OSCILLATION *v.* ROTATION.

BY PROFESSOR OSBORNE REYNOLDS, F.R.S.

No. IV.

(20) *Application to the dynamo and steam engine.*—In order to arrive at a just estimate of the friction caused by the inertia of reciprocation in practical cases, it is necessary to consider the forces which arise from inertia in conjunction with the working force—the force required to accelerate the piston in conjunction with the pressure of steam.

(21) *The resultant of inertia and the working forces on a reciprocating piece.*—When, as is generally the case, the reciprocating piece is subject to forces besides those which act between it and the crank, the pressure on the crank will be the resultant of this force and the force necessary to balance the inertia.

The working force may be represented, as in the case of the steam engine, by a diagram. Let p P M^1 be the working force at the point P. Consider the motion from A to B, and let M^1 be on the upper side of A B when the force is in the direction of A B, and on the lower side when the force is in the direction B A. That is, P M^1 is drawn

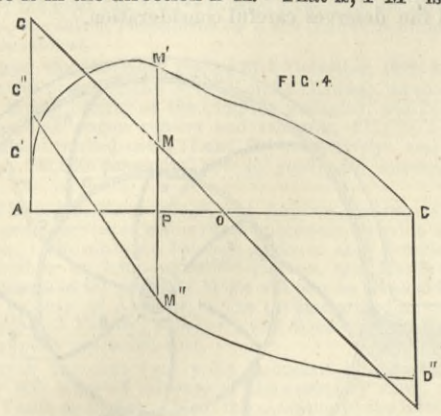


FIG. 4

on the same side to P M representing the forces to overcome the inertia. The pressure on the crank will therefore be

$$p\,(\mathrm{P\,M} - \mathrm{P\,M^1}) = p\,\mathrm{M^1\,M} \quad . \quad . \quad (25)$$

make P M^{11} = M M^1, noticing that M^{11} will be above A B when M is above M^1, and *vice versâ*. In this way a line A C^{11} M^{11} D^{11} B may be drawn, the distance of which from A B shows the pressure on the crank; and then the mean pressure may be found as before, substituting P M^{11} for P M. As far as the friction is concerned this will be independent of the direction of the pressure on the crank, so that in finding the mean P M^{11} must be taken always of the same sign.

There are two cases of special interest. First let A C^{11} be greater than A C, and let the forces acting from A to B be altogether in the direction A B. Take two points P and Q on the opposite sides of O, and at equal distances from it.

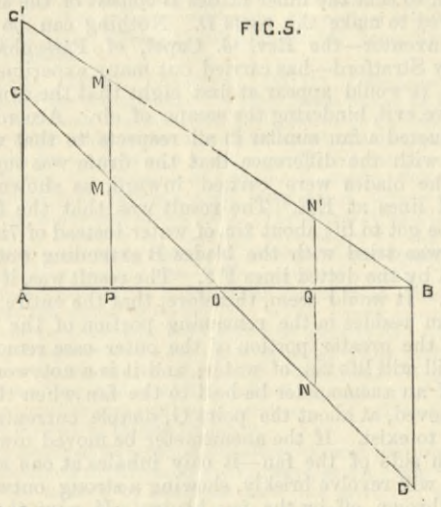


FIG. 5.

Then if the two triangles O A C and O B D are similar

$$\mathrm{P\,M^1} + \mathrm{Q\,M^1} = \mathrm{M\,M^1} + \mathrm{M\,N^1}. \quad . \quad (26)$$

Therefore the mean of the pressure at these two points on the crank will be unaltered by the inertia, and as at these points the crank is making equal angles with A B, in opposite directions, the mean pressure on the crank will be identically the same as would arise from the working forces, or, in other words, the inertia of the reciprocating piece will cause no extra friction; and this, as will be shown, is practically the case in the steam engine. Second, let the inertia be paramount, *i.e.*, A C greater than A C^1, and let the acting forces be symmetrical about O, as in Fig. 6.

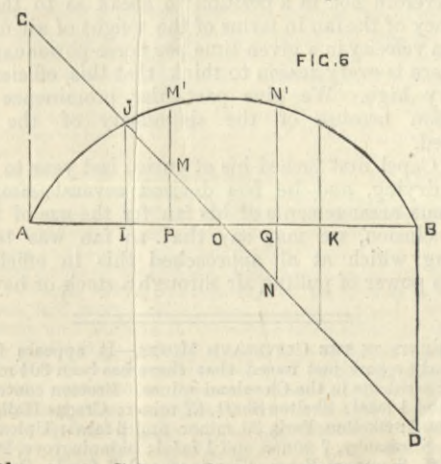


FIG. 6

Let the curve C O cut the curve C^1 D^1 in J; draw J I perpendicular to A B and take O K = O I. Then as before if P lies between I and K

$$\mathrm{P\,M^1} + \mathrm{Q\,N^1} = \mathrm{M\,M^1} + \mathrm{N\,N^1}. \quad . \quad (27)$$

So that between I and K the mean pressures on the crank will be the same as if caused by the working forces P M^1 only.

When P lies between A and I, then

$$\mathrm{P\,M} + \mathrm{Q\,N} = \mathrm{M\,M^1} + \mathrm{N\,N^1}, \quad . \quad (28)$$

or the mean pressure will be the same as if only the forces of inertia acted; and this, as will be shown, is the case of the dynamo machine.

(22) *Application to the dynamo machine.*—Since there has been no experience with oscillating dynamo machines, the formula obtained in the last article can only be applied to an assumed case. The revolving dynamo machine may be made to furnish the data for an oscillating dynamo machine; a, the length of the crank, may be taken equal to the mean radius of the armature, W equal the weight of the armature, and the time of an oscillation the same as the time of a revolution.

Taking a particular dynamo driven by 6-horse power, it appears that

$$\left.\begin{aligned} \mathrm{W} &= 200\ \mathrm{lb.} \\ a &= \cdot 3 \\ n &= 1000 \\ f &= \cdot 05 \end{aligned}\right\} \quad . \quad . \quad . \quad (29)$$

So that $v_0 = 30$ approximately;

$$\mathrm{L} = \cdot 008\, f \left(\frac{\mathrm{W}}{g\,a}\right)^{\frac{3}{2}} v_0{}^3. \quad . \quad . \quad . \quad (30)$$

This gives for L 1000 foot-pounds, in round numbers. This is the loss per revolution. Per minute the loss would be about 1,000,000 foot-pounds, or 30-horse power. So that the loss due to the friction arising from the inertia of the reciprocating armature would be five times greater than the work done in creating a current. Put this way, even supposing the assumed data admit of considerable modification, it is clear that the friction arising from reciprocation is prohibitory in the case of a dynamo machine. But before adopting this view, it is well to see how far this loss might be modified by the work which the dynamo machine was doing. 6-horse power, with a stroke of ·6 and 1000 revolutions per minute, would be equivalent to a uniform resistance on the vibrating body of 165 lb. The force $\dfrac{\mathrm{W}v^2}{a\,g} = 20{,}000$.

So that if in the diagram A C = 1$''$, and p A C represent 20,000 lb., p = 20,000; and if p A C^1 = 160 lb., A C^1 = ·008. This is too small to be drawn to scale; but if drawn, the line J I in Fig. 6 would be ·008 A C and O P would be ·0080 A. Therefore the amount of work represented by the diagram I L L K would be ·008 × ·160, or 1·3 foot-pounds, and this may be neglected. And for the rest of the diagram, as shown in Section 21, the mean pressure on the crank pin will be the same as if the forces of inertia were alone to be considered. In this case, therefore, where the forces of inertia are paramount, the friction is determined almost entirely by the forces of inertia, the working forces neither adding to or subtracting from the friction.

It thus appears that there is no chance for the reciprocating dynamo machine, driven by a crank, and it will appear equally clear that there is no chance for a reciprocating dynamo machine driven direct from the piston of a steam engine, for in this case the energy of motion, which, as in the last example, is 3000 foot-pounds, would have to be stored by cushioning steam, that is to say, 3000 foot-pounds would have to be transmitted to and from the steam twice each revolution; the entire transmission therefore would be 12,000 foot-pounds. Now, taking the smallest estimate of loss in this transmission, namely, 15 per cent., we have a loss of 1800 foot-pounds per revolution, nearly double as great as with the crank.

If we substitute a steel spring for the cushioning, then the weight of steel, which, estimated as before, would be 6 tons, is prohibitory.

Thus in every case we have amply sufficient reasons for the non-applicability of reciprocation to the dynamo machine.

These results are sufficiently striking in themselves, but they become still more so when compared with the corresponding results for the steam engine.

(23) *Application to the steam engine.*—For the sake of comparison the circumstances of the engine may be taken similar to those of the dynamo machine just considered. Thus, the weight of piston and reciprocating parts is taken at 200 lb., and the length of crank, 3. This would only give a 7in. stroke, which is somewhat out of proportion, considering that 200 lb. would correspond with a piston some 15in. in diameter, that is, considering the shortness of the stroke. This will be a convenient size to assume for the piston, taking the initial pressure of steam 120 lb. on the square inch; since this over a 15in. piston is 21,120 lb., which is just about the same as the force of inertia,

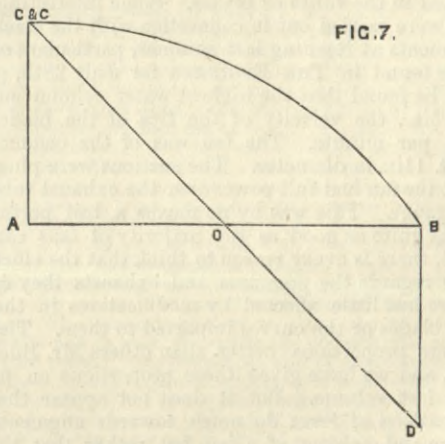


FIG. 7.

and in the diagram A C = A C^1, or C and C^1 coincide, *i.e.*—if, for the sake of comparison, the number of revolutions is taken the same as before n = 1000.

Since W, n, and a are the same as before, the crank pin will be subject to the same pressures, on account of inertia; and since we may assume, from expansion, the pressure of steam to fall towards B, the greatest pressures on the crank pin will not exceed the greatest forces of inertia; therefore r_1 r_2 may be taken to have the same value as before. And considering only the force of inertia, we should find as before—

$$\mathrm{L} = 1000 \text{ foot-pounds}$$
$$n\,\mathrm{L} = 1{,}000{,}000$$

or the loss would be at the rate of 30-horse power. But even supposing this loss to take place, it bears a very different comparison to the work done by the steam engine from what it did to the dynamo machine. With an initial pressure of 120, the steam being used as in the locomotive, the mean pressure would be, say, 70 lb.; this would give the work per stroke 15,000 foot-pounds, so that the loss would only be one-fifteenth, or between 6 and 7 per cent., instead of 500 per cent. in the case of the dynamo machine.

As a matter of fact, however, there would be no such loss in the engine when doing its full work. This appears on compounding the diagrams of inertia and working pressure as in Fig. 5, Art. 21, for since A C^1 is not greater than A C.

$$\mathrm{P\,M^1} + \mathrm{Q\,N^1} = \mathrm{M\,M^1} + \mathrm{M^1\,N} \quad . \quad (31)$$

throughout the diagram, or the mean pressure on the crank taken all round is not affected by the inertia of the piston; and hence whatever loss the friction arising from the pressure may cause, it will be due entirely to the acting pressure of steam, and so long as this remains unaltered, the loss per revolution will be the same at all speeds up to 1000 revolutions. Considering that the speed of piston here taken 1800ft. per minute, and the number of revolutions, 1000, are well outside all practical values, this example shows that in whatever other ways the forces arising from the inertia of reciprocation act to limit the speed of the steam engine, they need not affect the friction of the engine, either directly or indirectly by requiring larger bearings, even should the speed of the steam engines reach values five or six times greater than the present values. Thus, although, as we have seen in the case of the dynamo machine, there are circumstances in which the friction arising from the inertia of the reciprocating force is so large compared with the acting forces as to be prohibitory to oscillating motion, yet in the case of the steam engine these forces give rise to no loss whatever, and do not place the reciprocating engine at a disadvantage as compared with the rotary engine.

It seems, then, that we have a good reason for the general impression in favour of rotary motion as compared with reciprocating motion, and also a good reason why the impression is erroneous as applied to the steam engine.

Before closing these articles, it may be well to refer shortly to cushioning, or compression, as used in reference to the steam engine.

(24) *Cushioning.*—The useful purposes attributed to this are these:—

(1) Cushioning is supposed to save steam by filling the passages to the ports and other necessary clearance, so that this has not to be filled with fresh steam which does no work in filling them.

(2) Cushioning is often supposed by relieving the crank from the duty of stopping the piston, and so by diminishing the pressure on the crank pin and bearings, to diminish the friction.

(3) Cushioning is found by experience to be necessary in the case of all high-speed engines, to prevent a sudden shock attending the admission of steam.

Now, the last of these advantages is a matter of experience, and is alone sufficient to warrant a certain amount of cushioning. If, when running at its greatest speed, an engine knocks or bumps in its bearings, it is a sign that it is insufficiently cushioned. This admits of theoretical explanation. If cushioned, as the piston approaches the end of its stroke A it will be stopping itself driving the crank, the force arising from inertia being at its greatest. Thus the force will have a tendency to close all the joints between the piston and the bearings in the direction B A, opening them in the direction A B. On the admission of the steam, owing to the small clearance to be filled, the pressure suddenly rises to a greater value than the force of inertia, and the piston is, as it were, shot back by the pressure of the steam and the elasticity of the engine against the force of its inertia. The joints thus close towards B with a bump. This bump could not have occurred had not the reversal of the direction of the combined force and inertia been sudden when the joints were open towards A. By cushioning, the pressure of the steam which balances the inertia rises gradually, so that the joints which are at first open towards A close gradually.

As regards the first two advantages, the first of these must be regarded as hypothetical, or rather, as theoretical, and the second as imaginary.

The steam with which the clearance is filled is not all gain. This is well known. The work done in compression has to be deducted from the work done by the forward pressure of the steam, or the power of the engine will be diminished by the power spent in compression, while the entire friction and the losses by condensation remain the same. As these losses appear to be something like 40 per cent. of the theoretical power of the steam as used in the engine, there cannot be much margin for gain of steam. The advantage may be a little one way or the other, but it is not worth mentioning.

The second assumed advantage of cushioning, namely, the diminution of the mean pressure on the engine, vanishes when it is perceived that it is the working pressure of the inertia that is diminished. This assumption amounts to nothing more or less than assuming that the moving energy of the piston might be more efficiently stored and restored by compressing steam than it is by the crank. It has, however, been shown that the crank performs this work in the steam engine with no loss, whereas in compressing steam there will probably be a loss of from 15 to 25 per cent. of the energy stored. This is the loss which has been shown to balance the gain in steam in (1). In respect of (2), therefore, the cushioning is a disadvantage. That this has not been practically perceived is because, as long as cushioning is only carried to the extent of filling the necessary clearance, then the loss and the gain, as in (1), are nearly balanced, as has already been shown.

The conclusion is, therefore, that cushioning should not be carried further than is sufficient to prevent bumping.

THE CRYSTAL PALACE GAS AND ELECTRICAL EXHIBITION.

No. II.

The Exhibition of Gas and Electric Lighting at the Crystal Palace is probably as complete now as it will be. It lacks the attractions which made the Exhibition of last year famous; but this naturally ensues from the fact that the things shown are no longer novelties. There is very little indeed at the Palace which is new, although there is a great deal which is good and interesting; but the public like to see something which cannot be seen elsewhere in return for their shillings, and very few seem to care much for what is on view at Sydenham. Furthermore, the exhibitors have taken small trouble. They have for the most part contented themselves with exhibiting, but there are no attendants to supply information—no offices in the building where it can be sought. There are subordinates, it is true—workmen for the most part, competent and civil, but either knowing very little or very reticent. We do not mean to say that there are no exceptions to this rule, but they are exceptions, and all that we have said is specially true of the electric light exhibitors.

We suppose that so much gas was never before burned in one building. All that gas can do in the way of giving light it is made to do. Almost the whole south nave of the Crystal Palace is blazing with gas every night. It is an unfortunate circumstance for the gas that a comparison can readily be drawn between it and the electric light, for the result is little short of disastrous to the gas. The northern end of the south nave is lighted by four Gerard clutch arc lamps, with 15mm. carbons. These lamps, when they work well, give an admirable light; the globes with which they are fitted are elegant in shape and good in colour; but we have never had the good fortune to find all the Gerard lamps—there are about a dozen in all—working well at once. But the contrast between the light they give, cool, brilliant, and fairly steady, and the hot yellow glare of the gas close by, is not at all to the advantage of the latter. The southern end of the north nave is lighted by three or four Mackenzie lamps exhibited by Mr. Strode. These are the worst electric lamps we ever saw in action, or else no proper care has been taken to supply them with a proper current. They are extremely unsteady; apparently they strike too long an arc, and as there is not sufficient electromotive force to maintain a long arc, they proceed to "make and break," in a way known to all makers and users of clutch lamps. In marked contrast to these are half-a-dozen arc lamps, Brockie's new pattern. This is a fly lamp, somewhat of the Crompton type, but with a different arrangement for striking the arc. The light given by these lamps is the perfection of electric lighting. It is absolutely steady, and it is quite silent. We have watched the lamps for half an hour at a time, and we have not once detected so much as a flicker. Now and then there is a slight increase or diminution in the light of a particular lamp, but nothing more. As we have never been fortunate enough to meet with anyone at the Palace representing Mr. Brockie, and willing to afford information, we are unable to say precisely how this excellent result is obtained. We should imagine, however, that in the first place very great pains have been taken to get the current perfectly steady. It is supplied by the generating machinery of the British Electric Light Company, which consists of a large Gramme dynamo driven by one of Messrs. Davey, Paxman, and Co.'s 10-horse engines; and in the second, we presume that the carbons used are what are known as Mignon, Ruart, et Cie.'s show carbons, namely, carbons which are as near perfection as carbons have yet been made, and therefore enjoy high favour with all makers of arc lamps, who wish to show them to advantage. Their defect is that they are very expensive—far too dear for ordinary use. In the Alhambra Court will be found Werderman lamps, which are burned without a globe—four in one group in the Court of Lions. This is an excellent way to show a lamp to advantage. The four lamps being within a few feet of each other, and hanging at a good height, diffuse the light well and prevent black shadows being thrown; and it is, of course, quite impossible to examine the behaviour of any of the lights minutely without the aid of black glasses. The flickering of any one lamp is lost in the flood of light from the other three. So far as can be seen, however, the lamps work very well. They have much larger negative than positive carbons, and it is stated that their lower carbons being 20 mm., while the top are but 10 mm. in diameter, the former burn away at the rate of but 1in. in five hours. Several attempts have been made to work arc lamps with carbons of unequal diameter; but up to the present the results have been disappointing, as much of the light from the crater in the top carbon is intercepted by the bottom carbon unless the arc be long. This we judge it to be with the Werderman-Lee lamps under consideration. We have never seen them at work for two minutes at a time without flaming, and this, under the circumstances, probably denotes the presence of an arc a quarter or five-eighths of an inch long. There is a wide diversity of opinion among electricians concerning the proper length of an arc. Our own experience is that there is very little difference in the amount of light given by an arc $\frac{1}{10}$in. and one $\frac{4}{10}$in. long, always supposing that the carbons were doing equally well in both cases and burning without "mushrooms" or "flashes." The feed arrangement of the lamp is very neat, the top carbon being pushed down as required by a solenoid core, which works on a species of make-and-break system, so that a great many very small feeds can be obtained in a very short time. The lamp is, however, somewhat delicate in its mechanism, but not more so than many others not so good in many respects.

In the gas department the most prominent features are the huge Siemens lamps at the southern end of the south nave. Some of these burn as much as 120 cubic feet per hour, and give, it is stated, a light of 1000 candles. These lamps are lighted a long time before they are wanted, in order that they may become thoroughly heated, and they are, we need scarcely say, burned with great care; but they do not show to advantage. They are, to begin with, extremely ugly, and the enormous base to the great burner, some 12in. in diameter, casts a heavy shadow over a large floor space. It is not easy to show any light to advantage in the Palace nave, least of all gas, and this must not be forgotten. Not far off, however, are some very ordinary sun burners, such as are used freely now in theatres—one lights the hall of the Institution of Civil Engineers—which are, apparently at all events, far more effective than the Siemens lamp, and certainly much more simple.

The most brilliant gas illumination in the Palace will be found in the Pompeian Court, which is lighted by the Albo-Carbon Light Company. Several firms appear to have gone into the manufacture of this type of lamp, among others, Mr. G. Kent, of Holborn, and Mr. Kidd, of Farringdon-road. Albo-carbon simply means white carbon, and what is known as white carbon is not, properly speaking, carbon at all, but crystallised naphthalene, a hydro-carbon, made up in the form of small hollow cylinders, much resembling ends of stearine candles with the wicks pulled out. A few of these are put into a copper globe about as large as an orange, one globe to each gas-flame. The globe is fixed to one side of and a little higher than the gas-flame, over which projects a flat spoon-shaped piece of metal, which conducts heat to the globe. The naphthalene is melted, and the gas passing through it is enriched, and shows a much better light than it would otherwise do. The suspension gasaliers in the Pompeian Court are very elegant in form; but as much cannot be said for either the standard lamps or wall brackets exhibited either in the Pompeian Court or elsewhere in the Palace—on the contrary, they are extremely ugly—it is almost impossible to work in the copper ball and spoon in an artistic device. Furthermore, after the lamp has been at work for some time, corrosion of the spoon is set up, and it becomes covered with a greenish white powder, unpleasant to the sight, and conveying an impression of old age, and decay, and neglect, and general wearing out, which is not nice. Regarded as ornaments, Albo-carbon lamps are dreadful failures; regarded as apparatus for producing light, they are a complete success. If they could only be taken away or covered up in the day-time, they would find favour in private houses. If they cannot, we fear their use will be confined to situations where utility is everything, appearance a secondary matter. Naphthalene, we may add, is a solid hydrocarbon, C_{20} H_{10}, obtained in a tolerably pure form by re-distilling coal tar. It is, we may add, a nuisance to gas makers, for it forms in mains and blocks them up. It fuses at about 180 deg., and burns with much smoke. It is one of the most powerful light-producing hydrocarbons in existence.

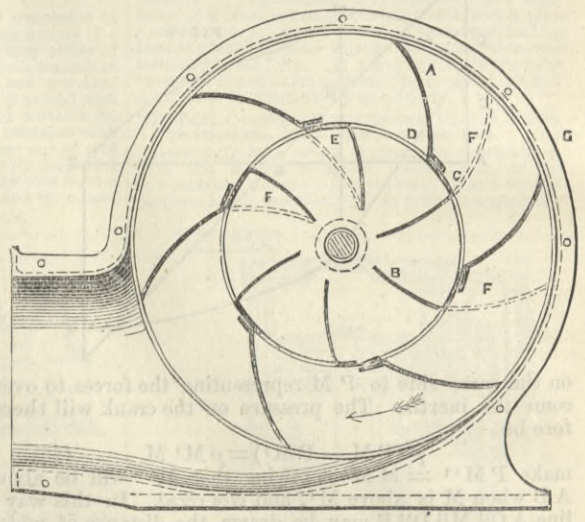
Two novel systems of gas lighting have been referred to in our pages; one is shown by M. Ernest Resch, of Upper Baker-street, in the French Court. It is the invention of M. Victor Popp, of Paris. Tubes are fitted at the upper ends with little baskets of platinum gauze; these are about 2in. long and 1in. in diameter. A mixture of gas and air is forced at high-pressure into and through the little baskets, and burning without flame, in the way pointed out by Mr. Fletcher, of Warrington, long since in our pages, the baskets are heated white hot, and give out a good light. The other is Clamond's system, exhibited by M. Servier, of Paris. He uses pendant tubes, at the lower ends of which are little baskets of what the inventor terms "magnesia," apparently steatite. These are heated in just the same way as the platinum baskets just described. The light given is fairly good, but neither system could be tolerated in domestic use because of the roaring noise produced by the blast. Furthermore, the lights rise and fall and vary in intensity with every external draught of air. In a word, the effect produced by each is that of a very indifferent arc lamp. Indeed, the greater number of uninitiated visitors invariably go away with the impression that they are electric lights of a new type, and we have heard remarks made which were not complimentary. The idea involved in both the Clamond and Popp lamp is ingenious, and if it can be improved upon the results would be satisfactory; but before any progress can be made the noise must be got rid of, and it is at least encouraging to notice that one of the systems is very much less noisy than the other.

A NEW FAN.

The literature of fans is extremely meagre; so meagre indeed, that it may be said that little or nothing useful has been written concerning them. It is known, however, that in practice fans cannot give high pressures or powerful exhausts, and that both pressures and exhausts are comparatively insignificant, unless a very high velocity is imparted to the vanes or blades. Some interesting experiments were carried out in connection with the stack drying experiments at Reading last summer, particulars of which will be found in The Engineer for July 28th, page 61. It will be found that the highest water column supported was 5·5in., the velocity of the tips of the blades being 9233ft. per minute. The fan was of the common type, and 2ft. 11in. in diameter. The suctions were plugged up, so that the fan had full power over the exhaust tube to the water gauge. This was by no means a bad performance, and was quite as good as the majority of fans can show. Indeed, there is every reason to think that the efficiency of fans as regards the pressures and exhausts they can produce are but little affected by modifications in the shape of the blades or the curves imparted to them. That there are some proportions better than others Mr. Buckle has shown, and we have given these proportions on page 171 of our last volume. But it does not appear that these modifications of form do much towards augmenting the pressure and exhaust of a fan, but rather that they tend to make it run silently, and give a higher efficiency per horse-power expended in driving the fan than it would give without them.

In order to get higher pressures with foundry fans, backing two fans on each other has been tried. In this case the first fan delivered air under a pressure of 3in. or 4in. of water into the second fan, which further augmented the pressure; but it does not appear that any success has attended these experiments; at least, very few, if any, fans of the type are now in use.

We illustrate here a fan which gives results so remarkable that they tend to prove that all the theories hitherto held concerning the action of fans must be modified. Indeed, it is perhaps hardly too much to say that this fan is more powerful than any other fan which has yet been made. We have carried out some experiments with a model fan only 6in. in diameter and 3in. wide, which gave results quite unparalleled by any fan of the size with the construction and working of which we are acquainted. With a velocity of 4200 revolutions per minute it supported on the exhaust side a column of water over 7in. high, the exhaust tube end passing through a hole in a piece of board placed over the central orifice, which is 3in. diameter. A 14in. fan, worked by hand, and making 2100 revolutions per minute, supports a column of 8in. The velocity of the tips of the blades is 7700ft. per minute. The largest fan at Reading, carried, as we have said, but 5·5in. of water with a blade speed of 9233ft., so that the Capel fan is, roughly speaking, twice as powerful. Further experiments will be tried, and more information obtained, but as the matter now stands it appears to be clear that the Capel fan deserves careful consideration.



It is not easy to see why it should be so powerful. If we had not convinced ourselves by direct experiment of the capabilities of the fan, we should not have hesitated to condemn its design. It will be seen that it consists of two sets of blades, an outer set A and an inner set B. There is nothing remarkable about the curves of these blades, nor does it appear that any particular curve must be accurately followed. The outer blades are fixed on a drum C, and in this drum are cut ports or openings D. The sheet iron is cut along three sides, and bent along the fourth, so that the inner blades B consist of the sheet iron removed to make the ports D. Nothing can be simpler. The inventor—the Rev. G. Capel, of Passenham, near Stoney Stratford—has carried out many experiments with fans. It would appear at first sight that the drum C is a positive evil, hindering the escape of air. Accordingly he constructed a fan similar in all respects to that which we tried, with the difference that the drum was suppressed, and the blades were carried inward, as shown by the dotted lines at E E. The result was that the fan could only be got to lift about 2in. of water instead of 7in. Then a fan was tried with the blades B extending outward, as shown by the dotted lines F F. The result was, if possible, worse. It would seem, therefore, that the entire value of the fan resides in the remaining portion of the drum C. With the greater portion of the outer case removed, the fan will still lift 2in. of water; and it is a noteworthy fact that if an anemometer be held to the fan when the casing is removed, at about the point G, double currents will be found to exist. If the anemometer be moved towards the suction side of the fan—it only inhales at one side—the wheel will revolve briskly, showing a strong outward current thrown off by the fan blades. If, now, the anemometer be moved towards the opposite side of the case, still at the same level it will be found that there is a strong *indraught* at the circumference of the fan.

We do not at present attempt to account for the efficiency of this fan. Possibly some of our readers may like to make the attempt; we prefer to await the issue of further experiments. We shall only add here that suctions as great have been obtained with other fans; but never with anything like the same small velocity of blade tip. It is in this that the efficiency of the Capel fan consists. No dynamometer experiments have yet been made, and we are therefore not in a position to speak as to the actual efficiency of the fan in terms of the weight of air moved at a given velocity in a given time per horse-power expended; but there is every reason to think that this efficiency will be very high. We give particular prominence to the invention because of the singularity of the results obtained.

Mr. Capel first turned his attention last year to fans for stack drying, and he has devised several simple and ingenious arrangements of his fan for the use of farmers. In conclusion, we may say that no fan was tested at Reading which at all approached this in efficiency as regards power of pulling air through a stack or hay rick.

Accidents in the Cleveland Mines.—It appears from the half-yearly report just issued that there has been 304 minor and 11 fatal accidents in the Cleveland mines. Brotton contributes 21 minor and 1 fatal; Skelton Shaft, 27 minor; Craggs Hall, 5 minor and 2 fatal; Skelton Park, 39 minor and 2 fatal; Upleatham, 28 minor; Normanby, 7 minor and 1 fatal; Skinningrove, 20 minor; Huntcliff, 6 minor; Eston, 65 minor and 2 fatal; Ormesby, 10 minor; North Skelton, 8 minor and 1 fatal; Longacres, 18 minor; South Skelton, 9 minor; Stanghow, 1 minor; Kirkleatham, 2 minor and 1 fatal; Boosbeck, 11 minor; Slapewath, 11 minor; Chaloner, 6 minor; Spa, 7 minor and 1 fatal; Belmont, 5 minor.

RAILWAY MATTERS.

ULYSSES S. GRANT, president of the Southern Railway Company of Mexico, has concluded a treaty with the Government of Guatemala for the extension of the Mexican line in Guatemala.

AN interesting item of the Midland Railway report, published on Wednesday, is the statement that during the half-year 62½ miles of relaying with steel rails have been completed during that period.

THE *City Press* states that a portion of the old Roman wall can be seen at the back of the Tower of London station of the Metropolitan Railway. It is a remarkably fine specimen, and in perfect preservation.

THE fact is recorded in a recently published report of the Massachusetts Railway Commissioners, that for the third time in Massachusetts railway history, the income of her roads from passengers is larger than that from freight.

THE London, Chatham, and Dover Railway Company is making preparations for the commencement of the widening westward of the Blackfriars Bridge, by which Blackfriars will be connected with the new extension of Ludgate-hill station.

THE report of the directors of the North-Eastern Railway for the half-year ending December, 1882, shows that the locomotive power cost £502,276 16s., while the train mileage was, passengers, 4,871,848; goods and minerals, 7,322,729—a total of 12,194,577.

IN consequence of the opposition partly of persons interested in the New Forest, who state that if this scheme were carried out some of the most beautiful woodland scenery in England would be marred, the Bill in Parliament for a new line to Bournemouth has been abandoned.

DURING the half-year ending 31st December, 1882, the cost of locomotive power on the North London Railway, as shown by the report to the meeting of the company yesterday, was £41,100 15s.; carriage and wagon repairs and renewals, £12,724 14s.; miles worked and worked over, 17 and 98¼ respectively; and the train mileage 928,860 passenger, and by goods and minerals 226,899 miles.

THE Swindon, Marlborough, and Andover Railway is now fully open, and a service of trains running between Swindon and Southampton. The distance between Andover and Swindon will be traversed in an hour and three-quarters, and Marlborough and other places in the north of Wilts will now be reached from south Wilts by way of Andover. The preliminaries for commencing the proposed Pewsey, Salisbury, and Southampton Railway are being rapidly proceeded with.

WITHIN the next four years Roumania intends to construct nearly 400 miles of railways of the secondary class, except one from Vaslin to Berlad. With the exception of the latter, a broad-gauge line, the estimate for which is nearly £6400 per mile, all the others are estimated to cost about £2500 per mile. Roumania only began railway making thirteen years ago, yet has now nearly a thousand miles of broad gauge lines, and will have by the end of 1886 a network of lines of nearly 1500 miles.

ON the 11th December last, near Bradford station, on the Lancashire and Yorkshire Railway, the coupling between the engine and the leading carriage of a train fitted with the Faye brake parted, and after running for about 1200 yards the carriages overtook the engine, and struck it with considerable force, throwing the leading carriage off the rails, and injuring four passengers and the driver and fireman. In his report on the subject, Major Marindin says:—"This collision is one of a class which would not occur if automatic continuous brakes were generally adopted."

THE report of the directors of the London, Chatham, and Dover Railway, submitted last week to the half-yearly meeting of the company, shows that the working expenses were 52·77 per cent., or slightly more than in 1880, though less than any other year. Locomotive power cost £72,797 7s. 7d., and carriages and wagons £91,717 1s. 9d., and maintenance of ways and works—154 miles 55 chains double line, and eleven miles, nearly, single line—£45,301. The mileage worked by the engines was 172·8 miles, and total train mileage 1,928,563, 326,015 being by goods and mineral trains.

MESSRS. HAWKS, CRAWSHAY, AND CO., Gateshead, have just completed the construction of a large girder bridge to the designs of an American engineer, Mr. Collingwood C. Schreiker, of New York. This bridge is for the Canadian Pacific Railway, and will cross the Frazer river at a point about 150 miles to the eastward of Port Moody, the terminus of the line in British Columbia. The river here runs between high, steep banks, which contract its width to somewhere about 300ft. The stream, which is sometimes swelled by floods to a height of 60ft. above its ordinary level, runs with great force and speed, so that the cost of building a pier in mid-river would have been exceedingly great. The design therefore provided for a span which should be of sufficient length to cross the entire waterway, and which should be supported at each end on abutments built from the solid rocks. Its length is 315ft., while two smaller spans of about 105ft. each, complete the line to the sides of the valley. The bridge is of the true American type, and special pains have been taken to facilitate the fitting together and jointing in erection. It will be the first iron bridge erected in British Columbia.

THE Austrian Government Sanitary Council has prepared a set of regulations for life-saving on railways, and a guide to first help to those injured by accidents until the arrival of a physician. These have been sent to the several railway companies for examination and suggestions. Every conductor is to be provided with a leather case of bandages; a lister to be placed at every station and half-way between such stations as are more than nine miles apart; at every station a small case of surgical instruments, of specified kinds is to be kept; that a larger supply of instruments and bandages at stations fifty and sixty miles apart, where there are reserve locomotives, which locomotives are to pick up the cars and litters on the way to an accident. Still more complete provision is to be made at important stations where there are many servants. For every 250 or 300 miles of road, at an engine-house, there must be an hospital car, of a specified pattern, used for carrying sick and wounded in time of war. The guide to first aid to the injured prescribes how the servants or others shall carry the victims of accidents, how place them, treat their wounds, apply bandages, transport them in the cars, and what to do in case of sudden illness.

AN American contemporary states that the Brooks Locomotive Works turned out 203 locomotives last year. These and other works need turn out a few if that described in the following, from the American *Railroad Gazette*, takes place very often. A dispatch from Albuquerque, N.M., January 21st, says: "On Thursday evening an engine on the Atlantic and Pacific Railroad while trying to force the blockade of snow between Coolidge and Fort Wingate jumped the track. A second engine came to the rescue, but, not being able to render the needed assistance, two more engines were telegraphed for from Coolidge. These started for the scene of the accident at full speed, and in the blinding storm nothing was seen in the way, when suddenly a tremendous crash occurred and fragments of four 60-ton engines were piled up on the road-bed. Charles Lakin, an engineer, and his fireman were seriously bruised, and several others were slightly injured. Friday afternoon the men working on the wreck being exhausted from fatigue and cold, Coolidge was again asked for assistance, when two more engines, with a way-car loaded with workmen, started for the scene of the accident. The snow was blinding and the wind blew so terrifically that no object could be seen ahead, and the rescuing train, sweeping along the track, went crashing into the wreck of the other four engines, adding tenfold to the confusion already existing. Both the engine and way-car were completely wrecked, but strangely no one was seriously hurt. The storm was the worst known for years. The danger lights were completely covered up and the intense cold made it impossible for the signalmen to be out."

NOTES AND MEMORANDA.

AT the Royal Observatory, Greenwich, the mean reading of the barometer last week was 29·69in. The mean temperature was 42·7 deg., and 2·6 deg. above the average in the corresponding week of the twenty years ending 1868. The lowest night temperature was 33·4 deg. on Tuesday, and the highest day temperature in the shade 53·1 deg. on Thursday.

GERMAN silver acts like brass in presence of carbonic acid, but on the average is less energetically attacked. In air free from carbonic acid, it is less strongly attacked than brass, although quite strongly by sal ammoniac, less by chloride of magnesium, alkaline chlorides and caustic soda, not at all by distilled water, sulphate of potassa, saltpetre, carbonate of soda, and lime water.

MANY of the stores in Astoria, Long Island, are lighted by a naphtha gas of 24-candles power, produced by bringing together in a retort heated to 1700 deg. or 1800 deg. Fah. the vapours of naphtha and superheated steam, the gas so formed passing from the retort through a three-quarter inch sheet of water for purification. The men who control the patent say they can supply gas at from 4s. to 5s. per 1000ft.

THAT carbon dioxide contains it own volume of oxygen may be shown by burning a bit of prepared carbon in a flask of pure oxygen provided with a mercury pressure gauge. The carbon is made by mixing lampblack and a little gum water to a paste, and forming rods of it by pressing through a glass tube. These rods are first dried at 100 deg. Cent., then ignited in a current of carbon dioxide. After burning the carbon and cooling, no diminution of volume is noticed.

To illustrate the great difference between the volumes of equal weights of liquid and gaseous water, Dr. Hofmann employs a glass bulb of about 300 c.c. capacity, with a narrow glass tube at each end, the upper tube being fitted with a stop cock. This apparatus, *Nature* says, is supported so that the lower tube reaches to about 1 centimetre from the surface of the mercury in a basin; a rapid current of steam is passed into the apparatus; after five minutes or so, when every trace of air is expelled, the stop cock is closed, and at the same moment the lower tube is pushed beneath the mercury, which at once begins to rise into the bulb; after a little time the bulb is almost filled with mercury, on the surface of which the condensed water appears as a thin layer.

SOME more remarkable archæological discoveries have recently been made at Mitla, a village in Mexico, situate between twenty and thirty miles from Oajaca, in the table land of Mixtecapan. Extensive remains of ancient palaces and tombs have been revealed, and it is stated that they are exceptionally remarkable from the columns supporting the roof, a style of architecture peculiar to the district of Mexico, in which they have been found. These ruins have been explored and photographed by Herr Hemil Herbruger, who states that the great hall contains six columns, and is 37 metres long by 7 broad. Each column is 37½ metres in height and is of solid stone.

THE following formula for a fine varnish for covering negatives, has been given by the *British Journal of Photography*: Palest orange shellac, 2¾ oz.; bleached lac, 5½ oz.; gum sandarac, ½ oz.; methylated spirit, 1 quart. Bruise the bleached lac till reduced to small pieces. Powder the sandarac, and then add the whole of the spirit, putting in a few small pieces of glass to prevent the shellac caking at the bottom of the jar. Stir or well shake the whole from time to time, till it is evident that solution is complete. All that is then necessary is to set aside to clear, pour off the clear, supernatant fluid, and filter the rest. It is best to allow a month or two for subsidence; for the insoluble part occupies so large a space that much waste through evaporation, &c., is caused if an unnecessarily large quantity be passed through the filter.

THE maximum density of water may be shown by means of a glass float, if just enough platinum wire be wound about it to make it heavy enough to just float in the water at 4 deg. C., and sink in that which is neither colder nor warmer. As this requires careful readjustment every time it is used, Professor Hofmann prefers the following modification of the apparatus:—A glass tube 15 centimetres (6in.) long and 2 centimetres (·08in.) wide is nearly filled with distilled water, and in it is placed any object made of coloured glass which will just float in water at 4 deg. Cent., and sink in that at any other temperature. As soon as this is properly adjusted, he seals the upper end of the tube above the water, and in this form it is always ready. This apparatus, called a "maximum density tube," is put in a tall glass jar of ice water, and by the side of it a thermometer. Of course the coloured float sinks, but on allowing a stream of water of the ordinary temperature to flow through the jar, from bottom to top, a point will be reached when the float will rise to the top of the tube; but this will not take place until the water outside is warmer than 4 degs. Cent., usually about 7 deg. or 8 deg., or a difference of 3 to 4 deg. is necessary to start it.

AT a recent meeting of the Chemical Society, Mr. R. Cowper read a paper "On the Action of Chlorine on Certain Metals." As previously noticed by Wanklyn, dry chlorine is quite unable to act upon metallic sodium. The author finds that chlorine which has been perfectly dried by long contact with fixed calcium chloride is without action on Dutch metal foil. On introducing a minute quantity of water, the ordinary reaction ensues immediately. Similarly zinc-foil and magnesium are not attacked. Silver and bismuth are tarnished very slowly. Tin-foil, arsenic, and antimony are attacked immediately. The author remarks that these three metals all form chlorides, which are liquid at ordinary temperatures. Chlorine, whether dry or moist, attacks mercury. If dried chlorine be passed over a piece of potassium, the latter catches fire. This is probably caused by the envelope of hydrate. Potassium was sealed up in a tube containing dry air. The tube was then heated until all the oxygen was absorbed, and a bright surface of potassium obtained. The tube was then filled with chlorine; the surface of the metal became slowly covered with a deep purple film, and the potassium finally ignited when heated considerably above its melting point.

THE following process for making a preparation of spongy tin is described by C. Puscher (*Kunst und Gewerbe*):—"Dissolve one part of tin salt in 400 parts of water acidified with hydrochloric acid. A rod of zinc is put in this solution, and the precipitated tin, most of which floats on the surface, is carefully collected on a sieve without pressing, washed with water, and dried by warming. The tin sponge thus obtained can be readily pulverised in a mortar with water, and floated on a hair sieve without acquiring a metallic lustre. After triturating well with starch paste, it is ready for use in making silver paper, or in printing textiles, or the tin sponge can be dried and ground to a fine gray powder, and employed for tinning all other metals, except lead. For this purpose the tin powder is rubbed up into a paste with a hot saturated solution of sal ammoniac, and the metal to be tinned is painted with it. This is repeated according to the amount of tin it is desired to deposit on it, after which it is heated over a spirit lamp or a Bunsen burner. The tinning is effected in about one minute; it is only necessary now to wash the article and polish it with chalk to give it a good polish. This process can also be used to mend spots that have been formed on tinned articles, or to make white drawings on other metals. If the spongy tin is mixed with 5 to 10 per cent. of reduced antimony and 5 per cent. of powdered sal ammoniac and a little water, the paste can be applied as before, and produces a still whiter and harder coating of Britannia metal. Reduced antimony is obtained as a black powder by dipping a rod of zinc into a solution containing equal parts of antimonic chloride and water, to which, however, enough hydrochloric acid is added to dissolve the white precipitate first formed. The black precipitated antimony is collected on a filter, well washed with water, and then dried. The spongy tin above described is sold in Germany, it is stated, at 5 marks per kilogramme, or about 2s. 4d. per lb."

MISCELLANEA.

THE new tramway from Adelaide to Marylands and East Adelaide has been opened.

AT Plymouth 70ft. of the new stone pier under the Hoe has been carried away.

A LARGE company has been formed at Berlin for erecting a sugar refinery, in which the sugar will be extracted from molasses by strontian.

THE death is announced of Professor Peter Merian, one of Switzerland's best known geologists and mineralogists, at the age of eighty-seven.

SIR JOHN HAWKSHAW and Messrs. Jones and Abernethy, MM.I.C.E., have been appointed judges of the New Zealand Napier Harbour designs.

A BUILDING Trades' Exhibition is to be held in the Agricultural Hall in April. Information respecting it can be obtained from Mr. P. Shrapnel, secretary, Walbrook House, Walbrook, London.

ARRANGEMENTS are being made in Sheffield for the visit of the Gas Institute in June. The Mayor will be asked to convene a public meeting to consider the matter. There are 801 members and associates.

THE Pilson Joel and General Electric Lighting Company, Limited, has withdrawn its application for a provisional order, deposited with the Board of Trade under the Electric Lighting Act, with regard to the City of London.

ANOTHER landslip of a serious nature has occurred on the grounds of the Whitby West Cliff Spa Saloon. The slip, or rather settlement, is at a point about half-way down the circuitous carriage drive. Many hundred tons of earth have moved, carrying with it a portion of the road and causing a great gap in the line of railing.

ON Tuesday a meeting was held at the Guildhall, Lydd, in order to bring under the notice of the Government the paramount claims of Dungeness for the construction of a national harbour of refuge. Petitions to the House of Lords and Commons were adopted praying for an exhaustive inquiry by practical men into the claims of Dungeness.

AT the request of the Austrian Minister of Commerce and of the managing committee of the Vienna Electric Exhibition, in August, September, and October next, the council of the Society of Electricians have appointed a committee for the purpose of receiving applications for space from intending British exhibitors, and for promoting generally the formation of a British section.

A PAMPHLET on the proposed Ship Canal between Rotherham and Goole, and containing facts and figures in favour of water carriage for the great import and export trade of South Yorkshire and North Derbyshire, by Mr. F. Rodgers, is published at Rotherham, by Messrs. Garnett and Whitehead. A map accompanies it showing the distribution of population of district.

THE Council of the Institute of Mechanical Engineers have accepted an invitation from M. Trasenster, President of the Association of Engineers from the University of Liége, to hold the summer meeting of the Institution this year in Belgium. The meeting will take place at Liége in the last week of July, beginning Monday 23rd, and will comprise a visit to Antwerp towards the end of the week.

THE following are the subjects of the lectures of the course to be given at the Royal Institution by Professor Robert S. Ball, the Royal Astronomer of Ireland, on "The Supreme Discoveries in Astronomy," "The Scale on which the Universe is Built," "The Sun no More than a Star, the Stars no Less than Suns," "The Law of Gravitation," and "The Astronomical Significance of Heat." The first lecture will be given on Tuesday, February 20th.

A LARGE number of schemes which have in view the construction of lines of tramways in various parts of the metropolis, as well as in other places in the kingdom, have been adjourned by the Examiners of Petitions for Private Bills to February 19th. This has been done in order to enable the promoters of the measures to obtain, if possible, the consent of the local authorities in whose district they propose to make their line, in accordance with Standing Order 22. Should this consent not be recorded, the Examiners will decide that the Standing Orders have not been complied with, and, unless that decision is upset by the Standing Orders Committee, the Bills will have to be dropped for the ensuing session.

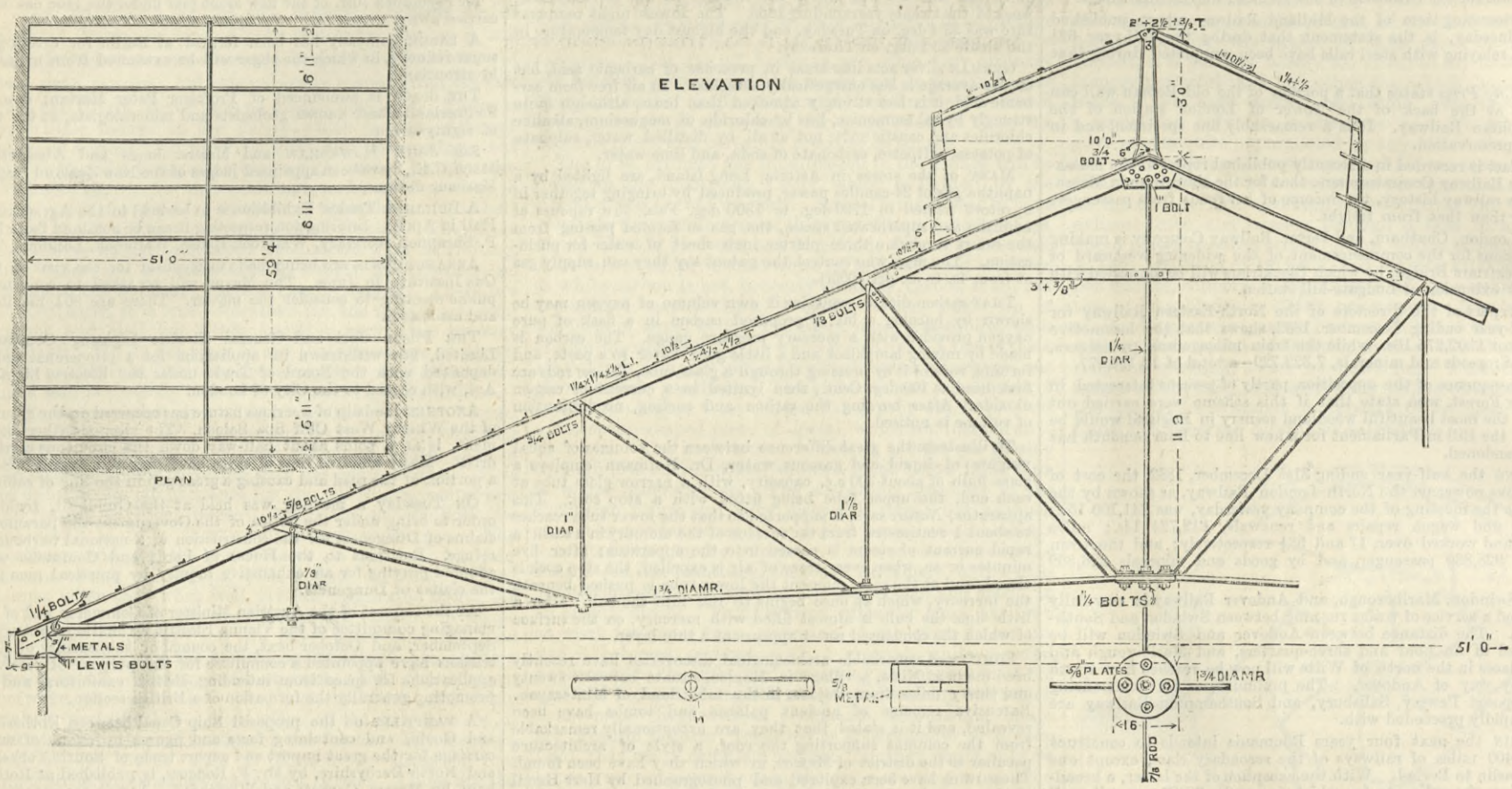
THE Council of the Huddersfield Technical School and Mechanics' Institute have decided to hold a fine art and industrial exhibition, in connection with the opening of the new technical school and mechanics' institute, in June next, and a large committee has been appointed for that purpose. The exhibition will contain, besides the fine art collections, combing, carding, spinning, weaving, and all descriptions of machinery used in the woollen and worsted trades, as well as a variety of machinery adapted to other textile manufactures. Models, mechanical designs, and metal work will also be exhibited in this department, as well as electrical apparatus and general machinery. Mr. A. Keen is the secretary.

A COMPANY has been formed to take over from Sir H. Hussey Vivian the extensive nickel and cobalt works at Swansea, and the German silver and brass rolling mills, tube and wire mills at Birmingham, and also the nickel plating works and warehouses at that place, with the businesses carried on at those places, together with the nickel mine and smelting works at Senjen, in Norway, worked in connection therewith. The business at Swansea was established by Sir H. Hussey Vivian upwards of twenty-seven years ago, and that at Birmingham was added in 1860, and has been from time to time extended. Mr. A. S. Merry, who has hitherto managed the Swansea Works, will continue to reside at Swansea, and as managing director there, give all his time to the business.

THE requisite buildings for the Calcutta International Exhibition are now being erected under the superintendence of Colonel the Hon. S. T. Trevor, Royal Engineers. The general and executive committees include the Governors of the Presidencies of India, and foreign Consuls, and the Princes and Rajahs of Bengal. His Excellency the Viceroy has recently sent a cable message to Earl Kimberley requesting that all due publicity may be given to the Exhibition. Invitations have been sent throughout India to all the Rajahs and Princes, inviting them to contribute to the Indian display, which is to be on a very grand scale. The machinery department is expected to attract much interest. The official agent for Great Britain is Mr. W. P. Dilworth, 4, Westminster-chambers, Westminster.

MESSRS. JOHN READHEAD AND CO., of South Shields, who recently opened out an extensive shipbuilding yard at West Docks, are now erecting large works for the construction of marine engines on an adjacent piece of ground. The buildings of the new works will consist of two bays, each about 200ft. long and 90ft. broad, and it is intended to make the height from the shop floor level to travelling crane rails, sufficient to admit of the engines being erected without the use of pits, so gaining considerable advantage as regards light, and facility in erection. The new shops will be in operation in a few months, and when they are completed, Messrs. Readhead and Co. will be able to construct and engine vessels in one establishment, and so save the delay of transport in bringing the machinery from their old works at the Lawe, South Shields. As an additional instance of the great activity prevailing in the great shipbuilding trade, we may mention that no less than three new yards are to be opened on the Tyne, while it is now reported that Messrs. Vaughan and Dymond are negotiating with the Ecclesiastical Commissioners for the occupation of a piece of land on the banks of the river Sound, three miles from Newcastle, it being their intention to commence iron shipbuilding, provided satisfactory arrangements can be made.

CONTRACTS OPEN.—GASWORK ROOFS, WALLASEY LOCAL BOARD.



CONTRACTS OPEN.

GASWORK ROOFS—WALLASEY LOCAL BOARD.

The Wallasey Local Board require tenders for a new roof at their gasworks at Great Float, near Birkenhead. The contract includes the manufacture, delivery, and erection complete of the wrought and cast ironwork of a retort house roof and purifier house roof, on the premises of the Wallasey Local Board, at Great Float, near Birkenhead, according to the drawings and specification, with all minor details which may not be shown in the drawings or described in the specification, but which are necessary to the proper execution and perfect completion of the works according to the true intent and meaning of the contract. The retort house will be completed by June 30th, 1883, and the roof must be erected complete within twenty-one days of the date which shall—about that time—be announced to the contractor as that on which he is to begin the erection, and in case the contractor shall fail so to complete the work, then he shall pay to the local board the sum of £5 for every day which the said work shall remain incomplete.

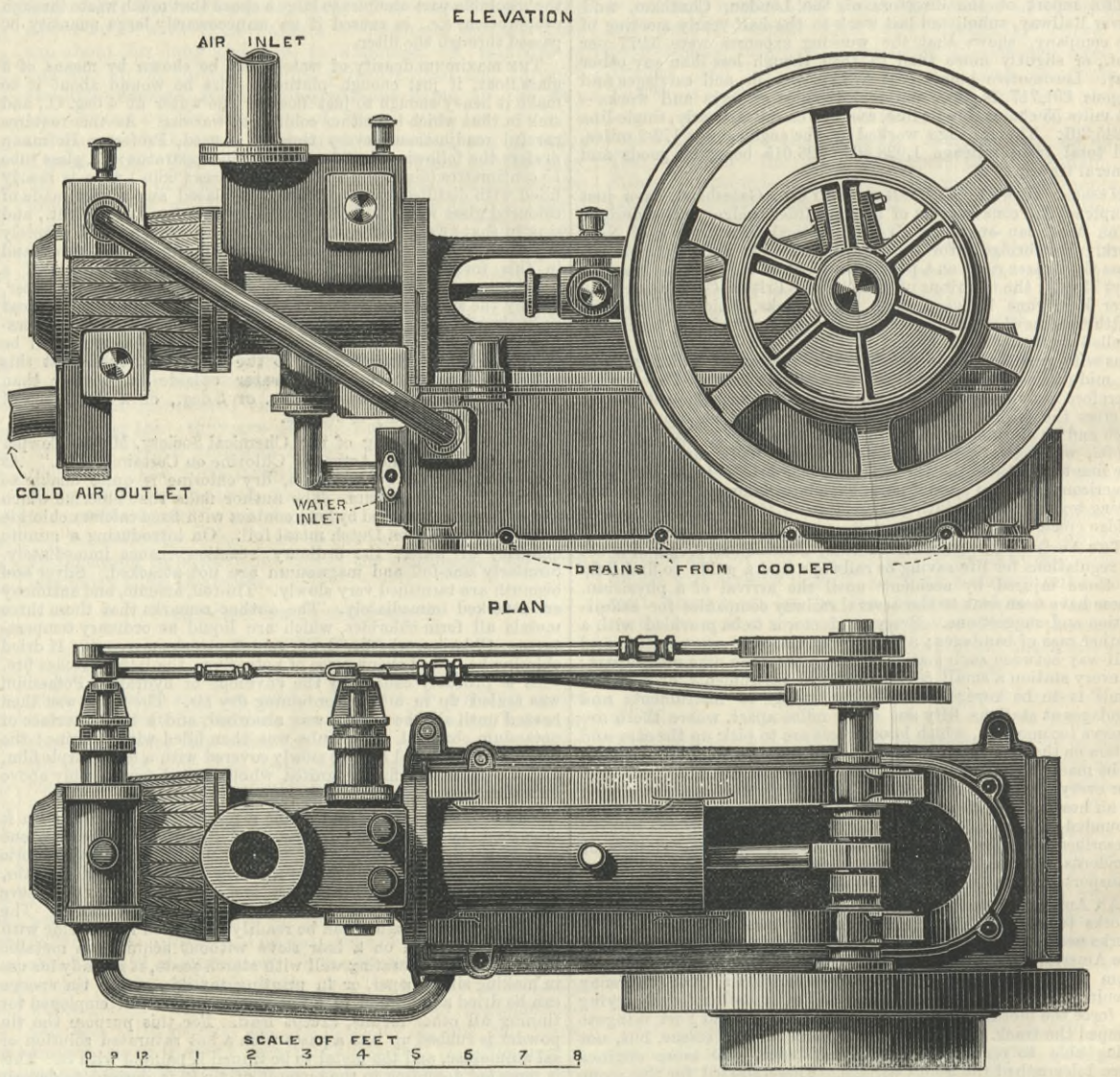
The principals of the roof will be nine in number, 51ft. span between the walls, the iron shoes being 21ft. from ground or floor line. The rafters will be formed of tee iron 4in. by 4½in. by ½in. The upper ends of rafters will be attached to two gusset plates, ½in. rivets as shown. The struts, tie bolts, &c., must be of dimensions shown on drawings. The ends of tie rods and where tie bolts pass through must be neatly and strongly forged to the sizes shown, and all screwed ends of tie rods, &c., must be swelled out so that the roots of screws may be of the same sectional area as the rods themselves. Top ends of struts must be neatly and truly cut, and they must butt against under side of rafters, and be fastened to rafters with bolts as shown, and a jaw formed of 3in. by ⅝in. flat iron, forged and rivetted to struts with ½in. rivets. Bottom ends must have table part of tee iron, neatly forged to form a strong eyelet for tie rods to pass through, and the web of the tee iron must be neatly and truly cut to butt against principal tie rods. Tie rods, ring post, struts, and wind ties must be connected together by circular plates ⅝in. thick, with bolts, back nuts, &c., as shown in drawing. Bars of 3in. by ⅝in. flat iron, bolted to rafters with ⅞in. bolts, and fastened to ring posts with a 3in. by ⅝in. flat iron clip, forged to clip ring posts, and fastened with two ⅝in. bolts to each principal. There will be a 7in. longitudinal tie rod the whole length of the roof, the ends to be screwed and carried through walls, and provided with cast iron wall plates 10in. diameter. The cast iron shoes of principals will be constructed as shown on drawings. The top surface to be of such an angle that when the full weight of roof is on them they shall be true and level on landing stones. The cast iron louvre standards to be of the design shown on drawing, and firmly bolted to principals by four ⅞in. bolts. The louvre rafters to fit truly to standards, and fastened to standards with ⅝in. bolts as shown. Ridge bar to be 2in. by 2½in. by ⅝in. T-iron fitting truly into standards, and fastened to lugs cast on for that purpose by two ⅝in. bolts to each standard. The laths for slating on main roof will be 1¼in. by 1¼in. by ¼in. angle iron, placed 10½in. apart from centre to centre; all joints in same to break joint. Ends of laths will lie on and be built into wall 4½in. The slating laths on louvre roof to be ¼in. by 1⅜in. flat iron. All laths, both for main and louvre roof, to be rivetted to rafters with ⅝in. rivets, but louvre laths must be punched and countersunk and rivetted flush on top side. The whole of the ironwork shall be equal in quality to the best Staffordshire, and every bar shall bear the brand of some approved maker, and shall be equal to a tensile strain of 25 tons to the square inch. The contractor shall give every facility to the engineer, or whosoever he or the local board may appoint, for inspecting the whole of the work during construction from beginning to end, and shall provide means to his satisfaction of testing any or every bar of iron. The whole of the ironwork shall have one coat of hot boiled linseed oil and one coat of good oxide before leaving the works, and two other coats after the work is fixed, but the top sides of rafters shall have the second coat before the laths are fixed. The retort house roof to be similar in design and construction to purifier house roof, but to have angle iron laths cut and let down flat on to rafters, and 1¼ by 1¼ by ¼ angle iron laths cut and let down to rafters of louvre roof, the louvre standards to have lugs cast on to receive three louvre boards, same as on existing roof. Span of roof between walls, 52ft.; height of shoes from floor line, 24ft.; No. 8 principals as shown on plan. Roof to be made to match retort house roof, of which it is an extension. Conditions and specification for purifier house roof to apply to retort house roof with above exceptions. Provide and fix wrought iron rolled joist 12ft. 6in. for springing arches from over liquor tanks, to be delivered within twenty-one days of signing contract. Lengths as shown on drawing. All castings to be cast from the best Staffordshire pig iron run from a cupola, and to be free from all flaws, cold shutes, sponges, air blows, or any other defects. The whole of the ironwork to have one good coat of boiled linseed oil, and one coat of good oxide of iron paint before leaving the manufactory, and two coats of good oxide of iron after erection. Finishing colours to be chosen by the engineer.

A NEW REFRIGERATOR.

Below we illustrate a new form of dry air refrigerator which has recently been designed by Mr. T. B. Lightfoot, M. Inst. C.E., to meet the wants of a large section of the community, such as butchers, fishmongers, and dairymen, who annually lose considerable sums of money from the rapid destruction of their perishable foods in warm weather. It has been long since proved that all kinds of fresh meats, game, fish, milk, butter, &c., can be kept in good condition for an almost indefinite period by exposing them to the action of dry cold air, and the system would doubtless ere this have received extended application had not the complication of the machinery and its excessive first cost been so great as to deter any but those persons employing skilled assistance from entering into it.

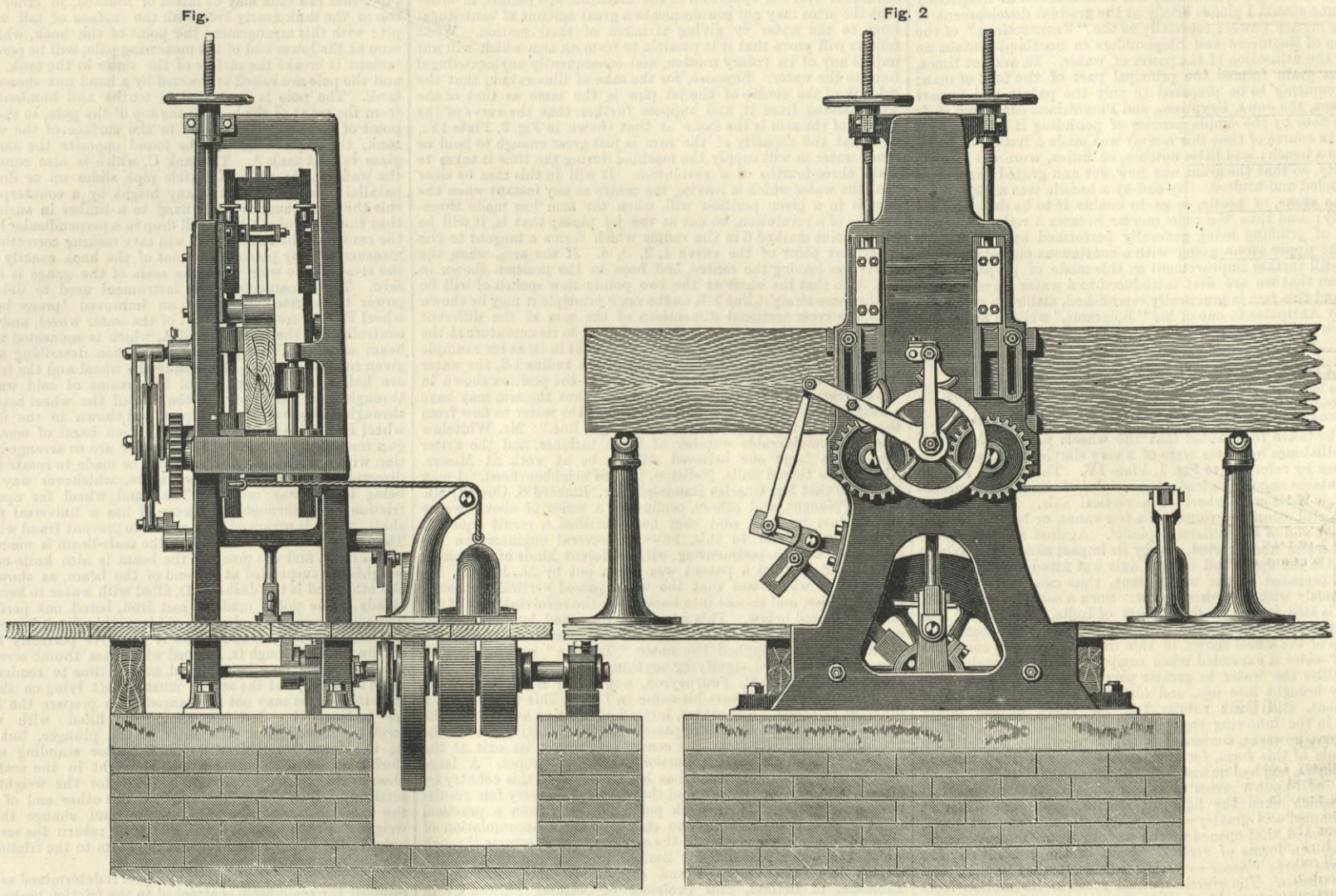
The refrigerator shown in the engraving is, as will readily be seen, not only free from complication, but is so designed as to lessen the cost of production in every possible way without reducing efficiency. It is also exceedingly compact, and in general construction is as follows:—The bed-plate, which is simply a rectangular cast iron box, forms also the cooler, being fitted with clusters of solid drawn Muntz metal tubes, suitably arranged for circulating the water so as to bring it in contact with the heated compressed air. To the bed is bolted the frame with which the motion bars and plummer blocks are cast, and which has at one end a turned flange for attaching the cylinders. The compressor and expander are bolted to each other, and have one piston-rod in common. All the valves and circular slides are worked by excentrics, so that they are absolutely noiseless and free from the breakages which sometimes happen in the case of the ordinary compressor clacks.

We recently had an opportunity of inspecting the working of one of these "Universal" air refrigerators at the factory of Messrs. Siebe, Gorman, and Co., Westminster Bridge-road, who are the sole makers, and were very much pleased with the result. At an average speed of about 300 revolutions per minute, a temperature of from 5 deg. to 10 deg. below zero Fah. was obtained with an air pressure of 30 lb. per square inch. The machine was perfectly steady and noiseless, with the exception of a slight puff of air at each stroke. The workmanship throughout is of a



SINGLE DEAL SAW FRAME.

MESSRS. S. WORSSAM, AND CO., LONDON, ENGINEERS.



very high-class description, and special attention has been given to providing proper adjustments for the wearing surfaces and ample means of lubrication, so that frequent stoppages are not required for oiling. We tested the tightness of the valves by allowing the engine to stand, and found that the pressure gauge fell very slowly indeed. The machine to which we refer was driven by a strap from the shafting of the fitting shop, but it is intended to make them with a steam or gas engine combined.

The space occupied by a "Universal," capable of giving 2200 cubic feet of cold air per hour is only 6ft. long by 3ft. wide and 3ft. high, which is considerably less than that required for any other air refrigerator, except those in which compactness has been secured by doing away with proper motion bars and taking the thrust of the connecting rod upon the piston itself. The machines can be made to give any usual reduction of temperature, and from the small amount of room taken up, and freedom from noise, would seem to be specially adapted for use on board passenger vessels for preserving the food to be used during the voyage.

MESSRS. WORSSAM AND CO.'S SINGLE DEAL FRAME.

THE above engraving represents a new machine made by Messrs. S. Worssam and Co. for cutting single deals, as often required by builders and others who do not want a large powerful deal frame. The deal runs over and is fed by the lower of two pairs of edge rollers, which are driven by gearing in connection with the silent frictional feed wheel and pawl shown in Fig. 2. The top rollers run on spindles, the shanks of which are carried in boxes provided with springs, so that the rollers may follow the inequalities of the deals. They are also adjustable by screws, as shown in the engravings, for deals of different widths.

EVAPORATION OF LIQUIDS.—WAHL'S IMPROVED VACUUM PAN.

THE evaporation and concentration of liquids is an operation of special importance in almost every one of the chemical industries. Solutions of sugar, glucose, glue, extracts of dye-woods, tanbark, meat, and other substances, wort, milk, and a great many other liquids have to be concentrated by evaporation, to either advance them in the course of manufacture or to bring them into a marketable condition. For all these purposes vacuum pans are now generally used, as they allow the evaporation to be carried on at a comparatively low temperature, and thus largely diminish the chance for liquids becoming coloured or undergoing changes in their chemical composition. But although these dangers are diminished, they are by no means entirely obviated, for even in vacuum pans of the best construction, solutions are coloured and decomposed to a more or less extent. Cane sugar is converted into molasses, glue into glycine, while all other substances are coloured in a more or less degree, owing to the long time during which the liquids are exposed to the temperature in the vacuum pan.

Mr. C. Wahl, of the firm of Wahl Bros., of Chicago, who in many ways have advanced the manufacture of glue, fat, and other animal products, conceived the idea that a pan might be constructed in which the liquid would have to remain the shortest possible time while being evaporated. The construction of the vacuum pan is illustrated by the *American Chemical Review* by the accompanying cuts and description. Figs. 1 and 2 show the result of his endeavours, which, our contemporary says, were crowned with perfect success.

Fig. 1 shows a view of the pan and a part of the inside arrangements; the pan is provided with the usual attachments, eyeglasses D, a condenser F, vacuum gauge, thermometer, &c., but the liquid to be evaporated, instead of being filled into the pan in one bulk, passes gradually through the spiral-shaped canal or gutter A, which is shown separately in Fig. 2. The space formed between this continuous channel and the bottom of the pan is used as a steam jacket, the heating capacity of which is increased by a coil of steam pipe, B, running along on the bottom of the channel; *d* and *c* represent the inlets, and *e* and *f* the outlets for the steam. The liquid to be concentrated runs in at *b*, and after being concentrated issues at *g* and runs into a vessel, G, located about 30ft. below the vacuum pan. Where the localities do not admit of this latter arrangement, the concentrated liquid must be pumped out, in which case vessels to be used alternately will be found convenient for the reception of

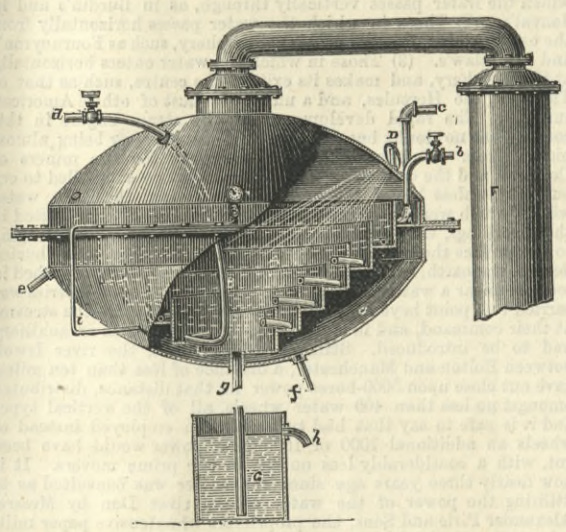


FIG. 1.

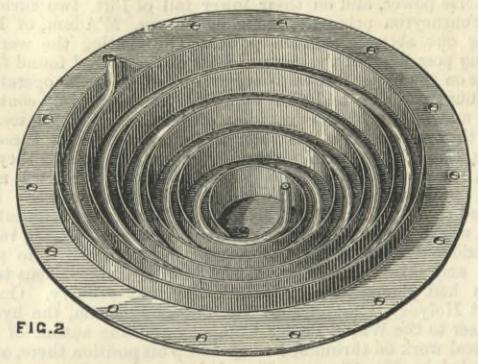


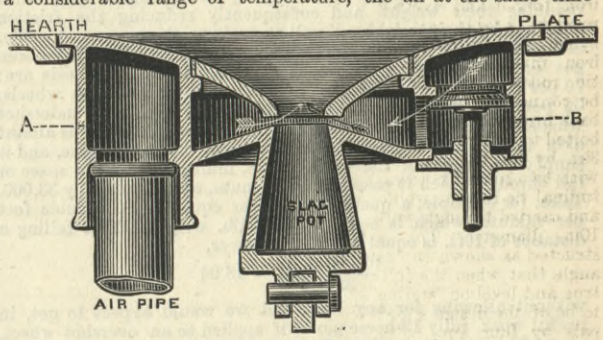
FIG. 2

the concentrated mass. It will be seen that the operation of this pan is continuous, and that its working can be regulated with the precision of clockwork by the admission of liquid through the faucet *b*. While in the old style pans large batches containing up to fifty barrels are treated at the same time, being exposed to the high temperature for hours and more, in Wahl's pan every drop, so to speak, is treated by itself, and leaves the pan after having attained the desired concentration, which is accomplished in a few minutes, owing to the effective application of heat, which has to penetrate a low column of liquid of ½in. to 2in. height at the utmost.

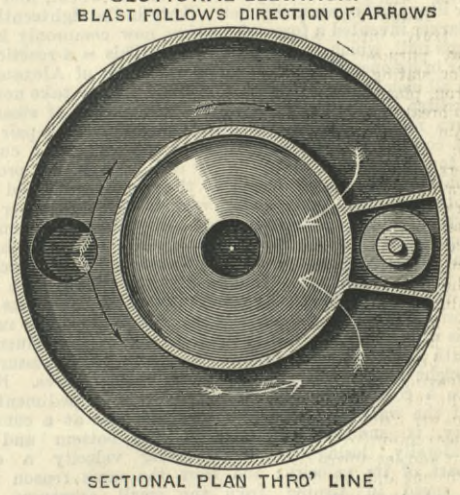
The high column of liquid in the old style pans also causes violent ebullition and overboiling, which cannot happen with the improved apparatus. At the glue works of Messrs. Wahl Bros., of Chicago, these pans have been in successful operation for some time past, and parties desiring any further information will receive prompt answer by addressing them. The use of this pan is not confined to the evaporation of liquids, but the principle involved may also be applied in the cooling of liquids, such as wort, &c. The drying of lard, oils, and other substances can also be effected in this apparatus in the shortest possible time and without discoloration and decomposition.

NEW FORGE TUYERE.

IT is claimed that the form of the tuyere we illustrate secures several advantages. As shown by this section and plan, the tuyere is circular in form, and is cast with an outer partition, by which the blast is caused to circulate round the tuyere before escaping to the fire. By contact with the plates made hot by the fire itself, the air becomes heated through a considerable range of temperature, the air at the same time



SECTIONAL ELEVATION.
BLAST FOLLOWS DIRECTION OF ARROWS



SECTIONAL PLAN THRO' LINE

keeping the plates cool. The heat that would be wasted in water tuyeres is thus utilised, and instead of having a cold blast a warm blast is used with beneficial results. An arrangement of slag valve is adopted, by which the slag is dropped downwards through the centre of the fire, so that the fire can be cleaned in the middle of a heat without disturbing it. The tuyere is made by Messrs. Everitt, Adams, and Co., 53, Queen Victoria-street, London, E.C., and a large number of them are in use in different parts of the kingdom.

NAVAL ENGINEER APPOINTMENTS.—The following appointment has been made at the Admiralty:—John Keast, engineer, to the Forester, vice Langham.

ON WATER WHEELS AND TURBINES.*

By Mr. John Turnbull, jun.

In bringing under your notice the comparative merits of water wheels and turbines, I trust it may not be considered as trespassing on your time should I glance briefly at the gradual development of water as a motive power; especially as the "Transactions" of the Institution of Engineers and Shipbuilders in Scotland contain no papers on the utilisation of the power of water. In ancient times, farinaceous grain formed the principal part of the food of man; and this requiring to be prepared to suit the palate and impart nourishment, the Jews, Egyptians, and Phœnicians converted their grain into flour by the simple process of pounding it by hand in a mortar. In course of time this mortar was made a fixture by being screwed to a bench; and little notches, or flutes, were cut into its inner cavity, so that the grain was now cut and grated instead of being pounded and bruised. By-and-by a handle was added to the top of the stone, or pestle, so as to enable it to be driven round more easily; and thus the rude mortar became a ruder mill—the operation of grinding being generally performed by two women keeping the upper stone going with a continuous circular motion. It is in a still further improvement on this mode of preparing the food of man that we are first introduced to a water wheel—about 70 B.C.—and this fact is practically established, although poetically treated, by Antipater in one of his "Epigrams," written about this period, in which he says:—

Cease your work, ye maids!
Ye who labour in the mill, sleep now,
And let the birds sing to the ruddy morning!
For Ceres has commanded the water nymphs to perform your task.
These, obedient to her call, throw themselves on the wheel,
Force round the axletree, and, by these means, the heavy mill.

It may be taken for granted that the wheels first employed for turning millstones by water were of a very simple construction, as may be seen by referring to Fig. 1, Plate IV. This wheel, strange to say, contains one of the leading principles of the modern turbine—namely, a horizontal wheel on a vertical axis. They were of small size, and consisted simply of a few vanes, or boards, secured to the lower end of the millstone spindle. Against these vanes the current of water was directed, and by its impact caused the axle to revolve. On the upper end of this axle was fitted a cross bar, let into slots prepared in the upper stone, thus causing it to move simultaneously with the wheel below. Such a contrivance as this, I believe, is still in use in many parts of India, and a model was shown at the first Exhibition in 1851. It will be readily seen, from the nature of the wheel shown in this drawing, that an enormous amount of water is expended when compared with the work done; and to utilise the water to greater purpose, vertical wheels were ultimately brought into use, and although they were a decided improvement, still their results fell far short of the power contained in the inflowing streams. The succeeding ages of millwrights were, however, contented with the results obtained from wheels made of this form, for in this state they remained through many centuries, and had no new light thrown on them until Smeaton began his well-known series of experiments at the end of last century, which shed the light of science upon the different values of impact and gravity—from which deductions were made, and data formed, that opened up the way for future improvements. The well-known forms of vertical wheels of the present day are divided into three classes—overshot wheels, breast wheels, and undershot wheels. The overshot wheel receives its motion from the preponderating weight of the water on one side; the breast wheel partly from the weight and partly from the impulse of the water; and the undershot wheel from the impulse of the water alone; and they have each a special adaptation convenient to certain circumstances in the situation of the stream, or the formation of the country where they are to be erected. In other words, the overshot wheel is best adapted for high falls, say from 30ft. to 60ft.; the breast wheel for more moderate falls, say from 10ft. to 30ft.; and the undershot where the fall is trifling, and the stream flowing with considerable velocity. These wheels were formerly made of wood in every part, including even the axletree. Few or no attempts were made to improve the form of the bucket until General Poncelet, after a series of experiments, introduced the form of curved bucket now called by his name. Since then an additional improvement has been added by Sir William Fairbairn, which has for its object the ventilation of the buckets. This improvement permits the air to escape from the buckets from behind, whilst the water is flowing in to fill them at the front. Other improvements have also been made, such as constructing them wholly of iron, and principally of wrought iron, thus reducing their weight, and consequently reducing the friction absorbed by their weight, as well as making them more durable, and giving higher results. The best performances that have been got on experimenting with each of these classes of wheels are: 70 per cent. of the total power in the water for overshot wheels, 52 per cent. for breast wheels, and 30 per cent. for undershot wheels. The formula for ascertaining the power of water is almost akin to that for ascertaining the power of a steam engine, and is simply the weight of the water in lbs. multiplied by the space or fall through which it passes in one minute, and divided by 33,000. Take, for example, a quantity of water equal to 1000 cubic feet per minute, which is equal to 62,500lb. weight. This falling a distance of 10ft. is equal to 19-horse power,

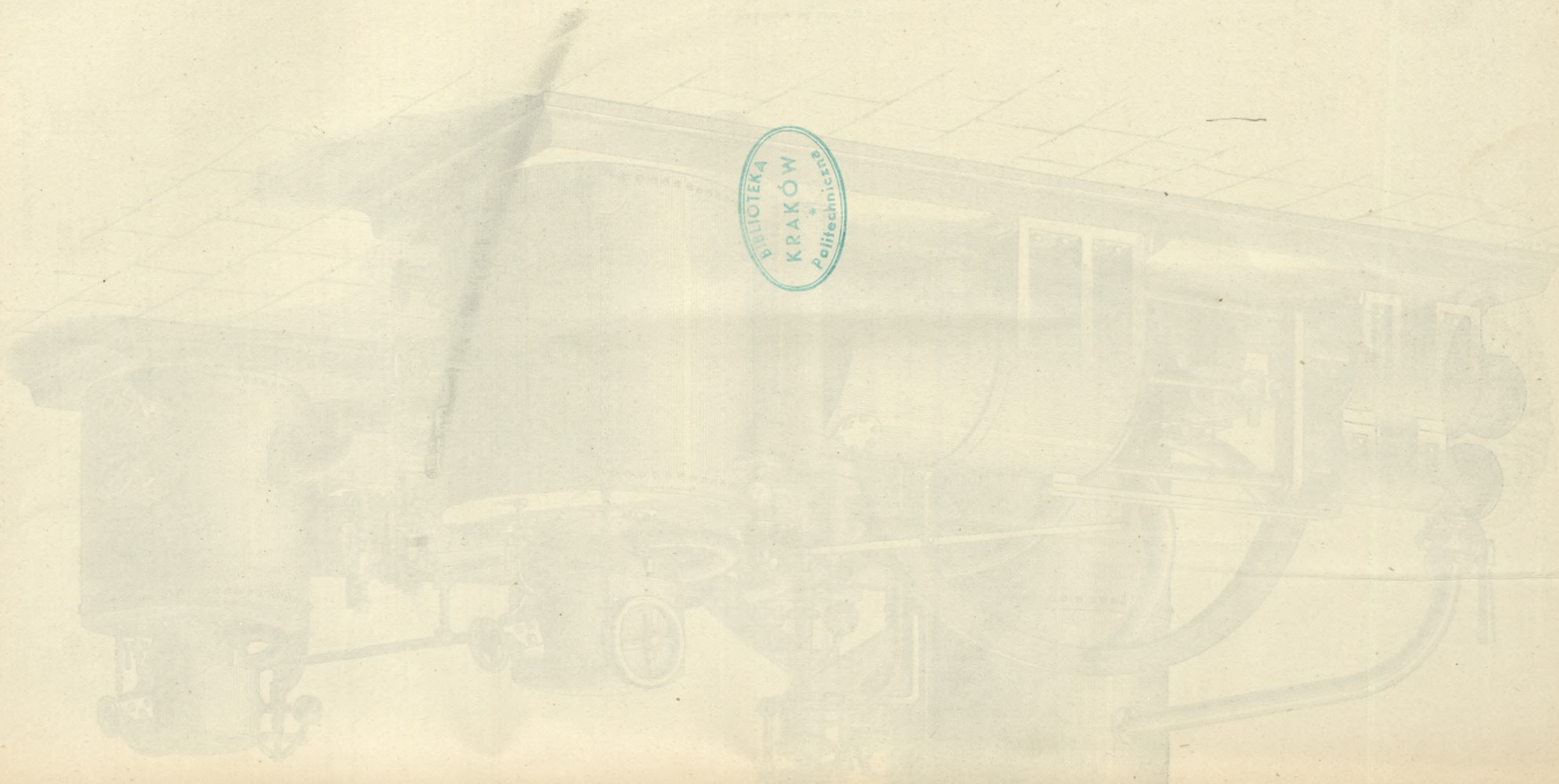
$$\frac{62{,}500 \times 10}{33{,}000} = 18{\cdot}94$$

without allowing for any loss; and we would expect to get, in useful work, fully 13-horse power if applied to an overshot wheel, about 9¾-horse power if applied to a breast wheel, and 5¾-horse power if applied to an undershot. Early in the eighteenth century Dr. Barker invented a form of turbine, now commonly known as Barker's mill, which is shown in Fig. 2. This is a reaction wheel, similar in its operation to the æolipile of Hero of Alexandria, and which all elementary works on the steam engine take notice of as the earliest illustration of the use of the power of steam. This Barker's mill—which is shown giving motion to a pair of millstone—consists of an upright pipe or tube, having a cup-shaped open top, but closed at the lower end, from which project two horizontal pipes or arms, closed at their outer ends and opposite each other, at right angles to the vertical tube—together forming an inverted cross. Near the end of each of these horizontal pipes is a round hole, the two holes being opposite to each other. The upright pipe is mounted on a millstone spindle which passes inside the pipe. The water flows into the pipe at the top, and issues from the holes already referred to at the opposite ends of the horizontal arms, which causes the machine to rotate rapidly on its axis with a velocity nearly equal to that of the effluent water, and with a force proportionate to the hydrostatic pressure due to the height of the fall and the area of the apertures. But there is here a considerable loss of power from impediment to the flow of the water, which, descending the tube at a considerable velocity, is suddenly arrested at the bottom and spread out laterally, losing by this angular velocity a considerable part of its velocity; and from the same reason it again loses speed in issuing from the small apertures at the ends of the horizontal arms; and, further, a considerable portion of the power is expended in giving the water a circular motion as its passes along the arms. It was to prevent in a great degree this waste of water that Mr. James Whitelaw invented his improved reaction wheel. Mr. Whitelaw's name must be familiar to many of you, as he was for some years foreman to Messrs. David Cook and Co., of this city, and was much respected for his gentle qualities and his abilities as an engineer. I have brought here a model of Mr. Whitelaw's reaction wheel, presented to the Mechanics' Institution of this city; and in order to make the nature of its operation clearer to you, I cannot do better than read Mr. Whitelaw's own description, taken from a work which he published in 1843:—"The new water mill acts upon a principle similar to that of the well-known Barker's mill, but the arms are bent and otherwise shaped so as to allow the water to run from the central opening out to the jet pipes, when the machine is in motion at its best speed, in as near to a straight line as some principles connected with the operation of the machine will permit, in order that the arms may not communicate a great amount of centrifugal force to the water by giving it much of their motion. What follows will prove that it is possible to form an arm which will not impart any of its rotary motion, and consequently any centrifugal force to the water. Suppose, for the sake of illustration, that the velocity of the centre of the jet pipe is the same as that of the water issuing from it, and suppose further that the curve of the middle of the arm is the same as that shown in Fig. 3, Plate IV., and that the capacity of the arm is just great enough to hold as much water as will supply the machine during the time it takes to make three-fourths of a revolution. It will in this case be clear that the water which is leaving the centre at any instant when the arm is in a given position will, when the arm has made three-fourths of a revolution, be out at the jet pipes; that is, it will be at the point marked 6 in the radius which forms a tangent to the innermost point of the curve 1, 2, 3, 4. If the arm, when the water was leaving the centre, had been in the position shown in Fig. 3, so that the water at the two points now spoken of will be in the same straight line 1-6, on the same principle it may be shown that the cross sectional dimensions of the arm at the different distances from the centre may be so adapted to its curvature at the corresponding points, that whenever any point in it, as for example that marked 3, arrives at the point 5 in the radius 1-6, the water which left the centre when the arm was in the position shown in the diagram will have passed out to 5, and thus the arm may have a form which, when it is in motion, allows the water to flow from the centre out to the jet pipe in a straight line." Mr. Whitelaw erected a considerable number of these turbines, and the writer has seen a large one believed still to be at work at Messrs. Alexander's thread mills, Neilston, in this neighbourhood. I may also state that Mr. Charles Randolph, Mr. Richard S. Cunliff, Mr. Wm. M'Naught, and others, conducted a series of about twenty experiments in 1843, and they have certified a result equal to 76 per cent. Prior to this, however, several engineers on the Continent were experimenting with different kinds of horizontal wheels, and in 1826 a patent was taken out by M. Burdin, the principle of which was that the water passed vertically through curved guides, and thence into buckets on the revolving part of the machine placed below. This wheel was improved by Jonval later on, and is generally known now by his name. It was M. Burdin who first applied the name "Turbine" to this class of motor—a Latin word, signifying anything that can be made to spin round like a top. M. Fourneyron, a pupil of Burdin's, erected the first wheel which bears his name in 1827. This wheel is on a different principle. The water, instead of entering and leaving the buckets in a vertical direction, passes into the revolving part of the machine horizontally from the centre and makes its exit at the periphery of the revolving portion, or wheel proper. A large number of this class of wheel has been erected in this country by Messrs. M'Adam, of Belfast, and they have given very fair results in many instances. Their weak point, however, from a practical point of view, is their liability to choke, from an accumulation of leaves or other other matter in the streams, the apertures through which the water passes being limited in area, and thus causing serious loss from stoppage and delays. In 1851 Mr. James Thomson, of Belfast, now Professor of Natural Philosophy in Glasgow University, and a distinguished member of this institution, patented a turbine on a new principle, wherein the water enters from the exterior and discharges vertically at the centre. This he calls a "vortex" wheel, and it is from turbines on this principle that the most satisfactory results have been got amongst the legion of turbines that have been patented in America. Poncelet in 1826 had suggested this principle, but never put it into practice, Mr. Thomson being, I believe, the first to do so, and we have it as the opinion of Sir William Fairbairn that perhaps no turbines are more efficient, or capable of more general application to every variety of fall than the vortex wheels on Professor Thomson's principle. From the foregoing remarks it will be seen that the various turbines may be divided into three classes:—(1) Those in which the water passes vertically through, as in Burdin's and in Jonval's. (2) Those in which the water passes horizontally from the centre and makes its exit at the periphery, such as Fourneyron's and Whitelaw's. (3) Those in which the water enters horizontally at the periphery, and makes its exit at the centre, such as that of Thomson, the Hercules, and a numerous host of other American turbines. The rapid development of the steam engine in this country has no doubt been the cause of water power being almost hidden from view for the last half century; for the miners of Cornwall and the colliers of Wales were long ago compelled to cry out that unless better means could be devised than the water wheels which were then in use, for removing the water collected in their workings, they would require to give up all hope of bringing to the surface the valuable minerals which they knew lay buried deep in the earth, and in the case of many industries established in localities near a water power, the expansion of those industries was carried to a point beyond the total available power in the streams at their command, and in consequence steam power as an auxiliary had to be introduced. Still, as late as 1846, the river Irwell between Bolton and Manchester, a distance of less than ten miles, gave out close upon 5000-horse power in that distance, distributed amongst no less than 400 water wheels, all of the vertical type; and it is safe to say that had turbines been employed instead of wheels an additional 1000 or 1500-horse power would have been got, with a considerably less outlay on the prime movers. It is now nearly three years ago since the writer was consulted as to utilising the power of the water of the river Don by Messrs. Alexander Pirie and Sons, the proprietors of extensive paper mills a few miles north of Aberdeen. They had already in operation on their upper fall of 10ft. a vertical water wheel giving out about 100-horse power, and on their lower fall of 13ft. two turbines on the Fourneyron principle, made by Messrs. M'Adam, of Belfast, giving out about 200-horse power. On visiting the works and getting possession of the general facts of the case, I found that the works on the upper fall were only required to be in operation for ten hours per day, and the works on the lower fall continually night and day, with the exception of Sundays. I also ascertained that they required no less than 1000-horse power at these lower works, and that the total power in the water to which they had a right, if conveyed to the lower falls at the upper level, namely, 23ft., possessed a gross power of 1250-horse power. Having learned that in the city of Holyoke, in Massachusetts, an establishment was in operation for the express purpose of testing turbines, I considered it my duty, before advising my clients, to proceed there and satisfy myself as to the merits of the various turbines which had gained some reputation in that country. On arriving at Holyoke, I found that Mr. James Emerson, the hydraulic engineer to the Water Power Company and the author of a very practical work on turbines, had given up his position there, and was succeeded by Mr. Clemens Herschel, by whom I was conducted over the testing works. Fig. 4 is an elevation of the testing flume; Fig. 5 represents the dynamometer or weighing instrument, thus described by Mr. Emerson in his treatise:—"Through an opening in the side of fore-bay, Fig. 4, may be seen a turbine wheel with its shaft extending upwards, on the upper end of which, above fore-bay, is secured the instrument or brake for weighing the power transmitted from the water discharged. To ascertain the useful effect it is necessary to know the head under which the wheel works, also the quantity of water discharged by it in a given time. The head is the difference in height between the surface level of water in pit and fore-bay when the wheel is running, at which time there is generally too much disturbance in the water to allow of accuracy by direct measurement, thus necessitating the use of the tanks A and B; the tank A is connected with water in fore-bay by a short piece of ¾in. steam or gas pipe, through which the water flows too slowly to cause ebullition, but fast enough to keep the surface in tank equal in height with that in fore-bay; from the bottom of the tank a rubber pipe extends to the bottom of glass tube, placed beside the measuring pole at the right. The tank B is connected with the water in pit by a rubber or flexible pipe, that the tank may be raised or lowered, in order to keep the top of the tank nearly even with the surface of tail water in the pit; with this arrangement the point of the hook, which may be seen at the lower end of the measuring pole, will be perceptible the instant it breaks the surface of the water in the tank. This hook and the pole are raised or lowered by a hand nut shown above the tank. The pole is graduated in tenths and hundredths of feet from the point of the hook to the top of the pole, so that after the point of the hook is adjusted to the surface of the water in the tank, the exact head may be found opposite the surface in the glass tube at tank A. The tank C, which is also connected with the water in the pit by a flexible pipe, slides up or down on two parallel rods, and is kept at any height by a counterpoise; above this the hook gauge is firmly fixed to a timber in such a position that the point of the hook will drop in a perpendicular line through the centre of the tank, and it will save making corrections for each measurement by placing the point of the hook exactly level with the crest of the weir when the scale of the gauge is standing at zero. The dynamometer, or instrument used to determine the power transmitted, is simply an improved 'prony brake.' The wheel B is secured to the shaft of the water wheel, and its speed is controlled by the friction band A, which is connected to the scale-beam as shown, the point of connection describing a circle of a given number of feet. The rim of the wheel and the friction band are hollow, and are kept cool by streams of cold water passing through them; the water in the rim of the wheel being supplied through its hollow arms by a pipe, not shown in the figure. The wheel B is made of cast iron, the friction band of composition or gun metal. The hands of the counter are so arranged in connection with a worm gear that they can be made to rotate in the same direction the hands of a clock move, whichever way the wheel being tested may revolve. The hand wheel for operating the friction band through the screw M has a universal point in its shaft, which is arranged with a slide to prevent fraud while testing. The connection of the band with the scale-beam is made by knife-edged links, and the pivot of the beam is also knife-edged. The weights are suspended at one end of the beam, as shown at C; at the other end is the dash-pot D, filled with water to keep the beam steady. The pot is made of cast iron, bored out perfectly true. The plunger on one end of the rod is a thin disc of iron turned to fit the pot loosely, so as to allow it to move perfectly free; it has six ⅜in. holes through it, stopped with brass thumb screws; one or more of these may be removed at any time to render the beam more sensitive, but the screws must be left lying on the plunger, that the weight may not be changed. To prepare the instrument for testing, the dash-pot should be filled with water, the screws removed from the holes in the plunger, but left upon it, the beam levelled with the indicator standing at zero, as shown at E; then place a small weight in the scale-pan and observe the number of seconds required for the weighted end to settle ½in.; then change the weight to the other end of the beam, the same distance from the fulcrum, and change the balance-weight until the beam is balanced; then return the screws to the holes in the plunger, and connect the beam to the friction band by the links for that purpose."

"The power transmitted by any wheel is determined as follows:—Suppose the scale-beam is attached to the friction brake at a point, which, if revolving, would describe a circle of 20ft., and the wheel running 100 revolutions per minute holds the beam at zero when loaded with 500lb. 20 multiplied by 100 gives 2000, which multiplied by 500 is equal to 100,000. This divided by 33,000 gives 30·30-horse power. To ascertain the useful effect of the wheel, divide the transmitted power by the power of the water used."

Without entering into the minutiæ of the many wheels there tested, I have prepared a diagram (Fig. 6), showing the results obtained from a few of the principal turbines, with the variations in their power under various quantities of water. First I may mention what is known as the Houston wheel, in which the water enters through the shoots or gates at an angle of about 45 deg. This wheel, while giving out about 88 per cent. with full gate, came down to 55 per cent. at ¾ gate, and only yielded 25 per cent. with the gate half open, or in other words, with half the maximum quantity of water passing through it. The next, known as Hunt's double-action wheel, and which has a downward and outward discharge, gave results very similar to the Houston, that is, a high full-gate result but an exceedingly low half-gate result. Another, known in America as the Boyden, but in reality the Fourneyron, also gave similarly low results at hafl-gate; and one result of Mr. Emerson's tests has been to determine the fact that whilst all wheels on the principle of outward discharge may be made to give a high effect at whole gate, at part gate their useful work is reduced in a rapid ratio. The next, the Victor, a wheel of very simple construction and of considerable reputation, gave 84 per cent. as its highest efficiency at full-gate, running down pretty regularly to 40 per cent. at half-gate. Another wheel of some repute, namely, the Risdon, which returned 40 per cent. of the power at half-gate, rose as high as 91 per cent. when being supplied with its maximum quantity of water at full gate. The Swain turbine, which also comes under the definition of a double-action turbine, has a greater number of buckets in the same space than most others, gives a half-gate efficiency of 50 per cent., and at full-gate 82 per cent. The next is the American turbine, manufactured by Messrs. Stout, Mills, and Temple, of Dayton. It has been used to some extent in this country, and gives out a half-gate efficiency of about 54 per cent., which increases to 74 at ¾ gate, and 76 per cent. at ⅞ gate, but falls down again to 72 per cent. at full gate. The Leffel double-action wheel, which is probably better known in this country than any of the other American turbines, gave a half-gate efficiency of 59 per cent., ¾ gate 65 per cent., ⅞ gate 68 per cent., and full-gate 73 per cent. I now come to the performances of the Hercules turbine, which you will see from the diagram gave out no less than 72 per cent. at half-gate, 85 per cent. at ¾ gate, 88 per cent. at ⅞ gate, and about 82 per cent. at full-gate; and if you compare the power curves of the American turbine with those of the Hercules you will see that they correspond very nearly to each other, accompanying the variations of water, with this difference that the Hercules turbine all through gives out 10 per cent. more efficiency than the American. Having thus discovered that a turbine of which I had no previous knowledge was so efficient under circumstances which are patent to all the streams of this country, namely, variations in the quantity of water in the dry season, I set about making inquiries where they were at work, and so satisfied myself of the justness of their performances that this was the wheel which I decided to recommend to my clients. Another peculiarity possessed by the Hercules is its large capacity when compared with its diameter, being nearly approached only by the Victor; that is to say, taking the capacity of the Hercules as 1, the Victor is ·96, the Swain ·71, the Leffel ·68, the Houston ·67, the Hunt, ·66, the Risdon, ·60, the American ·58, and the Boyden ·54. Or, in other words, a Hercules turbine 20in. in diameter is equal to a Victor 21in. diameter; Swain, 28½in. diameter; Leffel, 29½in. diameter; Houston, 30in. diameter; Hunt, 30½in. diameter; Risdon, 33½in. diameter; American, 34½in. diameter; Boyden, 37in. diameter. A great deal has been said about the merits of the double-action wheel when compared with the single-action turbine, the double turbines having two independent sets of buckets, one a vertical and the other a central discharge, each being entirely different in its principle of action upon the water, yet each series of buckets receiving the water from the same set of guides at the same time, half of the water passing to the one wheel and the other half to the other wheel, the water leaving both wheels at the same time, and as quickly as possible; but Mr. Emerson tells us that although there is not the slightest reason to doubt the ability of such devices to discharge an abundance of water, years of experience and demonstration by decisive

* Institution of Engineers and Shipbuilders in Scotland.

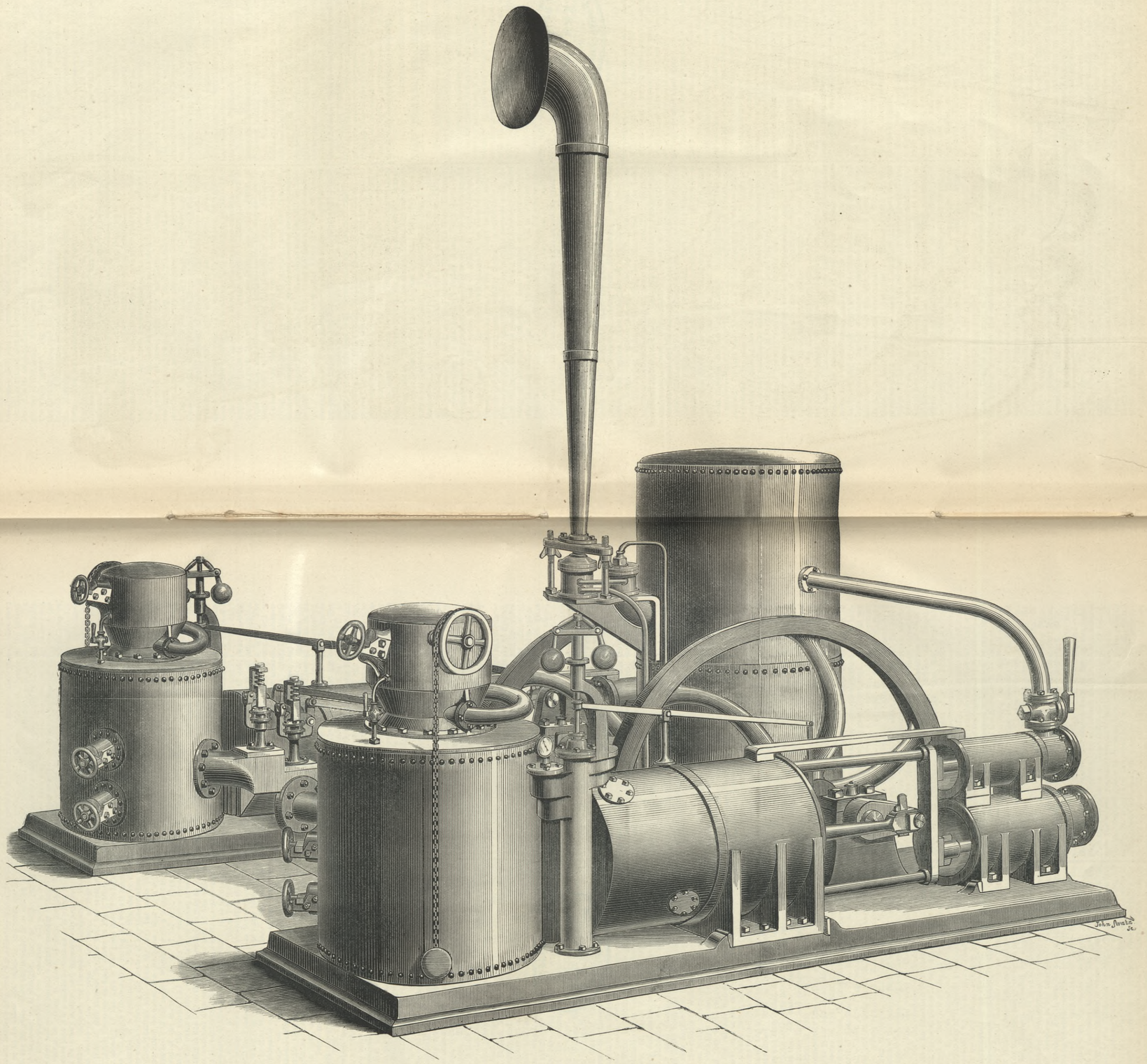


FOG-SIGNAL APPARATUS

FOR LIGHTSHIP AND COAST SIGNAL STATIONS.

CONSTRUCTED BY THE CALORIC ENGINE AND SIREN FOG-SIGNAL COMPANY, LIMITED, LONDON; MR. CHARLES INGREY, SUPERINTENDENT ENGINEER

(*For description see page* 129.)



tests proves beyond chance of dispute that all double arrangements are less effective than the simple single turbine. Different kinds have been tested, and invariably with the same result; the single wheel has proved best in every way, and the Leffel has been continued in its original form simply because all the claims hinge upon the use of the double wheel, and to give up that would invalidate the whole patent. Fig. 7, Plate V., shows the peculiar form of the Hercules wheel, and Fig. 8 is an elevation and plan of a single bucket. I have also brought here one bucket taken from a small 9in. Hercules turbine, which will give you a better idea of their form. You will observe that the upper portion of the bucket stands almost vertical, and contains two or three projecting shelves; the lower part inclined inward like the section of a hollow sphere. These projections are said to be important factors in the great efficiency given out by this wheel, by diminishing the waste of water. On my reporting the result of my inquiries in America to the Messrs. Pirie, before coming to a final decision one of their firm proceeded to the United States, and after making inquiries and seeing many tests he also came to the same conclusion that I had already laid before his firm, and on his return I was instructed to proceed at once with the installation of three Hercules turbines, having a total capacity for 30,000 cubic feet of water per minute, under a 22ft. head; my suggestion being approved of to bring the whole of the water past the upper mill—which, as I have already stated, only worked ten hours per day, and required a comparatively small amount of power—to drive the lower mill, which worked continuously night and day, and required somewhere about 1000-horse power. The water in the dry season decreases to about half the quantity, or to about 15,000 cubic feet per minute—equal, in round numbers, to about 500-horse power effective. The largest Hercules turbine yet made is 4ft. 6in. diameter—that is the moving part—the outer case, containing the guides, being, of course, extra; and this size of turbine, under the summer conditions, is itself able to pass the full quantity of water. Alongside of a turbine of this size I placed one 48in. diameter, capable of giving out 400-horse power at full capacity; and also one 42in. diameter, capable of giving out 300-horse power at its full capacity. By referring to Fig. 9, Plate VI., these three turbines will be seen *in situ*. As the power from these three turbines when at work had to be passed into the mill at a point below the level of the inflowing stream, it was necessary—as it is in all cases where turbines are erected under this condition—to enclose them in water-tight cases. These cases are also shown in the drawing. The sides are made of malleable iron, with bottom and top covers of cast iron; the covers fitted with stuffing boxes and glands in the usual way, to prevent the escape of water which is in the cases under pressure. The largest case is 11ft. 6in. diameter, by 10ft. 6in. high, having a 10ft. branch leading into it; the centre case, 10ft. 6in. diameter by 9ft. 6in. high, having a 9ft. branch leading into it; and the smallest case, 9ft. 3in. diameter by 9ft. 6in. high, having an 8ft. branch leading into it. The object of these cases and branches being made so large is to permit the water to pass into the respective wheels with comparatively little motion. The American turbine builders themselves lay it down as a rule that the velocity of the water approaching the turbine should at no place exceed from 2½ft. to 3ft. per second; and, as long back as 1848, Sir Wm. Thomson, in commenting on his brother's vortex wheel, lays down this principle:—"In any water wheel whatever, only a percentage of the work due to the entire fall can be obtained; but if the water be introduced into the wheel without shock, be allowed to pass through it in a continuous mass, with no violent rushing, and be discharged with a very small velocity through a sufficiently large channel or pipe, the adaptations being in other respects good, the loss will be as slight as possible." Owing to the Aberdeen turbines being of different diameters, their number of revolutions per minute also differ—the 54in. turbine making 102 revolutions per minute; the 48in., 112 revolutions; and the 42in., 128 revolutions. The principle regulating the number of revolutions of a turbine requires the velocity at the circumference to be as near as possible to the velocity which a body would acquire falling through a distance equal to half the fall. The three pairs of bevel wheels to transmit the powers from the turbines are machine-made by Messrs. P. R. Jackson and Co., of Salford, and are fitted to swells on their respective shafts, secured by two keys at right angles; those on the horizontal shaft are made to be easily taken out of gear, as the necessities arising from diminishing quantities of water may require. The small pair of bevels are 3½in. pitch by 10in. broad; the centre pair, 4in. pitch by 10in. broad; and those for the largest turbine, 4½in. pitch by 12in. broad. The total length of horizontal shafting is about 100ft., and 12in. diameter between turbines and mill. The mill is driven by two horizontal shafts on the same plane, about 33ft. apart, and each capable of transmitting about 500-horse power. One of these shafts is connected to the turbine shaft by a pair of machine-made spur wheels, 7ft. 9in. diameter by 4½in. pitch, and 14in. wide. One of the wheels has one tooth less than the other, and the velocity at the pitch line is close upon 2000ft. per minute, working iron on iron. The other mill shaft is driven by two belts, 24in. wide, from two pulleys set close together on the turbine shaft, the pulleys being 14ft. in diameter—thus driving the belt at a speed of about 3500ft. per minute. So that when there is a plentiful supply of water—which is generally the case for nine months in the year—the turbines are capable of driving the whole mill. But, supposing the water to fall, or any accident to occur which prevented the turbines working, there is a pair of inverted compound engines attached direct to each of the mill shafts; and, in the case of only half the quantity of water coming down in dry seasons, one of those engines would work the one line of mill shafting while the large turbine would drive the other, either through the spur wheels direct, or to the other shaft by belts, as already described. A simple arrangement of plates fitted between one pair of couplings on each of the mill shafts, and one pair on the turbine shaft, enables the various changes desired from water to steam, or *vice versa*, to be effected easily and with little delay. These turbines have now been at work, night and day, since the month of July, and have given no trouble whatever, except one little incident which occurred in connection with the 48in. one, which set down ⅜in. on its step one morning about three months ago. It all occurred in about an hour's time, and has gone no further since—my impression being that some sand had somehow got in between the bottom of the turbine shaft and the footstep, but which gradually got washed out. The footsteps, I may mention, are made advisedly of young live oak, as its being of a porous nature permits it to be at all times thoroughly saturated with moisture. They are convex where they receive the upright shafts, which are of a concave form to correspond, and steeled at foot. The footsteps have means, in case of wear, to take up no less than 4½in. I would also like to mention that, with the exception of the bevel and spur wheels, and the turbines themselves, the whole of the machinery in connection therewith was supplied and erected to my designs by Messrs. Douglas and Grant, of Kirkcaldy, to whom I must accord the highest credit for the careful manner in which they executed their part of the work. The aqueduct for conveying this large quantity of water was designed and carried out under the superintendence of Messrs. Jenkins and Marr, civil engineers, Aberdeen. The upper portion, consisting of about half the total distance, was the original channel for conveying the water to the upper mill. This was widened and deepened, and the bottom and sides faced with concrete. The continuation at the high level, composing the remaining portion of the whole, is built entirely of concrete, except at that point where it crosses the original inlet to the turbines formerly on the low fall, which is spanned by a wrought iron bridge. The section of the aqueduct throughout is 25ft. wide by 7ft. 6in. deep, through which the maximum quantity of 30,000 cubic feet per minute flows at a velocity equal to 2¾ft. per second. There is now no doubt but that the turbine has thoroughly proved itself to be a superior motor to any other form of water wheel; but, as I have already shown you, there are bad forms of turbines as well as bad water wheels. Still, the comparatively large size of water wheels, especially where a large power is wanted in a concentrated form, is a serious objection against them, as well as their great cost when made of iron. I may just mention an instance which is no doubt familiar to most of you. The large water wheel made for the Shaws Water Worsted Company's Mill, Greenock—now, I believe, a sugar refinery—is 72ft. in diameter by 12ft. wide. It was designed by Mr. James Smith, of Deanston, and has been admired by all for the beautiful symmetry of its proportions. It gives out about 200-horse power on a 65ft. fall; weighs no less than 115 tons; and cost, exclusive of buildings, about £3000. If any accident were to befall it, or if the proprietors saw fit to replace it by a turbine, a Hercules, 15in. in diameter, weighing 10 cwt. without the case, and costing about £50, would do the work with a less expenditure of water. All water wheels require to be housed, to avoid the danger of ice forming in the buckets in winter, and a multiplication of heavy gearing is generally necessary, to change the slow speed to a quick one; and in certain states of the river, when the tail water rises, they will not work at all, or if they do, it is at considerable risk of damage; whereas for simplicity, economy of water, great power, cheapness both in first cost, fixing, and housing, the turbine is far superior to the best constructed water wheel. There is a story told of Brindley, the engineer, that when giving evidence before a committee of the House of Commons on the subject of canals, he spoke in so decided terms of their superiority as a mode of communication, that the question was put to him, for what use he thought rivers were intended? "To feed canals," was his reply. Now, whilst the engineers of this age cannot agree with him in that opinion, we cannot shut our eyes to the fact that there is an immense amount of undeveloped power lying dormant in most of our rivers. I will only mention one case—that of the river Shannon, in Ireland, the fall of which between Killaloe and Limerick—a distance of fifteen miles—is 97ft.; and which, from the great quantity of water passing through it, is equal to fully 33,000-horse power. Now, it is a source of alarm to many, that year by year our coalfields are becoming exhausted in a rapidly increasing ratio; and this fact alone should cause us to direct our attention more than we are doing to the utilisation of the power of water; and if electricity is ever to be placed on a firm footing as a cheap means of giving light and power, it must be by the advantageous use of our streams and rivers. It has been my privilege to have assisted at the installation of the largest water power in Scotland, if not in Great Britain. Still it was with no small degree of pleasure that I visited the wonderful city of Holyoke, which is already ably laid out for utilising no less than 30,000-horse power from the Connecticut river, which winds gracefully round its shores; and, still more recently, the wonderful rush of the waters of the Rhone at Bellegarde, on the eastern frontier of France, which is also said to be equal to 30,000-horse power, and of which about 2000-horse power are already in operation day and night.

THE "FRANKFORT OBSERVER" ON THE LOSS OF THE CIMBRIA.

THE following is a free translation of an article in the *Frankfurter Beobachter*, on this lamentable collision:—

The terrible catastrophe, with its attendant sacrifice of hundreds of human lives, brings into prominence the natural question as to whether such events are unavoidable, and are freaks of fate? or whether by judicious construction, equipment, and navigation, even the danger of fog may be coped with? Deeply as we mourn with the friends of those who have been engulfed, and sympathise with the company which owned the ship in its heavy loss, we must look round at once to see how such calamities may in future be averted, and endeavour by studying modern inventions and improvements, to discover the "art of safety on the high seas." The only points aimed at by those who have endeavoured to improve the safety of ships during the last ten or fifteen years have been, first, to improve the so-called "water-tight" compartments so as to localise the position of the in-rushing water to such an extent, that when even several such compartments are under water the vessel, by the buoyancy of those uninjured, shall still remain afloat. Sometimes these conditions are very difficult to carry out, the doors of these water-tight compartments are not shut at the early stages of the accident, or cannot be closed in consequence of the guides in which they run having been bent by the force of the collision. The Cimbria had such "water-tight compartments;" of how much value they were the sequel has shown! Secondly, to improve boat lowering tackle and releasing gear, also with doubtful results, as we have seen in the case of the Cimbria, all of whose boats on one side were useless, as the ship heeled so much to the other side they could not be got to reach the water, and there was no time to shift them over.

The greatest defect at present is, perhaps, in the system of signal lights—the red and green, which in fog are only seen when they are close aboard; and even the steam-whistle, which in certain circumstances is easily heard, does not seem in itself to be a powerful antidote for collisions. And here comes in, naturally, the question: How is it that the electric light—which for domestic and town use has made such great strides—is not universally adopted for steamships' lights? We think the time is not distant when this light will be compulsory for steamships. Were this so, how many vessels, how much wealth, and lastly how many human beings, long since engulfed, would still have been safe? What safety do a pair of ordinary red and green side lights give in a thick fog? The value of the steam-whistle is equally problematic, when one remembers that in many cases the whistle of an approaching steamer is drowned in the ear-piercing roar of the whistle of one's own steamer; or the ear of the look-out is partially deafened, so that it does not understand the signal until too late. We wish here to bring forward one or two propositions of possible ways of avoiding such calamities which appear to us worthy of trial. It is well known that red and green lights have, in comparison with white light, very little power of penetration; therefore, at the forward end of a ship, white electric light with powerful reflectors should be placed, one on the foremast, one abreast of it on the starboard, and one on the port side. At the after end of the ship, three powerful red lights, grouped as already described, should be placed.

The two masthead lights should shine parallel with the centre line of the ship, and the side lights should also show on their respective sides and forward, as is at present the custom. If so arranged, one would know at once, on seeing three white lights, two white and one red, or, lastly, a white and a red, whether a ship was coming end on, passing in a parallel course, crossing at right angles, or whether likely to cross ahead or astern of the observer. Three red lights would show us that we are in the wake of a ship. Any change of course of the approaching or receding ship will show itself by change in the position of the lights, and the direct approach by three white, powerful lights; whilst under the present system we have a white masthead light, and a red and green side light to make out, of which two are of very questionable power.

The steam whistle—with three notes—should be so placed that it is not immediately near the navigating bridge, the officer on watch, pilot, or helmsman, as is now too often the case. It should be either high up on the funnel, or, perhaps better, at either end of the ship. When the bellowing tone of the steam fog-horn resounds close to the officer on the bridge his hearing is for some seconds afterwards blunted, so that he cannot hear the distant signal of the approaching steamer.

Lastly, in ships' boats and the means of lowering, it is desirable that great changes should be made. In great modern steamers there are often ten or twelve boats of various sizes, which in moments of peril are rushed for by everyone. In order to insure their working properly, and their timely release by even the simplest boat-lowering apparatus, it is necessary that the crew should be drilled at least a dozen times, as is the custom in the Cunard service, which is managed with Navy discipline, so that every man in the ship—passengers included—know to which boat he is to go, so there is no rushing from side to side, no confusion, and the boats are rapidly and safely in the water. We think that if, instead of such a number of little boats, each ship carried two large decked over steam launches, big enough to take between them every soul on board, and the more valuable section of the mails or specie, it would be far better. The engines of these boats should, during a heavy gale and during fog, always have steam up. For this purpose they could take steam from the main boilers, have their fires laid, and the water in the boiler at boiling heat. All necessary coal, provisions, water, &c., on board, they would then be ready for launching at once. These "steam sloops" must, of course, be provided with powerful hoisting gear in the form of a steam crane, by which they can be rapidly put on the water. The women and children could be placed on board them before lowering. In any case, the wretched system of little boats must be done away with, that the soul-stirring scene of the Cimbria may not be repeated; and these things concern everyone, for we who write these lines and you who read them may some day be in such a scene as that of the Cimbria.

There is also a question as to whether the present vertical stems have not much to answer for in wounding a ship below the water line instead of above as with the old sloping bows. In addition to, and besides these points of construction and equipment, there is the important one of discipline and drill, so that everyone on board, in case of need, shall know what to do, instead of as now getting in the way of the sailors and rendering difficult, if not impossible, the work of lowering the boats.

Further, in passenger ships, as indeed in all others, safety must be the first consideration, instead of, as now, a quick passage. Then the standpoint of the Mississippi steamer's captain, who when racing sat on the safety-valve lever will not be—as it too often now is—the principle which regulates the minds of those who send ships to sea. Then even the most unknown transatlantic emigrant will have more chance—by travelling somewhat slower and, therefore, safer—of reaching his haven on the shores of the New World than of passing the narrow gate of the other. The lesson to be learned from these calamities is to cease to think them inevitable, for when we once recognise that such things are preventible, technical skill can and will find out the way to prevent them. If this last sad foundering of the Cimbria will lead to this result she will not have been lost in vain.

THE WAR EXHIBITION AT KNIGHTSBRIDGE.—On Wednesday afternoon, H.R.H. the Duke of Cambridge, Lord Wolseley, and other distinguished personages, inaugurated the opening of this Exhibition at Humphrey's Hall, Knightsbridge, the object of which is to raise funds to be added to the Egyptian War Fund, which is for the benefit of invalided soldiers and the families of those who were killed or have since died from wounds or disease consequent on the Egyptian campaign. The building in which the exhibits are displayed is of iron, with wood and iron roof, the latter carried by wood principals, as designed by the late Captain Fowks. It is a large structure, occupying about 20,000 square feet of ground. The most interesting of the exhibits are the Nordenfeldt machine guns. These range from 3 to 10-barrel guns. The 4-barrel is similar to that mounted on the armour-clad train. There is also a 5-barrel Gardner gun, with the frame and standard entirely of gun-metal. This seems to be quite as light and handy as the Nordenfeldt. Two guns are of the Gatling type, made at Elswick Works. Near these are two 10in. spherical shells, one of which passed through the port side of H.M.S. Alexandria, above the armour, and rolled on the deck, when Gunner Harding lifted it, and dropped it into a tub of water—for which gallant conduct he received the Victoria Cross. The other shell also found its way into one of the ironclads, and finally settled on a table. Grouped around these shells are several other interesting relics of the war, which attracted considerable attention—such as Arabi's tent, from Tel-el-Kebir; the swords of Arabi and Toulba; Arabi's pistols, lent by Lord Wolseley. In the galleries we find some of the appliances used by the Army Medical Department and the Red Cross Society in Egypt. Side by side are ranged ambulance and medical store wagons, suitable for field work, as distinguished from permanent hospitals at the base of operations. Not the least interestiug of the articles hanging on the walls are the original drawings of the most stirring events of the campaign, by Paget, West, Taylor, and others. The most exciting are those which represent the death of Captain Wardell at Tel-el-Kebir; flight of Arabi after the fall of this place; cavalry dispersing the flying foe. During the afternoon Captain Evatt Acton recited Clement Scott's "Midnight Charge at Kassasin." Altogether the Exhibition is very interesting, and deserves the success it will, no doubt, command, when the object for which it has been organised is taken into consideration.

THE NEW UNION MAIL STEAMER MEXICAN.—The screw steamer Mexican, the largest, and, we believe, the most elegantly furnished vessel that has yet been completed by a Wear shipbuilder, made her trial trip at sea on the 6th inst. The Mexican was launched from Mr. Jas. Laing's yard at Deptford, Sunderland, last year, and is the latest addition to the Union Steamship Company's large fleet. She is intended to convey passengers and goods between Southampton and the Cape. The vessel left the Hendon Dock on Monday at noon, and shortly before ten o'clock on Tuesday morning a large company were taken off in the steam tug Rescue to the ship. The Mexican is 392ft. in length, 47ft. in breadth, and 33ft. 8in. in depth, her gross tonnage being 4669, with a displacement of 8000 tons. She has twenty-one bulkheads, an unusual number, seven extending to the upper deck. She is divided into thirty water-tight compartments, and has a double cellular bottom running her entire length, capable of carrying 570 tons of water ballast. Eleven boats, including six lifeboats, are on board, and by means of patent davits a boat can be got ready for lowering in any weather in a few seconds. The steam steering gear and winches are Bow and McLachlan's patent, the steam windlass and capstan by Harfield, compass and sounding machines the patents of Sir William Thomson. The full width of the steamer, 47ft., has been utilised. The fittings of the ship are very excellent in the saloon, which is 56ft. long. The Mexican will be commanded by Capt. Coxwell, and will have a crew of 120 all told, including four officers, surgeon, stewards, and six engineers. The engines have been constructed by Mr. G. Clark, at Southwick Engine Works. They are on the compound surface-condensing principle, of 600 nominal horse-power. The cylinders are 50in. and 94in., with a stroke of 54in.; the crank shafts and propellers are of steel, manufactured by Vickers, of Sheffield. The boilers are three in number, double-ended. They are constructed of steel, each being 12ft. 8in. wide, 16ft. 6in. high, and 17ft. 6in. long, and have Fox's patent corrugated furnaces—numbering eighteen—affording altogether a heating surface of 10,000 square feet; the working pressure is 90 lb. The engines are fitted with every appliance calculated to economise labour and fuel, including steam starting gear, Weir's patent feed-heater, Thomson's air extractor, and Buckley's patent pistons. The pumping power provided is very considerable, as in addition to the ordinary engine pumps, a 12in. Gwynne's "Invincible," and a large donkey engine are fitted, so that about 1000 tons of water per hour may be pumped out of the vessel. They are so arranged that even after the fires in the main boilers are extinguished they can be worked by means of a large boiler on deck. An excellent system of ventilation has been arranged, and the engine-room and stokehole are quite cool. Owing to the state of the weather no real trial of her speed was attempted, but even under the circumstances the engines worked up to 64 revolutions per minute, indicating about 3000-horse power, and the speed attained was 14¼ knots per hour. The result must be extremely satisfactory to both builders and owners, for while neither the maximum horse-power nor the speed were tried for, the contracted speed—14 knots per hour—was more than attained.

TURBINES, AND TURBINE TESTING APPARATUS.

(*For description see page* 124.)

FIG. 9

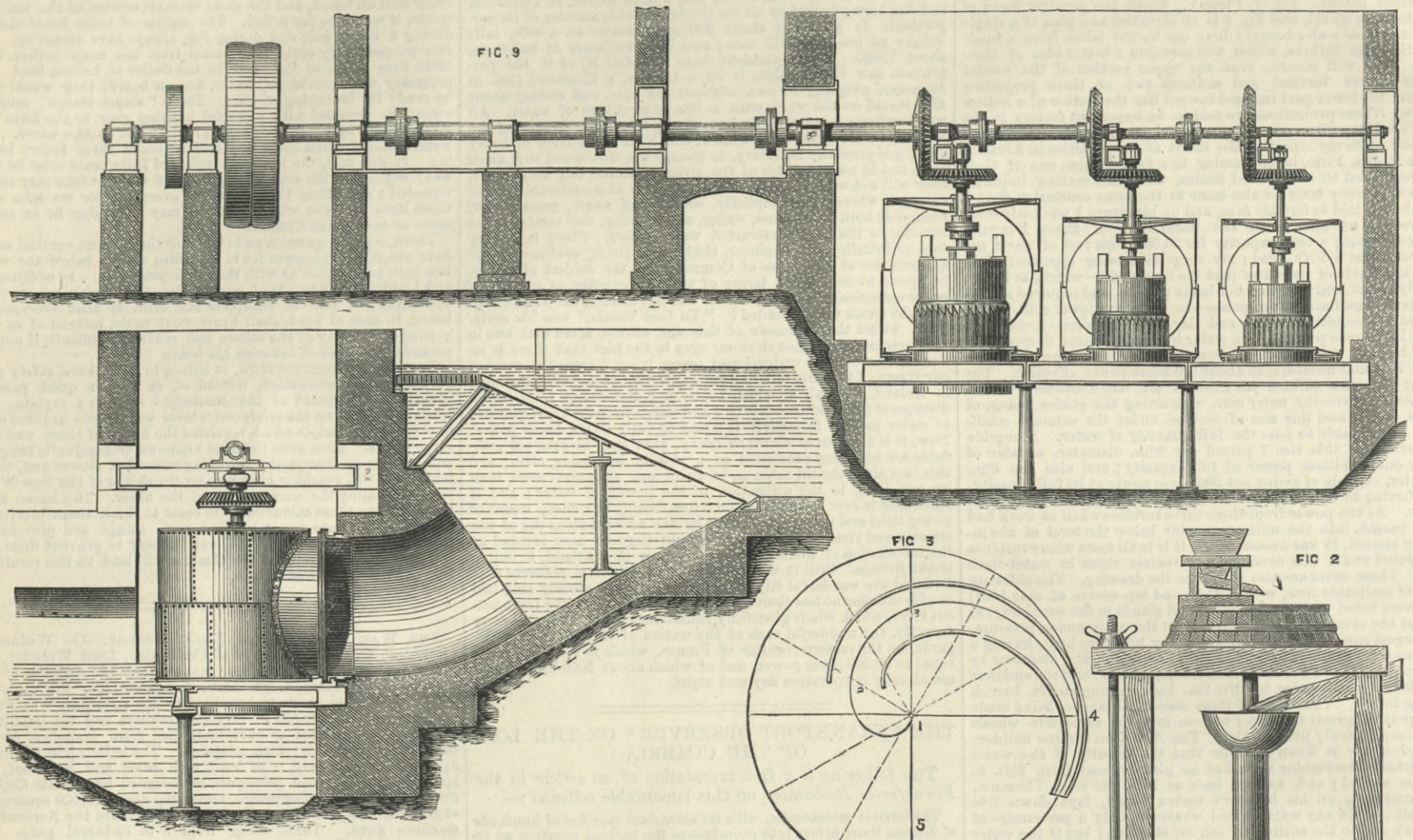


FIG. 3

FIG 2

FIG. 1

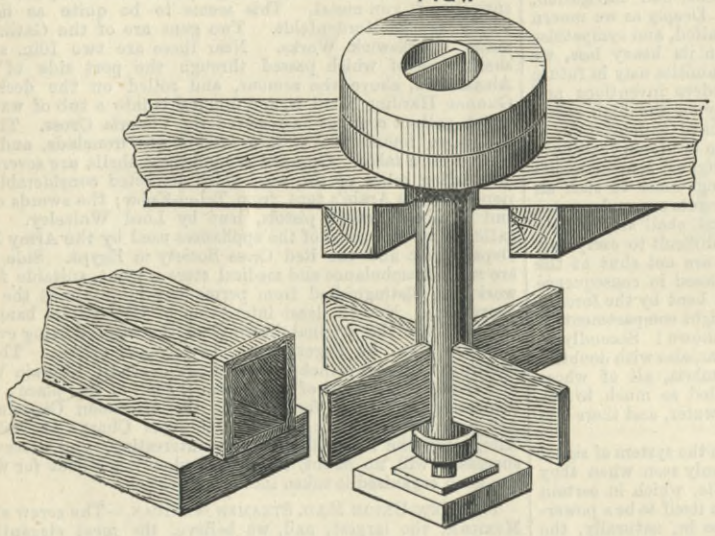


FIG. 4

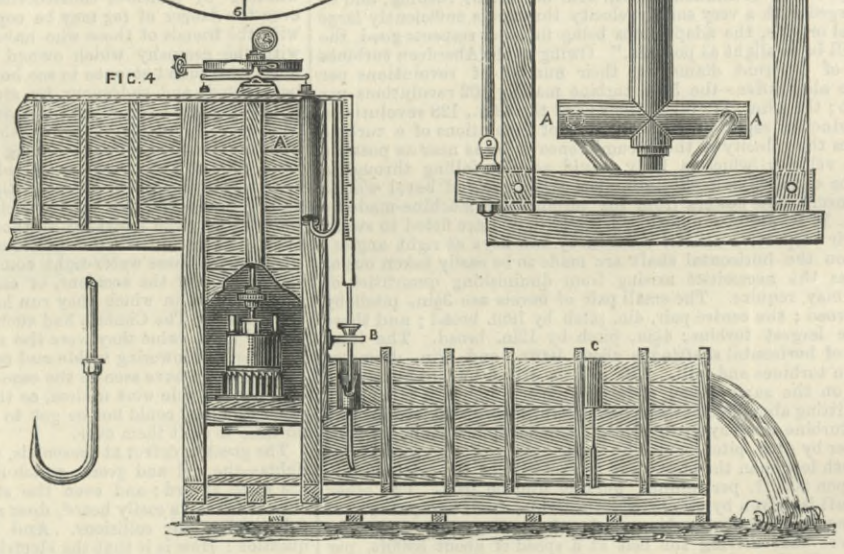


FIG. 5

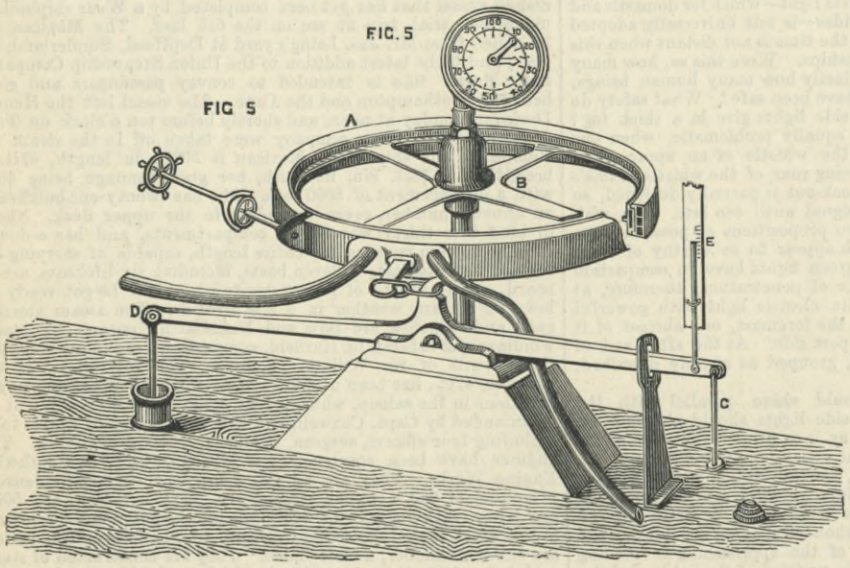


FIG 6

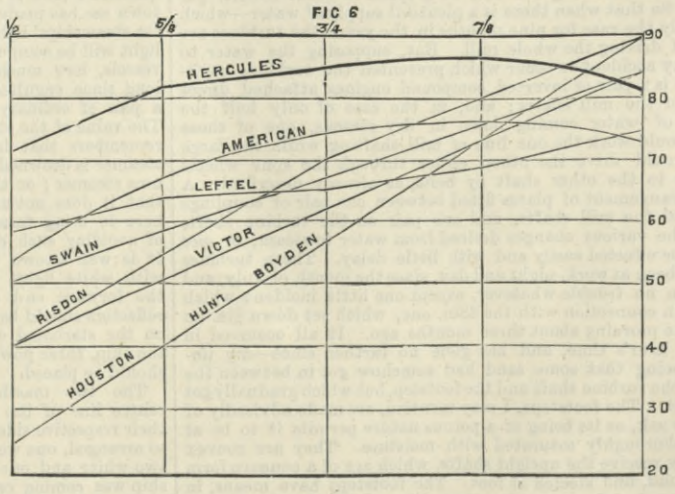


FIG. 8

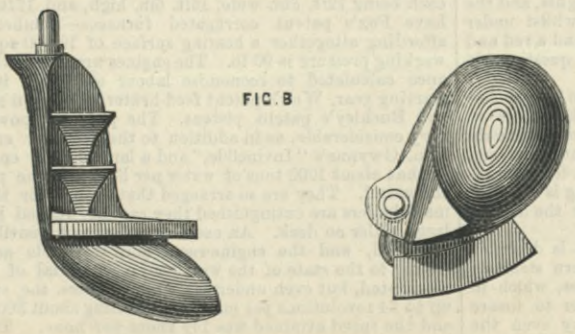
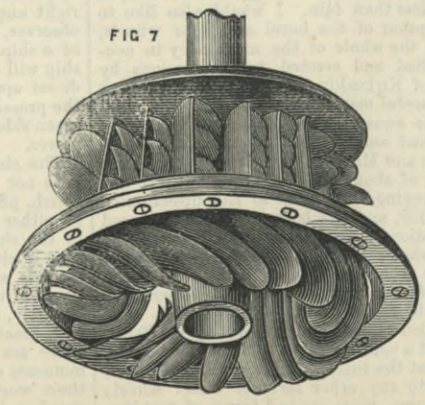


FIG 7



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TO CORRESPONDENTS.

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

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J. K. L.—£2000 *to* £2500.

F. G. (Paris).—*We shall be obliged for the drawing.*

PINE.—*You have not complied with the above conditions of correspondence.*

J. S.—(1) *We cannot say.* (2) *Apply to Messrs. Hansard,* 13, *Great Queen-street.*

C. C.—*The water will flow from the upper into the lower vessel as you suppose.*

E. L. B.—*Mr. E. F. Duckham, Millwall Dock, can give you the information you require.*

G. P. G.—*You can purchase specifications at the office for the sale of Patent Specifications, Cursitor-street, Chancery-lane.*

F. H. M.—*It is not easy to say with whom the first idea of a compound engine originated, but Hornblower and Woolf were the first to make one.*

J. Y. B.—*The Whitehall Club, Westminster, is an engineer's club, and the prospectus of another is advertised in our columns. What would you have more?*

J. G.—*You can obtain full information concerning Whitworth Scholarships on application to General Scott, Education Department, South Kensington Museum.*

H. D.—*Put a stop valve in each suction pipe, and you can draw from either or both tanks at pleasure by shutting the stop valve of the suction you do not wish to use.*

W. W. T.—*We regret that we can give you no further information than that published already in our pages. So far as we are aware there is no English agent for the indicators. You might apply, however, to Messrs. Elliott, West Strand.*

D. R. (Bradford).—*Your first question is quite unintelligible. What do you mean by "*100 *lb. to the inch?" Is it per square inch, or one hundred inch pounds? Your second question is equally unintelligible. Any modern elementary treatise on mechanics will give you information on the laws of motion.*

BUBBINHALL.—*If you decide that you have not gone "round" the squirrel unless you see his back, then of course you are right; but if your friends hold that it is not necessary to see his back to go "round" him, then they are right. The question is not whether you go round the squirrel or not, but what you and your opponents mean by going round, and your dispute never can be settled until you agree on a common definition of the words "going round."*

MOTEUR.—*Messrs. Easton and Anderson, Erith Ironworks, Kent, made the dynamometers formerly used by the Royal Agricultural Society, and they would no doubt supply you with an equally good one. It was rumoured some time since that as the Royal Agricultural Society would never carry out any more engine tests, the dynamometers of the Society would be sold. It might be worth your while to ask at the offices of the Society, Hanover-square, whether there are any dynamometers for sale.*

W. P. (Oldham).—*If the gentleman to whom you refer is making patented inventions for his own use without paying the patentees their royalties he is simply robbing the patentees, and if he is found out, he may discover that the consequences are so unpleasant that honesty would have been the best policy. If he has any doubts on the legal aspect of the question, we advise him to write to one of the patentees whom he is defrauding, and tell him what he is doing. He will very soon have the question settled.*

J. D.—(1) *Both raw and roasted ore are used.* (2) *We have no precise information concerning Greek and Norwegian ores, which are not used in this country to any extent Cumberland hematite ore is in a sense the best in the world.* (3) *The covers to which you refer are "Bells and Hoppers." The cover is put on to prevent the escape of gas from the top of the furnace into the open air. It is led off by a large pipe to the stoves, in which the air for the blast is heated in cast iron pipes or by hot bricks. The waste gas from the blast furnace is burned in these stoves. Almost all, but not all, blast furnaces are now fitted with hoppers and bells.*

THE ENGLISH SALT MANUFACTURE.

(To the Editor of The Engineer.)

SIR,—I shall be obliged to any reader of THE ENGINEER who will give me the name of any good recent book, paper, or pamphlet on the manufacture of salt in England.

A. W.

Bucharest, February 7th.

ENGINEERING IN AUSTRALIA.

(To the Editor of The Engineer.)

SIR,—I will be greatly obliged if any of your readers who have had personal experience can tell me the best part of Australia as a residence for a mechanical engineer who is recommended by his medical adviser a dry climate. Is he likely to obtain employment there, and what is the remuneration?

A WEAKLY ONE.

Bassingbourn, February 12th.

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

MEETINGS NEXT WEEK.

THE INSTITUTION OF CIVIL ENGINEERS.—Tuesday, Feb. 20th, at 8 p.m.: Paper to be discussed, "The Design and Construction of Repairing Slipways for Ships," by Mr. Thomas Bell Lightfoot, M. Inst. C.E., and Mr. John Thompson. Paper to be read, time permitting, "Covered Service Reservoirs" by Mr. William Morris, M. Inst. C.E., Deptford.

THE METEOROLOGICAL SOCIETY.—Wednesday, Feb. 21st, at 7 p.m.: The following papers will be read:—"Note on a Remarkable Land Fog Bank, 'The Larry,' that occurred at Teignmouth October 9th, 1882," by Mr. G. Wareing Ormerod, M.A., F.G.S., F.M.S. "Barometric Depressions between the Azores and the Continent of Europe," by Capt. J. de Brito Capello, Hon. Mem. M.S. "Weather Forecasts and Storm Warnings on the Coast of South Africa," by Capt. Campbell M. Hepworth, F.M.S. "Note on the Reduction of Barometric Readings to the Gravity of Latitude 45 deg., and its Effect on Secular Gradients," by Professor E. Douglas Archibald, M.A., F.M.S.

SOCIETY OF ARTS.—Monday, Feb. 19th, at 8 p.m.: Cantor Lectures, "Solid and Liquid Illuminating Agents," by Mr. Leopold Field, F.C.S., A.S.T.E. Lecture IV.—Secondary, or manufactured products. Chevreul's discoveries. Fatty acids; their formation by saponification, distillation, and pressure. Glycerine. Collateral benefits accruing from the palm oil trade. Wednesday, Feb. 21st, at 8 p.m.: Twelfth ordinary meeting, "Recent Improvements in Agricultural Machinery," by Mr. D. Pigeon. Sir Frederick Bramwell, F.R.S., will preside. Thursday, Feb. 22nd, at 8 p.m.: Applied Chemistry and Physics Section, "Some Causes of Fires and Methods for their Prevention," by Mr. Walter G. McMillan, F.C.S. Captain Eyre N. Shaw, C.B., Chief Officer, Metropolitan Fire Brigade, will preside.

THE ENGINEER.

FEBRUARY 16, 1883.

MR. BARNABY ON SHIPS OF WAR.

WE give elsewhere a paper read by Mr. Barnaby at the United Service Institution on the afternoon of last Friday, February 9th. The audience was naturally large, and comprised some of the best authorities on the subjects in hand. Mr. Barnaby was received with enthusiasm. His paper may be summarised as follows:—The power of a nation at sea depends mainly on four elements: (1) Its mercantile marine; (2) the *personnel* of its navy; (3) its war material; (4) its ships of war. Mr. Barnaby employed some admirable diagrams to illustrate his statistics. One of these showed the individual battle ships possessed by England, France, Germany, and Italy, with their tonnage and armour; wood being distinguished from iron, and the state of readiness of each ship being shown. England in this was, perhaps, at present better than France in the proportion of four to three, reckoning only completed ships; but in a little time the relations will be more nearly ten to nine or eight to seven, guessing roughly. Another diagram showed the relative proportions of all merchant ships; also of those having a speed of 14 knots, and sailing and steam vessels were distinguished apart; also those steam vessels which have come up to the standard laid down by the Admiralty, and have been registered accordingly. England and France alone possess any merchant vessels of this high class. England's merchant fleet would hardly appear much larger if all those of other nations were added to it, so completely disproportionate is it to all others.

The question to be considered is how to protect and utilise our vessels in the time of war. Mr. Barnaby appears to recommend that the swiftest and largest merchant ships should be modified so far as to incorporate them in our national defences; they could, he thinks, be secured against foundering suddenly, and might be made very formidable in certain running kinds of sea-fighting. Men-of-war, whose speed and handiness need not be very great, might do the heavy fighting. Mr. Barnaby looks forward to ships of 2000 tons displacement carrying two heavy guns of about twenty-five to thirty tons each, one gun firing ahead and the other astern; the vitals of the ship are to be protected as far as possible by being placed below water, and by the use of horizontal armour decks. The heavy battle ship may have 63-ton guns, probably firing shell of larger diameter than has latterly obtained. Mr. Barnaby expects that side armour will almost disappear, being confined to a thick steel-faced, or steel, wall protecting powerful guns, and that consequently the onslaught will consist chiefly in what has been termed the secondary attack made by common shell on unarmoured parts of the ships. He thinks that the guns should be powerful, and the method of working is a specially important element. In this matter he considers Elswick may be looked to to give English ships the first place in the world. He suggests five questions for discussion:—(1) Should England have monster men-of-war such as are ably advocated by the Italian authority Signor Brin? (2) Can we attack an enemy's ports in spite of torpedoes, and with what ships? (3) Shall we build very swift men-of-war to run down fast cruisers, and employ armed merchantmen? (4) What part will fast gun and torpedo ships play in future battles? (5) Ought we to carry monster guns like the 100-ton gun at once?

In the discussion which followed it was evident that Mr. Barnaby's paper had taken his audience by surprise in some respects. To begin with, the order of importance in which he ranked the elements of a nation's maritime power appeared to be opposed—we might almost say resented—by naval officers. Admiral Boys, Admiral Ryder, and Admiral Colomb, and others spoke. The general sense of these officers' opinions appeared to be that the primary element of strength would be the number of war ships ready to act at the opening of the war, when blows might be struck which might shape the entire course of the naval operations; that the merchant ships were, as depicted on the diagrams, not a source of strength, but of weakness; that the great mass of slow steam vessels and sailing vessels, whose existence was so graphically depicted on the diagrams, formed a helpless prey for the enemy's fleet; while, on the other hand, it was clearly shown that there was no corresponding prey in the shape of an enemy's merchant fleet for our own vessels to attack. Consequently, in spite of our apparent great superiority, we should be acting on the defensive and have a difficult task, for England depends on a supply of food brought in a great measure by slow trading vessels. The question, indeed, might be raised whether matters would be helped by turning our largest merchant ships, and those that by their high speed are most likely to elude pursuit, into armed cruisers. Yet, as Mr. Rendel pointed out, there are serious objections against making special swift men-of-war in large numbers, which would rapidly be superseded by still faster vessels. Admiral Ryder congratulated the Admiralty on having come to the opinion arrived at by himself, and advocated some years ago with regard to horizontal armoured ships, or what may be termed "protected" ships, in contradistinction to the "armour clad" vessels which carry side armour. On the question of determining the gun to be adopted for our most powerful men-of-war, it was suggested, and Mr. Barnaby agreed with the suggestion, that we need experiments against hard armour, to determine the relative powers of guns to rack or break up steel on a large scale. Our experiments have been too much confined to punching holes in wrought iron. Now a class of armour is fast coming in which cannot be pierced, but which can only be destroyed by fracture, and with this armour, new type small-bore guns lose much of their power. Our own chilled shot are designed for soft armour, and are declared by our own authorities to be useless against steel; while the fact that the best and thickest compound English armour has been destroyed by foreign chilled shot, shows us that we are suffering indeed from want of experience in dealing with hard armour. Probably hard armour experiments would lead to the adoption of heavier guns than are at present advocated.

What can we conclude from this rather patchwork treatment of the very important questions raised by Mr. Barnaby's paper? Probably we must all admit that England, depending as she does on supplies of food brought to her shores by her enormous merchant fleet, must stand in very serious peril of being starved in general trade, if not in food, unless very efficient means of protection are found. The starving of Paris in the Franco-German war illustrates how successfully an operation of this kind may be carried out on a vast scale, although in the case of England it would doubtless be of a slower and less complete character. The length of the discussion prevented Mr. Barnaby, perhaps, from explaining how the difficulty would be met. Let us consider it. France is at present the only power whose fleet could seriously menace our supplies of food. Other fleets might damage us much, however. The Italia, for example, seems framed to be a scourge to trading vessels, and is a host in herself; but no fleet appears competent to ruin us, unless it be that of France. We might keep the mouth of the Mediterranean or the Baltic, and in the case of Italy, Russia, or Germany we should shut up the hostile fleets—but what about France? Probably it is considered that we might so far ascertain the locality of her fleets that our own men-of-war might wait on hers; nevertheless, to have sufficient force for this argues a very decided superiority. Supposing that we have it now, Mr. Barnaby's diagrams remind us that so many powerful ironclads are building in France that in a few years the inequality between our fleets will be very small. Is it supposed that by that time we shall have a strong contingent of swift merchantmen available? We can hardly say, but if so, will they really answer the required purpose? It appears as if hunting the enemy's ships home and accounting for them would be the only means of safety. For this, vessels of real power are needed, not such as may keep up a running fight, and so hold their own, but ships that can close with their enemy and master her or drive her into port. The whole question is a serious one, because, although we hope that the probability of its actually arising is not great at present, the elements on which success would depend would be statistics which would be well known, and the condition such as could not be altered by the greatest efforts in a short time. Ships take longer to build than armies to train.

THE MANCHESTER SHIP CANAL SCHEME.

THIS project has received a rather serious check in the initial stage of its existence; but there is every hope on the part of the promoters that they will be able to forward the undertaking to a successful issue. It has been decided by Mr. Frere, the Examiner for Standing Orders, that the plans and description have not been sufficiently full to enable him to pronounce that the Standing Orders have been duly complied with. The bill was opposed by the Upper Mersey Navigation Commissioners, and the Bridgewater Canal Company, also by the Mersey Docks and Harbour Board, and the London and North-Western Railway Company. The chief ground of objection was found in Clause 26 of the Standing Orders of the House of Commons, which provides that "in cases where the work is to be situate on tidal lands within the ordinary spring tides, a copy of the plans and sections, shall, on or before the 30th day of November immediately preceding the applicatiou for the Bill, be deposited at the office of the Harbour Department, Board of Trade, marked 'Tidal Waters,' and on such copy all tidal waters shall be coloured blue; and if the plans include any bridge across tidal waters, the dimensions as regards span and headway of the nearest bridges, if any, across the same tidal waters, above and below the proposed new bridge, shall be marked thereon; and in all such cases, such plans and sections shall be accompanied by an ordnance or published map of the country over which the works are proposed to extend, or are to be carried, with their position and extent, or route accurately laid down thereon."

Evidence was called to prove in what particulars the plans were defective, but it was urged by the parliamentary agent for the promoters that it was quite impossible that any precise information could be submitted regarding the works proposed to be executed in the estuary. It will be remembered that in the descriptive account of the undertaking which we have already given, it was shown that the ship canal, in the literal sense of the term, is intended to stop a little above Runcorn, which is the point where the estuary of the Mersey may be said to terminate. The estuary from this point down to near Garston is almost silted up with deposit, carried down from the high lands of the watershed of the rivers Irwell and Mersey. Below Runcorn the low-water channel of the river is constantly

subject to change; and sometimes its course sweeps across from one side of the estuary to the other in the most capricious manner. It is the intention of the engineers of the Ship Canal to select a suitable line for the lower end of the canal—the portion through the estuary—and by training and dredging to establish a permanently deep and uniform channel through the sands into deep water; but as Mr. Abernethy stated in his evidence before the examiners, it would hardly be possible, with the information at present at his disposal, to prepare plans and sections which would present the views of the promoters with anything like exactness. In his opinion, training walls might be necessary in one part of the estuary and not in another, and without a careful survey, which would take a year or two to carry out, the necessary data could not be obtained. It is not unusual, in matters of equal importance with the Ship Canal, for the promoters and the public to conclude that the executive are the responsible parties when difficulties arise upon a question so purely technical as that upon which the Examiner had to decide; but the point raised by the opposition in this instance, was one which had received very careful consideration before the 30th of November; and we understand that before either the engineers or even the parliamentary agent would decide to follow any particular course counsel were consulted, who advised that sufficient precedent was forthcoming to justify the promoters in omitting the plans and other information which the 26th Clause appeared to demand. In support of this view, it was urged by the parliamentary agent that in certain undertakings of a somewhat similar character to the Ship Canal—notably the case of the Aire and Calder—plans and sections had not been deposited, and Mr. Abernethy could not see why the same powers should not be granted as in the case of the Clyde and Tyne.

The Examiner, stating that he could not lightly pronounce upon a point that might seriously affect a magnificent scheme like the Ship Canal, took some time to consider his decision; but when the promoters again appeared before him, he announced that the Standing Orders had not been complied with. The parliamentary agent had pleaded that the Mersey Conservancy Acts gave the conservators ample power to dredge and deepen the channel of the river, or to authorise such work to be done, and that it was therefore unnecessary for the promoters to ask for any further powers. The Examiner, however, held that the work which it was proposed to leave to the Mersey Conservators to execute was beyond their powers, which only extended to the deepening and widening of the river for the maintenance of the existing navigation, and that the Conservancy Acts could not have contemplated the making of a perfectly new channel for use in connection with the Ship Canal or other new undertaking. The Examiner further referred to the evidence of Mr. Abernethy in which he stated that a year must elapse before the requisite surveys could be made and the promoters enabled to clearly define the line of the channel through the estuary, and he expressed his opinion that before this portion of the scheme could be brought before Parliament, the deposit of the plans contemplated by the 26th Clause of the Standing Orders should be submitted. The Examiner also pointed out that although the allegation had not stated that the necessary deposit of 4 per cent. had not been made on the estimate of such works as would be necessary below Runcorn, he considered that such deposit should have been made

It is, of course, competent for the promoters of the scheme to appeal to the Standing Orders Committee of the House of Commons, and there is no doubt that they will do so. Indeed, petitions are being prepared and signed in Manchester and the surrounding districts to an extent that is almost unexampled, praying that the Standing Orders may be suspended in respect of the Ship Canal, and that the Bill should be allowed to go on and take its chance in committee on its merits. It is satisfactory to learn that the projectors of the undertaking are in no way deterred from their purpose by their first repulse. Their energies remain quite undiminished, and subscriptions to the undertaking are coming in as quickly as heretofore.

RICHARD TREVITHICK.

On the 22nd of April, 1833, Richard Trevithick, engineer and inventor, died at Dartford, in Kent. Not a relative stood at his bedside; not a penny was in his purse. Messrs. Hall's workmen were the bearers of his coffin, and the mourners at his funeral. For the last offices he was indebted to strangers. Thus passed away from among us a man beyond all doubt or question a genius; a man who possessed not only astounding fertility in invention, but an indomitable and fiery energy which bore down all opposition, and brooked no contradiction even from the powers of nature themselves. Trevithick was made of the same stuff as that from which some of our greatest preachers have been hewn. Had fate so ordered it, he might have been a preacher, a martyr, a soldier—he might have been anything, in short, with a mission, a work to be done, a kingdom to be overcome. As it happened, he was an engineer, and he attacked mechanical problems with a courage and pertinacity which carried all before them. If others could but have kept pace with Trevithick, he would have been even a greater man than he was; but the world lagged behind. Who but a genius would have had the audacity to attempt to work with steam of 120 lb. pressure, at a time when a boiler plate two feet square was looked upon as a curiosity? Who but a man of abnormal courage would have dared to work engines under the conditions which Trevithick accepted for the moment as inevitable? James Banfield, for many years principal smith to Messrs. Harvey and Co., of Hayle Foundry, said, in 1813: "I was rivet boy at the making of Captain Trevithick's high-pressure boilers at Millinear mine. The largest plates then to be had in Cornwall were three feet by one foot." Trevithick did much for the pumping engine in Cornwall, as did his father before him. He has been called, and with justice, the inventor of the high-pressure engine, and that means much more than appears at first sight.

Up to Trevithick's time there were but two forms of steam engine in existence—one was Watt's, the other Newcomen's. When Trevithick began to play a part in this world's affairs, the Newcomen engine was dying out, the Watt engine was slowly supplanting it; the first was an atmospheric engine, the second used steam of not much greater pressure than that of the air. Both relied on a vacuum for the performance of their duties. Trevithick made an engine which worked without a vacuum. He was not the first to do this, but he was very nearly the first. Leupold made high-pressure engines before Trevithick. But Trevithick was the first man in Great Britain to make a non-condensing engine which was of use. His first model was made about 1796 or 1797. Between 1802 and 1804 he and his partners, Andrew Vivian and William West, received £1250 in royalties on high-pressure engines erected. He made, too, what were practically portable engines at a very early period. But perhaps his most original invention was the locomotive. In 1801 he produced a small engine which he worked at Camborne; and in 1803 Mr. Henry Vivian ran a Trevithick locomotive, built by Mr. Fulton to Trevithick's designs, from Leather-lane, through Liquor-pond-street into Gray's-inn-lane, past Lord's Cricket-ground to Paddington and Islington, and back. Trevithick did not confine himself to inventing steam engines. He invented the first steam dredger ever used, and worked it successfully on the Thames, and he was employed as engineer to the first Thames Tunnel Company in 1807. In 1809 he invented a floating dock of iron. It would not be difficult to fill many pages of this journal with a record of his inventions and his deeds; but it is unnecessary. We have said enough to give such of our readers as know nothing about Trevithick an idea of what manner of man he was. Those who, like ourselves, are more or less familiar with his history, need no aid from us in this direction.

We have said that Trevithick died penniless, almost forgotten, wholly alone. We do not imagine that anyone was to blame for this. Like all masterful men who lack mental balance, Trevithick was not one who made many friends; that he had several was true, but he held himself aloof from them. Beyond doubt he was a disappointed man. Much that he had done was apparently snatched from his grasp. His very versatility stood in the way of his success. He lacked the commercial element with which money could be made, and the sympathetic characteristics, the charity which is long suffering, without which no true friendship can be maintained. It is none the less a deplorable circumstance that so able a man should have died in want and misery; and the misfortunes which clouded the happiness of his latter years seem to have enshrouded his very memory in a mist. There is not, perhaps, a dead engineer who has done so much, and about whom so little has been heard. In another generation Richard Trevithick will be as though he had no existence unless some step is taken to keep his memory from utter oblivion.

Trevithick was born in Illogan, Cornwall, on the 13th of April, 1771. Consequently, he was but sixty-two at the time of his death. We are glad to learn that it has been resolved by influential men that a testimonial of some kind shall be devoted to his memory. Nothing has yet been determined on, but a committee has been formed, consisting of the Duke of Sutherland, Mr. Hyde Clarke, Mr. Henry Chapman, Major John Davis, Dr. Pole, Mr. Husband, Mr. Harvey, Mr. Webb, of Crewe, and Mr. Trueman Wood. These gentlemen have issued a circular, in which we find the following passage:—"It has happened, in the course of events, that while there are many statues and other tributes to James Watt and to George Stephenson, no adequate memorial has been provided for another well-known engineer to whom our country and the world are indebted for many great and valuable inventions. To Richard Trevithick we owe the application of high pressure to the steam engine, the locomotive for the railway and the common road, the steam dredging apparatus, the application of steam to traction and other purposes in agriculture, &c. Few men have ever displayed so great a fertility in inventions, and when we consider their ultimate development, few have conferred on the population of the globe such vast practical benefits. In these claims Trevithick stands unsurpassed, but although matters of history, they are little known by the public at large, and have been little regarded. A bust of the great engineer in the Board Room of the London and North-Western Railway at Euston—on which spot it happened that so far back as 1808 Trevithick ran the first locomotive—another bust in the locomotive workshops at Crewe, and a medallion on the Victoria Bridge, in Canada, are the chief memorials of him. This year is the fiftieth from his death, and that is regarded as a fitting time to repair the national neglect, and also the neglect of his own countrymen in the Duchy of Cornwall, where his greatest inventions were carried out with enormous benefits to the country. The nature of the testimonial or testimonials to be provided must be determined hereafter, and be dependent on the amount of the contributions. Various suggestions have been already made, and it has been thought that, so far as the tribute is national, it should take the shape of a statue, to be placed in Westminster Abbey, while the memorial to be provided in Cornwall and Devon may include a statue in Truro Cathedral, a Trevithick School, or museum of art, or scholarship, so that his example of achievement may offer to many a further stimulus to exertion." We trust that the reply which will be made to this appeal will leave nothing to be desired. It would be better that no appeal at all should have been made, than that being made, the response was not adequate to the occasion. In such a case as this a slur would be cast, not on Trevithick, but on the engineers, who, being asked to help to raise a monument to the memory of one of who was an honour to the profession, refused. Little trouble was incurred in getting funds to raise a memorial hall to Stephenson. Stephenson possessed gifts which Trevithick lacked. Yet Stephenson's works are an everlasting monument to his memory. Nothing of his works save a few models remain to tell the world that Trevithick lived. This was the man's misfortune, not his fault. Let us now, ere his memory is for ever lost in the mists of time, do what in us lies to provide such a memorial as will preserve to England first, to Cornwall next, the memory that Richard Trevithick lived and laboured.

SCIENCE AGAINST DARKNESS—A STAGE ALLEGORY.

It is not often that engineering science is depicted on the stage, but at the Eden Theatre in Paris just now it is presented in an amusing "Ballet in twelve tableaux," entitled "Excelsior"—which has for its theme a prolonged struggle between the powers of darkness and light, the former being represented by a Mephistophelian personage named l'Obscurantisme, and the latter by a charming lady in white satin and gold, named la Lumière. The first scene opens with a struggle between the two, which is ended by Lumière breaking by a sudden effort the fetters which have bound her, and the "march of progress" commences. In a succeeding tableau is a beautiful landscape with a broad river. Boatmen and peasants are dancing, and all is joy, when suddenly the demon appears, and announces that a new boat invented by a certain Denis Papin, and propelled by fire, is approaching, and that, unless restrained, it will render their strong arms useless. The boat appears with smoke issuing from a mysterious funnel, and the angry boatmen rush upon it and destroy it with axes. Papin mourns its loss, but Mdlle. Lumière comforts him by a glimpse into the future, showing him in a grand tableau the harbour of New York, with large ferry steamers with working beam engines passing under the Brooklyn Suspension Bridge, over which, with an audacity which a merely mundane engineer might envy, railway trains are rapidly passing; an equal disregard of facts being shown in a background of lofty mountains. M. Obscurantisme has, however, been busy elsewhere, and now has his malignant eye on Volta, who is seen seated in his laboratory "inventing the electric pile." The wealth of books and apparatus is peculiarly displeasing to the demon, who attempts to destroy them, but Volta, with a pitying smile of superiority, makes the sparks fly, and knocks him head over heels with an electric shock, and Lumière, chasing him from the scene, reveals to the delighted philosopher the future of his invention in a tableau of the Washington Telegraph Office with a hundred messenger boys (ballet girls) in gay uniforms rushing in all directions with despatches. The scene again changes, and shows an African desert. A caravan is passing across the plain, pyramids and the sphinx in the background. Brigands attack the caravan; the simoom with its hurricane of sand envelopes the combatants, who appear to die of thirst, to the great delight of the demon, who gloats over their misery. But Lumière is equal to the occasion, and by a stroke of her wand, produces a magnificent tableau of Ismailla and the Suez Canal, the blue waters of the latter supporting large steamships, and its banks embellished with green trees. As an appropriate incident, with which doubtless our merchant captains on their way to India are familiar, a grand dance by two hundred ladies of the corps de ballet is given on the banks of the Canal, in honour of "the immortal Lesseps," with much display of tricolour flags. The pantomime continues, for not a word is spoken, and all depends upon the scenery and acting, assisted by the explanations on the play-bill. Obscurantisme, baffled on the surface of the globe, attempts to hinder the progress of science in the gloomy recesses below, and finds a specially favourable opportunity in the works of the Mont Cenis Tunnel. This scene is well depicted, the sombre vault, the huge rocks, and the silent but industrious miners. Pick and shovel are at work, and very inefficient they appear, but one can hardly expect percussion rock-drills on the stage, and dynamite would be out of place. The demon has cast his baneful glance upon the work, and has discomfited the engineers, for they are evidently at fault. Either their dials have betrayed them or their levels are wrong, for they show signs of despair, wring their hands, weep upon each other's shoulders, and display other appropriate action. The gracious lady Lumière appears opportunely, drives back the demon, sheds her light upon the theodolites, and the engineers are restored to their wonted equanimity. Then a sudden pause, all listen breathlessly to distant sounds; the foreign miners are approaching, the points of foreign pickaxes are seen to pierce the wall of rock, and with a grand crash the huge stones fall asunder, and the junction is effected. The workmen mingle, the Italian and French engineers embrace, kiss each other copiously after the manner of engineers, and the triumph is complete. And then the ballet. Never before was there such a scene in a railway tunnel—but it is not the time for criticism. It is needless to add that Obscurantisme can no longer maintain the unequal combat, but finally disappears, and a last grand tableau displays the Temple of Civilisation with Progress and Concord in the foreground, and ballet dancing all around. The Eden Theatre, wherein the play above described is being acted, has only been opened for a few months, and is hardly yet known to Englishmen. Situated in the Rue Auber, close to the new Opera House and the Grand Hotel, the site in so central a part of Paris cost an enormous sum, the total outlay for land and building being stated at ten million francs. The architecture is described as in the Hindoo style, the somewhat bizarre ornamentation being a repetition of that in a theatre by the same architect in Brussels. The auditorium is octagon in shape, and is about equal in size to the Alhambra Theatre just destroyed in London. But the stage of the Eden Theatre is much larger than that of the Alhambra, everything being arranged for grand spectacular displays. The saloons for promenade and refreshment are as large as the theatre itself, much revenue being sought from various minor attractions in these departments. With the recent memory of disastrous fires in theatres, the construction and arrangement of the building strike one as very dangerous in case of a panic, for not only are the staircases and doors too few in number, but the avenues between the benches and stalls are blocked by extra seats.

DRAUGHTSWOMEN.

It will interest engineers generally to know that the system of employing draughtswomen in the drawing-office, which has been successfully introduced in several large establishments on the Clyde, and in one or two other places, has now been adopted in the extensive engineering works of Messrs. Clarke, Chapman, and Gurney, at Gateshead. Some twelve months ago this firm determined to make the experiment, and went to the expense of erecting a special building, so as to give the ladies accommodation quite separate and apart from that of the ordinary draughtsmen. The new office is roomy, well ventilated, and decorated with flowers during the summer months, and is approached by a door so placed that the draughtswomen need never meet or even see the other employés of the firm. Up to the present time five ladies have had occupation, chiefly in tracing plans of steam winches, boilers, &c., for the shops, and in finishing off drawings of machinery prepared by the draughtsmen. The office hours are from 8.45 to 11.45 in the morning, and from 1.15 to 4.45 in the afternoon. So satisfied have the firm been with the result of the experiment, that they are now making arrangements for the intro-

duction of lady clerks in the execution of the ordinary commercial work of the office, and as soon as the necessary structural alterations to the buildings have been made some fifteen extra hands will be taken on. All the clerks will be required to have a knowledge of shorthand, for, in addition to their usual book-keeping, their duties will consist in writing business letters from dictation, and in taking down messages from the telephone. No difficulty was found in obtaining a good number of candidates for the situations, and though the pay was at first small, so apt have the ladies been in acquiring the knowledge of their business that most of them are now earning fairly good salaries. The opening out of a new field of usefulness for well-educated girls will be regarded with satisfaction by many heads of families, and if ladies would only go in for a proper preliminary training there can be little doubt that they would easily find suitable and lucrative employment for both heads and hands in many of the departments in our engineering works. Much of the ordinary routine of an office can be at least as well performed by women as by men, while in such duties as tracing and correspondence the former actually excel the latter. Messrs. Swan and Hunter, shipbuilders on the Tyne, are also making arrangements for the employment of female clerks.

RAILWAY ACCIDENTS AND AUTOMATIC BRAKES.

THREE reports upon railway accidents have recently been issued, to which it is worth while drawing special attention. The first was that of a London and North-Western train at New-street Station, Birmingham, on the 12th December last, which caused a double collision and injured nine persons. The train was fitted with the Clark-Webb chain brake, which, according to the driver, failed to act, but Colonel Rich, the Government Inspector, suggests that he forgot to make use of it on seeing his danger. In any case the emergency brake was on this occasion, as on so many others, of no use in the emergency. The second report is by Major Marindin, and relates to a collision with the buffer stops at Edgware station on the Great Northern Railway on the 29th December, from which injury was caused to seven persons, or half the number in the train. The vehicles were fitted with the Smith vacuum brake, and after the accident it was found that the vacuum brake pipes between the engine and the leading vehicle had become uncoupled. The inspector reports that the accident was due "to the parting of the vacuum brake coupling," and that "if the brake had been an automatic one the effect of the coupling coming asunder would have been the application of the brake, and the consequent prevention of the accident." The third report we have referred to is also from Major Marindin, and relates to an accident which occurred on the 11th January, near Bradford, on the Lancashire and Yorkshire Railway. The train was fitted with Fay's brake, under the control of the guard. When running between Lowmoor and Bradford, on a falling gradient of 1 in 51, the screw coupling between the engine and train broke, and after running 1200 yards, the carriages overtook the engine and struck it with considerable force, causing injury to six persons. The inspector reports, "This collision is one of a class which would not occur if automatic continuous brakes were generally adopted." It will be noticed that each accident occurred upon a different railway, and that each train was fitted with a different system of brake, the only point of resemblance between them being that all were equally useless in preventing the collisions. It may be added that the London and North-Western and Lancashire and Yorkshire trains might just as well have not been fitted at all, while the Great Northern collision was directly brought about by a vacuum brake being fitted to the carriages.

LITERATURE.

Cutting Tools Worked by Hand and Machine. By ROBERT H. SMITH, M.I.M.E., Professor of Engineering in the Mason College of Science, Birmingham. London: Cassell, Petter, and Galpin. 1882. Small 8vo. 224 pp.

THERE is a freshness in the style of this book which is striking without being at all pedantic. The subject is not, perhaps, one which gives much room for display, but it is one which has given the author an opportunity of writing a book that is new, and is not a copy or a mere compilation. It is one of Messrs. Cassell, Petter, and Galpin's new series of manuals of technology, and is a most promising pioneer of the series. In his preface Professor Smith gives credit to some of those who have written on this subject, and in speaking of Hartig's "Versuche ueber die Leistungen der Werkzeugmaschinen," he remarks, that this is the only book to which one can refer for trustworthy information regarding the horse-power required to drive these machines; but further on he says, "Hartig's work supplies very valuable data from which to judge of the requisite power to drive tools. Unfortunately, he seems to have been led away by the idea that the cutting force varies in simple proportion to the depth of shaving. This idea is wholly erroneous. It seems first to have received definite expression in certain mathematical papers published in the appendix to the late editions of Holtzapffel's works. These papers are singularly apt illustrations of the extremely vicious results of the attempts occasionally made by mathematicians to interpret nature by algebraic formulas alone, without the aid of experiment. The author fully believes that mathematical theory is the only ultimate possible way of perfectly describing fully-developed scientific knowledge, but it is worse than useless for anyone to dabble in mathematical theory before becoming thoroughly and intimately acquainted with all the *facts* of the subjects obtainable by experiment and observation. In consequence of the above error, Hartig has divided the work done in each of his experiments by the volume of material cut away, and thus obtains what he calls a 'constant' but what is in reality a most delusive variable." That this is not the expression of one unable to appreciate and apply mathematical reasoning, is well known by those who read Professor Smith's valuable articles on "Braced Piers for Bridges," published in THE ENGINEER, vols. xlix. and l., and those on the strains in locomotive coupling rods in vol. lii. In continuing his preface, the author dwells upon the importance of securing stiffness as distinguished from mere weight in machine tools, and he devotes some attention to the calculation of the strength of the parts of machine tools, so as to lead to proportions that will secure this stiffness without unnecessary weight. The aim of the work is, however, educational, and he does a great deal towards effecting his object, which is to elevate the art of tool making from its present entirely empirical position to one more scientific. The book is divided into nine chapters—namely: (1) Chisel tools for wood; (2) chipping chisels and hand planes; (3) machine planes for wood; (4) saws and milling machines; (5) planing, shaping, and slotting machines; (6) lathes; (7) cutting tools for lathes; (8) boring and drilling, and (9) punching and shearing machines. It would be impossible in the space at our disposal to follow the author through his treatment of the different parts of these subjects. He takes the tools, describes them as made, shows their faults, and how to remedy them, and certainly does more than has ever been done in any book of the kind to enable young men entering on the practical part of an engineering education, and who will really study the book, to obtain real knowledge, which will save the time otherwise actually necessary to gain intelligent perception of the behaviour and the action of cutting tools, and the behaviour of materials under that action. There is, moreover, so much original information on these subjects that experienced tool makers may read the book with very much interest and edification. It may be said that Professor Smith takes nothing for granted, but examines for himself and leads the reader through that examination; and where experimental data are necessary for proof he is in almost all cases able to give them. The book is illustrated by fourteen plates and a number of woodcuts, but it needs an index.

Useful Rules and Tables relating to Mensuration, Engineering, Structures, and Machines. By W. J. MACQUORN RANKINE. Sixth Edition, revised by W. J. MILLAR, C.E., and with Appendix and Tables, Tests, and Formulæ for the use of Electrical Engineers. By ANDREW JAMIESON, C.E., F.R.S.E. London: Charles Griffin and Co. 1883. Small 8vo. 384 pp.

ALTHOUGH this well-known book has now been thoroughly revised by Mr. Miller, it is hardly necessary to do more than announce that Professor Rankine's "Useful Rules and Tables," has reached its sixth edition; indeed, it would not be necessary but for the fact that an important addition to Rankine's work has been made by Mr. Andrew Jamieson. So many engineers find it now necessary to have something more than a lecture experiment knowledge of electrical subjects, that no book of miscellaneous rules and formulæ can now be considered complete without the most frequently required rules, formulæ, and tables relating to the practical application of electrical currents and their generation. This part of the book occupies sixty-three pages, and commencing with formulæ of the absolute units, including fundamental, derived mechanical, derived magnetic, electro-magnetic, and electrostatic units, proceeds to the practically employed electrical units, including those most recently adopted, namely, the Watt and the Joule proposed by Dr. Siemens at the Southampton Meeting of the British Association, the Joule being the work done or the heat generated by a Watt in a second. Both these units are being generally adopted, though perhaps the Watt, namely, the power conveyed by a current of an Ampère through a conductor whose ends differ in potential by one volt is the more commonly in use at present. Mechanical units are next given, and the C G S derivation of the constant 746 of the expression for the horse-power of a given amount of electrical energy shown. This is followed by heat units, light units, electro-chemical equivalents; electrical measurements as effected by Wheatstone's Bridge in different forms, which are illustrated, and by Sir W. Thomson's and Mr. Varley's slide resistance coils. The measurements of electro static capacity by Sir W. Thomson's method is followed by the measurement of potentials, Munro's method for battery resistance, joint tests, and cable faults. Rules and constants relating to copper, and tables of the resistance and weight of copper and German silver wire, are next given, followed by data relating to the physical, mechanical, and electrical properties of guttapercha. Some facts relating to the electro-motive force of batteries with cells of various kinds, followed by information concerning the construction and laying of cables, and relating to telegraphs, complete this part. It will be seen from this that it comprises a wide range of subjects, some of the information being new, the chief part being condensed from authentic sources, most of which are acknowledged. This book was previously held in deservedly high esteem, and its value has now been much enhanced. Part of Mr. Millar's work has been the remodelling and extension of the index, a very important part.

THE LATE PROFESSOR HENRY J. S. SMITH.

OXFORD could scarcely have lost more by the death of any one man than by that of Mr. Henry J. S. Smith. "Henry Smith" he was called by everyone. The impetus of late years given to the study of physical science on the Isis was in a great degree owing to his work and example. The reforms which have followed the last Oxford Commission were largely due to his initiation. In short, he surpassed all but a very few of his contemporaries in his endeavours to broaden and invigorate the life of Oxford, and by so doing to strengthen and expand the intellects of those whose *alma mater* she is. He combined, in a manner quite unique in this generation, the qualities of the man of learning with those of the accomplished man of the world. In conversational brilliancy he represented the best type of Irishman. Those who were personally acquainted with him will recollect numberless brilliant things which he has said, and will search in vain amongst their friends for his peer. He was Savilian Professor of Geometry and Keeper of the University Museum. He died at his residence in the Museum on the 9th inst., after a very short illness. He had had more than one severe affection during the last two or three years, but he was comparatively well until the Saturday before, being present and speaking at a meeting on the previous evening in favour of the extension of the franchise, which was held in the Town Hall. He was born in Dublin in 1826, and after matriculating at Balliol, took a double first-class in 1849. He also gained the Ireland scholarship, the highest undergraduate achievement, in 1848, and took the senior mathematical scholarship in 1851. He then became Fellow and Tutor of Balliol, Savilian Professor of Geometry, Fellow of Corpus Christi, Member of the Hebdomadal Council, and Delegate of the University Press. On the death of Professor Phillips he was appointed Keeper of the University Museum. He was chairman of the Meteorological Council, and an active and important member of the British Association for the Advancement of Science. He was also a member of most of the scientific societies connected with mathematics, as the Royal, the Mathematical, the Physical, and the Astronomical Societies; and he was a corresponding member of the Academy of Sciences. of Berlin. He was an LL.D. of Cambridge, and had a similar honour conferred upon him by the Universities of Edinburgh and Dublin. He was a strong Liberal, and contested the representation of the University of Oxford in 1878, on the elevation of Mr. Gathorne Hardy to the peerage, on which occasion he received the support of the majority of the Oxford residents, but was defeated by the non-resident members of Convocation. He was also a member of the recent University Commission, to which we have already referred, and the new administration and organisation were largely influenced by him. The loss to Oxford it is hardly possible to estimate.

MASON COLLEGE—ENGINEERING LABORATORY.

THE Mason Science College in Birmingham is rapidly advancing in popular favour. The college is not yet three years old, and the engineering department, under Professor R. H. Smith, was only commenced last session. Already the day students number nearly 300. This bodes well for the future utility of this institution in the Midland Counties. Situated as the college is in the midst of the great iron district of England, parents and guardians find it a great convenience to be able to obtain thoroughly good scientific and technico-professional education for their sons without sending them to live away from home. Among the laboratories of the college that of the engineering section holds an important place. Ample space is devoted to it, and to the students' drawing-office, where each student has a drawing table for his own exclusive use, and where also is found a large collection of patterns and models, from which drawings are made. The more advanced drawing classes use the machines of the workshop, and the engine as exercises in drawing. The workshop is well stocked with excellent machine tools made by Messrs. Archdale and Co., and these and the rest of the college machinery are driven by an engine made by Messrs. W. and J. Player. It is a compound condensing engine of the launch-boat type, with an extremely light-looking frame of steel bars braced horizontally. The engine is specially designed for the purposes of experiment on the working and efficiency of steam engines, and seems to be fitted with everything that could be desired for that object. The cylinders are 6in. and 12in. by 10in. stroke. The steam supplied by the boiler is at 140 lb. per square inch, and the normal speed is about 200 revolutions per minute. At the left-hand end stand the air and circulating pumps, both driven by one pin directly by the crank shaft. The cranks are discs, and the two crank pins may be placed at almost any angle to each other in order to determine experimentally which are the best relative positions for them. The high-pressure slide valve is driven by a one-excentric gear, which gives a variable cut-off controlled by the governor. A conical sleeve rotating with, and lifted by the governor, engages with a disc in the form of a flat hollow cone. According as it engages with the upper or lower side of the disc, a vertical screwed rod rotates right or left-handedly, and shifts the block in which the radius rod of the valve gear is centred. The ratio of expansion in the low-pressure cylinder is variable by hand. Both cylinders are jacketted on the sides and top covers, each jacket being supplied with fresh steam and drained independently. A pipe standing on the top of the cylinders is an extension of the chamber between the cylinders, and the volume of this may be changed by screwing in or out a long plunger which enters this pipe through a stuffing box. The condenser is a surface one, consisting of a nest of vertical tubes of two different sizes, enclosed in a cylinder of cast iron. Each larger tube is closed at the top and has an open-topped tube of smaller size inside it. The circulating water ascends between the two tubes, and descends by the inner one. Very complete provision is made for taking indicator diagrams conveniently, and a speed indicator shows at each instant on a scale the number of revolutions the engine is making.

In the workshop experimental apparatus is being gradually made by journeymen and by the students themselves, and judging from Professor Smith's laboratory programme as published in the "College Calendar," we ought soon to hear of interesting and valuable series of experiments having been carried out in this laboratory. Of course the value of such experiments to the students themselves must be very great indeed, provided they are conducted in a systematic and earnest fashion. We heartily congratulate Professor Smith and his pupils upon having so many facilities for the study of engineering science, not by the aid only of books and mathematical formulas, but also by those experimental methods which are recognised to have far greater educational value in all branches of physics. We are sorry to hear that the funds at the disposal of the trustees of the college will not permit them to purchase a powerful machine for tension, compression, and tension tests of constructive materials. Such a machine, to be of real scientific use, must necessarily cost a considerable sum; but surely the £400 or £500 needed could be obtained from the liberality of the prosperous iron manufacturers and engineers of the Birmingham district, whose interests it would so greatly further to have their young men taught the strength of materials in a thoroughly practical manner. We recommend Professor Smith to ask, and, if he does so, we trust he will not be refused.

FOG SIGNAL APPARATUS FOR LIGHT SHIPS.

OUR supplement illustrates Professor F. H. Holmes' arrangement of fog signalling apparatus as now adopted by the Trinity House and numerous foreign Governments. The "Siren" of Professor Holmes is now well-known, as it is used extensively on board men-of-war and on shore, but this it appears has caused considerable confusion owing to the similarity of sounds emitted by the Sirens on the various coast stations and the vessels. To overcome this it has been necessary to establish a distinctive form of signalling for the stations, and the apparatus we illustrate is for that purpose. To describe the operation of this fully will require reference to detail drawings, which, with the discription, we will give in another issue.

LONDON ASSOCIATION OF FOREMEN ENGINEERS.—Sir James A. Douglass, C.E., Chief Engineer to the Trinity Board, has consented to preside at the thirtieth anniversary festival of this society, to be held at Cannon-street Hotel on Saturday, April 21st.

MAY'S PRESS MANUAL.—The sixth annual issue of this manual has reached us. It contains a complete list of newspapers, magazines, reviews, periodicals, &c., published in the United Kingdom. It is of small quarto size and contains 184 pages, and is published by Messrs. C. H. May and Co., Gracechurch-street.

EDWARDS' SLOW-COMBUSTION GRATES.

THE accompanying engravings represent the construction in section of grates now being made in various sizes and patterns, by Messrs. Benham and Sons, of Wigmore-street, W. The grate is constructed to receive a body of coal sufficient for a day or a night's consumption. A fire is then made in the usual way on the top of the body of coal, and allowing the coal to burn gradually downwards till the whole is consumed. The principle is substantially the same as that adopted in Dr. Arnott's grate, but instead of machinery to lift the basket of coals as it burns

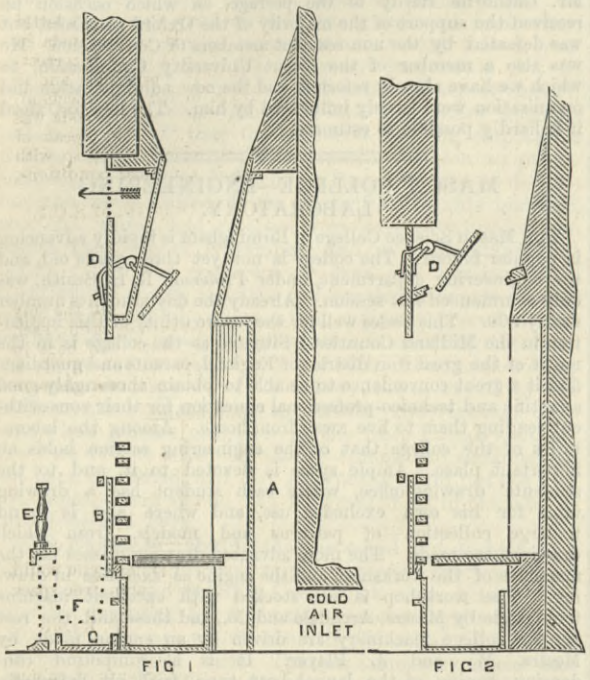


FIG 1

FIG 2

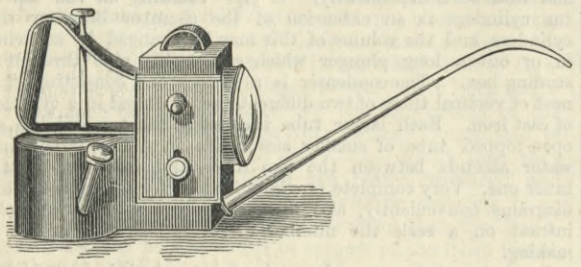
down, a blind B is suspended so as to move down by degrees in front of the body of burning fuel. A sunk ashpit is not used. The blind is balanced in front of the body of fuel by chains and weights.

For regulating the chimney draught a door is provided at D with a chain in front of the grate, which may be adjusted at any time without inconvenience.

In our engravings the section Fig. 1 shows a warm air chamber A, a grating in front, chain register D, suspended blind B, fender guard E, cinder basket F, and dust trough C. Fig. 2 is a section showing register stove worked by a chain in front of the grate, and the movable blind in front of the bars.

A NOVEL OIL CAN.

WHO that has had much to do with machinery at sea has not experienced the difficulty of carrying a lamp in one hand, an oil can in the other, and holding on to a rail with his elbows? The ingenious American combination oil can and lamp which we illustrate overcomes this difficulty. The engraving explains



itself. It will be seen that the bull's-eye concentrates the light just where it is wanted. In the United States the can is known as the "Excelsior Illuminating Oiler," and is made by Messrs. Walker and Co., Lake-street, Chicago.

BATTLE SHIPS—A FORECAST.*

By Mr. NATHANIEL BARNABY, C.B., Director of Naval Construction, Admiralty.

BEFORE I make any remarks on battle ships, which form the subject of this paper, I should like to define the position which I think they occupy in the naval resources of the Empire. The power of waging war on the seas depends, I consider, upon the following elements stated in their relative order of importance: (1) The quality and extent of the mercantile marine in ships and men, provided that the national tie in both is real and firm. (2) The quality and strength of the trained *personnel* in the State Navy. (3) The ability to produce or procure rapidly and continuously *materiel* of war for the use of the State. (4) The number and efficiency of the regular ships-of-war possessed by the State on the outbreak of war. Battle ships form a part of the last-named element. There has been much controversy concerning the distribution of their armour; the size, number, and mode of mounting the guns; their speed, and coal endurance, and other matters. But these questions all resolve themselves into one of size of ship. Armour, guns, speed, and fuel, all demand as much as can be conceded to them; and the limit to each is finally imposed by the size or displacement of the ship. The controversy has taken form and shape in Italy in more imposing proportions than it has in England or France, and it has fastened itself on the question of absolute size. Signor Brin, the Director of Material, and ex-Minister of Marine in Italy, is responsible for the designs of the large battle ships she has produced and is now producing. In a very able pamphlet on the question he says, comparing single ships of great power with a group of ships of less power, that the case stands as follows:—"The slower group cannot overtake the single faster ship, and she can always be mistress of the situation and maintain herself in the front, in the rear, and on the flank of the group at whatever distance she pleases, by changing these positions, by approaching nearer or drawing away from the group in order to attack one of the vessels." By combining greater defensive "and offensive powers she can employ with greater precautions for herself, and with greater probability of success, the terrible torpedo." He says further: "There is an old rule in military strategy, which, nevertheless, is always new, since it has never been belied by facts or experience; and it is the rule of concentrating successively, first of all on one point, and then on another, the greatest possible amount of force. Following this rule, we have seen small armies successful against large ones. In order to carry it out rapidity of movement is indispensable. But in what way would it be possible to put this rule more effectually into practice than by accumulating in the smallest space, in one very fast ship, such fighting and such defensive power as to enable her without hesitation to seize on the weak points of the enemy with the probability of success?" In this paper I neither adopt nor challenge these arguments. I am content to say here that with increase in speed and size the ship not only increases in mass, signifying greater energy in striking at given speeds, and greater resistance to injury when struck, but it becomes more easy to secure speed and endurance. And not only so, but England possesses exceptional advantages in forging such weapons, and within the limits imposed by sizes of docks and shoaling of water, it is conceivable that she might furnish herself with ships far more powerful than any which have been yet seen. The cost of individual ships must always be an important consideration, and it is especially so with a Power having extended empire, requiring her to be present in force at the same time at many remote parts of her dominion. It is a consideration, however, which must not be pressed too far, because the possession of ships which the financial limitation precludes might enable her to close a war rapidly, by blows at the heart of the adversary. In this way war at the remote parts of the empire might be avoided, or terminated very quickly. Constantly improving modes and means of attack upon ships by ships, and from the shore, threaten to change the character of the battle ship; and it is uncertainty in this respect which emphasises the financial limitation. The recent operations at Alexandria show that, for certain portions of the work the Navy is called on to perform, the ships designed twenty years ago are still efficient. But the absence of torpedo boats, and the neglect of torpedo defence on the part of the Egyptians, count for so much in this question, that the argument derived from success in that operation in favour of the earlier and also of modern types of battle ships is not worth much. We may perhaps get some clearer notion as to what the battle ship should be for England, if we consider more closely what it will be required to do. (1) It must be capable of striking very destructive blows where the enemy is fortified, either in his ships on the open waters, or in his forts upon the sea-coast. (2) The machinery for striking these blows must be capable of being kept in position in the face of an enemy in the open sea, or off a port. (3) The use of torpedo boats of high speed and in great numbers tends to the gradual extinction of the power of attacking or blockading the sea forts of an enemy by means of large ships, because of their great cost, and the risk of fatal blows from the torpedo. (4) The advantage of being able to inflict damage upon the shipping which may be under the protection of land fortifications, or to close the port, will also be so great that the mode of attack must modify itself to suit the change in conditions. There can be no doubt, I think, that gun-vessels with numerous long-range shell guns, and costing not more than one-fourth of the modern battle ship, will displace the battle ship *for this service*, notwithstanding the disadvantages of the smaller ships in unsteadiness of platform and inferior seaworthiness. The battle ship of large size is not only likely to become obsolete for the attack and blockade of ports, but also for another important service, viz., harassing the commerce of an enemy. This results from the great speed and coal endurance of the large ocean steamers. Armed ships of the same character as those to be captured will probably be the favourite weapons for inflicting damage upon commerce. These ships are now nearly twice as long as the ship-of-war of the same weight, and they can, therefore, much more easily secure and maintain a high rate of speed at sea. I consider it would be most impolitic to build regular ships of war on similar principles for the purpose of pursuing and engaging them. The 17 knots ocean speed of to-day may be exceeded by commercial rivalries in the course of a very few years. It is desirable that this should be so; and instead of attempting to produce fleets of regular ships of war as a consequence of the existence of these fast possible war cruisers, we should endeavour to modify them and incorporate them in our national defences. That they need very considerable modification to make them reasonably secure against the assaults of an enemy by artillery or ram is obvious enough. But too much importance must not be attached to cases of rapid foundering on collision. Ships having many "water-tight bulkheads" and passing the survey of Lloyd's and of the Board of Trade are often so circumstanced as to bulkheads that they may as well be without them so far as they affect the question of foundering when they are struck by the bow of another ship. We may well look for great improvement in this respect by very simple precautions not now enforced or adopted. The Secretary of the Navy of the United States in his annual report to Congress, dated November 29th, 1882, dwells at great length on the position and prospects of the mercantile marine from the point of view of the Naval Administrator. He says: "As the merchant marine is dependent at critical periods upon the Navy, so, on the other hand, the Navy, no matter how strong it may be, must, in emergencies, avail itself of the resources of the merchant marine." At the outbreak of the rebellion the State Navy had nominally a tonnage of 105,000 tons. To increase it they had to buy 216,000 tons, which they found very "ill suited for war purposes, but none the less indispensable." They had also to make additions to the officers and men of the war Navy by drawing from the mercantile marine 7500 officers and over 40,000 seamen. He shows that between 1860 and 1865 the percentage of the foreign carrying trade of the United States performed by American vessels dropped from 66½ to 27¾, and since then has fallen steadily, so that it is now only 15½ per cent. He demands for the shipping trade the removal of impositions which he thinks unfair, the extension of protective measures to the neglected industry, and the reform of administration. He apparently does not like to propose the abolition of the protective measures which make shipbuilding materials so dear.* Referring to the French Bounty System of January, 1881, and the recommendation of a similar system by Prince Bismarck to the German Parliament in 1881, he recommends a system of postal subsidies, involving the condition that such ships should be built according to Government requirements, and be subject to be taken for national use in time of war. He gives us credit for having such conditions in our postal contracts, but in that he is mistaken. Our postal subsidies have reference exclusively to postal requirements. One need hardly say, for it is obvious, that every trading ship possessed by a State is an advantage to the whole world, because it is an additional guarantee given for peace. Operations on or in the neighbourhood of an enemy's ports, and attacks upon his commerce, are the two most important fields of maritime warfare. Fleet actions have hitherto grown out of them; and it is reasonable to expect that they will do so in future, and that the ships best adapted for these two fields of warfare will always be found in contending fleets. The presence among the lighter ships of some ships with steady platforms, exceptionally heavy guns, and those guns defended by armour, would of course be a great advantage; and this may possibly become the sole function of what we now call the battle ship. For this purpose neither exceptionally high speed nor great handiness would be regarded as so important as they now are held to be. They would need to have the average speed of the smaller ships of the squadron, and no more. What they would especially require would be heavier guns than can be mounted and worked at sea in the small vessels, steady platforms for working them, and good protection. The guns that can be mounted and worked at sea with advantage in vessels of very moderate size may be of considerable power. Their weight and power will be limited by the following considerations:—(1) As they are unprotected by armour against even the lightest shell, and as the ship carrying them would hardly be suitable for the service at all if less than about 2000 tons displacement, there must be at least two such guns in each ship. In other words, the ship will be too large and costly to justify dependence upon a single gun so greatly exposed to fatal injury in itself, its mountings, and its communications with its magazines. (2) The vulnerability of the ship will keep down its size to a minimum; and it will almost certainly take the shape of a vessel of 2000 to 3500 tons, with a protecting deck, high speed, and two guns mounted in the middle line, one firing ahead and the other astern. It will, therefore, be necessary to place the guns as far out of the centre of the ship as possible consistently with seaworthiness, inasmuch as the spar deck spaces before and abaft them must be of the nature of a glacis, and be uninhabitable. (3) With this limited number of guns it will be desirable not to have a very slow fire from each gun. The introduction of machinery for the purpose of quickening the operation would be perilous, seeing that it cannot be protected. These considerations will tend to keep down the size of the guns, and they will probably not exceed a weight of 25 to 30 tons each. But it may be anticipated that guns of this weight will be found in this class of small and fast protected sea-going ships. This justifies the expectation that the protected battle ship proper will require guns of larger size and power than 30 tons, so long as such larger guns are found to have advantages. These guns may possibly have large calibre. Excepting the guns of the Inflexible, the largest gun yet constructed for the British Navy has 12in. bore, and a weight of 43 tons. The ships recently commenced will have larger guns, probably 63 tons in weight, or heavier. Experiments against steel and steel-faced armour have shown that we have at present no material out of which to forge or cast a projectile which will act at the same time efficiently as a punch and a shell. And even if we give up the attempt to make the shell, we have not yet found a way to punch a hole through the plates as we could through iron. We have to break a way through, and small diameter of projectile and small mass, with high velocity, are not favourable to this. Large diameter gives mass, strength of form in the projectile, and favours the conversion of the projectile into a destructive mine for use against the unarmoured parts of the ships attacked, and against the walls of barbettes. England has been successful in producing guns of 16in. and 17in. bore. And she has also done what no other nation has yet effected, viz., she has mounted such guns in a manner which brings them under perfect control by very simple mechanism. The skill of the firm of Sir William Armstrong and Co., which has produced this mounting, is only an example of the mechanical power in design and execution which may be trusted to place in English battle ships weapons of power which other people cannot exceed. I have never pleaded for large and costly ships, but I have always agreed with those who hold that England should put into the hands of her seamen the most powerful guns which can be made and worked. In this way she ought to make her manufacturing skill tell in her favour. One reason why some other Powers do not adopt large guns may be that their own engineers find difficulties in mounting and working them. As to armour, I ventured to say in 1876 that I thought the thickness of armour in the Inflexible was not likely to be exceeded. I am still of that opinion. I do not believe that increasing the calibre and weight of the gun will tend to thicken the armour. The result will, I believe, be that armour will finally nearly or quite disappear as side plating for the hull of the ship, and that where it must continue to be used for the protection of the gun and its mounting it will improve in quality, so as to be impenetrable to shell, however made. The principal projectile must be shell, and we shall probably find ourselves with steel defences of excellent quality, but of very limited extent, over our gun mountings; and the smallness of their size and their impenetrability to shell will practically leave them unassailed, while the upper works of the ship, above the shot-proof deck, are attacked by shell. Reluctance to introduce large guns would, I believe, only delay this process of change. I have not touched upon those other reasons for advocating the association of small and fast protected but unarmoured vessels with battle ships, which arise out of a consideration of the exigencies of the purely naval fight upon the high seas. A thoughtful paper was read on that subject at this Institution by Captain Harris last year, and the chairman then referred to the great debate on the question in the Institution of Naval Architects in 1876, and to a subsequent paper of mine of 1880. What I have tried to do in this paper is to strengthen the argument in that direction, by considering more particularly how two well defined naval operations, the attack upon ports and the protection of commerce, have in their changed conditions affected the question of the character of the battle ship. The questions raised in this paper which seem to be debateable are:—(1) Should England build ships greatly exceeding in speed, coal endurance, guns, and armour, existing ships of the first class, regardless of size and consequent cost? (2) Will not the enemy's ports require to be attacked and blockaded, notwithstanding the torpedo? and if so, what description of ship will be suited for this attack? (3) Ought regular ships of war to be built of sufficient power and speed to capture ships like the Servia and Alaska and their larger and faster successors? or should we not rather look to the services of such ships for the work, endeavouring to fit them for it? (4) When the powers of the ram and the torpedo come to be tested in actual warfare between two great Powers, what part may we expect to be assigned to the first gun and torpedo ship with protecting deck, and the merchant auxiliary, as a result of these contests? (5) Ought the battle ship of the first-class to carry guns of the largest calibre which can be made and worked? or should we be content to allow the gun to progress slowly with the advance of the armour? I have wished in this paper to guard myself against the advocacy of a particular policy with regard to any of these questions. It is my duty to observe tendencies carefully, and as no discussion on such subjects can be profitable which does not take the elements tending to change the conditions into account, I have submitted them to you. When travelling along a badly-defined road in an unknown and difficult country, we may avoid errors and delays by getting on high ground, overlooking the minor features of the road along which we are passing.

* Read before the United Service Institution, February 9th, 1883.

* The action of the American House of Representatives in proposing a "Free Ship" Clause in the Shipping Relief Bill had not been taken when this was written.

BATLEY BOROUGH SURVEYORSHIP.—An advertisement for a borough surveyor was inserted in our pages, and it may be interesting to some of our readers to know that there were 158 applications, and that they were reduced to six—the six undermentioned candidates having been invited to come before the committee with whom the appointment rests on Monday next. The candidates referred to are—Mr. R. H. Middleton, assistant in Borough Surveyor's-office, Dewsbury; Mr. T. Netherwood, assistant in Borough Surveyor's-office, Birmingham; Mr. J. W. Horsfield, assistant in Borough Surveyor's-office, Leeds; Mr. George Meek, assistant in Borough Surveyor's-office, Manchester; Mr. F. L. Button, assistant in Borough Surveyor's-office, Barnsley; Mr. John Brockbank, assistant in Borough Surveyor's-office, Salford.

THE SOUTH AFRICAN DIAMOND FIELDS. — A correspondent writing from Winburg, Orange Free State, under date Jan. 12th, says:—"The task of pumping water from the Vaal river to Kimberley, a distance of about twenty miles, I daresay you have heard, has been accomplished and with the greatest success. The water arrived a few days since only, and is an enormous boon to the mining world there and the general public. The Boers all over South Africa are just now very hard up, and many of them, really wealthy, cannot lay their hands on a £10 note. Things at the fields are bad; several companies gone, and more going. Some people at Jagersfontein are finding some nice stones. Whether they are previously bought and put there to be found again, as many do—and for which practice one man got ten years on the breakwater only a few days since—it is difficult to say. The Kimberley Coal Company has gone to nothing, as everyone predicted it would, working a seam of coal 4in. in thickness. They paid from some parts 20s. per mina—220 lb.—for transport alone, and then the coal was all shale and could not be used.

LETTERS TO THE EDITOR.

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

THE DISCHARGE OF SEWERS.

SIR,—Replying to your correspondent "H. B.," Southport, the following simple formula for calculating the discharge from cylindrical pipes is taken from page 384 of "Hughes' Treatise on Waterworks," "Weales' Series," and though undoubtedly intended to apply to clean pipes, will probably be found to approach near enough to accuracy for practical purposes:—

Let U = velocity in feet per second.
,, D = diameter of pipe in feet.
,, H = inclination of pipe in feet per mile.
,, C = 2·3 coefficient for friction (Mr. Blackwell's.)

$$\text{Then, } U = \sqrt{\frac{D\,H}{2{\cdot}3}}$$

Applying this to the sewer referred to in "H. B.'s" letter, and supposing it to be running full under the most favourable conditions, that is, with a free outfall, the gradient given, 1 in 800= 13·2 in two miles, therefore $H = \frac{13{\cdot}2}{2} = 6{\cdot}6$, and D = 2. Then

$U = \sqrt{\frac{2\times 6{\cdot}6}{2{\cdot}3}} = 2{\cdot}4$ft. per second, and as the sectional area multiplied by the velocity equals the discharge in cube feet, 3·1416 (the area of a pipe 2ft. in diameter) $\times 2{\cdot}4 = 7{\cdot}53$ cubic feet per second.

Calculated by tables given on pages 202 and 203 of "Stagg's Book on Sanitary Work," the velocity would be rather less:—

(Hydraulic mean depth 6in.)

Table 1, Log. of 307 $\sqrt{d}-0{\cdot}1 = 2{\cdot}85812$
,, 2 ,, $\sqrt{s}-L\sqrt{s+1{\cdot}6} = 1{\cdot}39690$
(Slope of 1 in 800)
Log. of $28{\cdot}92 = 1{\cdot}46122$

Deduct value of 0·3 $\sqrt{d-0{\cdot}1} = \frac{{\cdot}7}{28{\cdot}22} = 2{\cdot}35$ft. per second.

Then, $3{\cdot}1416\times 2{\cdot}35 = 7{\cdot}38$ cube feet per second.

"H. B." is evidently in error in assuming that the gradient changes with the rise of the water in the river. What really happens is that the point of free outfall is changed to a point in the sewer probably somewhat higher than the level of the water in the river, and the quantity of sewage passing this point will of course be the quantity discharged. The head of water formed in the sewer will represent the force necessary to overcome the weight and velocity of the water in the river and the increased friction in the pipe. The statical pressure for a "head" of 5ft. is 2·17 lb. per square inch—"Molesworth's Pocket Book of Engineering Formulæ," page 176—but the actual pressure on the mouth of the outfall will be greater should the angle formed by the junction of the sewer with the river exceed 90 deg., that is, it will vary within certain limits with the angle and velocity of the current. W. G.

Ealing, February 12th.

CONTINUOUS BRAKES.

SIR,—In the very interesting article on "Continuous Brakes on the Prussian States Railway" in your last week's impression, a slight mistake occurs in the quotation from the "Centralblatt der Bauverwaltung," owing to the translator having erroneously made it appear as if the duties of the trained fitter—who, according to the decision of the conference of the Royal Prussian Railway authorities, is in future to accompany, in lieu of an ordinary brakesman, each train fitted with a continuous brake—are to include those of warming and oiling the brake, whereas it was merely resolved that, in addition to looking after the brake, he could attend to the warming of the carriages and the due oiling of the axle-bearings. This mistake, which would otherwise be unimportant, becomes, however, extremely interesting, because your translator happens to have thus hit unwittingly on a very important requirement in the probable future duties of this train attendant during the winter season, and one which it would appear has been completely overlooked by the members of the conference.

With all air or vacuum brakes the thawing of frozen portions of the apparatus, such as pumps, valves, or hose pipes, is frequently necessary as soon as the temperature falls below 8 deg. to 10 deg. Reaumur. I was myself detained for some minutes at one of the stations whilst travelling on the Berlin Metropolitan Railway shortly before Christmas, until a fire had been lit under the locomotive to thaw the exhaust pipes of the vacuum brake, although the cold had only reached 6 deg. Reaumur. The Parliamentary Returns of continuous brakes for the winter of 1881, which, owing to the mild seasons ever since, is the latest date at which the ordinary cold of a Swiss or German winter was experienced in this country, show numerous instances of the compressed air and vacuum brakes being rendered unserviceable by frost on the Great Eastern, Great Northern, London and Brighton, Midland, Metropolitan, and other railways, between the 14th and 21st of January. As frost is also supposed by the opponents of the automatic friction brake system to be one of its most dangerous enemies, the special appointment of a man to keep the friction gear duly warmed ought to have been hailed with delight also by its supporters, although it might possibly, I think, prove a dangerous experiment to test practically the extent to which the coefficient of friction between cast steel and cast iron becomes affected by frost, by placing the fingers between the axle drum and friction roller, when the temperature is even as low as 15 deg. to 20 deg. Reaumur.

As an interesting proof, however, of how "doctors differ," the curious fact may be here noticed that one of the engineers of a large and important Government railway in North Germany actually reported at a conference, not long ago, as a ground for his objections to friction brakes, that ice had formed between the axle drum and friction roller whilst the brakes were off and the train was running, thus filling up the space intended to be left free between them, and putting on the brakes automatically, thus proving how carelessly even the best known works of reference have been compiled, a coefficient of friction for ice on ice not being given, as far as I can ascertain, in any table published. C. FAIRHOLME.

February 13th.

BRASS-FINISHING LATHES.

SIR,—Having seen a letter in your impression of the 27th last month referring to brass-finishing lathes, in which it is asserted that the American lathes can turn out 200 to 300 per cent. more work than any other make, and that Messrs. Smith and Coventry, of Manchester, are makers of lathes after their plan, I thought it an astounding assertion. The writer of that letter cannot, I think, be acquainted with what has been in use in this country for the last quarter of a century. I designed and had made for Messrs. J. Lambert and Son and Lambert Bros., a lathe for finishing gun-metal cocks and valves about twenty-five years ago, that, I think, will turn out as much work, and as good, in as quick time as either the Fox or Cooper lathe, and has been doing so ever since it was started. By it a 2in. gun-metal gland steam cock body can be bored and faced, the two ends bored, faced, and screwed, including the chucking and shifting the lathe from the taper to the parallel, in twenty minutes, and be made a good job of. The boring taper is self-acting; the turning is self-acting; so also is the screwing; while the Fox lathe has nothing self-acting about it except the screwing motion.

The lathe I am describing has no back poppet head to it; I designed it for work to be done on the face plate or universal chuck only, and is especially adapted for it, the other parts being done in another lathe, as I consider that to be the quickest and cheapest way of getting the work done. Of course, quantities are given out to a workman, and not one at a time, as I have described. Therefore they can be done quicker than the time I have mentioned; the one only that I timed was done at a great disadvantage, the lathe having to be shifted in the time from taper to parallel. This lathe has been at work ever since it was started, and thousands of gun-metal cocks and valves have been made by it, and thousands more can yet be made.

I think I can challenge the Cooper or American Fox lathe to do the same work in the same time as I have stated. I therefore do not believe that the American lathe can do brass work any cheaper or quicker. Besides that, the American lathe costs about £150, while I could get nearly three of the lathes made that I have described for the money. J. B. DAVIS.

46, Lysways-street, Walsall, Staffordshire,
Feb. 6th.

ELECTRICITY *v.* GAS.

SIR,—Will you kindly grant me the favour of inserting in your columns the following remarks on this subject: In the *Times* of the 16th ult. is a very able and explanatory letter from Mr. C. E. Coope, showing that to light Berechurch Hall by electricity cost £1470 8s. as against £1333 18s. by gas, thus showing the small sum of £136 10s. in favour of gas. But in the estimate for electricity a sum of £300 6s. is for engine and boiler, which when not at work for electric lighting, he says, pumps water, cuts wood, &c. &c. Now suppose we put that the reverse way, and say the engine that pumps water, cuts wood, &c., also drives the dynamo, then we may surely deduct its cost from electric lighting, and show a balance of £163 16s. in its favour, or, say, deduct one-half and balance the costs. As the said engine only works for 1150 hours per annum in lighting, there is the whole day for its other uses, and its cost should be charged accordingly.

If we examine the relative cost of the two lights on a scale of 2000 of both kind, each of 18-candle power, we shall find electric incandescent lighting considerably the cheapest. Let us put the aggregate of lighting hours in a year at 2200, and allow five cubic feet of gas as producing eighteen candles, and we then have a simple calculation thus:—5 × 2200 × 2000 = 22,000,000 cubic feet, which costs consumers as follows:—

At 3s. 6d. per 1000 cubic feet ..	..	£3850, or £1 9s. 0d.	per light.
At 4s. 0d. ,, ,,	..	£4400, or £2 4s. 4d.	,,
At 4s. 6d. ,, ,,	..	£4850, or £2 9s. 0d.	,,
At 5s. 0d. ,, ,,	..	£5500, or £2 15s. 0d.	,,

Those figures are, I believe, correctly put and beyond dispute. Mr. Coope has put the cost of his electric lights at £1 3s. 3d. each for his year of 1150 lighting hours, and it is remarkably significant of accuracy that my calculations, made five months ago for 2200 lighting hours, work out as costing £1 5s. 8d. each when using storage batteries, and £1 10s. each when lighting direct off the dynamo, as does Mr. Coope, the difference of 6s. 9d. well showing the economy of working in quantities. His figures are based on 200 lights and mine on ten times as many, and whereas he charges steam coal at 20s., I put it at 15s. per ton.

As this letter refers to the commercial aspect of lighting, I will omit to describe the comfort of electricity; but I must mention one point which none but the few practised like myself clearly understand. At least one-third of our gas, oil, and candle bills is caused by our dislike to the trouble of re-lighting, and duplex lamps, gas, &c., once lighted are, as a rule, lit for the night; to extinguish and re-light, or even turn down, is labour, and mineral oil is apt to smell if the flame is lowered. But electric incandescent lamps may all flash into light in the twinkle of a second, and may be turned out, or up, or down, separately, or all together. In illustration of that I lately took a lady into dinner, and as we entered the room sprang into light, while her husband coming last left instant darkness in the drawing-room. This was done to show that electric lighting, being under complete control, is more economical than other lights. Whoever will be kind enough to examine my figures, while bearing in mind how electric incandescent lights can be modified or extinguished without a fraction of trouble, will, I think, acquit me of an over statement when saying I find electricity considerably the cheapest.

J. D. SHAKESPEAR,
M. Soc. Tel. Eng. and Electricans, A.M. Inst. C.E.
19, Matheson-road, West Kensington,
February 6th.

THE BOILERS OF THE POLYPHEMUS.

SIR,—With regard to your remarks upon the boilers of the Polyphemus in yours of last week, there seem several points that want clearing up. It may be asked why locomotive boilers were selected for the ship, to be worked on the forced air system in closed stokeholes? If space was the object, an experiment could have been made on the conditions required with one boiler set up on land, and the results ascertained before putting ten boilers on board, for what would be true to one would be equally so for a dozen. The cost to test a boiler in the makers' yard under the conditions required for sea service would be but trifling. As it is, it appears that no information was obtained; all the boilers were made and put on board before the error was discovered. I have tested many marine boilers under full speed trials in some of our naval ships; but the Admiralty, for some reason or other, did not think proper to follow it up. Why the full knowledge of the working of boilers should not be as interesting as that of the engines it is difficult to say. Not only the Admiralty, but engineers and shipbuilders, are equally indifferent upon the subject; if a set of boilers can be got to supply steam for the trial run, they are satisfied. If marine engineers are going to adopt locomotive boilers for sea service, the least they might do would be to inquire into the conditions necessary for working them efficiently. The locomotive is so common that marine engineers fail to discern that circumstances alter cases. Put any locomotive in the Polyphemus, and the result will be identically the same as with the present boilers. The difference is, on a railway the blast is in the funnel, and the gases evolved from the fuel are drawn through the tubes, and an equal distribution of the heat insured. In a closed stokehole on board a ship the force of air is applied to the furnace end, and the process reversed; the heat in the fire-box is like a large forge fire, producing intense local heat and excessive priming; the flames on entering the tubes become extinguished, so that the heat passing through them is below the flame point, whilst the temperature in the fire-box would average 2800 deg., and a large portion of the gases passes through the tubes unconsumed and will light up in the funnel just where they are not needed. A locomotive boiler without a blast in the funnel will not steam satisfactorily.

Pocock-street, London, S.E. W. A. MARTIN.

PREVENTION OF SCALE IN STEAM BOILERS.

SIR,—No one possibly will be surprised to learn that the hypothetical case of a 20-horse power boiler costing £9 per annum for soda exists only in the imagination of the Disincrustant Marseillais Company. The attempt which that firm makes to show how costly soda is, and how much more economical it is to use their composition, will scarcely bear examination. I take it they do not overstate the cost of their own composition, and yet excellent results can be obtained by the careful use of soda costing very much less. I know of a series of boilers using in the aggregate nearly 5000 tons of small coal per annum where soda is used, and giving excellent results, and the cost of the soda used in a year does not amount to more than £14. There is no excessive wear and tear in the gun-metal boiler fittings, the gauge cocks in several instances not having been replaced or re-ground for years. We have upwards of thirty steam boilers at work in different parts of the factory, but those I mention are a group of seven tubular boilers—Cater, Walker, and Co.'s patent—which raise steam principally for boiling and other manufacturing purposes. They are provided with scum cocks, and are regularly blown out four times in the course of twenty-four hours. A couple of large chests receive the steam direct from the boilers, and these are cleaned out every three months, when a considerable accumulation of orange-coloured sludge is removed. The boilers themselves are examined internally every five weeks. The soda used is common soda, not caustic soda, introduced with the feed-water. The feed-water is taken from the Thames, part of it direct, but the larger portion is return water from the condensers of a pair of large steam engines. The water is first used for cooling purposes, and then passes into the condensers in the form of injection water, and even though it passes through a strainer, it carries with it a considerable quantity of small particles of fat, which, of course, pass into the boilers. Small coal of inferior quality is the fuel used, all the boilers being provided with Jukes' furnaces, and very seldom can smoke be seen issuing from any of our chimneys. SODA.

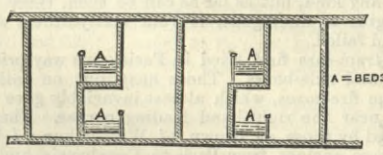
London, February, 1883.

SIR,—I notice in the Disincrustant Marseillais Company's letter in last week's ENGINEER, they still stick to it that caustic soda in boilers causes the iron to be eaten away, which is quite incorrect. In their first letter they did not speak of boilers "priming," and so the water and what it has in solution being carried over mechanically with the steam; their statement was that "caustic soda was passed along with the steam into the engine." They speak of priming as a natural condition of boilers, which is not so with stationary boilers, it only taking place under abnormal conditions, such as over-work and bad construction.

THOMAS R. DUGGAN, M.S.C.I.
59, Lauriston-road, South Hackney.

BERTHS IN STEAMERS.

SIR,—In your article on "Berths in Steamers," you say the only way you see to give two passengers, now united in one cabin, each a separate room, is to divide an ordinary cabin with two beds in two cabins, each with one bed, and in doing so you divide a cabin with 2ft. breadth of bed and 7ft. free space, into two cabins in



which you get only 2ft. 6in. free space. Now, I believe you could divide the large cabin so as to get 3ft. 6in. in each cabin free space by placing the beds as in sketch. A shows the beds.

14, Dundas-street, Sunderland, Feb. 10th. C. KLOOS.

SIR,—In your late article on the interior arrangements of cabins or state rooms of ocean steamers, it is held that little or nothing can be done by shipowners—without increasing fares—to alleviate those miseries of overcrowding that have of late caused such loud complaints. The reason attributed is want of space. The instance given to illustrate the result of providing separate cabins shows the necessity of paying treble fares. But the question arises, Can no middle course be followed? if a whole cabin cannot be assigned to each individual, could not shipowners afford to limit its occupants to two? Then it would be easy to see how its space of 9ft. by 7ft. could be utilised, with proper regard to decency, isolation, and comfort. The present style of magnificent ocean steamers can fairly be likened to a gorgeous mansion, consisting of a ball-room and various cattle pens. Were any company to pay attention to the cattle pens, even at the expense of the ball-room, it would doubtless benefit by a largely increased business. If shipowners still plead nothing can be done, let them state their wants, and offer a bonus for the best elucidation of the puzzle. As it appears to be rather a matter of arrangement than of space, a very small encouragement would evoke the best efforts of the public to solve the matter. G. L. C.

February 14th.

STEAM ON TRAMWAYS.

SIR,—With reference to a letter which appeared in your last issue under cover of the signature, "A. B.," permit us to make the following remarks.

It is only right and proper, if the Wigan Tramways Company are careless and inattentive in the use of their engines, that the local authorities should intervene to wake them up to a proper sense of their duty. As regards the emission of steam, we may remark that it is quite possible at the termini where the engines have to wait twenty minutes that steam may be apparent. The driver has to keep a black fire during the interval to keep steam down, and this necessarily interferes with the superheating arrangements; but it is simply an impossibility that during the journey, with proper attention to the fire, there should be the slightest appearance of steam. Coke is used alone, so that no smoke can possibly be seen. The fact that the servants of a tramway company are allowed to become lax and inattentive in their work does not affect the main issue as to the merits of the Wilkinson engine and its capabilities of effecting a considerable saving in working expenses as compared with horse traction, and the fact of its adoption by so many important companies, after a careful inspection and comparison with other types, is the best possible proof of the opinion which competent and unbiassed judges have formed as to its capacity for increasing the shareholders' dividends. To all new systems of locomotion there must always be some strong opponents, whose interests are affected more or less, and in considering objections and complaints it is as well not to overlook this.

As regards the letter of Mr. Henry Hughes, we may state that all charges for a correct comparison between steam and horse traction were included in Mr. Mawson's statement. It is not usual to charge office expenses in such calculations. MARPLE AND CO.

Dashwood House, New Broad-street, London,
Feb. 12th.

SIR,—Having seen two letters in your last issue—9th February—one signed by Mr. Henry Hughes, and the other "A. B.," which reflect somewhat on the performances of our engine for tramway purposes, we shall be greatly obliged if you will give us space in your next issue for a few remarks thereon.

First, as to Mr. Hughes' letter. The statement of working expenses—3·75d. per mile run—is more than correct, inasmuch that, instead of any of the items in the account being understated, in anticipation of criticism, the reverse is the case—viz.: engine-drivers and cleaners on the line referred to are paid less than 30s. and 24s. per week respectively; oil and tallow are bought at less than 3s. 6d. per gallon and 6d. per lb.; the water used is under 2000 gallons, and the price paid for it under 1s. per thousand; the repairs to the engines have been done by a local firm—the Tramway Company not having any fitters of their own—and therefore must necessarily cover "files, tools, &c." We have the best reason possible for stating that the whole cost of working this line of heavy gradients—1 in 21, 1 in 19, and 1 in 16—including all administrative expenses, is a very small fraction over 6d. per car mile run, since the introduction of steam, as against 9¾d. before that event. In reference to the engines being driven by "other than well skilled and intelligent men," the fact of them—the engines—being under such complete control, and so easy to manage by the "unskilled and non-intelligent" men who now drive them, after having run upwards of 75,000 miles with only one accident to life or limb—viz.: that of a child running from behind another vehicle going in an opposite direction right in front of the engine, speaks well for both engines and men in charge of them. We would remark also that during the above time there have been no less than four lives lost in the borough of Wigan by slow moving carts, lurries, &c.

In reference to the second letter, signed "A. B.," calling attention to an extract from the *Wigan Observer*, we beg to say, for the information of readers interested in steam tramways, that Pem-

berton is a straggling township outside the borough of Wigan, that refused to avail itself of the advantages of a free library, and that the opposition to steam on the tramway emanates from two or three fossil members of the local board, who happen to be in that happy position of being able to drive to Wigan behind their own and other people's horses, and who are so narrow-minded in their views, and opposed to progress generally, that we believe they would hail with delight the abolition of railways, steamships, telegraphs, and the postal service, and would monopolise the highways for their own exclusive use, without any consideration whatever for the comfort and convenience of the public at large. As proof of what we say, we have before us at this moment a letter from the chief constable of this borough, saying that he has not had a single complaint about the engines; also letters from the ex-mayor, a member of the Streets Committee of the Corporation, a surgeon, and a magistrate of the borough, all speaking well for the working of the engines inside the town. We therefore have no hesitation whatever in saying that if there was any actual nuisance, it would have developed itself in the borough, where the engines are running every ten minutes from 9 a.m. till 10.30 p.m. through the principal street, which is constantly crowded with heavy and light traffic of every description.

I hope you will insert the above in justice to ourselves, and that "A. B." may have the courage and honesty that Mr. Henry Hughes has, to sign his real name when next he writes a letter to the public papers.

Wm. Wilkinson (for Wm. Wilkinson and Co., Ld.)
Holme House Foundry, Wigan, February 12th.

Sir,—As one taking considerable interest in the working of tramways, may I ask for space to say a few words concerning the Wilkinson engine?

It is a curious circumstance that no illustration or description of this engine has ever been made public by the inventor or any one else. I have before me a photograph of one, however, which shows no details of any kind, but as far as can be seen, there is nothing about the engine to distinguish it from many others which have been tried and failed.

The steam tram-cars first tried in Paris gave way principally in the journals and axle-boxes Those next put on failed by the cracking of the fire-boxes, which almost invariably gave way, after a few weeks, near the right-hand leading corner. These engines were succeeded by those of Brown, of Winterthur. I have often ridden on these engines from Paris to Courbevoie, and I at first thought that they had solved the problem; but a month was all that was needed to convert these engines into ricketty rattletraps.

Hitherto steam tram-engines have been killed by the cost of repairs. I want Mr. Wilkinson, or Messrs. Marple, to tell me in what respect his engine differs from those which have gone before. Has he special appliances for keeping dust, and dirt, and road grit out of his slide bars, crank pin bearings, and valve gear? Has he better springs than are commonly met with in such engines? Has he a boiler which is better than any other boiler? In one word, why is Mr. Wilkinson's engine better than those made by Merryweather, Brown, Kitson, Hughes, and others? We have the word of Mr. Wilkinson, at all events, that it is better; but I want to know why.

Director.

London, February 14th.

Sir,—I have never seen mentioned in The Engineer particulars about the tramways of the Compagnie Gènèrale des Omnibus de Paris. Some prominent features are: First, the wheels which have flanges only on one side, while the rails are grooved each side so as to allow the cars to run either way. From experiments that were made by M. Tresca, the saving in the power needed for traction amounts to 10 to 12 per cent. against wheels with two flanges. This difference comes from the impossibility of keeping the two rails on common roads always exactly at the same distance, so that it brings a strain and resistance on the flanges of the wheels. Small stones and mud in the rails will have the same effect. It gives also facilities for turning curves, and still the cars keep the metals as well as other vehicles. They use no switches or points for sidings, which are necessary with other cars. They have also an ingenious device for turning very sharp curves, which could probably be applied in other circumstances. These tram-cars have a fore carriage, having only a very small locking motion, as the wheels being very large would not pass under the body of the car. There is a lever at the side of the driver which communicates with a pin falling in the circle of the fore carriage which fixes it in position to keep the wheels perfectly parallel. When coming to the sharp curve the driver pulls the lever, which releases the pins and allows the fore-carriage to move slightly. The front wheels then take the rails A and the back wheels go on the lines B. The sketch is not drawn to any scale, but has been exaggerated so as to show the principle.

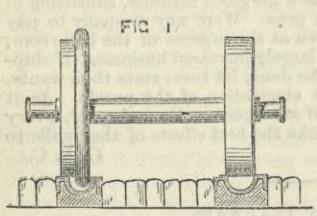


FIG. 1

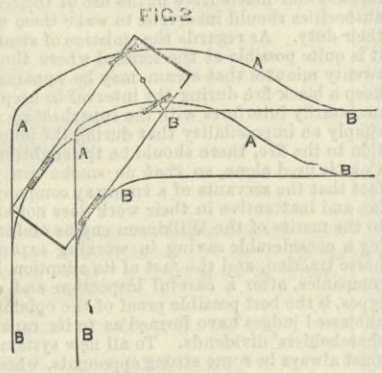


FIG. 2

F. Gougy.

Boulevard Mont Parnasse, 6th February.

AUTOMATIC COUPLING FOR RAILWAY PURPOSES.

At the meeting of the Manchester Association of Employers, Foremen, and Draughtsmen held on the 26th ult., Mr. Thos. Ashbury, C.E., in the chair, a paper on "The Necessity for an Automatic Coupling for Railway Purposes" was read by Mr. Joseph Nasmith. The subject of improved appliances for coupling railway vehicles was one, he said, which was gradually but surely forcing its way towards a settlement. It was one of the anomalies of railway practice that while the whole of railway plant and material had been materially improved in structure, and, in fact, completely changed, the old-fashioned unmechanical method of coupling was still used by railway companies, and the most careful observer could not find the least improvement. Our American cousins had gone far ahead of us in this respect, and he thought the time had fully come when the necessity for improved couplings should be at once admitted to this country and means taken for their adoption. In view of the rapidly increasing goods traffic, the loss of time entailed in coupling up and uncoupling, the consequent delay and loss in the subsequent running of the trains and the great loss of life under the present system, the largest possible outlay would be more than recouped if the goods wagons were all fitted with an efficient automatic coupling. In his opinion any improved coupling should have four chief features:—(1) It should be automatic—that is, self-coupling; (2) all operations of uncoupling, tightening up, or untightening must be done from the side of the wagon; (3) it must be adaptable to present stock; and (4) the cost must not be excessive. The devices which had been invented in this country might be divided into three classes: (1) There was the class of coupling poles which were designed to enable men to couple the wagons with the present hanging links without going between the wagons or leaning over the buffers; (2) they had the numerous class of inventions which might be termed lever couplings, which enabled the hanging links to be coupled by means of a carrier shoe or other appliance which was worked by means of a lever at the side of the wagon; (3) we had a class of couplings which, so far as coupling up was concerned, were purely automatic, and which could be uncoupled easily from the side. The last class might be divided into two subdivisions by the appliances which were both coupler and buffer combined, and those which were only intended as couplers. He thought that between the lever and the automatic coupling the fight would be short and sharp, and that whenever the companies adopted a new coupling their best interests would be served by the introduction of an automatic one. The centre buffer and coupler combined was already extensively used on American, Colonial, and Continental railways, but it was not likely, he thought, to find much favour in this country, not only because of a very general preference for centre couplings and side buffers, but because the combined buffers and couplings could not be so readily adapted to the present stock. That coupling was as effectually performed by the centre buffer was, however, undoubted, and it only became a question of adaptability and cost. Mr. Nasmith then exhibited models of a couple of wagons fitted with two forms of automatic couplings, one designed for use on ordinary stock, and the other being a form of buffer and coupling combined, which he said were at present largely in use in the Colonies. The first coupling, which would be the best adapted for English stock, consisted of a spoon-bill-shaped link working on a pin placed in the same position as for an ordinary link coupling. The link had a cap piece fitted, which served the double purpose of a stop, preventing the link from dropping too far, and of strengthening the link. The drawbar hook was slightly altered in shape; instead of being rounded off as usual on the underside, it was shaped with an angular nose, strength being thus obtained, and the form being a convenient one to enable the cap piece to act as a stop. A small pin was fixed in the side of each link, to which was attached an L lever, which was keyed on a cross shaft running underneath and across the wagon, and having at each end a short hand lever attached. The links were rounded off at the nose on the underside, so as to enable them to move freely up each other. The action was as follows:—When two wagons were pushed together one of the links mounted the other, moving up the link until it passed over the drawbar hook, when the weight of the link and the levers attached caused it to fall and keep its place. In case of a difference in the height of the wagons, the link attached to the highest wagon was the one which mounted and coupled. In order to uncouple, the lever at the side of the wagon was pulled over, and the link was raised by means of the L link already referred to. Thus the coupling was purely automatic, and the wagons were readily uncoupled from the side; the working parts were few and simple, and the alterations which will be required for adapting it inexpensive. When fly-shunting was required it could be performed with this coupling with certainty and without danger. When it was required to couple to a wagon with the ordinary link, all that was necessary was to throw back the automatic link. Tightening apparatus could also be easily applied, so that the carriages could be readily drawn together. The automatic coupling would act with a difference in height of wagons of 7in., and coupled on the sharpest curve known. In the buffer and coupler combined, which was by far the most common form of automatic coupler at present adopted, being in use in various shapes in several countries, the buffer-head was formed at the end of the drawbar, and was so arranged as to present an elongated orifice outward, which allowed of the coupling link being caught and lifted when it was in a position in which it hung a little. The coupling link was loose, and could be attached to either car at pleasure. A catch formed by an inclined plane at its bottom side worked in a slot which was formed in the head, and dropped sufficiently far as to have a good bearing when the draught was on. When the link was pushed up the orifice of the coupling head, it raised the catch and passed forward until the buffer faces were together, when the catch dropped into its place through the inside of the link, and the coupling was effected. A hanging link was attached to the catch, and was lifted by a bent lever worked from the side of the wagon, much in the same way as in the previously described automatic coupling, with the exception that the levers at the side of the wagon had weights attached, and not until the weights were over the centre was the uncoupling commenced, so that there was no possibility of the wagons being uncoupled by shock or vibration. The models he had produced showed that an automatic coupling was an accomplished fact mechanically, which was in use in other countries, and he urged that it ought to be an accomplished fact as an instrument in daily use in this country. In the discussion upon the paper the ingenuity and simplicity of the appliances described by Mr. Nasmith were generally admitted, but so far as their adoption by English railway companies was concerned, it was considered that the necessity of their being introduced throughout every system to secure their thoroughly effective working would be a fatal objection. The introduction of automatic couplers on English railways, it was thought, would only be effected by gradual steps, unless Government could be induced to insist upon the universal adoption of one particular system, which was not very probable.

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

(*From our own Correspondent.*)

Fuller price lists are to hand this week from one or two of those ironmakers who a fortnight ago reduced their quotations 10s. per ton. Messrs. E. T. Wright and Son, of Wolverhampton, quote "Monmoor" best boiler plates, up to 5 cwt. each., £9; double best, £10; and treble best, up to 4 cwt., £12. Special plates for flanging purposes, up to 3 cwt., are £15 10s., and charcoal plates £17 10s. "Monmoor" sheets—singles—not more than 8ft. long, nor 36in. wide, nor thinner than 20 w.g., are £8 10s.; best, £9 10s.; double best, £10 10s.; and charcoal sheets, £17. "Monmoor crown" bars, ½in. to 3in. round and square, or to 6in. flat, are £7 5s.; best, £8 5s.; and double best, £9 5s. Best rivet iron is £9, and double best £10. Angles, to 8 united inches, ordinary "Monmoor" quality, £7 15s.; best, £8 15s.; and double best, £9 15s. T bars are:—"Monmoor" quality, £8 5s.; best, £9 5s.; and double best, £10 5s. Hoops and strips, from 16 to 19 w.g., are £7 10s.; 20 w.g., of ⅝in., £8 5s.; and 20 w.g., of ¾in., £9.

The demand for marked iron, as bars, sheets, hoops, or plates, has been only slightly improved by the reduction. On some hands it has checked buying, by inducing a want of confidence in the stability of the market. Business on the whole has not improved on the week. Yet in Wolverhampton yesterday, and in Birmingham this afternoon, a few sheet makers spoke of rather more inquiries from the galvanisers, and from merchants on account of Russia and India. The number of mills, however, that have been put to stand for want of orders is larger this week than last. Prices are very varied. Singles may be given as £7 10s. upwards; doubles, £8 5s. upwards; and trebles, £9 to £9 2s. 6d. upwards. Plates are tame at £8 as a minimum for tank sorts, and £8 10s. to £9 and on for boiler qualities. The competition of North Staffordshire in this branch is somewhat severe.

Bars, hoops, strips, and nail rods, of second and third-class qualities, are selling steadily, but without any "push." Business is elmost exclusively of a hand-to-mouth character. Second-class bars are £7 to £6 15s., and third-class are a minimum of somewhat under £6. Hoops are £6 10s. to £7, and strips £6 7s. 6d. upwards for gas tube sorts.

Welsh mill shearings for piling purposes are quoted at 60s. per ton delivered into this district.

Pig iron is dull. Buyers will only purchase in satisfaction of immediate necessities. Stocks of all mines are rapidly accumulating at the furnaces, and Messrs. H. and G. Ward Brothers, who produce this class, have this week blown out their plant at Priestfield. Their stock is variously estimated at from 6000 to 10,000 tons. Other firms in the district are credited with having stocks equally heavy.

Quotations for pigs are:—All-mines, 65s.; hematites, 62s. 6d. for Blaina brand, 65s. for Tredegar, and 67s. 6d. for Barrow; Staffordshire part mine pigs, 50s., with the Castle Iron Company, Walsall, quoting 52s. 6d. for their mine iron; and native cinder pigs, 40s.

Ironstone and cokestone: Leicestershire stone is being pushed here in competition with Northampton, the price of both being 6s. to 6s. 2d. delivered; South Yorkshire washed cokes, 15s. 6d. delivered. Furnace and mill and forge coal dull at 11s. to 9s. 6d. for furnace; 9s. to 7s. 6d. for mill sorts; and 7s. to 6s. 6d. for forge; all large weights at the pit.

The work of opening out the Hamstead Colliery, situate on the Staffordshire side of Birmingham, which has been started some seven or eight years, is now proceeding steadily. The inset in the second and principal shaft is now being put in, but it will be some months before it is finished. As the shaft is unusually deep—623 yards—a very large quantity of coal will have to be put into the market to cover the expenses. The plant, therefore, is of some magnitude. A three-decked cage is being used for drawing, each of the decks having two tubs, so that six tubs are raised at a time. Arrangements are being made for underground haulage. The directors anticipate that they will be in full work next year.

Mr. Henry Johnson, jun., president for the ensuing year of the South Staffordshire Institute of Mining Engineers, in his inaugural address on Monday, claimed that during the sixteen years the Institute had been in existence it had done good work. There were fewer accidents, and the coal-field had been enlarged with machinery and plant unknown to former colliers. There was still plenty of vitality, however, in the older portions of the field. The search for coal in greater depths had introduced new ideas, and among the first of these was electricity, and underground haulage was making rapid progress.

The Home Secretary has consented to receive a deputation from the Operative Chainmakers' and Nut and Bolt Makers' Associations, of Walsall, to urge the necessity of legislative enactment for regulating female labour in those trades. The promoters do not wish to drive females entirely out of the industries.

Mr. W. J. Davis, formerly secretary to the National Amalgamated Brassworkers' Association, will be appointed to the Sheffield district as an inspector under the Factory and Workshops' Act. This is the second working man appointment which Government has made to this office.

At the instance of the Mayor, it has this week been determined by a number of the leading traders of Dudley to form a Chamber of Commerce.

Encouraged by the success which last year attended a Building Trades' and General Manufacturers' Exhibition in Birmingham, it is proposed to hold a similar exhibition this year from April 30th to May 28th.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—Buyers and sellers in the iron market are at present engaged in a struggle over prices, and there is not much actual business being done. Buyers hold the opinion that prices have not yet touched their lowest point, and are using every effort to pull them down still lower; whilst makers—who, as I have pointed out in previous reports, have found that concessions already made did not satisfy buyers—seem to have set their faces strongly against any further giving way. For pig iron inquiries during the week have been very limited, and where offers have been made, they have for the most part been at considerably under makers' minimum prices. As regards finished iron, the "bears" seem in large measure to have taken possession of the market, and even known brands have been offered at 2s. 6d. per ton under the lowest possible makers' prices.

There was a fully attended market at Manchester on Tuesday, but the results were anything but satisfactory so far as business was concerned. Lancashire makers of pig iron report a falling off in inquiries, and the offers which buyers make do not in the majority of cases come within 1s. or 1s. 6d. per ton of the minimum quoted rates. As, however, local makers are not at all anxious sellers, there is no disposition to entertain such low offers as these. The projected new cotton mills in the neighbourhood have brought contracts into the market for fire-proof castings, and local founders have been compelled to buy some iron recently to cover these. A moderate quantity of Lincolnshire iron has been sold in connection with these contracts, and this represents the bulk of the business which has of late been done in district brands. For delivery equal to Manchester quoted prices remain at about 46s. 6d. to 47s. for forge and foundry Lancashire, 45s. 10d. to 47s. 10d. for Lincolnshire, and 48s. 6d. to 50s. for Derbyshire, less 2½ per cent. In outside brands, such as Scotch and Middlesbrough, there has been underselling, and merchants are open to book forward at very low figures.

In the finished iron trade, as already intimated, "bear" operators are endeavouring to force down the market. There is very little business offering, and local forge proprietors, who are getting short of specifications, would no doubt be willing to take prompt orders at very low figures; but merchants are offering at prices which it would be difficult to get even the most needy maker to accept. In the present state of the market it is difficult to get any definite basis of prices, but it may be stated that whilst makers as a rule are asking £6 7s. 6d., there is no difficulty in buying bars at £6 5s. per ton delivered into the Manchester district.

The engineering trades generally are kept fairly well employed. I have very few complaints to make of any actual scarcity of work. Machinists seem to be rather better off for orders than they were a short time back, and wheelwrights appear to be generally well supplied with work.

A specially designed lathe for fly-wheels has just been completed by Messrs. Kendal and Gent, of Manchester, for Messrs. Crossley Brothers' new gas engine works. The lathe is designed for boring, turning, and facing the bosses, and for turning the rims of fly-wheels up to 8ft. 6in. diameter complete at one setting, and consists of a fixed head-stock, mounted on a base plate, carrying self-acting slide rests. The main spindle, which is 26in. diameter in the neck, has two internal steel spindles, the central one forming a bar for boring the wheel, and turning and facing the outer boss, the second spindle carrying a slide rest for turning and facing the inner boss of the wheel. A face plate, with jaws for fixing the fly-wheels, is carried by the main spindle, and is driven by treble gearing and cone pulley. The two internal spindles are driven at the back by independent treble gearing, and from a separate driving apparatus, and provided with the necessary self-acting motions. The duplex slide rests for turning the rim have each direct, positive, self-acting motions for sliding and surfacing, slides and former plates being provided for finishing the face to any given curve. This is the first machine of the kind constructed by the firm, and it has an exceptionally massive head-stock, with corresponding strength in the other working parts, and is adapted for carrying out simultaneously all the operations of boring, bossing, facing, and turning.

The Manchester and district members of the Institute of Civil Engineers held their annual local dinner on Thursday last at the Albion Hotel, Mr. W. B. Worthington occupying the chair and Mr. J. G. Lynde the vice-chair. The toast of the evening—the Institute of Civil Engineers—was proposed by the chairman and responded to by Mr. Lynde, who is one of the oldest members, having been connected with the Institute for over fifty years. The toast of the Institute of Mechanical Engineers was proposed by Mr. Lynde and responded to by Mr. R. Peacock. These local gatherings are, I believe, a speciality of the Manchester district,

and the wish was expressed that they might be extended to other provincial engineering centres throughout the country.

A somewhat better feeling is making itself apparent in the coal trade, and prices show more steadiness than they did at the commencement of the month. There is still an absence of any general activity in the demand, but orders seem to have been more plentiful; house fire coal has been going off better than during January, and an improvement in the shipping trade has helped up the demand for manufacturing classes of fuel. The restriction of the output, although it has only been very partially carried out, and has only in exceptional cases had any material effect upon supplies, has no doubt had some influence in bringing forward buyers who have shown more disposition to send out inquiries than for some time back. So far as prices are concerned the market generally is steady with the pit quotations averaging 10s. for best coals, 7s. 6d. to 8s. for seconds, 6s. 6d. to 7s. for common, 5s. 6d. to 6s. for steam and forge coals, 5s. to 5s. 3d. for burgy, and 3s. 6d. to 4s. for ordinary qualities of slack.

The improvement in the demand for shipment has not been followed by any increase in prices, and for delivery at the high level Liverpool, or the Garston Docks, the better qualities of Lancashire steam coal do not realise more than 7s. 9d. to 8s., with ordinary house fire coal averaging 9s. 3d. to 9s. 6d. per ton.

A fair demand is kept up for coke, and late rates are maintained.

As an organised general definite action, the movement for the restriction of the output of coal in Lancashire has, so far as the men are concerned, proved a failure. At the principal collieries in the Manchester district there has been no definite action on the part of the men with regard to restricting the output, and for the most part the pits have been kept going pretty near full time, any actual stoppages of the collieries being the result of the action of the owners, and not of the men. In some of the Lancashire districts a limitation of the output to five days a week has been in operation for some considerable time past, and the introduction of eight hours' work per day from bank to bank has had no material effect upon the quantity of the get. In the West Lancashire districts some attempt has been made at carrying out the restriction, and to a certain extent there has been a reduction in the quantity of the output at some of the collieries, but not such as to have any material effect upon the supplies generally. So far as the colliery proprietors are concerned, the general feeling has been that no definite action on their part was necessary to counteract the movement. A strong objection has, of course, been raised against keeping the day men on full time, whilst the miners are working only a portion of the day, and in some cases this has been met by running the pits only four and a-half days, whilst in one or two cases the attempt on the part of the men to regulate the hours of work has been resented by discharging all those who were not willing to accept the working hours as fixed by the colliery. Beyond this no steps have been taken by the coalowners, the movement being pactically left to work out its own cure.

The report issued this week by the directors of Messrs. Andrew Knowles and Sons, Limited, one of the largest colliery concerns in Lancashire, working a number of pits in the centre of the Manchester district, contains ample evidence of the depressed state of the coal trade. The property and assets of the company are valued at £1,224,655, and upwards of 1,100,000 tons of coal have been raised during the year, yet the gross profits only amount to £31,891, and out of this there is nothing available for distribution as dividend amongst the shareholders. Out of the profits £24,362 is absorbed as interest on debenture bonds, £882 as interest on calls paid in advance and reserve fund, £2000 to write off preliminary expenses, and £4647 is carried to reserve, but this only puts the reserve fund at £3150. The directors report that all through the year prices have ruled exceedingly low, and competition from all directions has been as keen as at any time during the depression, large quantities of coal having been sent into Manchester and the outlying districts from the eastern coal-fields.

The committee of the Manchester Coal Exchange have this week issued their balance-sheet for the year 1882. They are able to report the continued success of the Exchange; the number of members is 405, as compared with 404 in the previous year; the total subscriptions, as against those of the previous year, are less by the sum of £11 5s. 6d., but this is attributable to there being fewer subscribers for the guinea tickets. The income of the past year amounted to £212, which, after the payment of expenses, leaves a balance in favour of the profit and loss account of £62. The committee congratulate the members on the completion of the scheme of incorporation, and invite the co-operation of all connected with the trade in furthering the interests of the Exchange.

Barrow.—The demand for hematite pig iron in this district is still very quiet, and there is no immediate probability of an improvement. The business doing in hematite pig iron is, however, likely to improve with the approach of spring, and probably it is with this object that makers are allowing stocks to accumulate, although deliveries are at present small, and shipments to foreign ports comparatively inextensive. There is no change in values, as it is thought prices are as low as they possibly can be with raw material and labour at the values they now stand at; 53s. 6d. is the quoted price of mixed parcels of Bessemer iron. There is a large amount of Bessemer now being used by makers of steel, and the consumption is expected to increase as extensions are being made in steel-producing plant, which will doubtless swallow up a large tonnage of iron. Stocks are still large, but makers are nevertheless resisting a further decline in the value of iron. Shipbuilders are fairly employed, but new orders will be wanted if the present activity is to be maintained. Iron ore is on heavy stock. Prices vary from 10s. to 12s. 6d. per ton net at mines.

The works lately bought by Messrs. Caird and Massicks, at Salthouse, Barrow, are, it is said, about to commence operations in steel conversion, plate rolling, forging, and wagon building.

The foundations of the new Town Hall, at Barrow, have well-nigh been put in.

Nothing is now heard of the scheme of Mr. Walduck, of Silverdale, for constructing a new railway from Hest Bank to Barrow.

THE SHEFFIELD DISTRICT.

(From Our Own Correspondent.)

THE crisis in the coal trade has now reached a stage which bodes early mischief. As I anticipated last week, an interview took place on Friday between the coalowners' committee and the delegates of the men with the officials of the Yorkshire Miners' Association. The interview lasted fully an hour, and the result was simply to leave things as they were. Mr. J. D. Ellis, the chairman of John Brown and Co., Limited, who presided, explained very tersely and clearly the objections of the employers to the policy of restriction as laid down by the men in their circular. Mr. A. M. Chambers—Messrs. Newton, Chambers, and Co., Limited, Thorncliffe—followed in a very able speech, in which he contended that the colliers' proposals were wrong in theory, wrong in principle, and could never be right in practice. The whole policy was opposed to free trade, to which England owed its commercial supremacy. Mr. E. Cowey, the president of the Miners' Association, Mr. B. Pickard, the Conference secretary, and Mr. John Firth, corresponding secretary, replied at some length. Their position was that coal was now 30 per cent. below its real value; that gas companies and other concerns dependent upon coal were making large dividends, while coalowners had little or no profit and colliers were working at scanty wages. The upshot was that the employers emphatically declined to be persuaded into any combination for restricting the output, and the delegates left to report the result to the adjourned Conference.

The Conference took place on Monday at Barnsley. Some 30,000 colliers were represented. Mr. E. Cowey, who presided, ridiculed what he called "musty-fusty doctrines of political economy," and contended that to continue selling coal at 30 per cent. under its value was an outrage not only on political economy, but on commonsense. Resolutions in favour of persevering in the restriction policy were carried unanimously—thirty-nine voting in favour, five neutral, and none against. The association say they will only carry out restriction—or, as the officials prefer to call it, "regulation"—if the other counties and districts agree to do the same. There seems at present to be every appearance of a stiff fight on this subject, and it looks as if the colliers' delegates were determined to have their way. A successful resistance can only be offered by the employers being firmly united and unanimous; and the colliers profess to know that the owners are not at one on the score.

The dispute in the file trade, which employs some 3500 hands, has not yet terminated. All the four Unions connected with file-making decline to concede the 10 per cent. asked by the manufacturers, who met at a Conference on Tuesday to consider the situation. The practical outcome of their deliberations was to leave each manufacturer to do as he pleased. At present several of the employers are receiving the concession, and these, of course, have no reason for joining in the agitation. The file-cutters and other workmen say distinctly that trade does not warrant any reduction in wages; therefore they will stand out for full statement price.

In the razor department there is an agitation on the part of the men for 10 per cent. advance in wages. They state that trade has been brisk for several yeras. Messrs. Joseph Rodgers and Sons, Limited, who are the best authorities on the subject, admit that for eighteen months business has been much brisker, owing to the Americans having taken a sudden fancy for hollow-ground razors. Orders, however, are now much lighter, the demand having been fully met. This company reminds the razor forgers that in 1877-78, when the trade was so depressed, they would have been justified not only in reducing wages, but in dismissing a number of workmen. Instead of doing so, they kept the hands at work making for stock, at considerable loss.

Mr. W. J. Davis, of Birmingham, has been appointed assistant Factory Act inspector for the Sheffield district at a salary of £500 a year. Captain Smith is the chief inspector here.

THE NORTH OF ENGLAND.

(From our own Correspondent.)

THE attendance at the Cleveland iron market, held at Middlesbrough, on Tuesday last, was but moderate. Pig iron was 6d. per ton lower than on the previous Tuesday, and as it is not at all certain that the lowest figure has been reached, very few orders were placed. Merchants, and some of the makers, accepted 41s. per ton for prompt f.o.b. delivery of No. 3 G.M.B., but the principal producers would not take less than 41s. 6d. per ton. Consumers were offering 40s. 9d., and would not give the higher rate, except for immediate requirements.

Warrants are again in poor request, though many holders would be glad to part with them for 40s. 9d. per ton.

The stock of Cleveland iron in Messrs. Connal's Middlesbrough stores, on Monday evening, was 87,203 tons, being a reduction of 444 tons for the week.

The shipments this month have, so far, been worse than in the corresponding period of January. Up to Monday night the quantity of pig iron shipped from the Tees was 18,120 tons; in January the corresponding quantity was 25,400 tons.

The manufactured iron trade is still in a depressed condition. Prices are very low, and must be unremunerative to many producers. Ship plates are to be had at from £6 2s. 6d. to £6 5s. per ton, f.o.t. at makers' works; ship angles at £5 5s. to £5 7s. 6d.; and common bars at £5 10s. to £5 15s. per ton. Puddled bars are still £3 15s. per ton net.

The steel rail trade is very quiet, and few orders have been given out of plate, though the price is down to about £5 per ton.

A deputation of Northumberland miners met the colliery owners at Newcastle on Saturday last, to discuss the question of adopting a new sliding scale. After some discussion, the owners suggested that the whole matter should be referred to a joint committee of masters and men, who should have full power to arrange the terms for a new scale for the county. The deputation promised to put this proposition before the miners, and get their decision as soon as possible.

At a Council meeting of the Durham Miners' Association held on Saturday last it was decided to make a proposition to the coalowners to reduce the output by working the collieries only five days per week.

H.M.S. Wanderer, the second of the two gunboats which Messrs. Raylton Dixon and Co., of Middlesbrough, are building for her Majesty's navy, was launched on the 8th inst. The Wanderer has a displacement of 1000 tons, and will be exactly the same in every respect as the Dolphin, which was launched a few weeks before.

The eighteenth annual dinner of the Cleveland Institution of Engineers was held at the Erimus Club, Middlesbrough, on Friday, the 9th inst. Over eighty gentlemen were present; Mr. E. J. Jones, the president, occupied the chair. Mr. Dodds, speaking of the growth of the iron and steel trade in the Cleveland district, referred to the enormous output of 2,600,000 tons of pig iron last year, and said that to produce that quantity of iron 12,000,000 to 15,000,000 tons of minerals would have passed over the North-Eastern Railway. The sum of money represented was something like five millions sterling. Mr. E. W. Richards, in the course of his remarks, said that Messrs. Bolckow, Vaughan, and Co. were now using three 15-ton converters at Eston to obtain steel from Cleveland iron, and it was probable that more converters would be put into operation, so as to take the produce of more blast furnaces off the general market. Mr. Richards said there would also soon be four large converters at work at the North-Eastern Steel Works, which would use not less than 150,000 tons of Cleveland pig iron per annum. The quantity of steel ingots produced last year was 1,673,649 tons, being an increase of 231,000 tons on 1881. The output of steel rails was 1,265,783 tons, or 242,545 tons more than in the previous year.

The adjourned meeting of the North of England Board of Arbitration was held at Darlington on Thursday, the 8th instant. Mr. W. Whitwell presiding. There was a long discussion on the new rules, and it was some time before the question of the appointment of a referee was finally decided. The rules most keenly disputed were finally passed in the following form:—"Rule 9. At the meeting of the Board, to be held in January in each year, it shall elect a referee, a president and vice-president, two secretaries, two auditors, and two treasurers, who shall continue in office till the corresponding meeting of the following year, but shall be eligible for re-election. The president and vice-president shall be *ex officio* members of all committees, but shall have no power to vote." Rule 11 now reads:—"All questions shall in the first instance be referred to the Standing Committee, who shall investigate and have power to settle all matters so referred to it, except a general rise or fall of wages, or the selection of a referee to be empowered to fix the same. Before any question be considered by the Standing Committee, an agreement of submission shall be signed by the employer and operative delegate of the works affected, and be given to the committee. In case of the Standing Committee failing to agree, the question in dispute shall be submitted to the referee, who shall be requested to decide the same, but that in all such cases witnesses from all the works affected may be summoned to attend, and give evidence in support of their case." When all the rules had been agreed upon, the Board appointed officers for the year. Mr. Whitwell was elected president, and Mr. Cullen vice-president. As the funds of the Board had been exhausted, it was decided that both operatives and employers should for the present double their contributions. This will bring the income of the Board up to about £2000 for the year. The names of Mr. Dale and Mr. J. Dodds as referees are to be submitted to the men.

NOTES FROM SCOTLAND.

(From our own Correspondent.)

THE Glasgow iron market is in a rather more satisfactory state than it was last week. Prices continued to decline till last Friday, but shortly before the close on that day a better feeling set in, with some appearance of a much-needed inquiry. On Monday and Tuesday the market was also firmer. Buyers coming to the front, and getting scent of this fact, sellers became reticent and rather disposed to wait. But in the course of the week a large business has been done. The impression now seems to be gaining ground that for the present business of importance will be done by consumers, without waiting for a further decline in prices. This has helped the market, the position of which has been further strengthened this week by the very good report as to the past week's shipments. The stock in Messrs. Connal and Co.'s stores continues to decrease at the rate of fully 1000 tons per week.

Business was done in the warrant market on Friday forenoon at from 47s. 3d. to 47s. 4d. cash, while in the afternoon the quotations were 47s. 4d. to 47s. 6d. cash, and 47s. 7½d. to 47s. 9d. one month. On Monday forenoon the market was firm, with transactions at 47s. 4½d. to 47s. 5½d. cash, and 47s. 7½d. to 47s. 8d. one month. The same afternoon transactions were effected at 47s. 5½d. to 47s. 7d. cash, and 47s. 8d. to 47s. 10d. one month. Tuesday's forenoon market was strong, with business at 47s. 7½d. to 47s. 9d. cash, and 47s. 10½d. to 47s. 11d., and 48s. one month. Market was quiet on Wednesday, with business at 47s. 10d. to 47s. 6½d. cash. To-day—Thursday—transactions were effected at 47s. 6½d. to 47s. 8d. cash, and 48s. one month.

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

The malleable iron trade is, on the whole, in a satisfactory condition, although at certain works there is necessarily less activity than at others.

The stormy weather has, to a considerable extent, interfered with the departure of coal cargoes from the west coast ports, and by this means the week's shipments are not so large as was to be expected. But there are good orders on hand to be supplemented in succeeding weeks. In Lanarkshire the coalmasters are still complaining loudly of the insufficient service of wagons provided by the railway companies, their operations from this cause being much delayed. There is a good demand for coals for consumption in the public works and factories, and the prices are nominally unchanged. Business is much restricted in Fifeshire at present, and the prices are comparatively low. Indeed, they have of late been barely remunerative, and owing to the fewness of orders, there was a temptation for coalmasters to undersell each other, and so render the trade altogether unprofitable. This matter has been engaging the serious attention of the coalmasters, and it appears that those masters who are members of the Association have fixed a minimum price at which the coals are to be delivered. The object of this is to ensure that, in the present dull season, whatever business is to be had shall not be done at a decided loss.

At different meetings held in the course of the past week the colliers of Fife and Clackmannan have been considering the proposal of the employers to reduce their wages. It was admitted that just now the coal trade was in a languid state, but Mr. Weir, the secretary of the men's association, asserted that while the masters had enormous profits during the months of September, October, and November, the men did not then receive the wages to which they were entitled. Mr. Weir also gave it as his opinion that the employers were just now receiving a price for middle-class coals which quite enabled them to pay the present wages without reduction. At the most of the meetings the miners declared themselves in favour of working only five days a week, in order to restrict the output of coals. The secretary of the employers has written to Mr. Weir that the masters are quite willing to receive a deputation of the men to discuss the position of affairs, but he adds that the state of trade is at present so bad that they can hold out no hope of a withdrawal of the notice for a reduction of wages.

The great activity that characterises the Clyde shipbuilding trade is being still further enhanced by the booking of fresh orders, and the prospects of the trade and of the other branches dependent upon it are therefore exceedingly favourable.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

THE Severn tunnel works, which in Mr. Walker's hands have been carried on so energetically, and with immunity from any calamity, were the scene of a sad accident last week. One of the workmen pushed the skip down the pit, thinking that the cage was there to receive it, and four men were killed and many injured.

The death is announced of Mr. W. Done Bushell, one of the oldest directors of the Taff Vale Railway. He had been resident director for forty years.

The coal trade has been brisk, as usual, and the collective shipments have exceeded 200,000 tons during the week. Prices are firm for large, but are drooping for small coal. Great briskness has characterised the principal collieries of late, and I am glad to record that operations in the "Harris's Deep Navigation" are steadily improving. There has been a persistent struggle for some time by Mr. Evans, the manager, against the heavy falls which have attended operations, due, it has been suggested, to opening out too soon from the bottom of the shaft; but the corner would now appear to have been turned, and the output to steadily increase. Many collieries have got into a method of turning out 1000 tons a day; the Great Western Rhondda Valley has occasionally exceeded this; Penrhiwceiber, in the Aberdare Valley, also. The Cwmaman collieries and Nixon's, at Merthyr Vale may also be named as being in great activity.

There is little more movement in anthracite collieries, and a new company has been started called the Swansea Anthracite Colliery Company, Limited. The aim is to work the Hendreforgan Colliery, near Swansea, containing 125 acres, capital £20,000 in £10 shares. Cory, of Swansea, and other known men are interested. Amongst other new companies is the Cymrodorion, a Welsh company, and the Brittany Steamship Company.

Iron ore is rather dull, and stocks at port accumulating. This will probably be the case until the spring movement in trade. The iron trade has flagged a little of late, and prospects are not quite so satisfactory. Makers are holding out against falling prices, and considering the excellent quality of pig iron and the high standard of steel rails, they are quite justified in doing so.

The tin-plate trade is by no means encouraging. Except in a few isolated instances the returns show a falling off in inquiry from America. There is a falling off of several thousand boxes per month to the States alone, and I hear little movement amongst those who are hoping to start the works that were stopped lately.

One of the large collieries of Flint has been closed. The Forest of Dean colliers have had a meeting at which they requested the Welsh colliers to reconsider their determination, and not to work more than eight hours per diem. By working eight hours only it was thought that neighbouring districts might have a share of the present prosperity.

A fund has been started in aid of distressed tin-plate men, and nearly a thousand pounds collected. It is much needed. But for Earl Jersey still greater distress would exist.

Considerable damage is reported to the Swansea docks this week, caused by the storms.

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.

6th February, 1883.

632. STORAGE BATTERIES, J. H. Johnson.—(*J. A. Maloney, Washington, U.S.*)
633. FINELY-DIVIDED LEAD, &c., W. Cross, London.
634. REGULATING ELECTRIC LAMPS, &c., A. and T. Gray, Glasgow.
635. SATCHEL, C. A. Morris, Herne Hill.
636. SUBSTITUTE for the IRONWORK of CARRIAGES, &c., W. E. Gedge.—(*G. Lefèvre, Paris.*)
637. RENDERING WALLS DAMP-PROOF, W. White, London.
638. GAS MOTOR ENGINES, C. W. King, Manchester, and A. Cliff, Forest-gate.
639. ELECTRIC LAMPS, J. G. Lorrain, London.
640. ENVELOPES, &c., J. C. Mewburn.—(*A. T. Howard, Brooklyn, U.S.*)
641. BOTTLE-STOPPERS, H. E. G. Luyties, New York, U.S.
642. FURNACES, &c., D. Caddick, Middlesbrough.
643. HYDRAULIC ENGINES, J. C. Etchells, Chester.
644. REGULATING APPARATUS for ORGAN BLOWERS, &c., W. Ainsworth, Blackburn.
645. MOTIVE-POWER ENGINES, J. Robson, Birmingham.
646. SECURING GAS RETORT LIDS, &c., H. E. Newton.—(*A. Klönne, Dortmund, Germany.*)
647. PLATE PRINTING PRESS, H. Luetke, Berlin.
648. ADAPTING INCANDESCENT ELECTRIC LAMPS to STAGE, &c., PURPOSES, W. J. Saward & A. Koerber, London.
649. PISTONS, W. Rowan, Belfast.
650. DRILLS for SOWING SEEDS, P. Pierce, Wexford.
651. RAISING, &c., WEIGHTS, H. C. Symons, London.
652. GAS CLUSTERS, &c., M. Pinder, London.
653. SPINNING MACHINERY, J. T. Nelson, Leeds.
654. PREVENTING EXPLOSIONS, &c., in STEAM ENGINES, T. C. Fawcett and J. C. Hargreaves, Leeds.
655. FASTENINGS, W. M. & J. C. Newey, Birmingham.
656. TESSELATED, &c., TILES, W. Hobson, Birmingham.
657. LAMPS, R Ogden, Manchester, and R. J. Anderson, Liverpool.
658. BEDSTEADS, &c., G. Lowry, Salford.
659. VOLTAIC BATTERIES, W. R. Lake.—(*J. M. Stebbins, New York, U.S.*)
660. COMBUSTIBLE COMPOUND, W. R. Lake.—(*J. C. Cooper, Brooklyn, U.S.*)
661. DYNAMO-ELECTRIC MACHINES, J. Munro, Croydon.
662. ARTIFICIAL STONES, &c., F. Wirth.—(*K. Grünzweig and P. Hartmann, Ludwigshafen, Germany.*)
663. GAS PRODUCERS, C. W. Siemens, London.
664. BELT FASTENERS, C. D. Abel.—(*P. Thacher, U.S.*)
665. COMBINED ENVELOPE and NOTE-PAPER PACKET, A. M. Clark.—(*S. J. Spurgeon, Houstania, U.S.*)
666. HEARING and SPEAKING APPARATUS, H. Marlow, Shepherd's-bush.

7th February, 1883.

667. FURNACES, T. Robinson, Preston.
668. SUBSTITUTE for COFFEE, E. J. T. Digby, London.
669. PREVENTING, &c., DAMAGE to SHIPS ARISING from COLLISIONS at SEA, S. Heimann, London.
670. PIRN and SPOOL WINDING MACHINES, P. H. Marriott and J. Hall, Stockport.
671. LUBRICATORS, H. J. Haddan.—(*A. W. Swift, U.S.*)
672. INTEGRATING ANEMOMETER, W. F. Stanley, London.
673. TILTING APPARATUS, W. Greenwood, T. Delamere, and S. Greenwood, Liverpool.
674. PREPARING, &c., CASTINGS, D. Matthews, Newport.
675. FURNACES, J. D. Kemp, London.
676. TELEPHONIC APPARATUS, H. H. Eldred, London.
677. BOILER FURNACES, A. Pinkerton, Glasgow.
678. PROPELLING BICYCLES, &c., E. Nunan, London.
679 SAFETY LAMPS, L. T. Wright, Beckton.
680. MULTIPLE CYLINDER COMPOUND ENGINES, R. Matthews, Hyde.
681. ELECTRIC METERS, C. V. Boys, Wing, and H. H. Cunynghame, London.
682. PREPARING COTTON SEED, F. S Fish.—(*T. Taylor, Washington, U.S.*)
683. FIBROUS PADS or BATS for SURGICAL, &c., PURPOSES, W. R. Lake.—(*D. Goff, Pawtucket, U.S.*)
684. SUPPLYING, FLUSHING, &c., APPARATUS, J. G. Stidder, London.
685. DRYING GRAIN, &c., J. J. Turner, Kington.
686. PLOUGHS, &c., T. Walker, Whitstable.
687. BREECH-LOADING SMALL-ARMS, T. Woodward, Birmingham.
688. DEVICES to be ATTACHED to DRIVING REINS, W. R. Lake.—(*L. Neviere, Paris.*)
689. PRINTING MACHINERY, W. W. Colley, London.
690. ORDNANCE, W. L. Wise.—(*C. T. V. de Bange, Paris.*)

8th February, 1883.

691. COMBING WOOL, &c., F. Fairbank and J. Robertshaw, Allerton.
692. PRODUCING POPPED CORN, T. B. Kinder and E. R. Southby, London.
693. INSTRUMENT for TAKING and PLOTTING LEVELS, F. Low.—(*A. T. Fraser, Madras Presidency, E.I.*)
694. PORTABLE RIVETTING MACHINES, R. Binns, Halifax.
695. WINDOW-SASHES, J. Hay & G. Robertson, Glasgow.
696. TAPS or COCKS, J. B. Fenby, Sutton Coldfield.
697. ETCHING TOOLS, J. Sowerby, Gateshead-on-Tyne.
698. SWITCH for ELECTRIC LAMPS, &c., J. T. Todman, Dorking.
699. MOULDS, A. Swan, Gateshead.
700. RAILWAY CHAIRS, J. Lindley, Walkley.
701. FILE-CUTTING MACHINES, P. Ewens, Cheltenham.
702. INK-SUPPLYING PENHOLDERS, L. Bertram, London.
703. GROOVED TIRES for WHEELS, W. H. Carmont, Manchester.
704. COLLECTING and REMOVING DUST from AIR, W. R. Lake.—(*F. Prinz, Milwaukee, U.S.*)

9th February, 1883.

705. COOKING RANGES, W. Russell, Pendleton.
706. COLOURING MATTERS, I. Levinstein, Manchester.
707. CUTTER BOX, R. D. Bennett, Manchester.
708. STEERING GEAR for SHIPS, G. D. Davis, London.
709. LABELS or TABLETS, G. B. Peirce, Richmond.
710. RAILWAY SLEEPERS, F. G. M. Stonay and R. C. Rapier, London.
711. COMBING WOOL, &c., J. Holden, J. Burnley, and J. Fawell, Bradford.
712. FIREPLACES, &c., G. Ermen, Holcombe.
713. HOSE REELS, J. T. Foot, Hammersmith.
714. WARMING HOUSES, S Deards, Harlow.
715. SODA, L. Mond, Northwich.
716. SODA, L. Mond, Northwich.
717. LAMPS, J. Bowman, Huntly.
718. MANUFACTURE of CRYSTALLISED SUGAR from STARCH, G. W. von Nawrocki.—(*T. von K. Sakovicz and D. Rosenblum, Warsaw.*)
719. ELECTRIC SAFETY PLUGS, K. W. Hedges, London.
720. OXIDISING ALCOHOLS, &c., E. T. Hughes.—(*D. Sandmann, Charlottenburg, Prussia.*)
721. FELTING WOOL, A. Monchablon, Paris.
722. SPRINGS and FITTINGS for STOPPERS for BOTTLES, &c., J. S. Davison, Sunderland.
723. ROUNDABOUTS, W. Meeds, W. Meeds, jun., and T. Blinkhorn, Boston.
724. CARTRIDGES for FIRE-ARMS, W. Gardner, London.
725. LAMPS, T. E. Bladon, Birmingham.
726. FURNACE BARS, &c., F. Livet, London.
727. BREECH-LOADING SMALL-ARMS, W. M. Scott, Birmingham.
728. HAND RAKES, W. R. Lake.—(*T. Carlsson, Sweden.*)
729. FASTENINGS for GLOVES, &c., J. Pitt and J. Wormington, Birmingham.
730. FURNACES, J. H. Selwyn and R. Walker, London.
731. PREPARING MALT, &c., for BREWING, J. H. Johnson.—(*B. Kokosinski and E. Bernet, Paris.*)
732. TREATING MINERAL PHOSPHATES, W. G. Strype, Wicklow.
733. WHEELS, R. R. Gubbins, New Cross.
734. UNHAIRING SKINS, W. H. Beck.—(*A. Laure, Paris*)
735. RINSING WOOL, W. H. Beck.—(*A. Laure, Paris.*)
736. TRANSPARENT BLOCK ICE, M. Mutter, Stockport.
737. METALLIC SOLUTIONS, C. R. A. Wright, London.
738. FITTING the MOUTHPIECE to the STEM of a PIPE for SMOKING, A. Strauss, London.

10th February, 1883.

739. TREATING ALKALI WASTE, J. Simpson, Liverpool.
740. JACQUARD MACHINES, I. Thomis, Eccleshill, and M. Priestley, Wibsey.
741. TAKING MEASUREMENTS for CUTTING-OUT WEARING APPAREL, J. Baier and J. Werner, Liverpool.
742. COMPRESSING AIR, J. Imray.—(*J. Schweizer, Paris.*)
743. POLISHING the SURFACE of SATIN FABRICS, E. Edwards.—(*F. Rousselon, Lyons.*)
744. HYDRANTS, T. Suffield, London.
745. POINTS for TRAMWAYS, H. Scott, Liverpool.
746. SLEEPING BERTHS for RAILWAY CARRIAGES, T. R. Hutton, Disley, and R. A. Gartside, Manchester.
747. TREATING IRON ORES, &c., A. Adair and W. Tomlinson, Seaton Carew.
748. BICHROMATES of POTASH and SODA, J H. Johnson.—(*O., A., and A. Neuhaus, Elberfeld, Germany.*)
749. ROASTING APPARATUS, R. Walker, London.
750. WHITE PIGMENT, T. Griffiths, Oxton.
751. COLOURED MARKING INKS, J. Hickisson and H. W. Langbeck, London.
753. SAWING, &c., MACHINERY, J. H. Johnson.—(*G. Westinghouse, jun., Pittsburg, U.S.*)
754. LANDAU, &c., CARRIAGES, W. H. Bailey, London.
755. PREPARING COTTON SEED, F. S. Fish.—(*T. Taylor, Washington, U.S.*)
756. GUN CARRIAGES, A. Noble, Newcastle-upon-Tyne.

12th February, 1883.

757. BREAKING, &c., GRAIN, C. Pieper.—(*A. C. Nagel, R. H. Kaemp, and A. Linnenbrügge, Hamburg.*)
758. PRESSING GLASS, J. Sowerby, Gateshead-on-Tyne.
759. WASHING MACHINES, J. Kennedy, Strabane.
760. EXERCISE APPARATUS, J. Smith, West Bromwich.
761. LACE, G. Bentley, Nottingham.
762. PREVENTING WATER-WASTE, A. Codd, Battersea.
763. TREATING TEXTILE VEGETABLE FIBRES, J. Imray.—(*E. Frémy and V. Urbain, Paris.*)
764. CARBON FILAMENTS, G. Bowron and W. Hibbert, London.
765. PURIFYING GUM COPAL, &c., A. B. Rodyk.—(*J. D. Ross, jun., Singapore.*)
766. COAL GAS, &c., APPARATUS, A. Perkins, Shepherd's-bush.
767. ATTACHING CORKSCREWS, &c., to BOTTLES, F. H. F. Engel.—(*E. Berlien, Altona, Prussia.*)
768. FASTENING ARMOUR PLATES, L. Broadwell, London.
769. MATCH-BOXES, J. G. Stokes.—(*H. de Schwabacher, Paris.*)
770. TRAWLING NETS, W. B. Wilson, Aberdeen.
771. SCREWS, H. H. Lake.—(*The Harvey Screw Company, Incorporated, Jersey, U.S.*)
772. SOUNDING BELLS, G. Porter, London.
773. BREAD, H. H. Lake.—(*T. Montérichard, Paris.*)
774. SPINNING and DOUBLING COTTON, &c., W. and C. G. Bracewell and A. Pilkington, Barnoldswick.
775. SMOKE-CONSUMING APPARATUS, J. H Johnson.—(*La Compagnie du Chauffage Industriel, Paris.*)
776. SELF-ACTING EXCAVATORS, T. Whitaker, Horsforth.
777. GRINDING CORN, &c., H. H. Lake.—(*H. M. Rounds, Clear Lake, U.S., and R. K. Noye, Buffalo, U.S.*)
778. BRUSHES, C. Jack, London.

Inventions Protected for Six Months on Deposit of Complete Specifications.

612. COVERED WIRE, W. Halkyard, Providence, U.S.—*5th February*, 1883.
621. FINING or CLEANSING MALT LIQUORS, R. Dean, Fulham.—*5th February*, 1883.
684. SUPPLYING, FLUSHING, &c., APPARATUS, J. G. Stidder, London.—*7th February*, 1883.
704. COLLECTING and REMOVING DUST from AIR, W. R. Lake, London.—A communication from F. Prinz, Milwaukee, U.S.—*8th February*, 1883.

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

525. WRITING SLATES, &c., S. Jones, Liverpool.—*6th February*, 1880.
542. CARDING ENGINES, G. and E. Ashworth, Manchester.—*7th February*, 1880.
567. TRAPS for CATCHING MOLES, &c., A. Notcutt and G. Scopes, Ipswich.—*9th February*, 1880.
609. PRINTING and ENGRAVING, J. J. Sachs, Manchester.—*11th February*, 1880.
650. PLASTIC or FICTILE COMPOUND, F. Wirth, Frankfort-on-the-Maine.—*14th February*, 1880.
672. TOOL, W. R. Lake, London.—*16th February*, 1880.
703. CONDENSING, &c., APPARATUS, J. H. Johnson, London.—*17th February*, 1880.
521. CONDENSING, &c., APPARATUS, D. Hulett, London.—*6th February*, 1880.
921. SECURING WINDOW BLIND and other RODS, &c., J. W. Meacher, London.—*2nd March*, 1880.
535. MOTOR ENGINES, F. E. B. Beaumont, London.—*7th February*, 1880.
583. CONVEYING PERSONS, &c., by ELECTRO-MOTIVE POWER, C. H. Siemens, London.—*10th February*, 1880.
593. PAINTS, M. Rees, Mumbles.—*11th February*, 1880.
709. GILDING METAL, A. M. Clark, London.—*17th February*, 1880.
739. PURIFYING CAST IRON, J. Imray, London.—*19th February*, 1880.
757. RAISING and LOWERING SHIPS BOATS, &c., L. Thomas, Bayswater.—*20th February*, 1880.
836. FINISHING TEXTILE FABRICS, A. M. Clark, London.—*25th February*, 1880.
837. HYDROCHLORIC ACID, E. Solvay, Brussels.—*25th February*, 1880.
838. HYDROCHLORIC ACID and CHLORINE, E. Solvay, Brussels.—*25th February*, 1880.
839. CHLORIDE of LIME, E. Solvay, Brussels.—*25th February*, 1880.
840. CEMENT, E. Solvay, Brussels.—*25th February*, 1880.
591. METERS, A. W. Pocock, Wandsworth.—*10th February*, 1880.
594. CONTROLLING the FLOW of LIQUIDS, W. W. Hopkinson, London.—*11th February*, 1880.
601. GAS STOVES, J. Adams, Glasgow.—*11th February*, 1880.
627. EXTRACTING TANNIC ACID, &c., from WOOD, H. Palm, Vienna.—*13th February*, 1880.
654. KILNS, G. W. H. Brogden and E. Casper, London.—*14th February*, 1880.
736. ACTIONS for PIANOFORTES, &c., C. Kesseler, Berlin.—*19th February*, 1880.
553. REGULATORS for ELECTRIC LIGHT, G. W. Wigner, London.—*9th February*, 1880.
556. AXLE-BOXES, W. R. Lake, London.—*9th February*, 1880.
578. ELECTRIC LAMPS, T. A. Edison, New Jersey, U.S.—*10th February*, 1880.
590. FINISHING PILE FABRICS, S. C. Lister and J. R. y Gispert, Manningham.—*10th February*, 1880.
602. UTILISING ELECTRICITY for LIGHT, HEAT, &c., T. A. Edison, New Jersey, U.S.—*11th February*, 1880.
656. TREADS and LANDINGS for STAIRS, W. H. Lindsay, London.—*14th February*, 1880.
692. PAPER PULP, &c., A. Forbes, Dalkeith.—*17th February*, 1880.
697. COOLING, &c., LIQUIDS, F. Hocking, Liverpool.—*17th February*, 1880.
596. REMOVING IMPURITIES from GRAIN, A. B. Childs, London.—*11th February*, 1880.
598. COMPRESSING OIL SEEDS, &c., H. F. Smith, Hull.—*11th February*, 1880.
606. FASTENINGS for BAGS, C. Appleton, Wigan.—*11th February*, 1880.
611. MEASURING TAPES, W. Chesterman, Sheffield.—*11th February*, 1880.

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

591. FEEDING STEAM BOILERS, E. Hamer and J. Metcalfe, Aberystwith, and E. Davies, Pontypridd.—*14th February*, 1876.
682. HARVESTING MACHINES, B. Samuelson and W. G. Manwaring, Banbury.—*18th February*, 1876.
1146. KNIFE, A. M. Clark, London.—*16th March*, 1876.
657. BOLTS, J. F. Miller and D. Robb, Glasgow.—*17th February*, 1876.
1158. STEEL and IRON TUBES, F. H. Lloyd, C. Faulkner, and W. E. and W. H. Lloyd, Birmingham.—*17th March*, 1876.
519. KILNS, R. Free, Mistley.—*9th February*, 1876.
587. STAMPING MACHINES, J. Patterson, Belfast.—*12th February*, 1876.
550. TREATING STREET SWEEPINGS, &c., A. Fryer, Wilmslow.—*11th February*, 1876.

Notices of Intention to Proceed with Applications.

(*Last day for filing opposition, 2nd March*, 1883.)

4693. EXCAVATING MACHINERY, J. F. Sang, London.—*3rd October*, 1882.
4694. GENERATING, &c., ELECTRICITY, E. Edwards and H. L. Phillips, London, and A. F. St. George, Redhill.—*3rd October*, 1882.
4695. ELECTRIC LAMPS, E. Edwards, London, and A. F. St. George, Redhill.—*3rd October*, 1882.
4715. STOVES and FIREPLACES, J. Bateman, London.—*4th October*, 1882.
4722. TREATING FIBROUS PLANTS, &c., E. G. Brewer, London.—A communication from the La Compagnie Générale des Fibres Cosmos.—*4th October*, 1882.
4727. TRAPPING SEWERS and DRAINS, W. A. Barlow, London.—A communication from M. L. Henry.—*4th October*, 1882.
4733. INTEGRAL EXTRACTION of the CONSTITUENT PRINCIPLES of FATTY BODIES, W. H. Beck, London.—A communication from C. Violette and A. Buisine.—*4th October*, 1882.
4734. FURNACES for CONSUMING SMOKE, F. Brown, Farley Hill, Luton.—*5th October*, 1882.
4742. PLANTATION, &c., HOES, W. Edwards, Wolverhampton.—*5th October*, 1882.
4744. CONVERTING CAST IRON into STEEL, J. Bond and H. J. Whiteley, Tow Law, near Darlington.—*5th October*, 1882.
4753. AIR-COMPRESSING, &c., PUMPS, J. H. Davis, London.—*6th October*, 1882.
4756. SECONDARY VOLTAIC BATTERIES, A. Khotinsky, London.—*6th October*, 1882.
4760. HOISTS, S. Jones, Warrington.—*6th October*, 1882.
4762. REVOLVING LAMPS, J. Trotter, London.—A communication from L. F. Lindberg.—*6th October*, 1882.
4763. BURNER for GAS FIRES, F. R. Mosley, London.—*6th October*, 1882.
4766. DOUBLE-BARREL SMALL-ARMS, D. Bentley and W. Baker, Aston, near Birmingham.—*6th October*, 1882.
4776. ORGANS, D. Casson, Denbigh.—*7th October*, 1882.
4787. MOULDING PIPES or TUBES from PLASTIC MATERIAL, J. H. Johnson, London.—A communication from G. F. Lufbery.—*7th October*, 1882.
4808. TREATING, &c., ISINGLASS, C. Vaux, Doncaster.—*9th October*, 1882.
4809. SECONDARY BATTERIES, R. Tatham, Rochdale, and A. Hollings, Salford.—*10th October*, 1882.
4813. LIGHTING by GAS, W. T. Sugg, London.—*10th October*, 1882.
4880. ELECTRIC ARC LAMPS, A. M. Clark, London.—A communication from W. S. Parker.—*13th October*, 1882.
4892. GAUGE for MEASURING the CIRCUMFERENCE of the WRIST, &c., B. H. Joseph, Birmingham.—*14th October*, 1882.
4899. MACHINE GUNS, T. Nordenfelt, London.—*14th October*, 1882.
4900. FIRE-ARMS, T. Nordenfelt, London.—*14th October*, 1882.
4979. PREPARING FLAX, &c., C. and C. W. Murland and J. Montgomery, Annsborough, Castle Wellan.—*19th October*, 1882.
4981. GOVERNING, &c., GAS, W. Key, Glasgow.—*19th October*, 1882.
4999. ADMINISTRATION of ALIMENTARY FLUIDS, &c., L. A. V. Pellegrin, London.—*20th October*, 1882.
5077. PNEUMATIC ELEVATORS, A. W. L. Reddie, London.—Com. from C. A. Needham.—*24th October*, 1882.
5123. DRILLING, &c., MACHINES, J. Morris, London.—*27th October*, 1882.
5158. PRODUCING, &c., ELECTRICITY, J. D. F. Andrews, Glasgow.—*30th October*, 1882.
5782. GAS ENGINES, W. Watson, Leeds.—*5th December*, 1882.
5862. BUCKET DREDGERS, G. Klug, Hamburg.—*8th December*, 1882.
5909. BEDSTEAD, A. J. Boult, London.—A communication from F. Lebacq.—*11th December*, 1882.
5970. PHOTOGRAPH ENGRAVING MACHINES, J. Mowat, Barrhead.—*14th December*, 1882.
6038. WINCHES, &c., W. Pitt, Bath.—*18th December*, 1882.
6050. REGENERATIVE HOT-BLAST STOVES, E. A. and C. E. Cowper, London.—*19th December*, 1882.
6083. ELECTRO-MOTORS, L. Milne and L. B. Miller, London.—*20th December*, 1882.
6214. GAS ENGINES, W. Watson, Leeds.—*29th December*, 1882.
16. CALCULATING MACHINES, J. Edmondson, Halifax.—*1st January*, 1883.
56. ROAD TRACTION, &c., ENGINES, M. Shillito, Leeds.—*4th January*, 1883.
96. SULPHURIC ACID, W. Weldon, Rede Hall, Burstow.—Com. from G. Lunge.—*8th January*, 1883.
130. GAS MOTOR ENGINES, F. J. Odling, Derby.—*9th January*, 1883.
159. SILICA BRICKS, A. H. Dunnachie, Glasgow.—*11th January*, 1883.
161. CRIMPING, &c., METALLIC CARTRIDGE CASES, A. H. A. Thorn, London.—*11th January*, 1883.
182. COVERINGS for PREVENTING the RADIATION, &c., of HEAT, C. Toope, London.—*11th January*, 1883.
205. POSTS for SUPPORTING WIRES, C. E. J. May, Charlton.—*13th January*, 1883.
219. SELF-FILLING, &c., GRAPPLES, G. F. Fuller, London.—*13th January*, 1883.
233. DISTRIBUTING, &c., POWERFUL LIGHTS, A. P. Trotter, London.—*15th January*, 1883.
237. SCREW TRAPS, H. H. Lake, London.—A communication from C. R. C. French and F. Bullivant.—*15th January*, 1883.
243. GALVANIC BATTERIES, H. H. Lake, London.—A communication from A. Skene and F. Kühmaier.—*15th January*, 1883.
281. MECHANICAL MUSICAL INSTRUMENTS, H. H. Lake, London.—A communication from the American Automatic Organ Company, Incorporated.—*17th January*, 1883.
564. BRAKE APPARATUS, W. R. Lake, London..—Com. from H. Marneffe.—*1st February*, 1883.
621. FINING or CLEANSING MALT LIQUORS, R. Dean, London.—*5th February*, 1882.

(*Last day for filing opposition, 6th March*, 1883.)

4777. ELECTRICAL COMMUNICATION on RAILWAYS, R. Tatham, Rochdale.—*7th October*, 1882.
4794. FILTERING APPARATUS, E. Edwards, London.—Com. from N. A. B. Chevallot.—*9th October*, 1882.
4800. GOVERNING the FLOW of WATER under PRESSURE, G. Wightman, Retford.—*9th October*, 1882.
4805. ELASTIC TERRY WEB, J. Swann, sen., Nottingham.—*9th October*, 1882.
4815. TOOLS, &c., for BORING TAPER HOLES, J. G. Perkin and J. Scott, Sandal, near Wakefield.—*10th October*, 1882.
4823. DRYING WOOL, D. P. Smith, Glasgow.—A communication from J. Scott.—*11th October*, 1882.
4826. VAPORISERS, P. Chapelain, Paris.—*11th October*, 1882.
4827. TREATING STEEL INGOTS before ROLLING, H. J. Kennard, London.—*11th October*, 1882.
4844. ROTARY PRINTING MACHINES, J. Dobson, London.—*11th October*, 1882.
4845. GALVANO-ELECTRIC BATTERIES, J. Oliphant, London, and E. B. Burr, Walthamstow.—*12th October*, 1882.
4855. HYDROGEN GAS, S. Pitt, Sutton.—A communication from W. H. Bradley.—*12th October*, 1882.
4859. VELOCIPEDES, G. W. von Nawrocki, Berlin.—Com. from L. Schmetzer.—*12th October*, 1882.
4864. CLIPS or HOLDERS for MACHINES, D. P. Smith, Glasgow.—*13th October*, 1882.
4867. WASHING WOOL, &c., W. H. Greenwood, Bradford, and C. Hoyle, Keighley.—*13th October*, 1882.
4901. HIGH-SPEED ENGINES, P. W. Willans, Thames Ditton, and M. H. Robinson, London.—*14th October*, 1882.
4914. UMBRELLAS and PARASOLS, J. J. B. Seel, Urmston.—*16th October*, 1882.
4931. ELECTRIC MOTORS, A. G. de Neeff and E. Desfossés, Paris.—*17th October*, 1882.
4961. OIL CANS, J. Kaye, Kirkstall.—*18th October*, 1882.
4969. INVERTED DIRECT-ACTING MARINE ENGINES, W. Allan, Sunderland.—*18th October*, 1882.
4980. COOKING RANGES, H. McRuer, Glasgow.—*19th October*, 1882.
5001. TELEPHONIC INSTRUMENTS, G. L. Anders, London.—*20th October*, 1882.
5018. TREATING SMALL COAL, &c., C. E. Hall, Sheffield.—*21st October*, 1882.
5030. ANHYDROUS ALUMINA, H. A. Bonneville, London.—A communication from F. Gardair and T. Gladysz.—*23rd October*, 1882.
5071. SUGAR, W. R. Lake, London.—A communication from L. May.—*24th October*, 1882.
5124. ALARM BELLS, A. W. L. Reddie, London.—A communication from E. J. Masseron.—*27th October*, 1882.
5159. RECOVERY of TAR, &c., from the VOLATILE PRODUCTS of COKE FURNACES, J. Wetter, London.—*30th October*, 1882.
5220. SAFETY VALVES, D. Cockburn, Glasgow.—*1st November*, 1882.
5301. METALLIC BEDSTEADS, R. G. Hodgetts, Birmingham.—*6th November*, 1882.
5423. STEERING VESSELS, W. Pepper, Kingston-upon-Hull.—*14th November*, 1882.
5908. TOBACCO PIPES, A. Barr, Glasgow.—*11th December*, 1882.
6139. SHUTTLES, T. Brooks and T. Tweedale, Crawshawbooth, near Rawtenstall.—*23rd December*, 1882.
6145. FLOUR-SIFTING MACHINES, H. E. L. Bauermeister, Hamburg.—*23rd December*, 1882.
51. FEEDING CATTLE, J. P. Milbourne, Manchester.—*4th January*, 1883.
120. MAGNETO-ELECTRIC MACHINES, H. F. Joel, London.—*9th January*, 1883.
154. OMNIBUSES, &c., S. Andrews, Cardiff.—*10th January*, 1883.
183. ELECTRIC ARC LAMPS, J. G. Lorrain, London.—*11th January*, 1883.
210. KEY for SECURING RAILS on their CHAIRS, H. B. Moreton, Cardiff.—*13th January*, 1883.
217. WORKING, &c., SECONDARY BATTERIES, J. S. Sellon, London.—*13th January*, 1883.
221. BEARINGS and LUBRICATING APPARATUS for UPRIGHT SPINDLES, J. Nicoll, Dundee.—*15th January*, 1883.
227. PRESERVING MILK, H. W. L. O. von Roden, Germany.—*15th January*, 1883.
229. REPEATING MECHANISM for BREECH-LOADING FIRE-ARMS, G. E. Vaughan, London.—A communication from J. Werndl.—*15th January*, 1883.
365. VELOCIPEDES, J. Hopwood, Heaton-Norris.—*23rd January*, 1883.
372. BRACES, F. Hovenden, West Dulwich.—*23rd January*, 1883.
575. SHIPS' SLEEPING BERTHS, W. R. Lake, London.—A communication from the Huston Ships' Berth Company, Incorporated.—*2nd February*, 1883.
704. COLLECTING &c., DUST from AIR which has passed through MIDDLINGS PURIFIERS, &c., MACHINES, W. R. Lake, London.—A communication from F. Prinz.—*8th February*, 1883.

Patents Sealed.

(*List of Letters Patent which passed the Great Seal on the 9th February*, 1883.)

2728. WASHING-HOUSES, M. Cockburn, Falkirk.—*10th June*, 1882.
3805. HARDENING, &c., STEEL WIRE, S., M., and A. Wood, Brighouse.—*10th August*, 1882.
3806. VACUUM and STEAM BRAKE, S. Carlton, Swindon.—*10th August*, 1882.
3829. VENTILATING SEWERS, &c., T. S. Wilson and H. T. Johnson, Manchester.—*11th August*, 1882.
3830. DRYING, &c., TEXTILE FABRICS, W. M. Riddell, London.—*11th August*, 1882.
3837. BROOMS, &c., A. J. Boult, London.—*11th August*, 1882.
3838. TRANSPORTING LOADS on INCLINED ROADS, A. J. Boult, London.—*11th August*, 1882.
3843. WORKING PNEUMATIC LEVERS of ORGANS, W. Carling, Hitchin.—*12th August*, 1882.
3850. HERMETICALLY CLOSING BOXES, &c., A. J. Boult, London.—*12th August*, 1882.
3851. DRESSING GRAIN, G. W. Murray, Banff, N.B.—*12th August*, 1882.
3860. SHUTTLE SEWING MACHINES, J. E. Walsh, Halifax.—*12th August*, 1882.
3866. VALVE MOTIONS for STEAM ENGINES, J. Edge, Liverpool.—*14th August*, 1882.
3869. DYNAMO-ELECTRIC MOTOR MACHINE, E. Desfossés, Paris.—*14th August*, 1882.
3871. STARTING ENGINES, A. B. Brown, Edinburgh.—*14th August*, 1882.
3878. WHEELS, H. J. Barrett, Kingston-upon-Hull.—*14th August*, 1882.
3886. SPANNERS, J. Brown, Liverpool.—*15th August*, 1882.
3907. CIGARS, O. W. T. Barnsdale, Nottingham.—*16th August*, 1882.
3921. FABRICS for COVERING WALLS, S. Fisher, London.—*16th August*, 1882.
3928. STEPS or LADDERS, C. A. Jones, Gloucester.—*16th August*, 1882.
3936. SUPPORTING the BOTTOMS of PANTALOONS, W. Brierley, Halifax.—*17th August*, 1882.
3960. GAS APPARATUS for HEATING WATER, &c., M. M. Brophy, London.—*18th August*, 1882.
4000. RENDERING WALL PAINTINGS WATERPROOF, A. Heim, Munich.—*21st August*, 1882.
4006. VELOCIPEDES, J. Stassen, jun., London.—*21st August*, 1882.
4017. MANUFACTURE of GLUCOSE from STARCH, H. J. Haddan, London.—*22nd August*, 1882.
4031. HEATING APPARATUS, W. R. Lake, London.—*22nd August*, 1882.
4041. PREPARING FIBRE, W. Lord, Todmorden.—*23rd August*, 1882.
4043. MAKING MOULDS for CASTING NAILS, S. Williams, Aston, near Birmingham.—*23rd August*, 1882.
4044. TELEPHONE RECEIVING APPARATUS, R. and M. Theiler, London.—*23rd August*, 1882.
4078. SPRING HINGES, E. Barnes, London.—*25th August*, 1882.
4089. GUNS and RIFLES, W. Anson, Aston.—*26th August*, 1882.
4291. GAS BURNERS, J. J. Shedlock, Barnet.—*9th September*, 1882.
4356. GLOBE HOLDERS, G. H. Nash, Birmingham.—*13th September*, 1882.
4538. PURIFYING [illegible] H. Symons, Totnes.—*23rd September*, 1882.
4966. WHEELS, J. [illegible] and H. McLaren and C. Morris, Leeds.—*18th October*, 1882.
5039. PARALLEL RULERS, C. E. Baillie-Hamilton, Kent.—*23rd October*, 1882.
5188. GAS-MOTOR ENGINES, T. Aksbury, H. Summer, W. Lees, and R. W. [illegible] Sanderson, Manchester.—*31st October*, 1882.

5554. COLOURING MATTERS, C. Lowe, Reddish, near Stockport.—22*nd November*, 1882.

(*List of Letters Patent which passed the Great Seal on the 13th February*, 1883.)

3428. SHOES for HORSES, &c., T. H. Baker and T. Wilson, London.—19*th July*, 1882.
3890. PISTONS, R. R. Gubbins, New Cross.—15*th August*, 1882.
3900. SMOKE-CONSUMING GRATES, W. I. Henry, London.—15*th August*, 1882.
3901. FOUNTAIN PENS, J. Nadal, London.—15*th August*, 1882.
3914. STEAM ENGINES, P. Armington, Lawrence, Essex.—16*th August*, 1882.
3915. FIRE-ESCAPES, &c., J. Kennedy, Strabane.—16*th August*, 1882.
3916. SCREW GILL-BOXES, D., H., and W. Smith, Keighley.—16*th August*, 1882.
3924. PROPELLING TRAM-CARS, O. Mobbs and L. G. Moore, Northampton.—16*th August*, 1882.
3925. PONTOONS, A. H. Williams, London.—16*th August*, 1882.
3933. SAFETY APPARATUS for ROLLING MILLS, T. Neuray, Belgium.—17*th August*, 1882.
3934. RING SPINNING, &c., MACHINERY, J. McGregor, London.—17*th August*, 1882.
3940. CONNECTING together INTERCHANGEABLE TAPPETS, J. Bywater and C. Bedford, Birstal, near Leeds.—17*th August*, 1882.
3943. SEPARATING CREAM from MILK, D. Baynes, Canterbury.—17*th August*, 1882.
3948. LOOMS for WEAVING, C. Catlow, Burnley.—17*th August*, 1882.
3983. MAKING BORE-HOLES, J. Waddington and B. Longbottom, Barrow-in-Furness, and J. Ashworth, Dalton-in-Furness.—19*th August*, 1882.
3994. MOTTLED SOAP, A. Headley, Mayfield, Gosforth.—21*st August*, 1882.
4096. GAS-BURNERS, W. R. Lake, London.—26*th August*, 1882.
4128. REDUCING TIN STUFF, &c., J. Toy, Helston, and S. H. Stephens, Sithney.—29*th August*, 1882.
4290. WORKING VALVES, W. G. Stuart, London.—9*th September*, 1882.
4416. INCREASING the ILLUMINATING POWER of GASES, A. M. Clark, London.—16*th September*, 1882.
4473. BICYCLES, &c., C. Clarke, London.—20*th September*, 1882.
4669. STEAM GENERATORS, W. Clark, London.—30*th September*, 1882.
5005. ROPE TRAMWAYS, H. H. M. Smith, London.—20*th October*, 1882.
5089. MAN-HOLES, &c., A. Watkins, Greenwich.—25*th October*, 1882.
5168. STEAM BOILERS, S. P. Wilding, London.—30*th October*, 1882.
5472. PAVEMENTS, &c., S. Hawksworth, Scarborough.—17*th November*, 1882.
5565. PREPARING EXTRACTS of MEAT, F. S. Barff, London, and A. P. Wire, Leytonstone.—22*nd November*, 1882.
5689. COUPLINGS for RAILWAY WAGONS, &c., C. Roberts, Wakefield.—29*th November*, 1882.
5874. RING SPINNING, &c., FRAMES, J. Young and E. Furniss, Mellor.—9*th December*, 1882.
6085. TELEPHONIC APPARATUS, W. R. Lake, London.—9*th December*, 1882.

List of Specifications published during the week ending February 10th, 1883.

*1678, 4d.; *2010, 4d.; *3548, 4d.; 1989, 2d.; 2422, 2d.; 2572, 2d.; 2610, 2d.; 2687, 2d.; 2745, 2d.; 2766, 2d.; 2823, 8d.; 2824, 2d.; 2919, 8d.; 2939, 8d.; 2948, 6d.; 2956, 10d.; 2973, 6d.; 2985, 6d.; 2987, 6d.; 2988, 6d.; 2990, 6d.; 2992, 8d.; 2993, 6d.; 2997, 6d.; 2998, 8d.; 3060, 6d.; 3010, 4d.; 3017, 6d.; 3018, 6d.; 3020, 6d.; 3023, 4d.; 3027, 6d.; 3034, 6d.; 3036, 6d.; 3037, 6d.; 3042, 6d.; 3045, 6d.; 3047, 6d.; 3054, 2d.; 3056, 6d.; 3060, 6d.; 3061, 6d.; 3062, 6d.; 3064, 6d.; 3065, 6d.; 3066, 6d.; 3067, 4d.; 3068, 6d.; 3076, 6d.; 3078, 2d.; 3087, 6d.; 3088, 6d.; 3089, 6d.; 3091, 4d.; 3092, 2d.; 3093, 4d.; 3096, 6d.; 3097, 2d.; 3101, 6d.; 3102, 6d.; 3106, 6d.; 3108, 2s. 4d.; 2110, 4d.; 3111, 2d.; 3112, 6d.; 3113, 4d.; 3114, 6d.; 3116, 2d.; 3117, 2d.; 3118, 2d.; 3119, 2d.; 3121, 2d.; 3122, 4d.; 3124, 6d.; 3126, 6d.; 3127, 2d.; 3129, 2d.; 3131, 2d.; 3134, 6d.; 3135, 4d.; 3138, 8d.; 3139, 2d.; 3145, 6d.; 3146, 2d.; 3147, 2d.; 3160, 4d.; 3161, 2d.; 3163, 6d.; 3164, 6d.; 3166, 2d.; 3168, 2d.; 3169, 2d.; 3173, 2d.; 3175, 4d.; 3176, 4d.; 3181, 2d.; 3184, 4d.; 3186, 4d.; 3188, 2d.; 3191, 2d.; 3192, 2d.; 3201, 2d.; 3203, 2d.; 3205, 2d.; 3208, 4d.; 3209, 4d.; 3214, 4d.; 3216, 4d.; 3218, 4d.; 3220, 2d.; 3221, 2d.; 3222, 4d.; 3224, 6d.; 3227, 2d.; 3238, 2d.; 3240, 4d.; 3277, 6d.; 3311, 4d.; 3316, 2d.; 3491, 6d.; 3494, 6d.; 3818, 8d.; 5197, 4d.; 5217, 6d.; 5279, 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.*

1989. MAKING BARRELS, *H. J. Haddan, Kensington.*—27*th April*, 1882.—(*A communication from W. Stewart, Canada.*)—(*Not proceeded with.*) 2*d.*

This relates to improvements on patent No. 3264, A.D. 1881, and it consists, First, in providing counterbalancing mechanism to bring the frames together to grasp the barrel; Secondly, in mechanism to force each stave to conform to the circle of the cylinder, so as to form the groove to receive the head of uniform depth; Thirdly, in arranging the chain so that the staves are fed with regularity; Fourthly, in arranging the frame so as to allow staves of different thicknesses to pass through.

2422. INDICATING the LENGTH of CLOTH or other FABRICS in ROLLS, &c., *J. and J. Darling, Glasgow.*—23*rd May*, 1882.—(*Provisional protection not allowed.*) 2*d.*

This consists in rolling up a strip of paper marked with divisions with the cloth.

2572. CORSETS, *G. Wrencher, Bethnal Green-road.*—31*st May*, 1882.—(*Provisional protection not allowed.*) 2*d.*

This consists in inserting one or more strips of elastic material in the back of the corset, so as to dispense with the laces.

2610. CORSETS, *W. H. Taylor, London.*—2*nd June*, 1882.—(*Provisional protection not allowed.*) 2*d.*

This relates to the insertion in each half of the corset of an elastic gore instead of the ordinary gores, the object being to permit of the free movement of the wearer.

2687. LADIES' UNDERCLOTHING, *E. Clark, Old Bond-street.*—8*th June*, 1882.—(*Provisional protection not allowed.*) 2*d.*

This relates to the employment of an adjustable arm strap for ladies' underclothing.

2745. MACHINERY for the MANUFACTURE of ARTIFICIAL FLOWERS, *P. K. Klein, Adelphi.*—10*th June*, 1882.—(*A communication from G. Bittner, Munich.*)—(*Not proceeded with.*) 2*d.*

This relates to machinery for, First, covering the wire stem with silk; Secondly, for attaching the sprigs or tufts to the stem at intervals; Thirdly, for preventing the silk becoming unwound by applying gum; and Fourthly, for cutting off the flower at the gummed point.

2766. COFFINS, *S., J., and R. Turner, Rochdale.*—13*th June*, 1882.—(*Not proceeded with.*) 2*d.*

The object is to keep the remains of a buried body together so that it shall not be dispersed in spite of the natural decay of the same, and it consists in providing the outer coffin with an inner coffin of asbestos cloth to receive the body.

2824. SUBSTITUTE for COFFEE, *H. J. Haddan, Kensington.*—15*th June*, 1882.—(*A communication from E. A. Grote, Germany.*—(*Not proceeded with.*) 2*d.*

This consists of a mixture of roasted and ground rye-paste, or bread, with roasted and ground rye, adding some caramel, bicarbonate of soda, and, if desired, a variable quantity of ground cacas shells and coffee beans.

2919. CABLE TRACTION TRAMWAYS, &c., *J. Wright, Cornhill.*—20*th June*, 1882.—(*A communication from C. F. Findlay, Chicago.*) 8*d.*

This relates, First, to the form, construction, and the structure of the roadway or railway proper, including the formation of a tunnel, within which the ropes or cable for actuating the carriages are enclosed and mounted; and Secondly, to the appliances to transmit the motion of the cables to the carriages, and the means for throwing the transmitter into or out of action.

2939. VALVE and PLUNGER or PISTON COCKS for REGULATING the TRANSMISSION of FLUIDS THROUGH THEM, &c., *T. S. Truss, Portland-place.*—21*st June*, 1882. 8*d.*

One modification of the valve consists of an oblong circular box with an inlet pipe at about the centre of its length, through which the fluid enters the box, one end of which contains a plunger, and the other a disc discharge valve, the plunger and disc being connected by a spindle. The valve is actuated by moving the plunger by means of a wedge acting on the outer end of the spindle.

2948. VALVES and PACKING, *W. R. Lake, London.*—21*st June*, 1882.—(*A communication from F. F. Raymond, Massachusetts.*) 6*d.*

The packing consists of refractory earths or earthy and stony matters, such as French chalk or talcose, mingled with india-rubber, or such other materials as are necessary to vulcanise the rubber, in such quantity that the earthy or stony matter and the vulcanising agent shall be more than four-tenths of the entire compound. The invention further relates to valves to which this packing may be applied.

2956. MACHINERY for SEPARATING and COLLECTING DUST from AIR, *J. F. Stewart, Mark-lane.*—21*st June*, 1882.—(*A communication from A. H. Kirke and W. J. Tender, Minneapolis, U.S.*) 10*d.*

A series of tightly-stretched permeable bags or reticulated screens are arranged with their open mouths presented downwards for the entrance of the dust-laden air, such mouths being consecutively closed by a travelling box, while at the same time they are subjected to the beating action of rods, which cause the dust collected on their inner surfaces to fall into the travelling box.

2973. VENTILATORS for BUILDINGS, SHIPS, &c., *R. Boyle, London.*—22*nd June*, 1882. 6*d.*

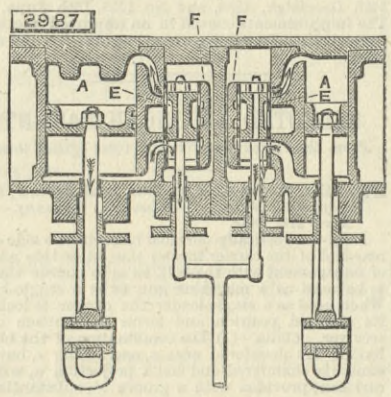
One part of the invention relates to ventilators with stationary deflecting plates, and consists in providing the part of each uptake leading to the outer air with a V-shaped inner deflecting plate in a central position, the angle being presented outwards, while on both sides thereof are plates which curve inwards and then outwards, and extend for a considerable distance opposite the respective sides of the V plate, so as to form spaces between the outwardly-curved surfaces and the sides of the V plate. Opposite these spaces a guard or projecting plate is arranged at a short distance beyond the outward angle of the V plate. Other improvements are described.

2985. THRASHING MACHINES, *E. Foden, Sandbach, Chester.*—23*rd June*, 1882. 6*d.*

Instead of using the usual blast fan for the first winnowing operation in thrashing machines, this consists in the employment of an exhaust fan, which answers the purpose of a chaff lifter, thus dispensing entirely with the first fan and the power required to drive the same.

2987. STEAM ENGINES, *R. Duncan, Glasgow.*—23*rd June*, 1882. 6*d.*

This consists mainly in combining with the ordinary engine valves of compound engines reversing valves or cocks, by means of which the admission of steam may be directed through the usual inlet to drive in one direction, or through the usual exhaust passages to reverse the direction of motion. In the drawing the high and low-pressure cylinders A and



A1 are arranged side by side and their pistons connected to the crank shaft, the valve chests and valves being fitted between the cylinder and separated by a partition. The valves E are operated direct from the crank shaft by a single excentric. A pair of piston valves F act as reversing valves, and their rods pass out of the valve casing and are connected so as to be operated simultaneously by one hand lever.

2988. HARNESS, *W. Powell, Merthyr Tydvil.*—23*rd June*, 1882. 6*d.*

This relates, First, to the construction of a bridle rein, so as to remove the liability of its falling off the horse's neck and becoming entangled with its feet, and also to give increased power over the horse; and Secondly, to connecting the bit and rein to the head part of the bridle by a drop link boot at the end of the rein at each side, whereby the bit and rein can be detached from the head part of the bridle and the remaining part thereof used as a head collar if required. Other improvements are also described.

2997. OIL CAN, *G. Cornut and A. Castelin, Paris.*—24*th June*, 1882. 6*d.*

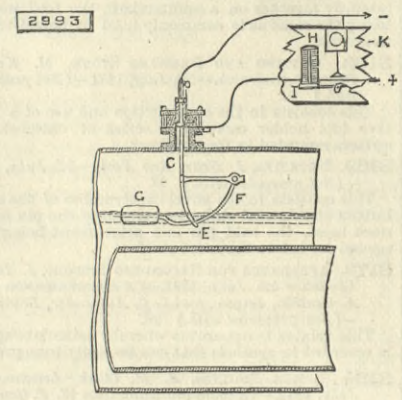
The object is to eject oil from the can without necessarily turning the can over, and also to supply the oil in easily regulated quantities, and to provide against accidentally spilling the oil if the can is overturned, and it consists principally in fitting a sliding piston in a chamber above the oil can, and which communicates with the space above the oil contained in the latter, so that when the piston is depressed the air in the chamber is compressed, and acting on the surface of the oil, forces a certain quantity out through the spout of the can.

2998. WEIGHING MACHINES or BALANCES, *C. D. Abel, London.*—24*th June*, 1882.—(*A communication from H. Gerike, Berlin.*) 8*d.*

This relates to weighing machines or balances in which the variable load is balanced by the varying position of a weighted lever or system of levers, and it consists mainly in arrangements whereby the levers may be loaded with a small weight only when light objects are to be weighed in order to obtain delicacy of indication, while a heavy weight is brought to bear on the levers when weighing heavy objects; the indications in either case being effected by a separate pointer on a separate circular scale, in such manner that each pointer has a range equal to the entire circumference of its scale. The system of levers is so arranged as to be guided at six points of its parallel motion.

2993. PREVENTING and REMOVING INCRUSTATION, and OPERATING a LOW-WATER ALARM or INDICATOR in STEAM BOILERS, *E. Field, Adelphi, and W. L. Thompson, Old Jewry.*—24*th June*, 1882. 6*d.*

This relates to causing a current of electricity to pass from the shell of the boiler to a negative electrode in the water, and insulated from metallic contact with the shell, so long as the water does not fall below a certain point, when a visible or audible signal is



operated. The current from a generator is conducted to the water by the insulated conductor C, to which, near the low-water level, is attached a metallic surface E, kept clean and bright by the friction of a piece F, actuated by float G, when the water falls so as to be below the cleaned surface of the conductor and this circuit broken. As long as the current flows the magnet H attracts armature I, but when the circuit is broken the current is switched into a signalling apparatus K.

3000. KITCHEN RANGES, *G. Dawson and C. Butcher, Thorncliffe.*—24*th June*, 1882. 6*d.*

This relates to improvements in the general construction of kitchen ranges.

3017. MACHINES for SORTING and CLEANING GRAIN, SEEDS, &c., *A. J. Boult, London.*—26*th June*, 1882.—(*A communication from L. Rappaport, Breslau.*) 6*d.*

This relates to the application of sieves which are not movable, but only yielding and springing, and which are made of perforated sheet metal or of wire fabric, or of textile fabric, with or without a frame, and receive vibration by impact for the purpose of imparting to the material placed thereon a skipping and a forward motion.

3018. SHEEP-SHEARS, *C. Burgon, Sheffield.*—26*th June*, 1882. 6*d.*

According to this invention the shearer can take the shears in halves, or he can loose them so as to enable him to turn the blades in any position he may wish for grinding and sharpening.

3020. WEIGHING MACHINE, *H. E. Newton, London.*—26*th June*, 1882.—(*A communication from E. A. Chameroy, Paris.*) 6*d.*

This consists in an arrangement of parts whereby the small weights on the steelyard can be worked by mechanical means instead of by hand.

3023. VELOCIPEDES, *G. Moss, London.*—27*th June*, 1882. 4*d.*

This relates, First, to the mode of producing a silent ratchet and a reversing ratchet action; Secondly, to the manner of forming and applying the brake clutch; Thirdly, to the manner of closing in the springs of the travelling wheels and providing for easy removal of such springs when needed.

3027. FITTING for HORSESHOES, *J. Vernon, Newton Stewart.*—27*th June*, 1882. 6*d.*

This relates to the use of sponge as a liquid-absorbing filling for hoseshoes, whereby the hoof may be kept moist and grit be excluded.

3034. RECEIVING and COLLECTING EXCREMENTITIOUS and OTHER FOUL and WASTE SOLID and LIQUID MATTERS in HOUSES, &c., *F. A. Bonnefin, London.*—27*th June*, 1882. 6*d.*

The objects are to provide houses with a complete system for the reception and collection of human excreta, both solid and liquid; also slops, dish washings, house sweepings, ashes, and all other waste or refuse solid and liquid matters, and to treat these matters, or some of them, when so collected, for sanitary and commercial or industrial purposes.

3037. MACHINES for SYRINGING PLANTS, *J. A. Drake and R. Muirhead, Maidstone.*—27*th June*, 1882. 6*d.*

The machine consists essentially of a tank or cistern to contain liquid; it is carried upon a pair of travelling wheels, and fitted with a pump actuated by mechanism set in motion by the travelling wheels.

3045. APPARATUS for SLICING MATERIALS into STRIPS, *J. B. Whytehead, Ilkeley.*—28*th June*, 1882. 6*d.*

This relates to the use of a cutter consisting of a plane iron in combination with retractile slitting knives.

3056. APPARATUS for REMOVING INGOTS from MOULDS, *J. Hampton, Sheffield.*—28*th June*, 1882. 6*d.*

This relates to that class of apparatus employed for removing from their moulds ingots which stick therein, by means of a plunger or pushing head and a lever attached to a chain connected or hooked to the arm of the crane.

3060. SEWING BUTTONS, HOOKS, &c., to BOOTS and OTHER ARTICLES, *E. C. Barron, London.*—28*th June*, 1882. 6*d.*

This relates to various modes of constructing metallic fastenings.

3061. MAGNETIC COMPASSES, *F. Betbeder, Foxley-road.*—28*th June*, 1882.—(*A communication from E. Bourse, Rochefort-sur-Mer, France.*) 6*d.*

The invention consists essentially in floating the compass card upon a liquid instead of hanging it upon a pivotal pin as usual.

3062. JOINT for DETACHABLE GAS LAMPS, *W. R. Wynne, London.*—29*th June*, 1882. 6*d.*

This consists in providing a valve within the connecting arm, which shall automatically shut off the gas from the lamp whenever the latter is not properly secured in its place.

3064. PRODUCTION of SOUND INGOTS and CASTINGS of STEEL, &c., *A. Longsdon, London.*—29*th June*, 1882.—(*A communication from F. A. Krupp, Essen.*) 6*d.*

The inventor claims the mode and means for diminishing the size of the crop end of steel and other ingots and castings, and for promoting or producing the uniform contraction of the ingot or casting from the bottom upwards, consisting in the enveloping or surrounding the upper part or crop end of the casting or ingot with a jacket of liquid slag or other non-conductor of heat, directly or indirectly, on the top of the crop end, with or without the employment of means for cooling the lower part of the mould.

3066. APPARATUS for WORKING RAILWAY POINTS and SIGNALS, *W. Stroudley, Brighton.*—29*th June*, 1882. 6*d.*

The inventor claims, in combination with a railway point or signal lever, a cylinder fitted with a piston or plunger, which can, when required, be subjected to fluid pressure, so as to assist the movement of the lever.

3065. MACHINERY for OPENING, CLEANING, and SEPARATING or SORTING FUR, *J. Woodrow, Stockport.*—29*th June*, 1882. 6*d.*

The object is to make the machine more self-acting and continuous in its operations.

3067. SCREW PROPELLERS, *J. Carr, Heaton.*—29*th June*, 1882. 4*d.*

The invention consists in forming a screw propeller of separate blades, so arranged as to be fitted together to form a propeller of two, three, four, or more blades.

3068. FLUID METERS, *T. R. and T. W. Harding, Leeds.*—29*th June*, 1882. 6*d.*

This relates to patent No. 309, dated 15th July, 1881; and consists in improvements in the gearing.

3078. UTILISING the RISE and FALL of TIDAL WATERS for MOTIVE POWER, *J. A. Timmis, Westminster.*—30*th June*, 1882.—(*Not proceeded with.*) 2*d.*

The objects are to utilise the rise and fall of tidal waters, by treating such risings and fallings as primary agents and so dealing with them as to create motive power, which is either used as made or stored for after use.

3076. MILLS for GRINDING CORN, &c., *W. R. Lake, London.*—29*th June*, 1882.—(*A communication from W. Hartmann, Geisa, Germany.*) 6*d.*

The invention comprises a peculiar mode of forming the grinding discs, and various other novel features of construction.

3087. LOOMS for WEAVING CHENILLE or FUR PILE FABRICS, *J. Dodd, Oldham, and W. Adam, Kidderminster.*—30*th June*, 1882. 6*d.*

This relates partly to a novel arrangement of parts for giving the requisite motions and dwells to the lathe, healds and picking motions. Other improvements are described.

3088. MACHINERY for COMBING WOOL, &c., *J. W. Bradley and J. Wood, Bradford.*—30*th June*, 1882. 6*d.*

This consists in the construction and employment in combing machinery of an intermediate circular receiving comb and two outer feed combs, or of an intermediate feed comb and two outer receiving combs.

3089. BREECH-LOADING FIRE-ARMS, *H. A. A. Thorn, London.*—30*th June*, 1882. 6*d.*

The object is to provide a four-barrel arm with only two hammers to be operated by one or more triggers.

3091. UTILISATION and TREATMENT of DEPOSITS, *J. C. W. Stanley, London.*—30*th June*, 1882. 4*d.*

This relates to the treatment of the deposits which form on the beds of rivers and in other waters by calcination in a vessel from which air is partially or wholly excluded, whereby the said deposits are rendered dark in colour and suitable for use as a base in the manufacture of colours and for other purposes.

3092. SAFETY VALVES, *C. W. Collins, Manchester.*—30*th June*, 1882.—(*Not proceeded with.*) 2*d.*

This relates to patent No. 5729, dated 30th December, 1881, and consists in various improved modes of compensating or counteracting the additional load upon the valve from the increased resistance of this spring when the valve rises.

3093. PLOUGHS, *J. Howard and E. T. Bousfield, Bedford.*—30*th June*, 1882. 4*d.*

The inventors claim, First, connecting the balanced beam of reversible ploughs with the axle of the carriage in such a manner as to permit of its vertical adjustment; Secondly, the application to a reversible or balanced plough of the draught attachment, consisting of an adjustable lever fitted at its pendent end with a link or shackle for connecting with the draught chain, such lever being provided with stops for limit the movement of the shackle.

3096. WATER-WASTE PREVENTERS, *H. Conolly, London.*—30*th June*, 1882. 6*d.*

This relates to a water-waste preventor consisting of the combination in a cistern of the supply pipe, which extends to the bottom of the said cistern, the syphon and the float or displacer, the pull of which passes through the bottom of the cistern.

3102. TRAPPING "MICAS" or MICA PITS in WASHING CHINA CLAY, *J. Covering and R. Martin, St. Austell.*—30*th June*, 1882. 6*d.*

This relates to the mechanism for actuating the traps.

3106. PROPELLERS for STEAM VESSELS, *R. Bell, Liverpool.*—1*st July*, 1882. 6*d.*

The invention consists essentially in a two or three-bladed fan, each blade formed of a true screw blade, joined to a second and rather narrower true screw blade by means of curved paddles or blades approximately tangential to circles having the axis of the fan for their centres, inclined backwards and inwards towards the centre of the fan at an angle of, say, 45 deg.

3110. DOOR FURNITURE, &c., *J. Brown, Windermere.* 1*st July*, 1882. 4*d.*

This consists in the use of a concave spring washer with a dowelled adjusting nut in combination with the ordinary through spindle screwed into the knob.

3111. MACHINERY for SCOURING, &c., HANKS of FIBROUS MATERIALS, *J. F. Kilburn, Meltham.*—1*st July*, 1882.—(*Not proceeded with.*) 2*d.*

This relates to a combination and arrangement of apparatus to be employed in scouring, washing, dyeing, and sizing hanks composed of fibrous materials.

3112. REMOVING SURPLUS BRONZE or other POWDER in COLOUR PRINTING, *J. Bromley, Hunslet.*—1*st July*, 1882. 6*d.*

This consists partly in the use, in conjunction with means for removing surplus powder from paper or other material, of a pair of rollers for drawing the paper or other material to be treated into the machine, the arrangement being such that the said material is subjected to elastic pressure before being acted upon by the dusting apparatus.

3113. MACHINERY for RENDERING PEAT and PEAT-MOSS SUITABLE for LITTER, *T. D. Cox, New Charlton.*—1*st July*, 1882. 4*d.*

This relates to the employment of rotary beaters properly set and adjusted, to which the peat-moss is fed.

3114. FORMING or UNITING ARTICLES of GLASS, &c., *C. H. Stearn, Newcastle-upon-Tyne.*—1*st July*, 1882. 6*d.*

This consists in apparatus for forming or uniting articles of glass, and in so connecting the mechanism or means by which the air is forced into the interior of the article, with the supply of gas or air, or both, to the blow-pipe or blow-pipes, that the said supply is automatically cut off, or so that the blow-pipe or pipes is or are turned on one side, so that the flame or flames do not play upon the glass whilst the air is being forced to its interior.

3116. VENETIAN BLINDS, *E. D. Emery, Canonbury.*—1*st July*, 1882.—(*Not proceeded with.*) 2*d.*

The object is to cause the laths of Venetian blinds to collect at the top when the blind is being drawn up, instead of at the bottom.

3117. LIFTING BARRELLED BEER or OTHER LIQUIDS ABOVE THEIR LEVEL, &c., *W. Wood and W. Whitaker, Burnley.*—1*st July*, 1882.—(*Not proceeded with.*) 2*d.*

This relates to pumping air or other suitable gas.

3118. STEAM BOILERS, *J. T. Ward, Ossett.*—1*st July*, 1882.—(*Not proceeded with.*) 2*d.*

The ordinary flues or internal fireways of Lancashire boilers are connected or in communication with each other, by means of cross connecting fire-tube flues or passage ways, so that at will the heated gases and flame from either furnace may be diverted to the other furnace, and applied for consuming smoke therein.

3119. MECHANICAL PARTS OF MUSICAL INSTRUMENTS, &c., *J. M. and J. B. Draper, Blackburn.*—*1st July*, 1882.—(*Not proceeded with.*) 2d.

According to this invention the repeat of any particular tune may be secured when desired instead of changing from tune to tune.

3121. TRICYCLES, &c., *W. Lloyd, Harborne.*—*1st July*, 1882.—(*Not proceeded with.*) 2d.

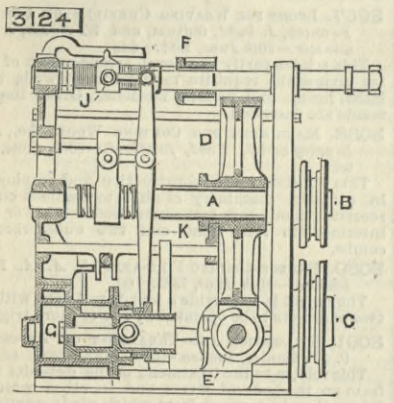
This consists in the construction and arrangement of the parts connected with the hind or steering wheel and the steering apparatus of the tricycle.

3122. COATING OR PLATING CERTAIN METAL SURFACES WITH CERTAIN OTHER METALS OR ALLOYS, *A. M. Clark, London.*—*1st July*, 1882.—(*A communication from C. H. Halegele, Geislingen.*) 4d.

This relates to the coating or plating of metal surfaces, such as plates, rods, wires, or fancy articles of copper, iron, or steel, with German silver, yellow metal, and other alloys, by welding, and to the composition of the alloys themselves, and to the further coating of such plated surfaces with precious metals.

3124. COMBINED STEAM AND HAND STEERING APPARATUS, *J. Hastie, Greenock.*—*3rd July*, 1882. 6d.

The drawing shows one form of the apparatus. The frame consists of end standards combined with a base plate and castings containing the steam cylinders and valve casings. The standards carry a shaft A, having a chain pulley B at one end for driving the chain, which also passes partly round pulleys C on studs, and is connected to the rudder. The wheel D is both a worm wheel and a spur wheel, and is movable on feathers on the shaft A, so as to gear either with worm



E below or pinion F above. The worm is on a crank shaft driven by a pair of horizontal steam cylinders G, with the trunk pistons, and the annular spaces round the trunks are always in communication with the steam inlet passages, whilst distribution valves are arranged to act only in connection with the passages of the other ends of the cylinders. The pinion F is on the hand shaft I, which has a screw thread acting on nut J, jointed to lever K, which is connected to a controlling valve, by which steam is admitted to the casings of the distribution valves of the steam cylinders.

3126. SIDE SADDLES, *G. T. Jenkins, London.*—*3rd July*, 1882. 6d.

The invention consists in an arrangement for passing the stirrup leather over the back or withers of the horse, so that it may act freely when pulled backwards or forwards by the use of the stirrup or otherwise, and fastening the stirrup leather when so passed over to another strap fixed on the near side of the saddletree and passed under the horse's body.

3127. MANUFACTURE OF ARTIFICIAL STONE OR CONCRETE, *G. Hodgson, Loughborough.*—*3rd July*, 1882. —(*Not proceeded with.*) 2d.

When imitating in artificial stone or concrete, a natural buff stone, the following proportions are used: —8 parts of the yellow oxide of iron or ochre of the Malago Vale, 1 part of the red oxide or ochre, and 36 parts of Portland cement.

3131. RAILWAYS, *A. M. Clark, London.*—*3rd July*, 1882.—(*A communication from J. H. Meacham, Petersburg, U.S.*)—(*Not proceeded with.*) 2d.

This relates to improvements in the class of iron railroad-ties having a flat base and vertical longitudinal web formed in the upper side of the latter.

3134. GRAIN ELEVATORS, *H. E. Newton, London.*—*3rd July*, 1882.—(*A communication from J. F. Rojer, Vienna.*) 6d.

This consists in grain elevators in which an endless chain of buckets is used for raising the grain, of the employment of a carriage for supporting the "elevator leg" or endless chain of buckets, such carriage being arranged to move up or down on inclined ways by means of an endless chain.

3135. PREPARING AND TREATING MALT EXTRACT, &c., *L. Hoff, London.*—*3rd July*, 1882. 4d.

This relates to the preparation of malt jelly, and to the combination therewith of cod-liver oil, castor oil, or other medicinal oil and cocoa.

3138. TUNNELLING AND QUARRYING SLATES, *G. Hunter, Egham.*—*3rd July*, 1882. 8d.

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

3139. GUIDES FOR SPINNING MACHINERY, *P. Sharp, Aberdeen.*—*4th July*, 1882.—(*Not proceeded with.*) 2d.

The invention consists in providing a special movable or adjustable guide, which is to be shifted by hand, when a thread breaks and then holds the rove or sliver just to one side of or free from the nipping parts of the retaining and drawing rollers, so that the rove or sliver ceases for a time to be fed and drawn down.

3145. RACK PULLEYS FOR BLIND CORDS, &c., *C. Priestland, Birmingham.*—*4th July*, 1882. 6d.

This consists in a rack pulley for blind cords and the like, in which the rack teeth or notches are formed on turned-in edges of the slot of the frame, whether at the front or back of the frame.

3146. SEPARATING AND COLLECTING AMMONIACAL AND OTHER PRODUCTS FROM BLAST FURNACE GASES, &c., *W. Ferrie, Chapelhall, Lanark.*—*4th July*, 1882.—(*Not proceeded with.*) 2d.

The object is to effect the separation and collection of the ammoniacal and other contents from blast furnace gases, and, when necessary, to recharge the residue of the said gases with tar and other hydrocarbons from which some of the tars and the hydrocarbons have become separated with the ammoniacal products, so as to restore the heating value of the gases more or less approximating to what was their orignal heating value prior to the said separation.

3147. MANUFACTURE OF COLOURED GLASS GLOBES, &c., *R. W. Harris, Paris.*—*4th July*, 1882.—(*Not proceeded with.*) 2d.

This relates to the employment of colouring compositions in the manufacture of the globes.

3163. SPINNING FRAMES, *A. M. Clark, London.*—*4th July*, 1882.—(*A communication from G. Jaquith, Maysville, U.S.*) 6d.

The invention more particularly relates to the bobbin spindles of spinning frames, and consists in various novel constructions and combinations of parts, including a tube forming an oil reservoir, and support for a step bearing and bushing within it, which bearing and bushing hold up and guide the spindle that rotates freely within the oil. It also includes a whirl of peculiar construction, and various other details and combinations of details whereby waste of oil is avoided. Lint or dust is excluded from the spindle, and from mixing with the oil.

3164. STILL FOR DISTILLING LIQUIDS CONTAINING AMMONIA, *W. A. Barlow, London.*—*4th July*, 1882. —(*A communication from J. Gareis, Deutz, Prussia.*) 6d.

The apparatus consists of four distinct vessels or receivers, two whereof contain the liquid to be distilled, and one of the other vessels contains, besides the liquid to be distilled, an addition of milk of lime, which is introduced from a superposed vessel, the last of the four above referred to.

3166. HEMSTITCHING MACHINES, *A. Gass, Belfast.*—*5th July*, 1882.—(*Not proceeded with.*) 2d.

This consists in dispensing with the use of a wide slot or a moving piece in the shuttle-box of a hemstitch sewing machine, and in employing instead a moving face which carries the needle bar and shuttle-box laterally together on a countershaft, the feed motion being the same as is commonly used in hemstitching machines.

3168. CUTTING AND DRESSING STONE, *M. Kellow, Penrhyndeudraeth.*—*5th July*, 1882.—(*Not proceeded with.*) 2d.

This consists in the construction and use of a rotative tool holder carrying a series of chisel-shaped cutters mounted in its periphery.

3169. NECKTIES, *J. Noar, New York.*—*5th July*, 1882. —(*Not proceeded with.*) 2d.

This consists in the novel construction of the collar button attachment and arrangement of the pin for the neck band, the said pin and attachment being connected for use in the same scarf.

3173. APPARATUS FOR RECORDING SPEECH, *J. Imray, London.*—*5th July*, 1882.—(*A communication from A. Gentilli, Leipsic, and L. C. Alexander, Boulogne.*) —(*Not proceeded with.*) 2d.

This relates to apparatus whereby articulate speech is recorded in symbols that can be easily interpreted.

3184. STEAM ENGINES, *A. M. Clark, London.*—*5th July*, 1882.—(*A communication from W. F. Goodwin, Stelton, U.S.*)—(*Not proceeded with.*) 4d.

The objects of this invention are to make two complete revolutions of the crank shaft where one was made before, and to require but one reverse movement of the valve to each revolution where two were required before to effect the same purpose.

3186. RECOVERY OF SULPHUR FROM ALKALI WASTE, *W. Weldon, Burstow.*—*6th July*, 1882.—(*A communication from Dr. M. Schaffner and W. Helbig, Aussig.*) 4d.

This relates to patent No. 955, A.D. 1878, and consists in several various improvements.

3188. COMMUNICATING POWER BY MEANS OF DRIVING BELTS, *J. K. Tullis, Glasgow.*—*6th July*, 1882.—(*Not proceeded with.*) 2d.

This consists essentially in using a series of flat belts with tapered or inclined sides or edges corresponding to the shape of tapered grooves in the driving and driven pulleys.

3191. MANUFACTURE OF BRICKS, &c., *W. C. Gibson, Newcastle-on-Tyne.*—*6th July*, 1882.—(*Not proceeded with.*) 2d.

This refers to the manufacture of fire-clay or other bricks and other articles made of fire-clay or other clay, which have one or more of their sides glazed.

3192. APPARATUS FOR CUTTING CHEESE, *R. Alexander, jun., Edinburg.*—*6th July*, 1882.—(*Not proceeded with.*) 2d.

This relates to the construction of a frame for holding the wire.

3201. VELOCIPEDES, *J. Walker, Coventry.*—*6th July*, 1882.—(*Not proceeded with.*) 2d.

The object is to enable the rider to store up a large part of the power of gravity, which acts on the vehicle and its rider when running down a hill, or surplus muscular power of the rider, so as to utilise this power in propelling or assisting to propel the vehicle and rider up the next or any other hill or part of the road.

3203. APPARATUS FOR CLEANING OR SCRUBBING THE SIDES OF SHIPS, *H. C. H. Allen, Liverpool.*—*6th July*, 1882.—(*Not proceeded with.*) 2d.

This relates to the construction of a frame for holding the brush or scraper.

3205. MILLING MACHINERY, &c., *J. Cadogan, New Ross.*—*6th July*, 1882.—(*Not proceeded with.*) 2d.

This consists, First, in forming a spiral groove round the collar or "hackle," which is attached to the balance irons carrying the upper stone in milling machinery; Secondly, to the wooden teeth or cogs of wheel gearing.

3208. SEPARATING HAIR FROM SKINS, *J. T. Tussaud, London.*—*6th July*, 1882. 4d.

This relates to the chemical treatment of the skin.

3209. FANS FOR COOLING STACKS AND FOR WINNOWING AND DRYING CORN, *C. Clay, Wakefield.*—*6th July*, 1882.—(*Not proceeded with.*) 4d.

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

3214. APPARATUS USED FOR THE MANUFACTURE OF SULPHATE OF AMMONIA, *J. Coates, London.*—*7th July*, 1882. 4d.

This refers to the manufacture of sulphate of ammonia from ordinary gas liquor, and relates to improvements in the apparatus.

3216. PRODUCTION OF ORTHO-NITRO-META-METHYL-BENZALDEHYDE FROM META-METHYL-BENZALDEHYDE (TOHNYLALDEHYDE), AND IN THE PRODUCTION OF METHYL INDIGO, *J. Erskine, Glasgow.*—*7th July*, 1882.—(*A communication from Meister Lucius and Brüning, Hoechst-am-Main.*) 4d.

This consists in the production of ortho-nitro-meta-methyl-benzaldehyde from meta-methyl-benzaldehyde by nitrating the meta-methyl-benzaldehyde.

3216. PRODUCTION OF CINNAMIC ACID AND OF SUBSTITUTED CINNAMIC ACIDS FROM BENZYLIDEN-ACETONE AND ITS SUBSTITUTION PRODUCTS, *J. Erskine, Glasgow.*—*7th July*, 1882.—(*A communication from Meister Lucius and Brüning, Hoechst-am-Main.*) 4d.

This consists in the production of cinnamic acid and of cinnamic acids substituted in the benzol nucleus, from the monobenzyladenacetone and the corresponding substitution products, by means of hypochlorites, hypobromites, or hypoiodites.

3220. METALLIC WOOL, *R. H. Woodley, Limehouse.*—*7th July*, 1882.—(*Not proceeded with.*) 2d.

The process consists essentially of placing the material—for instance, lead—together in the form of sheets, and then cutting such edges by a knife or knives, or by a guillotine or planing action.

3272. SHOOTING SEATS, *H. F. Beaumont, near Huddersfield.*—*10th July*, 1882. 4d.

The invention consists in the combination, forming one article, of an umbrella, parasol, or sunshade, with a shooting seat.

3942. PUMP, *W. B. Tibbits, Clifton.*—*17th August*, 1882. 6d.

This relates to an oscillating pump which is adapted for use on board ship, and specially on board of such vessels and in such places where only manual power is available for working pumps.

4633. MUSICAL INSTRUMENTS, &c., *H. J. Haddan, Kensington.*—*29th September*, 1882.—(*A communication from W. F. Abbott, Montreal.*)—(*Complete.*) 6d.

This relates, First, to the arrangement of the reed box; Secondly, the construction of valve to be used on the feeders and bellows; Thirdly, the arrangement of feeders and bellows; Fourthly, the arrangement of the reeds; Fifthly, a modification in the construction of the reed box and the manner of attaching it to the guide rails; Sixthly, to the construction of the hinges and catches by which the removable frame carrying the tremulant and swell box is attached to the said instrument; Seventhly, to the construction of the motors for propelling the music sheet and otherwise operating the whole instrument.

4073. IMPROVEMENTS IN ELECTRIC BELL AND AUTOMATIC ALARM APPARATUS, &c., *P. M. Justice, London.*—*25th August*, 1882.—(*A communication from V. Vankeerbergen, Brussels.*) 6d.

This is partly an improvement on the inventor's patent, No. 3791 (1882). It consists in the combination of a plate of metals of different expansive powers, with a contact point, by means of which and an electric bell and battery in circuit, the bell can be rung, either by hand in the ordinary way, by closing the circuit, or automatically by an increase in the heat of the room where the apparatus is, the metals expanding by reason of the heat until the circuit is closed.

4857. PRODUCER GAS FURNACES, *C. D. Abel, London.* —*12th October*, 1882.—(*A communication from the Stettiner Chamotte Fabrik Actien-Gesellschaft vormals Didier, Germany.*)—(*Complete.*) 6d.

The principal features of this invention consist, First, in dispensing with a fire-grate in the gas producer, the requisite air for the combustion of the coke being supplied through slits or channels of small height in the bottom of the producer; Secondly, a much less radiation of heat is obtained; Thirdly, all detonations when adding the coke supplies are prevented by the form of the producer, and by the position and distance of the gas passages relatively to the slit in the bottom of the producer and to the furnace itself; Fourthly, the construction of the regenerator can be effected in a simple manner even with old furnaces; Fifthly, a regulating contrivance in front of the air channels regulates the admission and heats the same; Sixthly, the regulation of the draught dampers for the escape flues, and also that of the air supply for the combustion of the carbonic oxide gas; Seventhly, the accurately determined dimensions, form, and position of the several openings relatively to each other, through which the carbonic oxide and air are led beneath the retorts, have the effect of producing complete combustion and consequently complete development of heat at once in the lower part of the furnace directly over the air inlet openings; Eighthly, the construction of the flues through which the products of combustion pass to the chimney, and through which the air required for combustion with the carbonic oxide enters the furnace, is such that the waste heat passing away is utilised to the greatest possible extent, while the air is heated so considerably that a great saving of fuel is effected thereby.

4992. MANUFACTURE OF FATTY MATTER FROM WOOL FAT, *F. C. Glaser, Berlin.*—*20th October*, 1882.—(*A communication from Dr. O. Braun and Dr. O. Liebreich, Berlin.*)—(*Complete.*) 4d.

This relates to the manufacture of fatty matter from wool fat, termed "Lanolin," which may be produced either from the waste liquors of wool-washing works or from ordinary commercial wool fat.

5062. SEWING MACHINES, *S. Pitt, Sutton.*—*24th October*, 1882.—(*A communication from L. B. Miller and P. Diehl, New Jersey, U.S.*)—(*Complete.*) 8d.

This consists partly in improvements in the feeding and shuttle-driving mechanism and the presser-bar, shuttle, and tension mechanism.

5165. GAS COOKING STOVES OR RANGES, *A. M. Clark, London.*—*30th October*, 1882.—(*A communication from W. W. Goodwin, Philadelphia, U.S.*)—(*Complete.*) 4d.

This consists in the peculiar construction and arrangement of the top plates of the stove and of the burners.

5223. LOWERING, RAISING, AND DETACHING SHIPS' BOATS, *M. Bourke, Youngstown, U.S.*—*1st November*, 1882.—(*Complete.*) 6d.

The object is to provide simple means by which the boat can be quickly lowered and automatically detached from its fastening immediately upon coming in contact with the water when so required or found necessary.

5644. MANUFACTURING RAILWAY RAILS, &c., *A. J. Acaster, Sheffield.*—*24th December*, 1881.—(*Complete.*) 6d.

This consists partly in so shaping the grooving or ribbing parts and all adjacent parts of the rolls as that while the rails are having the grooves or ribs rolled into or on to them, all adjacent parts thereof shall be completely supported by the rolls and prevented from being altered in shape.

5665. IMPROVEMENTS IN APPARATUS FOR PRODUCING AND REGULATING ELECTRIC LIGHT, &c., *S. A. Varley, Islington, Middlesex.*—*24th December*, 1881. 10d.

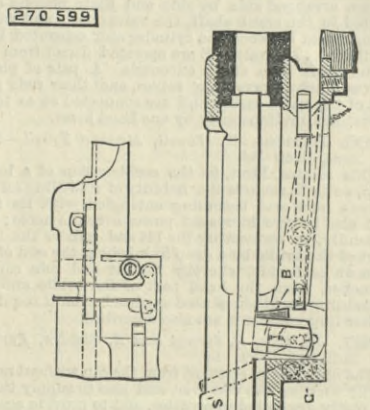
This relates to improvements on patent No. 3394, 24th December, 1866, and No. 1755, 15th June, 1867. The improvements consist in an improved method of constructing electric generators, a governor, and an arc lamp.

SELECTED AMERICAN PATENTS.

From the United States' Patent Office Official Gazttee.

270,599. MAGAZINE FIRE-ARM, *Paul Mauser, Oberndorf-on-the-Neckar, Wurtemberg, Germany.*—*Filed April 21st*, 1882.

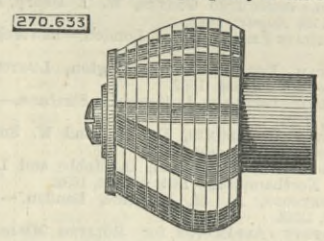
Brief.—A vertically-movable block in the side of the rear end of the carrier throws the latter into and out of engagement with the bolt, so as to enable the arm to be used as a magazine gun or as a single-loader. When used as a single-loader the carrier is locked in its elevated position and forms the bottom of the receiver. *Claim.*—(1) The combination of the block *i*, having the chamfered nose *x*, and spring *e*, having a similarly chamfered end and a projection *n*, with the carrier *b*, provided with a groove b^1, substantially as



and for the purpose set forth. (2) The spring s^1, having one end doubled and secured to the gun-case, and provided with a head s^{11} upon the other end, protruding through a hole in the case, in combination with the lever *s* and extractor *o*, as and for the purposes described. (3) The lever *s*, turning upon the centre *g*, and provided with the pin v^1, in combination with the spring s^1, having the head s^{11}, and with the block *i*, provided with the slot i^1, and carrier *b*, substantially as set forth. (4) The lever *s*, with the pin v^1 and centre *g*, in combination with the spring s^1, having the head s^{11}, block *i*, and offset *x*, and with the carrier *b*, substantially as described and for the purpose set forth.

270,633. ROTARY CUTTER, *James H. Bussell, Boston, Mass.*—*Filed November 20th*, 1882.

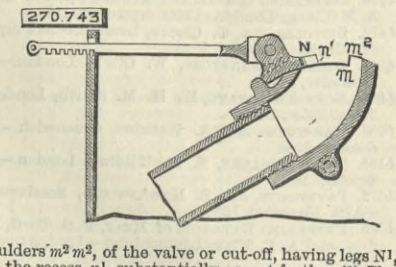
Claim.—(1) A rotary cutter having its periphery moulded or curved longitudinally, and provided with a series of cutting blades projecting from and connected homogeneously at their inner edges with a common central hub, and having the inner portions of their front radial or nearly radial faces reduced in thickness to a radial width varying according to the longitudinal curvature of the periphery of the cutter, sub-



stantially as and for the purpose described. (2) A moulded rotary cutter composed of a series of sections or discs clamped upon a central core or mandril, and provided with a series of radial or nearly radial cutting blades, the inner portions of the front faces of which are cut away or reduced in thickness to a varying radial width corresponding to the varying diameters of the several sections, or having the width of the face to be ground, in sharpening each blade, about equal upon all the sections, substantially as described.

270,743. EXHAUST NOZZLE FOR STEAM ENGINES, *Willard A. Clarke, Stillwater, Minn.*—*Filed November 13th*, 1882.

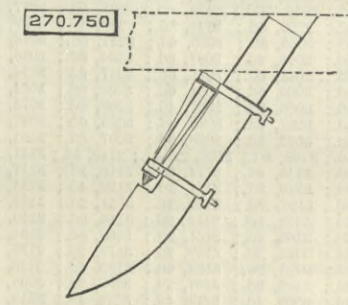
Claim.—(1) The combination, with the smoke stack and the exhaust pipe, of the herein described nozzle having the aperture *m*, and the pivotted valve N, arranged to narrow said aperture, substantially as set forth. (2) The combination, with the nozzle having the elongated throat or slot *m* and the lugs or



shoulders m^2 m^2, of the valve or cut-off, having legs N^1, and the recess n^1, substantially as set forth. (3) The combination of the curved valve-seat, the hinged valve, the rod pivotted to the valve and projecting through the side of the smoke stack, and the devices for fastening the rod in different positions for adjusting the valve, substantially as set forth.

270,750. PLOUGH COULTER, *David W. Copeland, Lowville, N.Y.*—*Filed December 4th*, 1882.

Claim.—(1) In combination with a recessed ploughcoulter, a rotary clearer having radial wings and supporting brackets, and a tapering point below the lower bracket in line with the edge, substantially as



described. (2) In combination with a recessed ploughcoulter, a rotary clearer having radial wings, in combination with vertically adjustable supporting brackets, and with a tapering point below the wings in line with the edge, substantially as described.

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