STEEL FOR STRUCTURES.

AMONGST engineers and constructors there seems still to be a good deal of difference of opinion as to what should be the limits of strain which may be visited upon steel in structures, and more especially such structures as bridges and roofs. A paper on steel for structures was read before the Institution of Civil Engineers on the 1st inst. by Mr. Ewing Matheson, the value of which was greatly enhanced by the important discussion which it provoked then and on the 8th inst. The chief object of the paper was to draw attention to the fact that though the uncertainties and want of uniformity in steel, which hindered its application to shipbuilding and boiler-making purposes, have been removed, steel is nevertheless but little used, in this country at least, for bridge building, and hardly at all for roofs or buildings. In stating his case, which may be termed steel *versus* iron, Mr. Matheson resorted to a series of propositions as the most convenient way of eliciting opinions on the various points. In these propositions he referred to the certainty with which plates and bars of all forms are now rolled of steel, to the advantages in respect of sizes and weights as compared with iron, to the superior mechanical properties of steel, to the question of manipulation, and to others leading to the proposition that structures of steel are superior to those of iron, but that there are at present only a few instances in which its use offers any pecuniary advantages, and that this limit to the application of steel is partly due to official rules and partly to exigencies of design. On all these propositions, and more, Mr. Matheson enlarged, especially from the point of view of the constructor; but the question to which particular attention is drawn is what is considered the anomalous character of the rules of the four official bodies by whom the maximum strain which shall be visited on the parts of structures is limited, and the properties of the material determined by certain stipulations. Of these we have first, the Admiralty demanding that the steel used for ships shall have an ultimate tensile strength of not less than 26 tons, or more than 30 tons per square inch, with an elongation of 20 per cent. in 8in. By Lloyd's rules the minimum and maximum ultimate tensile strengths are 1 ton higher, or 27 and 31 tons, the other figures remaining the same; while the Liverpool Underwriters raise the limit to from 28 to 32 tons. The French Admiralty rules demand higher minimum strength than any of the English bodies, and they apportion the strength according to the section. Thus it is only when $\frac{3}{4}$in. in thickness is reached that the minimum of 28 tons is allowed, no maximum being prescribed; but the minimum increases inversely as the thickness of the plates or bars, and for plates above $\frac{1}{4}$in. and under $\frac{3}{4}$in. is $28\frac{1}{2}$ tons. The rules of the fourth English body referred to—namely, those of the Board of Trade—are of a different character, and prescribe the maximum working strains to which steel shall be subjected in structures, and not the quality, as is done by the other bodies. Not only is the quality of the steel prescribed by the Admiralty and Lloyd's, but the strains to which it shall be put are as far as possible limited, because the thickness of plates and framing and character of rivetting for ships of given sizes and for given purposes are also prescribed. The Board of Trade rules, however, secure no control or check upon the quality or character of the steel employed, but only enforce so low a maximum strain that a structure cannot be other than safe. This maximum tensile strain is $6\frac{1}{2}$ tons. It is urged by Mr. Matheson and by others that this very low maximum is obstructive to the progress which should now be made in the application of steel to structural purposes, and that the system of low minimum and maximum tensile strength imposed by the Admiralty and Lloyd's acts in the same way, and it is moreover pointed out by them that though so particular about steel, these bodies do not trouble themselves one bit as to what sort of iron is put into ships.

There is probably little doubt that mild steel having an ultimate tensile strength of 35 tons per square inch may now be obtained with certainty and uniformity. It cannot, however, be said that this has been the case for a sufficient length of time to have warranted any very material change in the rules enforced by the bodies referred to. Steel for structural purposes may certainly now be obtained which may be trusted to do the work to which it is put, but this trustworthiness is obtained by making steel of such great ductility and malleability that it will stand almost any manipulation, and then using it with a factor of safety so high that a comparatively low limit of elastic strength meets the requirements. In most, though not in all cases where this mild steel may be used under tension, it is a matter of small importance that its elastic strength is not so great as in the harder steels, or that it does not exceed about, say, 55 per cent. its ultimate strength, for in no case would it be knowingly strained to its limit of elasticity, as the usual factors of safety would prevent this.

Mr. Matheson proposes that the Board of Trade rule should be changed to 8 tons per square inch as the maximum tensile strain instead of $6\frac{1}{2}$ tons, and it is clear that until some such change is made very much progress cannot be made in the employment of steel for bridges and roofs. The advantages which would attend the use of steel in these structures are very great, as the principal load of large bridges, namely, the dead load, would be immediately enormously reduced, and especially would this be the case if the harder steels could be used for compression members, advantage being taken of their very high elastic strength under strain. It would enable us to build large bridges of superior type and appearance at a low cost. Before, however, any united action is taken in order to obtain some relaxation of the Board of Trade rules, it seems desirable that measures should be taken to arrive at a definite index expressive of the structural value of steel employed under tensile and compressive strains. At present the value of a material is expressed by four sets of figures experimentally ascertained, namely, its elastic limit, ultimate strength, extension within the elastic limit or elastic extension, and its total elongation previous to rupture. The elastic extension is seldom obtained or considered, though a most important element. Now the comparison of these four sets of figures for a number of different specimens or makes of steel is not very easily made so that the best relation of the four values is clearly conceived. It is desirable that they should be so collated as to express in one quantity or index the value of the material for work under tension and in one quantity the value for work under compressive strain. Having brought all the values down to a pair of indices in this way, the relative values of iron and of steel could be so simply and clearly shown that the demonstration of the desirability for relaxing the official rules would be a comparatively simple matter.

As far as we know, the best attempt to express in this way the structural value of a given material was made by Mallet in his work on the "Physical Conditions Involved in the Construction of Artillery," and in a paper in the "Proceedings" of the Institution of Civil Engineers, vol. xviii., on "The Coefficients T*e* and T*r* of Elasticity and of Rupture of Wrought Iron." These coefficients expressed the balance in any material between strength and toughness, or the work done by an extending and compressing force on an elastic body at the point where its elasticity becomes permanently impaired and at the further point where rupture occurs. These coefficients express the value, then, of a structural material by two indices, either for tensile or for compressive resistance, and the formulæ at length and their application will be found illustrated in THE ENGINEER for the 8th October, 1880. In the simplest form the formula for $Te = \frac{P\,E}{2}$ and $Tr = \frac{P'\,E'}{2}$, in which P and P′ = elastic and ultimate strength respectively in pounds, and E and E′ the elastic and ultimate extension respectively in feet. Thus for a material having an elastic strength of 15·3 tons, an elastic extension of 0·0143in. in a length of 1ft., an ultimate strength of 24·06 tons, and total extension of 2·216in. in a foot,

$$Te = 20{\cdot}579, \text{ and}$$
$$Tr = 4978{\cdot}1\,;$$

While for a material having an elastic strength = 14·22 tons, elastic extension = 0·0288in., ultimate strength = 42·3 tons, and total extension = 0·67in. in one foot,

$$Te = 38{\cdot}22 \text{ and}$$
$$Tr = 2693$$

To arrive at the values of the same materials for work under compression it is only necessary to substitute the compression for the tensile strengths, and the corresponding elastic and total compressions. From the preceding examples relating to tensile strains and extensions it will be seen that the comparative structural values of very diverse or similar materials may be gathered at a glance, which is not at all so easy to do from an inspection of the four sets of figures showing their mechanical properties in the four separate elements. It will, however, be seen that to complete the index it is necessary to take T*e* and T*r* simultaneously into consideration, for although T*e* is the coefficient of the greater importance in most cases, T*r* becomes a very important element in the members of, say, lattice structures, where ductility may be usefully brought into play before every part of the structure assumes the strain or work assigned to it, either through reasons of a practical character, or as in continuous girders through slight unassignable changes in the strains. There would be little difficulty in combining these indices, though there are several questions to be considered in making the best combination, and the subject is one which might be usefully dealt with by our readers in our correspondence columns.

Before concluding, it should be mentioned that though the Board of Trade rule fixes the working tensile load at 6·5 tons per square inch for steel in bridges, it was recommended by the committee appointed to consider the subject, that a higher or other load might be allowed under circumstances justifying a change. This recommendation was adopted by the Board of Trade, and Mr. B. Baker stated on Tuesday evening that it has been acted upon with reference to the proposed Forth Bridge, and a higher load than 6·5 tons allowed. If, however, it can be shown that uniformly homogeneous steel, having the necessary mechanical properties, can be always obtained with certainty, it is undesirable that every engineer who has a bridge on hand should have to make a special representation to the Board of Trade for permission to use steel as steel, and not as something only a little stronger than iron. Mr. Baker also stated on Tuesday that an extensive series of experiments would be made on the qualities and properties of steel, in view of the construction of the Forth Bridge, and we may express the hope that the elastic extension will not be omitted from these observations, as it too commonly is.

SOCIETY OF ENGINEERS.

NOTES ON ELECTRIC LIGHT ENGINEERING.

ON Monday evening, the 6th inst., the following paper, by Mr. C. H. W. Biggs and Mr. W. Worby Beaumont, was read before the Society of Engineers :—

Twenty-five years ago the man of science was able to obtain a very fair idea of the position of knowledge of a number of branches of science; but since then, so great has been the progress and the development of each branch that it is as much as he can do to make himself thoroughly conversant with any one branch. Just so is it with the work of engineers. Gradually but surely an engineer has to confine himself and his labours to one distinct branch—it may be sanitary engineering, or bridge work, railway work, and so on—whilst quite recently the extraordinary development of the applications of electricity seems to point to a great future for the engineer who devotes himself entirely to this branch of work. Although electrical engineering is still in its infancy, sufficient has been done to show the necessity for a better comprehension of the laws which determine the success of the work undertaken. Accidents at various places have, as is well known, occurred; but each of these accidents can be traced to ignorance, or a culpable negligence of the laws just referred to. There is no reason why an ordinary observer should be under the slightest danger from contact with connecting wires, or that any such danger as of fire to buildings should be possible. An electric light could be without danger, and many engineers would undertake without hesitation to put a lighted lamp into the middle of a powder barrel. We wish to emphasise the assertion that the accidents that have happened, or which may happen, are due entirely to insufficiently careful engineering.

Sufficient has also been done in the practical application of electricity to lighting purposes to indicate the directions in which engineers and electricians must work in order to arrive at the most economical and most complete systems of electric lighting plant. Much of the progress which has been made toward a large use of electricity for the purpose has been effected by engineers and practical machinists who have turned their attention to the subject. The electrician alone has moved slowly, and the engineer would move even more slowly, but the combined labours of the members of these two professions have brought about a sufficiently wide application of electricity for lighting purposes to enable us now to take stock of the information which has been obtained by the work thus carried out.

In considering the selection and arrangement of a set of electric light plant, the first question is the character or kind of light to be employed; secondly, the kind of electrical generator most suited for this light; thirdly, the kind of motive and means of transmission from motor to machine; and fourthly, the apparatus and material for the distribution and regulation of the current between and at generator and lamp. If we speak, then, first of the kind of light, we have the choice of three kinds—that is to say, we have the choice of lamps of three kinds, viz.: (1) the arc lamps, (2) incandescent lamps, and (3) semi-incandescent lamps.

Of these lamps, then, experience has only confirmed the reasons for selecting the arc lamp as the most suitable and the most economical for lighting large spaces, and, except in ornamental design, little now remains to be done in the improvement of these lamps other than in the perfection of the carbons employed. The incandescent lamp will probably remain permanently the best for general indoor illumination. It may, however, be found upon further experience that it is adapted also for street lighting purposes. Two things remain to be done in its improvement, viz., the perfection of the carbons and contacts, and the mechanical arrangements in processes of manufacture, so as to produce it at a minimum cost. The experience gained with these lamps is at present too small to speak with certainty as to their length of life. Many of the earlier ones lasted for comparatively a few hours, but improvement has been so rapid that the later ones have an average life of from 700 to 1000 hours. Some of the makers guarantee this, others do so by guaranteeing renewals over and above a certain percentage, on condition, of course, that the lamps are worked properly. There is no reason why, as experience is gained in the manufacture of these lamps, and with the current regulated in accordance to the design of the lamp, the average light of a lamp should be limited to a thousand hours. It is quite probable that the average life may be extended to two thousand hours, or to even a longer period, and that the first cost of a lamp will be far less than the most sanguine expect now.

It is, perhaps, unnecessary to say more of the semi-incandescent lamp than that it does not seem to command itself to public favour, although the light is steady and of moderate intensity. This may be on account of its cost. Referring now to the electric generator, which is usually a dynamo-electric machine, a selection has to be made in accordance with the selection which has been made from among the different lamps. It is, therefore, necessary to take into consideration the special requirements of the chosen lamp—for example, arc lamps may be chosen, such as Crompton's, as used at King's Cross, which require for three lights in series a machine having an E.M.F. of 250 volts, or we may have incandescent lamps such as the 20-candle power lamp of Swan, which require a machine having an E.M.F. of 45 volts, or the Edison 16-candle power lamps which require a machine having an E.M.F. of 110 volts, or 8-candle Edison which requires but half that E.M.F., and so on. It will thus be seen that the E.M.F. of the machine must be proportional to the resistance of the lamps. If this is not insured, and if the machine has too high or too low an E.M.F., the carbons in the one case will be destroyed, and in the other will not be heated to incandescence. From an engineering point of view we may compare the E.M.F. to head or to pressure of water in an hydraulic system, and thus engineers not conversant with these terms will understand that E.M.F. is the electric condition necessary to overcome the resistance of the lamps, just as a given pressure in the hydraulic system is necessary to cause the plunger of a hydraulic press to move; and engineers will also understand that a quantity of water under that pressure, or similarly of electricity under that condition, is necessary to keep the plunger moving. Thus a certain E.M.F. is wanted to overcome, so to speak, the resistance, and to put the lamp in a certain condition, as well as a certain quantity of electricity to keep up the condition.

The unit of E.M.F. practically employed is termed a *volt*, which is approximately the E.M.F. of a standard cell. This cell gives a certain deflection on, say, a tangent galvanometer, and the E.M.F. of other batteries or electric generators is calculated in terms of such deflection.

Resistances are measured in terms of a unit called the Ohm. A copy of the ohm can, like a pressure gauge or 2-foot rule, be purchased at any electrical instrument maker's. As an illustration of the ohm it may be mentioned that it is the resistance which an electrical current experiences in passing through a copper wire 10·29ft. long and 10 mils. in diameter.

One of the most important points with which an electrical engineer should be acquainted is that of resistances. An electric current passes only when the conductor of that current forms a complete circuit. This circuit in electric light arrangements is divided into two parts, one being part of the machine itself, the other being the cables and lamps, &c., external to the machine. The internal part of the circuit is the wire and commutator connection from brush to brush, and the resistance of this would remain constant after the machine is made if it were not that the metal varied its resistance with change of temperature, increasing with increase of temperature according to the following rate, ascertained by Dr. C. W. Siemens :—

$$r = \alpha\,T^{\frac{1}{2}} + \beta\,T \pm \gamma$$

T = absolute temp. reckoned from — 273 deg. C

α, β, γ = constants thus for

$$\text{Pt}\ r = 0{\cdot}039369\ T^{\frac{1}{2}} + 0{\cdot}00216407\ T - 0{\cdot}2413$$
$$\text{Cu}\ r = 0{\cdot}026577\ T^{\frac{1}{2}} + 0{\cdot}0031443\ T - 0{\cdot}22751$$
$$\text{Fe}\ r = 0{\cdot}072545\ T^{\frac{1}{2}} + 0{\cdot}0038133\ T - 1{\cdot}23971$$

The heating of the armature coils is sometimes looked upon as affecting the insulation only, but it will be seen that the heating also affects the resistance of the circuit, and hence the steadiness of the light. The external part of the circuit is the one coming under the control of the engineer after the machine is made, and it is here that his knowledge of the laws affecting resistance can be applied in the successful arrangement of any system of electric lighting plant. Generally, then, every substance resists more or less the passage of electric currents, some, such as metals, resist the passage but slightly, and are called good conductors; others, such as glass, shellac, gutta-percha, &c., offer an enormously great resistance, and hence are called non-conductors or insulators. The fundamental formula, which should be the basis upon which the calculations are made, is called Ohm's law, viz.:—

$$C = \frac{E}{R}$$

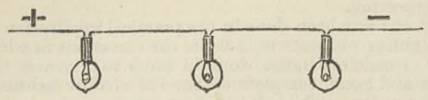
in which C = current
E = electromotive force
R = total resistance.

We have previously pointed out that the total resistance is divided into the external resistance and the internal resistance and if we signify these by R and r respectively, we may write the formula

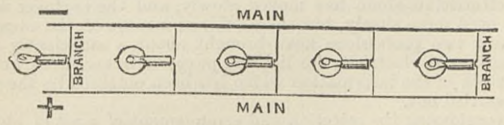
$$C = \frac{E}{R + r}$$

Ordinarily, the external circuit consists of the leading wires and the lamps. Now, the lamps can be arranged in three ways—

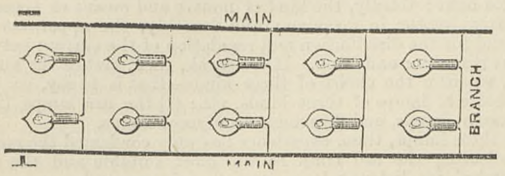
Firstly, one after the other as—



Secondly, in this way, when the lamps are said to be parallel or in divided or multiple arc.



A third way would be a combination in series and in multiple arc, thus:—



Inasmuch as the resistance of the external circuit should bear a certain proportion to the internal circuit, in order to obtain the best effect, there is a good deal of art required to arrange the lamps properly. Sir W. Thomson, at the last meeting of the British Association, in one of his papers concludes that the resistance in the external circuit should be about twenty times that in the internal circuit.

The calculations to obtain the value of the resistance R in these arrangements are fairly simple.

Firstly, the sum of the separate resistances = R; that is, we obtain R by adding together the several resistances of the lamps and the connecting wires.

Secondly, the resistance R is represented by a formula in the form of a fraction, whose numerator is the product of the n resistances; that is, the resistances of each branch, and whose denominator is the sum of the products of the combination of such resistances taken $n-1$ together. Thus the resistance of a circuit with two branches, with r (say 3 ohms) and r_1 (say 4 ohms), the resistance of each branch respectively is—

$$R = \frac{r\,r_,}{r + r_,},\ \text{or with the figures}\ \frac{3 \times 4}{3 + 4} = \frac{12}{7} = 1\frac{5}{12}.$$

With three branches, the resistances being r (3) $r_,$ (4) $r_{,,}$ (5), the formula is—

$$\frac{r\,r_,\,r_{,,}}{r\,r_, + r\,r_{,,} + r_,\,r_{,,}} = \frac{3 \times 4 \times 5}{3 \times 4 + 3 \times 5 + 4 \times 5} = \frac{60}{12 + 15 + 20}$$
$$= \frac{60}{47} = 1\frac{13}{47}.$$

From this it will be seen that by arranging the lamps in multiple arc the resistance of the circuit is diminished. Thus, in the first of these examples the resistance in series is $3 + 4 = 7$ ohms, whereas in multiple arc the resistance is but $1\frac{5}{12}$ ohm. This is somewhat analogous to the resistance to the passage of water through, firstly, two pipes end on, and secondly, to the two pipes placed side by side. When the branch resistances are all equal, as is frequently the case with incandescent lamps, the formula is very simple, and becomes

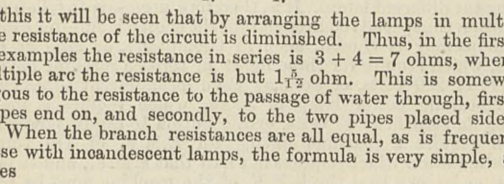
$$\frac{R_,^n}{R_,^{n-1} \times n} = \frac{R_,}{n}$$

where $R_,$ = the resistance of one branch,
n = the number of branches.

Thus, if in the previous example, of $r = r_, = r_{,,} = 5$ ohms we get

$$\frac{5^3}{5^2 \times 3} = \frac{5}{3} = 1\frac{2}{3}$$

Thirdly, the resistance is obtained by a combination of the previous methods. But it must be remembered that each lamp requires a



certain current C. For example, some arc lights require from 20 to 30 ampères, while incandescent lamps require only from 1 to 2 ampères. The lamps have, therefore, to be arranged not only with regard to resistances, but with regard to the quantities of current required. The current passing through any branch circuit being inversely proportional to the resistances, we obtain the following formula for the current in any branch of multiple conductor:—

Let $C_,$ = current in branch.
C = total current.
$R_,$ = resistance of branch.
R = joint resistance of circuit.

Then

$$C_, : C :: R : R_,$$

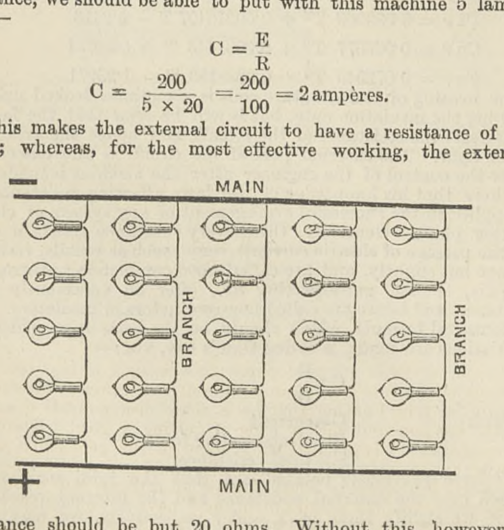
that is

$$\frac{C_,}{C} = \frac{R}{R_,},$$
$$\therefore\ C_, = C\frac{R}{R_,}.$$

As an example of these calculations, we may take the following hypothetical case:—Suppose we have a machine, the E.M.F. of which is 200 volts, and internal resistance = 1 ohm; suppose E.M.F. required by lamps = 40 volts. The current required through lamp, 2 ampères, and the resistance of the lamp 20 ohms. If we were to arrange these lamps in series, neglecting the wire resistance, we should be able to put with this machine 5 lamps. Thus—

$$C = \frac{E}{R}$$
$$C = \frac{200}{5 \times 20} = \frac{200}{100} = 2\ \text{ampères.}$$

but this makes the external circuit to have a resistance of 100 ohms; whereas, for the most effective working, the external



resistance should be but 20 ohms. Without this, however, it would be seen to be an uneconomical method, and it will be seen that by arranging twenty-five lamps in a five-branch circuit, thus each circuit having five lamps in series, the resistances and circuits is to be as follows:—

$$R_, = 5 \times 20 = 100\ \text{ohms.}$$
$$R = \frac{100^5}{100^4 \times 5} = \frac{100}{5} = 20\ \text{ohms.}$$
$$C = \frac{E}{R} = \frac{200}{20} = 10\ \text{ampères.}$$
$$C^1 = C\frac{R}{R_,} = 10\ \frac{20}{100} = 2\ \text{ampères.}$$

This circuit having the proportionate resistances suggested by Sir W. Thomson, and the current as required through each lamp. We have now glanced at a few of the calculations with the methods of which it is necessary the electric light engineer should be perfectly familiar. It is unnecessary for us to describe the practical methods employed for finding resistances, electromotive force, &c. These are pretty generally known. At present copper wire is used for carrying the electric current, and, in order to guard against fire, should the current by some means sent into the wire be too great for its capacity, and hence heat it considerably, it has become customary to insert short pieces of fusible metal, such metal easily conducting the ordinary current, but fusing should the current be much stronger, and thus, by breaking the circuit, stopping the current, and so the danger. It may also be necessary, through the extensive use of copper, and consequent rise in price, to attempt the use of some other metal for conducting purposes. The engineer, then, should be familiar with the sectional area and other properties of the wire he uses, in order to exchange his conductors, or parts of them. The dimensions of equivalent conductors have been simply described by Matthiesen and Hockin. The resistance of a given material varies directly as its length and inversely as the area of its section, or as the square of the radius.

Let L = length,
r = radius of section of wire,
S = specific gravity,
W = weight,

then resistance varies, as $\frac{L}{r^2} = \frac{L^2\,S\,\pi}{r^2\,S\,\pi\,L} = \frac{L^2\,S\,\pi}{W}.$

So that to determine dimensions of the wire L must be known, and then either diameter or weight of wire and specific gravity.

To find diameter of wire D,

Let S = specific gravity,
W = weight,
L = length,
r = radius,
D = diameter,
π = 3·1416; log. π = ·4971499;

then

$$W = \pi\,r^2\,L\,S$$
$$r^2 = \frac{W}{\pi\,S\,L}$$
$$r = \sqrt{\frac{W}{\pi\,S\,L}}$$
$$2\,r\ \text{or}\ D = 2\sqrt{\frac{W}{\pi\,S\,L}}$$

Thus the diameter of a piece of hard drawn silver wire, with L = 2138, W = 7·0189, S = 10·455, is ·632, the resistance of a material depending on length, section, and conductivity. Then with two conductors C $C_,$, wire length L $L_,$, conductivity K $K_,$, and section S $S_,$, we should get the same resistance, and the one might be substituted for the other, when

$$\frac{L}{K\,S} = \frac{L_,}{K_,\,S_,}.$$

Suppose, for example, we wanted to replace a copper wire with iron wire of the same length, we should, of course, require the iron wire of greater sectional area, because its conductivity is less than that of copper. The ratio of the conducting of wire to copper is as ·138 : 1

From the formula L being constant,

$$K\,S = K_,\,S_,,$$

or as sections are, as the square of diameter,

$$K\,D^2 = K_,\,D_,^2.$$

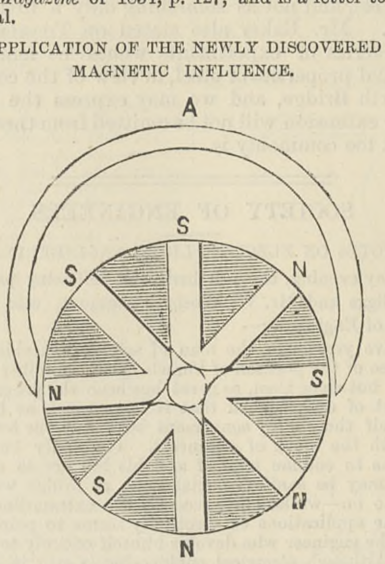
Now, if the diameter of the copper wire is, say, one inch,

$$1 \times 1^2 = {}^{\cdot}138 \times D_2$$
$$D^2 = \frac{1^2}{{}^{\cdot}138} = \frac{1}{{}^{\cdot}138} = 7{\cdot}2\ \text{nearly,}$$
$$D = \sqrt{7{\cdot}2} = 2{\cdot}7\ \text{nearly,}$$

which shows that the diameter of the iron wire required to conduct the same current as the copper wire must be 2·7 times greater. Now, 100in. of copper conductor 1in. diameter would weigh about 25lb., and cost, at say £90 per ton, about 19s., while the iron conductor 2·7in. in diameter, and 100in. long would weigh 160lb., and cost, at £7 per ton, about 10s. Thus the relative cost of iron to copper is about 1 to 2. It must, however, be noticed the cost of the metal is not the only item of cost inasmuch as insulating material to cover the iron conductors would be about as 3 to 8, except in the case of large conductors placed in troughs filled up with cheap insulating material. Further, the extra size and stiffness of the iron wire would undoubtedly increase the mechanical difficulties of installation. Notwithstanding this, however, there is a considerable margin in favour of iron for a great many purposes.

In the construction of dynamos there are some points to which attention may be directed. It will however be of historic interest to reproduce here what seems to be the earliest sketch and description of an electro dynamic machine. It is taken from the old *Mechanics' Magazine* of 1834, p. 127, and is a letter to the editor of the journal.

DYNAMIC APPLICATION OF THE NEWLY DISCOVERED ELECTRO-MAGNETIC INFLUENCE.



Sir,—The prefixed figure represents a dynamic application of the newly-discovered electro-magnetic influence. A is an arc of iron, measuring about two-thirds of a circle, and supposed to be armed with a helix of wire, and connected with a galvanic battery in the usual way. N S, S N, &c., is a solid circle, showing a section of its axis at the centre, and having fixed on its surface the magnets N S, S N, &c. These magnets are built of steel bars, bent so that their straight parts shall incline to each other at an angle of 45 deg. There are many such bars in each, and the whole compound is firmly fixed on the solid circle, with the straight parts in the direction of its radii. The wires which form the connection between the poles of the iron arc and those of the battery are to be so arranged that the connection may be interrupted or reversed at stated times. Finally, the solid circle is to be so adjusted with respect to the arc that it will revolve all but in contact with them, and that a line of joining them will pass through its centre. The action will take place thus:—Suppose the battery in connection with the arc, and that any two of the magnetic poles of the circle are within one-third of their common interval, or 15 deg. of the poles of the arc, since the peculiar arrangement of the magnets ensures the being always poles at opposite sides of the circle, the sum of the mutual attractions of the arc and magnets will be exerted in giving rotary motion to the circle. The moving power will continually increase until the centres of the magnetic poles fall into the line of junction of the arc poles. Here the machine must itself interrupt the communication between the arc and the battery. The circle being supposed so massive as to serve for a fly-wheel will continue to revolve until the next pair of magnetic poles approach within 15 deg. of the arc poles. Here the machine must itself renew the connection, and, if necessary, reverse it also. The expense of power involved in this suspension and change of the current of electricity will be trifling indeed, as the necessary effect will be produced by the shifting of a few wires, which do not present among themselves any attraction to be overcome; such is the singular nature of this power, it is absolutely latent, except just at the point where you please it should develope its mighty energies. The facility, also, and instantaneous quickness with which it reverses the direction, without impairing the energy of its force, are no less wonderful, paralleled only by the similar qualities of steam. The quantity of power that has been developed by actual experiment with the electro-magnetic apparatus is so considerable as to leave no doubt of its efficiency as a mechanical agent; there are, however, to be taken into account its strong disposition to concentrate itself, and its rapid decrease in proportion to the distance from the point of development. Notwithstanding these disadvantages, I should anticipate a satisfactory average of constant working power produced. It may be objected that a serious check will be sustained by the circle, at the moment of any suspension of the galvanic influence, in consequence of the tendency the magnetic poles would then exert to maintain their places opposite to the arc poles, which, though now inert, are still iron. To this I should answer, that that tendency will bear but a small proportion to the impelling force the moment before exerted, and that this impelling force being continued by the mass of the circle will find but little difficulty in overcoming the retarding influence, which, moreover being overcome in the first instance, lessens so rapidly—according to the law of magnetic influence—as to become zero very soon. If, however, the loss of power so sustained should prove equivalent, or nearly so, to the gain made by having the radii magnetic, the difficulty may be at once got rid of by making the radii of unmagnetic iron. I am sanguine, Mr. Editor, in hoping that some of your contributors will put this matter to the test of an experiment.

φ. μ.

It is desirable that the armature coils should have the highest practical velocity in passing through the magnetic field. The construction of armatures which will withstand the strain of this high velocity is a mechanical question which must occupy the attention of electrical engineers. It would be an advantage, for instance, to be able to cut through the magnetic field at a velocity equal, to say 10,000ft. per minute, but the centrifugal tendency of such velocities would be so great that it would be necessary to employ a system of construction not yet devised. An armature, as far as is at present known, must consist of a combination of conductors and non-conductors. It must be built up of many parts, some of which have little structural strength, and steel can be but little used in it, because of it becoming permanently magnetic. The difficulty arises from the necessity of building up the armature of soft iron, which is magnetisable, and of another metal which is not magnetisable, with interposed insulating materials, and, at the same time, making it and its connections with the commutator simple, good and inexpensive. Phosphor and manganese bronze have great strength, and provide the means of making enormous armatures, but both these materials are costly. The difficulty is, probably, not very great, and needs only to be known by engineers to be overcome. There are other directions in which there is room for improvement in the construction of dynamos, as, for instance, an arrangement by which the whole magnetic field, instead of part of the field, may be cut by the armature. Engineers have also a good deal of room for invention in providing means for imparting the necessary high velocity to the armature in the most economical way, whether this is to be done by large armatures or very high velocity of rotation of small armatures. With respect to the motive power for generating electric currents, the steam engine is at present mostly employed, and gives the best results. A good deal has recently been said concerning the future of the steam engine, and Sir F. Bramwell has been followed in his prophecy that the steam engine is on its last legs. This may perhaps be a safe prophecy, as neither Sir F. Bramwell nor his followers have assigned any period as that of the life of these last legs. They do not tell us whether they will last as long as they yet have, or whether it would be well to collect the best steam engines for museum purposes at once. Gas engines have not yet been made of sufficient power to meet the requirements of large installations, and they are not sufficiently uniform in velocity of rotation to give the best results. Neither do they always run without making an uncalled-for stop. There are many situations whereat water power may be made available, as it has been by Sir W. Armstrong, and as it may be at Bristol and elsewhere by the rise and fall of the tide. In the greater number of cases, however, and for some time to come, steam will probably be the chief motive power. Electric light engineers are as much the manufacturers of light from coal as are the gas engineers, and assuming that steam engines are to be the chief medium in this manufacture, it would seem that its improvement more than ever forces itself on engineers. By the introduction of the compound system, a great reduction in the consumption of coal has been made, and particularly so by the small engines now largely used for electric lighting purposes.

In the construction of combined steam engines and dynamo machines, the simplifications already referred to may be carried a little further, for there does not seem to be any reason why the bed-plate and crank-shaft brackets should not be made to form the field magnets, while the fly-wheel may constitute the armature. There are some difficulties to be overcome, but they do not seem to be insurmountable, and one advantage would be that the combined machine so made need not weigh more than two-thirds that of the present form of combined engine and machine on one bed. A lecture was given in Paris, and subsequently published and circulated in this country, by Professor Ayrton, in which a very unfair comparison was made between the cost of power from steam engines and from gas engines. The comparison was made on the assumption that steam engines consumed 6 lb. of coal per horse-power per hour, and gas engines used but 18 cubic feet of gas per hour. Every engineer knows that steam engines are common enough that consume but 2 lb. of coal per horse-power per hour, and a report by Mr. Michael Longridge, on the trial of a compound engine in a mill at Farnworth, was published in THE ENGINEER, which showed that the consumption by an engine of moderate size, namely, about 300 indicated horse-power, need not be more than 1·85 lb. per indicated horse-power. With coal at 10s. per ton, this represents a cost of 0·09d. per indicated horse-power per hour, or under one-tenth of a penny. At 15s. per ton the cost would be 0·138d. per indicated horse-power per hour. Now, the largest gas engines yet made are said to have used but 17 cubic feet of gas per indicated horse-power per hour, and this, at 3s. per 1000, makes the cost of power by the best gas engines 0·612d. per indicated horse-power, or over six times as much as for power from good steam engines. The gas engine has, therefore, a good deal to do yet, and the steam engine's legs may not be so very shaky at present. When gas is used made by Mr. Emerson Dowson's process, the cost is said to be considerably less; but we are not yet warranted in comparing gas engine power from this gas with steam engines.

It has not yet, however, become a matter of cost only in comparing gas engine power with steam engine power for working dynamo-electric machines; for, so long as the piston of gas engines receives but one impulse in every four strokes the regularity in their running is incomparably inferior to that of the steam engine. It is highly necessary to maintain a constant electromotive force in the electric mains, and this is at present best done by varying the speed of the engine, which can be well done with steam engines with good governors and valve gear, such as the Corliss, controlled by an electric regulator. It cannot be so done by gas engines as yet constructed. In the Mansion House plant Mr. Crompton has to a considerable extent overcome the irregularity in the electromotive force by putting a fly-wheel on the dynamo shafts; but this is an undesirable addition which is not necessary with the steam engine. The electromotive force may, of course, be regulated by an artificial resistance, but this is wasteful. Preparatory to making any remarks on the relative cost of electric and gas lighting, it should be stated that here cost is not the only item to be considered. The electric light, to put it briefly, is better than gaslight, and offers several advantages not offered by gas. These we need not enter into, as they are generally conceded by all who have considered the subject, or visited the Paris or Crystal Palace Exhibitions, or the Savoy Theatre. We must, however, state that we have not yet been able to obtain comparative figures from our own experimental apparatus, as we had hoped to have done before the time arrived for reading these notes.

One great defeat of the electric light when obtained on a small scale is the disproportionate cost of one light to that of a hundred or a thousand lights. When the shades of evening begin to fall it is possible to light one gas-burner, but for one electric lamp the steam engine and dynamo must be put in motion. We say must, for although the public has heard a good deal about secondary batteries it has seen little of them. Yet methods of storing up electricity—to be used as conveniently and in as small quantities as is gas—are as certain to be developed and perfected as that we are now discussing the question. The problem to be solved is fairly well known, and there are rumours of more than one experimenter having obtained a satisfactory solution. At present, however, only two secondary batteries can be purchased—those of M. Planté and M. Faure. The ultimate principle of both these batteries is the same. M. Planté commenced his experiments in 1859. Briefly, he takes pairs of lead plates, but for the purpose of explanation we will speak of a pair of plates. These plates are placed in a dilute acidulated water, and connected to the poles of a battery. The action of the battery, as is well-known, is to decompose the acidulated water, and hydrogen is given off at one of the lead plates, oxygen being given off at the other. This nascent oxygen combines with the lead to form a peroxide of lead. If now the current from the primary battery is stopped, and the heated lead plates joined through a galvanometer by wires, they will be found to give current for a longer or shorter time, according to the quantity of peroxide of lead. The peroxide is degraded, and it is this degradation or deoxidation that gives the secondary battery current. The upshot of the primary current is a particular chemical combination; the reversal of this, or the decombination of this chemical, gives the secondary current. In order to obtain a good coating of peroxide the Planté cell has to be charged and discharged a large number of times, and preferably with a constant change of poles. In this manner the lead plates are eaten as it were into a porous condition, and when in this condition they are said to be "formed." After being thoroughly formed they are always charged in the same direction.

Now in January, 1881, M. Faure patented his form of battery. Instead of obtaining a good coating of peroxide of lead by electrolysis he uses his lead plates as a backing and a coating of red lead—which consists mostly of peroxide of lead—mixed with dilute sulphuric acid on the plates. The object of both M. Planté and M. Faure is, as stated in M. Faure's patent, "to obtain plates of lead or other suitable material covered with pulverulent lead." We have for many months past given a careful attention to the theory and the construction of secondary batteries, and were often surprised to find how exhaustively the subject had been discussed by those who experimented years ago. It may be interesting to notice here how the recent great practical applications of electricity have been founded upon phenomena which were formerly the bugbears of electricians. Such, for example, as the microphone dependent on its success upon bad contacts—things hateful to those telegraphists who walked in the old-fashioned paths. The secondary battery is the outcome of "polarisation," the very thing inventors have tried to get rid of, and so on. We feel quite jubilant that these bye-products, these hindrances to the good old electricians, should turn out such useful creations. Time was when a gas works was noted for its waste products, but science and civilisation—that is, Paris fashions—have turned the waste products into good honest coin of the realm, but this is a digression from the history we were engaged upon.

It does not seem to be generally known that tolerably complete descriptions of all that has been done in secondary batteries were published many years ago. The technical literature on the subject seems to be but little known, though important information was published in an English periodical on March 20th, 1863. The *ipsissima verba* of the article is as follows:—

"The great power of the secondary combinations we have referred to is due to the presence of the peroxide of lead in contact with the negative element in these combinations. This substance, as was pointed out by M. De la Rive, surpasses even nitric acid in its affinity for hydrogen, and for this reason a couple constructed with a negative element of platinum, surrounded by a mixture of dilute sulphuric acid and the peroxide of lead, and with a positive element of amalgamated zinc, in dilute sulphuric acid, is more powerful even than the couple of Grove. And when lead, instead of platinum, is used for the negative element, the power of the couple is but little diminished."

Attention must be directed to the fact that the negative element was surrounded by a mixture of peroxide of lead, with dilute sulphuric acid, and this mixture was evidently put on or around by hand, for the writer goes on to speak of the great cost of the peroxide as obtained by chemical methods, and to show how his readers might obtain it electrolytically, as indeed did M. Planté. Although it is not specially mentioned that both poles might be of lead, it can be inferred that this was well known from further remarks of the writer and of other correspondents to *The Electrician*, in which paper the article referred to appeared. These notes have but briefly referred to many matters which are exceedingly interesting to the engineer; but we hope they may induce others who have had larger practical experience to come forward and give from the stores of that experience hints which may be useful to those who are looking for a field in which their energies may with advantage be thrown.

An animated discussion followed the reading of this paper, and finally the discussion was adjourned until Monday evening, the 20th inst., at 7.30. On the table in the Society's room was a considerable number of articles illustrating some of the points considered in the paper, the systems of constructing lamps, arranging circuits, &c. These were lent by the British Electric Light Company, by Messrs. Crompton and Co., by Messrs. Siemens Brothers, Messrs. Elliott Brothers, by the Edison Company, and others.

MESSRS. BARNSLEY & SONS, builders, of Birmingham, have this week secured a contract from the Birmingham Corporation, for the erection of gas offices and an art gallery and museum, for the sum of £81,022, on land at the rear of the Council House.

LETTERS TO THE EDITOR.

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

ENGINEERS IN INDIA.

SIR,—Your paper of January 13th has just been received, containing a letter from Colonel G. Chesney, R.E., late president of Cooper's Hill College, in which, in order to defend the system of supply of engineers for India instituted under his advice and presided over by himself, he depreciated the value of the engineers sent out under the system of open competition previously in force. No one denies that the theoretical training given at Cooper's Hill is good, or that the men from the College are well fitted to become engineers, but when Colonel Chesney writes, "But as regards the statement that the 'Stanley engineers' possessed the advantage of superior practical training before they entered the service, Sir A. Clarke was misinformed as to facts. Some of them may have had some practical training, but *a large proportion of them had none whatever*. . . . . Practically the training of a large proportion of these young engineers had fallen into the hands of *a few 'crammers' who lived in London who had no professional practice to speak of*"—the italics are mine—he states what are not facts, and this he ought to be in a position to know.

I have before me the Parliamentary returns from June, 1861, to July, 1869, inclusive—with the exception of that for 1863. These returns refer to the examination and previous career of 148 of the Stanley engineers. These returns show that over eighty of these gentlemen were pupils of well-known engineers or engineering firms, including such names as John Fowler, W. H. Barlow, Joseph Cubitt, Edwin Clarke, G. Berkeley, R. Stephenson and Co., Sharpe, Stewart, and Co., John Penn, Sir C. Fox and Sons, and many others, most of whom were Members of the Institution of Civil Engineers. The remainder were articled to less known men in the provinces.

The public can best judge if the above-named gentlemen and firms are engineers, or only "crammers who live in London," with "no professional practice to speak of," and whether Government can now find men of larger practice, or firms of greater repute, with whom to place the students from Cooper's Hill College. Many of the "Stanley engineers" had as many years on actual works as the Cooper's Hill men were given months, but it is doubtful if Colonel Chesney knows what practical work means, for he has had none whatever himself, the greater part of his own service having been passed in teaching, either at Roorkee or Cooper's Hill, or as head of the accounts branch of the Public Works Department in India.

Enough proof has, it is hoped, now been given that Colonel Chesney's statements regarding "Stanley engineers" are not facts. That still better men were not procured under the old system was simply due to the terms offered, for while the men from Cooper's Hill have had a great part of their education paid for by the State —*vide* the return to Lord Belper's motion in the House of Lords last July—they also get over double the salary on joining given to the "Stanley engineers," and thus receive far more encouragement to enter Government service than ever did the men under the

India, February 6th. OLD SYSTEM.

THE FOUNDATIONS OF MECHANICS.

SIR,—I do not feel qualified to enter fully into the discussion of the points raised by "Φ. Π.," nor have I time to look into the matter thoroughly, but he concludes his letter in your issue of the 24th ult. by certain remarks which are somewhat interesting. His statement as to the answer received by the inquiring student is more interesting when viewed in conjunction with the remarks you made on the same point in an able article which you published in one of the back numbers of THE ENGINEER, the reference to which I cannot at present give. But it seems to me not to be such an abstruse point as to need the inquiring student to be more than a second year's man, or to require to be shrouded in mystery, with a conditional promise to remove it at some future time; but I am unable to say if it is answered in any book in the languages "Φ. Π." mentions. The problem thus presents itself to me:—An engine is attached to a train by a draw-bar, and when the engine is set in motion the train moves with it. If reaction be equal and opposite, if the locomotive be pulled back with the same force as the train is pulled forwards, why do they move and not remain at rest? The answer is that the forces mentioned as acting simply produce a strain on the draw-bar, and that the engine and train do not move, but remain at rest, as related to each other, for after any interval of time during which the forces act, the engine and train will be in the same relative positions as they were before. The real cause of the movement of the train—as a whole, rigidly connected, the engine included—is to be found in the reaction taking place between the wheels and the surface of the rails, where forces tend to move the rails in one direction and the train in another.

Hundreds of the clearest cases might be cited, but the matter seems so clear that I will not occupy your space in giving them, simply saying, in conclusion, that this is how it appears to me, and I shall be glad if "Φ. Π." will show me where I am wrong, if wrong anywhere. Should the matter have been answered before this letter, I must excuse myself for writing, as I have not seen the last issue of THE ENGINEER. ARTHUR ADAMS.

Smethwick, Birmingham.

VACUUM BRAKES ON THE MIDLAND RAILWAY.

SIR,—The drivers on this line are indeed glad to read in this week's ENGINEER that one of our number has been so bold as to write to you, Sir, and tell you what the vacuum brake is that we have to use. Every word "Midland Driver" has said I can confirm, as every word is true.

We men are sure that our directors don't know what a poor kind of brake is provided upon their trains, or they would never allow such enormous sums of shareholders' money to be wasted upon it. The steam brake on the engine and tender is powerful, and that is what makes us able to work as well as we do. As for the vacuum brake on the carriages, it is a very poor thing indeed. To get a vacuum with the big ejector uses a deal of steam, and makes a fearful noise in the stations. The small ejector is all the time blowing, and this baffles the blast and prevents the engines getting steam as they ought. Now, Sir, suppose I have got a big train on and find a signal against me, I wish to put the brake on a little; but no, I cannot regulate it—on it goes, and I find I am coming to a stand; the signal is taken off, but I can't get the brake off for some seconds, and until the big ejector has lowered my boiler pressure very much. I try all I can to get this pressure up again, but perhaps there is another signal on, and I have to go over this process again. Well, Sir, I now find myself with less than 100 lb. pressure in my boiler, my fire all pulled to pieces by the action of the big ejector, the little ejector baffling her steaming, and worst of all—I am losing time. Something must be done, and quick too, and although I don't like to run without any vacuum in the brake, it is all no use—I must shut off the little ejector, let the vacuum die away, and run on, trusting to my steam brake on engine and tender. You will say, Sir, that is not right or safe; we all know it is very dangerous. But what can I do? It won't do to stick on the road for steam, or we should soon hear of it.

One good thing for us drivers is there are no gauges in the vans now, so we know the guards cannot report us if we have no vacuum; but they know how we are situated, and perhaps if they had gauges they would kindly say nothing if we ran well and made up a minute or two for them when they have lost it at stations.

I do not see, Sir, how our directors are to get to know the truth about this brake, because we men dare not say anything to them. If one was to ask us privately about the brake and tell us he would not mention names, I should soon tell him just what I am writing to you in this letter. But, now, if we say a word we hear of it—thus, "Driver so-and-so, what have you said such a thing to Mr.—— for about the brake?" "Well," you say, "because he asked me;" in reply you get told "Your job is to work the brake, not to talk about it; if you don't like the brake you'd better get off on another line where they use a brake you do like." This is just the way we get talked to if we dare say the truth about a bad brake. Several of my mates thought of going to Derby and stating the truth, but we have been told it will be hot for us if we do; so instead, I have been asked to send this letter to you on behalf of my mates. I ought to say that the steam and vacuum brakes do not work well together, and that when stopping our trains sometimes break loose—there have been several cases lately of this.

EXPRESS DRIVER MIDLAND RAILWAY.

March 7th.

SIR,—I read in your number of last Friday a letter from one of the Midland drivers, complaining of the difficulty in working the automatic vacuum brake in use on that railway, on account of the great amount of steam it takes to maintain a large enough vacuum to keep the brake off in a long train of say fifteen carriages. There was a good deal of correspondence on the same subject in your numbers of September, 1881, and I also see from the back numbers which I have, that in the number of October 14th a "Shareholder and Traveller" writes and says that he can find no mention of any defective working of the brake in the returns of the Midland Company, but on the contrary, the report made on the brake was more in its favour. Now it seems to me curious that any railway company can fit its rolling-stock with a particular description of brake which it must surely be aware is entirely useless under certain circumstances. According to what the drivers say, I understand that with a heavy train it is very hard to make an engine keep time on account of the small ejector wasting a great deal of steam in maintaining the vacuum for the brake power, and that the only way they have of obviating that is to shut off the ejector altogether, and that only makes matters worse, for all their brake power is then gone. That makes it very hard for the men, for they are suspended for over-running stations when they have no continuous brake to stop the train with, and yet they would be punished in some other way if they lost time through the engine not having enough steam to work the train with.

It must also be obvious that this brake is a most dangerous one in case of a break-away on an incline such as the Lickey, near Birmingham; for even supposing in such a case that there was a vacuum to work the brakes with, when the brake is applied it only continues for a very short time and then leaks away to nothing. Thus it is hardly worthy of the name of an automatic brake, for although it does apply itself when the vacuum is destroyed, yet it does not hold for any length of time as to make itself of much use in such a case as the above.

I also see that another way the drivers have of working it is when approaching stations at which they wish to stop to open the ejector, and thus create a vacuum strong enough to stop the train when they reach the platform. By doing this they save some steam while running between stations, but in doing so run a great risk, for if they were suddenly called upon to stop in a very short distance when they have no vacuum, what could they do to prevent what might be a terrible accident? Why they have only then got their steam brake and the hand brakes in the guard's vans, which I am afraid would not be of very much use.

I was over in England not very long ago, and particularly watched the working of the brake upon both the Midland and Great Western Railway, which uses it also. One day I travelled by the Great Western Railway from Warminster to Bath, and through the bad action of the brake the train was delayed for more than twenty minutes. The ejector was evidently not able to keep up the vacuum, and the consequence was that every few minutes the brakes went on a little and caused the train to diminish considerably in speed. Although the big ejector on the engine was kept blowing all the time, yet the two together did not seem to be able to keep the brake blocks off the wheels; and finally the train came to full stop altogether, and we were kept nearly a quarter of an hour standing in the middle of the line between two stations. That mishap was probably the result of two things, namely, the ejector being unable to maintain a proper vacuum and also some leakage in the train pipes, which would be likely to aid in causing the grievances of which the Middlesbrough drivers complain. Of course a leakage anywhere in the train would cause the blocks to come away from the wheels in a short time after the brake was applied. If what the drivers state in their letters is true—and we have every reason to believe that it is—it certainly is about time that the company made an inquiry into the matter, and either remedied the faults in some way—although I do not myself see how they are to be remedied—or discarded the use of that particular class of brake and adopted the simple vacuum, or if it wanted an automatic brake, the Westinghouse seems to be a good one, or, at any rate, better than the one it at present has. HIBERNIA.

Dublin, March 6th.

STEAM ENGINE ECONOMY.

SIR,—I have obtained a copy of Mr. Longridge's report, referred to in your last impression, and would like, with your permission, to ask Mr. Longridge one or two questions. From the tables given by Mr. Longridge it appears that the power of the engine was practically the same on all the days of his experiments. But it is certain that the speed of the engine must have been constant, for no variation would have been tolerated in the weaving shed.

Now an inspection of the diagrams will show that the pressures varied every day, and so did the ratio of expansion; but it also appears that when the low-pressure diagram was small, the high-pressure diagram was large, and *vice versâ*. The power of the two engines respectively varied continually, but the combined power of the two was constant. How does Mr. Longridge explain what is certainly more than a coincidence? That some amount of compensation might take place I can understand, but that the compensation should be minutely accurate I cannot understand.

Furthermore the diagrams engraved by Mr. Longridge do not agree with the figures he gives in his tables. Perhaps this is the fault of the engraver.

A few words of explanation by Mr. Longridge would be appreciated, not alone by myself but by others. ZERO.

London, March 8th.

THE SCREW PROPELLER.

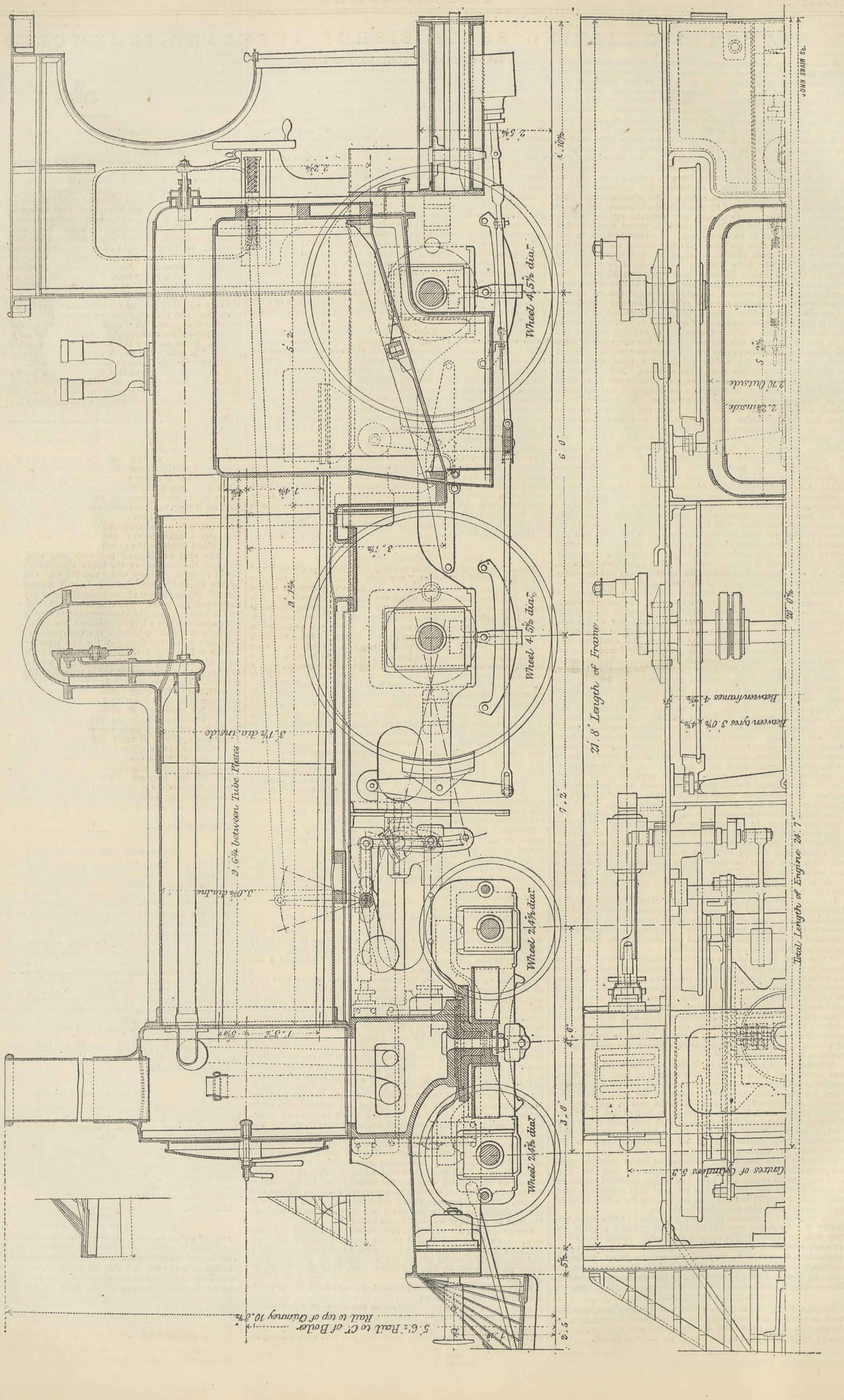
SIR,—In a recent number of your journal you allude to the screw being a wasteful instrument of propulsion. For reasons which are incompatible with the ideas generally entertained concerning its mode of action, and which it would therefore be useless here to mention, the screw propeller would, however, no longer deserve your disapproval on the score of wastefulness if, in any given case, its diameter were reduced to at least one-half of that which custom seems to prescribe, the engines driving it being at the same time so constructed that they could without risk make half as many double strokes again as they now do. C.

March 3rd.

ENGINEERS IN SOUTH AUSTRALIA.

SIR,—I notice in your paper this week a letter from a correspondent in Adelaide signing himself "Fortiter et Fidelites," and from its tone I gather that he is some disappointed draughtsman who has gone out with a view of getting a good job and has not succeeded. I happen to know some of the gentlemen connected with the departments he mentions, and I feel sure if those of your readers interested in South Australian railways will withhold their opinions until the parties mentioned have an opportunity of reading your paper, they will be able to give a good account of themselves and also of "Fortiter et Fidelites." FAIR PLAY.

Manchester, March 6th.

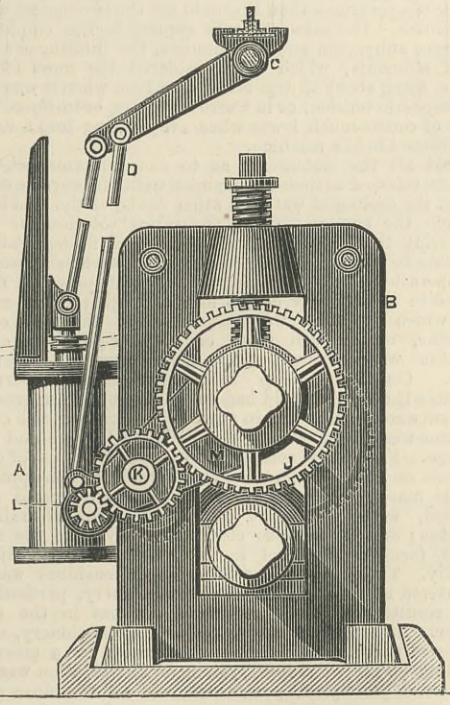


CONTRACTS OPEN.—FOUR-COUPLED ENGINES FOR INDIAN STATE RAILWAY.

(For description see page 174.)

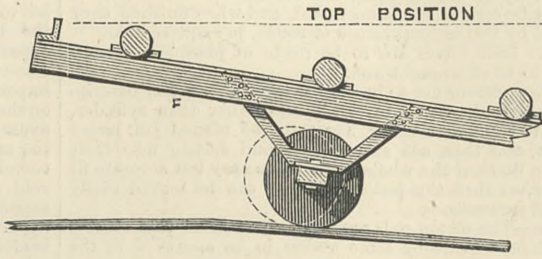
AUTOMATIC LIFTING BOGIE, BISHOP AUCKLAND IRONWORKS.

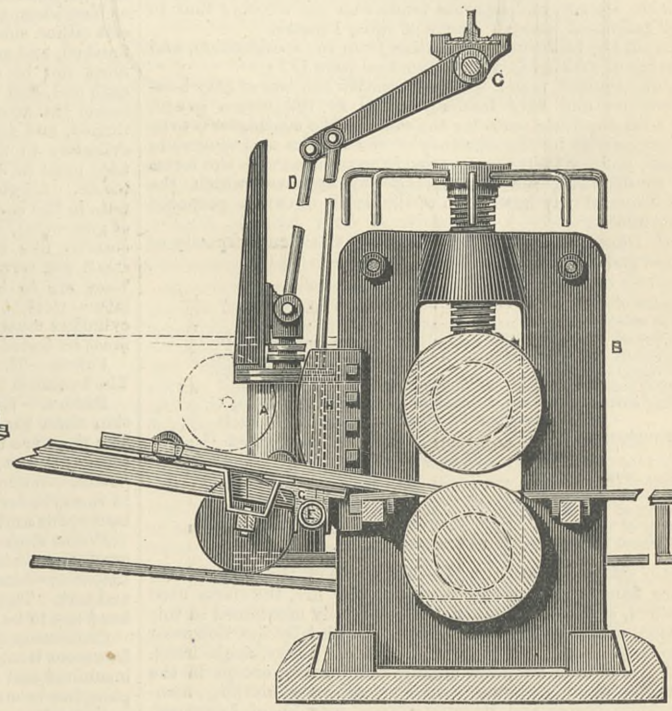
MR. EDWARD HUTCHINSON, ENGINEER.

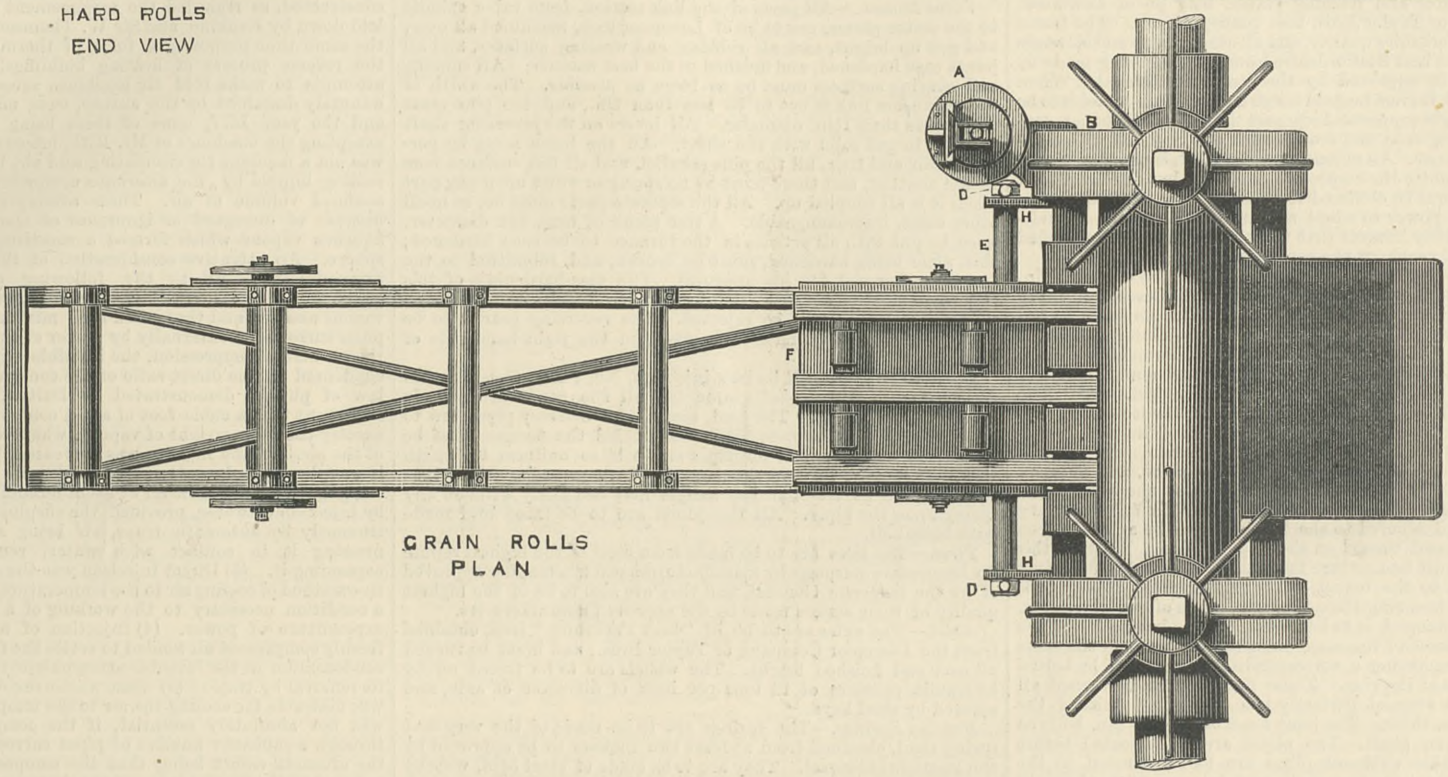


HARD ROLLS
END VIEW

GRAIN ROLLS
CROSS SECTION







GRAIN ROLLS
PLAN

THIS apparatus has been designed by Mr. Edward Hutchinson, the general manager for the Bishop Auckland Iron and Steel Company, for facilitating the manipulation of heavy plates in, and increasing the productive power of, plate mills which are not provided with gearing for reversing the rolls. It is also intended to take the place to a large extent of such gearing, as it is found that by its aid the productive capacity of reversing mills may be successfully rivalled, and at the same time the enormous expense due to wear and tear in reversing avoided. Whatever means are used for obtaining the reversing action, whether a clutch with spur wheels, link motion applied to the engine, or any of the various devices designed to relieve the machinery of the shock produced by continually altering the direction of motion of such heavy masses of material, it is impossible to avoid the necessity for frequent renewals of spindles, boxes, and rolls, not to mention more or less frequent breaks down of a more serious character, implying great loss of time as well as heavy expense in repairs.

For the roughing or grain rolls, the apparatus consists of a steam cylinder A, which for convenience may be fixed to the side of the main standard or housing B, the piston of which actuates a rocking shaft C, hung nearly over the centre of the roll train to the roof of the works, or otherwise to a beam specially provided for the purpose. To two levers on the rocking shaft hang rods D D which carry between them a strong round bar E. F is the lifting gantry or bogie, which receives the plate as it leaves the rolls, and the horns of which project between the guides of the mill. The floor upon which the bogie stands has such an inclination towards the rolls that it runs by its own weight into working position. The plate having left the rolls, steam is admitted beneath the piston lifting the rods D D and the bar E, which catches two inverted saddles on the underside of the bogie G G, and raises that end of the bogie with the plate on it till the bogie itself is horizontal and level with the top of the roll. In such a position the plate can be pulled over without much manual labour. Guide plates H H are bolted to the side of each standard, giving to the bogie a movement backwards as it rises, so that the horns of the bogie may clear the top roll. In case of accident the whole apparatus can be promptly wheeled out of the way. At the finishing rolls the apparatus is similar to that at the grain rolls so far as the cylinder, rocking shaft, &c., are concerned. Here, however, the common bogie is used, and the lifting bar catches the end of the rolled plate itself, and raises it to the requisite height. The lifting bar has also a revolving motion given to it by means of the spur wheels J K L, the driving wheel of the set J being attached to the wobbler end of the top roll, and the others being carried by the radial arm M. By this means the plate, after having gone through the rolls, passes back again without any labour on the part of the men, whose duties are almost confined to guiding the plate as it re-enters the rolls.

As compared with reversing, it will be seen that although a heavy plate cannot perhaps be raised and put over the rolls quite so quickly as it could be passed through again were the rolls reversed, the time is more than saved in other ways. In a reversing mill it is clearly impossible to work at both the roughing and finishing rolls at the same time, and before a pile to be rolled can leave the furnace, the last rolled plate must have been wheeled away and deposited on the floor, and the men back in their places again behind the rolls. With this apparatus, however, it is not so. No labour is required behind the roughing rolls, and the men being employed only at the finishing rolls, and the operations of the two gangs of men not being interfered with by the mills being reversed, it is practicable to work at both sets of rolls simultaneously, and so soon as a plate leaves the roughing for the finishing rolls another pile can be drawn from the furnace. In this way a saving of time is effected which more than compensates for any loss at the roughing rolls in pulling over, whilst the weight of pile which may be dealt with is limited only by the power of the lift. The apparatus is in constant work at the Bishop Auckland and other plate rolling mills in the North of England. The designer estimates that by its use the output of a pull over mill is increased at least 30 per cent.

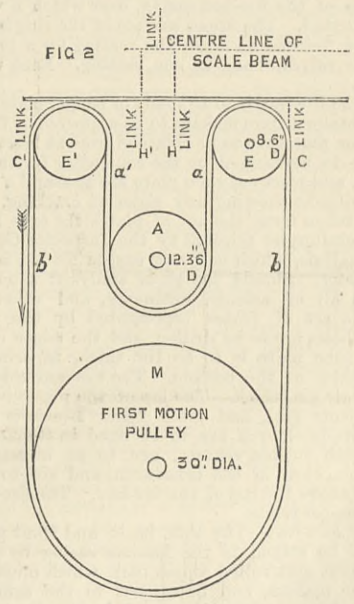
TATHAM'S DYNAMOMETER.

IN a recent impression we illustrated a new form of dynamometer invented by Mr. Tatham. The accompanying engraving illustrate another modification. Mr. Tatham writes: "The closing paragraphs in the *Journal of the Franklin Institute* indicate a form of the machine which is not illustrated—a skeleton sketch of one I am having made is annexed. I have made experiments to test the point which determines the effective diameter of the pulleys for the delivery of belt per revolution that is necessary to determine the velocity of belt. Then I have also made some experiments to determine the effective diameter of the pulleys for the moment. This is necessary to determine the exact position of the fulcrum. I experimented with two pulleys—one, straight, of 44in. circumference; one, high, of $74\frac{13}{16}$in. circumference on the edge; $75\frac{3}{16}$in. circumference on the middle high part. I ran about one and a-half miles of belt $\frac{3}{8}$in. thick over them, and divided this length by the number of revolutions of the pulley. I tried it with the flesh side of the belt against pulley, and then with the hair side next pulley. The result with the belts strained to about 50 lb. per 1in. width was—

	Circumference.	Belt per revolution. Flesh side next.	Belt per revolution. Hair side next.	Gain in diameter. Flesh.	Gain in diameter. Hair.
14in. straight pulley	44in.	44·6093	44·7784	·1939	·2478
24in. high pulley, low	74·8125	75·4732	75·845	Gain in diameter above 75in. is ·1506	·26[illegible]9
,, high	75·1875				
,, average	75·				

On the whole I find the effective diameter of the pulley varies with—(1) the thickness of the belt; (2) the diameter of the pulley; (3) the tension on the belt. However, the possible error arising from these considerations is so exceedingly small that I do not apprehend any practical difficulty. I made some other experiments with a weight hung on to the belt hanging over the pulley, but my apparatus was not sufficiently accurate to give trustworthy results. I think I can take it for granted that the two points mentioned above, namely, the effective diameter for

FIG 2



measuring the delivery of belt, and the effective diameter to determine the position of fulcrum, must be one and the same point. All considerations for slip of belt or creeping of belt or friction of any part but that of pulley A is excluded. If the belt is kept so tight that the sum of tensions running light shall exceed the sum of tensions doing work, the friction of A running light will be the deduction to be made from the indication of the scale beam."

ENGINES OF THE SS. LA FRANCE.

ON page 176 we give two elevations, which complete our illustrations of the engines of the ss. La France.

CONTRACTS OPEN.

INDIAN LOCOMOTIVES.

THE Indian Government want fifty locomotive engines having eight wheels—four coupled—and four-wheeled bogie, outside cylinders, outside frames, and separate tenders on six wheels; tank to hold 1000 gallons of water. Gauge of rails, 1 metre.

We extract the following information from the specification, and an engraving of an engine will be found on page 172:—

The work required under this specification consists of fifty locomotive engines and fifty tenders, suited to the metre gauge, together with duplicate parts for the same. The contractor is to be entirely responsible for the efficiency of the engines and tenders in all respects, and for their construction in accordance with the terms of this specification, notwithstanding any approval which the Inspector-General may have given of the detail drawings prepared by the contractor.

General Dimensions.—The general dimensions and capacity of the engines and tenders are to be as follows:—

Engines.	
Diameter of cylinder	14in.
Length of stroke	20in.
Diameter of coupled wheels	4ft. $5\frac{1}{2}$in.
Diameter of bogie wheels	2ft. $4\frac{1}{2}$in.
Total wheel base	15ft. 2in.
Working steam pressure, per square inch	140 lb.
Heating surface, external, tubes, not less than	496 sq. ft.
,, fire-box, not less than	56 sq. ft.
Grate surface	10·6 sq. ft.
Tenders.	
Number of wheels	Six.
Wheel base	7ft.
Diameter of wheels	2ft. $4\frac{1}{2}$in.
Capacity of tank	1000 gallons.
Total wheel base of engine and tender	30ft.

Nature of Materials to be used.—The whole of the boiler plates which are flanged or otherwise worked in the fire, the rivets used in the boilers, and also all other parts specially mentioned in this specification, must be of Lowmoor iron supplied by the Lowmoor Iron Company. The remainder of the boiler plates, angle irons, bars, and rivets used in these engines and tenders, except in the platforms, tanks, smoke-boxes, chimneys, ash-pans, clothing, awnings, fire-doors, buffer and framing plates, may be of Lowmoor, Bowling, Farnley, or Taylor Bros. best quality of iron. The frame plates are to be of Yorkshire quality, and all other plates and all angle irons must be of best best Staffordshire irons, all iron being made by manufacturers to be approved by the Inspector-General. When "brass" is specified, it must be good tough metal. Gun-metal is to be composed of five parts copper and one part tin. The axle-boxes, connecting and coupling rods, and crossheads are to be fitted with bearings of phosphor bronze. All materials are to be obtained of the manufacturer specified under the respective heads, unless the consent of the Inspector-General be obtained to an alteration. The Inspector-General is to have power to adopt any means he may think advisable in order to satisfy himself that the kinds of materials specified are actually used throughout the contract.

Boiler Barrels.—The barrel of the boiler is to be made of $\frac{3}{8}$in. plates, in two rings, each of one plate, arranged telescopically, the smallest internal diameter being 3ft. $\frac{5}{8}$in., and the length of barrel being 9ft. $1\frac{5}{8}$in. The vertical seams are to be lap-jointed and single rivetted, $2\frac{1}{4}$in. lap, $1\frac{7}{8}$in. pitch of rivets, and $\frac{5}{8}$in. diameter of rivets. The longitudinal seams are to be butt-jointed and double rivetted, with inside and outside butt strips, $7\frac{1}{2}$in. wide by $\frac{5}{16}$in. thick. The butt strips are to be so rolled that the fibre of the iron may be in the same direction as in the plates they connect. The joint of the back plate will be under the dome, and the inside strip must be carried round the opening to the edge of the plate, and be $\frac{7}{16}$in. thick; the joint of the other rings must be above the water level. The front tube plate is to be $\frac{5}{8}$in. thick, flanged forward to carry the smoke-box, and secured to the boiler barrel by an angle iron ring, bored, faced, and turned on the edges. When finished, this angle iron ring must be nowhere less than $\frac{5}{8}$in. thick, and it must be zigzag rivetted to the barrel, but single rivetted to the tube plate. A wrought iron ring 18in. diameter, made of one plate $\frac{9}{16}$in. thick, welded and flanged, is to be rivetted to the back plate of the boiler barrel. A dome of the same diameter and made in the same way, of $\frac{7}{16}$in. plate, having a corresponding flange, is to be bolted to the upper flange of the ring. These flanges must be turned all over, and the joint scraped perfectly true, and when finished the flanges must be 1in. thick. The joint must be held by $\frac{7}{8}$in. bolts at not more than $2\frac{3}{4}$in. pitch. The plates are to be heated before being bent. Suitable wash-out plugs are to be inserted in the smoke-box tube plate, fire-box shell, and in any other places in which the Inspector-General may consider they are required. The longitudinal stays are to be supported by a bracket in the barrel of the boiler. The barrel of the boiler may be made of one plate, 9ft. $1\frac{5}{8}$in. wide, with the rivetted joint at the top, if this construction be preferred.

Fire-box Casing.—The top of the fire-box casing will be made flat, and the top and sides of the fire-box shell are to be made in one plate $\frac{7}{16}$in. thick. The front and back plates are to be $\frac{1}{2}$in. thick. The front plate is to be flanged and rivetted to barrel of boiler.

Safety Valves.—A hole, not larger than $3\frac{1}{2}$in. diameter, is to be made in the top of the fire-box casing, over which a wrought iron ring is to be rivetted. The upper surface of the ring is to be turned and faced, and finished to form the seating for a pair of Ramsbottom's safety valves, made in one casting. Each valve is to be $2\frac{1}{2}$in. diameter.

Fire-box.—The fire-box is to be made of copper plates of the very best quality, obtained from makers to be approved by the Inspector-General, and the plates are to be obtained from at least two makers. The plates are to be flanged by the contractor for the engines in his own works, and pieces of each plate are to stand a test of being doubled cold without showing any signs of cracking. A piece of copper will be taken from the set of plates for each fire-box, and tested by a metallurgist selected by the Inspector-General. The cost of each analysis, which will not exceed £3 3s., is to be borne by the contractor. Should the piece analysed show more than $\frac{1}{2}$ per cent. in all of arsenic, antimony, and other deleterious substances, the set of plates represented by the test will be rejected. All holes are to be drilled, and the edges of the plates planed. The tube plate is to be 1in. thick, tapering below the tubes to $\frac{1}{2}$in. thick at the bottom. The top and sides are to be made in one plate $\frac{1}{2}$in. thick. The lap of the plates is to be $2\frac{1}{2}$in., diameter of rivets $\frac{7}{8}$in., and pitch $1\frac{7}{8}$in. Brackets or studs for supporting a fire-brick arch are to be fixed in the fire-box. Two brass plugs, with fusible centres, are to be inserted into the crown of the box, clear of the brick arch, and are to project $\frac{1}{2}$in. into the water above the top of the fire-box. The fire-box must be rivetted with copper rivets.

Side Stays of Fire-box.—The side, back, and front plates of the fire-box are to be stayed to the fire-box casing by copper stays, made of the best soft rolled copper bars, which must be obtained from the same makers, and be subject to the same tests and analysis as the plates. These stays are to be $\frac{7}{8}$in. diameter, screwed twelve threads to the inch, and spaced not farther apart than 4in. centres.

Roof Stays of Fire-box.—The roof of the fire-box is to be stayed to the top plate of the outer casing by rods of Lowmoor iron, $\frac{7}{8}$in. diameter at the smallest part and $1\frac{1}{8}$in. diameter at the screwed ends. These stays are to be screwed into the roof plate of the fire-box and the flat top plate of the outer casing. They are to be further secured inside the fire-box by nuts, and, where required, washers not less than $\frac{1}{2}$in. thick at the thinnest part are to be provided. Each stay must be made from a single piece of iron, not welded.

Tubes.—The tubes are to be made of a mixture composed of 70 parts of copper and 30 parts of best Silesian spelter. The tubes are to be solid drawn, and obtained from makers to be approved by the Inspector-General, and they are to be obtained from, at least, two makers. They are to be $1\frac{5}{8}$in. diameter outside, No. 12 B.W.G. thick for 1ft. next the fire-box, then tapering to No. 14 B.W.G. at the other end.

Cylinders.—The cylinders are to be of cold blast cast iron, as hard as possible, perfectly free from honeycomb and other defects or blemishes, and they are to be made so that one cylinder will suit either side of engine. They are to be 14in. diameter when finished, and suited to a 20in. stroke. The clearance at each end must not be more than $\frac{3}{8}$in. They must be $14\frac{1}{4}$in. diameter at each end, and the leading piston rings must overrun the end of the barrel $\frac{1}{4}$in. at each end of its stroke. All joints are to be planed or turned, and scraped to a true surface. All the bolts securing the cylinders to the frames are to have cupped heads on the outside; they must be driven in as tight as possible, and have nuts on the inside. All glands and packing rings to be of gun-metal. All the nuts in the smoke-box connected with the cylinders are to be also of gun-metal, and must have solid ends. The cylinders are to be cleaded like the boiler, the sheet iron being fastened down by small set screws, with cupped heads, tapped into the flanges. They are to be provided with lubricators and water-cocks, the latter worked by a handle from the foot-plate. Each pair of cylinders must be cast of the same metal, and when finished they must be tested by hydraulic pressure to 250 lb. per square inch.

Valves.—The slide valves are to be made of phosphor bronze. The buckle is to be of wrought iron.

Pistons.—The pistons are to be of cast iron, of a softer description than the cylinders, and turned $\frac{1}{32}$in. smaller than cylinder. The rings are to be of cast iron. They will be turned $\frac{1}{4}$in. larger than cylinders, and then cut at an angle and sprung into their places. When finished the whole must be an easy but accurate fit in the cylinder, so that the piston and rod can be moved easily backwards and forwards.

Piston Rods.—The piston rods are to be of crucible cast steel—carefully annealed—made by some maker to be approved by the Inspector-General. They are to be fixed to the piston by a cone and nut. The coned parts fitting into the piston and the cross-head are to be of larger diameter than the body of the piston rod.

Connecting Rods.—The connecting and coupling rods are to be of Lowmoor iron, forged solid in one length, without weld, and then machined and finished bright all over. They are to be fitted with phosphor bronze bearings.

Valve Motion.—All parts of the link motion, from valve spindle to the sector plates, are to be of Lowmoor iron, machined all over, and got up bright, and all rubbing and wearing surfaces, and all joints case hardened, and finished in the best manner. All rubbing and wearing surfaces must be as large as possible. The width of the expansion link is not to be less than 2in., and the pins must not be less than $1\frac{1}{2}$in. diameter. All levers on the reversing shaft must be forged solid with the shaft. All the holes must be perfectly fair and true, all the pins parallel, and all the surfaces true to one another, and there must be no spring or twist upon any part when it is all coupled up. All the separate parts must be, as in all other cases, interchangeable. A test piece of iron, $\frac{3}{4}$in. diameter, must be put with all articles in the furnace to be case hardened; this, after being hardened, must be broken, and submitted to the Inspector-General for his approval. The case-hardening of this test piece must be at least $\frac{1}{16}$in. deep, or the articles case hardened with the test piece will be rejected. The reversing gear is to be worked by a screw which is to be fixed on the right-hand side of the engine.

Injectors.—There will be two injectors, No. 7 size, Gresham and Sheward pattern, and of gun-metal, all the cones being made movable for renewal. The feed, steam, and delivery pipes are to be of solid drawn copper, No. 9 b.w.g. All the flanges must be marked to template, and the pipes are to be so uniform in length that they may be used in any engine. Care must be taken that they may be so set that the flanges may bed fairly without any spring upon the pipes. All the joints are to be faced and made with boiled oil.

Tires.—The tires are to be made from steel of the highest repute for locomotive purposes by manufacturers and in a manner approved of by the Inspector-General, and they are also to be of the highest quality of their classes made by the approved manufacturers.

Axles.—The axles are to be of "best Yorkshire" iron, obtained from the Lowmoor Company or Taylor Bros., and must be turned all over and finished bright. The wheels are to be forced on by hydraulic pressure of 12 tons per inch of diameter of axle, and secured by steel keys.

Bearing Springs.—The springs are to be made of the very best spring steel, obtained from at least two makers to be approved by the Inspector-General. They are to be made of steel $3\frac{1}{2}$in. wide by $\frac{5}{16}$in. thick.

Tenders.—The tenders are to be made to carry 1000 gallons of water and $1\frac{1}{2}$ tons of coal, the coal being carried in front of and partly on the tank. They are to have six wheels, and the centre pair of wheels and axles will be fitted with sliding axle-boxes. The extreme centres of the wheels will be 7ft. Tenders are to be delivered at the Store Department in the India-office, Westminster, S.W., on Tuesday, 14th March, before 2 p.m., after which hour no Tender will be received. They are to be addressed to the Secretary of State for India in Council, with the words "Tender for Locomotives and Tenders" on the left-hand corner of the envelope, and are to be placed in a box provided for that purpose in the Store Department.

THE INSTITUTION OF CIVIL ENGINEERS.

AIR-REFRIGERATING MACHINERY.

AT the ordinary meeting on Tuesday, the 14th of February, Sir Frederick Bramwell, F.R.S., vice-president, in the chair, the paper read was on "Air-Refrigerating Machinery and its Applications," by Mr. J. J. Coleman. The paper first dealt with the thermodynamic laws regulating mechanical refrigeration as successively enunciated by Joule, Sir William Thomson, Rankine, Clerk-Maxwell, and others, particularly pointing out the fact that atmospheric air having lately been proved to be the vapour of a liquid, there was no essential difference in the theory of machines for producing cold, whether air or the vapours of such substances as ether and ammonia were employed. Any machine which was worked through the medium of a readily-condensable vapour had its action limited by the boiling point of the volatile liquid, and therefore it was impossible with such machines to get so large a range of cooling in one operation as could be accomplished by air. The low temperatures which Pictet required for the liquefaction of oxygen and hydrogen were obtained in stages, first by ebullition of liquid sulphurous anhydride in vacuo, producing sufficient cold to liquefy carbonic acid gas at a pressure of four atmospheres, and then in taking advantage of the still greater cold produced by the ebullition of the liquid carbonic acid gas in vacuo. There was, however, no reason to suppose that the same or much lower temperatures could not be obtained by the compression and expansion of air in a single operation. The boiling point of ether in the air was 95 deg. Fah., so that to use it as a medium for refrigeration it must be evaporated in vacuo—that was, a pump was required which caused it to boil rapidly, and it became cooled as the vacuum increased; but the cooler it became the less slowly it evaporated, until, when its temperature sank to a little below zero, evaporation ceased, although the pump might be maintaining the vacuum. It followed that if the brine, which was usually the medium being cooled, returned back to the boiling ether without having picked up heat from the substance being cooled, the action was gradually diminishing. This phenomenon was very likely to occur when the brine cooled by such a machine circulated in pipes through a chamber containing atmospheric air, more or less saturated with aqueous vapour, and as would be the case with a chamber containing fresh meat being cooled. The brine pipes in such circumstances became externally coated with a non-conducting covering of ice, which, unless removed, accumulated to the extent of several inches in thickness, thus interfering with the transfer of heat, and preventing the room from being reduced to a lower temperature than the freezing point of water, or the melting point of the exterior surface of the crust which surrounded the pipes, whilst the brine was liable to be returned to the evaporating ether at lower temperatures than it should for the economical working of the machine. The same remarks applied to the employment of sulphurous anhydride and of ammonia, the limiting action in the case of ammonia, which was considered the most effective in practice, being about 35 deg. below zero Fah. when it was employed at atmospheric tension, as in Carré's process, or in Reece's process, though of course much lower when evaporating into a vacuum, as in Professor Linde's machine.

Almost all the statements as to the performances of these machines referred to their employment under favourable conditions, namely, the cooling of water or other fluids, or the making of ice, in which the temperature of the saline solution or glycerine transferring the heat never need sink below 20 deg. Fah. When they came to be employed for cooling solids, such as masses of meat, to temperatures below freezing point, great practical difficulties occurred in the transfer of the heat through the non-conducting air in which the meat was suspended to the pipes containing the brine, unless such pipes or other equivalent circulating apparatus were brought into close proximity to the solid masses. On board ship such arrangements were almost impossible if the ship's hold had to be employed for general cargo on the outward voyage, and in any case networks of such circulating apparatus were inconvenient and liable to leakage and injury of the cargo. From these considerations, even if the use of dangerous chemicals on board steamers were allowable, it was apparent that cold air machines, in which air was first compressed and then expanded, were the most convenient form of refrigerating apparatus; and it was also clear that they were the most convenient form of machine for cooling the air of apartments generally. The great enemy of cold air machines was friction encountered in the working of the machinery, particularly that which resulted in the development of heat in the expansion cylinder. In regard to the prime cost of machinery, experience had proved that not much difference existed for a given amount of cooling power whichever system of refrigeration was adopted. The general principles upon which cold air machines should be constructed, as regarded the arrangement of cylinders, had been laid down by Rankine and Sir W. Thomson in 1852, the former at the same time proposing a form of thermodynamic machine for the reverse process of heating buildings, and various practical attempts to make cold air machines successful, and which were minutely described by the author, were made between that year and the year 1877, none of them being thoroughly successful, excepting the machines of Mr. Kirk, introduced in 1862, and which was not a machine for circulating cold air, but for producing ice or cooling liquids by the alternate compression and expansion of a confined volume of air. These attempts were failures, chiefly because of disregard or ignorance of the peculiar behaviour of aqueous vapour which formed a constituent part of the atmosphere. An attentive consideration of the matter upon general principles had led to the following conclusions:—(1) That atmospheric air was really not air alone, but a mixture of aqueous vapour and air, and that when such mixture was compressed into pipes surrounded externally by water of the same temperature as the air before compression, the invisible vapour of the air became condensed in the direct ratio of the compression, in virtue of the law of physics demonstrated by Dalton, and expressed by the statement that a cubic foot of air in contact with water contained exactly the same weight of vapour, whatever might be the density of the air. If the density was increased, the vapour liquefied—if it was diminished, water evaporated into the air. (2) Therefore compressed atmospheric air of usual humidity was not made wetter by injection of water, provided the surplus water was run off continuously by automatic traps, air being actually dried by compressing it in contact with water, removing the water and expanding it. (3) Direct injection was the quickest and most effective method of cooling air to the temperature of the water, which was a condition necessary to the working of a machine with the least expenditure of power. (4) Injection of a shower of water into freshly compressed air tended to settle the fog caused by the sudden condensation of the invisible atmospheric vapour, thus facilitating its removal by traps. (5) That whilst the direct injection of water was desirable for cooling the air to the temperature of the water, it was not absolutely essential, if the compressed air was passed through a sufficient number of pipes surrounded by cooling water, the ultimate result being that the compressed air could only be reduced to the temperature of the water, which was not sufficient to liquefy the vapour usually contained in the air, except the air pressures employed were excessively high, which was fatal for working a machine economically. (6) That every pound of vapour unnecessarily condensed liberated as much heat as would raise about 4000 times its weight of air 1 deg. Fahrenheit, and that air absolutely dry was a condition that would abstract the fluids of animal tissue, and, indeed, was a phenomenon unknown in nature, the degree of humidity being generally over 50 deg., even in what was, in common parlance, called "dry air." (7) That a convenient way of liquefying such vapour was to apply a portion of the cold air produced by the machine to the external surface of the pipes conveying the compressed air already cooled by water to the cylinder in which it was to be expanded, the liquid being removed by automatic traps. The last principle had not been applied in practice in this country prior to the author adopting it in conjunction with Messrs. Bell.

The author commenced to design machines in 1877 which afforded a uniform degree of dryness in the cold air, suitable for carrying provisions without drying up their juices, and used principally for the importation of meat from the United States. The experimental machine which brought the first cargo from New York, in 1879, and the first cargo of meat from Australia, in 1880, was described in detail, as also the construction of the machines generally employed in Transatlantic traffic, which had a pair of compressors of 16in. diameter, steam cylinder of 18in. diameter, an expansion cylinder of 17in. diamater, and 2ft. length of stroke. These machines had been worked continually from leaving New York to the arrival in British waters, and had brought over, to the end of 1881, meat to the value of between £2,000,000 and £3,000,000 sterling. Several machines constructed for land purposes and erected at Sydney, Barrow-in-Furness, Waterford, Limerick, and Hamburg, &c., were described with the cooling chambers attached; also machines erected in the West Indies, on the Cunard liner Servia, and on the Spanish mail steamer Antonio Lopez. A list of the machines at work in the Australian traffic was given, which included those on the Cuzco, Dunedin, Chimborazo, Lusitania, Kaiser-i-Hind, Rome, and Carthage, erected by the Bell-Coleman Company; and those on the Protos, Europa, Clyde, Orient, Garonne, and Sorrento, erected by other makers, the sizes of the cylinders and comparative powers being described, and which had brought into the United Kingdom frozen meat to the value of about £50,000 sterling.

The latter part of the paper dealt with the efficiences of cold air machines and formulæ for their calculations; and stated that air-refrigerating machines of the larger sizes were giving an efficiency not much different from that of ether and ammonia machines; and it also pointed out the probable future development in ventilating and cooling buildings, especially in India and other tropical countries, which, by calculation, should not cost more than $\frac{1}{10}$th of a penny per head per hour.

THE POLYPHEMUS was taken out for another trial of her engines and machinery on Monday on the measured mile at the Maplin Sands. The trip was again exceedingly unsatisfactory. The boilers priming as much as ever, and so seriously that she returned to Sheerness about three hours after her departure.

RAILWAY MATTERS.

The first section of the Great Eastern Railway extension from Spalding to Lincoln was opened for traffic on Tuesday.

In 1881, 187 miles of new railroad were opened for traffic in Austria, and 79½ in Hungary, in twenty different lines, the longest being 33½ miles long.

The proposed company has, it is said, been formed at Palermo for constructing a railway to the summit of Mount Etna, in imitation of the Vesuvius Railway.

The Austrian Government now works 200 miles of railroad which it owns, and 1194 miles belonging to companies, while 407½ miles that it owns are worked under contract by corporations.

Although several engines have been tried on the Liverpool tramways, the directors of the Tramway Company state that the results are not sufficiently encouraging to warrant their recommending the adoption of steam power.

In Germany there are twenty-three car works, which together can turn out from 21,000 to 25,000 four-wheeled freight-cars yearly, if wholly engaged in such work. Most of the works, however, also construct passenger cars, street cars, turntables, &c.

The proposed International Railroad Exhibition at Berlin has been abandoned. The reason given is that the old railroad station and yard designed for the Exhibition must be devoted to other purposes, and that there is no other fit place in the city that can be had.

The Wiener-Neustadt Works, near Vienna, Austria, during the fiscal year 1880-81 received orders for 215 locomotives, most of them from foreign countries. Since the middle of November, 1880, the number of men employed in these works has risen from 460 to 1920.

One of the Austrian railroads has introduced an exceptionally low rate for exports of various articles, such as iron, coal, salt, potters' clay, &c., namely, 1·57d. per ton per mile, which, the *Railroad Gazette* says, is "just about twice the average rate in the State of New York in 1878-79."

The late Earl of Wilton, who died on Tuesday last at the age of 82, was one of the last survivors of the distinguished company which took part in the ever-memorable opening of the Liverpool and Manchester Railway in 1830. His lordship was the first to render assistance to Mr. Huskisson when he met with the accident which caused his death.

The longest tunnel in this country is the Box tunnel on the Great Western Railway, 3123 yards in length. The next in length is the Kilsby tunnel on the London and North-Western Railway, which is 2398 yards, and cost nearly £120 5s. per yard run. The Honiton tunnel on the London and South-Western Railway is 1350 yards in length, in red marl and green sand, and cost £50 per yard. The Lydgate tunnel on the London and North-Western Railway is 1332 yards in length, chiefly in the coal measures, cost £30 per yard. The Guildford tunnel is 965 yards in length.

The administrations of the German, Italian, and Swiss railways are making extensive arrangements for facilitating traffic between Germany and Italy during the coming season. The Geneva correspondent of the *Times* says:—Travellers will be carried from one country to the other with as few stoppages as possible, and return and circular tickets, the latter available for a round by the Brenner, will be issued at very low rates. All the bridges on the St. Gothard line between Fluelen and Goeschenen are now completed. The Monte Cenere branch and the stretch from Biasca to Chiasso will be opened for traffic on April 1.

A locomotive for hilly lines has been made by Sig. Alfredo Cottrau, director of the Impresa Industriale Italiana, of Naples. The driving axles are fitted with a second and smaller pair of driving wheels either outside or inside the ordinary driving wheels. As they are smaller than the latter, they of course revolve idly in the air when the train is passing over levels or slopes of small gradient. Where the gradient is steep, separate high rails are laid down, and upon them the supplementary drivers mount and run, raising the large drivers off the ordinary rails. The superior hauling power is of course in the inverse ratio of the size of the ordinary and supplementary drivers.

At a recent meeting of the West Ham Local Board, Mr. Lewis Angell, C.E., called attention to the inconvenience of the antiquated Standing Order of Parliament, requiring the deposit of railway and other plans in November with the "parish clerk," whereas such deposits should now be made with the Local Board or other authority whose duty it is to take cognisance of such matters. In accordance with this suggestion, Colonel Makins, M.P. for South Essex, has prepared an amendment to Standing Order No. 29, which has been accepted by the Chairman of Committees and Local Government Board, to take effect at the end of the present session, after which parliamentary plans affecting any district will have to be deposited with the local authority.

An American contemporary gives the following:—"A crude old farmer living on the line of one of the recent railway surveys, and who is owner of a barn of large dimensions, with huge swinging doors on both sides, observed a *posse* of surveyors busily driving a row of stakes through his premises that extend to the very centre of his big barn. Sauntering leisurely toward the trespassers with an air savouring somewhat of indignation, he addressed the leader of the gang as follows:—'Layin' eout another railway?' 'Surveying for one,' was the reply. 'Goin' threw my barn?' 'Don't see how we can avoid it.' 'Wall, now, mister,' said the worthy farmer, 'I calkerlate I've got somethin' tew say 'bout that. I want you to understan' that I've got somethin' else tew dew besides runnin' out tew open and shet them doors every time a train wants tew go threw.'"

A somewhat noted light railroad in Germany is the Felda-road, in Saxe Weimar Eisenach, a narrow gauge line 27½ miles long, three-fifths of which is laid in the public highways. It was built and is worked under a long lease by a firm of locomotive builders who make a speciality of light locomotives, and who have just published a book about the road. When the road was built, on the shortest curves—of 190ft. radius—the superelevation of the outer rail was made as much as 4in., and the gauge at the same places was widened 1⅛in. But as there were several derailments at these places, the elevation was reduced so as not to exceed ⅜in. anywhere, with a widening of the gauge of from ⅜in. to ⅝in., since which there have been no more derailments. The *Railroad Gazette* says the engines which this firm builds are usually made purposely so as not to run faster than seven miles an hour, at which speed the centrifugal force on a curve of 190ft. radius can hardly be formidable.

The enlargement of New-street Station, Birmingham, by the London and North-Western Railway Company, the proposals for which we have previously mentioned, has now been begun. By the expenditure of about half-a-million pounds sterling, the company intend to secure to the people of Birmingham, the finest passenger station in the kingdom. Nearly four acres of land are being absorbed in the work, which is to take the form of "a covered station with sidings." About half of Dudley-street and the whole of Station-street, Bread-street, and Vale-street—now public thoroughfares—will become railway lines and platforms, whilst Great Queen-street will be used by the company as a cab-drive running through the station. The two existing tunnels will be opened out for another 100 yards in the course of the alterations, and three spacious platforms, with six through lines of rails, will be laid. A good deal of constructive iron work will be needed, among which may be mentioned four large ornamental iron bridges. The preparation of the site has already been undertaken by Messrs. Nelson and Co., contractors, of York; and local engineers are expecting some good orders when the constructive work is put in hand.

NOTES AND MEMORANDA.

The results of the census of Rome taken 31st December, 1881, have been published, and it appears that the increase of population during the last ten years has been greater than was expected. In the city, 145,594 males, 126,430 females, 272,024 total; in the suburbs, 9192 males, 3351 females, 12,543 total; in the Agro Romano, 12,541 males, 3184 females, 15,725 total; total, 167,327 males, 132,965 females, 300,292 total. The increase during 10 years, 20·1 per cent. males and 26·2 females. The female population is still, however much less than the male.

A new sun-spot fact has, it is said, been lately established by M. Spoerer from his own observations, together with those of Heis and Carrington. It is known that spots hardly ever appear on the equatorial zone of the sun, and they are never observed beyond a latitude of 51 deg. in either hemisphere. It is between 6 deg. and 35 deg. that the sun-spot activity is chiefly concentrated. Now the fact referred to is a periodicity or oscillation of the following nature:—The activity advances towards the equator, rising first to a maximum at 18 deg., then diminishing, as years pass on, till at 5 deg. or 6 deg. it seems to be exhausted, and disappears. Thereupon some cause brings out spots in the higher latitudes again, and the same advance towards the equator is repeated, with a maximum about 18 deg. M. Spoerer also finds a preponderance in production of spots to occur alternately in the two hemispheres; but this phenomenon is less pronounced than the other. The effects in question are apparently not explicable at present.

A paper was recently communicated to the Royal Society "On Electrical Conductivity, Part II., by Mr. Herbert Tomlinson, B.A. The temporary alteration of electrical conductivity which can be produced by longitudinal traction was measured for all the metal wires used in Part I., both in the hard-drawn and annealed condition, and, in addition, for carbon and nickel. The electrical resistances of all the substances which were examined were, with the exception of nickel, increased by temporary longitudinal stress. With nickel, however, of which metal a wire nearly chemically pure was at length with difficulty procured—through the kindness of Messrs. Johnson, Matthey, and Co.—the resistance was found to diminish under longitudinal stress not carried beyond a certain point; but after this point had been attained, further stress began to increase the resistance. The effect on nickel appears still more remarkable when we reflect that the change of dimensions produced by the stress, namely, increase of length and diminution of section, would increase the resistance. The specific resistances of all the substances, except nickel and aluminium, were increased by temporary longitudinal stress. With aluminium and nickel the specific resistances were diminished by stress not carried beyond a certain limit.

A paper "On the Solubility of Glass in Certain Re-agents," was read before the Chemical Society on the 2nd inst. Ammonium sulphide was the first re-agent, the action of which was investigated 100c.c. of the ammonia, Sp. 880, from which the ammonium sulphide was prepared in the usual way, left ·0015 grm. residue. The other re-agent was ammonium hydate. A measured quantity of the re-agent was sealed up in a tube of hard Bohemian glass, and kept at 100 deg. C. for six days. The liquid was then poured out, neutralised with HO, evaporated, and the residue ignited. The following table gives the results obtained:—

Re-agent.	Milligrams dissolved by 100 c.c.
H_2O	8 and 10
H_2S	12·5 ,, 8·7
Dilute Am_2S (from Am HO ·982)	49·6 ,, 52·5
Strong Am_2S (from Am HO ·880)	34·0 ,, 47·2
Dilute Am HO ·982	25·8 ,, 42·5
Strong Am HO ·880	7·5 ,, 7·7
Am HS (from Am HO ·982)	51·2

It will be seen that the dilute solution of AmHO and Am_2S have a very marked solvent action on glass.

The health of Paris, according to Dr. Bertillon's *Annuaire Statistique* for 1880, was very bad. The *Annuaire* is a retrospective summary of the statistics for that city during a long series of years. The death-rate in the two more recent periods of five years is given as 26·5 and 24·3, showing a considerable decline as compared with the early part of the century, but, at the same time, a large excess upon the rate that prevailed during the same period in London. The rate for 1880 was about 25 per 1000, while in London it did not exceed 21·6. The *Lancet* thinks that the difference in these figures very far from correctly represents the true excess of mortality in Paris as compared with that in London, as the age-distribution of the Paris population, in consequence of its exceptionally small proportion of young children and of elderly persons, should cause a considerably lower death-rate in Paris than in London. Calculated by the English life-table standard, 1000 of the Paris population should give but 19·8 deaths annually; whereas 1000 of the London population—in consequence of its larger proportion of young children and elderly persons—would, according to the same standard, give 21·8 deaths per annum. After due allowance for this, it may be calculated that the death-rates in the two cities in 1880 were as 19·6 to 25·0 per 1000 respectively. It must, however, be pointed out, that a very considerable proportion of the population of London consists of young and full grown healthy workers from the provinces, and that so many of those who count in the population get out of London to die.

At a recent meeting of the Chemical Society Dr. Carnelly read a paper "On the Action of Heat on Mercuric Chloride." This paper has important and interesting bearings. About twelve months ago the author exhibited to the Society some experiments on the action of heat on ice and mercuric chloride under low pressures, and subsequently read a paper on the subject before the Royal Society. Two propositions were advanced:—(1) That when the superincumbent pressure is maintained below a certain point called "the critical pressure," it is impossible to melt ice, mercuric chloride, and probably other substances, no matter how great the heat applied. (2) That under these circumstances ice and mercuric chloride attain temperatures considerably above their natural melting points without melting. Subsequent observers have confirmed the first proposition, but have been unable to verify the second. The author has, therefore, repeated his previous experiments with mercuric chloride, and in addition has made determinations of the temperature of mercuric chloride, heated in a vacuum by dropping the heated solid into calorimeters containing turpentine, benzine, and petroleum. Some unexpected results were obtained. When the salt is pressed as a compact powder round the bulb of the thermometer and heated in a vacuum, the thermometer rises 21 deg. to 50 deg. above the melting point of the mercuric chloride, though still surrounded by the solid salt. When the salt is in the form of a solidified cylinder, the temperature rises 15 deg. above the melting point. When a turpentine calorimeter is used, the temperature of the mercuric chloride came out 100 deg. above the ordinary melting point; but with petroleum or benzine, temperatures above the ordinary melting point could not be obtained. The author, therefore, withdrew his previous statement, and concludes that although mercuric chloride does not fuse when heated under diminished pressure, yet its temperature never rises appreciably above its ordinary melting point, the high temperatures indicated by the thermometer being due to the diffusion of the superheated vapours of the mercuric chloride through the pores of the solid salt. The author also concludes that turpentine cannot be used in a calorimeter for the determination of the specific heat of bodies soluble in water, since some substances such as mercuric chloride, zinc chloride, &c., when heated, cause an evolution of heat, due probably to the polymerisation of the turpentine. Hence many of Regnault's specific heat determinations in which turpentine was employed are probably too high—they are, it may be remarked, in almost all cases higher than Kopp's numbers, that observer having used coal-tar naphtha. The specific heat of mercuric chloride is 0·06425, and zinc chloride 0·14301, neither value being altered by a rise of temperature.

MISCELLANEA.

A paper "On a Channel Tunnel" is to be read at an early date, not yet fixed, before the Society of Arts, by Sir E. Watkin.

In our last impression we gave some figures showing the number of fatal accidents caused by tram-cars and omnibuses in London. A correspondent draws attention to the fact that not one fatal accident is recorded for the past year as due to bicycles, though they are in such common use in and about London.

The American Ironmasters' Association reports that last year's pig iron product of the United States was 4,144,354 tons, an 8 per cent. increase over 1880. The stock of pig iron unsold on December 31st was 210,896 tons, against 456,658 tons at the beginning of the year. The probable annual consumption is 4,982,565 tons, an increase of 1,000,000 tons.

With regard to reports which have appeared in various papers as to the serious failure of contract guns in proof at Woolwich, we are in a position to say that such reports are altogether unjustified, and were read with greater surprise in the Royal Arsenal, perhaps, than anywhere else. Nothing more than the most ordinary faults in detail in any guns have manifested themselves, and nothing to our knowledge has failed.

Though unsuccessful, the attempt to cross the Channel in a balloon by Captain Brine, shows that such a trip need not be attended with loss of life, even if the balloon takes to the water. Captain Brine had certain appliances fitted around the outside of the "Balloon Car," which prevented the car from sinking or upsetting when in the water. They were made by Messrs. Cornish and Co., Fenchurch-street, and are similar to their boat protectors for converting ordinary boats into life-boats.

The lectures which have been delivered at the Crystal Palace on the electric currents, the production of electric currents by steam, and on electric arc lights, by Professor Sylvanus Thompson, are well attended, and seem to be well appreciated. The lectures are of a popular character, but are at the same time sufficiently technical and scientific to be of interest to those who have considerable knowledge of the subjects treated. The next lecture, the last of the series, will be delivered on Wednesday next at eight p.m.

At the sale of the plant of the late Royal Polytechnic Institution £82 was paid for the mechanical life-size figure of Blondin. Blondin, like Léotard, whose counterfeit presentment was purchased by America for £20, was put through his various performances, to the great amusement of the crowd on business intent assembled. Amongst the other largest prices realised during the second day's sale were £60 for the cast iron diving bell and its gear; £29 for the 4-horse power double-cylinder expansive condensing steam engine, and £22 for the large induction coil.

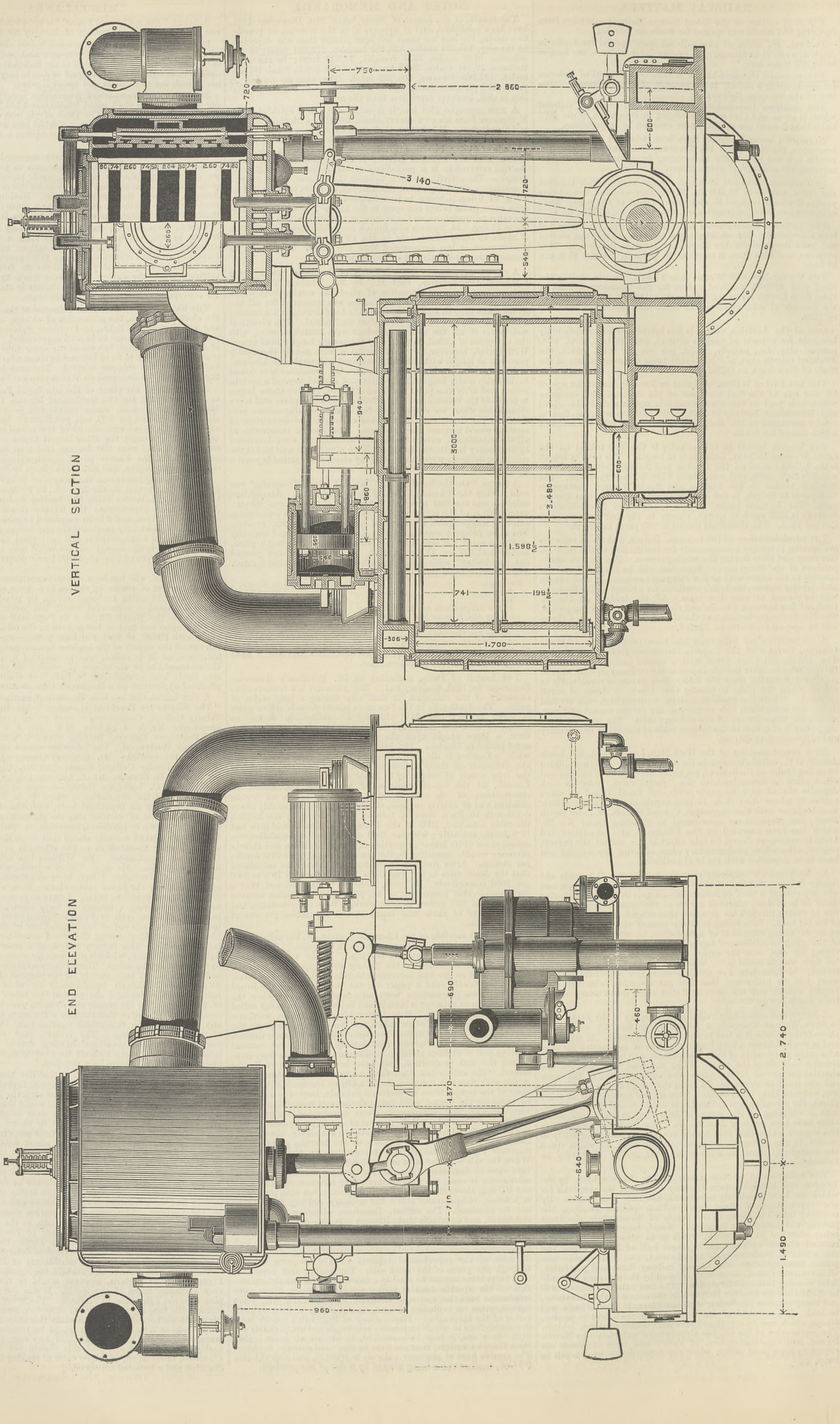
An interesting lecture on the storage of power was delivered at the Royal Institution, on the 2nd inst., by Professor Ayrton, storage by secondary batteries being the leading feature of the lecture. Among other experiments the lecture theatre was lighted, a circular saw driven, and a hoist employed to raise up boxes entirely by means of electricity produced the day before at the other side of London, and transported to the institution in Faure's accumulators. The total energy so conveyed was said to be about 50,000,000 foot-pounds, or about 25-horse power exerted for one hour.

Mr. Sheilds, who has been recently experimenting at Peterhead with the object of rendering the sea in a storm sufficiently calm to allow ships to enter harbours safely, by pouring oil upon the water, obtained a successful result last week. The sea at the entrance to the North Harbour at Peterhead was running high, and the water was broken, but as soon as the oil apparatus—a force pump with 1200ft. of lead and iron piping—was set to work, the fairway at the mouth of the harbour became quite smooth, and the invention, as it is called, was pronounced a success. Although the statement as to the effects of pouring oil on troubled waters was made long enough ago to have lost claim to novelty, its practical application on a large scale may amount to invention.

A new association has been established, under the designation of "The Society for Psychical Research." Mr. Henry Sidgwick, of Trinity College, Cambridge, is said to be president; the vice-presidents—Mr. A. J. Balfour, M.P., Mr. J. R. Holland, M.P., and Professors Barrett, Balfour Stewart, Stainton Moses, and Hensleigh Wedgwood. The following names have been given as those of the council:—Mr. Edmund Gurney and Mr. F. W. H. Myers, of Trinity College, Cambridge; Mr. Charles C. Massey, Mr. Walter R. Browne, Mr. E. Dawson Rogers, Mrs. Boole, Dr. Wylde, Dr. C. Lockhart Robertson, and several others. The main object of the association is stated to be "to unite students and inquirers in an organised body, with the view of promoting the investigation of certain obscure phenomena, including those commonly known as psychical, mesmeric, or spiritualistic."

A contemporary recently stated that Sir William Thomson had admitted being mistaken as to the efficiency and practicability of the Faure accumulator. Sir William has written an unqualified denial of this. He says: "Since my return to Glasgow at the beginning of November, I have been unintermittingly engaged in experiments on the Faure accumulators, from which I anticipate results of great practical value. I have at present in constant use for electric lighting a battery of forty elements in series, each consisting of three cells of Faure's original pattern. This battery includes three cells out of the original box of four brought to me from Paris last May, during the time I acted for them as consulting electrician. This battery served as a reserve store for the lighting of my house, which is now done for every room and passage, by Swan and Edison lamps. Thus at the present moment—ten o'clock in the forenoon—I have, merely for the purpose of verification, four Swan lights brilliantly incandescent by what remains in the battery from yesterday's charge, and two hours' reduced lighting of the house after the engine and dynamo were stopped yesterday evening. The reserve that remains is far more than sufficient for any practical use in this bright weather until the engine is again started for the evening. The reserve, even at this season, is very convenient for occasional lighting during the day in dark rooms or cellars, where without the electric light lucifer matches and gas jets have hitherto been required."

Two deputations waited upon authorities last week respecting the preservation of Smeaton's Eddystone Lighthouse. The first from the Corporation of Plymouth was with the Trinity Brethren. It was urged that the Plymouth people would bear the greater proportion of the cost of removal. If it were erected on Plymouth Hoe and used as a sea mark, it would be useful to the maritime community, and would at the same time perpetuate the memory of Smeaton. It was mentioned that about £1000 had been subscribed. Sir R. Collinson, in reply, said it was the opinion of the brethren that the lighthouse should be preserved, and that Plymouth was a very suitable place for it. He proposed that the Trinity House should land the lighthouse at as small a cost as possible. They would be able to do this better than anyone else, as they had the advantage of skilled labour and a steamer adapted to the purpose. The second deputation from Plymouth and Devonport waited upon Mr. Chamberlain, at the Board of Trade, in order to ascertain how far the Board of Trade would sanction the Trinity House in handing over to Plymouth so much of the Eddystone Lighthouse as they intended to destroy. Mr. Chamberlain, in reply, proposed that the inhabitants of Plymouth should, at their own cost, remove and rebuild the lighthouse on the Hoe, Plymouth. The lantern, however, would be retained, as it was very valuable, being of gun-metal. It was not the original one placed on the lighthouse by Smeaton. The lower part of the tower forming the base cannot be moved so as to reconstruct it, and the Plymouth authorities propose to make this anew. The Plymouth people ask, as a free gift, the part to be removed, including the lantern not on the rock but on Mill Bay Pier, and it does seem shabby, to say the least, that this should not be granted when Plymouth offers to pay all other costs of making it a monument to Smeaton and a national memorial.



THREE CYLINDER COMPOUND ENGINES OF THE S. S. LA FRANCE.

LA SOCIÉTÉ NOUVELLE DES FORGES ET CHANTIERS DE LA MÉDITERRANÉE, MARSEILLES, ENGINEERS.

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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.*

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

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

DORSET.—*It is more than probable that you are not using lime enough as a flux in the cupola; try increasing the quantity, and let us know the result. When pig has much "kish" on it, it sometimes gives trouble in the cupola in the way you describe; but before taking any other step we advise a change in the quantity of lime used.*

BUNSEN BURNER.—*If you use tiles, or better still, a plate of thick sheet iron with slots cut out to receive the tubes, the arrangement shown in your sketch will work pretty well. The tubes should lie half their diameter deep in the slots, and these last should clear the tubes about* ¼in. *at most at the sides. No air must be admitted save through the slots and burners. You will require plenty of chimney room to take away the products of combustion, not less than* 3 *square inches of area for every* 10 *cubic feet of gas burned per hour. The bottom of the boiler should be* 3in. *at least above the tubes.*

W. L. AND CO. (Oxford).—*A* 6in. *cast iron pipe* ⅝in. *thick will be perfectly safe with a pressure of* 120 *lb. in it, provided it is properly made and properly put up. If the pipes are bad castings and of common metal, they cannot be called safe at any pressure. When any considerable length of cast iron piping is put up to carry steam an expansion joint must be introduced to permit expansion and contraction; an ordinary stuffing-box will answer better than anything else. No augmentation in the thickness of the pipes will obviate the necessity for an expansion joint. The pipes you name are half as thick again as they need be. The fault lies either in their quality or in the way they have been erected.*

W. S. A.—*The diagrams you enclose show that the valves are well set. The rise and fall in pressure are due to the imperfection of the particular indicator you use, and have nothing to do with the action of the valve gear. The vacuum is very nearly* 25in. *of mercury. What more would you have? There is some defect in the air pump, which accounts for the irregular action in the condenser. It is quite possible, however, that you give too much injection and so swamp the condenser. If you will send a sketch and description of the air pump and condenser, we shall be happy to advise you on this point. So far as the diagrams go, they show that you have a very good, instead of a very bad, engine, as you seem to think.*

POLISHING EBONITE.

(*To the Editor of The Engineer.*)

SIR,—Would any reader kindly inform me who are the makers of an apparatus for polishing ebonite? CONSTANT SUBSCRIBER.
London, March 2nd.

PARABOLIC RAILWAY CURVES.

(*To the Editor of The Engineer.*)

SIR,—Would you kindly allow me to ask through your columns if any of your readers can give me some information about parabolic curves for railway centre lines? (1) Have any such curves been actually set out? (2) Under what circumstances are such curves advantageous? (3) Practical methods of setting out such curves on the ground. C. E.
March 4th.

CHILLED CASTINGS.

(*To the Editor of The Engineer.*)

SIR,—I shall be much obliged to any reader who will give me any information about the making of chilled cast axle-boxes, both the ones chambered all round and also those with three recesses. I cannot get any preparation to stand on the chills. K. S.
Lismore, Ireland, March 3rd.

[Our correspondent may consult the articles on "Chilled Castings" which will be found in our impressions for the 24th Dec., 1880, and 7th Jan., 1881.—ED. E.]

MEETINGS NEXT WEEK.

THE INSTITUTION OF CIVIL ENGINEERS.—Tuesday, March 14th, at 8 p.m.: Papers to be read and discussed:—(1) "The Design of Structures to Resist Wind Pressure," by Charles B Bender; (2) "On the Stability of Structures against the Wind," by Jules Gaudard.

CHEMICAL SOCIETY.—Thursday, March 16th, at 8 p.m.: (I.) "On Valency," by Dr. Armstrong. (II.) "On Pentathionic Acid," by Watson Smith and T. Takamatsu. (III.) "On some Constituents of Resin Spirit," by G. H. Morris. (IV.) "On the Preparation of Diethylnapthylamine, and the Action of Sulphuric Acid on that Substance," by B. Smith.

THE METEOROLOGICAL SOCIETY.—Wednesday, March 15th, at 7 p.m.: Exhibition of anemometers, and of such new instruments as have been invented and first constructed since the last exhibition. During the evening the president, Mr. J. K. Laughton, M.A., F.R.A.S., will give a historical sketch of the different classes of anemometers, and will also describe such forms as are exhibited.

SOCIETY OF ARTS.—Monday, March 13th, at 8 p.m.: Cantor Lectures, "Hydraulic Machinery," by Professor John Perry. Lecture II.—Water at rest and water in motion. The energy law. Gauge notches. Centrifugal pumps and fans. Flow of water in pipes. Steam pumps and other reciprocating pumps. Wednesday, March 15th, at 8 p.m.: "Gas for Lighthouses," by Mr. John R. Wigham. Prof. Tyndall, F.R.S., will preside.

DEATH.

On Feb. 22nd, at Bigbury Court, South Devon, SYDNEY FRANK RUSSELL, aged five years, the only and dearly beloved son of Frank Russell, C.E., A.S.I.E.

On March 7th, at Rochester, Mr. THOMAS AVELING, aged 57 years.

THE ENGINEER.

MARCH 10, 1882.

PROFESSOR AYRTON ON THE FAURE BATTERY.

ON Thursday, the 2nd inst., Professor W. E. Ayrton, F.R.S., delivered a lecture at the London Institution on "The Storage of Power." The title is in a sense a misnomer, his lecture being mainly devoted to the consideration of the Faure secondary battery, other expedients for storing up power being very briefly passed over. Professor Ayrton is an experienced lecturer, and no doubt understood his audience. As a popular exposition of the results obtained with the Faure battery his lecture left nothing to be desired. He did, to say the least, ample justice to the battery. But when we have said this, we have said all that can be said in his favour. His lecture was in no sense a strictly scientific production. It contained certain interesting statements of fact; with the "reason why" Professor Ayrton did not trouble himself—or, shall we say, his audience. There are two points in the lecture which deserve to be specially mentioned. In the first place he asserted that we cannot store up force; in the second place he repudiated the idea that a Faure battery accumulates electricity within its substance. He was not quite so precise as he might have been in dealing with force, and we may be excused if we point out in what his lack of precision is manifest. He began by pointing out that the world at large is wrong in speaking of "the storage of force." In this he was quite right, but he was right only in a limited sense. When he went on to explain that "we cannot store force any more than we can store time, there is as much difference between force and power as there is between a mile and the speed of a ship," he used the words "storage of force" to express an idea which they cannot legitimately convey; and it does not follow that because they are used erroneously in special applications, that they should never be used at all. Professor Ayrton thus defined force:—"When a weight rests on the ground, the weight pushes the ground down with a certain force, and the ground pushes the weight up with the same force. If, then, there was such a thing as a storage of force, the mere resting the weight on the ground would be such a storage, since the force exerted between the weight and the ground never grows less." Here, then, we have force defined as push, or pressure. It is quite clear that push or pressure can be accumulated and stored up for future use, and indeed if it could not be so stored up, compressed air engines, to take one example out of many, could not be worked. He then went on to define power:—"What, then, is the other component idea, in addition to force, that must be present to obtain power or work? The answer is—motion. Work is force exerted through space; the pressure that this weight resting in my hands produces is a force and not a power, but the operation of raising a pound weight through any height is doing work, and, when the weight has been thus raised, it has a store of power or energy in it, which is the greater the larger the weight and the higher the distance through which it has been raised." The preceding passage merits careful perusal. Professor Ayrton, having taken some pains to show that force by itself is not work or energy, goes on to add that force and motion together are work or energy. As, however, on his own showing force is not power, it follows that in the combination motion is the active agent, and to this we shall certainly take no objection; but very important deductions, the nature of which Professor Ayrton has overlooked, may be drawn from this proposition. If motion is inherent in power, how can power be stored without motion? The obvious answer is that either we cannot tell, or that motion is stored. The last alternative is the more probable of the two, and its truth admits of at least partial demonstration. As an example we shall cite Colonel Beaumont's compressed air engine.

The engine depends for its work on "the power," to use Professor Ayrton's words, stored up in in its reservoirs of compressed air. We prefer to use the word energy in lieu of power. Now, the energy of any elastic fluid depends on the internal motion of its molecules. These molecules, to use Tyndall's words, "continually bombard" the internal surfaces of the containing vessel; and the energy of a given weight,—say, 1 lb.—of any permanent gas—say air—is constant, so long as the temperature remains unaltered. In any given weight of air w, at any given temperature T, the energy is a known quantity. Thus in 1 lb. of air at 60 deg. it amounts to 95,577·45 foot-pounds. The energy which can be got out of air in expanding can never equal this in practice, because it would be necessary to cool the air down to absolute zero; and all that can be realised depends on the difference between T, the initial temperature before expansion and the doing of work began, and t the temperature at which expansion and the doing of work ceased, the coefficient of energy being 183·45-foot pounds for air at constant pressure, and 130·30 foot-pounds for air at constant volume, per deg. Fah. of change of temperature. With numerical statements of energy, however, we need not just now further concern ourselves. The energy of 2 lb. of air is just double that of 1 lb., and so on. Therefore, when Colonel Beaumont compresses air in his tram-car receivers, he simply collects within the space previously occupied by 1 lb. or 2 lb. of air all the energy possessed by, let us say, 50 lb. of air; and the quantity of motion thus stored up in the receivers is that proper to 50 lb. of air, and is fifty times as great as that proper to 1 lb. of air. We state here a broad principle, and it is, we think, unnecessary to digress to point out how conditions modify the truth of the proposition, or to show how waste and loss of effect may take place from the moment we begin to deal with air, either by compressing it or expanding it. In this case we have, with due deference to Professor Ayrton, not only stored force—pressure—but power—that is to say, motion. Putting this in another way, we may say that when work is done in compressing, say, 1 lb. of air, into a smaller space than that which it previously occupied, we augment the energy of the pound of air; but this is only true when we suffer temperature to rise at the same time. If we compress air at a constant temperature its energy remains unaltered, but we confer on it the power which it did not before possess of parting with some of its energy and doing work when it is suffered to resume its original volume.

So far we feel sure that there can be no difference of opinion between Professor Ayrton and ourselves. Advancing a step further, however, we come upon debatable land. Professor Ayrton has shown, very clearly and very properly, that power without motion has no existence; yet he went on to say "the vast fields of coal underground form another enormous store of power—not force, bear in mind—the initial work, in this case corresponding with the winding up of the clock by hand or the raising of the rain-clouds by evaporation, being performed by the leaves of plants. Under the influence of sunshine, these split up the carbonic acid gas in the air, liberating the oxygen and absorbing the carbon, thus making wood, which eventually, after long ages, becomes coal. But there are other substances besides coal and oxygen which are found separated from one another, and which desire to re-combine, constituting, therefore, stores of energy;" and he goes on to cite copper and zinc as examples. We think that few more unscientific or unsatisfactory passages have, perhaps, ever been penned than this which we have just quoted. We are to bear in mind that coal is a store of power—not force. But at the very beginning of his lecture he told his hearers in the plainest language that power cannot exist without motion. He did not assert that motion has been stored up in the coal, or that coal exerts pressure, so that both the attributes of power are lacking. Presently becoming aware of this truth, he was compelled further on to modify his views as to what power is, and to call in a new agency, "The desire to re-combine." We shall not take exception to this phrase; but we may ask whether it is to be classed as a force or a power; is it a thing to be stored up, and if it has been stored up, when or by what agency? It will be seen, we think, by this time that even such a man as Professor Ayrton finds it impossible to form a definite and consistent definition of certain words which are in daily use; and that when he corrected, to use his own opening words, "well-informed *Punch*," he substituted for the word force something about which he has himself formed very few well-defined ideas. We do not say this with any desire to disparage Professor Ayrton. On questions connected with power, and force, and work, and energy, he is no doubt just as lucid as most public teachers of science. The names of those who have more precise ideas can almost be counted just now on the fingers of one hand.

In dealing with Faure's secondary batteries, and their applicability to various purposes, Professor Ayrton was much more happy; and he made, as we have previously said, certain statements of interest. It appears that electric motors can be had which give out 1-horse power per 50 lb. dead weight of machine, and that 18,000 foot-pounds of work can be obtained from 1 lb. of lead and red-lead. A secondary battery weighing 81 lb. will give out 1-horse power for three-quarters of an hour. Thus, then, for a gross weight of 131 lb. we can get 1-horse power exerted. Professor Ayrton hastened to point the moral of his tale:—"I have said that a cell containing 81 lb. of lead and red-lead stored 1,440,000 foot-pounds of work. Now consider what that means. It represents all the energy required to be expended to pull a tram-car containing forty-six passengers over two miles, after allowing for considerable waste of power in the electrical arrangements. The electro-motor need not weigh, as I told you, more than about 200 lb. to produce about 2-horse power. We have, therefore, this wonderful conclusion, that about 300 lb. dead weight contains all the energy and all the machinery necessary for over two miles run of a tram-car with forty-six passengers. Now, is this result actually obtained at present in the tram-car running at Leytonstone, and which is propelled by Faure's accumulators? No, and why? Partly because the electro-motor has not been made to suit the accumulators, nor the accumulators the electro-motor, nor is the gearing adapted to either." We admit that an engine and boiler weighing 300 lb. probably could not be made which would do the same work. The advantage is all on the side of the Faure cell. As to what we may call, for want of a better word, the intensity of the Faure battery, we reproduce the following passage, the last in Professor Ayrton's lecture:—"There has been an erroneous impression existing lately that the Faure accumulator could not produce a constant current of more than 17 ampères, but that this is a mistake is clearly seen from the fact that, at the present moment, each of the cells in this room is producing a current of about 75 ampères."

As we have said Professor Ayrton delivered a good lecture—that "goes without saying," He was interesting; his experiments were numerous and successful, he had a story to tell which was new; but—we regret that we have to use this little word—his lecture was most unsatisfactory in that it conveyed not the smallest idea to the minds of his audience of how all the energy of which he spoke, and which he counted up by millions of foot-pounds, was stored up. Concerning the theory of the battery he was absolutely silent. "Now does such a cell," he said, "store electricity? No! Emphatically no! When charging it just as much electricity passes out as passes in, and when discharging it just as much electricity passes in as passes out. Imagine a stream of water was turning a waterwheel, and the waterwheel was employed to raise corn up into a granary; the arrangement might be called one for storing corn, but certainly not one for storing water. So a secondary battery does not store electricity, but electric energy." Time was when the people were content with great words as explanations of phenomena. The time is past—as far, at least, as the scientific world is concerned; and men like Professor Ayrton cannot address the unscientific world only. His utterances are heard far beyond the limits of a lecture hall. Let us compare what we have just quoted with the opening passages of his lecture, and we cannot fail to see how lame and impotent is the conclusion at which he has arrived. He started with the idea of setting the world at large, including *Punch*, right concerning what it is Faure's cells store up. It was not force but power; but power, he defines, is inseparable from motion. Therefore, when we store power, we must store motion. Not seeing, however, very clearly, or not seeing at all, where motion is stored in the Faure cell, he abandons the word power which he had introduced with so much pretension, and tells his hearers that a secondary battery stores "electrical energy." What is the difference between this and power? Why did he not entitle his lecture "The Storage of Energy?"

COLONEL MAITLAND ON MODERN ORDNANCE.

THE paper recently read by Colonel Maitland before the Society of Arts consisted in a great measure of a very clear explanation of the general principles bearing on the questions of the proportions, material, and system of loading of guns. So far his paper would be a matter calling for attention rather than discussion. Special interest attaches to it, however, for other reasons. The statement of any fact by an officer in Colonel Maitland's position means more than the bare fact perceived by an individual, for it means that it is an established fact, and accepted as such at the Royal Gun Factories. Discussed also as the paper was by other Government officers in high position, we gain valuable information concerning their conclusions, for probably none but their tolerably matured opinions would find expression. No one can accuse the War-office of encouraging officials to play the part of irresponsible "free lances." This is our chief reason for going over old ground, and all Colonel Maitland's paper is by no means old ground.

First, then, the question of iron *versus* steel seems nearly conceded in favour of steel in the form in which steel is now adopted; a form which we have long maintained causes it to resemble the built-up guns of wrought iron more closely than the original cast steel guns. For the material now employed in guns under the name of steel is very nearly wrought iron, differing from it chiefly in the absence of cinder and of any special spiral arrangement of fibre, though not in the absence of all fibre when drawn out as it is under a hammer. Then the gun is built up very much on the original principle, so that it has little beyond the name of steel and absence of *spiral* fibre in common with the first cast steel guns of Krupp. We have therefore maintained, what we now repeat, that far from being ashamed of having originally adopted wrought iron built-up guns, our authorities may plead that the same reasons which led them to prefer wrought iron at first now compel them to adopt steel when it offers the same advantages with a higher degree of excellence. In saying so much, however, fairness compels us to point out how much we owe to the steel gun-makers of our own country—Whitworth and Vavasseur. We say fairness, for we have no other motive. With all respect to Sir Joseph, we cannot say that he is an unprejudiced man, or that he has a frank or winning way of putting forward his views; so that there is no particular pleasure in doing justice to his inventions. Mr. Vavasseur has great ability, but we do not feel that in calling attention to what he has done we are serving a popular cause. The bare fact of our present form of steel gun being so exactly what these makers have long advocated and perfected, if not in the teeth, certainly in advance of others, deserves recognition, we think, by the Government. In the large orders that we believe ought to be given for new type guns, these firms ought to be remembered, just as Elswick should be for the great development of power which we owe to that establishment, especially to Captain Andrew Noble's investigations. In doing this we ought to benefit by the experience of the steel makers in the material of the guns supplied. Colonel Maitland makes use of the following significant words:—"The longitudinal or end strength varies; thus in the German guns the tube and hoops do nothing—the jacket is considered sufficient. The French construction relies entirely on the thick body, while the English method aims at utilising the whole section of the gun both ways. Of course, if the others are strong enough, there is no particular advantage in this; and it is by no means improbable that eventually we shall find it cheaper and equally good to substitute hoops for the 'overcoat.'" We think that many who are not specially interested in the admirably strong form of breech which is the peculiar child of the gun factories and of Mr. Fraser, would hesitate to recognise the possible wisdom of dispensing with it as fully and fairly as Colonel Maitland does. Considering the tendency that a large charge of powder has to increase longitudinal strain compared with transverse strain, we are a little surprised ourselves, but we may be sure that Colonel Maitland knows what he is talking about. Turning for a moment to the discussion on the question of iron *versus* steel, we think he has hardly done Mr. Mallet justice in bracketting him with Tubal Cain. Mallet's plea for wrought iron cannot, we venture to think, be severed from the use of that metal. Indeed the question is this moment at issue in the American hydraulic trials of coil-strengthened guns *versus* cast iron guns. The gun factory text-book draws a very much needed distinction, in the words "tensile strength" and "tenacity," between the total amount of work and the maximum pressure that a tube will bear. Mallet urged that wrought iron would not bear a high maximum, but that it would stretch so that it would take a larger amount of work to rupture it than the rigid steel of those days, and he therefore considered it the best metal for ordnance. On this plea wrought iron has generally been advocated, both as to endurance and safety should rupture occur. The weak point we feel—and this is possibly what Colonel Maitland feels in this argument in favour of endurance—is that the extension which a metal will undergo *within the limits of elasticity* is so small that we do not know anyone who has attempted to specify it. Mr. Abel, however, still maintains that steel is not so capable of resisting sudden strains as wrought iron, and Colonel Maitland himself considers that the introduction of slow burning powder has favoured the adoption of steel. With regard to the most advanced form of steel guns, namely, that embodying steel riband, we learn that experiments continue, but no definite conclusions are arrived at as yet. As to breech-loaders, Colonel Maitland points out that increase in the length of guns alone brought them in.

The details of various systems of breech-closing and the question of development of work by detention of the projectile by means of gas check, &c., we do not propose to notice, nor the important question of what is termed "sectional density" of shot; we will therefore confine ourselves to citing Colonel Maitland's opinion on the question raised by Sir W. Armstrong, concerning the terms on which armoured and swift unarmoured ships would engage. This opinion is not favourable to the unarmoured ships; in fact, while Colonel Maitland lays stress on the fact of the armoured ships having a steadier platform, he quotes the very results we have referred to, obtained by firing shrapnel with percussion fuses against the Shannon target, to show how different an effect is produced when armour is pierced from what takes place with thin iron. On this we have written at some length in our article of Feb. 17th. We ought, however, to point out that should we succeed in driving steel shells containing gun-cotton bursting charges through iron armour so as to act well on the inside, a great advantage would then be given to the unarmoured ship in consequence; steel plates, however, would present greater difficulties, and might then find greater favour in this country. To conclude, we commend Colonel Maitland's paper to the careful attention of all interested in artillery matters.

STEAM ENGINE ECONOMY.

IN our last impression we dealt at some length with a report prepared by Mr. Michael Longridge, on the performance of a compound engine at Audley Hall weaving shed. We by no means exhausted Mr. Longridge's report, however, and we propose now to consider figures and statements which it contains, and which we have as yet hardly touched. We concluded what we had to say last week with the statement that Mr. Longridge had found it necessary to calculate a new coefficient for the flow of water through notches, and he has thus unwittingly confirmed the accuracy of statements which we have repeatedly made, and which have been persistently contradicted. Messrs. Farey and Donkin devised several years ago an exceedingly elegant device for measuring the efficiency of a condensing engine. The number of heat units passing into an engine per minute is easily ascertained if the weight of feed-water and the temperature in the boiler are known. The whole of this heat, less that converted into work and wasted by radiation, must re-appear in the condenser, heating the injection or cooling water. If, now, the temperatures of the injection and of the hot-well are known, and the weight of water discharged per minute from the hot-well, a very simple calculation will show how many heat units have been converted into work. We have said that the device is elegant. We add now what we have often said before. It cannot be used in practice with good effect, because of the difficulty experienced in measuring the delivery from the hot-well. It is well understood that hardly any two authorities on hydraulics are agreed as to the coefficient of delivery through a notch board, and Messrs. Donkin carried out experiments to fix a set of coefficients. There is, however, every reason to conclude that theirs is no better than those obtained by other authorities. Indeed, there is good cause to think that with minute variations in the conditions, a change must be made in the coefficient. For what Mr. Farey has to say on this point we must refer our readers to THE ENGINEER for December 29th, 1876, page 446. It is clear that if the coefficient is not accurate, it is impossible to arrive at a correct conclusion concerning the delivery from the hot-well, and the coefficient is the weak point in Messrs. Donkin's system of testing. This fact is well illustrated by Mr. Longridge's report. He used the Donkin system to check his calculations. He writes thus concerning it:—

"In calculating the results of the experiments made by the company last year the writer, after considerable hesitation, adopted the coefficient of contraction used by Messrs. Bryan Donkin and Co. in forming their published table of discharges over notches, pointing out at the same time that other observers had arrived at different figures. A rough calculation of the results showed that this coefficient was inapplicable to the present case, as it would have given the quantity of heat received from the engines in excess of the heat supplied to them, which is impossible. Indeed, from the nature of the case it is clear that a constant coefficient for every width of notch and for every head is contrary to reason, for as contraction only takes place at the edges of the notch, its amount must depend in some way on the ratio of the lengths of these edges, compared to the area contained by them and the free surface. Such being the case, it was necessary to seek another coefficient. The experiments of Mr. Castel, quoted in 'Downing's Hydraulics,' seemed to furnish the necessary data. In the present instance the average head was about 0·38ft., the absolute width of the notch, 0·666ft., or nearly one-third that of the tank. Therefore, if we consider the head and absolute width of the notch as alone influencing the discharge, we should choose the coefficient 0·592, applicable to a notch 0·65ft. wide and a head of 0·39ft. If, on the other hand, we consider the head and relative width of the notch only, we should choose a coefficient rather less than 0·604, which according to the table is the coefficient applicable to a head of 0·39ft. and a relative width of 0·4 Taking all three disturbing influences into consideration, it seemed best to adopt the coefficient 0·595." Whether Mr. Longridge was right or not we shall not pretend to say.

As an example of the uncertainty attending the flow through notches, we may cite the following authorities:—Neville says: "It may be remarked here in passing how universal the coefficients ·613 to ·628 are for all forms of orifices in thin plates, or with the outside arrises chamfered. Indeed, the coefficient ·62 may always be used with certainty for practical purposes, for every orifice of this kind, whether at the surface in the form of a notch, or at the sides or bottom of a vessel, if the section of the approaching water be large in proportion to the area of the discharging orifice or notch." This statement seems to be based on Bossut; but Brindley and Smeaton give ·637 as a coefficient. Du Buat's coefficient varies from ·624 to ·646, according to depth and width of notch. Poncelet and Lesbros give coefficients varying from ·577 to ·636. Rennie's mean coefficients vary between ·585 and ·613. At pages 436 and 437 of the third edition of Neville's "Hydraulic Tables" will be found further information on this subject, to which we refer our readers. We have said enough to show that the result of the use of the Farey-Donkin system of testing must always be unsatisfactory, unless the discharge from the hot-well can be accurately measured. We may now return to the performance of the Audley Hall engines.

We have already called attention to some of the extraordinary anomalies presented by the results obtained by Mr. Longridge; as, for example, the apparent fact that jacketting the low-pressure cylinder nearly doubles the condensation in the high-pressure cylinder, and we naturally turn to the indicator diagrams given by Mr. Longridge in the hope that they will help us to a solution of the problem. Turning to his diagrams for the 25th October, and Tuesday, November 1st—not November 2nd as printed by Mr. Longridge's lithographer—we find one set for both days. No steam was admitted to the jackets. The initial absolute mean pressure front and back was on the 25th October 96·4 lb., and on the 1st November 95·2 lb.; but the difference does not appear on the diagrams. The ratio of expansion was practically the same on both days, namely, 8·27-fold on the 25th October, and 8·29-fold on the 1st November. The mean total initial pressure in the low-pressure cylinder was 19·5 lb., and the mean total back pressure in the high-pressure cylinder was very nearly 20 lb. If we turn now to the diagrams for October 31st, when the high-pressure cylinder only was jacketted, we find that the initial total average pressure was, according to Mr. Longridge's table, 95·5 lb.; but, according to the diagram he has published, it was 99·5 lb.; ratio of expansion, 8·58-fold; average mean total back pressure in high-pressure cylinder, 18 lb.; average initial total pressure in low-pressure cylinder, 19 lb. nearly. The back pressure in the low-pressure cylinder is about the same in both cases, hardly 4 lb. The only information supplied by the diagram is that jacketting seems to have increased the pressure in the small cylinder, while it hardly at all affected the pressure in the large cylinder. Turning next to October 28th, when all the jackets were supplied with steam, we find the initial total average pressure as per table 98·8 lb.; as per diagram 97·5 lb.; total average back pressure 22 lb.; total average initial pressure in large cylinder, a small fraction less than 22 lb.; back pressure in large cylinder, 4 lb. nearly; ratio of expansion, 9·82 fold. We have calculated the average pressures in the low-pressure cylinder on the 28th October, with all the jackets filled with steam, and on the 31st October, when only the small cylinder jacket was in use. On the first-named day the pressure was 11·35 lb., while on the last it was 8·5 lb. only, with a corresponding lowering of the back pressure in the small cylinder. In other words, much more work was done in the small cylinder on the 31st October than was done on the 28th, and this was due in a great degree to the reduction in the back pressure. On the other hand, we have a dead loss of 2·85 lb. on a piston area of 908 square inches = 2587 lb., while the gain is equivalent to about 3 lb. on an area of 314in. = 942lb. On both the days we have selected for comparison, the initial pressures were nearly the same. With all the jackets in use, the cut-off took place earlier in the stroke than when the high-pressure cylinder only was jacketted; but in spite of this the pressure, as we have said, was 2·85 lb. higher in the large cylinder than when no jacket was used. The indicator affords no clue whatever to the cause of the fact that when the low-pressure cylinder was jacketted condensation was augmented in the high-pressure cylinder. It is worth notice that the quantity of steam used per total horse-power per hour appeared to be practically independent of the point of cut-off. It amounted to 14·6 lb., 15·3 lb., 15·12 lb., 14·61 lb., 14·14 lb., 14·86 lb., and 14·8 lb., with ratios of expansion of 8·27, 8·78, 8·71, 9·82, 8·58, 8·29, and 8·49 times, and under all circumstances the power of the engine scarcely fluctuated in the smallest degree.

Mr. Longridge gives a well-written dissertation on the action of the cylinder walls in condensing steam and re-evaporating water. He follows the same line of argument as that adopted by Isherwood in "Experimental Researches in Steam Engineering," vol. ii., published in 1865. The following quotation is worth reproducing; we take it from page 25 of the preface. Mr. Isherwood having explained the phenomena of cylinder condensation—and we believe he was the first writer who ever published an exposition of the facts in a connected shape—goes on: "We thus see that upon a portion of the feed-water pumped into the boiler there has been performed, during one double stroke of the piston, two evaporations and two condensations; it has been boiled off once in the boiler and once in the cylinder; it has been condensed once in the cylinder and once in the condenser; and during the whole of these operations it has produced no dynamic effect on the piston. The amount of loss then resulting from the cylinder condensation may be measured by the fact that the steam so condensed has been twice evaporated at the expense of the fuel, and no work obtained from it." We must take exception to one of Mr. Longridge's statements which will

WATER SUPPLY OF SMALL TOWNS.

No. I.—CARNOUSTIE.

IT has been shown by the work of local engineers in many recent instances that almost all the small towns and villages which have hitherto suffered the disadvantages and dangers of insufficient and unwholesome water supply, may be furnished with water satisfactory in quality and quantity at a cost within the means of even poor places. Where, however, the owners of the watershed or springs are not interested in the welfare of a small town or village proposing to obtain an efficient water supply, their action is often effective in preventing such a supply being obtained, or enhances the cost so much that the residents have to choose between extortion or bad water. Reform in matters relating to water supply of towns and villages is much needed. For this purpose it is very desirable that more power should be placed in the hands of local authorities, and that a reform of the existing law for the acquisition of land and water rights should be made. The negotiation for the land, &c., is, as matters now stand, most difficult, where the works are too small to warrant the expense of promoting a private Bill. In the case of a small waterworks for a Local Board, carried out by Mr. Roberts about five years ago, about half an acre of land and water were wanted for about 3000 people. To secure this the Board had to fight a Chancery suit and two arbitrations, costing altogether about £1900, and causing much annoyance and delay. The works only cost £2500. This we believe is not an uncommon case. The Public Health Act gives power for acquiring land compulsorily by Provisional Order, but water, the very thing generally wanted under the Act, is exempted. Local authorities are forced to provide a water supply by the Public Health Act, but the Act gives them no power to acquire water except by agreement. Consequently owners get their own terms, which are naturally under such conditions almost always exorbitant. Many examples of small successful works may be given, amongst which are those carried out at Bala, Pwllheli, and Llanrwst, by Mr. Thomas Roberts, of Port Madoc, and elsewhere by Mr. T. S. Stookes, of Shrewsbury.

To some of these works we have previously referred, and now, as further examples of cheap supplies, we may give some particulars of the recently completed supply to Carnoustie by Mr. A. M'Culloch, of Dundee, who was called in to prepare a report and scheme when the village authorities found that the bad supply was beginning to tell on the prosperity of the village, which depends largely on its summer visitors. The scheme was submitted to Mr. F. J. Bateman and approved. The means adopted are not novel, though not frequently resorted to. The water instead of being collected on the surface is all collected below ground. The source of the supply consisted of what used to be known as the Brax Spring, one of the feeders of the Lochty Burn. This spring rose in a disused quarry. The quarry was opened about fifty years ago. In opening it and cutting into the rock water commenced to flow, and a channel had to be cut to carry it off. The volume increased as the quarrying operations proceeded, and the flow has continued ever since. It was originally proposed to rely mainly on this spring. During the drought of 1880, however, the volume fell considerably, so that the engineer was led to consider the propriety of relying chiefly on this source of supply. Seeing that there was no visible spring at Brax till the quarry was opened, and that as the quarrying operations proceeded the volume of the water increased, the engineer concluded from this, and from the configuration of the ground, that there were water-bearing strata in the neighbourhood, which, if properly treated, might yield an abundant supply. Knowing that at Droitwich, in the neighbourhood of Birmingham, the outflow from a small spring had been enormously augmented by operations carried out for the purpose after the engineer for the works had studied the geology of the locality, Mr. M'Culloch obtained from Professor Geikie, of Edinburgh, full information as to the geology of the district in the neighbourhood of the proposed sources of supply. He then consulted Mr. Pritchard, who had been the engineer for the Droitwich Works previously referred to.

A similar means of supply had been adopted for Warwick, and a modification of the plans adopted for these places has been pursued for Carnoustie. About 1500 lineal feet of adits have been cut into the water-bearing strata of the upper bed of the old red sandstone formation at an average depth of 12½ft. Into these fire-clay pipes have been laid and surrounded, as illustrated by the accompanying engraving, by a filtering medium consisting of broken red sandstone, several layers of washed gravel, sand and coke of a total depth of 3ft., indicated in cross section by Fig. 1 and in longitudinal section by Fig 2. These adits, besides intercepting the water in the water-bearing strata, serve also, with the surrounding porous strata, as natural underground reservoirs in which the water rises and falls according to supply and demand. The storage capacity thus obtained has been estimated at 7,000,000 gallons. The water from two of these adits, of an aggregate length of about 800ft., is led to the reservoir at a distance of about 400 yards off, in cast iron pipes, provided with sluice valves to admit of the water, either from the one or the other singly or from both combined, being discharged into the reservoir, or past it direct to the village. The water from the remainder of the adits being at too low a level to discharge into the reservoir, is conveyed by fire-clay pipes to a collecting well adjoining the reservoir, and can be used as a partial constant supply, supplemented by water from the reservoir, or direct from the higher sources, the quantity required being regulated by a self-acting float-valve. The ground secured for the reservoir is three acres in extent. Of that nearly two acres are covered with water, the remainder being occupied with embankments, &c. The reservoir has been formed by excavating in a natural hollow, the excavated material being thrown upon the four sides to form the embankments. It is 270ft. square at the top by from 19ft. to 20ft. deep, and contains above the top of the outlet pipe to the top of the overflow a little over 6,000,000 gallons. There being no clay on the site of the reservoir, the usual method of rendering the reservoir water-tight by forming a thick puddle wall in the centre of each of the embankments has not been followed. Instead, the inner slopes of the embankments are lined throughout with concrete 8in. thick, backed by clay puddle 6in. thick on the made ground, as indicated by Fig. 3. This lining serves the double purpose of rendering the slopes impervious to water and protecting them from the disintegrating action of the waves and weather at the same time, and presents a clean, smooth surface. The bottom of the reservoir, which consists wholly of a soft porous rock, has been grouted with thin liquid cement mortar. The time taken to fill it after it was ready for the water to be let in was four weeks. It was calculated that during that period the springs were yielding at the rate of upwards of 300,000 gallons per day, including the water sent into the reservoir, the supply for the village, and what was running to waste from sources below the level of the reservoir, but available as a direct supply to the district. From the reservoir the water is conducted in cast iron pipes of 8in. bore to the village, passing on its way through one of Kennedy's waste-detecting meters provided with an arrangement to indicate the quantity of water passed through during any hour of the day. The water is distributed throughout the district by cast iron pipes ranging from 6in. to 2in. bore. The pipes are arranged for the water to circulate without becoming stagnant, "dead ends" being avoided as much as possible; but where they do occur they are provided with elbow hydrants to admit of the pipes being scoured occasionally. Fire-cocks are placed on the mains at suitable intervals. The pressure is ample for the highest building within the district, the top water-level of the reservoir being at an altitude of 157ft. above the mean sea level of high-water mark, while the highest land within the water supply districts is only at an elevation of about 87ft. Sluice valves are placed throughout the districts to admit of the water being turned off for making connections or repairs over a small area at a time without interfering with the supply to the remainder of the district. Special provision is made for flushing the drains periodically. The whole of the iron pipes, after being laid and before the trenches were filled up, were tested under hydraulic pressure 50 per cent. above the ordinary working pressure to ensure that the pipes were sound and properly jointed.

Mr. G. Mackay, Broughty Ferry, has been contractor for the work. The whole works for both districts, including the enlarging of the reservoir to a capacity of upwards of 6,000,000 gallons, extending the adits and increasing the quantity of filtering material round the perforated pipes, a considerable amount of extra piping throughout the village to provide for future requirements and lead a supply within easy distance of every house, will amount to only about £7000. Loans of £7300 have been obtained from the Public Works Loan Commissioners, repayable in thirty years on the annuity principle. A rate of 1s. per pound —one-half payable by landlords and one-half by tenants on the assessable rental—being equal to about 10d. in the pound on the gross rental, has been laid on for the current year, and when the loan is paid off the annual expenditure will be trifling. Like most spring waters derived from the old red sandstone formation, the water is comparatively soft and suitable for domestic use or manufacturing purposes. In future impressions we shall describe other small works.

FIG I

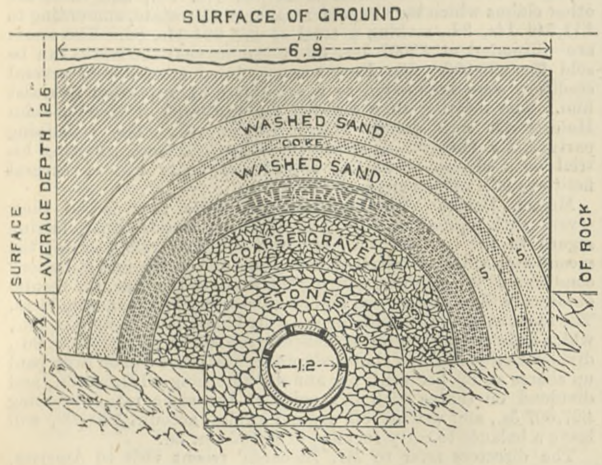


FIG 2.

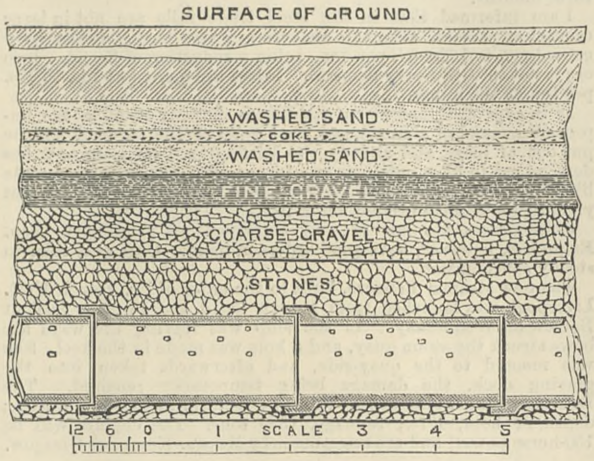
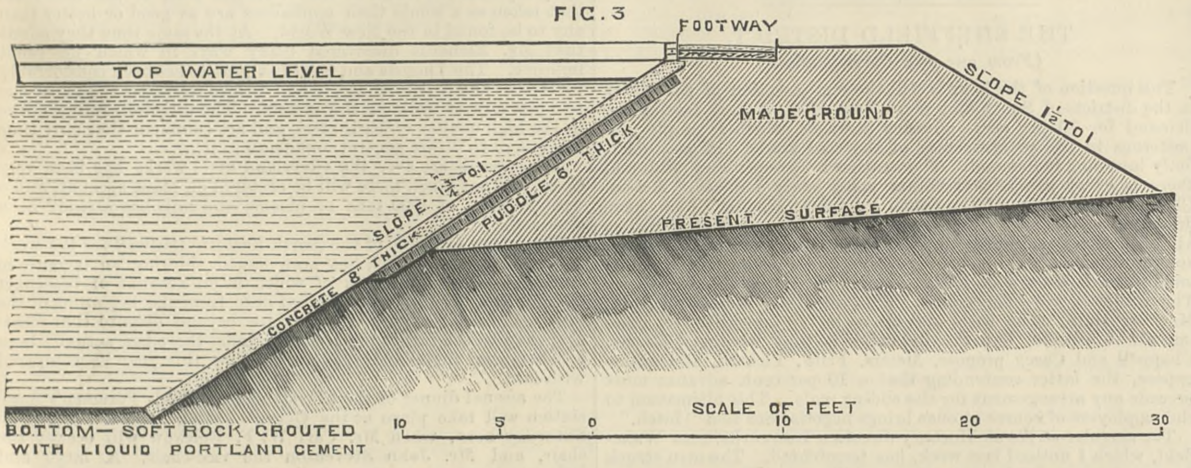


FIG. 3



TENDERS.

FOR the plant and machinery of a new 50-quarter brewery for Mr. Peter Walker, Burton-on-Trent. Messrs. Scamell and Colyer, engineers, 18, Great George-street, Westminster, S.W.

	Coppers.	Coils.	£	s.	d.
CONTRACT No. 3.—BOILERS.					
Galloway and Sons, Manchester			1450	0	0
Piggott and Co., Smethwick			1255	0	0
Thornewill and Warham, Burton—accepted			1195	0	0
CONTRACT No. 4.—MILLWRIGHT WORK.					
J. Oxley, Frome			4060	0	0
Thornewill and Warham, Burton			3975	0	0
H. Woods and Co., Manchester			3945	0	0
Wilson and Co., Frome			3738	0	0
G. Waller and Co., Southwark, London—accepted			3677	0	0
CONTRACT No. 5.—COPPERS.					
Pontifex and Wood, London	1028	635	1663	0	0
Shears and Sons, London	1013	452	1465	0	0
Siddeley and Co., Liverpool	900	420	1320	0	0
H. Pontifex and Sons, London	908	348	1256	0	0
J. J. Bennett and Sons, London	877	370	1247	0	0
J. Dale, London	764	472	1236	0	0
J. Smith and Co., Derby	800	375	1175	0	0
Bindley & Briggs, Burton—accepted	780	360	1140	0	0
CONTRACT No. 6.—BACKMAKERS' WORK.					
Church and Co., London			1240	0	0
Bennett and Sons, London			1011	0	0
J. Oxley, Frome			908	0	0
J. Morris and Sons, Burton			890	0	0
Wilson and Co., Frome—accepted			880	0	0
CONTRACT No. 7.—SLATE MASON.					
A. Braby, London			330	0	0
J. Stirling and Co., London			300	0	0
J. J. Sharp and Co., London			260	0	0
Ashton and Green, London—accepted			244	0	0
CONTRACT No. 8.—PIPE CONNECTIONS.					
Bennett and Sons, London			2635	0	0
Wilson and Co., Frome			2582	0	0
Thornewill and Warham, Burton			2525	0	0
J. Smith and Co., Derby			2500	0	0
Bindley and Briggs, Burton—accepted			2485	0	0
CONTRACT No. 9.—REFRIGERATORS.					
Morton and Co., Burton—accepted			300	0	0

NOTE.—The results of the building and ironwork contracts have been previously announced.

	£	s.	d.
Lowe and Sons, Burton	20,409	0	0
Eastwood and Swingler, Derby	4,376	0	0

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

(*From our own Correspondent.*)

ON 'Change to-day—Thursday—in Birmingham, and also yesterday in Wolverhampton, there was a numerous attendance of ironmasters and merchants, and there appeared to be a greater desire to do business, but the sales were not a considerable aggregate.

Bars were changing hands for Australia and for the United States. The quality in demand was that for which £6 15s. is now the current price. There was something doing also in marked bars at £7 10s. and at £8 2s. 6d., but excellent bar orders went mostly to firms who are taking £7 and £7 5s. For hurdle bars at £6 10s. the demand was down upon the week, the hurdle trade being more than customarily quiet at this time of the year.

Baling strip and petroleum hoops were in request for America. Makers' prices were £7 5s. at the works.

Gas strip was dull. The wrought tube firms are getting much shorter of orders, but there is still more firmness than would have been possible a year ago in a similar state of the market.

Sheets of the ordinary qualities were not stronger upon the week. Singles were freely offered down to £8 5s. for galvanising, and some firms did not hesitate to encourage negotiation at that figure, consumers inferring that they might be able to place their orders down to £8. Yet for doubles £9 10s. was required, but not inflexibly; and trebles were procurable at within £11. The stamping sheet firms made no complaint. With them the trouble they reported is to get the orders out of hand fast enough. Messrs. E. P. Baldwin and Co. quoted their "Severn" singles £12, Severn B. £13, B.B. £14, and B.B.B. £15. For their charcoal singles they asked £17 10s., best charcoal singles £20 10s., and E.B. charcoals £22 10s. per ton. The prospect of the trade brightens with the advance of the year. Now that the Baltic is again open, a much larger demand is looked for in a few weeks. This opening of the approaches to the northern ports is viewed favourably all round, though the advancing tariff project of Russia is viewed seriously, even as the contemplated rise of 5s. a ton upon pig iron imported into Austria is viewed with disfavour in the North of England; and the breaking up of the ice is causing more attention to be given to the Canadian trade; which, indeed, has all the winter been better than for several years past.

Meanwhile tin-plates are being knocked about in the business doing with the States and with Canada alike. They are down upon the week in Liverpool by 1s. 6d. per box, and some dealers are proceeding upon the assumption that next week will see a similar drop. The common coke plates of this district were quoted to-day in Birmingham 20s., best 22s., and charcoals 24s. per box; but the price was rarely given. The goods going away are destined for United States, Australia, the Cape, Germany, and France.

Boiler-plates show a tendency to return to sluggishness. Lancashire and Yorkshire boiler-making firms are buying high-class Staffordshire brands, but less freely. The prices range from £8 10s. to £9 and £9 10s. per ton.

Several brands of galvanised sheets were procurable yesterday at £15 for 24 w.g. in bundles in London.

Pigs were not active to-day. Yesterday there were inquiries in Wolverhampton for melters for the use of ironfounders outside this district. The most general quotations for Derbyshire and Northampton forge sorts were 50s. to 52s. 6d., and for one Northampton brand 55s. was asked. Foundry iron was 1s. 6d. advance upon those figures.

Local pigs not of the highest grade were a little strengthened upon the week by the firmer attitude of the makers in Cleveland. But as the stocks the country through are an increase of nearly 200,000 tons upon a twelvemonth ago, and now aggregate over 1,736,000 tons, buyers were to-day shy of purchasing. Leicestershire pigs were offered at 53s. 6d. at railway stations, with 1s. on for delivery at works. All-mine Staffordshire was to be had at from £3 7s. 6d. to £3 10s. for the make is somewhat growing upon the demand. Hematites were less stringent at 72s. 6d. to 75s. per ton for forge kinds delivered here.

Coke was not so strong as a fortnight ago. Coal, on the other hand, was easier. To secure orders prices which show a very narrow fringe of profit are being accepted as to manufacturing sorts. The quotations for household qualities will soon have to suffer the usual change at the approach of summer.

There has been a dispute in the week at the Round Oak Works of the Earl of Dudley, where the Casson-Bicheroux gas furnaces are employed. The puddlers sought to be allowed a stoker or advanced wages on account of the alleged greater difficulty of cleaning their furnace bars. Their application was discouraged and they turned out. By the interposition of the Operative Secretary of the Wages Board, the men have been persuaded to submit the question to the sub-committee of that board; and pending a decision Mr. Smith-Casson, the manager of the works, has allowed the men to return. The single patent gas furnaces were started yesterday.

The manufacturers of Wolverhampton and the surrounding district are at last able to reap the benefit of the efforts that have been made by the Wolverhampton Chamber of Commerce, as I have before advised, to obtain greater facilities in War-office tendering.

A good deal of dissatisfaction was expressed at the annual meeting of the shareholders of the National Arms and Ammunition Company in Birmingham on Monday, at the smallness of the Government orders received during the year, and indeed for several years past. It was stated that the making of tricycles, which had been taken up by the company to employ some of the plant, was getting profitable, but that if trade in arms and ammunition did not revive, part of the works would be sold.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—The iron market here continues flat, with prices still tending steadily in the favour of buyers. Both pig and manufactured iron have been easier to buy during the week, and makers as well as merchants complain that there are very few new inquiries coming in. There is, however, still in hand a good deal of work, and although the number of unexecuted orders is gradually decreasing, prices may be said to be very steadily maintained considering the present depressed condition of the market.

I understand that Lancashire makers of pig iron have recently secured tolerably good orders in Staffordshire, but in their own immediate district they are booking very few new orders. Nominally for delivery equal to Manchester their quotations remain at 49s. to 50s. per ton, less 2½ for forge and foundry qualities, but local makers would be open to offer at under these figures.

Outside brands of pig iron are now coming into this district at very low prices, and this applies particularly to Lincolnshire iron, which, although some makers are still quoting 49s. to 50s., less 2½ for forge and foundry numbers delivered equal to Manchester, has been offered during the week at as low as 47s. 6d. to 48s. 6d. per ton. Middlesbrough iron delivered equal to Manchester is quoted at about 50s. 1d. to 50s. 4d. per ton net cash, but these figures do not bring forward business.

In the finished iron trade the leading local makers are still holding for £7 per ton for bars delivered into the Manchester district, but this is more because they are so well engaged for the present that they are not compelled to seek new orders just now than that it represents the actual market value. Makers in some cases although tolerably well sold are getting specifications in so slowly that they are open to book orders for prompt delivery at considerably under the above figure, and buyers with immediate specifications would be able to place them at £6 17s. 6d. or as low as £6 15s. per ton, and hoops, although quoted at £7 to £7 5s., could in some cases be bought at £6 17s. 6d. per ton.

In the engineering branches of trade most of the leading firms in the Manchester district continue well employed. Locomotive engineers and tool makers especially are busy. Inquiries are still coming in from abroad, and recently orders for tools for North of England ironworks have been placed in this district. A fair quantity of bridge work has also recently been placed in the hands of local firms. Complaints, however, are still made that generally new work is only coming to hand in limited quantities.

Hematites are very irregular in price, and foundry qualities delivered into the Manchester district range from 65s. up to 71s. and 72s. per ton.

It has long since been demonstrated by experiments that, with very few exceptions, the so-called safety lamps at present used in collieries are actually unsafe under conditions which come more than within the range of possibility with the present system of mine ventilation. This fact has, however been so forcibly demonstrated as regards the "Davy," as the result of the coroner's inquiry into the recent disastrous explosion at Abram, that a general attention on the part of colliery proprietors to the question of lamps has become almost imperative. It will therefore be of interest to notice briefly a paper on "The Safe Lighting of Mines," read by Mr. W. E. Teale before a very numerous attendance of Lancashire mining engineers at the meeting of the Manchester Geological Society on Tuesday. Mr. Teale, after alluding to the almost endless varieties of lamps at present in use, urged that the first step to be taken towards an improvement in the lighting of collieries was to try to reduce the great mass of divergent opinions, and thus lessen the existing anomaly. He was strongly of opinion that naked lights should be abolished, and the safest description of lamp securely locked only used. By the term safety lamp, he meant such a lamp as would give security not only in a still atmosphere, but also under a strong pressure of explosive gas, and that would effectually prevent the user of the lamp from exposing the flame. From the vast number of experiments made during the last twenty years, the only conclusions they could arrive at were that the Davy and Clanny lamp were thoroughly unreliable, both as regarded the power to withstand any great pressure of gas, the method of securing the flame, and the quality of the light. That the Stevenson, although slightly safer as regarded the first-named quality, was really little or no better than the Davy or the Clanny, and that the Belgian Mueseler, although a great improvement, was not actually safe as regarded the severest form of test. The addition of a shield or a double gauze did not materially improve the safety of the Davy, and the addition of a tin can, introduced of late, although increasing its safety in one respect, depreciated in another its quality of giving light, which was already poor enough, and he feared the tin can would not give that security when submitted to exhaustive experiments which some persons anticipated, but, on the contrary, when the burning gas was maintained a sufficient time, would explode in the same way as a gauze lamp with a cylinder of glass from top to bottom. After pointing out that the Davy lamp would fire in an explosive atmosphere travelling at or above 5ft. per second, that the Clanny and Stevenson would only withstand a slightly increased velocity, and condemning the system of locks generally adopted as altogether unreliable, Mr. Teale gave a description of his improved "Protector" Mueseler, the principles of which briefly, in his own words, consisted in utilising natural results—mechanical action in unscrewing the lamp, depriving the flame of support and destroying it, and the action of an explosive atmosphere on the flame producing carbonic acid gas in excess, which in turn prevented the continuation of combustion. In conclusion Mr. Teale urged that the safety lamps should be the property of the colliery proprietors, and if explosions were to be prevented, in addition to all known means of laying out and ventilating collieries, providing for what might be expected, the best mechanical means must be adopted for providing against the unexpected, whether it arose from carelessness, recklessness, not complying with regulations, or from causes which no human being could foresee.

Judging from the backward state of the preliminary arrangements for the Smoke Abatement Exhibition to be held in Manchester, the opening will scarcely take place on the 14th as anticipated. The exhibition, however, promises to be very successful, so far as the most important sections are concerned, and the industrial section, devoted to gas engines, boiler furnaces, varieties of fire-bars, mechanical stokers, smoke-preventing bridges, and other appliances for steam engine and general industrial purposes, is well represented by about forty exhibitors.

The Throstle Nest Weir on the Irwell, near Manchester, which has long been a ground of complaint, as one of the causes of the disastrous floods which have frequently been the result of the overflowing of the river, is now being reconstructed by the Bridgwater Navigation Company. The old stone wall and the upper structure of wood, which was intended to fall down in case of flood, but did not, have been removed, and an improved form of flood-gates, which, in case of flood, swing into a position in which they offer the least resistance, is being substituted, which, it is hoped, will remove the previous objections to the Weir.

There is no material change in the coal trade since last week. The reductions in price have brought no appreciable accession of new business, and short time at the pits is extending, whilst the winter is closing with heavy stocks of coal on hand. All classes of round coal are bad to sell, and engine fuel, although moving off fairly, is not at all scarce in the market. The prices at the pit mouth remain at about 8s. 6d. to 9s. for best coal; 6s. 6d. to 7s. for seconds; 5s. to 6s. for common; 4s. 6d. to 5s. for burgy; and 3s. 6d. to 4s. for slack.

Shipping, although collieries here and there are fairly supplied with orders, is generally very quiet, and steam coal is offered at the high level, Liverpool, and at Garton Docks at under 7s. per ton, whilst delivered alongside at Liverpool there have been sellers at as low as 7s. 6d. per ton.

Coke continues in fair demand at about 9s. to 10s. for common up to 12s. to 13s. per ton for the best qualities at the ovens.

Barrow.—The easier tone reported in the hematite iron trade during the past few days is still maintained, and the tendency is in the direction of an even quieter state of affairs. The inquiry from America and the Continent has fallen off, as also that on home account. The value of steel rails in America has dropped to such a figure that it cannot be expected that many orders for hematite iron will be placed in this district till a change in value takes place. Orders are, however, very well in hand, but as the metal now being produced is not for immediate delivery in every instance, stocks are accumulating. About 26,000 tons of pig iron are held under warrants, and the stocks of metal in the hands of makers and second-hand dealers is estimated to approximate 70,000 tons. Quotations are again easier. No. 1 Bessemer, 59s.; No. 2, 58s.; and No. 3, forge, 56s. f.o.b. west coast ports, delivery for the next three months.

I am informed that in the steel trade rails are not in large request at present, although makers are very busy. Prices have gone down to 122s. 6d. per ton, being a reduction of 2s. 6d. Iron ore is not in such heavy demand. Prices are quoted at 14s. to 15s. per ton at the mines.

It is expected that as no stability is showing itself in the improved demand of a month ago, that some of the furnaces will be put out of blast, and already the Distington Iron Company has determined to blow out their two furnaces for repairs, an example likely to be followed by other makers whose furnaces are not yielding an average production of iron.

Shipbuilders are not so well employed as they have been. Engineers, however, have good orders in hand. Coal and coke in steady consumption.

The new steamer Benacre, built to the order of Mr. Joseph Holt, Liverpool, was launched from Messrs. Caird and Purdie's yard at Barrow on Wednesday. As the ship was leaving the ways her bows struck the stone quay, and a hole was made in the keel. She was moored to the quay-side, and afterwards taken into the graving dock, the damage being temporarily repaired. The Benacre's dimensions are as follows: Length, 245ft.; beam, 34ft.; depth of hold, 17ft.; tonnage, 1350 tons. The engines will be 150-horse power, and are being made by Messrs. Kemp, of Glasgow.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

THE question of the hour is still the remuneration of the miners in the districts of South and West Yorkshire. I hear less of the demand for 10 per cent. advance in wages, which is simply preposterous in the present state of the coal trade. House fuel is daily lessening in demand. The weather keeps open and mild, and there is every prospect of values being early reduced. Messrs. Chappell and Casey, of the South Yorkshire Miners' Union, have drawn up a basis for a sliding scale. They fix upon four collieries as the selected collieries where the books shall be examined by accountants on behalf of the masters and men on the quarters ending the last days of March, June, September, and December. The collieries are—Thorncliffe, Strafford Main, Wombwell Main, Manvers Main. The basis appears to be fair enough in its more important aspects, but the difficulty is that whatever Messrs. Chappell and Casey propose, Messrs. Frith, Pickard, and others oppose, the latter contending that a 10 per cent. advance must precede any arrangement for the sliding scale. This ultimatum to the employers of course at once brings negotiations to a "hitch."

The singular strike at Horbury Junction Ironworks, near Wakefield, which I noticed last week, has terminated. The men struck for an advance of 9d. per ton for puddling, and 7½ per cent. upon other work, and the employers having conceded the demand, the advanced wages are to take effect from the 20th ult.

Mr. Henry Willis, of Old Windsor, writes to the *Sheffield Daily Telegraph*, directing attention to the reports sent to our Government by the British Consuls, indicating that the Germans and Americans are supplanting us in various industries by providing goods suitable to the wants of the people. Sheffield and Birmingham, he says, are most seriously concerned, and he instances the difficulty of buying good bradawls with movable steel, reliable rat traps, handles of gimlets and screw-drivers—which, he insists, should be crooked, like the key to a large clock—gardeners' hammers, "which should be small at the end, with the weight in the middle." Door-handles he condemns as "most execrable." I had occasion the other day to examine a large quantity of American "furnishings" sent for sale in this country. The shapes and sizes were handy; but the quality of the material and the workmanship could scarcely have been worse. Any British firm would have been ashamed to send out such goods.

The dividend of Messrs. Charles Cammell and Co., Limited, Cyclops Steel and Ironworks, is interesting, as showing how decidedly the heavy industries had benefitted by the revival of trade in 1881. At the annual meeting of the company, to be held on the 29th inst., the directors will recommend the payment of a further sum of £4 per share, making, with £2 already paid, a dividend equal to 7½ per cent. for the year. A similar dividend has not been paid since 1877, the dividends for 1878-79-80 having been at the rate of 5 per cent. per annum.

The American Consul here has kindly furnished me with the values of Sheffield exports to the United States during February last. Steel was exported to the value of £31,140 2s. 11d.; cutlery, £21,352 6s. 1½d.—as compared with £25,418 14s. 4d. and £23,740 4s. for February, 1881. The total value is £135,027 17s. 1½d.—an increase of £42,346 over February, 1881. Steel rails were exported to the value of £60,000; the exact figures are not attainable, as the Consul gives specific details of steel and cutlery only.

I notice the death of Mr. Henry I. Ibbotson, of Messrs. Ibbotson Brothers and Co., Limited, of the Globe Iron and Steel Works, Sheffield. Mr. Ibbotson was for several years in America as the agent for his firm, and was an excellent business man, thoroughly conversant with the staple trades of Sheffield, and universally esteemed in manufacturing and in private circles.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

THERE was a slightly better feeling in the iron market held at Middlesbrough on Tuesday last, attributable to the favourable return of stocks for February, and the considerably increased rate at which shipments have taken place so far this month. Up to Monday night the exports of pig iron from Middlesbrough had amounted to 21,369 tons for five working days, and a good trade locally has also been done. Taking advantage of these improved circumstances, the ironmasters held a meeting on 'Change in order to confer with one another as to the possibility of obtaining better prices. It is understood that an understanding was arrived at, although not a binding one, to fix upon 42s. 6d. as the price for prompt f.o.b. deliveries of No. 3 g.m.b. The market price, however, could not be considered to be above 41s. 9d. for immediate and 42s. for slightly postponed delivery. All the business actually done was by merchants, and at the latter price. Warrants were in moderate request at about 42s. 3d. for No. 3 f.o.b. The stock in Connal's stores was 210 tons less than the previous week, the stock being reported at 171,166 tons.

Manufactured iron continues quiet. For some weeks consumers have been holding back, influenced no doubt by the weakness of the Glasgow pig iron market. It is probable that within a few weeks there will be another rush of buyers upon the market. Shipbuilders are very fully at work and using up large quantities of material. They have also apparently an abundance of new orders to take the place of those which are being run off, and this indicates a considerable amount of fresh purchases so soon as they think the time opportune.

The present price of ship plates is nominally £7 5s., less 2½ per cent. There are some second-hand lots in the market which can be obtained for 5s. less, and some of the new firms who are only just starting operations, are also quoting the lower price. Many consumers will, however, not buy either of newly started firms or merchants, and these are biding their time. Bars and angles are quoted at £6 12s. 6d., less 2½ per cent., in trucks Middlesbrough, but odd lots can be purchased at £6 10s. The quantity of iron in second hands is not thought to be large. The foundry trade still continues slack, and all orders in this line are severely competed for.

A meeting of the creditors of Messrs. John Holdsworth and Co., of Westbourne Ironworks, Stockton, was held on Monday morning, the 6th inst., at the Royal Hotel, Mr. J. F. Wilson presiding. Mr. W. B. Peat, the receiver appointed by the court, made a statement as to the position of the liquidating firm. The amount owing to unsecured creditors is £41,587 17s. 5d., and there are other claims which may have to rank upon the estate, amounting to £11,346 14s. 3d., making a total of £52,934 11s. 8d. The assets are estimated at £9007 16s. 8d., assuming that the works can be sold for £20,000. Mr. Peat was appointed trustee, and several creditors were nominated as a committee of inspection to assist him. The meeting then granted the discharge of Messrs. John Holdsworth and James Henry Holdsworth. The remaining partner, Mr. Haworth, is at present in Durham Gaol, awaiting his trial on a charge of having forged and made use of several fictitious bills of exchange.

Messrs. Bolckow Vaughan and Co. have now issued their seventeenth annual report. The directors consider that, having regard to the low prices of pig iron which prevailed during the second and third quarters of last year, and to the unsatisfactory condition of the coal trade during the whole of the year, the results obtained will be pronounced highly satisfactory by the shareholders. The amount of profit available for distribution is £305,806 12s. 5d., which after paying interest on debentures absorbing £21,456 11s. 9d., dividend on preference shares absorbing £20,000, ditto on fully paid up shares at 8¾ per cent. per annum absorbing £121,546 6s., and dividend on shares with £12 paid, at the same rate, absorbing £97,607 5s., and writing off against capital account £40,000, will leave a balance to carry forward of £5106 10s. 8d.

The directors refer to Mr. Richards' recent visit to America. They say that the result of that visit has been to convince them that taken as a whole their appliances are as good or better than any to be found in the New World. At the same time they admit that Mr. Richards discovered many ways in which he could improve. The Thomas and Gilchrist process has been considerably perfected, and it is intended to add a third converter to each of the two pits now at work on the system. The directors fully believe in the high quality of basic steel, and are confident that only time is required to insure general confidence in it.

The expenditure over the Cleveland steel works has been very great, but not much more will be required on plant account, and a weekly make of 4500 tons of blooms and rails has already been obtained.

The return of traffic of the North-Eastern Railway for the week ending March 4th, 1882, has been issued, showing an increase in receipts of £2851, the bulk of which is on account of passenger traffic. The total increase to that date from the beginning of the year is £51,959. This seems to show beyond dispute that whatever may be the future prospects of trade, there has actually been a substantial increase in general activity this year as compared with last.

The annual dinner of the Cleveland Iron Trade Foremen's Association will take place at the Queen's Hotel, Middlesbrough, on Saturday next, when Mr. Carl W. F. Bolckow will occupy the chair, and Mr. John Stevenson the vice-chair. A large and influential gathering is expected.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

TOWARDS the close of last week the Glasgow pig iron market became very depressed in consequence of a number of holders pressing their iron upon the market. Business closed on Friday evening at the lowest point, the market being very dull. A rather better feeling manifested itself on Monday, and the market was quite strong on Tuesday; this change being due to several causes. The principal of these were the returns as to the reduction of stocks at Middlesbrough, and the report to the effect that the Cleveland ironmasters were considering a proposal to limit the minimum price of pig iron to 42s. per ton. The favourable Board of Trade returns have also been received with some satisfaction, and the stocks in the public stores show a slight decrease. The shipments continue extraordinarily good for the season of the year, comparing most favourably with those of this time last year. For the past week they amounted to 12,597 tons, as against 10,739 tons in the preceding week and 9902 in the corresponding week of 1881. There has been rather more business done with Germany, but less with the United States. Still a very large turnover of iron is taking place both at home and abroad, and the lowness of prices is to not a few somewhat inexplicable.

Business was done in the warrant market on Friday forenoon at from 47s. 6d. to 47s. 1d. cash, and 47s. 9d. to 47s. 4½d. one month; the afternoon quotations being 47s. 2d. to 47s. 4d. cash, and 47s. 5d. to 47s. 6d. one month. On Monday morning the quotations were 47s. 3d. cash, and 47s. 7d. one month, to 48s. 8d. cash and 47s. 10d. one month. In the afternoon business was done at 47s. 7½d. to 47s. 10d. cash, and 47s. 11d. to 48s. 1d. one month. On Tuesday forenoon the market was strong with business from 47s. 9d. cash, and 48s. one month, to 48s. 2d. cash, and 48s. 4d. one month; whilst in the afternoon the figures were 48s. to 47s. 9½d. cash, and 48s. 2½d. to 48s. 1d. one month, the market thus showing a slight relapse in the afternoon. The market was irregular on Wednesday with business between 47s. 7½d. and 47s. 11d. cash. To-day—Thursday—the market was firm with business in the forenoon at 48s. 1d. to 48s. 5½d. cash, and in the afternoon at 48s. 3d. to 48s. 5d. cash.

The prices of makers' iron are a shade easier this week, as follow:—Gartsherrie, f.o.b. at Glasgow, per ton, No. 1, 57s. 6d., No. 3, 50s. 6d.; Coltness, 58s. 6d. and 52s.; Langloan, 59s. and 53s. 6d.; Summerlee, 57s. 6d. and 50s.; Calder, 57s. and 50s. 6d.; Carnbroe, 53s. 6d. and 50s.; Clyde, 51s. 6d. and 48s. 6d.; Monkland and Quarter each 49s. and 47s.; Govan at Broomielaw, 50s. 6d. and 48s.; Shotts at Leith, 58s. 6d. and 53s.; Carron, at Grangemouth, 52s. 6d. (specially selected, 55s.) and 51s. 6d.; Kinneil, at Bo'ness, 49s. and 47s.; Glengarnock, at Ardrossan, 53s. and 50s.; Eglinton, 49s. and 47s.; Dalmellington, 49s. and 48s.

Of late weeks the demand in Scotland for Cleveland pig iron has somewhat fallen off in consequence of the difference in prices being favourable to a larger consumption of Scotch pig iron. There is still, however, up to date a comparative increase of 7424 tons in the imports from Middlesbrough.

Fair arrivals of hematite ore are taking place from Spain and Cumberland.

With reference to the malleable iron trade there is little fresh this week to note. So far as can be ascertained the malleable works are yet well supplied with work, but in most cases they are engaged upon old contracts, and new orders are not coming in so readily as could be desired. The various branches of the engineering trades also continue busy. Pipe founders are in some cases rather slack at present; nevertheless a few good orders have been booked lately, and there are others in prospect. Throughout the various branches of the smaller hardware trades a great amount of activity prevails, and in Glasgow particularly a very extensive business is being done in manufactures for export to the Continent and our colonies.

The coal trade is at the moment rather sluggish in some of its departments, although the shipments as a whole compare very favourably with those of the preceding week. A very large output is taking place, and also an extensive consumption at home; but the market is overweighted with production, and prices are so low that the question of reducing the wages of the miners has been forcing itself upon the employers, who have held repeated meetings to consider the matter. It is understood that on the present occasion the ironmasters, whose profits are small in consequence of the low prices of pig iron, do not look unfavourably upon the agitation of the colliery owners for reducing wages; but whether a concerted agreement will be ultimately arrived at is still regarded as somewhat doubtful.

As for the miners they have been holding meetings in different parts of the country, particularly in the west, with the object, if possible, of averting the threatened reduction. The men seem prepared to adopt in preference to reduced wages a stringent policy of restriction in the matter of the output, but whether the leaders of the movement would be generally supported by the miners in reducing the output is not very clear.

WALES & ADJOINING COUNTIES.

(*From our own Correspondent.*)

THE coroner's inquiry into the late fatal accident at Coedcae Colliery, in the Rhondda Valley, has brought to light, and to public commendation, the fact that no expense has been spared in making it a model colliery. All details were most carefully arranged, the management above and beneath most efficient, and yet two or three men, whether under the influence of drink, as alleged by some, or not, go in a most insane manner, when the fan is stopped, into the shaft with open lights, actually inviting the ascent of the gas, as the most illiterate must have known. The unfortunate men have paid dearly for their rashness, and the loss upon the proprietary is a heavy one. I commend the arrangements at Coedcae to coalowners generally. The leading maxim is to carry out the most simple of the rules with the same care as would be exercised if it were known that an explosion would take place and a rigid inquiry be instituted.

Another colliery inquiry has been finished this week; that into the circumstances attending the explosion at Blaina. This resulted in the death of five men. The verdict of the jury was to the effect that the foremen—one of the killed—had neglected his duty in not examining the pit before the men went in with naked lamps.

Neither of the staple trades is so good as it has been. Some parcels of iron and steel have been exported during the past week it is true, but prospective work has a dull aspect, and a flatness noticeable in the North of England, in Belgium, and in America, has not exempted the Welsh districts.

So, too, in steam coal. I have not seen for many months such a large collection of laden wagons as I saw last week at some of the principal collieries. At one, in particular—Nixon's, Merthyr Vale—the sight was a startling one. Probably in this case the storms had prevented incoming steamers from getting into port, as Nixon holds good contracts. However, short time has again become a characteristic, and four or five days a common occurrence, instead of a full week's work. The total foreign coal exports last week from all the Welsh ports were only a little in excess of 13,000 tons.

It is a singular fact that in one of the dullest weeks we have had at Cardiff for some time there was shipped from Penarth Dock on Tuesday the greatest quantity of coal ever shipped from that place in one day. The total was 10,263 tons 4 cwt.

Mr. Abrahams, of the Rhymney Collieries, has been appointed to the management of the steam coal collieries of Dowlais, Mr. Truran retaining the bituminous or upper seams. Mr. Truran has been a long and faithful servant of the Dowlais Company, and well deserves the relief he will now obtain from very arduous labours. Mr. Abraham comes into the wider scope of duty at Dowlais with high testimonials as to efficiency.

The patent fuel trade continues to look up, and in some cases at Swansea 1s. 6d. advance has been realised. The coal trade of that port is showing tolerable activity, though in common with other ports a falling off has to be recorded. Tin-plate remains dull. In the Swansea valley several works have resolved to reduce the work to five days a week, and at the Fox Hole Works, Llansamlet, notice has been given to the workmen which may mean a complete stoppage. The rumour at Swansea is that makers are about forming a "ring" to counteract the action of buyers in pressing prices down. Plates are in the market as low as 15s. the box, ordinary coke.

A colliery at Llanharran, on the Great Western Railway, was put up for auction this week at Cardiff, but there were no bidders.

Considerable anxiety is felt at Cardiff about the destiny of the Bute Docks Bill. If successfully opposed it will be a severe blow to the progress of the port, and none will be more gratified than the leading men of Newport. In the autumn the railway connecting Rhondda with Newport will be completed, and any shortcomings respecting dock accommodation at Cardiff must drift onwards trains of coal into the hands of Newport. I trust very heartily that, when the bill comes up for judgment, its merits will be such as to ensure its passing.

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.

28th February, 1882.

959. Paper Wrappers, T. Singleton, Darwen.
960. Ortho-nitro-benzaldehyde, J. A. Dixon.—(*C. Kœnig, Germany.*)
961. Capsuling Bottles, F. Bolt & P. Vogel, Hamburg.
962. Rowlocks, J. H. Clasper, Wandsworth.
963. Preventing Railway Accidents, C. Leroy, Paris.
964. Steering Ships, T. Walker.—(*J. Robinson, Acton.*)
965. Hats, &c., E. Vickers.—(*S. Gutmacher, Paris.*)
966. Spring Hinges, J. Bennet, Lozells.
967. Stoves, F. Wirth.—(*E. Schöneberg, Germany.*)
968. Cutting Holes, C. Scriven, Leeds.
969. Extracting Metals, J. Kagenbusch, London.
970. Lanterns, G. Bray, Leeds.
971. Ratchet-braces, C. T. Colebrook, London.
972. Cutting Screw-threads, J. Witham, Kirkstall.
973. Compensating Apparatus, F. W. and W. W. Brierley, London.
974. Fans, C. Cockson, Wigan.
975. Artificial Stone, J. Nottingham, U.S.
976. Drilling Rocks, W. Lake.—(*A. Shedlock, U.S.*)
977. Staple, W. Lake.—(*G. Smith, Chicago, U.S.*)
978. Gas, W. R. Lake.—(*T. B. Fogarty, Brooklyn, U.S.*)
979. Washing Coal, H. Allison.—(*E. Coppée, Belgium.*)
980. Moulding Bricks, T. le Poidevin, Guernsey.
981. Treating Dynamite, W. Howit, Ilford.

1st March, 1882.

982. Seat, &c., Protectors, C. P. Sharpley, London.
983. Scouring Wool, J. and W. McNaught, Rochdale.
984. Hose Couplings, J. C. Hudson, London.
985. Lighting Gas, C. Clarke & J. Leigh, Manchester.
986. Dynamo-electric Machines, W. H. Akester and T. B. Barnes, Glasgow.
987. Life-preservers, W. Wilkins, Tunbridge Wells.
988. Grinding Mills, B. Asplen, London.
989. Locking Devices, C. Bolle, Berlin.
990. Checking Speed of Trains, G. Redfern.—(*J. H. M. Waldorp, Holland.*)
991. Hanging Carriage Windows, G. Haycraft, Lyme Regis.
992. Steering Ships, J. Cooke, Richmond.
993. Pocket Hanger, A. Clark.—(*T. McDonald, U.S.*)
994. Gas-motor Engines, J. Fielding, Gloucester.
995. Obtaining Starch, W. Lake.—(*W. T. Jebb, U.S.*)
996. Sewing Machines, R. H. Brandon.—(*Morley Sewing Machine Company.*)
997. Horseshoe Nails, I. Briggs and J. W. Booth, Birmingham.

2nd March, 1882.

998. Ring Spinning, S. Brooks, Manchester, and A. Holden, Gorton.
999. Fastening Scaffold Poles, G. Wilson, London.
1000. Etching Patterns, E. Hancock, Worcester.
1001. Safety 'Cycle Saddle, S. Fry, London.
1002. Revolving Hair-brush, H. Lersner, Kew.
1003. Fish Joints, A. Davy, Sheffield.
1004. Ships' Logs, F. Webster.—(*W. Webster.*)
1005. Boiler Tubes, W. H. Wood, Cookley.
1006. Draw-off Cocks, S. B. Goslin, London.
1007. Damper Regulator, S. P. Wilding.—(*V. Hallock, U.S.*)
1008. Looms, T. Singleton, Darwen.
1009. Ships, H. H. Lake.—(*A. P. Bliven, U.S.*)
1010. Preventing Accidents, G. Minchin and L. Despeissis, Coopers Hill.
1011. Rotary Engines, A. Clark.—(*Elastic Wheel and Manufacturiug Company, U.S.*)
1012. Labelling Tins, G. Hutchings, New Cross.
1013. Lead Traps, A. Clark.—(*E. Blatchford and C. Gates, U.S.*)
1014. Caustic Barium, J. Tongue.—(*R. Ziomczynski, Germany.*)
1015. Reflecting Pavement Lights, W. Brass, jun., London.

3rd March, 1882.

1016. Measuring Cloths, J. Darling, Glasgow.
1017. Insulating Apparatus, J. Lewis, Birkenhead.
1018. Velocipedes, G. Singer and R. Lea, Coventry.
1019. Fire-resisting Bricks, C. J. Mountford, Birmingham.
1020. Transmitting Sound, J. Rapieff, London.
1021. Door Rods, L. Lenzberg, London.
1022. Discharging Grain, W. Blythe, Liverpool.
1023. Regulating Current of Electrical Generators, T. Handford.—(*T. Edison, U.S.*)
1024. Switch Apparatus, W. Irish, Sunderland.
1025. Lock-nuts, W. Lake.—(*W. Paige, U.S.*)
1026. Gas Engines, P. Niel, Millwall.
1027. Liquor Stands, J. Beresford, Birmingham.
1028. Registering Apparatus, H. Davey, Headingly.
1029. Incandescent Electric Lamps, F. Wright and M. W. W. Mackie, London.
1030. Colouring Matters, C. Abel.—(*C. Martius, Berlin.*)
1031. Vacuum Pumps, F. Wright & M. Mackie, London.
1032. Swimming Apparatus, C. Abel.—(*J. Andrée, Germany.*)
1033. Shaping Heated Glass, F. Wright and M. W. W. Mackie, London.
1034. Galvanic Chains, C. D. Abel.—(*A. Kraehmer, Germany.*)
1035. Stoppering Bottles, M. Macvay and R. Sykes, Castleford.
1036. Carbons, H. Liepman and P. Looker, London.
1037. Rotary Air Pumps, R. Skene, London.
1038. Pumps, H. Gardner.—(*H. Gilmore and J. Shaw, Canada.*)
1039. Feeding Stoves, G. Gore, Balsall Heath, and W. Morris, Blackheath.

4th March, 1882.

1040. Safety Valves, W. Brierley, Rochdale, and M. Mitchell, Bacup.
1041. Hose-couplings, J. Westley, Chorley.
1042. Wood-pulp, M. Jordan, Manchester, and A. Egestorff, Germany.
1043. Shears, T. Brown, Sheffield.
1044. Telephone Transmitters, R. & M. Theiler, London.
1045. Fountain Pens, J. R. Carter, London.
1046. Cutting Holes, J. Rowland, Sunderland.
1047. Window-sash Fastenings, S. Clark, Croydon.
1048. Filter-presses, S. H. Johnson, Stratford.
1049. Umbrella Slides, A. Henderson.—(*C. Grataloup and J. B. Lemarie, Paris.*)
1050. Reducing Valves, W. Weissenbach, Zurich.
1051. Armour-plates, J. D. Ellis, Sheffield.
1052. Velocipede, T. H. Ward, Tipton.
1053. Supporting Ships' Boats, M. Bülow, Germany.
1054. Telephonic Apparatus, N. Cherrill, Shortlands.
1055. Sugar, H. H. Lake.—(*L. Frères, Paris.*)
1056. Folding Boats, J. P. Wright, Redhill.
1057. Sugar, C. Scheibler, Berlin.
1058. Aluminium, J. Morris, Uddingston.
1059. Keys of Violins, J. Stuttaford, New Barnet.
1060. Testing Butter, F. Engel.—(*W. Osten, Germany.*)
1061. Preparing Music Sheets, A. J. Eli, London.
1062. Balls, A. M. Clarke.—(*P. and E. Jarre, Paris.*)
1063. Extracting Metals, H. Lake.—(*N. Evans, U.S.*)

6th March, 1882.

1064. Sowing, &c., A. Bonneville.—(*A. Couteau, France.*)
1065. Blinds, J. Wetherilt, London.
1066. Cleansing Spindles, T. Watson, Paisley.
1067. Self-acting Block Signalling, E. Callot, France.
1068. Portable Letter-copying Presses, W. Brewer and J. R. Meihé, London.
1069. Fixing Heels of Boots, J. Nief, Paris.
1070. Imitating Niello, F. Wirth.—(*F. Beck, U.S.*)
1071. Folding Chairs, C. Abel.—(*C. Timme, Germany.*)
1072. Ordnance Carriages, T. Nordenfelt, London.
1073. Steam Ships, J. E. Mouland, Roby.
1074. Feeding Water to Steam Boilers, J. Ripley and T. Scholes, Bolton.
1075. Musical Piston Instruments, W. R. Lake.—(*F. Sudre, Paris.*)
1076. Smiths' Hearths, P. Everitt, London.
1077. Fire Blowers, J. J. Lish, London.
1078. Steam Generators, C. Kingsford, London.
1079. Incandescent Electric Lamps, W. Crookes, London.
1080. Reels, A. Clark.—(*F. Kanne and L. Rogers, U.S.*)
1081. Water Velocipedes, A. Whittall, Kidderminster.
1082. Horseshoes, J. J. Norman, East Greenwich.
1083. Floating Lights, J. Imray.—(*J. Pintsch, Berlin.*)

Inventions Protected for Six Months on Deposit of Complete Specifications.

912. Washing Lighting Gases, H. A. Bonneville, Cannon-street, London.—A communication from L. A. Chevalet, Troyes.—*25th February*, 1882.
931. Dynamo-electric Machines, A. M. Clark, Chancery-lane, London.—A communication from H. B. Sheridan, U.S.—*25th February*, 1882.
942. Hair-clasps, F. L. R. Kopp, Hamburg.—*27th February*, 1882.
975. Artificial Stone, J. R. Nottingham, Washington, U.S.—A communication from A. Telletier, Washington, U.S.—*28th February*, 1882.
982. Seat and Cushion Protectors, C. B. Sharpley, Brixton-road, London.—*1st March*, 1882.
995. Obtaining Starch from Grain, W. R. Lake, Southampton-buildings, London.—A communication from W. T. Jebb, New York, U.S.—*1st March*, 1882.
996. Sewing Flat Buttons to Fabrics, R. H. Brandon, Paris.—A communication from Morley Sewing Machine Company, Boston, U.S.—*1st March*, 1882.
1013. Lead Traps and Tubes, A. M. Clark, Chancery-lane, London.—A communication from E. W. Blatchford and C. F. Gates, Chicago, U.S.—*2nd March*, 1882.
1925. Lock-nuts for Screw-bolts, W. R. Lake, Southampton-buildings, London.—A communication from W. H. Paige, U.S.—*3rd March*, 1882.

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

878. Scarf Rings, F. A. Walton, Birmingham.—*5th March*, 1879.
879. Dress-holders, F. A. Walton and T. Shaw, Birmingham.—*5th March*, 1879.
953. Locks, R. S. C. Jelley and R. C. Jones, London.—*11th March*, 1879.
831. Springs, I. A. Timmis, Stourbridge.—*1st March*, 1879.
838. Heating, S. Mart and C. W. Bradley, London.—*1st March*, 1879.
846. Combing Wool, I. Holden, Bradford.—*3rd March*, 1879.
870. Spinning Machinery, A. M. Clark, London.—*4th March*, 1879.
897. Pneumatic Tubes, A. M. Clark, London.—*6th March*, 1879.
1169. Treating Earth, G. H. With, Hereford.—*24th March*, 1879.
842. Spinning-frames, T. Coltman, Leicester.—*3rd March*, 1879.
862. Fireplaces of Furnaces, H. E. Newton, London.—*4th March*, 1879.
904. Governors, E. A. Bourry, Switzerland.—*7th March*, 1879.
952. Steam Pumping Engines, W. Morgan-Brown, London.—*11th March*, 1879.
844. Motive-power Engines, H. Davey, Leeds.—*3rd March*, 1879.
845. Nails, R. Parr and W. R. Phillips, Wolverhampton.—*3rd March*, 1879.
860. Lining of Guns, W. Palliser, London.—*4th March*, 1879.
865. Shaping Metal Bars, W. R. Lake, London.—*4th March*, 1879.
874. Frames for Umbrellas, J. Somerset and J. Walker, Manchester.—*5th March*, 1879.
892. Umbrellas, J. Minière, Paris.—*6th March*, 1879.
918. Looms for Weaving, J. Collins and J. Brownlee, Glasgow.—*8th March*, 1879.
885. Cop Tubes, B. J. B. Mills, London.—*5th March*, 1879.
929. Steam Engines, D. Joy, Barrow-in-Furness.—*8th March*, 1879.
933. Invisible Clock Winding, E. M. L. Maxant, Paris.—*10th March*, 1879.
1058. Furnaces, W. Williams, Tividale.—*18th March*, 1879.

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

769. Sinking Shafts, W. Firth, Leeds.—*2nd March*, 1875.
772. Spring Washers, J. W. Grover, London.—*3rd March*, 1875.
791. Centrifugal Pumps, J. E. Lawrence and E. V. Porter, London.—*3rd March*, 1875.
809. Steam Boiler Furnaces, D. Annan, Bow.—*4th March*, 1875.
828. Registering Machine, E. A. Chameroy, Paris.—*6th March*, 1875.
1103. Coffee Pulping, W. V. V. Lidgerwood, U.S.—*25th March*, 1875.
1046. Umbrellas, &c., E. Charageat, Paris.—*22nd March*, 1875.
784. Looms for Weaving, J. Whyte, Glasgow.—*3rd March*, 1875.
827. Treatment of Paper, J. Scoffen, London, and G. Tidcombe, Watford.—*5th March*, 1875.

Notices of Intention to Proceed with Applications.

Last day for filing opposition 24th March, 1882.

4656. Glass Tiles, T. H. Rees, London.—*25th October*, 1881.
4668. Stoves, A. H. Hearington, London.—*25th October*, 1881.
4670. Metallic Pillars, R. B. Lee, Manchester.—*25th October*, 1881.
4677. Screw Nuts, W. H. Lewis, Denmark-place, and W. R. Clark, Danby-street, Surrey.—*25th October*, 1881.
4681. Fastener for Scarves, &c., H. Scott, Liverpool.—*26th October*, 1881.
4685. Horseshoes, H. Dyer, South Audley-street, London.—*26th October*, 1881.
4699. Mashing, &c., Maize, W. H. Apthorpe, Cambridge.—*27th October*, 1881.
4706. Knife-boards, H. C. de Berenger, Sinclair-road, London.—*27th October*, 1881.
4717. Pills, W. R. Lake, London.—A communication from J. A. Whitney.—*27th October*, 1881.
4722. Velocipedes, F. W. Jones, Exeter.—*28th October*, 1881.
4724. Discharging Condensed Water, H. G. Grant, Manchester.—A communication from E. Briart.—*28th October*, 1881.
4725. Flushing Water-closets, H. Skerrett, Birmingham.—*28th October*, 1881.
4730. Locks, &c., T. Galloway, Gateshead-on-Tyne.—*28th October*, 1881.
4740. Purifying Wax, A. J. Boult, London.—A communication from D. T. Gray.—*29th October*, 1881.
4744. Extracting Fat from Bones, E Edwards, London.—A com. from E. Pyrhosch.—*29th October*, 1881.
4745. Heating Water, R. T. Gillibrand, Darwen.—*29th October*, 1881.
4749. Spring Balances, J. Linacre, Brecon.—*29th October*, 1881.
4757. Straining Semi-fluids, W. S. Scott, Southwick, near Sunderland.—*31st October*, 1881.
4763. Folding Printed Sheets, W. Conquest, Tudor-street, London.—*31st October*, 1881.
4764. Rock Drilling, W. Morgan-Brown, London.—A com. from L. B. Stone.—*1st November*, 1881.
4765. Mattresses, J. T. Lockey, Northwich.—*1st November*, 1881.
4775. Electric Lamps, H. A. Bonneville, London.—A communication from L. Daft.—*1st November*, 1881.
4781. Frillings, E. A. Cowper, Great George-street, London.—*1st November*, 1881.
4790. Vaccinating Apparatus, T. Smith, London.—A communication from V. Burq.—*2nd November*, 1881.
4802. Whiting, W. Brothers, Livesey Chemical Works, near Blackburn.—*2nd November*, 1881.
4811. Displaying Clothing, F. M'Ilvenna, Manchester.—*3rd November*, 1881.
4846. Pleating Machines, G. McC. Chamberlain, London.—*4th November*, 1881.
4853. Shaping Metals, J. Whitehouse and S. Peacock, London.—*5th November*, 1881.
4891. Preparing Grain, J. Fordred, Tottenham.—*8th November*, 1881.
4901. Velocipedes, R. E. Phillips, Great George-street, London.—*9th November*, 1881.
4926. Digging, T. C. Darby, Pleshey Lodge, near Chelmsford.—*10th November*, 1881.
4992. Centrifugal Drying Machines, A. Fryer, Wilmslow, and J. B. Alliott, Nottingham.—*15th November*, 1881.
5011. Permanent Way, J. Livesey, Victoria-chambers, London.—*15th November*, 1881.
5012. Making Casks, R. E. Gibson and D. Pope, Liverpool.—*16th November*, 1881.
5073. Pulping Turnips, W. N. Nicholson and W. Mather, Newark-upon-Trent.—*19th November*, 1881.
5199. Disinfecting Sewage, A. M. Clark, London.—A com. from P. Schlosser.—*1st December*, 1881.
5267. Desiccating Apparatus, A. M. Clark, London.—A com. from P. Schlosser.—*1st December*, 1881.
5268. Treating Fœcal Matters, A. M. Clark, London.—A com. from P. Schlosser.—*1st December*, 1881.
5296. Sulpho-acids, F. Wirth, Frankfort-on-the-Main.—A com. from Kalle and Co.—*3rd December*, 1881.
5393. Hollow Projectiles, R. H. Brandon, Paris.—A com. from B. B. Hotchkiss.—*9th December*, 1881.
5428. Burners, R. H. Brandon, Paris.—A communication from L. Sepulchre.—*12th December*, 1881.
5435. Breech-loading Cannon, R. H. Brandon, Paris.—A com. from B. B. Hotchkiss.—*13th December*, 1881.
5614. Boring Rocks, J. T. Jones and J. H. Wild, Leeds.—*22nd December*, 1881.
5621. Treating Gases, F. Wirth, Frankfort-on-the-Main.—Com. from H. Roessler.—*3rd December*, 1881.
40. Grape Sugar, W. R. Lake, London.—A communication from A. Behr.—*4th January*, 1882.
74. Applying Motive Power, W. B. Tibbits, Clifton.—*6th January*, 1882.
211. Fire-proof Paint, C. J. Mountford, Birmingham.—*16th January*, 1882.
241. Affixing Stamps, &c., C. A. Drake, London.—*17th January*, 1882.
304. Oil Cap, T. Watson, Paisley, N.B.—*21st January*, 1882.
308. Applying Springs, H. Smellie, Kilmarnock, N.B.—*21st January*, 1882.
352. Cutting Cheese, W. Chisholm, Hawick.—*24th January*, 1882.
379. Flush Cisterns, W. Wright, Plymouth.—*25th January*, 1882.
423. Machine Embroidery, C. A. Barlow, Manchester.—A com. from C. W. Wetter.—*27th January*, 1882.
451. Colouring Matters, J. A. Dixon, Glasgow.—A communication from C. Rumpff.—*30th January*, 1882.
459. Perambulators, E. Andrews, Sudbury.—*30th January*, 1882.
461. Signalling Apparatus, C. Barker, Shadwell.—*30th January*, 1882.
561. Dust Collectors, P. Van Gelder, Sowerby Bridge.—*6th February*, 1882.
592. Treating Wheat, J. A. A. Buchholz, Vauxhall.—*6th February*, 1882.
627. Colouring Matters, J. A. Dixon, Glasgow.—A communication from C. Kœnig.—*9th February*, 1882.
638. Refrigerating Apparatus, J. J. Coleman, Glasgow.—*10th February*, 1882.
695. Pipes, C. Morris, Maida Vale, London.—*13th February*, 1882.
709. Shoes for Horses, J. Camp, Lowestoft.—*14th February*, 1882.
737. Boiler Furnaces, J. H. Johnson, London.—A com. from E. J. Mallett, jun.—*15th February*, 1882.
912. Washing Gases, H. A. Bonneville, London.—A com. from L. A. Chevalet.—*25th February*, 1882.
931. Washing Gases, A. M. Clark, London.—A com- from H. B. Sheridan.—*25th February*, 1882.

Last day for filing opposition, 28th March, 1882.

4770. New Game of Chance, C. A. Glazbrook, W. H. O. Taylor, and W. P. B. Trench, London.—*1st November*, 1881.
4785. Preventing Incrustation in Boilers, E. Edwards, London.—A communication from H. Kolker.—*2nd November*, 1881.
4799. Gas Burners, J. B. Fenby, Sutton Coldfield.—*2nd November*, 1881.
4804. Filtering Paper, S. H. Johnson, Stratford.—*3rd November*, 1881.
4815. Carriages for Twist Lace Machines, W. Spowage, Nottingham.—*3rd November*, 1881.
4816. Candles, L. A. Groth, London.—A com. from L. C. A. and C. E. Motard.—*3rd November*, 1881.
4821. Measuring Water, W. Jones, Manchester.—*3rd November*, 1881.
4824. Electric Current Meters, C. A. Carus-Wilson, London.—*3rd November*, 1881.
4825. Regulating Dynamo-electric Machines, C. A. Carus-Wilson, London.—*3rd November*, 1881.
4829. Tricyles, A. Archer, Birmingham.—*3rd November*, 1881.
4830. Boats, W. R. Lake, London.—A communication from J. L. Lay.—*3rd November*, 1881.
4833. Locks, H. J. Haddan, London.—A communica- from O. Flagstad.—*4th November*, 1881.
4848. Locks, &c., H. Gibbons and A. Anthony, Hungerford.—*5th November*, 1881.
4850. Carbons, C. J. Allport, London, and R. Punshon, Brighton.—*5th November*, 1881.
4855. Electric Lamps, J. B. Rogers, London.—*5th November*, 1881.
4863. Bracelets, H. Allsop, Birmingham.—*7th November*, 1881.
5870. Folding Beds, H. Gardner, London.—A com. from D. C. Otis and C. G. Clark.—*7th November*, 1881.
4880. Portable Forges, G. H. Pym, Nottingham.—*8th November*, 1881.
4898. Balanced Slide Valve, A. M. Clark, London.—A com. from W. B. Turman.—*8th November*, 1881.
4999. Sewing Machines, W. Morgan-Brown, London.—A com. from N. Wheeler.—*15th November*, 1881.
5018. Gas Cooking, W. T. Sugg, London.—*16th November*, 1881.
5172. Water-closets, C. Pieper, Berlin.—A com. from R. Henneberg & A. Herzberg.—*26th November*, 1881.
5391. Cesspools, W. R. Lake, London.—A communication from L. Mouras.—*9th December*, 1881.
5497. Carrying Boxes, C. A. Carus-Wilson, London.—*15th December*, 1881.
49. Measuring Electricity, J. Hopkinson, London.—*4th January*, 1882.
70. Fitting Seats of Ships, E. S. Copeman, Downham Market.—*6th January*, 1882.
89. Lockwasher, T. H. Drew, Walsall.—*7th January*, 1882.
165. Valves for Pumps, P. Reid, Glasgow.—*12th January*, 1882.

498. Cutting Oval Holes, A. Muir, Manchester.—*1st February*, 1882.
547. Illumination Lamp, J. Pain and W. H. Gritton, jun., London.—*4th February*, 1882.
575. Storing Water, H. R. Lipscombe, London.—*6th February*, 1882.
608. Tricycles, J. Beeston, Lymington.—*8th February*, 1882.
509. Crimping Metal, W. W. Greener, Birmingham. —*8th February*, 1882.
656. Cut-off Apparatus, A. Brossard, Swansea.—*10th February*, 1882.
721. Humane Trap, W. Burgess, Malvern Wells.—*14th February*, 1882.
733. Spinning Machinery, C. H. Maxsted, Galgate.—*15th February*, 1882.
735. Sectional Warping Machines, R. Hall and J. Walmsley, Bury.—*15th February*, 1882.
781. Indicating Door Fastenings, A. Ashwell, West Dulwich.—*17th February*, 1882.
791. Exhibiting Buttons, W. Willeringhaus, London. —*18th February*. 1882.
981. Protecting Seats from Damp, &c., C. P. Sharpley, London.—*1st March*, 1882.

Patents Sealed.

(*List of Patent Letters which passed the Great Seal on the 3rd March*, 1882.)

3848. Steam Generators, J. Blake, Manchester.—*5th September*, 1881.
3852. Heels for Boots, &c., F. Cutlan, Cardiff.—*5th September*, 1881.
3854. Clouded, &c., Yarn, B. Norton and C. Turner, Nortonthorpe.—*5th September*, 1881.
3866. Fire-escape Apparatus, W. R. Lake, London.—*6th September* 1881.
3878. Steam Engines, C. Bedford, Birstall.—*7th September*, 1881.
3882. Products from the Distillation of Small-Wood, R. Haldane and J. Telfer, Glasgow.—*7th September*, 1881.
3886. Hollow Moulded Forms, E. Hoskins and C. Harvey, Birmingham.—*8th September*, 1881.
3888. Bicycles, H. Haes, Wednesbury.—*8th September*, 1881.
3889. Safety Valves, T. Davies, Sheffield.—*8th September*, 1881.
3890. Electric Lamps, D. G. Fitzgerald, Brixton.—*8th September*, 1881.
3892. Ornamenting Oil-cloth, J. H. Allin, Edgware-road, London.—*8th September*, 1881.
3893. Electric Lighting, W. R. Lake, London.—*8th September*, 1881.
3902. Packing Chloride of Lime, J. C. Steele, Glasgow.—*8th September*, 1881.
3920. Rotary Engines, R. Hodson, London.—*9th September*, 1881.
3923. Explosive Compound, W. R. Lake, London.—*9th September*, 1881.
3929. Multiplex Teleradiophone, E. J. P. Mercadier, Paris.—*10th September*, 1881.
3954. Couplings, A. Thompson, Southampton.—*13th September*, 1881.
3962. Open Fabrics, T. Coltman, Leicester.—*14th September*, 1881.
3969. Steam Steering Engines, H. Muir and J. Caldwell, Glasgow.—*15th September*, 1881.
3992. Beetling Machines, C. Edmeston, Salford, and S. Smith, Manchester.—*16th September*, 1881.
4010. Cooking Stove, J. Imray, London.—*17th September*, 1881.
4052. Electrical Alarm Apparatus, H. H. Lake, London.—*20th September*, 1881.
4262. Trans-shipping Salt, R. Verdin, Northwich.— —*1st October*, 1881.
4478. Electric Lamps, R. Harrison, Newcastle-upon-Tyne.—*14th October*, 1881.
4608. Gas Engines, W. Watson, Leeds.—*21st October*, 1881.
4662. Heating Baths, E. P. Alexander, London.—*25th October*, 1881.
4663. Burners, E. P. Alexander, London.—*25th October*, 1881.
4675. Grinding Mills, A. J. Boult, London.—*25th October*, 1881.
4756. Drawing-off Liquids, S. Pitt, Sutton.—*31st October*, 1881.
4761. Production of Spirits, P. Jensen, London.— —*31st October*, 1881.
4953. Ventilator, H. W. Yates, Brighton. — *12th November*, 1881.
5154. Stoppers for Bottles, H. Barratt, London.—*25th November*, 1881.
5369. Car Trucks, J. N. Smith, New York, U.S.—*8th December*, 1881.
5431. Telephones, A. W. Rose, London.—*12th December*, 1881.
5436. Machine Guns, J. G. Accles, London.—*13th December*, 1881.
5438. Spindles, &c., T. Watson, Paisley.—*13th December*, 1881.
5442. Rowlocks, E. C. Martin, Ipswich.—*13th December*, 1881.
5478. Hand Stamps, E. M. Richford, London.—*14th December*, 1881.
5480. Embroidering Apparatus, W. R. Lake, London. —*14th December*, 1881.
5637. Controlling the Action of Marine Engines, R. J. Smith, Sunderland.—*23rd December*, 1881.
5665. Electric Light, S. A. Varley, Hatfield.—*24th December*, 1881.
24. Removing Flocculent Matter from Spent Acids, W. R. Lake, London.—*3rd January*, 1882.
136. Gas, J. A. Slater and M. M. Brophy, London.—*10th January*, 1882.

(*List of Letters Patent which passed the Great Seal on the 7th March*, 1882.)

2991. Hat-shaping Machine, J. R. Kelsey, Bristol.—*7th July*, 1881.
3559. Electric Lighting, C. W. Harrison, London.—*16th August*, 1881.
3887. Fountain Pen-holders, D. H. Sparling, Oldham.—*8th September*, 1881.
3891. Steam Winches, T Archer, jun., Dunston.—*8th September*, 1881.
3904. Bone Boiling, G. W. von Nawrocki, Berlin.—*8th September*, 1881.
3908. Coupling Railway Vehicles, B. Askew, Edinburgh.—*9th September*, 1881.
3912. Railways, &c., F. Devooght, Antwerp. —*9th September*, 1881.
3915. Violins, E. Edwards, London.—*9th September*, 1881.
3922. Umbrellas, &c., A. M. Clark, London.—*9th September*, 1881.
3927. Sugar, J. Duncan and B. E. R. Newlands, London.—*10th September*, 1881.
3930. Purification of Albumen, W. P. Thompson, London.—*10th September*, 1881.
3933. Flower-pots, A. Booty, Harrogate. — *10th September*, 1881.
3935. Spinning, I. Buckley and E. Crossley, Dukinfield —*12th September*, 1881.
3963. Checking Issue of Tickets, W. M. Riddell and H. Wickens, London.—*14th September*, 1881.
3986. Watch Protectors, A. H. Turner, London.—*15th September*, 1881.
3990. Fire-extinguishing Apparatus, A. M. Clark, London.—*15th September*, 1881.
4029. Telephone Transmitter, S. Pitt, Sutton.—*19th September*, 1881.
4065. Building Walls, W. White, Abergavenny. —*21st September*, 1881.
4158. Rotary Blowers, F. M. Roots, London.—*27th September*, 1881.
4210. Boats, &c., S. Pitt, Sutton.—*29th September*, 1881.
4216. Protecting Buildings from Fire, E. Leonard, London.—*29th September*, 1881.
4285. Letterpress Printing, W. Conquest, London. —*3rd October*, 1881.
4548. Velocipedes, S. Hall, London.—*18th October*, 1881.
4620. Cistern Valves, H. T. Dawson, Chiswick.—*21st October*, 1881.
4690. Coupling Buffers, G. Turton, London.—*26th October*, 1881.
4728. Tunnelling, T. R. Crampton, London.—*28th October*, 1881.
4872. Actions of Small-arms, H. A. Silver and W. Fletcher, London.—*7th November*, 1881.
5104. Electric Batteries, A. M. Clark, London.—*22nd November*, 1881.
5215. Horse Nails, J. A. Huggett, London.—*29th November*, 1881.
5343. Kilting, &c., G. Browning, Glasgow—*7th December*, 1881.
5353. Divining Rods, C. F. Varley, Bexley Heath.—*7th December*, 1881.
5376. Frames for Music, J. F. Walters and J. H. Rosoman, London.—*8th December*, 1881.
5482. Blasting Cartridges, R. M. Gardiner, London, and G. Trench, Eaversham.—*14th December*, 1881.
5499. Measuring Electric Currents, J. W. Swan, Newcastle-upon-Tyne.—*16th December*, 1881.
5552. Heels for Boots, &c., A. M. Clark, London.—*19th December*, 1881.
5561. Increasing the Heating of Furnaces, E. Fair, San Francisco, U.S.—*19th December*, 1881.

List of Specifications published during the week ending March 4th, 1882.

2205,* 4d.; 350, 2d.; 3092, 6d.; 3119, 6d.; 3127, 6d.; 3128, 8d.; 3134, 6d.; 3136, 6d.; 3139, 8d.; 3140, 8d.; 3147, 6d.; 3148, 6d.; 3155, 6d.; 3158, 6d.; 3159, 6d.; 3162, 8d.; 3164, 6d.; 3165, 6d.; 3166, 6d.; 3171, 6d.; 3173, 6d.; 3175, 4d.; 3180, 6d.; 3187, 6d.; 3188, 6d.; 3190, 6d.; 3191, 6d.; 3192, 6d.; 3194, 6d.; 3195, 6d.; 3199, 6d.; 3200, 6d; 3203, 6d.; 3204, 4d.; 3206, 1s.; 3207, 4d.; 3212, 6d.; 3213, 4d.; 3214, 8d.; 3215, 6d.; 3219, 4d.; 3223, 8d.; 3227, 4d.; 3228, 8d.; 3234, 6d.; 3252, 6d.; 3259, 4d.; 3292, 6d.; 3295, 8d.; 3208, 6d.; 3300, 4d.; 3315, 2d.; 3319, 2d.; 3321, 2d.; 3322, 2d.; 3325, 2d.; 3327, 2d.; 3331, 2d.; 3336, 4d.; 3338, 2d.; 3339, 2d.; 3343, 2d.; 3345, 2d.; 3348, 2d.; 3350, 2d.; 3351, 2d.; 3354, 2d.; 3355, 2d.; 3356, 2d.; 3358, 2d.; 3359, 2d.; 3361, 2d.; 3363, 2d.; 3364, 2d.; 3366, 2d.; 3872, 3d.; 3376, 4d.; 3378, 2d.; 3385, 2d.; 3387, 2d.; 3391, 2d.; 3393, 2d.; 3398, 2d.; 3399, 6d.; 3403, 2d.; 3404, 2d.; 3410, 4d.; 3553, 2d.; 4625, 6d.; 5127, 2s. 4d.; 5167, 2d.; 5221, 6d.; 5344, 2d.

*** 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.*

350. Automatically Regulating the Speed of Marine Engines, *R. J. Smith, Sunderland.*—*26th January*, 1881.—(*Not proceeded with.*) 2*d.*

This consists essentially of a pendulum or balance working from a true centre to actuate the valve of the atmospheric or steam cylinder. The pendulum is fitted to move said valve, to close or partially close the port of the atmospheric or steam cylinder when the stern of the vessel lifts, and by a reverse movement to open another port to the desired extent as the screw becomes again immersed.

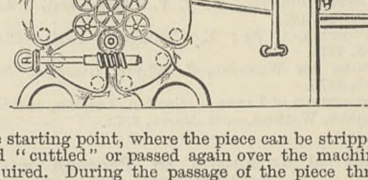
3048. Circular Combing Machines for Cotton, &c., *C. A. Barlow, Manchester.*—*12th July*, 1881.—(*A communication from P. P. Bandouin, père, Paris.*) 6*d.*

The invention is applicable to "Hubner's" combing machine, and it consists in drawing the fibre from above as usual from the comb by drawing rollers, and carrying it between endless aprons, from the upper one of which it is detached by rollers, while a scraper rests on the lower apron and detaches the fibre therefrom, such scraper extending across the apron and being fitted to a sliding bar actuated by an eccentric. The scraper is driven at a higher speed than the apron, and presses back the fibres and lays them parallel with each other obliquely to the apron. It guides the fibres into a rotating funnel mouth, from which rollers deliver it in the form of a sliver to a coiler. A cylindrical comb combs the fibre projecting from a dished wheel or turbine, the shortest fibre, and is retained by the comb being removed by a brush, from which it is taken by a doffing cylinder covered with card fillet, and from it the web of fibre is removed by an oscillating comb. Below the brush is an endless apron which conveys the fluff to a suitable receptacle.

3092. Tentering and Drying Machines, *F. Craven, Brighouse, Yorkshire.*—*15th July*, 1881. 6*d.*

This consists of a self-contained machine of circular form into which the fabric is fed from a platform on endless chains fitted with gills passing around the circumference of the machine, and at intervals in its passage around the circumference the chains with the fabric attached thereto by the gills converge towards the centre of the apparatus, passing over pulleys and back to the circumference as many times as there are divisions in the circle, and is finally brought back to

3092



the starting point, where the piece can be stripped off and "cuttled" or passed again over the machine as required. During the passage of the piece through the machine hot or cold air is drawn, by means of an exhausting fan, through the fabric, by which it is dried.

3119. Register for Scoring Games, &c., *J. Wood, Newport, Monmouth.*—*18th July*, 1881. 6*d.*

This relates to a register for scoring or checking the scoring of numbers, such register having indicator or indicators sliding in a slot or slots.

3127. Silk-dressing Machinery, *A. Greenwood, Leeds.*—*18th July*, 1881.—(*A communication from A. Schüle, Basel, Switzerland.*) 6*d.*

This relates to the application to silk dressing machinery of means for automatically gripping the books and releasing the same from pressure, while the combing action is proceeding.

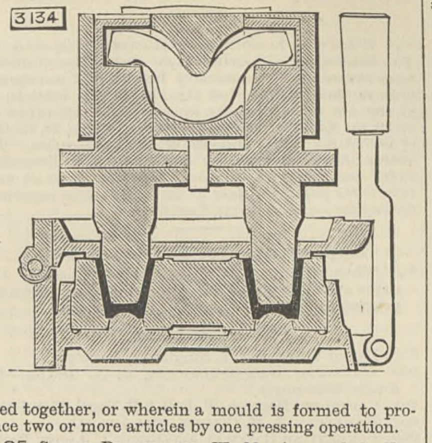
3128. Looms, *T. Singleton, Darwen, Lancaster.*—*18th July*, 1881. 8*d.*

This relates, First, to an improved arrangement and construction of brakes; Secondly, to an improved knocking-off motion; Thirdly, to improved strap, forks, regulating brackets, and joints; Fourthly, to improved spindle stud; Fifthly, to improved protecting guide for taking-up lever; Sixthly, to improved shed rod; Seventhly, to the arrangement for self-actingly regulating the tension on the warp beam; Eighthly, to improved shuttle-box. Other improvements are claimed

3134. Moulding and Pressing Glass, &c., *T. and J. Humphreys, Manchester.*—*19th July*, 1881. 6*d.*

This relates to the employment of compensating levers to transmit pressure to the charges in moulds in cases wherein two or more moulds are combined or

3134

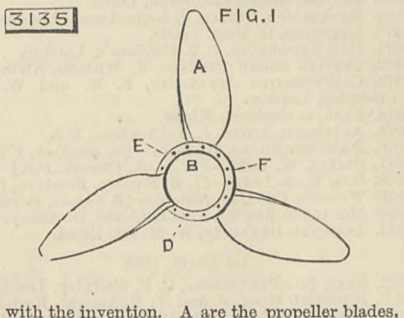


used together, or wherein a mould is formed to produce two or more articles by one pressing operation.

3135. Screw Propellers, *W. Morrison and C. Norfolk, Kingston-upon-Hull.*—*19th July*, 1881. 6*d.*

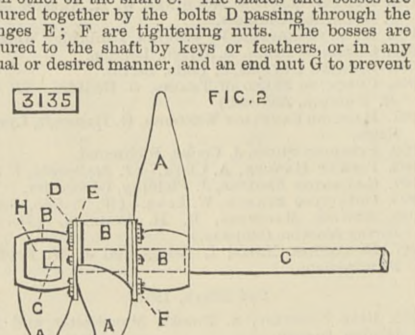
Figs. 1 and 2 are side elevations at right angles to each other of a screw propeller constructed in accord-

3135 FIG. 1



ance with the invention. A are the propeller blades, each cast with a narrow boss B and placed following each other on the shaft C. The blades and bosses are secured together by the bolts D passing through the flanges E; F are tightening nuts. The bosses are secured to the shaft by keys or feathers, or in any usual or desired manner, and an end nut G to prevent

3135 FIG. 2



longitudinal motion is provided. To avoid lengthening the propeller shaft the outermost boss overhangs the shaft, and is made with an aperture H through which the nut G is placed in position and screwed home.

3139. Lamps and Lanterns, *W. R. Lake, London.*— —*19th July*, 1881.—(*A communication from E. B. Requay, Jersey City, and F. F. Lambert, New York, U.S.*) 8*d.*

This relates to the peculiar construction, arrangement, and combination of parts whereby the flame is supplied with a uniform quantity of air without being affected by excessive drafts induced by sudden or rapid movements of the lantern, the excess of air above that required for proper combustion being removed through suitable flues, so as to cool the lamp frame and decrease the danger of explosions, and a free escape for the products of combustion being also provided through a perforated dome attached to a cap-piece, which is secured by an attachment and catch of novel construction.

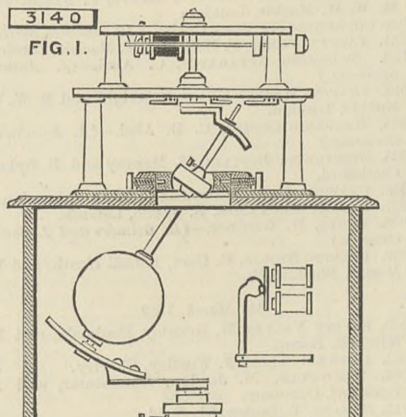
3155. Fog, Danger, or Distance Alarm Signals for Railways, &c., *A. Kelday, London.*—*20th July*, 1881. 6*d.*

This consists of an attachment to a locomotive engine of a vertical sliding rod having suitable projections for signalling by means of a bell, whistle, or shutting off steam for stopping an engine or train.

3140. Improvements in Fac-simile Telegraphs, *E. G. Brewer, London.*—*19th July*, 1881.—(*A communication from T. A. Edison, Menlo Park, N.J., and P. Keung, New York.*) 8*d.*

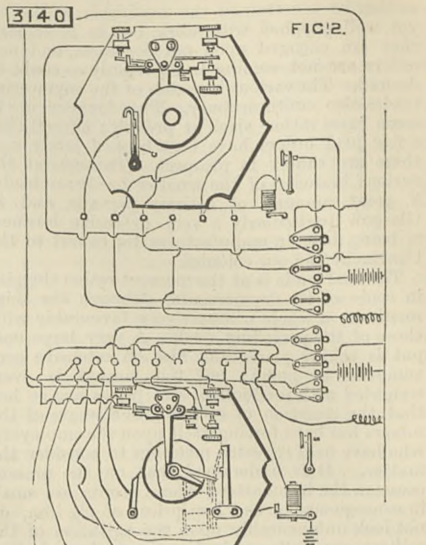
The inventors use a pencil or other instrument to mark the paper, and the message is then mounted on an insulating cylinder (of wood) for transmission.

3140 FIG. 1.



The message is received at the receiving office on chemically-prepared paper secured on a metal cylinder. The two cylinders are each mounted on the revolving spindles of the two machines at each end of the line, preferably in a vertical position, and turning through metal base plates resting on insulating supports. The spindles are revolved by electromotors. The axle of the motor armature has a crank arm on its upper end, to which is secured a slotted curved plate, in which slides an inclined rod carrying a centrifugal ball and a box at its lower end. The rod passes up into the collar of a universal rocking joint located centrally below the cylinder spindle. From this joint the rod projects upwards to a small box held by a curved slotted crank arm on lower end of cylinder spindle. Click springs are struck by a pin on the rod when the motor runs too fast or too slow. Both transmitter and receiver are synchronous. Fig. 1 gives a vertical

3140 FIG. 2.

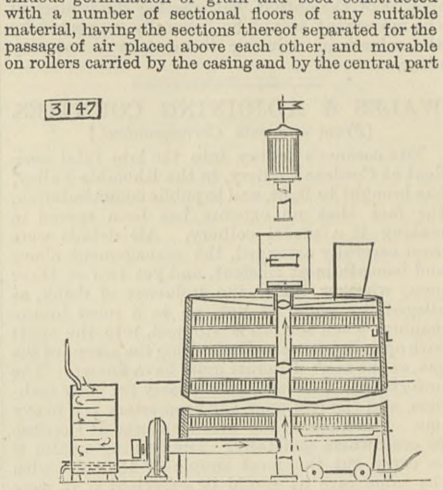


section through the motor case, showing motor in elevation; Fig. 2 is a diagram of the circuits.

3147. Germination of Grain and Seed for Malting Purposes, *A. J. and A. Q. Reynolds, Chicago, U.S.*—*19th July*, 1881. 6*d.*

This consists, First, in an apparatus for the continuous germination of grain and seed constructed with a number of sectional floors of any suitable material, having the sections thereof separated for the passage of air placed above each other, and movable on rollers carried by the casing and by the central part

3147

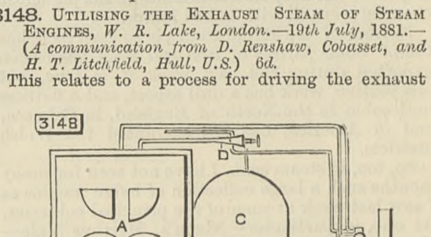


of the apparatus; Secondly, in the peculiar construction of the malting floor, composed of plates preferably of galvanised or enamelled sheet iron, forming sections of a circle pivotted between two concentric rings or hoops, and connected together in series at their lower parts by means of projections and bars or rods, so that two or more of such sectional plates can be discharged at a time by turning one of them. Other improvements are described.

3148. Utilising the Exhaust Steam of Steam Engines, *W. R. Lake, London.*—*19th July*, 1881.—(*A communication from D. Renshaw, Cobasset, and H. T. Litchfield, Hull, U.S.*) 6*d.*

This relates to a process for driving the exhaust

3148



steam back to the boiler A, consisting in pumping steam from a boiler into a superheater C, there superheating the said steam, and then using it to drive exhaust steam back to the boiler through an injecting device D.

3158. Weighing Cranes, *L. A. Groth, London.*—*20th July*, 1881.—(*A communication from A. Verdière, Paris.*) 6*d.*

The essential feature of this invention consists in the arrangement whereby the weight of the jib and the load raised by it is carried by a lever, through the medium of which a proportional part of the weight of the jib and load is transmitted to the steelyard weighing apparatus according to the leverage of the various levers intervening between the lower end of the jib and the steelyard of the weighing apparatus, instead of the entire load to be weighed exerting its effect upon the table or platform of the weighing apparatus.

3159. Safety Shaving Apparatus, *L. A. Groth, London.*—*20th July*, 1881.—(*A communication from C. T. Adams, Chemnitz, Saxony.*) 6*d.*

This relates to improvements in shaving apparatus, in which the shaving blade is connected to a guard or protector plate by screws or otherwise.

3162. Machinery for Making Satchel Bottom Paper Bags, *J. H. Johnson, London.*—*20th July*, 1881.—(*A communication from W. C. Cross, Boston, U.S.*) 8*d.*

This relates to improvements in machinery or apparatus for making the folds requisite to form satchel bottom paper bags while the paper blank is in motion, and in such manner as not to interfere with the continuous forward movement of said blank through the machine. This result is obtained by the employment of folding cylinders or devices, which rotate continuously in one direction.

3164. Machine Guns, &c., *T. Nordenfelt, London.*—*20th July*, 1881. 6*d.*

This relates to improvements on patent No. 4523, dated 4th November, 1880. In this mechanism the block will still be in two parts, an upper and lower. The lower has a vertical movement only, whilst the upper has a vertical and also a slight horizontal movement. The upper block is in the form of a truncated wedge, and carries the firing pins, hammer, and main spring. The extractor is pivotted to breech end of barrel, but is at the lower instead of the upper part, and is acted upon by the descending break blocks. Another improvement consists in making the gun self-feeding.

3165. Machinery for Drilling or Boring Blocks of Wood in the Manufacture of Fire-lighters, *J. F. Wiles, Old Charlton.*—*20th July*, 1881. 6*d.*

This relates to the arrangement of apparatus employed in drilling or boring blocks of wood in the manufacture of fire-lighters, consisting of square blocks of wood, through which holes are bored in various directions.

3171. MANUFACTURING ILLUMINATING GAS, *W. E. Thompson, Liverpool.—21st July, 1881.—(A communication from H. T. Smith, Sydney, and H. U. Alcock, Melbourne.)* 6*d*.

This invention consists in the peculiar construction and arrangement of an apparatus for manufacturing illuminating gas from gasoline or other light hydrocarbon fluids. The principal parts are a gas generator, a holder, an air pump, a seal, and a valve chamber.

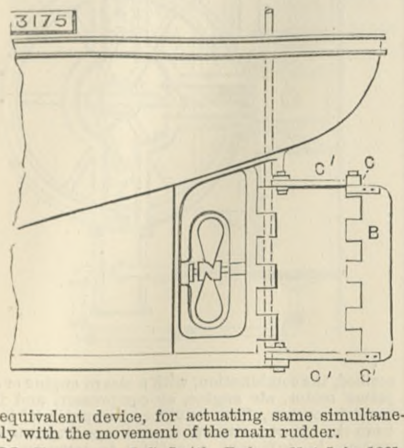
3173. RAISING BEER, &c., *P. J. Catterall and E. Birch, Manchester.—21st July, 1881.* 6*d*.

This relates to raising beer by the pressure of water upon a diaphragm, which is raised and allows the beer to flow through a pipe.

3175. STEERING AND PROPELLING VESSELS, *A. Figge, G. A. Köttgen, and H. Wedekind, London.—21st July, 1881.* 4*d*.

This consists in the hinged outer rudder pin B, together with the connecting rod C and fixed arms C^1,

3175



or equivalent device, for actuating same simultaneously with the movement of the main rudder.

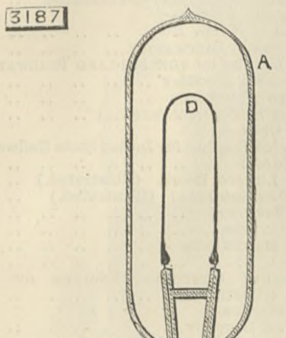
3180. TRICYCLES, *J. G. Smith, Eccles.—21st July, 1881.* 6*d*.

This relates to the means of propelling tricycles, and also to steering or guiding them.

3187. IMPROVEMENTS IN ELECTRIC LAMPS, *W. R. Lake, London.—(A communication from J. V. Nichols, Brooklyn, U.S.)—21st July, 1881.* 6*d*.

Instead of the ordinary globe with neck to carry the carbon filament, the inventor imbeds his wires in a disc of cement, composed of potash, silica, oxide of iron, and copper, which disc is sealed to the globe by

3187



means of the blow-pipe. The figure shows one form adopted. C C are the conducting wires, coated some way up with the cement; B is a plug of cement, D is the carbon filament, and A the globe.

3188. MALLEABLE BRONZE, &c., *H. H. Lake, London. —21st July, 1881.—(A communication from L. Létrange, Paris.)* 6*d*.

This consists, First, in the process of manufacturing the alloy of copper and tin, commonly known as bronze, and rendering it malleable and homogeneous by the introduction of manganese or phosphorus, or both combined; Secondly, in the manufacture of articles of such malleable bronze, by stamping, embossing, chasing, or similar means.

3190. FITTINGS FOR ELECTRIC LAMPS, *R. R. Hughes, London.—21st July, 1881.* 6*d*.

This invention relates to a number of minor arrangements in order that ordinary gas-fittings may be utilised for electric lamps.

3191. MANUFACTURE OF RUBBER-FACED METAL TYPE, *G. K. Cooke, London.—22nd July, 1881.* 6*d*.

This consists in making rubber-faced type, of the employment of type bodies, and the taking of a mould or cast therefrom, and the subsequent vulcanising upon the type face of said type bodies an elastic film or cushion which will exactly conform in register to, and will be supported by the metal configuration.

3192. ROLLING LEATHER, &c., *E. Wilson, Exeter.—22nd July, 1881.* 6*d*.

This consists, First, in driving the carriage direct off the pulley shaft without employing any countershaft, simply by winding a band of steel or other suitable material directly upon the shaft, or a small pulley keyed thereon; Secondly, the improved friction pulleys for driving and reversing the motion of the rollers, which may be applied also to machines for other purposes.

3194. SCISSORS OR HAND SHEARS, *G. G. M. Hardingham, London.—22nd July, 1881.* 6*d*.

This consists in forming or mounting a pair of scissors or shear blades on a finger sheath or its equivalent.

3195. SLEEPERS FOR RAILWAYS AND TRAMWAYS, &c., *H. Lindsay-Bucknall, Westminster.—22nd July, 1881.* 6*d*.

The drawings show a section and plan of a glass sleeper, constructed with lewis holes for the reception of screw bolts. According to one arrangement, the

3195 FIG. 1.

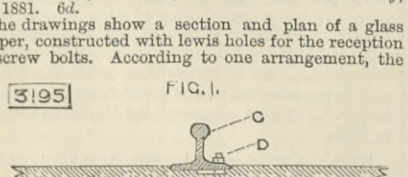
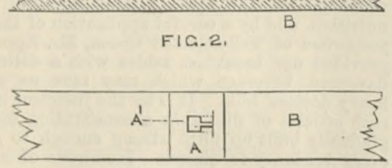


FIG. 2.



dovetail head of the bolt is dropped into the enlarged part A of the hole in the sleeper B, and is then slid into the undercut part A^1, after which the rail C is placed on, with the bolt D passing through a hole in its flange, and the nut is screwed on.

3199. COMBINATION CARRIAGE FOR COMMON ROADS, *J. N. Rowe, Rockland, U.S.—22nd July, 1881.* 6*d*.

This consists of two or more bicycles (or other suitable velocipedes) connected to a suitably constructed skeleton carriage.

3200. DRIVING MECHANISM FOR TRICYCLES, &c., *A. Burdess, Coventry.—22nd July, 1881.* 6*d*.

This consists of two toothed wheels, one of which is mounted upon the axis of the driving wheel of the machine, and the other upon the crank shaft thereof. Such wheels gear into each other, and are actuated by means of the treadles placed on the crank shaft. Both the treadles and crank shaft are so arranged that the latter is worked backwards instead of forwards as in the ordinary way; a backward motion is thus given by the crank shaft to the lower wheel, which gearing with the upper wheel imparts a contrary or forward motion thereto and so carries the vehicle forward.

3203. SPRINGS FOR PISTONS, &c., *W. Buckley, Sheffield.—22nd July, 1881.* 6*d*.

This consists in the manufacture of compound conical and helical, double conical, or single conical springs, and the use and application of such peculiarly formed springs as compensating packing for pistons, pumps, steam hammers, stuffing boxes, and other analogous purposes.

3204. LAWN TENNIS BATS, *C. W. Simons, Saintbury, Gloucestershire.—22nd July, 1881.* 4*d*.

This relates to improvements in the handle, so as to make it portable by folding or dividing it from the frame holding the net or gut.

3206. SHEAF-BINDING MECHANISM FOR HARVESTING MACHINES, *H. H. Lake, London.—22nd July, 1881. —(A communication from D. M. Osborne, Auburn, U.S.)* 1*s*.

This relates, First, to the knotting devices; Secondly, to pivotted switch for opening the jaws of the cord holder; Thirdly, a pressure plate on the cord finger with a bail on the cord carrier for holding the cord when released from the jaws of cord holder; Fourthly, to grain elevating aprons, slotted grain receiving table, horizontally oscillating arm below said table carrying hollow vertically rotating knotter and hook, a cord holder controlled by a fixed cam, and a vertically oscillating swinging cord-carrying arm.

3207. MANUFACTURE OF ROUND WROUGHT CHENILLE, *C. Forechi, Paris.—22nd July, 1881.—(Not proceeded with.)* 4*d*.

This relates to the general construction of the machinery for manufacture of round wrought chenille.

3212. VELOCIPEDES, *G. Singer, Coventry.—22nd July, 1881.* 6*d*.

This relates, First, to the contracting or reducing the width and length of tricycles to enable them to pass through narrow spaces when not in use; Secondly, to an improved form of brake connection applicable to tricycles; Thirdly, to an improved method of attaching the back wheel of bicycles and the smaller wheel of tricyles to prevent undue shock to the wheels.

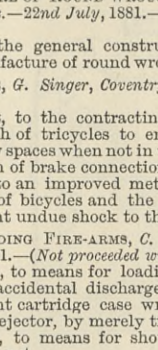
3213. BREECH-LOADING FIRE-ARMS, *C. Garbe, Berlin. —22nd July, 1881.—(Not proceeded with.)* 2*d*.

This relates, First, to means for loading; Secondly, for safety against accidental discharge; Thirdly, to discharging the spent cartridge case without the aid of an extractor or ejector, by merely tilting the gun sideways; Fourthly, to means for showing whether the gun is loaded or not.

3214. IMPROVEMENTS IN ELECTRIC LAMPS, *A. M. Clark, London.—22nd July, 1881.—(A communication from L. J. Bouteilloux and N. Laing, Paris.)* 8*d*.

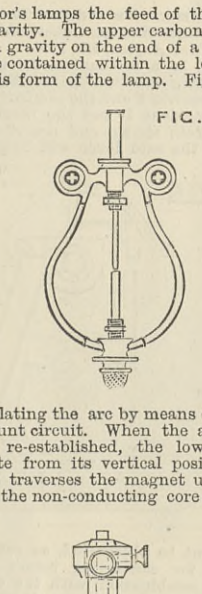
In the inventor's lamps the feed of the carbons is regulated by gravity. The upper carbon is solid and rests by its own gravity on the end of a central non-conducting core contained within the lower carbon. Fig. 1 shows this form of the lamp. Fig. 2 shows a

3214 FIG. 1.



method of regulating the arc by means of an electro-magnet and shunt circuit. When the arc has to be established or re-established, the lower carbon is caused to deviate from its vertical position when a strong current traverses the magnet until it is no longer opposite the non-conducting core of the upper

3214 FIG. 2

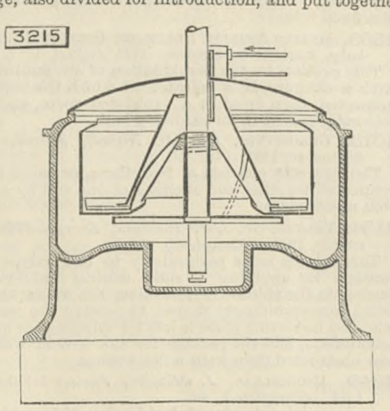


carbon, but comes opposite the carbon envelope, the arc being instantaneously established, the current in the magnet then diminishes and the lower carbon resumes its vertical position. The lower carbon is kept from pressing too heavily against the non-conducting core by the stop P and apparatus connected. The lower carbon is pushed upwards by a counter-weight attached to the cord shown on the left-hand side of the figure.

3215. CENTRIFUGAL MACHINES FOR TREATMENT OR MANUFACTURE OF SUGAR, &c., *J. H. Johnson, London.—22nd July, 1881.—(A communication from La Société dite Raffinerie de St. Ouen, Paris.)* 6*d*.

This consists in the combination with the revolving basket of any ordinary or existing centrifugal machine of a guard screen or partition composed of two or more distinct parts, which are connected together, after being introduced into the machine in such a manner as to form virtually one piece (provided or not with Mahoudeau's or other helical deflectors), and means for admitting steam into the space enclosed thereby for the purpose of adapting the said machines to be employed in what is known as "Weinrich's system" of clarifying, the steam being introduced into the space enclosed by this screen, thence passing into the centrifugal machine, which is closed for the purpose by means of a suitable lid or cover, the said guard screen or partition being provided at its lower part with a flange, also divided for introduction, and put together

3215



when in the machine, to form a false bottom, provided or not with deflecting helices or guides.

3219. PULLEY BLOCKS, *R. Priest, Cradley Heath.—23rd July, 1881.* 4*d*.

This consists in the combination with pulley blocks of freely turning wheels, runners, or rollers, correspondingly turned or conformed and spaced apart to the form of the chain of the pulley block, and carried or supported with the required freedom of movement.

3223. FOLDING OR CAMP FURNITURE, *T. Barnby, Birmingham.—23rd July, 1881.* 8*d*.

This relates to the construction of a combined chair, couch, or bed upon the folding principle.

3227. CHANGEABLE LASTS, *J. Fieldhouse, Keighley.—23rd July, 1881.* 4*d*.

This consists in the construction of a base last having a projecting stem with a tenon formed thereon, on which may be fitted changeable lasts; the base last, by inverting the same, may be used as a last, the changeable last thus becoming the base.

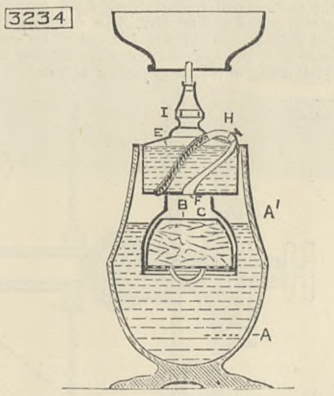
3228. IMPROVEMENTS IN APPARATUS FOR CONTROLLING TELEPHONIC COMMUNICATIONS, *J. Imray, London.—23rd July, 1881.—(A communication from L. A. Brasseur and O. Dejaer, Brussels.)* 8*d*.

The improvements consist in the use of a distributing tablet, as it is called by the inventors, which has a number of keyholes, one for each subscriber. When a subscriber A wants to communicate with another B, a key is placed in A's hole in the tablet, and when turned, disconnects the signal. The attendant at the commutator then does the same, and communicates with A, and subsequently informs the attendant at the tablet that he wishes to communicate with B, the latter puts another key into the hole belonging to B, and by turning it puts him into communication with A. The key consists of a shank on which are insulated pieces of metal, which on the key being turned one quarter round bears against lateral springs fixed on an ebonite casing of the key; these springs communicate by insulated wires with the line, return, and battery. The key cannot be withdrawn without turning it back, and this act connects A and B to central office. By means of interrupters, any attempt to listen to the conversation of A and B by connecting up to their line breaks up the connection between them, and by means of a current from the central station informs them of the interruption. Induction is avoided with instruments having two wires by combining with them one inducing and two induced coils.

3234. APPARATUS FOR PRODUCING ILLUMINATING GAS, *S. Pitt, Sutton.—23rd July, 1881.—(A communication from A. Berland, St. Petersburg.)* 6*d*.

The drawing shows the apparatus employed for domestic use. A is a reservoir containing a mixture of 1 part of commercial sulphuric acid with 5 parts of water. The vessel is filled up to a line A^1. A bell B dips into this liquid, and it contains a receiver of the

3234



same form C which has a strainer bottom, and is charged with pure zinc or iron in small pieces. The neck of the bell is soldered to the bottom of the box E and the bottom is pierced with an opening at F. The hole is fitted with a tube which passes through the cover of the box at H. The cover of the box has at the centre an open receiver I, by which the box E is charged with petroleum spirit.

3252. SHIPS' PENDULUMS OR CLINOMETERS, *J. Short, Southwark.—26th July, 1881.* 6*d*.

This relates to the construction of a ship's pendulum or clinometer, or pendulum alarm, by the use of which the amount of rolling or lurching of ships at sea may be accurately known either by observation of the instrument or by a signal from the electric alarm bell attached to the instrument.

3259. FUNNELS, *C. D. Abel, London.—26th July, 1881. —(A communication from O. Petzold, Sebnitz, Saxony.)* 4*d*.

This consists in constructing funnels whose discharge pipe can be closed by a valve attached to a tube that passes through the said valve, and extends up beyond the level of the liquid, the said tube being raised and lowered, so as to close or open the valve by means of a lever attached to the funnel.

3295. SPINNING YARNS FROM FLAX, &c., *T. Lawson, Leeds.—27th July, 1881.* 8*d*.

This consists in placing the spindles and flyers at such an angle with respect to the drawing rollers and line of gills, that the twist shall be free to run up to the nip or bite of the rollers, and the doffing of the bobbins will be facilitated.

3298. APPARATUS OR MECHANISM TO BE APPLIED TO A SEWING MACHINE TO ADAPT THE SAME FOR STITCHING OR SEWING BUTTON-HOLES, *D. Mills, Philadelphia.—28th July, 1881.* 6*d*.

This relates to apparatus designed to be attached to a sewing machine for sewing or stitching button-holes of that kind or class which are furnished and strengthened at each end by a bar formed of a series of comparatively long stitches extending crosswise or transversely to the direction of the length of the button-hole. It is more especially designed for attachment to machines provided with a vertically reciprocating needle and a reciprocating shuttle, and in which the needle does not vary its position in working relatively to the shuttle.

3292. DOOR FASTENINGS, *A. Schlanders.—27th July, 1881.—(A communication from J. P. Black, Nelson, New Zealand.)* 6*d*.

This consists in a door fastening or apparatus of the application thereto of spring bolts, operated from one and the same point by tooth wheel gear and levers.

3300. REPEATING SMALL-ARM OR GUN, *F. J. Cheesbrough, Liverpool.—28th July, 1881.—(A communication from J. Hemetz, Vienna.)—(Void.)* 4*d*.

This consists of certain breech, hammer, and lock mechanism, whereby the consecutive or repetition firing is effected.

3315. SUBMERGED PROPELLERS FOR NAVIGABLE VESSELS, *P. Amati, Nice.—30th July, 1881.—(Not proceeded with.)* 2*d*.

The vessels are provided with two shafts athwartship. These shafts are placed sufficiently low down in the hull to enable the propellers to be entirely below the load water line, and therefore at a greater distance therefrom than half the diameter of the propellers.

3319. MATCH-BOXES, &c., *H. Woodward, Birmingham. —30th July, 1881.—(Not proceeded with.)* 2*d*.

This consists in constructing an improved box or receptacle for matches in which the act of withdrawing a match causes its ignition.

3321. LOOM PICKERS, *J. Holding and E. R. Dutton, Manchester.—30th July, 1881.—(Not proceeded with.)* 2*d*.

The pickers are made wholly or principally of wood.

3322. APPARATUS FOR CONTROLLING THE SUPPLY OF STEAM TO PARTS OF STEAM ENGINES, *S. Hallam, Manchester.—30th July, 1881.—(Void.)* 2*d*.

This relates to the valves and valve gear of steam engines, and has for its object to obtain a variable cut-off with a prompt action of the valves and a free exhaust.

3325. MOTIVE POWER ENGINE, *H. Boyd, Weston-super-Mare.—30th July, 1881.—(Not proceeded with.)* 2*d*.

The engine is worked in a closed circuit between two reservoirs with the cylinder the same as in a steam engine, but with lip valves, not slide valves, and which cylinder is supplied with two reservoirs to equalise the work.

3327. ELECTRIC APPARATUS FOR AUTOMATICALLY GIVING ALARMS, *J. L. Rastrick, London.—30th July, 1881.—(Not proceeded with.)* 2*d*.

The expansion of matter was utilised to cause an electric contact, and hence to give an alarm.

3331. PADS FOR INSERTION UNDER THE LININGS OF HATS, &c., *J. Hobbs, Brighton.—2nd August, 1881. —(Not proceeded with.)* 2*d*.

In making the grease-proof pads, a soft porous material is used, such as blotting paper, cloth, or felt. and to one side thereof is attached a backing of tin foil or other grease-proof material.

3336. MANUFACTURE OF METALS AND METALLIC ALLOYS BY THE WET PROCESS, *W. L. Wise, Westminster.—2nd August, 1881.—(A communication from L. Guetat and T. Chavanne, Paris.)* 4*d*.

This consists in the production or manufacture of metallic alloys (including chromium iron, tungsten iron, phosphide of copper, &c.) in definite proportions by the reduction of a salt containing the required metallic or iron metallic elements, the said salt being obtained by double decomposition of two or more salts or oxides.

3338. ROLLING SCYTHES, *C. D. Abel, London.—2nd August, 1881.—(A communication from L. Werndl, Steyr, Austria.)—(Not proceeded with.)* 2*d*.

According to this invention lathes, such as those for scythes, reaping books, and the like, as also curved bars or plates, are rolled directly into the required curved form.

3339. LOCKS AND BOLTS, *L. Bensel, Iserlohn, Germany.—2nd August, 1881.—(Not proceeded with.)* 2*d*.

This consists in so arranging a sliding bolt or other opening and closing part of a lock in combination with a blade spring, that when the bolt or other part is in the closed position a projection on it enters a hole in the spring so as to be locked in position thereby, while in order to release the bolt the spring is depressed by means of a key.

3343. VELOCIPEDES, *J. M. Tyrer, Crosby.—2nd August, 1881.—(Not proceeded with.)* 2*d*.

This relates to the construction of bicycles (or velocipedes similarly mounted and driven), so that driving wheels of larger diameter than usual are admissible.

3345. MANUFACTURE OF SHAWLS, *R. Millar, Paisley. —2nd August, 1881.—(Not proceeded with.)* 2*d*.

This consists in weaving the shawl, fabric, or web in a loom with two distinct warps, one of cotton, as usual, and the other of silk, each warped and mounted on different beams, and respectively drawn or passed through alternate splits of the reed, so as to bind and show with the pattern weft only on sides of the fabric, while the cotton warp might as usual be dyed of an uniform colour throughout to harmonise or agree with the prevailing colour of the ground and pattern of the shawl.

3348. MACHINERY FOR PRESSING AND FINISHING TEXTILE FABRICS, &c., *L. Smethurst, Stainland, Yorkshire.—2nd August, 1881.—(Not proceeded with.)* 2*d*.

This consists in winding the fabric and a continuous sheet of paper around a roller. The fabric and paper travel together over one or more hollow rollers heated by steam or other means, and the paper and fabric are wound together around a roller, another heated hollow roller resting upon the same so as to press thereon with considerable pressure.

3350. PRESERVING MEAT, &c., *C. Reina and G. Betti, Milan.—2nd August, 1881.—(Not proceeded with.)* 2*d*.

This relates to a method of preserving meat or other articles by means of heated dry air.

3351. HANGING OR SUPPORTING WINDOW SASHES, &c., *E. J. Hill, Westminster.—2nd August, 1881.—(Not proceeded with.)* 2*d*.

This relates to means whereby the windows and blinds of carriages, &c., may be easily raised or lowered, and retained at any height by employing a gripping lever.

3354. SASH OR WINDOW FASTENINGS, *A. B. Carpenter, Clapton Park.—3rd August, 1881.—(Not proceeded with.)* 2*d*.

On the plate secured to one sash is mounted the ordinary locking or latch lever in the usual manner. On the under side of the plate to which the catch or locking piece is fixed is mounted a lever, one end of which forms a bolt or projection, which passes up through the plate and is held in a raised position by a spring. Secured to the under side of the catch plate there is another lever bearing on the under side of the opposite end of the first-mentioned lever. The opposite end of the last-mentioned lever carries a projection, which also passes up through the catch plate.

3355. WORKING OF GATES ON CROSSINGS OF RAILWAYS, &c., *T. Wright and W. Stubbs, Stafford.—3rd August, 1881.—(Not proceeded with.)* 2*d*.

This consists in so arranging the gates at level crossings of roads and railways that the gates of the one road rise as those of the other fall.

3356. RAILWAY CARRIAGE ALARM SIGNALS, *W. Petty, Kingsland.—3rd August, 1881.—(Not proceeded with.)* 2*d*.

This consists of a gong or other sounding instrument with its requisite working accessories fixed to or encased within the upper part of the partition by which railway carriages are usually divided into compartments; cords or pulls are placed as to be easily reached by passengers in any part of the compartment from their seats being attached to two sliding doors, which, on the cords or pulls being pulled, open from each other right and left and unmask apertures in the partition, through which persons in the next compartment may look, and thereupon, if necessary, pull the signal cord usually fixed along the train outside the carriages, or make any other signal.

3358. Manufacture of Metallic Palate Plates, &c., *H. J. Haddan, Kensington.—3rd August*, 1881.—*(A communication from R. Telschow, Berlin.)—(Not proceeded with.)* 2d.

This consists in the manufacture of metal palate plates by hydraulic pressure.

3359. Gasaliers, *T. Kennedy, Kilmarnock.—3rd August*, 1881.—*(A communication from G. Poirier and A. Chatouillot, Paris.)—(Not proceeded with.)* 2d.

This relates to a means for raising and lowering the gasaliers and dispensing with counterweights.

3361. Instrument for Opening Bottles with Internal Stoppers, *A. Lofthouse, Fartown, and R. King, Linthwaite, Yorkshire.—3rd August*, 1881.—*(Not proceeded with.)* 2d.

A guard fits around the neck, and attached to it is a tube, through which works a rod or plunger, which is pushed down by hand and returned to its place by a spring.

3363. Reaping or Mowing Machines, *R. Attenborough, Reading.—3rd August*, 1881.—*(Not proceeded with.)* 2d.

The machine is supported on one or more wheels, connected by an axle or axles, which carry the main frame. When the machine is pushed by a man or drawn by horses the axles rotate and give motion to the component parts of the machine for the purpose of actuating the sickle.

3364. Elliptic and Semi-elliptic Springs for Vehicles, *P. M. Justice, London.—3rd August*, 1881.—*(A communication from W. Davison, Hoboken, U.S.)—(Not proceeded with.)* 2d.

This consists partly in making the plates of greater thickness in the middle or intervening web, which sustains the tension, than the edges whereon the compression is sustained.

3366. Registering the Number of Passengers by Public Vehicles, &c., *J. Rogers, Oldham.—3rd August*, 1881.—*(Not proceeded with.)* 2d.

An apparatus is employed which furnishes a photographic record, which can be used to ascertain the number of passengers.

3373. Preventing Displacement of Wedges used for Securing Railway Rails in their Chairs, *J. Bland, London.—4th August*, 1881.—*(Not proceeded with.)* 2d.

A hole is formed in any convenient part of the chair at the side in which the wedge is driven, extending entirely through the metal forming the side, and through this hole a sharp-pointed pin is passed, which is forced into the wooden wedge or key.

3376. Manufacture of Artificial Ivory, &c., *F. W. Cottrell, London.—4th August*, 1881. 4d.

This consists in rendering fibre soluble in alcohol—with or without addition of hydrocarbon—by immersing such fibre in a saturated solution of nitrous acid in sulphuric acid.

3378. Manufacture of Artificial Manure, *H. F. S. d'Esplaviz, Twickenham.—4th August*, 1881. 2d.

The manure is composed of pure human urine not evaporated, powdered bones, powdered oyster shells, dried and powdered excrements of cattle, wood ashes, common salt, old red bricks powdered, soot and common Paris plaster.

3385. Syphon with Continuous Jet, *H. Descours, Paris.—4th August*, 1881.—*(Not proceeded with.)* 2d.

The principle consists in interposing a movable hermetic valve or plug in the suction column of the water or other liquid or fluid as soon as the rise is produced by a suction pump in such a manner as to completely separate this suction column from the body of water raised, thus constituting an independent and permanent discharge column, and always primed.

3387. Skates, *W. G. Rawbone, Birmingham.—4th August*, 1881.—*(Partly a communication from J. L. Rawbone, Toronto.)—(Not proceeded with.)* 2d.

This relates to means for adjusting the skates on and fixing them to the feet of the wearer.

3391. Capsuling Bottles, &c., *J. Maddocks, Dartmouth.—5th August*, 1881.—*(Not proceeded with.)* 2d.

A stock or stem is formed with a shoulder and with a reduced diameter, on which is fitted an india-rubber ring that it may be rolled along this reduced portion under the action of a sleeve or tubular sliding ferule, which is capable of being moved to and fro upon the stock or stem by hand or by an appliance. One end of the stock or stem is provided with a pad or cushion to press the head of the capsule firmly into contact with the cork.

3393. Supplying Air to Boiler Furnaces, &c., *D., M., and A. Sowden, Bradford.—5th August*, 1881.—*(Not proceeded with.)* 2d.

A series of short conical pipes of different sizes are partly inserted one within another, a space being around same for the air to pass. One end of the largest conical pipe is attached to a pipe that is connected to a plate closing the front of the ashes pit, or to what is known as the blow hole in a cupola furnace. Into the smallest conical pipe is inserted a steam jet, which blowing into the same causes the air to rush into the pipe through the spaces mentioned.

3398. Slubbing, Intermediate, and Roving Frames, *G. P. Leigh, Manchester.—5th August*, 1881.—*(Not proceeded with.)* 2d.

This relates to slubbing, intermediate, and roving frames, wherein the flyer, instead of being fixed on the top of the spindle and driven thereby as usual in such machines, is entirely disconnected from the spindle, and is driven independently thereof.

3399. Intermittent Syphons, *A. T. Bearing, Westminster.—5th August*, 1881. 6d.

This relates to syphons employed for occasional discharge of measured quantities of liquid as for flushing water-closets, &c., and consists in the combination of a syphon pipe and its flange with a moveable hood having a bulge or enlargement.

3401. Propelling or Navigating Aerostats or Aerial Machines, *J. H. Johnson, London.—5th August*, 1881.—*(A communication from G. Tissandia, Paris.)—(Not proceeded with.)* 2d.

The aerial apparatus is supported by means of a balloon, preferably of an elongated or cigar shape, and is propelled in any required direction by a screw propeller actuated by an electro-dynamic motor supplied with electricity from a secondary battery.

3404. Improvements in Apparatus or Appliances, for Automatically Lighting Electric Candles, *E. G. Brewer, London.—5th August*, 1881.—*(A communication from A. G. Desquiens, Paris.)—(Not proceeded with.)* 2d.

The invention consists of two supports for each candle, having levers and arms acted on by springs which put the two supports in electric connection when the candle is consumed. The springs are released by the action of heat on a brass pin placed at the bottom of the candle.

3410. Fireproof Documents and Drawings, *J. R. Meihé, London.—6th August*, 1881.—*(A communication from L. Frobeen, Berlin.)* 4d.

This consists partly in the production of fireproof colour or pigment for printing, composed of chloride of platinum, oil of lavender, lamp black, and varnish. Other improvements are described.

3493. Registering Apparatus for Public Conveyances, &c., *G. Wilson, London.—12th August*, 1881.—*(A communication from J. W. Fowler and D. F. Lewis, Brooklyn, U.S.)* 1s.

This relates to a passenger register, designed especially for registering or indicating the number of persons carried or fares collected in public conveyances which make repeated trips between given points at a fixed rate.

3553. Dyeing Aniline Black on Cotton, *G. Jagenburg, Rydboholm, Sweden.—16th August*, 1881. 2d.

This consists in the combination of an aniline salt with a chlorate, in a solution of which the cotton is immersed, then dried in a ventilated room, and subsequently placed in an oxidising bath.

4013. Cigarettes, &c., *D. Nicholl, Strand.—17th September*, 1881. 4d.

The cigarette consists of two, three, or more tubes connected together and enclosed at one end by a suitable mouthpiece.

4154. Valves, *W. J. F. Thomson, Kerry.—27th September*, 1881.—*(Complete.)* 4d.

This relates more particularly to ball valves, and consists in applying a solid conical india-rubber washer to the spindle of the valve, the valve seating being correspondingly shaped to receive the washer, whereby no resting place is left for clippings or grit to accumulate, and the passage for the flow of water is less obstructed than with a flat washer.

4249. Umbrellas, *J. Minière, Paris.—1st October*, 1881.—*(Complete.)* 4d.

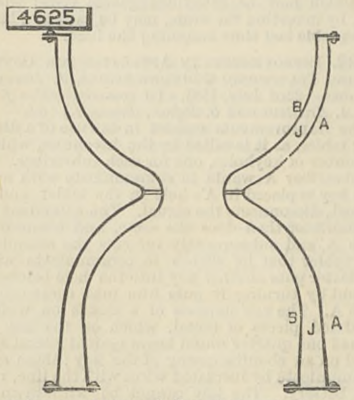
A draw wire is placed inside the stick, which is hollow, and when pulled serves to release a sleeve by which the umbrella is maintained in its distended position, so that the umbrella will then automatically close itself. The ribs are also of special construction.

4532. Confiture Preserves, &c., *H. A. Bonneville, Paris.—18th October*, 1881.—*(A communication from D. Cornilliac, wife of A. Ralu, Paris.)—(Complete.)* 2d.

This relates to the manufacture by a cold process of confiture-preserves, confiture preserves cut in pieces, and jam confiture-preserves, by treating all kinds of fruit with alcohol, liqueurs, or wines.

4625. Steam Boiler Furnaces, *G. W. Clark, San Francisco, U.S.—22nd October*, 1881.—*(Complete.)* 6d.

This consists in a steam boiler furnace of the outer plates or walls A, and the inner plates or walls B inclosing between them a water space or jacket J, said



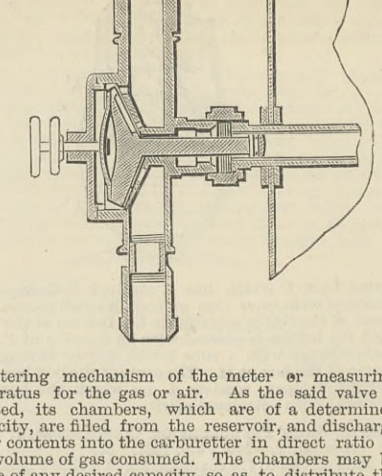
walls and space being of the shape as shown, contracted or converging at the middle.

4993. Horseshoes, *H. J. Haddan, Westminster.—15th November*, 1881.—*(A communication from J. D. Billings, New York, U.S.)—(Complete.)* 4d.

This relates to a horseshoe with a continuous calk extending from heel to heel, and which will wear evenly over its entire face, for which purpose it is made of varying width, being widest at the toe and tapered thence to the heels, whereby it is adapted to sustain the varying friction incident to the different portions of the shoe.

5117. Metrical Carburetters, *H. J. Haddan, Kensington.—23rd November*, 1881.—*(A communication from W. M. Jackson, Providence, U.S.)—(Complete.)* 6d.

This relates to improvements in apparatus whereby the volume of gas or air flowing to the burner controls the quantity of carburetting fluid exposed to a passing current of gas or air. The drawing shows a sectional view of the valve and the shaft for operating the meter and the hydrocarbon distributing devices. The distributing or delivery valve is rotated by the



registering mechanism of the meter or measuring apparatus for the gas or air. As the said valve is rotated, its chambers, which are of a determined capacity, are filled from the reservoir, and discharge their contents into the carburetter in direct ratio to the volume of gas consumed. The chambers may be made of any desired capacity, so as to distribute the carburetting fluid through the carburetter in a film of any required thickness, to be determined by the volatility or density.

5127. Apparatus for Setting and Distributing Printing Types, *S. Pitt, Sutton.—23rd November*, 1881.—*(A communication from H. A. Burr, New York.)—(Complete.)* 2s. 4d.

The First part is an apparatus for cutting suitable connecting nicks in ordinary types; the Second relates to a setter; Thirdly, a type-holding case; Fourthly, an apparatus for readily placing within reach of the operator the spaces which he desires to employ in completing his lines; Fifthly, a justifying mechanism to aid the operator in setting up his type in page form; Sixthly, apparatus for placing leads between the adjacent lines; Seventhly, apparatus by which a line of quadrats can be readily seized by the operator and inserted into a page of type; Eighthly, apparatus by means of which any spaces which may be rejected by the operator will be automatically set up in a case ready to be utilised again in the process of justification. The Ninth, Tenth, Eleventh, and Twelfth parts relate to the distributing mechanism.

5167. Woollen Fabrics, *H. A. Bonneville, London.—26th November*, 1881.—*(A communication from A. L. Pollet, Roubaix, France.)—(Complete.)* 2d.

This consists in the manufacture of textile fabrics from animal and vegetable materials combined with each other, of the chemical incineration after the manufacture of the vegetable materials, so as to leave a fabric composed solely of animal materials.

5344. Lubricant Packing, and Non-conductor, *J. G. Actes, Hartford, U.S., and J. D. Scott, South Shields.—7th December*, 1881.—*(Complete.)* 2d.

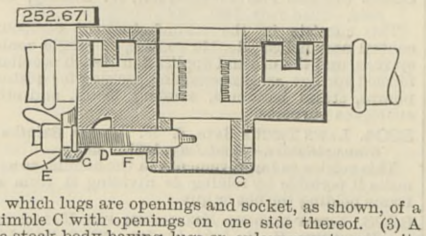
This consists of a lubricant containing alumina in admixture with tallows, greases, or oils. Fibrous materials are saturated with the mixture for packing.

SELECTED AMERICAN PATENTS.

From the United States' Patent Office Official Gazette.

252,671. Pipe-cutting Attachment for Screw-cutting Die Stocks, *Albert H. Jarecki, Erie, Pa.—April 8th*, 1881.

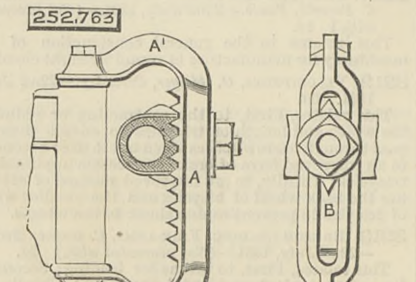
Claim.—(1) A die stock body having on one side of its neck lugs F and G, with openings and sockets, as described, and an opening on the opposite side of the neck, in combination with the die D and nut E, substantially as shown. (2) The combination, with a die stock body having an opening on one side of its neck and lugs F and G on the opposite side of said neck,



in which lugs are openings and socket, as shown, of a thimble C with openings on one side thereof. (3) A die stock body having lugs or enlargements upon its lower face, in which are openings or recesses for holding a pipe-cutting die and its operating nut, into which the said die enters by passing through an opening or passage across the neck or central opening of said stock.

252,763. Coupling for Cultivator Beams, *James T. Hamilton, Moline, Ill., assignor to himself and William K. Hoagland, Council Bluffs, Iowa.—Filed November, 10th*, 1880.

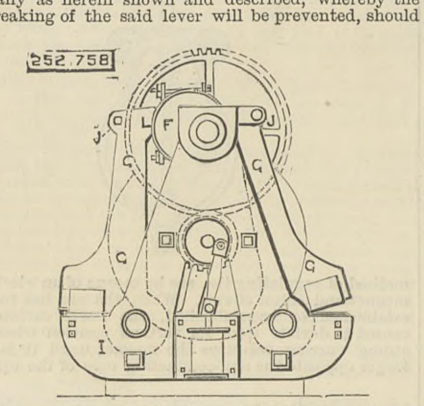
Claim.—(1) In a cultivator, a coupling for the plough-beams, having a section A A^1, provided with the slot B and adapted to receive the forward end of the plough-



beam, in combination with an eye bolt or connection with the sleeve or axle for allowing vertical play of the section to raise and lower the forward end of the plough-beam, substantially as and for the purpose specified.

252,768. Mechanism for Converting Rotary into Oscillating Motion, *Julius-Hornig, Jersey City, N.Y.—Filed August, 5th*, 1881.

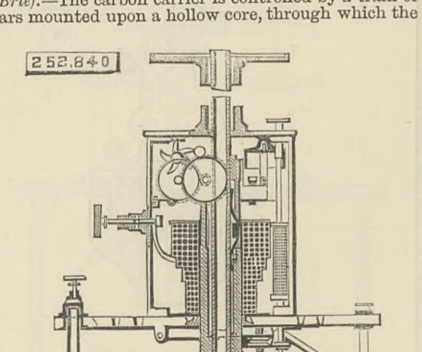
Claim.—(1) In a mechanism for converting rotary into oscillating motion, the combination, with the rotating excentric F and the oscillating lever G of the roller I or segment I^1 and the break-pin J, substantially as herein shown and described, whereby the breaking of the said lever will be prevented, should



its movement be obstructed, as set forth. (2) In a mechanism for converting rotary into oscillating motion, the combination, with the excentric strap L and the break-pin J of the arm M N, having a slot or clearance space O, substantially as herein shown and described, whereby the said arm will be kept from being broken, should the oscillating lever be obstructed, as set forth.

252,840. Electric Lamp, *Hiram S. Maxim, Brooklyn, assignor, by mesne assignments, to the United States Electric Lighting Company, New York, N.Y.—Filed November 27th*, 1879.

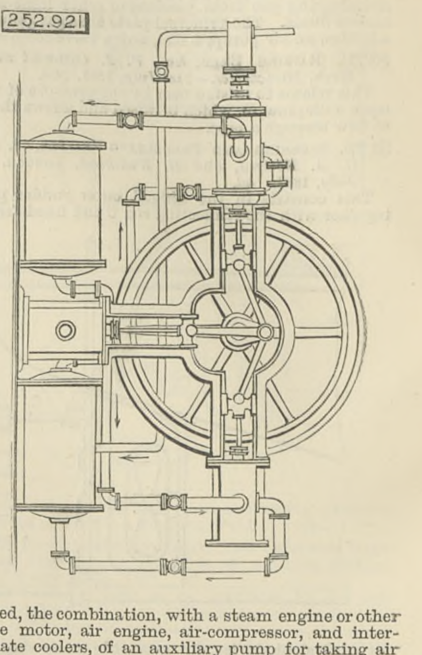
Brief.—The carbon carrier is controlled by a train of gears mounted upon a hollow core, through which the



carrier passes, and a fixed detent is employed in connection with the train. The lamp is suspended by means of a tubular support containing the carbon carrier.

252,921. Process of and Apparatus for Dynamic Cooling, *Leicester Allen, New York, N.Y., assignor to Henry T. Brown, Trustee, same place.—Filed May 25th*, 1881.

Claim.—(1) In a process for dynamic cooling, wherein air or other gas is first compressed, then cooled, then expanding to perform outer work, the mode of increasing the cooling effect of a stated bulk or volume of air or other gas, which consists in condensing the gas to and maintaining it above a stated limit materially higher than the normal atmospheric pressure, substantially as and for the purpose set forth. (2) In a process for dynamic cooling, wherein air or other gas is first compressed, then cooled, and then expanded in the performance of outer work, the mode of beginning and ending the cycle at a stated pressure materially above the normal atmospheric pressure, substantially as herein described. (3) In a dynamic cooling apparatus in which air or other gas is first compressed, then cooled, then expanded in the performance of outer work in a closed cycle to compress air above and expand it again to a minimum limit of pressure materially higher than the normal atmospheric pressure, substantially as herein de-



scribed, the combination, with a steam engine or other prime motor, air engine, air-compressor, and intermediate coolers, of an auxiliary pump for taking air from the exterior atmosphere and injecting it into the system in sufficient quantities to compensate for leakages, substantially as herein described and specified.

CONTENTS.

The Engineer, March 10th, 1882.

Comparative Value of the Crushing Strength and Stiffness of Different Woods.—Teak, 6555; oak, English, 4074; ash, 3571; elm, 3468; beach, 3079; oak, Quebec, 2927; mahogany, 2571; spruce, 2522; walnut, 2374; pine, yellow, 2193; sycamore, 1833; cedar, 700.

A great deal is now being said about the utilisation of water power at a distance through the medium of electricity. "A tenth part of the tidal energy in the valley of the Severn," Professor Sylvanus Thompson says, "would light every city, and another tenth would turn every loom, spindle, and axle in Great Britain." We have not seen his figures, but assuming that there is even a small part of this power economically available, it might be suggested that machinery for compressing air might be usefully brought into use in the Severn, after the manner now being adopted at the great falls near Rochester, N.S., and as proposed by Mann as long ago as 1833.