the same distance apart as the ends of the V-shaped magnets. The armatures being stationary, no commutator is used.

2068. Swinging or Self-levelling Berths, *P. M. Justice, London.*—24*th April*, 1883.—(*A communication from A. P. Bickmore and E. B. Pendleton, Hyde Park, U.S.*) 6*d*.
The object is to provide an upper and lower berth suspended from a common support, so as to have a simultaneous movement in one direction with supporting frame and separate movement laterally independent of the frame, one of the berths being placed above and one below the common point of support and balanced in that direction.

2206. Clasps for Garments, *H. J. Haddan, Kensington.*—1*st May*, 1883.—(*A communication from L. D. Minor, Washington.*)—(*Complete.*) 4*d*.
The object is to provide a clasp that will have no projecting points or edges to engage and damage the apparel of the wearer.

2220. Paper-feeding Devices for Printing Presses, &c., *C. Ellery, Albany, U.S.*—1*st May*, 1883.—(*Complete.*) 6*d*.
The objects are, First, to provide an apparatus for mechanically feeding sheets of paper to a printing press in an accurate, reliable, and expeditious manner; Secondly, to effect the separation of the sheets from a pile in such manner that only a single thickness at a time can be fed into the press; and, Thirdly, to provide a regulating device for controlling the degree of vacuum that is produced in the lifting mechanism.

2989. Manufacture of Compounds for Making Effervescent Liquids, *W. R. Lake, London.*—15*th June*, 1883.—(*A communication from G. Stollwerck, Cologne-on-the-Rhine.*) 4*d*.
The object is to prepare the compounds so that the substances or ingredients which they contain for producing the carbonic acid when combined with water, are kept separate from each other instead of being mixed.

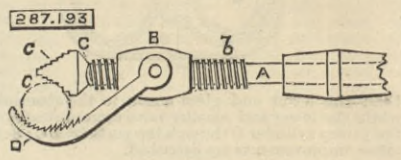
3149. Lubricating Compounds for the Valves and Cylinders of Steam Engines, *T. Colgan, Brooklyn, U.S.*—26*th June*, 1883. 4*d*.
This relates to a lubricating compound in solid form for use in the valves and cylinders of steam engines, composed of petroleum, beeswax, paraffine, and plumbago.

3177. Printing Cloth or Wall Papers, &c., *H. Philippi, Hamburg.*—26*th June*, 1883.—(*Complete.*) 2*d*.
The object is the application of photo-engravings or photo-relievos for the purpose of printing cloth and wall papers.

SELECTED AMERICAN PATENTS.

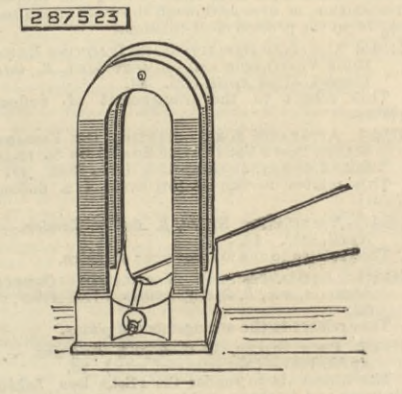
(From the United States' Patent Office Official Gazette.)

287,193. Pipe Wrench, *James L. Taylor, Ishpeming, Mich.*—*Filed June 30th*, 1883.
Claim.—(1) In a wrench, the fast head or jaw C, having tne opposite serrated sides *c c*, in combination with a concave swinging jaw D, forked and provided with duplicate inner serrated sides, as and for the purpose specified. (2) The combination, with the shank portion A of the handle, having a screw thread



b on it, of the fast head or jaw C, having opposite concave serrated sides *c c*, converging toward one another in an outward direction, the nut B, and the forked jaw pivotted to said nut, essentially as shown and described.

287,523. Dynamo or Magneto Electric Machine, *Thomas A. Edison, Menlo Park, N.J.*—*Filed September 13th*, 1882.
Claim.—(1) In a dynamo or magneto-electric machine, the field of force electro-magnet having two or more pairs of flat soft iron cores provided with separate windings and two polar extensions, to which all of such cores are attached, substantially as set forth. (2) In a dynamo or magneto-electric machine, the field of force electro-magnet composed of two polar extensions and two or more pairs of flat soft iron cores having separate windings and magnetically-separate yokes or back pieces, substantially as set



forth. (3) In a dynamo or magneto-electric machine, the field of force electro-magnet having two polar extensions and two or more pairs of flat soft iron cores provided with separate windings and yokes made integral with the cores, substantially as set forth. (4) In a dynamo or magneto-electric machine, the combination, with the armature, of the convergent polar extensions, of flat soft iron magnet cores provided with separate windings and two polar extensions, to which said cores are attached, substantially as set forth.

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