SOUND STEEL CASTINGS.

No. I.

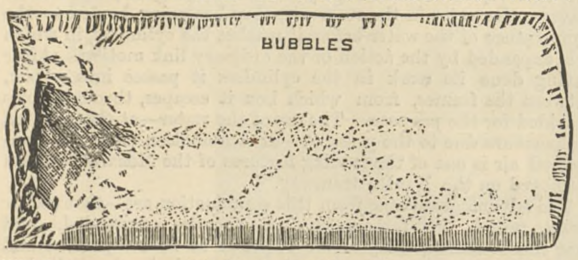
In these papers an attempt is made to ascertain the present condition of the problem, how to produce perfectly sound castings in steel, direct from the Bessemer converter, or from the Siemens-Martin hearth. We shall begin by showing exactly what the problem is, and why it is of the first importance that it should receive a practical solution; and we shall go on to indicate briefly in what ways that solution has been attempted, how far it has been carried, and in what direction it may be expected to receive its ultimate completion. It may be well to state at the beginning that we have no scheme of our own to propound; our object is the humbler one of putting the question in the clearest possible light.

First, then, as to the nature of the problem, and its importance. The practical conditions of the manufacture of steel can be nowhere better learnt than from two well-known papers by Chernoff, of St. Petersburg, translated by Mr. Wm. Anderson. To these, therefore, we turn for a statement of the problem. In the first of them—lately reprinted by the Institution of Mechanical Engineers—the author propounds the view, now generally accepted, that steel when raised to a temperature higher than some point *b*—varying with the nature of the steel, but roughly corresponding to a bright red heat—loses its crystalline structure, and takes an amorphous, wax-like condition; that this condition leaves the particles free to group themselves into crystals during the process of cooling; that if the cooling be slow and quiet these crystals will be large and regular, but if the cooling be rapid or disturbed they will be small; and that by cooling rapidly, and with constant disturbance, down to the point *b*, the structure may be made as fine as we please. When the temperature has once fallen to the point *b*, the mass will no longer tend to crystallise, even if left to cool in quiet. Now experience proves that the finer the grain of the steel the greater is its resistance to fracture, and the better its quality generally. Hence the excellence of steel forging consists in raising the steel to a temperature above *b*, and then bringing it to the required shape by the violent action of the hammer or rolls, without giving it a chance to crystallise quietly, until the temperature has fallen below the point *b*; after which the rate of cooling is of no importance, except as regards the hardening of the steel, which we are not here considering. Chernoff has shown that forging at high temperatures does not affect the density of the steel, or in any way improve the mechanical properties, except in the manner just described.

But, when the conditions are thus stated, it is seen at once that the costly process of hammering or rolling should not really be necessary; it should be sufficient to cast the steel direct to the required shape in chills, and to take care that the cooling is so rapid or so disturbed, or both, that large crystals have no chance of forming before the temperature has fallen below the critical point *b*. Under this process steel castings should be produced of any form at very little more than the cost of producing exactly similar castings in iron. Hence it can hardly be doubted that they would supersede iron castings in all cases where strength and durability were of importance; that they would supersede steel and iron forgings almost entirely; and that they would even supersede steel and iron "rollings"—to coin a much-needed word—except in cases such as that of rails, where these were required in large quantities and of simple form. Why is it then that while steel forgings and rollings are so common, steel castings are comparatively rare? The reason is not far to seek—it is because ordinary steel castings are rarely sound.

It is obvious that an ordinary Bessemer ingot presents a favourable example of a direct steel casting, being of large size and simple form. But if an ordinary Bessemer ingot be cut to pieces, far from appearing as a solid unbroken mass, it is found to contain innumerable cavities; as seen in the section, Fig. 1, which is taken from Chernoff's

FIG. I. LONGITUDINAL SECTION. CYLINDRICAL INGOT

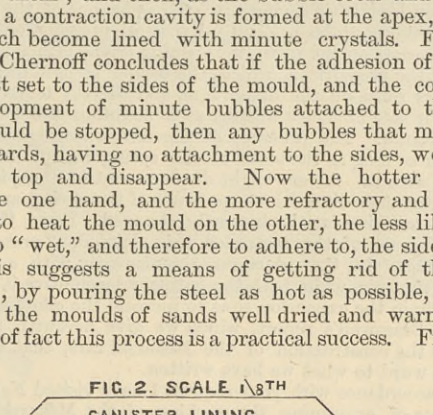


UPPER END ACICULAR STRUCTURE LOWER END

second paper. These cavities divide themselves into three classes, all indicated in the figure. They are (1) the central funnel-shaped cavity at the upper end of the ingot; (2) a layer of cavities, lying radially round the outside of the ingot, which may take the form (*a*) of slug-shaped bubbles, or (*b*) of "acicular," or needle-like flaws; (3) a number of similar cavities or bubbles, dispersed irregularly throughout the mass, but especially frequent towards the centre. Of these, class 1 is undoubtedly due to the mechanical shrinking and settling of the still fluid interior, after the outside has set; (2) is apparently due to the evolution of gas at the period when the outside is thus setting; and (3) is due to a similar evolution during the subsequent setting of the interior.

In his second paper—also published by the Institution of Mechanical Engineers—Chernoff has described very fully the phenomena of these various cavities, and the way in which, around these cavities, the steel gradually sets in feathery crystals of great complexity. This description is very curious and interesting, but we have not space to reproduce it here. More important is the study of the causes which produce these cavities, since this can alone lead to means being devised for their suppression; and to this study Chernoff has diligently applied himself. The cause of the central cavity, as already mentioned, is simply the shrinkage of the steel, and various means are known of removing it, especially the use of a runner, as always employed with iron castings. With regard to the outside bubbles, Chernoff's view is that the steel begins to evolve gas, previously dissolved or occluded in its substance, the moment it is left to cool in a mould. This gas adheres, in the form of minute bubbles, to the first particles of steel which solidify against the sides of the mould. Owing to the tendency of dissolved gases to escape into space, or into already existing cavities, these bubbles grow rapidly by drawing the gas from the surrounding steel. This growth must be radial to the surface, because the setting of the steel in layers parallel to the surface checks the growth in any other direction. If this radial growth is rapid the bubbles frequently break off and float to the top. If it is slow, the bubbles are soon sealed in by the setting of the steel round them; and then, as the bubble cools and the gas shrinks, a contraction cavity is formed at the apex, the sides of which become lined with minute crystals. From these facts Chernoff concludes that if the adhesion of the particles first set to the sides of the mould, and the consequent development of minute bubbles attached to these particles, could be stopped, then any bubbles that might form afterwards, having no attachment to the sides, would float to the top and disappear. Now the hotter the steel, on the one hand, and the more refractory and impermeable to heat the mould on the other, the less likely is the steel to "wet," and therefore to adhere to, the sides of mould. This suggests a means of getting rid of these bubbles, viz., by pouring the steel as hot as possible, and by forming the moulds of sands well dried and warmed. As a matter of fact this process is a practical success. Fig. 2

FIG. 2. SCALE 1/8TH



shows a section of an ingot, cast in a mould made half of sand and the other of metal; and it will be seen that the part of the skin in contact with the sand is quite sound, while that in contact with the metal presents all the characteristic cavities.

We have yet to deal with the cavities of Class 3, those which form sporadically in the interior of the ingot. According to Chernoff's view these do not begin to form until the top of the ingot has become covered with a solidified layer, so that the gases can no longer escape freely from the upper surface. At the same time the evolution of the gas is accelerated, because the lowering of the temperature diminishes their solubility. The gases thus formed collect under the top crust, and acquire considerable tension, so much so that they frequently blow it up, and carrying through with them a foaming mass of fluid steel. Each time that the tension is thus relieved, the development of gas, which had been checked by the pressure, begins afresh, and a new zone of bubbles is formed. This process may go on until the very centre of the ingot has set, but chiefly in the upper portions, because there the influence of the central contraction cavity assists the gases in forming. Hence the reason why the bubbles are most frequent towards the top of an ingot.

Hitherto we have been content to follow the guidance of the Russian metallurgist. But there is one point clearly of the first importance on which he has nothing of his own to tell us; and here we must turn for help to Germany and to England. This point is the chemical constitution of the gases which produce, and which occupy, these internal cavities. Chernoff remarks that they probably consist for the most part of carbonic oxide, and this, until lately, was the accepted view. The reasons for this acceptance appear to have been two-fold:—First, that, as lately remarked, CO has long been to the steelmaker what sulphur is to the ironmaker, the scapegoat on whose head all the sins of the material are laid; and secondly, that Bessemer, at an early stage of his researches, made an experiment, by placing a red-hot ingot in vacuo and collecting the gases given out, which appeared to show that CO was actually evolved in large quantities from the surface of a steel ingot during the process of cooling. So the question stood until about two years ago, when Dr. F. C. G. Müller, of Brandenburg, resolved to test the point by direct experiment. His results were first announced to the German Chemical Society, and afterwards published in the *Zeitschrift des Vereins Deutscher Ingenieure* for 1879. Recently he has republished them, with many practical comments, in *Glaser's Annalen* for 1880. This last article is a sufficiently amusing example of scientific polemics. Dr. Müller has been hardly treated by M. Pourcel and other French metallurgists, who have not only scoffed at his results, but invented circumstances to prove their falsity; and he does not spare them in his reply. These amenities of literature we must, however, pass over, and content ourselves with describing briefly the German professor's method of experiment, and stating its results.

Müller provided a wrought iron vessel, with a cast iron bottom, in the centre of which was fitted a stuffing-box. Through this stuffing-box he passed the boring-bar of a vertical boring machine placed beneath, so that the rotation of the machine caused the rotation of the boring tool within the vessel. This vessel was filled with water or oil, and a small steel ingot was then let down into it, and made to rest on the top of the boring tool. The ingot had a square cast on the top, which fitted in a guide, and prevented the ingot from turning. The boring machine was then started, and rapidly bored a large hole in the ingot, within which all the gases disturbed by the boring collected, and were retained by the liquid. From thence they were drawn into a flask, which was carefully sealed, and the contents afterwards analysed by Bunsen's eudiometric method. Not only Bessemer steel, but various other cast and forged metals were treated in the same manner, and the results of the analyses are given in the following table, which is of sufficient interest to warrant its republication:—

TABLE I.

Müller's Analyses.

No.	Materlal.	Volume of gas to volume of hole. Per cent.	Tension of gas. Atmosphere.	Hydrogen. Per cent.	Nitrogen. Per cent.	Carbonic oxide. Per cent.	Total. Per cent.
1	Bessemer rail steel	48·0	—	90·3	9·7	—	100·0
2	Bessemer spring steel.. ..	21·0	—	81·9	18·1	—	100·0
3	Bessemer metal before adding spiegel	60·0	3·5	88·8	10·5	0·7	100·0
4	Bessemer metal finished ..	45·0	7·0	77·0	23·0	—	100·0
5	Bessemer pig metal from cupola	15·0	—	86·5	9·2	4·3	100·0
6	Bessemer pig metal from cupola	35·0	—	83·3	14·2	2·5	100·0
7	Pig iron, "Solway No. 1"..	3·5	—	52·1	44·0	3·9	100·0
8	Siemens-Martin metal, from Bochum, before adding spiegel	25·0	—	67·0	30·8	2·2	100·0
9	Bessemer rail steel	29·0	8·0	76·7	26·3	—	103·0
10	Metal from converter, during blowing of 9	28·0	—	81·1	14·8	4·1	100·0
11	Pig iron, "Georg Marien Hütte, No. 1"	10·0	—	62·2	35·5	2·8	100·5
12	Mild Bessemer metal, Westphalian	16·5	—	68·8	30·5	—	99·3
13	Rail steel, from Prévali ..	51·0	4·5	78·1	20·7	0·9	99·7
14	Unsound rail steel, forged..	5·0	—	52·2	48·1	—	100·3
15	Rail metal from very spongy ingot, rolled	7·3	—	54·9	45·5	—	100·4
16	Sound steel ingot, Bochum	17·0	—	92·4	5·9	1·4	99·7
17	The same after forging ..	5·5	—	73·4	25·3	1·3	100·0

We have said that these were the first analyses made of the gases existing in the cavities of steel ingots; but with regard to some of the other materials given above this is not the case, and due honour should be paid to an earlier English investigator in the same field. In the *Journal of the Iron and Steel Institute* for 1872, Mr. John Parry, of Ebbw Vale, gave some analyses of the gases obtained by heating strongly *in vacuo* certain samples of iron and steel made at the works. These analyses we have combined in the following table:—

TABLE II.

Parry's Analyses.

No.	Material.	Volume of gas to volume of metal. Per cent.	Time of heating. Hours.	Hydrogen. Per cent.	Nitrogen. Per cent.	Carbonic oxide. Per cent.	Carbonic acid. Per cent.	Total. Per cent.
1	Speigeleisen	200	3	81·1	—	17·9	0·9	99·9
*2	Pig iron, common white	200	6½	84·0	6·9	2·3	6·8	100·0
3	Pig iron, grey	260	2	89·7	3·2	5·2	1·6	99·7
4	Good wrought iron ..	200	2	54·1	1·7	34·3	9·9	100·0
5	Soft steel	1300	2	52·6	6·5	24·4	16·6	100·1

* In subsequent experiments with pig iron (Journal Iron and Steel Institute, 1873, 1874) no nitrogen could be found.

Finally, Mr. E. Windsor Richards has recently repeated Müller's experiments, following exactly the same method, with a cast steel ingot weighing 25 cwt., and his results, as given in his recent address to the Cleveland Institute, are as follows:—

TABLE III.

Windsor Richards' Analysis.

Ingot No.	Material.	Analysis.			Volume of gas to volume of hole. Per cent.	Analysis of Gas.			
		C. Per cent.	Mn. Per cent.	Si. Per cent.		Hydrogen. Per cent.	Nitrogen. Per cent.	Carbonic oxide. Per cent.	Oxygen. Per cent.
I.	Rail steel ..	·33	·69	·10	55	86·62	13·29	0·32	0·37
II.	Hard steel ..	·45	·40	·04	74	83·35	14·65	—	—
III.	Soft steel.. ..	·17	·89	·09	25	87·21	11·15	1·64	—
IV.	Steel high in Si	·42	1·08	1·0	21	67·10	33·30	1·60	—
V.	Hammered iron	·05	·7	·15	28	30·62	69·38	—	—
VI.	Cast iron	3·65	·6	2·63	75	52·5	44·5	—	—

In all these cases, as we gather from Mr. Windsor Richards's account, the metal, when afterwards cut through, appeared quite sound.

These three tables, as will be seen, bring out some striking and unexpected results.

Taken broadly, they prove, in the first place, that all varieties of iron and steel, cast or wrought, do contain occluded gases in considerable quantities. It is true that Mr. Windsor Richards appears to throw some doubt on this, at least as regards his own experiments. For he states that the amount of gases appeared to him so large as to awaken suspicion that they might have come from the water. He therefore rested an ingot upon a blunt revolving drill for about twelve hours, and then collected gas to the amount of 1150 per cent. of the metal recovered, the composition being 88·70 hydrogen, 10·30 nitrogen. He afterwards drilled small ingots under mercury, and collected only a small quantity of gas, which was found to be hydrogen; and then concludes that most of the hydrogen in the former experiments must come from the water. But on this it may be remarked:—(1) Can we believe that clean iron, at moderate temperatures, will decompose water, and that so extraordinary a fact has been overlooked till now? (2) Müller made some of his experiments under oil and mercury, and notes no special difference in results; (3) the slow and minute disintegration by the blunt drill would seem specially to favour the extraction of large quantities of the occluded hydrogen; (4) the superior pressure of the mercury would be likely to hinder this extraction, and, moreover, mercury may itself dissolve hydrogen; (5) if the hydrogen came from the water, why does its amount differ so largely with comparatively slight differences in the analysis of the metals tested? Even if these remarks are not held to invalidate Mr. Windsor Richards' view, it must be remembered that he is speaking of sound metals, and not of the gases in the cavities of unsound metals, which alone we are treating in this article.

As to the amount of gas in each case—measured by the ratio between volume of gas and volume of metal—we cannot speak positively; for Mr. Parry does not seem to have been able to satisfy himself as to his measurements on this head. That the ratio as given by him, should be in general much larger than those given by the other observers is, however, explained by the fact that his quantities were obtained by heating the metal strongly in vacuo, while in the other cases there was simply a hole bored in a piece of metal generally more or less porous. Now, it is obvious that in the case where the metal is porous there are two classes of gases to be considered. These are (1) the gases which are occluded in the solid parts of the casting, as they are in the perfectly sound castings and forgings otherwise analysed; and (2) the gases which have been excluded from the solid metal but are imprisoned in the cavities. It seems probable that in the process of disintegration by boring, a portion, but a portion only, of the occluded gases, Class 1, would be set free, and would thus be found added to the cavity gases, Class 2, when the boring was finished. This is confirmed by Müller's analyses, Nos. 14, 15, and 17, which show that gas can be drawn by the boring process from sound castings and from forgings, but in much smaller volumes than when porous ingots are tested. Now, it does not at all follow that these two sets of gases—Class 1 and Class 2—have the same composition. In fact, since we know that the metal in setting has rejected the one and retained the other, it is probable, though not certain, that their composition is different. Whether this is the case or not we may judge by comparing the analyses of the gases from sound metals, especially those of Mr. Parry, with those from very porous metals, like steel ingots. When we do this, we are at once struck by the fact that the analyses from good wrought iron and soft steel are the only ones—omitting spiegeleisen as a special product—where CO and CO_2 are present in notable quantities—44 and 41 per cent. respectively, taking both gases together. The highest percentage elsewhere is in white pig iron, where Parry finds 9·1 for the two gases together; whilst the highest given by Müller's method is 4·3 for cupola metal. In steel castings of all kinds the percentage is everywhere very small, and in many cases absolutely zero. The gases collected from such castings are found to consist mainly of hydrogen, with a much smaller admixture of nitrogen, the percentage of the latter varying from 5·9 in a sound ingot to 48·1 in unsound rail steel, after forging. Looking at these results, we are justified in concluding that the cavities in steel contain no carbonic oxide or carbonic acid whatever, and that where these are present in Müller's or Windsor Richards's analyses, they are simply due to a small amount of the occluded gases, the last having been set free in boring, as already suggested. Hence we may venture to lay down the following laws,* as representing our present knowledge on this subject.

(1) Molten steel absorbs, or occludes, a large quantity of CO and CO_2; and its capacity for holding these gases in solution is increased, or at least not diminished, by cooling; so that the cold metal retains the whole amount of these gases, which it absorbed when hot, and they can only be expelled by severe heating in vacuo. This was exactly the process, both in Bessemer's early, and in Parry's more recent experiments. (2) Molten steel will also occlude a much larger quantity of hydrogen,† but its capacity for holding hydrogen in solution is diminished by cooling; and therefore in setting it expels a certain portion of its hydrogen, which either forms permanent bubbles in the metal, or escapes into the atmosphere. (3) Molten steel will also occlude nitrogen, but to a very much smaller amount than hydrogen, the proportion between the two being from $\frac{1}{4}$ to $\frac{1}{8}$. Its capacity for retaining nitrogen diminishes in cooling in much the same proportion as in the case of hydrogen, and therefore the two are found together both in the sound metal and in the cavities, very much in the same proportion. This is seen by comparing Parry's analysis No. 5 with Müller's Nos. 1, 2, and 13. (4) From Müller's Nos. 14 and 15, the effect of forging appears to be to expel the hydrogen partially from the metal, but not the nitrogen, or in a much smaller proportion; so that in the gases from such steel the percentages of the two approach an equality. This, however, does not seem to agree very well with Parry's No. 5, where the percentage of nitrogen is still small compared with that of hydrogen.

SOCIETY OF ARTS.—The next series of Cantor Lectures, to be delivered before the Society of Arts, will be by Professor W. G. Adams, F.R.S., his subject being "The Scientific Principles Involved in Electric Lighting." The course commences on Monday, the 7th March, and will continue on the three following Mondays, ending March 28th. The first two lectures will be mainly introductory, and will deal with such subjects as the production, regulation, and measurement of electric currents, and the action of magneto-electric and dynamo-electric machines. In the third and fourth lectures it is hoped to show a large number of illustrations of the various systems of electric lighting. The new incandescent lights of Swan and Lane Fox will be exhibited at the fourth lecture.

* These laws were practically sketched out, though not formulated, by Mr. G. J. Snelus in the discussion on Steel Compression at the Barrow meeting of the Institution of Mechanical Engineers.

† We believe Mr. Parry's opinion is that steel may absorb as much as fifty times its volume of hydrogen, or 5000 per cent.

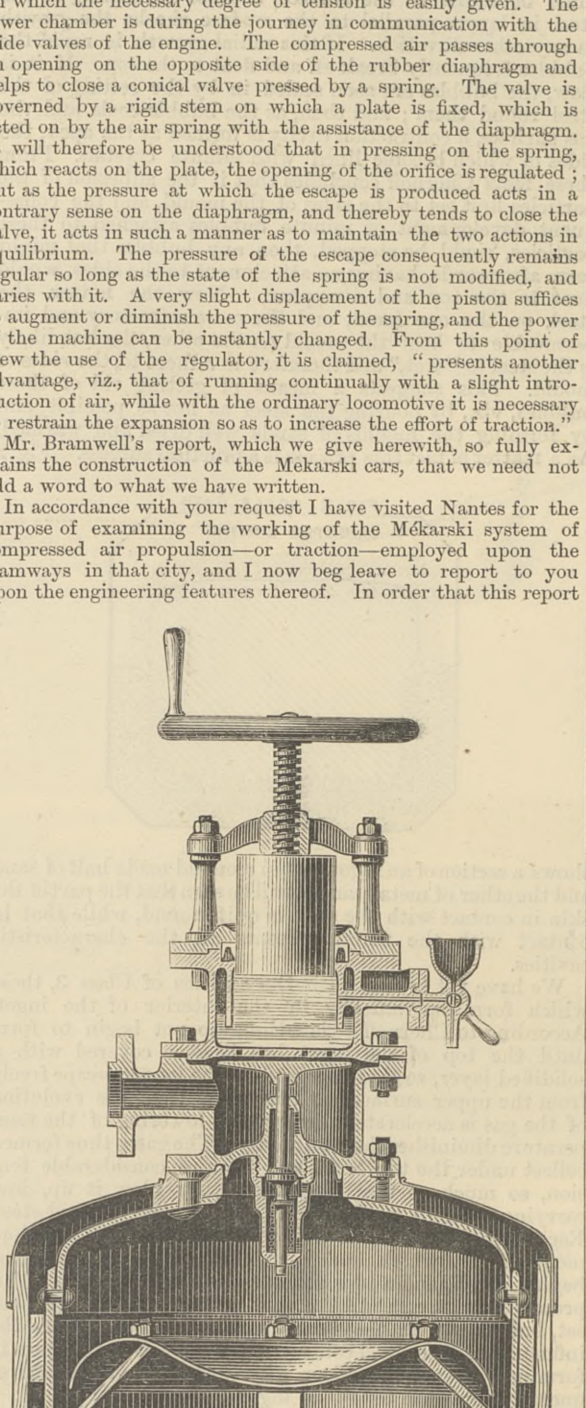
THE MEKARSKI TRAMWAY LOCOMOTIVE.

ON the 3rd March, 1879, we published an engraving of Mekarski's tramway locomotives. As the invention is now assuming considerable prominence, we make no apology for reproducing that illustration on page 155. And we give herewith what we did not give then, a section through the upper portion of the heater, showing the regulating valve.

This apparatus consists essentially of two brass chambers, superposed and separated by a diaphragm in rubber. The first forms a sort of hydraulic press, the piston of which is moved by a screw put in motion by means of a small wheel. In descending, the piston presses back water in an annular chamber where a small quantity of air is confined. It acts as a kind of spring, on which the necessary degree of tension is easily given. The lower chamber is during the journey in communication with the slide valves of the engine. The compressed air passes through an opening on the opposite side of the rubber diaphragm and helps to close a conical valve pressed by a spring. The valve is governed by a rigid stem on which a plate is fixed, which is acted on by the air spring with the assistance of the diaphragm. It will therefore be understood that in pressing on the spring, which reacts on the plate, the opening of the orifice is regulated; but as the pressure at which the escape is produced acts in a contrary sense on the diaphragm, and thereby tends to close the valve, it acts in such a manner as to maintain the two actions in equilibrium. The pressure of the escape consequently remains regular so long as the state of the spring is not modified, and varies with it. A very slight displacement of the piston suffices to augment or diminish the pressure of the spring, and the power of the machine can be instantly changed. From this point of view the use of the regulator, it is claimed, "presents another advantage, viz., that of running continually with a slight introduction of air, while with the ordinary locomotive it is necessary to restrain the expansion so as to increase the effort of traction."

Mr. Bramwell's report, which we give herewith, so fully explains the construction of the Mekarski cars, that we need not add a word to what we have written.

In accordance with your request I have visited Nantes for the purpose of examining the working of the Mékarski system of compressed air propulsion—or traction—employed upon the tramways in that city, and I now beg leave to report to you upon the engineering features thereof. In order that this report



may be self-contained, and therefore more readily intelligible, I will deal with the subject as though not only the details, but even the general features of the arrangement employed in the working with compressed air, were to be made known to you for the first time.

As will be seen from the print of a map published in Nantes appended hereto, and on which I have laid down the tramway in red, the line extends from Doulon at the eastern end of the town to Chantenay at the western end, the total length being nearly 4 miles—actually 3 miles 1514 yards. On starting from Doulon the line runs southerly along one of the approach roads to Nantes. This road terminates in the Boulevard Sebastopol, running parallel with the railway. The line traverses this boulevard until it reaches the railway station, and it then enters upon the beginning of the quays, and traverses these for their whole length, viz., about two miles. It then extends along a road practically parallel with the course of the river to the terminus at Chantenay. For nearly the whole distance the line is double, but in places—in one instance in the busiest part of the town—there is for a short distance only a single line. Generally the tramway, being on the quays, is practically level, but there are are some gradients, the steepest is very short, but has an inclination of about 1 in 30. Short as this incline is, it has, however, to be surmounted without the advantage of rapid pace before reaching it, inasmuch as at its foot there is a crossing which cannot be traversed at full speed. The gauge of the tramway is 4ft. 8½in., that is the ordinary railway gauge, but although the gauge is thus of full width, there are several places in which sharp curves occur; one in particular—at a point where the tramway makes a sudden bend to traverse the railway by a level crossing—is only 40 yards radius; at this same crossing, the rails of the railway are not cut to allow of the passage of the flanges of the tram-wheels and thus that passage has to be made by the tram-wheels mounting over the rails of the railway. In other instances where the tramway crosses some goods branches of the railway, the rails are cut. The line in its straight portions is carried on transverse oak sleepers, supporting cast iron chairs. To these chairs are bolted the rails and a guard rail, the joints of the guard rail occurring intermediate to those of the rail, the rails weigh 32 lb. per yard, the guard rails 22 lb. per yard. This is the system preferred. But for facility of construction, where the line is curved, an ordinary reversible grooved rail—but without a roughened guard edge—carried on longitudinal oak sleepers, united by wrought tie bars, is employed. This rail weighs 42 lb. per yard. All the rails are of steel. No precaution appears to be taken to prevent growing of the pitching at its junctions with the edges of the rails. I have dwelt thus at some length upon the circumstances of the tramway in order that you may appreciate the fact that the carriages traversing it have to encounter most if not all of the difficulties to be met with in the ordinary working of street tramways, and so far as the crossing the railway on a level is concerned a difficulty which is all but exceptional.

The service commences at 7 o'clock in the morning, and during the winter terminates at 9 at night, making fourteen working hours; during the summer, however, it is continued for an hour longer. Generally there is a departure each ten minutes from each end of the line, or as a fact eighty-six journies in each direction per day in the winter time, and ninety-six journeys in each direction per day in the summer time; but these journeys are not made at absolutely uniform intervals throughout the day, as during the busier hours there is only an eight minute interval between the departures, while in some of the less busy hours there is as much as a twelve minute interval; moreover, owing to markets and other causes, the Thursday, Saturday, and Sunday are days of greater traffic than the Monday, Tuesday, Wednesday, and Friday. Upon each of these days of greater traffic as many as ninety-six journeys are made in winter, and 106 in the summer in each direction. The ordinary work is performed by combined cars and air-engines, known as auto-mobiles, of which there are twenty-two. In addition to these there are two traction engines, which each draw two "imperial" cars, used at the times of greater traffic.

The combined cars have a total width of 7ft. 1in., and a length of 22ft. 4in., 3ft. 4in. being occupied by the front platform on which the driver stands, 13ft. by the body, containing seats for nineteen passengers, while 6ft. is taken up by the hind platform, which is covered, and on which there is standing room for twelve more passengers = making thirty-one in all—and also place for the conductor. No passengers are carried on the roof. The thirty-one is the number of passengers that the car is intended to carry, but as a matter of fact, as I saw on Sunday and on the New Year's Day, passengers were standing inside between the two rows of seats, and were closely crowded on the back platform, so that from forty to forty-five persons must have been travelling at one time.

Below the floor of the car are placed transversely ten cylindrical reservoirs, formed of steel plates for the compressed air; seven of these are united into one system called the "battery," and the remaining three are united into a second system—the "reserve." The capacity of the battery is 67·81 cubic feet, and that of the reserve 31·08 cubic feet making a total of 98·89 cubic feet. Both the battery and the reserve are charged at the principal station with air compressed to thirty atmospheres. The leading wheels—the drivers—are 2ft. 4in. in diameter; while the hind wheels are 2ft. 6in. in diameter; the distance between the centres of the axles—*i.e.*, the wheel base—is 5ft. 9in. The weight of the combined car, ready to work, is six tons. The bearings are external to the wheels, and outside the bearings on the driving axle are the cranks with counterbalances forged on, and return cranks with double pins to work the link motions for the slide valves. The cylinders are placed horizontally in front of the driving wheels, and are 5⅝in. diameter by 10¼in. stroke.

The engines with all their gearing are completely encased in wrought iron cases, with doors to open at the sides, and the engine being, as already described of the "outside cylinder" construction, perfectly ready and complete access is obtained to each engine by the mere opening of the case doors. The under frame of the car is of wrought iron, and is composed of two main longitudinals, with the requisite cross-ties and struts; the connection with the axle boxes is made by means of ordinary plate carriage springs.

In front of the car and standing up vertically through the driver's platform is a small reservoir of hot water and of steam, containing 4½ cubic feet; this is charged with water for about two-thirds of its capacity, at a temperature of 320 deg. Fah., equivalent to the pressure at which the steam is, viz., 75 lb. on the square inch. The air in passing from the battery, or from the reserve, as the case may be, to the engines, is made to traverse the water in the reservoir, thus becoming heated to the temperature of the water before it reaches the cylinders, in which it is expanded by the action of the ordinary link motion. After having done its work in the cylinders it passes into a box, between the frames, from which box it escapes, through holes provided for the purpose. The use of the water—at the elevated temperature due to the pressure—in combination with the compressed air is one of the leading features of the Mékarski system employed on the Nantes tramway.

The advantages arising from this combination are—that the air being raised in temperature is thereby expanded, and that thus a less quantity of air requires to be compressed and to be carried to do a given amount of work in the cylinders than would be required were not this heating provision made, and also that the air being thus raised in temperature prior to its expansion is not after the expansion reduced to a point at which ice forms in the exhaust passages of the cylinders as it does when no provision for heating the air is made. This formation of ice has proved a very serious impediment to the successful and economical working of many compressed air engines; moreover, the air being moistened in its passage throunh the water, keeps the surfaces of the side facings and pistons and their rods in a condition well adapted for thorough lubrication.

On the top of the hot-water reservoir is fixed the regulating valve; this is of a peculiar construction, one which effectually solves the problem, how automatically to reduce the pressure of the air from the reservoirs to any extent desired for the working in the engines, and to keep the air at this desired pressure, notwithstanding that the demand for air by the engines may vary, or in the event of the car being stopped may cease altogether, while at the same time the desired pressure itself can instantly be varied at the will of the driver, and when so varied the regulating valve automatically, as before preserves the new desired pressure under all circumstances of demand.

A cock being opened either to the battery or to the reserve, as the case may be, a movement by the driver of the regulating valve allows the compressed air to pass from the battery—or the reserve—out of the hot water reservoir—after having traversed the water in that reservoir—and thence by a

THE MEKARSKI COMPRESSED AIR TRAM CAR.

(For description see page 154.)

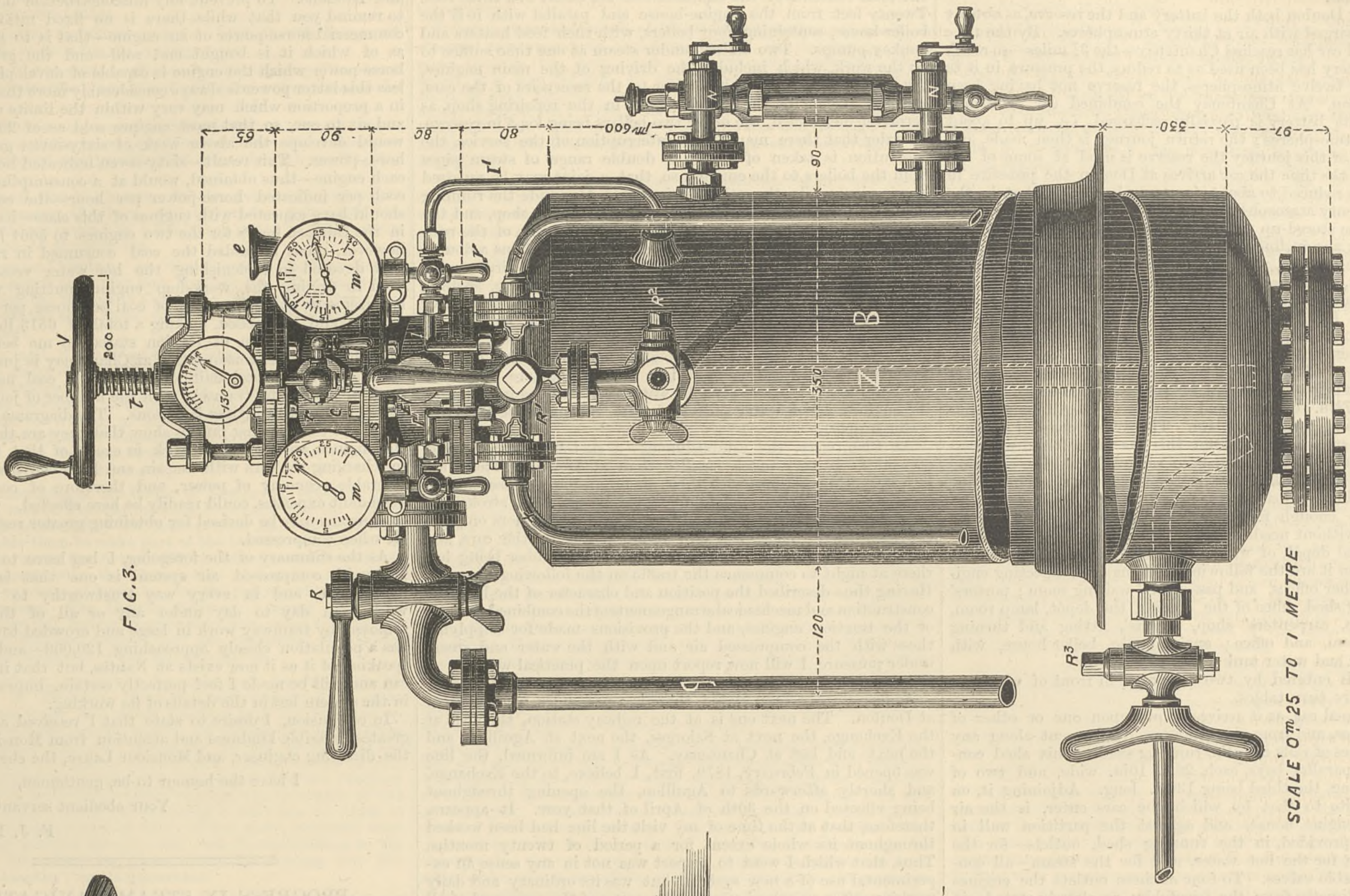


FIG. 3.

SCALE 0m.25 TO 1 METRE

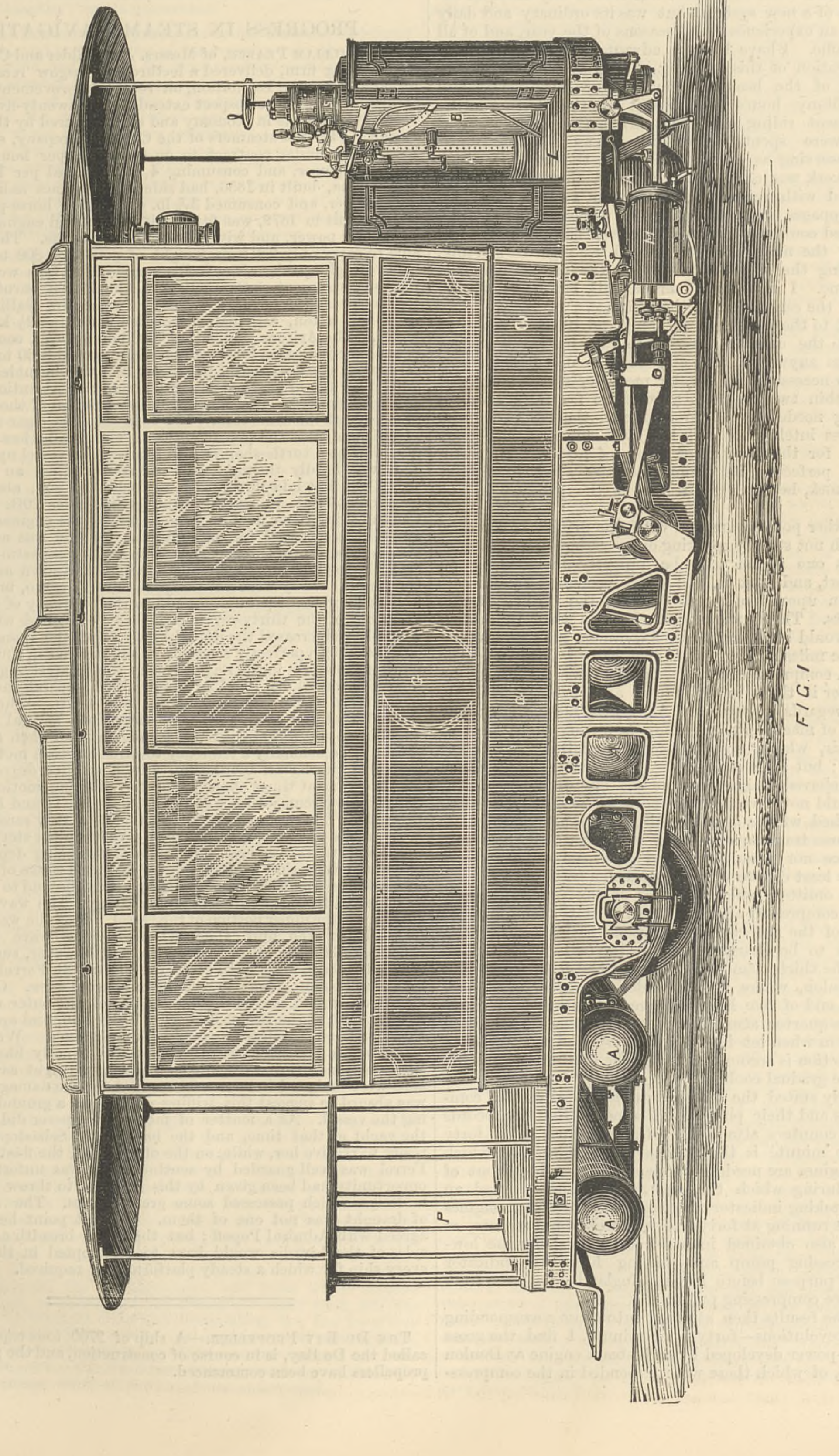


FIG. 1

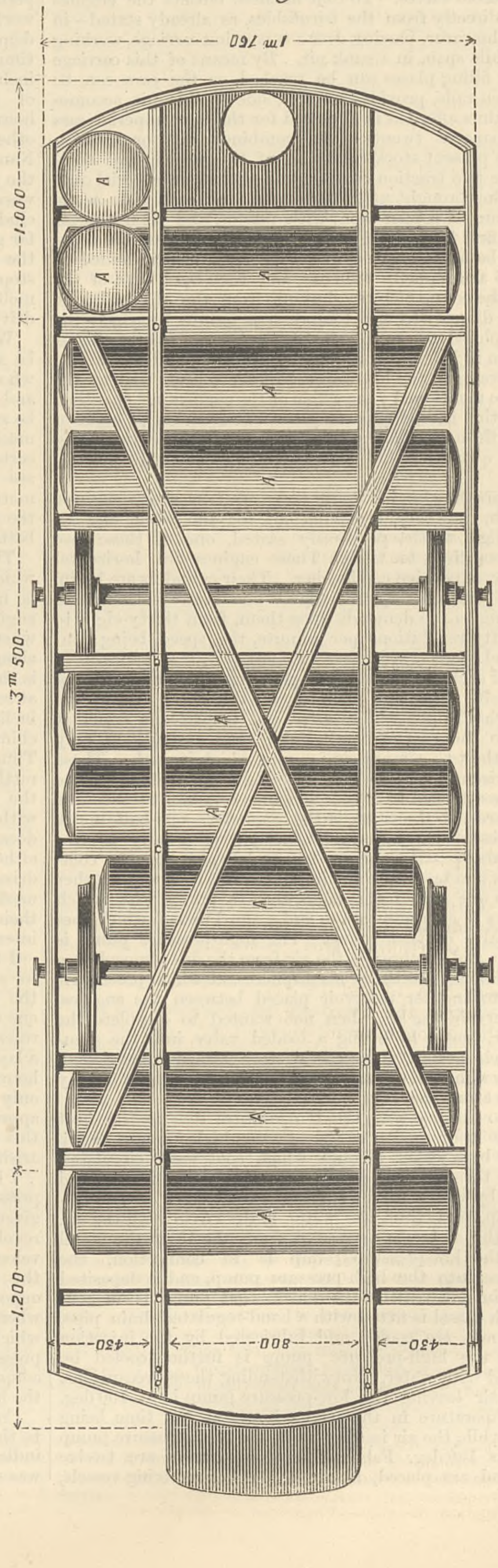


FIG. 2. PLAN OF FRAMING WITH CARRIAGE REMOVED

SCALE 0m.05 TO 1 METRE

pipe controlled by a three-way cock, either into the engines to propel the car or into the brake cylinder to arrest it. At the right hand of the driver there is the ordinary lever for working the link motion.

On leaving Doulon both the battery and the reserve, as already stated, are charged with air at thirty atmospheres. By the time the combined car has reached Chantenay—the $3\frac{7}{8}$ miles—so much from the battery has been used as to reduce the pressure in it to about ten to twelve atmospheres, the reserve not having been trenched upon. At Chantenay the combined car is turned round, and its battery is partially recharged, *i.e.*, up to about twenty-two atmospheres; the return journey is then made, and in the course of this journey the reserve is used at some of the inclines. By the time the car arrives at Doulon the pressure in the battery is reduced to about six atmospheres and that in the reserve to twenty atmospheres. It will be seen that the system of dividing the stored-up air into two portions affords the means of overcoming any incline or other obstacle, even quite towards the end of the journey, when the principal store of air, viz., that in the battery, is getting low in pressure.

The two traction engines of which I have made mention as being used at times of greater traffic are, as regards their machinery and mode of working generally, on the same principle as that of the combined cars, but they themselves carry no passengers, being used only to draw the imperial cars previously mentioned. Their engines are of larger dimensions, the cylinders being $7\frac{1}{2}$in. diameter, and $9\frac{1}{2}$in. stroke. All four wheels are of equal diameter, *i.e.*, 2ft. 4in. These were coupled so that the four were used as drivers, but this has been found unnecessary, the connecting-rods have been removed, and the adhesion of one pair of wheels is sufficient to propel the traction engine and to draw the two loaded cars behind it, while the charge of air carried is enough for the whole journey, out and home —$7\frac{3}{4}$ miles—without needing any replenishment at Chantenay.

The principal depôt, of which I append a plan sketch, is at Doulon, and on it are the following buildings:—Inspecting engineer's and other offices, and passengers' waiting room; porters' lodge, running shed, office of the chief of the depôt, lamp room, painters' shop, carpenters' shop, smiths', fitting and turning shop, store room, and office; engine house, boiler house, with chimney stack and water tank house.

The depôt is entered by two gateways, in front of which in the roadway are turn tables,

Each combined car, as it arrives, is put upon one or other of these turntables, and from these the cars can be sent along any one of four lines of rails into the running shed. This shed consists of three parallel bays, each 26ft. 10in. wide, and two of them 188ft. long, the third being 130ft. long. Adjoining it, on the side opposite to that by which the cars enter, is the air compressing engine house, and against the partition wall in six places are provided, in the running shed, outlets—for the compressed air, for the hot water, and for the steam—all controlled by suitable valves. To four of these outlets the engines can proceed directly from the turntables, as already stated—in one instance, however, passing over a traversing carriage, working along the middle span, in a sunk pit. By means of this carriage the two other filling places can be reached, or the cars can be put to stand on rails, provided on each side of this pit, accomodation being thus afforded in the shed for the four imperial cars and for as many as twenty-seven combined cars or traction engines. The present stock consisting of the twenty-two combined cars, the two traction engines, and their four imperial cars

The cars being brought up to the outlets, connection is made by means of curved copper pipes with unions, and then the air is introduced first from the general store contained in the accumulators—to be hereafter described—where it is maintained at from 20 to 25 atmospheres pressure, and then by a turn of the outlet valve, the connection is shut off from the accumulators, and is opened directly to the compressing pumps by which the charge is completed up to the 30 atmospheres. While this is going on steam is being introduced by its pipe, and passing up through the water in the hot-water cylinder reheats that to the 320 deg. before mentioned; the whole of the connecting, charging, and disconnecting is readily accomplished in from six to eight or ten minutes; the car or engine then backs out on the turntable, is turned one quarter round, and is ready to make its journey back.

In the compressing engine house there are four steam engines, two of which, however, are sufficient for the work, and on the days of light traffic, previously stated, one of these two is stopped from time to time. These engines are horizontal single cylinder, expansive condensing. Their cylinders are $19\frac{5}{8}$in. —half metre—diameter by 3ft. $3\frac{3}{8}$in.—one metre—stroke, and make, according to the demands upon them, from thirty-eight to as many as fifty revolutions per minute, the speed being controlled by hand.

Alongside of each engine is a bed plate very similar to that of the engine itself. The bed plate carries the outer end of the engine crank shaft, upon which outer end is placed a crank at right angles to the engine crank, but giving a stroke of only 1ft. $11\frac{1}{2}$in. to the two compressing pumps which it works. These pumps are horizontal, and are single acting; the pistons of the two pumps are attached to a rod which is common to the two. The pump nearest to the crank is $19\frac{5}{8}$ diameter—one-half metre —and compresses the air from atmospheric density to five atmospheres above atmosphere. Its outlet pipe for the compressed air has one branch which leads to a receiver, and another which leads to one end of the high-pressure pump, with which end it is always in communication, and a third branch which goes to the inlet valve of that pump. The high-pressure pump is $9\frac{1}{2}$in. diameter, and compresses the air from the five atmospheres, at which it receives it to thirty atmospheres, at which pressure it is delivered into another reservoir placed between the engines. From this reservoir the air, when not wanted to complete the charge in a car, passes, by lifting a loaded valve, into the accumulators which contain the general store already mentioned, where the prevailing pressure is, as previously stated, from twenty to twenty-five atmospheres.

In order to keep down the temperature due to the heat evolved in the compression of the air, the high-pressure pump is surrounded by a jacket through which cold water circulates, After passing through this jacket the same water is delivered into a funnel, by which the air enters the inlet valve of the low-pressure pump, and thus the water is drawn in with the air. A portion of the water is separated from the air in the vessel with which the low-pressure pump is in connection, the remainder goes into the high-pressure pump, and is deposited from the air in the vessel with which that pump is in connection. Each vessel is fitted with a hand-regulated drain pipe, thus both pumps are cooled and lubricated by the injection of water, and the high-pressure pump is further cooled by being jacketted with water. Notwithstanding these precautions, however, the air leaving the low-pressure pump is at 100 deg. Fah., the temperature in the engine house at the time being 56 deg. Fah., while the air issuing from the high-pressure pump is as much as 160 deg. Fah. The accumulators are twelve in number, and are placed, as are the other receiving vessels, below the floor of the engine house. Each accumulator is 7ft. $10\frac{1}{2}$in. long by 2ft. $10\frac{1}{4}$in. diameter. They are formed of steel plates 9-16 thick, double rivetted, and having semi-elliptical ends, the total contents of the accumulators are about 572 cubic feet. Twenty feet from the engine-house and parallel with it is the boiler house, containing four boilers, with their feed heaters and donkey pumps. Two boilers under steam at one time suffice to do the work, which includes the driving of the main engines, the supply of steam and hot water to the reservoirs of the cars, and the driving of the small engine in the repairing shop, as hereafter mentioned, the other two boilers being kept in reserve. In order that there may be no interruption of the service, the precaution is taken of having a double range of steam pipes from the boilers to the engines, so that a joint may be repaired in one pipe while the other is in use. Alongside the running shed there are the carpenter's shop, the painter's shop, and the repairing shop, into each of which the lay-by rails of the running shed are continued. The repairing shop contains a double smith's hearth, a larger ditto for heating wheel tires to be shrunk in, a medium size lathe and a small lathe, shaping machine and drilling machine, and vice bench with five vices. The various machines are driven by a small non-condensing steam engine, which, as already stated, is supplied with steam from the boilers of the main engines. Two large cylindrical wrought iron water tanks are placed on the tank house, these receive the water used for the injection of the engines, which water is derived from the mains of the town water supply.

At Chantenay, the establishment—a sketch of this is also appended—is very much smaller than at Doulon. There are but two steam engines with their air pumps, and these engines have cylinders only 1ft. $3\frac{3}{4}$in. diameter by 2ft. $3\frac{1}{2}$in. stroke, the air pumps being correspondingly small, and two boilers only are provided here. There are four filling places for the cars, and standing room under cover for five cars, this number being left there at night to commence the traffic on the following morning. Having thus described the position and character of the line, the construction and mechanical arrangements of the combined cars and of the traction engines, and the provisions made for supplying these with the compressed air and with the water and steam under pressure, I will now report upon the practical working of the system.

As has already been stated, there is a passenger waiting-room at Doulon. The next one is at the railway station, the next at the Exchange, the next at Salorges, the next at Aguillon, and the next and last at Chantenay. As I am informed, the line was opened in February, 1879, first, I believe, to the Exchange, and shortly afterwards to Aguillon, the opening throughout being effected on the 30th of April of that year. It appears, therefore, that at the time of my visit the line had been worked throughout its whole extent for a period of twenty months. Thus, that which I went to inspect was not in any sense an experimental use of a new system, but was its ordinary and daily working, after an experience of all seasons of the year, and of all demands of traffic. I have had the advantage of five days' continuous observation of this working of the system at Nantes, including that of the heavy traffic on New Year's Day and of Sunday. Many hours were spent at the depôts, other hours were spent riding with the drivers on the cars, and other hours were spent in walking about the quays at Nantes, and observing as one of the public the mode in which the tramway work was conducted. I found that the journeys were performed with regularity, and at an average speed, including all stoppages, of from five to six miles per hour, but a far greater speed could be attained if needed, that the driver had the car under the most absolute control as regards starting, stopping, varying the speed, and varying the pressure to surmount an incline. I not only observed this, but I tested it by driving one of the cars a part of the distance.

With respect to the facility of stopping and starting, it should be stated that the cars are arrested to take up any passenger who hails them anywhere, and also to set down anywhere, and that when necessary the car, by means of its air brake, can be stopped within two or three yards. So far from a skilled mechanic being needed to be in charge of the car, it is quite certain that less intelligence and less skill are necessary than are demanded for the conduct of a pair of horses. The automatic valve is perfect in its action, the cars starting without the slightest shock, however great may be the pressure in the battery.

There is another point connected with the driving of the cars, which, although not strictly speaking of an engineering character is nevertheless one which may be properly included in an engineer's report, and that is, the effect produced by the cars when in motion upon the horses drawing the ordinary traffic along the streets. The appearance of the cars when in motion is that which would be presented by a common tramcar running at seven to nine miles an hour of its own accord down a gentle incline, as with compressed air there is of course no smoke, no chimney, neither is there in these cars any visible machinery. Thus much as regards appearance. As regards noise, there is no rattle or jingle of machinery, but there is a very slight beat of the escaping air, which, however, could readily be done away with if desired; but I am told that the extent of beat which does exist is preferred, as a warning of the approach of the car, although I should not have thought it to be necessary, as each driver is furnished with a mechanically-blown horn, such as is used on the horse tramways in Paris. As a fact neither from their appearance nor from any sound produced do these cars interfere in the least degree with the ordinary traffic.

I find I have omitted, when speaking of the provision made for storing the compressed air in the cars, to state that I tested the tightness of the reservoirs and of the fittings by causing one of the cars to be charged both in its battery and in its reserve up to the thirty atmospheres, and I had it then put into a lay-by at Doulon, where it was under my eyes for several hours. At the end of five hours the reduction in pressure was only one and a-quarter atmospheres, and as the air had been appreciably warm when let into the battery and reserve, even this slight reduction is accounted for by the diminution in bulk, arising from the gradual cooling.

I have already stated the dimensions and speed of the compressing engines and their pumps. It appears from the records given by the counters attached to these engines that forty revolutions per minute is the average working rate, at which velocity two engines are needed for about thirteen hours out of the fourteen during which the cars are at work. I had an opportunity of taking indicator diagrams from the steam engines when they were running at forty-five revolutions per minute, at which speed I also obtained indicator diagrams from the low-pressure compressing pump and—having had my indicator adapted for the purpose before leaving England—diagrams from the high-pressure compressing pump.

Converting the results then attained into those corresponding to the average revolutions—forty—per minute, I find the gross indicated horse-power developed by each steam engine at Doulon was sixty-seven, of which there were expended in the compressing pumps 82 per cent. or fifty-five gross indicated horse-power, the remaining 18 per cent., or twelve gross indicated horse-power, being absorbed in overcoming engine and pump losses and frictions. To prevent any misconstruction it may be well to remind you that while there is no fixed ratio between the commercial horse-power of an engine—that is to say the power as of which it is bought and sold—and the gross indicated horse-power which the engine is capable of developing, nevertheless this latter power is always considerably more than the former, in a proportion which may vary within the limits of two to one and six to one, so that most engines sold as of 20-horse power would develope the above work of sixty-seven gross indicated horse-power. This result—sixty-seven indicated horse-power for each engine—thus obtained, would at a consumption of $3\frac{1}{2}$ lb. of coal per indicated horse-power per hour—the consumption I should have expected with engines of this class—have amounted in the thirteen hours for the two engines to 5661 lb.; to which, however, must be added the coal consumed in raising steam, that devoted to replenishing the hot water vessels, and that used in driving the workshop engine, putting these various requirements at another $\frac{1}{2}$ lb. of coal per horse per hour, 852 lb. more would be needed, making a total of 6513 lb.; the actual average consumption at Doulon stated to me being 3 tons, or 6720 lb., while the consumption at Chantenay is just the half of this, so that the total daily expenditure of coal used to do the work of the Nantes tramway with the number of journeys I have stated in the winter time is $4\frac{1}{2}$ tons. The diagrams I have taken from the compressing pumps show that they are throwing upon the engines an amount of work in excess of that really needed for charging the cars with the air, and I am convinced that considerable economy of power, and therefore of coal and other attendant expenses, could readily be here effected. I believe also that means may be devised for obtaining greater results from the air when compressed.

As the summary of the foregoing, I beg leave to say that the Mékarski compressed air system is one that is thoroughly manageable, and in every way trustworthy to do tramway work from day to day under any or all of the conditions imposed by tramway work in large and crowded towns—Nantes has a population closely approaching 120,000—and I say this, speaking of it as it now exists at Nantes, but that improvements can and will be made I feel perfectly certain, improvements not in the system but in the details of its working.

In conclusion, I desire to state that I received at Nantes the greatest possible kindness and attention from Monsieur Canivet, the directing engineer, and Monsieur Laure, the chef de depôt.

I have the honour to be, gentlemen,

Your obedient servant,

F. J. BRAMWELL.

PROGRESS IN STEAM NAVIGATION.

MR. WILLIAM PEARCE, of Messrs. John Elder and Co., the Clyde shipbuilding firm, delivered a lecture in Glasgow recently, at the Naval and Marine Exhibition, on recent improvements in marine architecture. His retrospect extended over twenty-five years, and showed the results in economy and speed secured by the compound engine. The first steamers of the Cunard Company, established in 1840, were under contract to go $8\frac{1}{2}$ knots per hour, indicating 740-horse power, and consuming $4\frac{7}{10}$ lb. of coal per horse power. The Persia, built in 1856, had side-lever engines indicating 3600-horse power, and consumed $3\frac{7}{10}$ lb. of coal per horse-power. The Gallia, built in 1879, was fitted with compound engines indicating 5000-horse power, and with a speed of $15\frac{1}{2}$ knots. The Persia was able to carry only 250 tons weight of goods, or 800 tons measurement of light goods. The Gallia carried 1700 tons weight, or 2000 tons measurement. Consequently, the Persia burnt $6\frac{1}{3}$ tons of coal for every ton of cargo it carried, while the Gallia burnt less than half a ton, although she carried the cargo $2\frac{1}{2}$ knots an hour faster. The Arizona, indicating 6000-horse power, consumed $1\frac{3}{4}$ lb. of coal per indicated horse-power, and carried 3400 tons weight of cargo at an average speed of $16\frac{1}{4}$ knots. She thus burnt less than 4 cwt. of coal per ton of cargo at a speed across the Atlantic faster than any yet recorded. Progress in the construction of the hull had not proceeded at the same rate. The twin-ship, the cigar-ship, and the Livadia had been the few exceptions. The Livadia has usually been described at a turtle-shaped hull bearing the vessel upon its back. This was hardly the case. In its construction, an oval-shaped vessel was first laid down with a double bottom, about 190ft. in length and 120ft. in width, with vertical sides 20ft. high. This was the ship proper, and in it were placed the engines and boilers and all the material for locomotion. To this was added on the outside a belting of thirty-seven water-tight compartments, 15ft. in breadth, to give the shape which has become known as the edge of the turbot. They were not designed to carry cargo, but merely as buffers to protect the hull and add to the buoyancy of the ship. If every one of the thirty-seven cells had been filled with water it would have increased the draught only 22in., the vessel would not only have been perfectly seaworthy, but steadier in rough weather. During the storm in the Bay of Biscay the greatest angle of heel on each side was $3\frac{1}{2}$ deg., and in longitudinal pitching the inclination at the stern was 5 deg. and at the bow 4 deg. The clinometer showed that the rolls were subdivided into several parts; the angular motion would cease for a moment and then again would proceed; occasionally a tendency towards a return motion could be perceived during an oscillation. In a smaller degree a similar tendency was at times observed in the pitching motion. A very remarkable circumstance was observed by the Grand Duke during this gale. The aneroid in his apartment, a very sensitive instrument, made by Dent, moved to one side when the stern was being lifted and to the reverse side when it was being depressed; the maximum deflection while lifting represented a rise of $17\frac{3}{4}$ft., and while descending $10\frac{3}{4}$ft., and these figures correspond to what would be expected from the leverage of oscillation. The waves had little effect upon the upper portion of the vessel, but on the waves receding from below the hull, the next aproaching wave struck the exterior cells with great force. No one, however, suspected any injury had been done until after the arrival at Ferrol, where the vessel was put in chiefly to rest the exhausted crew. On examination it was found that two plates in two of the outer cells on the external rim of the turbot had been bulged in, and appeared as if they had been struck with some solid substance. Wreckage was suggested as a possible cause, but it was equally likely that the heavy blows of the sea against structures so light as these outer cells were designed to be would account for the damage. Still, it was absurd to suggest this trifling damage as a ground for detaining the vessel. As a matter of fact, the Emperor did not require the yacht at that time, and the harbour at Sebastopol was not ready to receive her, while, on the other hand, the floating dock at Ferrol was well guarded by sentinels, It was unfortunate that opportunity had been given by this incident to throw doubt upon a design which possessed some great merits. The shallowness of draught was not one of them. On that point he had never agreed with Admiral Popoff; but the great breadth and receding sides of the Livadia would have to be adopted in the design of every ship for which a steady platform was required.

THE DE BAY PROPELLER.—A ship of 2700 tons capacity, to be called the De Bay, is in course of construction, and the gearing and propellers have been commenced.

RAILWAY MATTERS.

DURING the past year the North-Eastern Company spent about £15,000 on continuous brakes.

IT is expected that the Clacton-on-Sea Railway will be opened for public traffic in time for the coming season.

THE shares in the projected railway over the Brunig Pass, have now been fully subscribed, and it is thought the work will soon be commenced.

SOUTH AUSTRALIA now possesses 682 miles of railway, of which 112, or nearly one-sixth, were opened during 1880. There are now 306 miles in course of construction, 272 miles of which are 3ft. 6in. gauge.

WE understand that the increase in the number of passengers carried by the London, Chatham, and Dover during the past ten years was 13 millions instead of 1,300,000 as stated in this column in our impression of the 18th ult.

THE Moorswater Viaduct, on the Cornwall Railway below Liskeard, was opened on Friday last, the 25th ult. The viaduct is 150ft. high, being the highest in Cornwall. It is built of stone, has cost £30,000, and has been three years in course of construction. Its length is 800ft.

THE London and North-Western Railway Company have this week opened a direct route between Wolverhampton and Walsall, *viâ* Willenhall Bridge. The line will be a great convenience to passengers, the service of twenty daily fast trains running from Wolverhampton to Walsall in fifteen minutes—nearly twice as quickly as by the old route. Passengers from Darlaston to Wolverhampton will also be benefitted, as the circuitous route *viâ* Wednesbury will be now unnecessary.

A SELECT Committee of the House of Commons, presided over by Mr. Evans, met on Tuesday morning to inquire into the merits of the two Bills promoted by the Metropolitan Railway Company, the one to enable them to make part of the line for completion of the inner circle, under the Act of 1879, the other to authorise them to make agreements with the Corporation of London and other bodies for the purchase of land, &c., for the purpose of completing the City extensions. The District Railway Company petitioned against the latter Bill, but an arrangement was come to, and the preamble of the Bill was passed; and the committee ultimately decided that the preamble of the Bill was proved.

A LINE of railway, proposed to be made from London to Guildford by way of Kingston, promoted and supported by most influential landowners and others residing near the line, and so laid out that it does not, it is said, do damage to any of the beautiful commons and open spaces on the line of route, in the course of which it will open a district now totally devoid of railway accommodation, is opposed by the South-Western Railway Company, which has hitherto failed in supplying the wants of the inhabitants. This company has projected a rival line by which it proposes to take many acres of some of the most beautiful commons in Surrey, and yet not give any real accommodation to the inhabitants. Mr. Bryce has given notice for reading this Bill "this day six months" on its appearance.

THE Colonial Treasurer of Sydney made his financial statement on the 9th ult., and in the course of his remarks said that several sources of income had proved far more productive than had been anticipated—notably the railways, which yielded £1,594,000, or £89,000 in excess of his estimate. The railways last year yielded 4⅝ per cent. on the capital invested, and it was anticipated that this year they would be still more productive. Six hundred and seventy-nine miles of railway extension had been authorised, the greater part of which was now under construction, while for the remainder the plans were being completed. Surveys for a further extension of the lines had been made in various parts of the colony, and estimates for their construction were in preparation, and would be shortly submitted to Parliament for consideration.

SOME attention having been drawn in the chief daily papers to the great increase of railway capital, it may be of interest to state the amount of the increase for the current half-year on some of the great English railways. In the half-year ending with next June, the London and North-Western Railway Company proposes to expend not less than £1,016,818; the Midland Railway, £980,000; the Lancashire and Yorkshire Railway, £754,685; the Great Northern, £435,085; the North-Eastern Railway, £364,856; and the Manchester, Sheffield, and Lincolnshire Railway, £295,730. These six railways propose then to expend over £3,840,000 in the six months, a sum the immensity of which is almost exceeded by the variation in the proportion. The London and North-Western, for instance, proposes to expend £620,000 on lines and works that are open for traffic; the North-Eastern Railway only £129,856; whilst even the much smaller Manchester and Sheffield expects to spend £116,000. The diversity in the amounts is probably due to the different ideas held by different boards of directors on their responsibilities to the trades of the districts. The North-Eastern Railway has, as its chairman remarked a short time ago, a monopoly, and therefore it can apparently afford to neglect some of the claims that its district makes upon it.

TWO new railways were opened in South Australia just before Christmas. The frequency with which these additions to the colonial railways are announced shows the rapid growth of the colonies. In another year or two all the lines in the Colony, with some insignificant exceptions, will be brought into connection with each other. When the Nairne Railway is extended to Shashalbyn, a route will be open from 200 miles north of Port Augusta to Nilor Harbour, at the mouth of the river Murray, by rail, thence by steamboat into the heart of Queensland and New South Wales, and probably before long also by train to Melbourne, Sydney, &c. The lines formally opened on December 16th were an extension from Hallett to Terowie, twenty miles in length, and one from Jamestown to Yongala of 21½ miles in length. The former line is on the 5ft. 3in. and the latter on the 3ft. 6in. gauge. Both are laid with steel rails, and have cost, including rolling stock and stations, something like £6000 per mile. They run through slightly undulating country. Terowie is the end of the wide gauge system, being 120 miles from Adelaide. Thence the line is being made on the narrow gauge to join at Quorn the Great Northern Railway, which runs from Port Augusta, 200 miles inland, on the route of the future Transcontinental line, a work, the execution of which is looked upon as only a matter of time.

AN alarming accident took place on Saturday morning upon the North London Railway, between the Dalston and Mildmay Park stations. No person was killed, but about thirty passengers were more or less injured, and fatal results have followed in one or two cases. It appears that the St. Albans train, leaving Watford soon after eight o'clock, had proceeded on its way to Broad-street station nearly as far as Dalston Junction, when it was brought to a stand beneath the Boleyn-road Bridge by the distant signals at the western end of the station being against it. A slight fog prevailed at the time, and fog signals were in use, but so quickly did the accident follow upon the stoppage that there was not time to place them on the lines at the rear of the train. Closely following the Watford train was a Kensington train, the driver of which, probably owing to the fog, did not notice either the signals which were against him or the obstruction before him. The consequence was that this train ran with great force into that which was stationary. Both trains were heavily laden with passengers. Immediately the passengers had recovered from the shock a general rush was made for the carriage-doors, and those whose injuries permitted them to move, left the trains. Neither train left the metals, but the Watford train was driven along the line for a considerable distance. None of the company's servants were injured, though some had narrow escapes. Little or no damage was done to the permanent way, and neither of the trains had sustained he amount of damage which might have been anticipated.

NOTES AND MEMORANDA.

THE Thames Tunnel will have been opened thirty-eight years to-morrow.

TWENTY years ago on the 10th of December last, Queensland obtained separation from New South Wales. In the twenty years great progress has been made. In 1861 the population was 34,367; it is now 217,851. In 1861 the acres in cultivation were 3353; in 1880, 106,864. In 1861 there were of telegraph wires 169 miles; in 1880, 5871 miles. In 1861 there were no railways; in 1880, 503 miles. The shipping—tons—inwards and outwards—was 82,000; in 1880, 134,450,000. Exports increased from £523,477 to £3,434,034.

APROPOS of Solomon's assertion that "there is nothing new under the sun," we, the *American*, are informed by a Chinese encyclopædist under the article *Ye* (painting), that a certain Sir Ngoh possessed a *painted* ox which left its frame every morning, to go grazing, and returned to its frame at night to sleep there. The Emperor Tai Tsung—976-998, A.D.—having the picture brought to him, demanded an explanation from his Court, which none could give. Finally a Buddhist priest was found, who stated that the Japanese had the art of extracting a luminous substance from a species of oyster, which they collected and mixed with paint, rendering anything painted with the mixture invisible by day but visible by night, and doubtless the picture was painted in that way. Lately patents have been issued in England and on the Continent for a luminous matter resulting from calcining and manipulation of oyster shells and sulphur, and producing a luminous paint of more or less duration and intensity, and very sensitive to an induction spark.

IN his recent inaugural address as president of the Society of Engineers, Mr. Horsley said that the modern saving in coal in pig iron making in the foundry, and the enormous saving of fuel in steel making, is to a great extent the cause of the increasing surplus of coal throughout the country. Mr. Hunt's figures show that the average quantity of coal consumed has declined since 1871 to the extent of 16 cwt. per ton of pig iron made in the United Kingdom. As the annual make of pig is almost 6,000,000 tons, the total economy is about 4,800,000 tons per annum. Another saving occurs in the manufacture of steel rails by the Bessemer process, the quantity of coal required to produce a ton of such rails being generally admitted to be 65 per cent. less than that required for iron rails. The annual production of steel rails is about 650,000 tons, so that we have a reduced consumption of fuel of about 1,166,500 tons as compared with iron rails. There are also other departments of ironmaking in which the consumption of solid fuel has been greatly reduced of late years by the use of the waste gases from the furnace, as well as by improved methods of working.

DR. SCHAL, a German chemist, directs attention to the preservation of wood, which may be effected by impregnation with paraffin. It is especially effective for wood employed in alizarine manufactures, where it is exposed to the decaying action of damp, acid, and alkaline lyes. Wooden vessels which become totally rotten in two months, last for two years when impregnated with paraffin. The preparation of the wood is effected by drying it in warm air for three weeks, then steeped in melted paraffin to which has been added some petroleum, ether, or sulphuret of carbon. In preparing this bath great care must, however, be exercised, owing to the inflammability of its ingredients. To prevent the paraffin from escaping from the pores, the wood should be coated with oil varnish or soluble glass, washed after drying with diluted hydrochloric acid. The silicic acid thus formed closes the pores from the outside, and protects the paraffin from the action of water. Paraffin, melted with equal parts of linseed or rapeseed oil, is also, according to Dr. Schal, useful for coating iron vessels, which in chemical manufactories are otherwise very liable to rust.

A LECTURE experiment illustrating the combining and glowing of platinum in a current of illuminating gas with the rendering luminous of a Bunsen burner frame, when the gas is previously heated, is thus described in the *Scientific American* by Mr. C. Gilbert Wheeler, of the University of Chicago:—"An ordinary Bunsen burner is increased in length to the extent of, say, 3in. or 4in., by adapting a platinum tube to the upper end of such a calibre as to snugly fit. On placing the latter in a horizontal position, and opening the cock, the ordinary flame is first obtained; thereupon, with another burner, the platinum tube is heated to bright redness, the non-luminous flame now becomes the ordinary luminous one. The change is most marked when the cock is not more than half open. Now remove the second burner and place the first upright; the platinum then begins to glow at the upper edge, which glowing soon passes down and extends nearly throughout its entire length. On closing the cock and opening, after incandescence has entirely ceased, it will again glow as before; this time, however, without flame at its extremity."

THE official account of the publishing trade in Germany shows that during the year 1880 the number of new works or new editions published within the Empire was 14,941. This includes 300 maps. The increase on the previous year was 762: and for the three years 1878-80 the increase over the production of 1877 was 1016, or a little over 7 per cent. Educational literature of all kinds in 1880 included 1950 works; politics, law, and statistics, 1557; theology, 1390; the number in this class does not, as in England, exceed in number those of any other class. *Belles lettres*, 1209; "works for the people," 657; philosophical, 125; map, 301; medical and veterinary, 790; the natural sciences, 787; literature for the young, 496; antiquities, ancient classics, and Oriental philology, 533; modern languages and old German literature, 506; history and biography, 752; geography, 356; mathematics and astronomy, 201; military science and the management of horses—they are included in the same category—353; trade and manufactures, 583; architecture, mechanical engineering, railways, mining, and shipbuilding, 403; forest culture, hunting, &c., 112; domestic economy and farming, 433; the fine arts and stenography, 627; freemasonry, 20; miscellaneous, 423.

ACCORDING to the *Annuaire* of Brussels Observatory, for 1881, there are at present 118 public astronomical observatories in full activity, viz.:—84 in Europe, 2 in Asia, 2 in Africa, 3 in Oceania, and 27 in the two Americas. The United States alone have 19, Mexico has 2, Brazil, Chili, Columbia, Ecuador, the Argentine Republic, and New Britain, one each. In Europe, Prussia is the State which has most public observatories, it has 29; next come England and Russia, which have respectively 14 and 12; then Italy, which has 9; Austria, 8; France, 6; Switzerland, 4; Sweden, 3; Holland, Norway, Spain and Portugal, 2 each; lastly, Belgium, Greece, and Denmark. The oldest observatory in operation at present is that of Leyden, founded in 1632; it has thus existed nearly two centuries and a-half. That of Copenhagen was instituted a few years later; it dates from 1637. Forty years after, the observatory of Paris was founded, and in 1675 that of Greenwich. Of observatories founded in the eighteenth century, 41 still exist; 3 were founded between 1700 and 1725, 6 between 1725 and 1750, 19 between 1750 and 1775, and 13 between 1775 and 1800. Of those instituted during the present century, 19 date from between 1800 and 1825, 17 from 1825 to 1850, 39 from 1850 to 1880. The observatories of Italy date from the second half of the eighteenth century. In Russia the oldest observatory, that of Moscow, was founded in 1760, those of Warsaw and Wilna date from 1714, the nine others being instituted in the present century. In Germany the oldest observatory is that of Berlin—1705. Four new observatories have been erected within the last two years. In France, after that of Paris, which dates from 1667, the oldest observatories are those of Marseilles, 1702, and Toulouse, 1775. Those of Meudon, Lyons, and Montsouris are recent. The oldest observatory of the New World is that of Rio Janeiro founded in 1780. After it the oldest is that of Chicago, 1822. The other observatories of America have been constructed in the second half of this century. In America, since 1870, six observatories of the best construction and equipped with the most perfect instruments have been established.

MISCELLANEA.

AN outer harbour and canal south of the Semaphore, Adelaide, South Australia, is proposed.

THE dock fees during the repairs to the Sorata, the vessel which went ashore with a lot of machinery for the Melbourne Exhibition, will, it is said, cost the Orient Company £2500.

MESSRS. SHAND, MASON, AND CO., write to us to say that although a fire occurred on Wednesday morning on their premises, Upper Ground-street, Blackfriars, they have been enabled to make arrangements for carrying on their business as usual.

MR. S. MORLEY, M.P., has consented to preside at the Horological Institute, Northampton-square, on Monday, March 14th, at 7 p.m., when a lecture will be delivered by Mr. John Standfield, C.E., on "Cheap Patents and National Prosperity," between which there is supposed to be some direct connection.

IT is said that the total cost of transferring the obelisk from Egypt to Central Park, New York, was £20,515. Mr. William H. Vanderbilt paid the whole sum, the amount of which does not indicate that the Americans were able to have profited much by the experience gained in transporting and erecting obelisks elsewhere, and at much less cost.

A FIRST prize for portable steam engines, also a first prize for vertical steam engines have been awarded at the Melbourne Exhibition to Messrs. Ransomes, Head, and Jefferies, and, we are informed, that Messrs. Ruston, Proctor, and Co. have been awarded the highest prize for engines and thrashing machines at the Melbourne Exhibition.

IT is said that a process of dephosphorisation of phosphoric pig, devised by Herr Osann, of Dusseldorf, has been found successful at the works of Herr Krupp, on the Ruhr, and that the process secures equal production with the simple Bessemer process, equal ease in blowing, greater duration of lining and bottom of the converter, and facility for using any direct iron from the blast furnace.

IN December last Messrs. Yarrow and Co., of Poplar, received an order for six of their first-class torpedo boats of the "Batoum" type, 100ft. in length, from the Greek Government, and on Wednesday of last week the trial of the first one took place, this boat having been completed in the short period of a little over two months. The remaining five vessels of the same class will, it is understood, be finished in rapid succession.

THE *Anglo-Brazilian Times* reports that the Brazilian corvette Vital de Oliveira returned to Rio Janeiro on the 24th ult., after completing her voyage of circumnavigation of the world in 430 days, 268 of which were spent at sea. During the trip she traversed 35,045 miles. At Valparaiso, when leaving, the officers found that some unknown Chilian officers had paid their hotel bill. In all ports the officers received great attention.

WRITING from Sydney on the 30th of December last, a correspondent of the *Colonies and India* says that the 200,000 inhabitants of Sydney and suburbs are somewhat alarmed at the prospect of a water famine in consequence of the exceedingly small rainfall during the past year. The dams at Botany are supposed to supply Sydney with her present consumption of 4,000,000 gallons per day, while the stream only gives 3,500,000 gallons per day. At this rate the supply will soon be exhausted. But we hope to have rain in a few weeks at farthest. If not, we shall have to carry water by train from the river Nepean, about twenty-four miles distant. Works are now in progress for directing the waters of Nepean into Sydney, at a cost of one and a-half million of money, but nearly two years must elapse before they are completed.

A NEW process for the refining of petroleum is being tested, and is expected, the *American Manufacturer* says, to effect a great saving over the one now in vogue. By the old process, the refined article, at a fire test of 110 deg., costs 6⅛ cents per gallon, the process involving a loss of from 30 to 65 per cent. In bringing this grade of oil to a test of 150 deg., it loses 30 per cent. in the process of distillation; to raise it to 175 deg. it loses 45 per cent., and to 185 deg. 65 per cent. By the new process the oil is treated without heat, and, it is claimed, loses nothing. Oil at 110 deg., that costs 6⅛ cents per gallon, on being raised to a fire test of 150, is worth 13¾ cents per gallon; to 175, from 15 to 17 cents per gallons and if raised to 185 deg., is worth from 18 to 20 cents per gallon. The cost of raising it to any one of these tests is one cent per gallon.

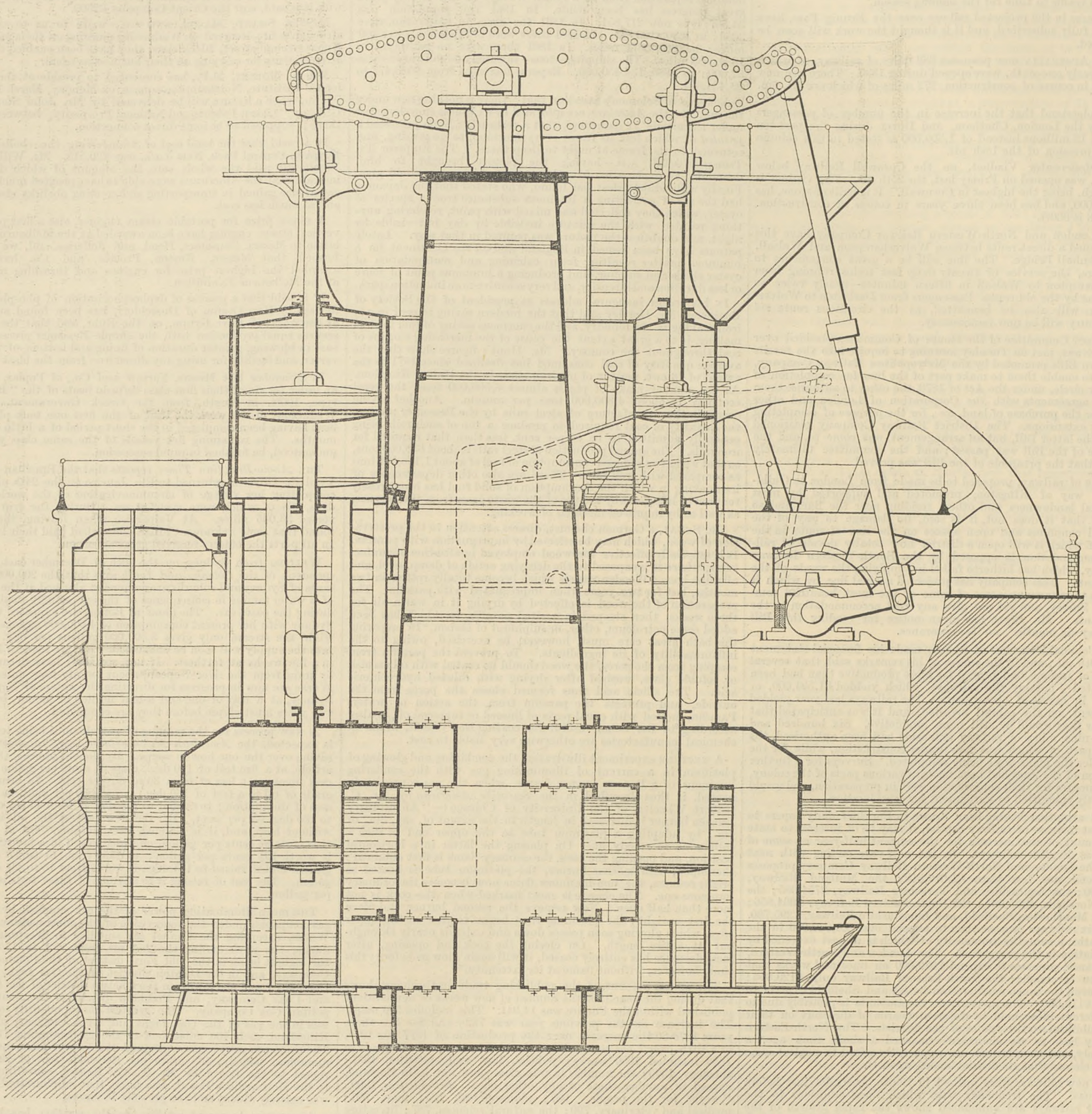
THE mean illuminating power of the gas supplied by the three gas companies under the supervision of the Metropolitan Board of Works, excepting the Cannel gas supplied to Westminster, was during the week ending the 2nd ult. from 17·1 to 17·8 candles, the highest being in the Old Ford district of the Commercial Gas Company, and in the Dalston district of the Gas Light and Coke Company; and the lowest in the Chelsea district of the Gas Light and Coke Company, and Peckham district of the South Metropolitan Gas Company. The greatest mean quantity of sulphur was in the gas of the Gas Light and Coke Company supplied to Kingsland, each 100 cubic feet of the gas containing 17·9 grains. The same company's gas contained the largest mean quantity of ammonia, namely, 0·5 grain per 100 cubic feet at Bow. The report to the Board by Mr. T. W. Keates, consulting chemist to the Metropolitan Board, also shows that sulphuretted hydrogen was entirely absent and the pressure in excess.

ACCORDING to recent intelligence the weather has been very favourable to block-setting at the Colombo breakwater, and the work has consequently made great progress. In spite of every exertion, the supply of concrete blocks could not be fully kept up to the demands of the "Titans" engaged on the block-setting. We hear that no less than 185½ft. of the breakwater, which is 36ft. in width at the bottom and 34ft. at the top, had been fully completed during the month of December, and that to latest date the total length of the work amounted to 1998ft., exclusive of the root where it connects with the shore. Altogether, by the latest advice, over 600ft. had been added during the present working season. In one previous season the length completed, owing to the exigencies of the weather, had only been 60ft. Unfortunately, a long-shore wind was, according to the *Colonies and India*, interfering greatly with the dredging operations within the breakwater, and the hopper-barge ordered from England was anxiously awaited.

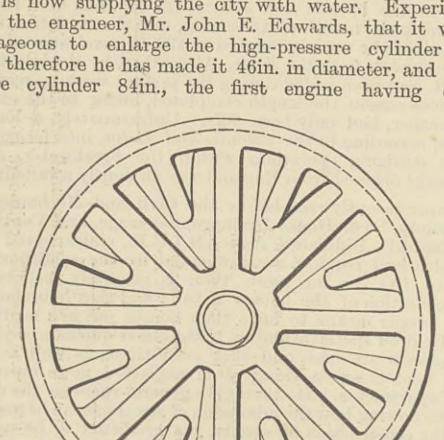
IN a paper recently read before the Civil and Mechanical Engineers' Society, "On House Drainage, Sewerage, and Ventilation," Mr. Reginald E. Middleton, Assoc. M.I.C.E., endeavoured to show that health and comfort are influenced by the condition of the houses we live in far more than is generally believed; the general condition of the houses is bad; and that householders do not take proper means to have their houses put in a healthy condition. He drew special attention to the closet question, saying that syphon closets are best, and that even these, as well as others, must be kept clean—a thing often neglected, more especially in servants' apartments. He then gave general rules for the drainage of houses, showing how the admission of sewer gas can be prevented, and for the construction of sewers, the gradients to be used, and the consequences of admitting rainwater to the sewers, and the difficulties in the way of excluding rainwater. Reviewing the means of disposing of sewage, he said that the sewage should be returned to the land, and that it should not be overloaded with water; that it should be put on as fresh as possible, and that sewage farming, in the ordinary sense of the word, seemed the best means of doing this. He considered that chemical means had been tried and found wanting. The latter part of his paper was devoted to some points relating to house and sewer ventilation, his opinion being that the lights and fire should be supplied with air by separate means, but that if this was done it was absolutely necessary to provide for the circulation of the air in the room; and for this he gave some directions as to the methods of arriving at the necessary quantity of air and size of ventilating apertures and shafts.

COMPOUND PUMPING ENGINES, DETROIT WATERWORKS, U.S.A.

MR. JOHN E. EDWARDS, ENGINEER.

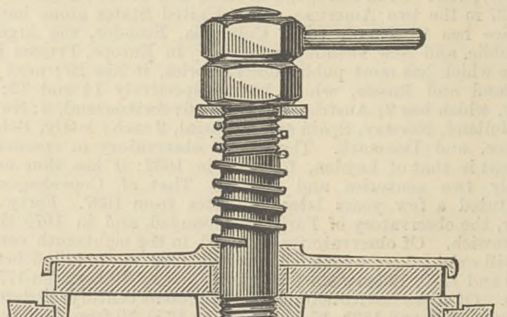


We illustrate above a compound pumping engine just completed for the city of Detroit, United States. The machinery was constructed by Mr. Samuel F. Hodge, Riverside Ironworks, Detroit. This engine is in many respects a duplicate of one built in 1876, which is now supplying the city with water. Experience had taught the engineer, Mr. John E. Edwards, that it would be advantageous to enlarge the high-pressure cylinder in this engine, therefore he has made it 46in. in diameter, and the low-pressure cylinder 84in., the first engine having cylinders



VALVE SEAT.

42in. and 84in. in diameter. The pumps are 41in. in diameter; stroke of piston 6ft. The fly-wheel is 24ft. 4in. in diameter, and weighs 33 tons. The beam is built up of four ¾in. steel plates, 5ft. 6in. wide, 26ft. long, rolled in England. The beam complete weighs 13½ tons. The crank shaft is 15in. in diameter, and total weight of the machinery is nearly 200 tons. The steam and exhaust valves—not shown in the engraving—are the ordinary double poppet valves, worked from a counter shaft operated by mitre gear from the crank shaft; the counter shaft carries the excentrics for vibrating the rocking shaft; the simple long-toe Steven's cut-off gear is used. The air-pump is worked by a rod and beam from the outer end of crank shaft, as shown by dotted lines. The suction valves of the water pumps are of leather on brass seats. The delivery valves, 232 in all, are of the disc class, of rubber, shown to an enlarged scale in detail. The Commissioners' engineer, Mr. Edwards, has for many years adopted the plan of slightly



SECTION OF VALVE.

inclining the ribs and wings of the seat so as to give the water an oblique direction, which is sufficient to impart a small rotating motion to the valve, and thus obviates the trouble of the valve beating on the seat at the same spot at every stroke. Mr. Edwards has some valves which have been in use five years, which are perfectly smooth on the under side. Water is pumped to a height of 127ft., the average consumption is 15 million gallons per day, the engine making nine revolutions per minute. The central column which carries the beam is lagged with black walnut bound with brass bands nickel plated. The cylinders, and steam chests, steam pipes, &c., are first covered with asbestos composition and then lagged with black walnut.

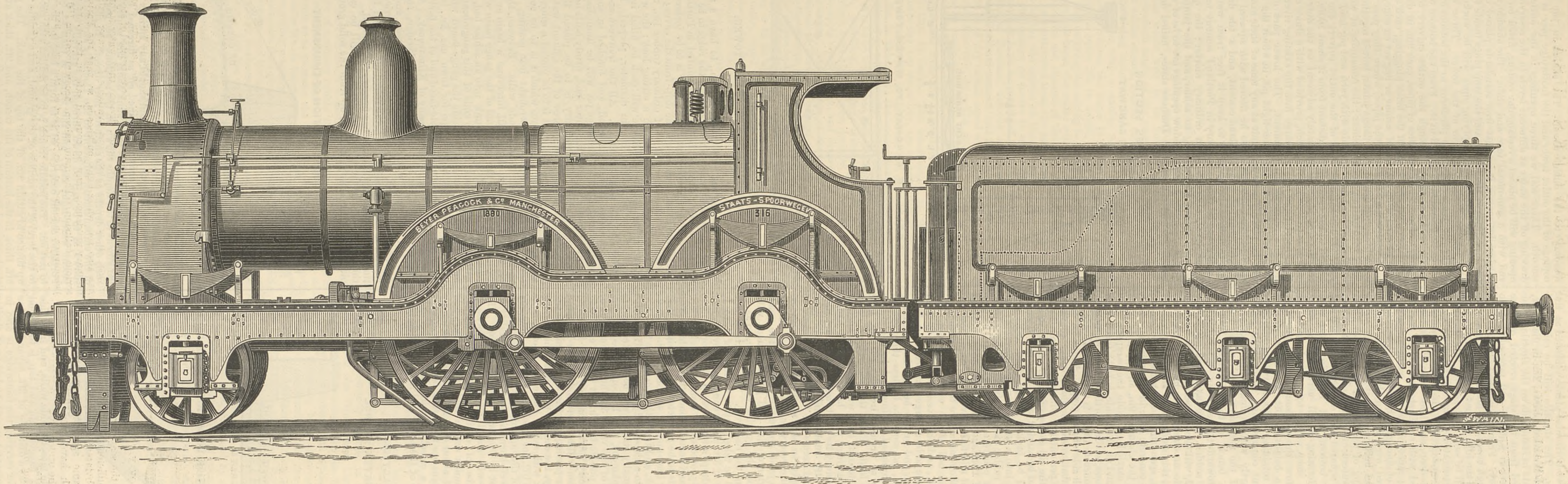
The engine was commenced in May, 1879, and the contract price was £16,400. An elevated cast iron platform with a brass railing surrounds the engine; this platform is 4ft. above the main floor of engine-room, and serves as a working floor for the engine tenters. The foundation and walls of the well are built of Ohio limestone. The rising main leading from the engine is 42in. diameter.

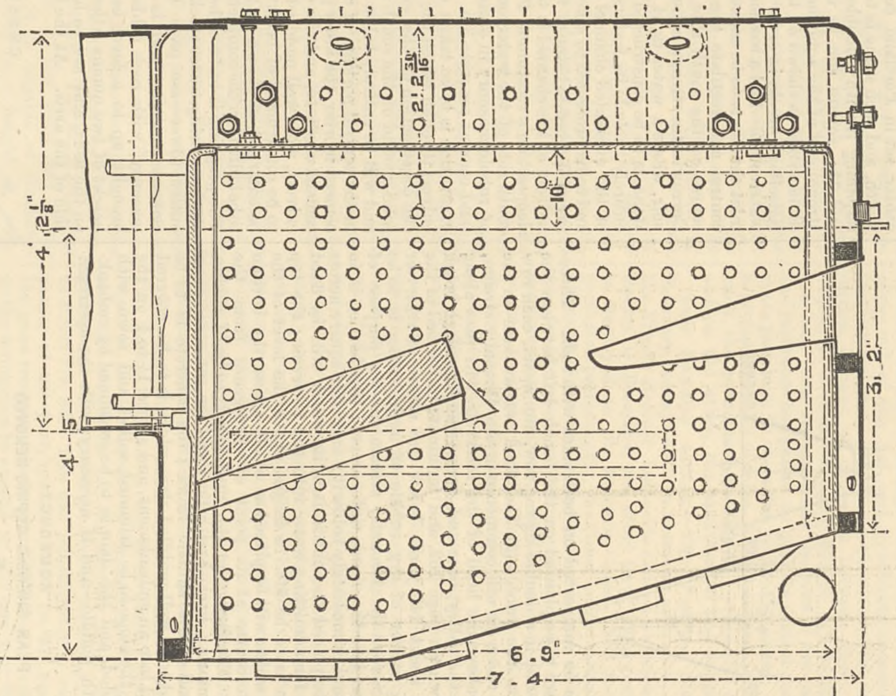
Leeds Civil and Mechanical Engineers' Society.—The usual fortnightly meeting of this Society was held at the Yorkshire College on Friday evening, the 25th ult., the President in the chair, when a paper on the "Photophone" was read by Mr. L. Boyd. A discussion followed, and the meeting terminated with a vote of thanks to the author of the paper.

The Allan Line.—The new Allan Liner Parisian, of a gross tonnage of 5050 tons, made an experimental run from the Clyde on Saturday last, previous to her departure for Liverpool. She has been built by Messrs. R. Napier and Sons for the Montreal Ocean Steamship Company's Royal Mail service between Liverpool and Montreal. In some respects she is a considerable advance upon others of her class, and for a few days, that is until the launch of the Servia on the 1st inst., she held the distinction of being the largest steel steamer afloat. She is 450ft. long, 46ft. broad, and 36ft. deep, and will carry a load of 10,000 tons. She stood high in the water on Saturday, with about 2ft. of her screw showing, so she was not tried for speed, but her three-cylinder compound engines are constructed to indicate 6000-horse power, and to propel the ship from 15 to 16 knots an hour. She has four double-ended boilers, with 24 furnaces. Her hull is constructed of steel, with an inner and outer skin, 5ft. apart, divided into water-tight compartments, designed for safety, but available for water ballast. She has also ten water-tight bulkheads, so that the Parisian, with ordinary prudence, may be counted safe in the event even of a serious collision. The main saloon, accommodating 150 first-class passengers, is placed in the fore-part of the vessel, and so are the state rooms, the second-class state rooms are still further in front, and the annoyance of the screw is left for the third-class passengers, who are otherwise well cared for.

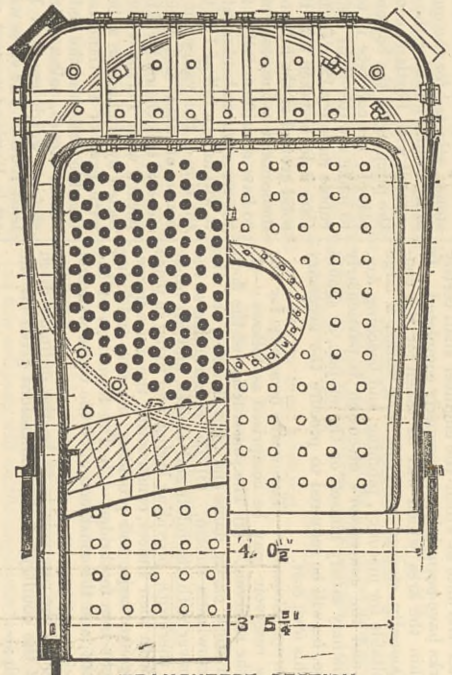
EXPRESS LOCOMOTIVE FOR THE HOLLAND STATE RAILWAY.

MESSRS. BEYER, PEACOCK, AND CO., GORTON FOUNDRY, MANCHESTER, ENGINEERS.





LONGITUDINAL SECTION



TRANSVERSE SECTION

For some weeks past high-speed locomotives have been discussed in our pages, and thanks to the courtesy of Mr. Peacock, of the firm of Messrs. Beyer and Peacock, of Manchester, we are enabled to publish above what may be regarded as the latest result of English engineering skill as applied to the production of high-speed locomotives. The engine is one of several built to work the fast trains which run from Flushing, across Holland, into North Germany, in connection with the steamers from Queenborough to Flushing, and they have been specially designed to maintain an average speed of sixty miles an hour with trains weighing 200 to 220 tons without the engine.

It will be seen at a glance that the engine is of the simplest possible type; there is not a superfluous part about it. The wheel base is very long, but the engine has been designed to work on a road nearly level and very straight, and the leading axle is provided with Cortazi's axle-boxes, with a traverse of half an inch each way. The fire-box is of the Belpaire type; we illustrate it in cross and longitudinal section.

Some of the advantages obtained by this type of engine are: (1) It admits of large cylinders with easy steam and exhaust ports, and large wearing surfaces of all the gearing, including long bearings for the axles. (2) It allows the trailing axle to be placed under the fire-box, with a simple spring arrangement, without risk to the bearings from the fire. (3) It gives a good distribution of the weight over the several axles without the employment of artificial weights, as shown in this engine, namely:—

	When full. Tons cwt. lb.	When empty. Tons cwt. lb.
On leading wheels..	12 0 3	11 1 2
On driving wheels..	13 12 0	12 10 0
On trailing wheels..	13 7 2	12 11 1
Total	39 0 1	36 2 3

Nothing is more remarkable perhaps about this engine than its small weight as compared with its great power.

The engine is of the inside cylinder double-frame type. The cylinders are 2ft. 4½in. apart centre to centre, and the valves are driven by the ordinary link motion. The leading axle has outside bearings only, as much as 11in. long, while the driving wheel axle has bearings both inside and out, the former 6in. and the latter 9in. long. The trailing axle has bearings outside only, 9in. long. The fire-box, it will be seen, is of enormous size, and sloped so as to clear the trailing axle. The engine is fitted with a complete Westinghouse brake apparatus.

We may also point out that the fire-box crown is stayed by direct stay bolts, and for this reason the fire-box shell top is made flat—Belpaire's system—which the makers are of opinion is the only correct shape for direct staying. These engines are worked at 150 lb. pressure, and for lines having sharp curves the design is well adapted to admit of a bogie, where such is considered necessary. We have here, we think, a specimen of a good, simple, straightforward, honest example of locomotive engineering, without "trickery" or over-scheming; and as such it will, we believe, compare favourably with any high-speed engine of the day in either this or any other country. The following are the principal dimensions of this engine:—

Gauge	4ft. 8½in.
Cylinders inside	18in. dia. by 26in. stroke.
Wheels	No. 6
Wheels, leading	4ft. dia.
Wheels, driving	7ft. dia. } coupled.
Wheels, trailing	7ft. dia. } coupled.
Boiler	10ft. 9in. long by 4ft. 2¼in. dia.
Tubes	242 of 1⅞in. outside dia.
Copper fire-box..	6ft. 9in. long by 3ft. 5¾in. wide by 5ft. 3in. high front by 4ft. high back.
Heating surface in tubes	1221·9 square feet.
Heating surface fire-box	102 square feet.
Total	1323·9 square feet.
Area of firegrate	23·4 square feet.
Tender, upon	6 wheels, each 4ft. dia.
Water tank to contain	2400 gallons.
Fuel space	142 cubic feet.

Weights.	Loaded. Tons. cwts. qrs.	Empty. Tons. cwts. qrs.
Engine	39 0 1	36 2 3
Tender	27 10 2	12 1 1
Total	66 10 3	48 4 0

The hauling power of this engine is as nearly as possible 100 lb. for every pound average pressure on the pistons. With 150 lb. in the boiler, the cylinder pressure may be fairly taken as 100 lb.; the gross tractive force being thus 10,000 lb., which, at a resistance of 30 lb. per ton, would suffice to haul a load of 300 tons. To draw a gross load, including the engine and tender, of 260 tons, would require a cylinder pressure of 78 lb., which would be obtained by 140 lb. of steam in the cylinder cut off at a little less than half stroke. It will thus be seen that the engine is well proportioned for the work it has to perform. It is much to the credit of English engineers that they have thus been able to beat foreign competitors on their own ground, and send locomotives to the Continent.

CONTRACTS OPEN.

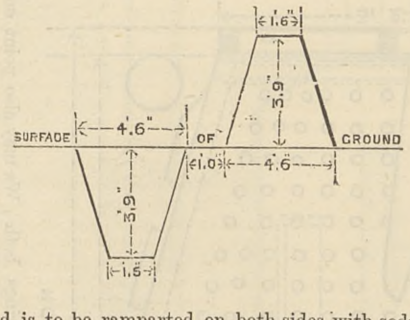
SLIGO CORPORATION WATERWORKS.

CONTRACT No. 1.—CONSTRUCTION OF RESERVOIRS, &c.

This contract includes :—(1) The construction of a substantial and water-tight storage reservoir on the Doonally and Kilsellagh streams, with all fencing, excavation, embanking, puddling, soiling, sodding, pitching, beaching or gravelling, forming and gravelling footways, flagging, concrete, masonry, brickwork, culverts, outlet tower, with its inlets and sluices, providing, laying, and fixing discharge pipes and sluices, construction of sluice house, discharge pits and gauge basin, providing and erecting footbridge, construction of floodwater courses, with their check dams and inlet shuttles, of the waste weir and byewash, and all other works or matters necessary or incident to the completion of the storage reservoir. (2) The construction of a service reservoir, with an inlet well and straining tower on Farranacardy Hill, with all fencing, excavation embanking, puddling, soiling, sodding, pitching, forming and gravelling footways, flagging, concrete, masonry, brickwork, laying and fixing inlet, waste, discharge and cleansing pipes with their sluices and stop valves, providing and erecting straining apparatus, and all other works or matters necessary or incident to the completion of the service reservoir. (3) The laying of a line of pipes about 4300 yards in length, partly of 7in. and partly of 8in. in diameter, between the storage reservoir and the service reservoir, and the construction thereon of a small relief tank, in a field adjacent to the public road, near where it crosses over the Doonally stream, at a short distance above Doonally House. (4) The maintenance in perfect order and condition, subject, however, to the full use of them by the Corporation, of all the works comprised in the contract, for the space of six calendar months after the date at which the engineer shall certify that the several works have been duly and properly completed. It is believed that within the area which will be taken for the construction of the Doonally storage reservoir and works, a large quantity of stone suitable for masonry, pitching, and beaching, &c., may be procured; and the contractor's attention is particularly called to this, that he may satisfy himself on the subject, as should it turn out otherwise, he will be required to procure the necessary stone elsewhere, at his own cost.

The Doonally Storage Reservoir.—The works necessary for the construction of this reservoir may be comprised as follows :—(1) The fencing round the reservoir. (2) The construction of the flood water courses, with their check dams and inlet shuttles, and the diversion of the Carrowlustia stream. (3) The construction of the outlet culvert and tower with its inlets and sluices, and all other ironwork connected therewith, providing laying and fixing in place the discharge pipes with their sluices, constructing the sluice house, discharge pits, and gauge basin, and providing, erecting and fixing in place the wrought iron footbridge. (4) The formation of the reservoir embankment, and the construction of the waste weir and byewash.

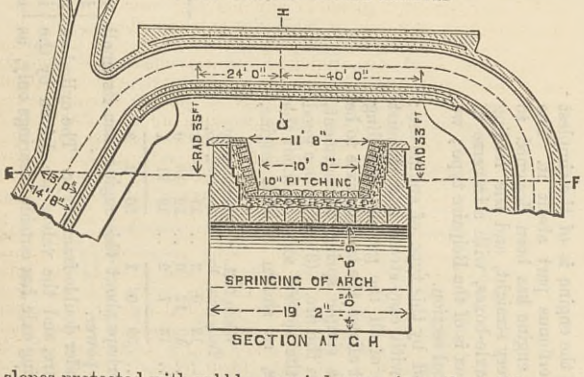
(1) The fencing round the reservoir is to be the ordinary ditch and mound fence of the country, of the dimensions given on the accompanying sketch :—



The mound is to be ramparted on both sides with sods. Three-years-old quicks are to be planted on the bench left between the ditch and the mound in a double zig-zag row, 4in. apart, each row to contain four to the yard. (2) The flood watercourse on the north side of the reservoir will commence in the Doonally stream, about fifty yards above the head of the reservoir, will pass along the north side of the valley, over and across the Kilsellagh brook by aqueduct, shown on page 162, and terminate in the bed of the Doonally stream about 140 yards below the centre of reservoir embankment. A barrier of dry rubble of large stones is to be placed obliquely across the Doonally stream for the purpose of diverting the water into the flood watercourse; this barrier is to be 6ft. in height and immediately below it; and built square across the stream is to be placed the check dam, in which will be fixed the inlet shuttles for admitting water into the reservoir; the top of this check dam is to be 6ft. in height above the level of the course of ashlar, which will be placed as a sill across the bottom of the flood watercourse at its point of divergence from the Doonally stream. The facing on the upstream is to be of rubble set in hydraulic mortar, backed with Portland cement concrete up to 3ft. above the sill of the shuttle frame; the concrete is to be backed and topped with well puddled clay, which is to be covered with earth formed into an embankment, and sloped $1\frac{1}{2}$ to 1 on the downstream side, the slope to be trimmed, soiled, and sown with grass-seed, or sodded, and the dam is to be continued by embankments hearted with puddle—and, if necessary, with the upstream

AQUEDUCT

PLAN SHEWING COPING REMOVED

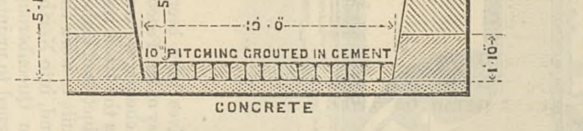


SECTION AT G H

slopes protected with rubble—carried across into the solid ground on one side and into the embanked side of the flood watercourse on the other, so as to form a perfectly water-tight barrier across the valley. Two rectangular culverts 3ft. wide and 1ft. 6in. high, with rubble side walls and flanged sole and top, all set in Portland cement mortar, are to be constructed through the dam, see page 162, for the purpose of conveying water into the reservoir from the inlet shuttles. The top of the dam is to be covered with sods, having in the centre a flagged or paved footway, 2ft. wide on each side of the planked stage erected above the shuttle frame. The shuttles and shuttle frames of well-seasoned British oak are to be wedge-shaped, and to have an opening of 3ft. in width, and to rise 1ft. 6in. Four tapered guides, one on each side of the shuttles, are to be bolted to the shuttle frames to press the shuttles when closed up against the faces of the frames. The shuttles will be composed of two horizontal planks stiffened at the back by three vertical timbers. The shuttles will be raised and lowered by wrought iron square-threaded screws, 2in. in diameter, working into the gun-metal nuts in standards on the shuttle. The screw shafts are to be worked from the stage erected over the shuttle frames, and to terminate in squared and tapered ends to take an ordinary sluice-cock key. From its commencement to the aqueduct crossing the Kilsellagh brook, the flood watercourse is to be constructed by cutting into the hill, so that the side of the new channel next the reservoir shall be sunk at least 5ft. into the solid ground. The bottom of the excavated channel is to be protected by a pitching of rubble stone on edge, 9in. deep, set on a bed of Portland cement concrete, 4in. deep, and laid by hand, the larger joints or interstices to be keyed with small stones. Each portion not to exceed 20ft. in length; must be grouted with one part of Portland cement to five parts of fine gravel, well mixed together, with water in buckets poured over it and thoroughly worked with a broom into all the spaces between the stones, so as to fill them flush up. In the pitching of the bottom of the channel at the commencement of the watercourse, is to be laid a course of ashlar kerbstones on edges, squared and dressed on the top and joints, extending across the bottom, and 1ft. 6in. into each side of the new channel, forming a sill across it, no stone to be less than 1ft. 9in. deep, and to extend into the hard clay at least 9in. below the bottom of the pitching. The sides of the channel to a height of 5ft. above the pitched bottom are to be protected by retaining walls of rubble masonry, set on a bed of Portland cement concrete 4in. thick, built partly with hydraulic mortar and partly with ordinary lime mortar, as shown below. At the top of the retaining wall, on the south side of the water course, a bench is to be formed 10ft. in width, with a slope of $1\frac{1}{2}$ to 1 towards the reservoir—this bench and slope are to be trimmed and sodded. The aqueduct across the Kilsellagh brook, see page 162, will have a semi-circular arch of 12ft. span; it is to be of rubble masonry, with heavy flat-bedded stones, selected for the quoins, ring stones, and ashlar copings set in hydraulic mortar; the arch, spandrils and abutments are to be covered with Portland cement concrete 15in. in thickness, on which the pitching of the bottom of the channel 9in. in depth is to be placed; the concrete is to be carried up inside the parapets, so as to make a water-tight lining, and on the inside is to be faced with rubble masonry 12in. in thickness, set in Portland cement mortar. Care is to be taken that the concrete lining is carried well into the solid ground of the hill on each side of the gorge. From its commencement to the reservoir embankment the flood water course is to have a uniform fall of 20ft. per mile, or 3in. per chain. From the reservoir embankment to the old course of the Doonally stream it will have a fall of 1 in 6, and be carried down the hill forming the side of the valley; it will be broken up by cross walls and masses of rubble and concrete into a succession of cataracts; the sides of this channel will be of rubble masonry in hydraulic mortar, backed with Portland cement concrete, the bottom will be protected by pitching on a bed of Portland cement concrete, grouted with grout of Portland cement and fine gravel; the space between the side walls and the bed of the channel are to be filled with large rubble stones, taken from the bed of the existing stream. No stone to weigh less than 120 lb., and the average weight to be at least 150 lb. The cross walls are to be of large flat-bedded rubble, set in Portland cement mortar, and are to be coped with heavy ashlar, set in Portland cement, no stone to be less than 2ft. in width, and each stone is to be cramped or dowelled to the stones adjoining it with a double row of wrought iron dowells 5in. long and 1in. square run in with lead. From the western or down stream end of the aqueduct, a branch flood watercourse of smaller dimensions, as shown on the drawings, is to be constructed to the Kilsellagh brook, in order to convey its flood waters into the new watercourse—and a barrier of dry rubble and a check dam with inlet shuttle is to be constructed across the bed of the stream, to control and regulate the supply to the reservoir. The watercourse on the south side of the reservoir will commence in the Carrowlustia stream, about 45 yards above the head of the reservoir, where a water-tight barrier of clay and puddle, faced with stone, is to be constructed across the existing watercourse, so as to entirely exclude its waters from the reservoir. The northern side of the excavated channel is to be taken out to a slope of 1 to 1, and to be protected to a height of 3ft. above the bottom by a pitching of flat-bedded stones 9in. deep, set square to the slope. The bottom of the channel is to be protected by a similar pitching 6in. deep-set on a stratum of Portland cement concrete, 3in. thick. The south side of the watercourse is to be protected by a retaining wall of rubble masonry in ordinary lime mortar, set on a bed of Portland cement concrete 3in. thick, and from the top of the wall the excavation is to be taken out to a slope of $1\frac{1}{2}$ to 1. (3) The outlet culvert through which the Doonally stream will be diverted during the construction of the embankment, will be constructed in the solid ground on the south side of the valley in the position shown, and will be entirely below the puddle trench. It will be, excepting in the central portion, of ordinary rubble masonry set in Portland cement mortar, the inner portion will be surrounded with Portland cement concrete, and the outer portion, for the upper half of the culvert, with well puddled clay, the central portion of the culvert to be constructed of brickwork with ashlar angles or quoins, is to be enlarged, as shown on page 162, for receiving the brick plugging to be built after the completion of the embankment and watercourses. The plugging is to be of hard well-burnt bricks, equal in quality to the best Bridgewater stocks, set in Portland cement mortar. The outlet tower—see page 162—will stand on a base of Portland cement concrete, and is to be of ordinary flat-bedded rubble masonry, with rock ashlar quoins set in hydraulic mortar, and brought up to a level bed at about each 2ft. of height, or at the height of two quoins: the quoins are to be rock faced, but dressed on the beds, and are to have a chisel draught $1\frac{1}{2}$in. wide on each side of the arris. At the base of the tower and in front of it, is to

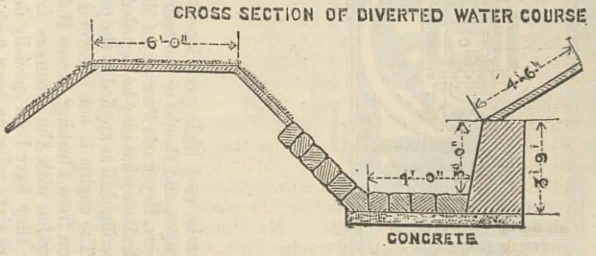
CROSS SECTION OF

DIVERTED WATER COURSE



CONCRETE

CROSS SECTION OF DIVERTED WATER COURSE

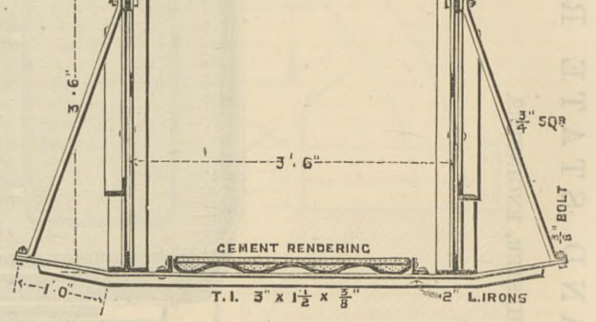


CONCRETE

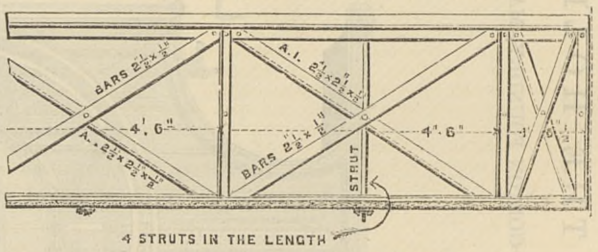
be constructed a pit with rubble masonry side walls, and from this pit a culvert 2ft. square, with flagged sole and top, is to extend into the reservoir, terminating at a distance of 3ft. beyond the toe of the inner slope. The pier for carrying the footbridge is also to stand on a base of Portland cement concrete, and to be of similar masonry to the outlet tower. The ashlar in the strings and copings of the outlet tower and the footbridge pier is to be tooled smooth. There will we three openings in the outlet tower for drawing off the water at different levels in the reservoir. In each opening will be placed a rectangular casting, fitted on the outside end with a gun-metal face and slide. The outside slides will be worked by screws from cast iron standards placed on the top of the inner face of the tower, and the stop plugs inside the tower for closing the supply and emptying pipes will be worked by screws from the cast iron platform of the tower. Three wrought iron ladders, to reach from the platform to the bottom of the tower, are to be provided and fixed in it. From the bottom of the outlet tower, and extending through the outlet culvert to the sluice house, are to be laid two lines of pipes, each 9in. in diameter. In the culvert, on either side of the brick plugging, each separate pipe is to be carried on a block of ashlar or flag set on edge, with a seat for the pipe worked in it; the pipes, where they pass through the brick plugging, are to have flange joints, bolted together, and made tight with gutta-percha washers; the remainder of the joints are to be spigot and faucet, made with yarn and pig lead in the usual way. From the outer end of the outlet culvert the pipes are to be laid to the sluice house, distant from it about 100ft. On one of the lines of pipes, immediately adjacent to the outer end of the outlet, is to be a short branch, provided with a sluice cock, so that this line of pipes may discharge into the existing river course outside the reservoir embankment. The lower part of the sluice house will consist of a water-tight pit, in which the sluice valves will be placed, so as to admit at any time of their examination or removal, and this pit is to be floored with squared and dressed flagging, jointed with Portland cement, and a tile drain is to be laid from it as shown, so as to keep it free from water; the side walls are to be rubble masonry in Portland cement mortar up to bench level, above that in ordinary mortar; the quoins to be selected stones assimilating to ashlar, and the jambs, sills, and lintels of the doors and window openings are to be of ashlar. The house is to be roofed with Duchess slates, nailed down to $\frac{3}{4}$in.

CROSS SECTION

OF GANGWAY



DETAIL OF GANGWAY TO WATER TOWER

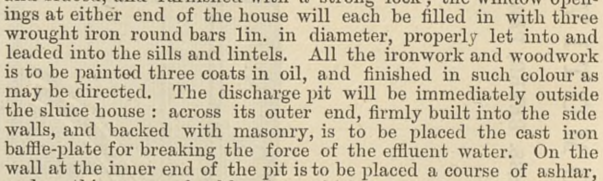


4 STRUTS IN THE LENGTH

FOOT BRIDGE TO OUTLET TOWER.

boarding carried on rafters 6in. by 2in., to have a ridge board, collar braces, and wall plates as shown, the ridge to be surmounted with a fire-clay ridge tile, bedded and jointed in Portland cement, and an ordinary paved channel or gutter is to be formed along each side of the house to carry off the drip from the eaves; the door at the side of the house will be of ordinary timber 1in. thick framed and braced, and furnished with a strong lock; the window openings at either end of the house will each be filled in with three wrought iron round bars 1in. in diameter, properly let into and leaded into the sills and lintels. All the ironwork and woodwork is to be painted three coats in oil, and finished in such colour as may be directed. The discharge pit will be immediately outside the sluice house: across its outer end, firmly built into the side walls, and backed with masonry, is to be placed the cast iron baffle-plate for breaking the force of the effluent water. On the wall at the inner end of the pit is to be placed a course of ashlar, and on this course of ashlar, into which it is to be sunk and properly leaded, is to be fixed a wrought iron grating, the ends of which are to be built into the side walls. Between the discharge pit and gauge basin there will intervene a basin or trough with two cross walls; at the outer end of the gauge basin will be placed a gauge-board, which is to be sunk into an ashlar bed, and jointed with Portland cement, and the ends of this gauge-board are to be built into the side walls. Outside the gauge-board will be a small pit, from which the supply pipe for town use, &c., is to be laid. The sluice cocks are to be double-faced and of the best class manufactured by the Glenfield Company of Kilmarnock. Access to the outlet tower is to be by a wrought iron footbridge, shown below, one end of which will rest on the outlet tower, and the other on the embankment, on a wooden sill or beam carried on folding wedges so as to admit of its being raised or adjusted from time to time, until the embankment has finally consolidated. The ends of the iron girders in the middle of the bridge will be carried on a pier of rubble masonry, brought up from the solid ground

CROSS SECTION OF EMBANKMENT



The Embankment.—The base of the embankment is to be prepared for the reception of the earthwork by the removal, for a depth of 9in., of all soft material, the exposed surface is then to be turned over to a depth of 6in., and should any springs or swampy places appear, they are to be drained off as directed by the engineer. A puddle trench is to be sunk along the centre of the embankment to the depths shown on the sections—see page 162—or to such other depths as the engineer may direct. In the central part of the embankment, adjacent to the Doonally stream, a trench, as shown, is to be carried down through the gravelly clay, to the subjacent water-tight clay, and the trench is then to be filled with Portland cement concrete, so as to form a base for the puddle wall to rest on. The puddle trench is to be refilled with good puddle up to the level of the surface of the ground, and a puddle wall carried up thence to within 9in. of the top of the bank. The puddle to be 8ft. thick in the bottom of the trench, and 9ft. thick at the top of the bank, and from thence to increase in thickness towards the base at the rate of 2in. per foot of depth. The puddle is to be composed of good clay, from which the stones have been carefully picked out; it is to be broken up or pounded fine, and to be laid on in courses not exceeding 8in. in thickness, to be puddled by soaking each course in water for twelve hours, and then cutting it lengthways and crossways and treading it, for which purpose each workman shall follow or walk behind his puddling tool. Each course is to be cut and worked into the one immediately below, so that the whole shall form a homogenous and water-tight mass, and each course is to be carried out to its full extent across the valley before another course is deposited on it. As the stability of the embankment will depend mainly on the proper perforance of the puddling, the contractor's attention is particularly called to the foregoing stipulations, which will be strictly enforced. Those portions of the embankment on each side of the puddle wall marked on the drawing "selected material" are to be made up in layers 2ft. thick, and to be of the most clayey and adhesive material—from which all large stones have been picked out—selected for the purpose. The inner slope three horizontal to one perpendicular, to be covered with a rubble facing 2ft. 6in. thick, composed of flat bedded stones, closely pitched on edge at right angles to the slope and bedded on a substratum of rubble or broken stone, from 9in. to 12in. in thickness; in the upper part of the slope the pitching is to be from 12in. to 15in. thick, and to diminish in thickness towards the foot of the slope, which is to protected with loose rubble, no stone to be of less than 4 lb. weight. When finished the slope is to be covered with a coating of fine gravel, which must be worked with a scraper or with a stiff broom into the spaces between the stones, so as to thoroughly fill them, and give the slope the appearance of being covered with a sheet of stone. The outer slope, two horizontal to one perpendicular, to be carefully trimmed and covered with soil 6in. deep, and sown with a mixture of rye grass and clover seed. A gravelled footway 6ft. in width, with a gravel coating 6in. deep is to be constructed along the top of the embankment for its whole length. The embankment must be carried up to a height sufficient to allow for all shrinking and settlement. The semi-circular waste weir to be formed in the solid ground in the south-western angle of the reservoir is to be 60ft. in length, coped with ashlar stones, bedded on a rubble wall set in hydraulic mortar; the coping stones are to be worked to a proper radius and cramped together with a double row of wrought iron cramps, leaded into the stones, the water to fall 1ft. over the wier, and be received into a basin 2ft. in depth, a mass of rubble being piled along the wall carrying the coping to break the force of the falling water; from this basin the water will pass off and flow down the byewash into the old channel of the Doonally stream. The byewash is to be constructed from the south end of the reservoir embankment to the old course of the Doonally stream; it is to be 9ft. wide, the bottom or invert is to be dished out, or of a segmental form; it is to be protected by rubble pitching 9in. deep, set on a bed of Portland cement concrete, the pitching to be grouted with Portland cement and fine gravel and sand; the side walls are to be of dry rubble coped with sods.

The Service Reservoir, &c.—The embankments round the reservoir are to be made water-tight by puddling the portions of the embankments adjoining the inner slopes with the most clayey and tenacious material from the excavations, deposited in layers not more than 12in. in depth. The inner slopes, up to a height of 2ft. 6in. above the top water line, are to be protected by a paving or pitching of rubble 9in. in thickness, laid or bedded on a stratum of gravel 3in. in thickness; the spaces between the stones being carefully pinned in with smaller stones and filled up with gravel. Generally it is to be understood that all stipulations with regard to earthwork, puddling, pitching, trimming, soiling, and similar matters, which have already been specified for the Doonally reservoir, are to apply equally here, and the work is to be performed in a similar manner. The bottom of the reservoir is to be covered with a stratum of Portland cement concrete, 4in. thick, rendered smooth on the surface, and is to have a fall of 1ft. from the bottom of the side slopes to the centre of the reservoir. At the north-eastern angle of the reservoir is to be constructed the inlet well; the walling is to be of ordinary rubble masonry set in Portland cement mortar, coped with tooled ashlar coping, 1ft. 9in. wide, and 6in. deep; the bottom is to be concrete rendered smooth, and across it, built into the side walls, is to be fixed the cast iron baffle plate, and the concrete is to be carried up behind the side and end walls of the well. The inlet pipe, 8in. in diameter, is to be built into the lower part, and the outlet pipe, 9in. in diameter, is to be built into the upper part of the well, and laid from it into the reservoir. The central cleansing pit is to be 5ft. 6in. in diameter and 1ft. 6in. deep, the bottom is to be covered with concrete, rendered smooth, and the walling is to be of ordinary rubble masonry, coped with bricks on edge, both set in hydraulic mortar. The waste or overflow will be a cast iron stand pipe, 12in. in diameter, having an enlarged or bell-mouth, and is to be placed on the south side of the reservoir. The straining tower is to be of ordinary rubble masonry, set in hydraulic mortar, and to be coped with tooled ashlar, 6in. deep, and projecting 2in. beyond the outer faces of the walls. On three sides of the outlet tower, near the bottom, are to be left openings 4ft. by 2ft. 6in., with proper sills, jambs and lintels, for admitting water to the interior of the tower, and in front of these openings are to be placed the timber framings for the straining screens. The wire gauze strainers are to be placed vertically at the bottom of the tower; the frames are to be of oak made in halves, the strainers are to be of copper wire gauze, forty strands to the inch, placed between two coarse copper wire nets of about 1½in. mesh; the whole to be placed between the halves of the oak framing, which are then to be screwed tightly together by brass countersunk screws. The strainers are to be counterbalanced by iron weights suspended in the interior of the tower. From the straining tower is to be laid about 100 yards of 11in. pipes to connect with the pipes to the town, laid under another contract. From the 11in. pipe in front of the sluice cock is to be laid about 30 yards of 3in. cast iron ventilating pipe to extend back to the embankment of the service reservoir, where it will terminate in a perforated globular head above the top water level. The cast iron pipes and special castings connected therewith, and the sluice cocks will be provided by the Corporation of Sligo. A relief tank for a private supply to Mr. Parke is to be constructed within a walled enclosure measuring 37ft. 6in. by 16ft. 6in. The tank will be of ordinary rubble masonry set in hydraulic mortar, and on a concrete bed, which is to be carried up behind the side and end walls so as to make the tank watertight. The enclosing walls are to be 9ft. in height above the surface of the ground, and of common rubble masonry.

Instructions are then given for the cutting of trenches, providing pipe-line marks, and laying 7in. pipes and 8in. pipes, &c., from the storage reservoir to the service reservoir, and 3in. pipes for supply to Mr. Parke. The line of 7in. pipes, about 1300 yards in length, will commence at the gauge basin of the storage reservoir and terminate in the relief tank adjacent to the bridge. The line of 8in. pipes about 2920 yards in length will commence in the relief tank above mentioned and terminate in the inlet well of the service reservoir on Farranacardy Hill. The line of 3in. pipes about 450 yards in length will commence at the relief tank, and terminate at the Ivy Bridge over the Doonally stream.

CONTRACT No. 2.

This contract relates entirely to the laying and fixing cast iron pipes, sluice cocks, fire plugs, and street wells, &c., for the water supply of the town. The pipes vary in size from 11in. to 3in. in diameter. On the line of 11in. pipes there will be placed two scouring cocks of 3in. diameter; these cocks will be fixed on branch pipes of 3in. in diameter, to terminate in pits of rubble masonry, set in Portland cement mortar; there will also be four air valves, each of which is to be connected with the main pipe by about 12ft. in length of ¾in. lead pipe weighing 8 lb. per lineal yard. The pipes, castings, sluice cocks, fire plugs, air valves, and street wells will be delivered to the contractor on the quays of Sligo. The pipes, excepting such proportion as may be necessary for meeting changes of direction in the line of pipes, about 10 per cent., have turned and bored joints, the remaining one-tenth of each size of pipes have spigot and faucet joints to be made with lead in the usual way. Tenders must be sent in sealed envelopes, and on forms which will be provided by the engineers, addressed to the town clerk of Sligo, Mr. James McKim, and marked outside, "Tender for Waterworks," on or before noon on the 16th inst.

THE CUNARD STEAMSHIP SERVIA.

THE rapidity with which the dimensions of vessels built for the mercantile service have increased in recent years has been remarkable, and such as to outstrip all former conceptions as to size and driving power. Within the past two or three years Messrs. Elder and Co., of Glasgow, constructed the Arizona, 5147 tons, and 1200-horse power; the Orient, 5386 tons; and the Austral," 5500 tons, the two latter for the Orient line; and likewise the Alaska, for the Guion line, 6250 tons. The City of Berlin, built by another firm, has a tonnage of 5491, her length being 488ft. Each of these vessels was regarded at the time she was put into the water as exceedingly large; but they are left far behind by the Servia, which was launched on Tuesday last from the shipbuilding yard of Messrs. James and George Thomson, Clydebank, Glasgow. The Servia has been constructed to the order of the Cunard Company, Limited, for their royal mail service between Liverpool and the United States. Our readers will recollect that a short time ago the Messrs. Thomson built a large and remarkably fine vessel named the Gallia, for the Cunard line. The Servia is constructed of steel, but is of much greater dimensions. As regards length and tonnage she exceeds all other merchant ships hitherto built, whilst in the matter of engine power, she will surpass anything afloat. The dimensions of the Servia are:—Length over all, 530ft.; breadth, 52ft.; depth, 40ft.; and tonnage, 8500. She is constructed with a double bottom on the longitudinal bracket system, and she will carry 1000 tons of water ballast. Her cargo capacity will be 6500 tons, with 1800 tons of coal. The machinery consists of three cylinder compound surface condensing engines, one cylinder being 72in. and the other two each 100in. in diameter, with a stroke of piston of 6ft. 6in., and it is anticipated that the indicated horse-power will be 10,500. Steam will be furnished by seven boilers, one single and six double-ended, all made of steel, with corrugated furnaces thirty-nine in number. The weight of the propeller shaft is 26½ tons, and the propeller, boss, and blades, which are made of Vickers' steel, weigh 38 tons. It may further be stated here that the anchor davits are 8in. and the chain cable pipe 22in. in diameter. The Servia is to all intents and purposes a five-decker, having four decks and a promenade, the latter, which is reserved for the passengers, being very large and spacious. The forepart of the promenade contains the steam steering gear, captain's room, and flying bridge. On the upper deck forward is the forecastle, while behind are the light towers for signalling. The captain's and officers' sleeping apartments adjoin the mid-ship-house, and next to the engine skylight there is a smoking room, 30ft. long by 22ft. wide, which can be entered either from the deck-house or the cabins below. Near the after deck-house is the ladies' drawing room, a magnificent apartment, with access from the deck, and also leading abaft into the music room, the dimension of which is 50ft. by 22ft. Behind the music room is the grand staircase, leading to the main saloon and the cabins below on the main and lower decks. The great saloon is 74ft. long and 49ft. wide, having a clear height under beams of 8ft. 6in., and it affords sitting accommodation for 350 persons. The panelling and upholstery of the saloon, and indeed of all the apartments, are very fine. There are 58 state rooms in the vessel, and accommodation for 450 first-class and 600 steerage passengers, besides a crew of 200 officers and men. The ship will carry twelve fully-equipped lifeboats. Built according to the Admiralty requirements for war purposes, the Servia is divided into nine water-tight portions, a special feature being the arrangement of the water-tight doors, which, in case of accident, can be shut from the upper deck in a few seconds. All the frames and beams of the ship have been rivetted by Twedell's hydraulic rivetter, as was also the keel, which consists of five thicknesses, the total thickness being 6¾in. Three of the decks are of steel, the upper covered with yellow pine, and the second and lower decks with teak. To give them the power of resisting heavy seas all the deck-houses and fittings are of iron, and strongly rivetted to the steel decks beneath. The Servia has three masts, which will carry a good spread of canvass. Great attention will be paid to her furnishings, and she will be provided with the newest and best appliances for steering, ventilation, heating and other purposes.

We are glad to see that the value of ample pumping power is now fully recognised by the owners of our great steamship lines. The Servia is fitted with three of Messrs. John and Henry Gwynne's direct-acting centrifugual pumping engines, two of which are capable of discharging 11,000 gallons of water per minute each; one of them is sufficient to circulate the water in the condenser, the other being held in reserve. They are so arranged that either engine may work either pump, or quite independently of each other as circumstances require; if necessary both engines can pump from the bilge. The third pumping engine will do the ordinary work of the ship and pump from the ballast tanks and bilge; it is capable of discharging 1800 gallons of water per minute to a height of 40ft. All the Cunard steamers, it may be noted, are fitted with Gwynne's pumping engines in a similar manner. The Garth Castle and the Drummond Castle of Donald Currie and Co.'s line, recently launched, are also fitted with them.

It may be of interest to state that, including the Servia, the Cunard Company have at present 30,000 tons of shipping in course of construction on the Clyde. Messrs. Thomson are building the Aurania, 7000 tons, and the Pavonia, 5000 tons, for the Cunard line; and Messrs. Barclay, Curle, and Co., of Glasgow, are building the Alligator, Dromedary, and Gorilla, and Messrs. Blackwood and Gordon, of Port Glasgow, the Lizard and Locust for the Belfast Line.

The launch was witnessed by an immense concourse of spectators, special trains having been run by the North British Railway Company, and three river steamers having also gone down to Clyde Bank with passengers. As the vessel glided majestically into the water, having been christened Servia, by Mrs. Burns, wife of the chairman of the Cunard Company, there were loud and hearty rounds of cheers. Tugs were in readiness to tow the big ship up to Finnieston Quay, where the 60-ton crane, which has been specially strengthened for the purpose, will be employed to put the machinery on board. After the launch, a large and distinguished company of ladies and gentlemen were entertained at luncheon by Messrs. J. and G. Thomson, the builders, in the Model Room at Clyde Bank. Mr. James R. Thomson presided, and the croupiers were Mr. George Thomson and Mr. James Neilson. The company included Mr. John Burns, chairman of the Cunard Company; Mr. Baring, Mr. Jardine, Mr. J. C. Burns, Mr. Cunard, Mr. Bevan, Mr. Williamson, Mr. Dudley Ryder, the Earl of Ravensworth, Mr. George A. Burns, the Lord Dean of Guild and Mrs. Mirrlees, Prof. and Mrs. Ramsay, Prof. and Mrs. Jebb, Mr. R. F. Shaw Stewart, Mr. Crum Ewing, Lord-Lieutenant of Dumbartonshire, Admiral Fellows, Capt. Townsend, R.N., of H.M.S. Hercules, and Mrs. Townsend, Mr. and Lady Isabella Gordon; Capt. Pryce, Board of Trade, Lord Balfour of Burleigh, Ward-room Officers of H.M.S. Hercules, Mr. J. B. MacBrayne, Mr. Campbell Finlay, Castle Toward; Mr. Nathaniel Dunlop, Allan Line; Mr. James White, of Overtoun; Mr. and Mrs. James Neilson and Miss Nielson, Col. and Lady Georgina Drummond Moray, Mr. Leonard Gow, Chevalier De Martino, Major and Mrs. Currie, Lieut.-Colonel Haye, and Officers 21st Hussars, Mr. and Mrs. Hugh Neilson, Mr. Orr Ewing, M.P., of Ballikinrain; Mr. John Neilson, Glasgow; Major Ferguson, Royal Engineers; Mr. and Mrs. Wm. Neilson, Capt. and Mrs. Polson. The loyal and patriotic toasts having been given and responded to, the chairman proposed success to the Servia, coupled with the name of Mr. John Burns, who replied. There was, he said, a great gulf between the Britannia, which started on her first voyage more than forty years ago, and the Servia, and the comparison showed the prodigious steps that had been taken in marine architecture. The Britannia measured 1139 tons, with a cargo capacity of 225 tons, and steamed 8¼ knots an hour, whereas the Servia measured 8500 tons, and would attain, it was believed, a speed of 17½ knots an hour. The Earl of Ravensworth, in proposing the health of the builders, said the Clyde was a name that was in everybody's mouth in every part of the world. The Clyde had always been celebrated, and was now at the head of the shipbuilding enterprise, and he thought that every citizen of Glasgow should feel proud of the additional laurel gained that day by the enterprising firm whose health he proposed.. The chairman acknowledged the compliment, and various other toasts being honoured, the company separated.

TENDER.

SALTLEY—BIRMINGHAM—SEWERAGE WORKS.

E. PRITCHARD, Engineer, 27, Great George-street, London, S.W., and 37, Waterloo-street, Birmingham. Quantities by Mr. E. J. Purnell, Coventry.

CONTRACT No. 3.	£	s.	d.
Fawkes Bros., Southport	9771	0	0
Law, Geo., Kidderminster	8777	0	0
Stevenson, Wm., Sheldon	8611	0	0
Hughes, Herbert, Lower Gornal, Dudley	8500	0	0
Hilton, Henry, Birmingham	8147	0	0
Currall and Lewis, Birmingham	8075	0	0
Palmer, Alfred, Birmingham	7703	0	0
Smith, J. Mellard, Westminster—accepted	7600	0	0

EMPLOYERS' LIABILITY.—A prospectus has been issued of the Employers' Liability Assurance Corporation, Limited, with a capital of £1,000,000, in 100,000 shares, of £10 each. The primary object of this corporation is to enable employers to protect themselves, by means of insurance, against the liability imposed upon them by the Employers' Liability Act, 1880. The establishment of this company will enable employers to dispense with the necessity of endeavouring to arrange with their workmen to contract themselves out of the Act, and by offering insurance facilities to both masters and men, will solve a question which has already caused a certain amount of ill-feeling between them. The liability of employers to their workmen, though new to the United Kingdom, has long been recognised by the laws of several foreign countries, and insurance companies to provide against such liability have for years past been in operation on the Continent. Dr. Farr, actuary, is preparing scales of rates, with the object of ensuring, on the one hand, the permanent stability and prosperity of the Corporation, and on the other, the approbation and support of the assured.

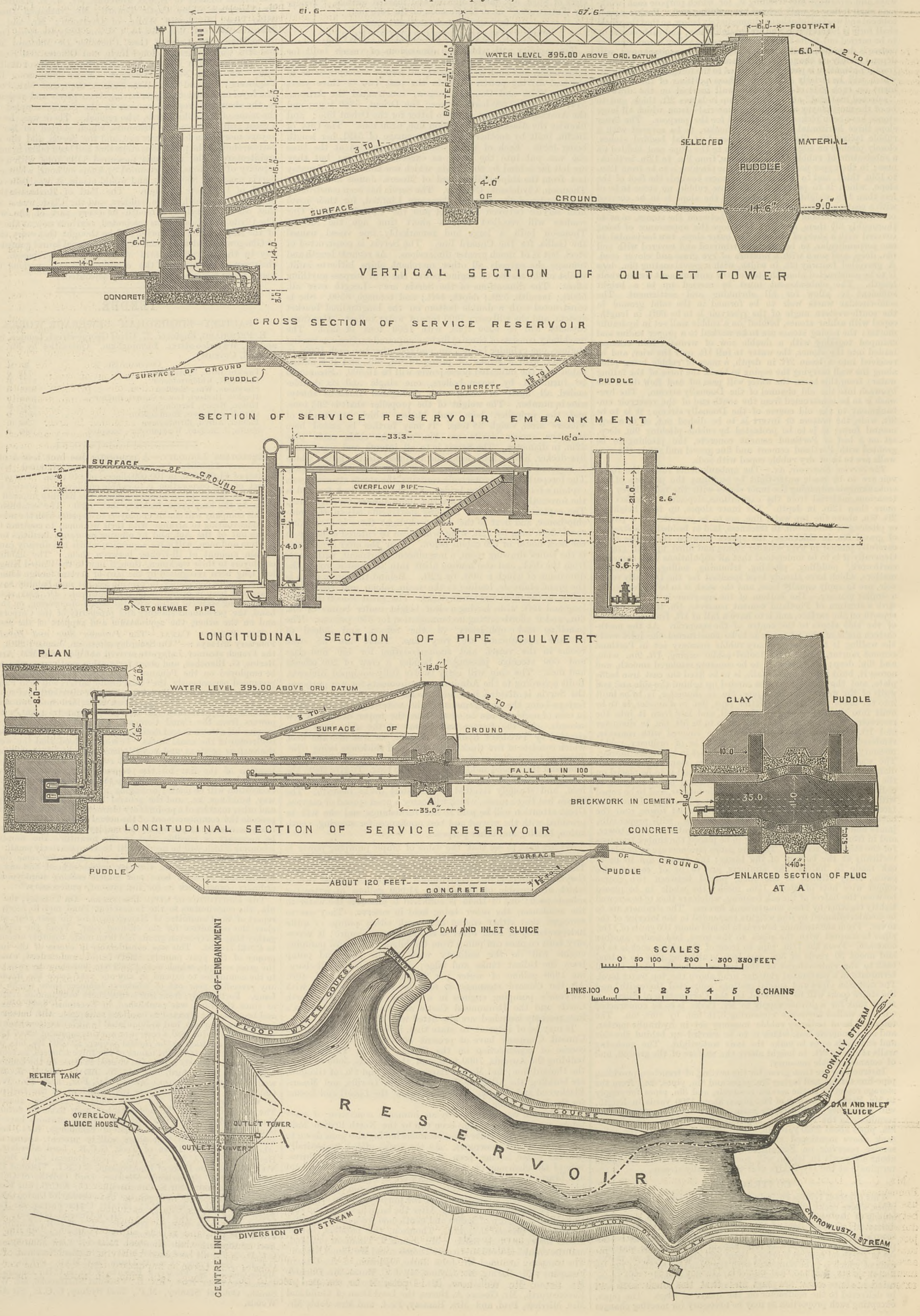
THE PANAMA CANAL.—The *Panama Star and Herald* of February 3rd says:—"On Saturday afternoon, January 29th, 1881, the French steamer Lafayette arrived at Colon with MM. Armand Reclus, G. Blanchet, and about forty other gentlemen, who are to be employed on the Panama Canal. For the present, and it is presumed permanently, the Canal head-quarters will be in Panama, although Colon will be the main point for distribution of supplies, &c., for the work. The expedition is divided into two distinct sections or departments. M. Reclus is the general agent, with full powers from the Canal Company over all matters which may require his attention and decision on the isthmus. M. G. Blanchet is director of the canal works. It is understood that the work of the various sections and commissions is to be begun at once and pushed on with energy. It will relate principally to the exact location of the line for the proposed canal, clearing away the timber, brush, &c., thus opening up the country through which the excavation will be made; arranging matters of titles for right of way, buildings, &c., and the general land grants of the company, and other matters of a preliminary character which must necessarily precede the commencement of the actual work. A year or more must necessarily elapse before the employment of machinery will be necessary or possible, and in the meantime the number of labourers which will be needed will be comparatively small. The demand can be easily supplied at present or for some time to come on the isthmus or in the near neighbourhood, and any great immigration of mere bone and muscle seeking employment in ordinary canal work is, for the present, unnecessary."

THE INSTITUTION OF CIVIL ENGINEERS.—On Tuesday, the 22nd ult., the contributors to the Benevolent Fund met to receive the report of the Committee of Management for the past year, and to elect the committee for the ensuing year. From the report we gather that thirty-seven grants had been made, together amounting to £2642 11s. 3d. This was considerably in excess of the income proper of the year, namely, £2035 7s. 4d., and, indeed, exceeded the gross receipts, which were £2639 8s.; but the rules gave power to the committee to expend in any one year twice the income of any preceding year out of whatever balances there might be in hand. Fortunately, from this source there were monies available, as since the fund was established, in December, 1864, donations and bequests not directed to be added to capital, with unexpended income in some years, had accumulated to such an extent that there was, as at the end of 1880, a reserve or working capital of £9097 17s. 2d. This was in addition to the capital proper, £25,363 19s. 6d., which had all been invested in the names of the three trustees, as required by the rules. The six gentlemen elected to serve on the committee were:—Mr. John Aird, Mr. J. W. Barry, Mr. F. J. Bramwell, Mr. G. B. Bruce, Mr. C. D. Fox, and Mr. W. R. Galbraith. Of this committee the President of the Institution of Civil Engineers for the time being is *ex-officio* chairman. The annual dinner of the members has been fixed for Saturday, the 2nd of April, at Willis's Rooms. The invitations have been issued to meet H.R.H. the Duke of Edinburgh, K.G., besides whom it is expected that there will be present, among many others, H.S.H. the Duke of Teck, G.C.B., Lord Aberdare, Sir Henry Barkly, G.C.M.G., K.C.B., Lieut.-General Sir S. Browne, V.C., K.C.B., the Duke of Buckingham, G.C.S.I., Viscount Bury, K.C.M.G., the Netherlands Minister, Lord Colville of Culross, K.G., Rear-Admiral Sir E. Commerell, V.C., K.C.B., the Earl of Cork, K.P., Viscount Cranbrook, G.C.S.I., the Earl of Derby, General Sir Collingwood Dickson, V.C., K.C.B., Canon Farrar, Sir Bartle Frere, Bart., G.C.B., G.C.S.I., Major-General Gallwey, R.E., Rear-Admiral Sir William Hewett, V.C., K.C.B., Admiral Sir Edward Inglefield, C.B., Admiral Sir Cooper Key, K.C.B., the Earl of Kimberley, the American Minister, Lord John Manners, G.C.B., M.P., the Lord Mayor, M.P., Sir Stafford Northcote, Bart., G.C.B., Sir Philip Cunliffe-Owen, K.C.M.G., C.I.E., C.B., Major-General Sir Frederick Roberts, V.C., K.C.B., General Sir Francis Seymour, Bart., K.C.B., Viscount Sherbrooke, Mr. W. H. Smith, Colonel Stanley, M.P., Earl Sydney, G.C.B., Sir Albert Woods.

CONTRACTS OPEN—SLIGO CORPORATION WATERWORKS.

MESSRS. R. HASSARD, M.I.C.E., AND A. W. TYRRELL, M.I.C.E., WESTMINSTER, ENGINEERS.

(*For description see page* 160.)



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 2d. 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.*

F. B. Y.—*We cannot tell where you can hire drawings of engines and boilers. Try an advertisement.*

A. B.—*Before you can enter the Royal Engineers as an officer, there is a good deal to be done. In the first instance apply for further information to the Principal of the College at Sandhurst.*

ENQUIRER (Newcastle).—*We can supply no information, as to ascertain what you want at the Patent-office would entail the making of a long search. Why do you not write to Mr. Mitchell?*

T. S. S.—*There is no such work, but a great deal of information on the subject may be found in the "Transactions" of the Institution of Civil Engineers in England and France, and also in the professional papers of the Royal Engineers in India.*

A. F. M.—*The longer the funnel of a steamship, other things being equal, the better will be the draught. There is a proper diameter for a funnel, which must not be reduced, no matter what the length. The sectional area of the chimney should not be less than half the sectional area of the boiler tubes.*

NEMO.—*A heat unit is that quantity of heat which will raise 1 lb. of water 1 deg. in temperature. It is used as a standard because no other substance requires so much heat to raise its temperature as water. Thus, the same quantity of heat which will raise 1 lb. of water 1 deg., will raise about 9 lb. of iron and nearly 4 lb. of air 1 deg. Heat may be converted into mechanical work, as in the steam engine, and each degree or heat unit represents as much power as would lift 1 lb. 772ft. high, or 772 lb. 1ft. high. The steam supplied to a steam engine, unless there is a superheater, is saturated steam, and to such ordinary steam the tables you have, apply.*

MEETINGS NEXT WEEK.

THE INSTITUTION OF CIVIL ENGINEERS.—Tuesday, March 8th, at 8 p.m.: Paper to be discussed, "Tide Gauge, Tidal Harmonic Analyser, and Tide Predicter," by Professor Sir William Thomson, F.R.SS., L. and E., M. Inst. C.E.

SOCIETY OF ENGINEERS.—Monday, March 7th, a paper will be read on "Gas Engines," by Mr. Charles Gandon, the leading features of which are as follows:—The introduction of gas as a motive power, with general descriptions of the principles of the Lenoir, Otto and Langen, Otto, Minerva-Excelsior, Eclipse, and Bischopp gas engines, and considerations of the cost of working gas as compared with steam engines.

SANITARY INSTITUTE OF GREAT BRITAIN.—Wednesday, March 9th, at 8 p.m.: Discussion upon the paper read at the last meeting, "The Law in Relation to Sanitary Progress," by Mr. W. H. Michael, Q.C., F.C.S.

SOCIETY OF ARTS.—Monday, March 7th, at 8 p.m.: Cantor Lectures, "The Scientific Principles Involved in Electric Lighting," by Professor W. G. Adams, F.R.S. Lecture I.—The production and regulation of electric currents—The laws of the mutual induction of currents and magnets. Wednesday, March 9th, at 8 p.m.: Ordinary meeting, in the Theatre of the South Kensington Museum, "Ascents of Chimborazo and Cotopaxi, in 1880," by Edward Whymper.

MARRIAGE.

On the 22nd ult., by special licence, at St. Mary's, Lewisham, ERNEST CLARK, only son of Mr. WILLIAM BAGLEHOLE, of Lee, Kent, to JESSIE, second daughter of the late Mr. WILLIAM EDWARD ROSE, C.E.

THE ENGINEER.

MARCH 4, 1881.

THE LIFE OF STEEL RAILS.

MR. C. B. DUDLEY holds the post of chemist to the Pennsylvania Railroad Company, and for a long time he has been engaged in endeavouring to trace a connection between the chemical components of steel rails and their durability. He has already prepared one report upon the subject, which was read at the Lake George meeting of the Institute of Mining Engineers in 1878. Its conclusions were not accepted, because it was urged that they were based on insufficient data. Since that date Mr. Dudley has therefore extended his investigations, and finds that the conclusions at which he had at first arrived are strengthened and confirmed. We are not aware that any elaborate investigation, such as that carried out by Mr. Dudley with unlimited resources at his disposal, has been made in this country, and the results will, we have no doubt, take many of our readers by surprise. Broadly stated, they show that the softer a steel rail is the longer it will last. Hitherto it has always been held, both in this country and everywhere else, that the harder a rail the better, so long as it is not so brittle as to be in danger of breaking; but there seems to be little doubt that this theory must be qualified in future, and that it can by no means be accepted as generally accurate. Mr. Dudley took up sixty-four rails in July, 1879; sixteen of these rails were taken from level curves, eight from the high sides, and eight from the low sides; sixteen rails were taken from curves on inclines, and the same number from tangents on inclines; and thirty-two rails were taken on various levels, half from the north and half from the south track. All these rails were submitted to various tests—for tensile, torsional, and transverse strength, and samples taken from them were submitted to rigorous chemical analysis. The results have been set forth in a series of elaborate tables, and the figures contained in these tables substantiate Mr. Dudley's statement, that "Notwithstanding we do not find absolute uniformity, yet no one can fail to observe, in general, a difference, both in physical properties and in chemical composition, between the slow-wearing and the more rapid-wearing rails. Thus, in regard to the physical properties, I think it is entirely evident to inspection that in the torsion tests the slow-wearing rails in each group, except, perhaps, on the high sides of curves, are characterised in general by lower height and greater length of diagram. In the tensile tests, again, the slower-wearing rails are in general characterised by lower tensile strength and greater elongation than the more rapid-wearing ones. In the shearing tests the same thing appears, viz., in general, lower shearing stress and greater detrusion; and in the bending tests we see the same result, perhaps more strongly than in any of the other tests, viz., that the slower-wearing rails are in general those which have the lower bending stress and the greater amount of deflection before rupture. In density, as would be expected, the slower-wearing rails have the greater density. Again, in the chemical composition the same thing is observable, viz., that the slower-wearing rails are characterised in general by the lower amounts of the substances determined, carbon, phosphorus, silicon, and manganese, while in phosphorus units the same thing may be seen, viz., in general, the slower-wearing rails are characterised by the lower numbers of phosphorus units."

The average results of an analysis of thirty-two slow-wearing rails gave—carbon, 0·334; phosphorus, 0·077; silicon, 0·060; manganese, 0·491 per cent.; density, ·28201; while that of thirty-two fast-wearing rails gave—carbon, 0·390; phosphorus, 0·106; silicon, 0·047; manganese, 0·647 per cent.; density, ·28165. The tensile strength of the former was 33·5 tons; the elastic limit was 16 tons, and the elongation 17·1 per cent. Annealing reduced the strength by about one ton per square inch, and increased the elongation 1 per cent. The fast-wearing rails had a tensile strength of 35·7 tons, an elastic limit of 17 tons, and an elongation of 14·2 per cent. Annealing, curiously enough, reduced the elongation to 13·8 per cent., which confirms certain statements recently made by Dr. Siemens in the course of a lecture delivered at the Royal United Service Institution. We venture to think that most of our readers would, if asked the question, reply that the harder and stronger rail would have the longest life; but as we have said the contrary is the truth, the average life of the thirty-two soft rails being 19·8 years, while that of the hard rails is but 9·7 years—that is to say, that a soft rail lasts practically twice as long as a hard one. As to what constitutes the life of a rail we prefer to let Mr. Dudley speak for himself:—"The data which have been obtained concerning the work done by this series of rails furnish likewise the means of getting at some interesting facts as to the life of rails. It is of course a difficult thing to say just exactly when a rail is so worn that it can fairly be called worn out, and yet we can perhaps make a few assumptions which, although not absolutely definite, may aid in throwing some light on this interesting question. If we take any standard 67 lb. rail, and suppose that the head is worn off on tangents or on the low sides of curves until it is from ¼in. to ⅜in. lower than it was when rolled, the amount of metal worn will vary from about 6 lb. to 10 lb. per yard. On the other hand, if the rail has done service on the high sides of curves, the amount of metal worn off when the side of the head is worn up to the fish-plate will not be far from 7 lb. per yard. But as I understand it, the present practice on the road is, when a rail has become worn on the high side of a curve up to the fish-plate, to remove it to the other side of the curve, and get two or three years' more wear out of it in that position. For the very general conclusions that we are after, therefore, it will perhaps be sufficiently accurate to say that a rail may fairly be said to be worn out when it has lost 8 lb. of metal per yard. This assumption of course does not pretend to actually represent the loss of metal by wear which may or ought to be obtained from every rail before it is worn out. In the case of the old standard section, it is probable that rails may fairly be said to be worn out when they have lost in the neighbourhood of 8 lb. per yard. In the case of the new standard section—section of 1875—a loss of from 10 lb. to 14 lb. per yard would leave the rail in as good condition as a loss of 8 lb. per yard from the old standard section. In the data, a rail is assumed to be worn out when it has lost 8 lb. per yard, and from the figures given it will be easy to obtain the life of rails for any other assumed less of metal." It will, we think, be seen that we have in Mr. Dudley's paper one of the most important statements that can be made with regard to steel rails. We do not suppose that his conclusions will be generally accepted as final, yet we do not quite see how it is possible to escape from them. If they were based solely on the results of chemical analyses we confess we should regard them with grave doubt. If Mr. Dudley said that he had found rails with carbon ·390 wear faster than rails with carbon ·334 per cent., and so on, we should have had little hesitation in saying that his analyses were erroneous. It is not, perhaps, as generally known as it should be that analyses of iron and steel, especially for carbon, are with few exceptions untrustworthy. The fact will come out some day in a very prominent form. Lest, however, we should be supposed to say something for which we have not sufficient foundation, we may state that certain samples cut from steel plates were recently sent for analysis to a number of chemists, who are supposed to make the analyses of iron and steel a special study. Their reports came in due course, and no two of them agreed. Lest it should be assumed that the divergence was due to want of uniformity in the metal, a hole was drilled in one of the plates. The drillings were divided, and sent in sufficient quantity to each chemist, and when the new analyses came in their disparity was greater than ever, some of the analyses giving 50 per cent. more of an impurity than others. It is well known, indeed, that the quantitative analysis of steel for carbon is one of the most difficult investigations known to the chemist. But Mr. Dudley's conclusions do not rest on chemical analysis, for he gives the mechanical characteristics of the metals, and the only possible way to avoid his deductions is to assume that his sixty-four specimen rails are not representative. When, however, we bear in mind that they were selected from every conceivable portion of the line, and that they were worked under all sorts of conditions, and that furthermore they support the deductions drawn from a similar investigation previously carried out on a smaller scale, we are compelled to admit that Mr. Dudley has made out a very good case indeed for the soft rail. Nor is it, we think, difficult to understand why a soft rail should last longer than a hard one. In the hard rail there cannot be much distribution of strain. If a perfectly cylindrical wheel rolled on a perfectly smooth and rigid rail, the line of contact would be infinitesimally narrow. In practice the wheel and the rail both yield, and the surfaces in contact are extended in area. Some experiments which we carried out a good many years since went to show that with a 7ft. wheel loaded with 5 tons, on an iron rail, the area of contact is a little over one-fourth of an inch by an inch and a-half, or say half a square inch; with steel rails, and especially with new steel rails high in the middle, the surfaces in contact will be still smaller. In the case of a soft rail the metal will tend to yield under the tread of the wheel, stretching out in all directions and augmenting the contact area; but with the hard steel this is not the case, and the minute surface of rail which has to carry the whole load is unable to sustain the strain, and is crushed and disintegrated, and so the whole top of the rail is by degrees reduced to steel dust, so to speak. On curves, or whenever a wheel slips, the small contact surface will always be liable to rend away from the metal beneath it. An illustration of what we mean may be seen on any of the curves on the Metropolitan or Metropolitan District Railways whenever the sun shines on the track, as it does, for instance, at such places as Westminster Bridge. The sleepers near the rails will be seen to be covered with glittering steel scales, dragged off the rails by the grinding of the wheels round the curves. In the case of the softer and tougher rail this does not take place, at least, to anything like the same extent. Glass is much harder than putty; but glass can be ground to dust and putty cannot; and other things being equal, so long as deformation is prevented it would appear that the softer a rail the longer it will last—a statement which finds some confirmation in the fact that good iron rails have been known to last as much as thirty years under heavy traffic. The great merit of steel rails is, firstly, that they can be made for about half the price of a really good iron rail; and secondly, that being homogeneous and free from cinder, they will not split or laminate like an iron rail; but the nearer a steel rail approaches in other respects to iron, the better.

Mr. Dudley draws a very simple and direct conclusion from his investigations:—"The question now arises," he writes, "how shall the results of this work be utilised? I think it is entirely evident that the direction in which effort must tend in order that these results may be utilised is toward securing softer steel; and just here, perhaps, is the proper place to notice what seems to me a very important point. This is our second investigation upon steel rails. The first investigation dealt principally with the question as to the relation between the chemical and physical properties of steel rails, and their power to resist crushing and fracture in track. The conclusion reached was that the softer rails are less liable to crush or break in service than the harder ones. Now, in this second investigation we find that the softer rails give the better wear. In other words, the softer steel makes rails which are not only less likely to crush or break in service, that is rails that insure greater safety in the track, but also the softer steel makes rails that give better wear; and, unless the conclusions upon these two points can be overthrown by an equal amount of work, as carefully and conscientiously done, I do not see how the Pennsylvania Railroad can, in the future, do otherwise than use every effort to secure softer steel in its rails."

To enable this to be done as far as lies in his power, Mr. Dudley has given certain instructions for the preparation of specifications. As regards the chemical constituents of the rail, he would insist that phosphorus should not be present in greater quantity than 0·10, or silicon 0·04 per cent. Carbon may be present in quantity between 0·25 and 0·35 per cent., and manganese between 0·30 and 0·40 per cent. Sulphur is totally excluded. He considers at considerable length the mechanical tests to which the metal is to be put, and rejects all in favour of a bending test, recommending that all steel rails for the Pennsylvania Railroad shall be tested by having a piece cut out of the webs of rails taken at haphazard from a lot; this test piece to be 12in. long, 1½in. wide, ½in. thick. It must stand a maximum bending load of not over 3000 lb., and shall bend not less than 130 deg. without rupture.

COMPRESSED AIR TRAMWAY LOCOMOTIVES.

A company has been formed to supply locomotives for working tramways, as announced in our last impression; and compressed air will at last have a chance of being fully and fairly tested as a motive power. A great many years have elapsed since Mr. Parsey first worked a locomotive by compressed air on the earliest opened portion of the South-Eastern Railway; and from that day to this the scheme has been continually revived in some shape or another as often as it apparently died out. Very considerable sums of money have been expended on it, especially in the United States; and although success has apparently been obtained for a time, in the end the compressed air locomotives have had to give place to steam or horse-power. The cause of failure is easily stated. We have stated it already in an article on "Compressed Air Locomotives," which appeared in our impression for June 18th, 1880. In that article we have fully set forth, in somewhat popular language, the theory of the action of all such engines. Briefly stated, one cause of the failure of compressed air engines has lain in the enormous waste of power due to the heating and cooling of the air. Under highly favourable circumstances as much as 50 per cent. of the whole power expended in compressing the air has been lost, and under such conditions as must obtain in general practice the loss would be far more than this; but worse than this, great trouble has been caused by the formation of ice in the cylinders and ports. We do not, we think, go too far when we assert that compressed air cannot be made to succeed as a motor for tramway or any other locomotives unless means are provided for heating the air before or during expansion. To heat air is a very difficult operation when little time and less space are available for the operation. There is, however, reason to think that the problem has been solved very fairly by Mr. Mekarski, who heats the air before expansion by passing it through a vessel containing hot water. Two Mekarski engines have been at work for some months on the Wantage tramway, and seem to have been successful. One was brought to London and shown for three days last week at the London, Chatham, and Dover terminus, Victoria. Engines constructed on a similar system have been in use for some time on the tramways of Nantes, and the company to which we have alluded, has sent out Mr. F. J. Bramwell to examine them and report on their performance. Mr. Bramwell's report we publish this week on another page. It contains very full information concerning the system on which the Nantes tramways are worked, and taken with the engraving which we also publish, leaves little to be said, save an explanation of one or two theoretical points which we propose to give here.

From the calculations published by the company, and the accuracy of which we have no reason to question, the Wantage engine, the only one which we have seen, is supplied before starting with 200 cubic feet of air compressed to 450 lb. on the square inch, which can be worked down to a pressure of 54 lb. Assuming the resistance to be 25 lb. per ton, the weight of each engine 7½ tons, and of each car, including passengers, 6 tons, we have a total of 13½ tons, which can be worked for 34 lb. of air expended per mile. The weight of 200 cubic feet of air at 465 lb. absolute on the square inch is 461 lb. nearly, and dividing this by 34 we have 13·5 miles as the distance which the car could run if the pressure could be run down to zero. We see no reason, therefore, to doubt that the car can run over ten miles with once charging, as claimed for it by the company. The air in being compressed to 465 lb. on the square inch has, however, lost a very large quantity of heat. This heat will nearly, but not quite, be equivalent to the whole of the work expended in compressing the air to the given pressure, and delivering it into the reservoir at that pressure, and that work will amount in round numbers to 127,000 foot-pounds per lb. of air. This is assuming that the work is done isothermally, which is not strictly true, as will be seen from Mr. Bramwell's report. However, the total heat carried away by the cooling water, &c., cannot be less than 164 thermal units per pound of air. The air is delivered to the engine at a pressure of about 90 lb. on the square inch, and is expanded down to, let us say, 15 lb. above the atmosphere, or 15 times in all; during the expansion each pound of air will give out, whether it is utilised or not, in round numbers, 108,000 foot-pounds, representing about 140 units. As we have explained, Mr. Mekarski restores the heat lost during compression by means of hot water, and it is very easy to see that the proportion of heated water required is not large. Steam is blown into the water in the reservoir until it reaches a temperature of 320 deg. Fah., the pressure in the vessel being then 72 lb. on the square inch. The compressed air bubbles up through the water and, according to a statement published by the company, carries the steam off with it in the proportion of one pound of steam to five pounds of air. The total heat in one pound of steam of 87 lb. absolute pressure, measured from zero, Fah., is 1210. The air is not allowed to fall below 212 deg. on entering the cylinder, and the steam being condensed by the cooling of the air in which it is suspended during expansion, can part with 1210—212=998; or in other words, it can give up to each pound of air in round numbers 200 deg., or much more than enough to supply all that was lost during compression. The quantity of water to be carried by the Mekarski car under such conditions is easily calculated. The weight of air to be heated, as we have seen, is 461 lb. That of the steam required is one-fifth of this, or say, allowing a margin for loss by leakage, 100 lb. The temperature of the water to begin with is 320 deg. Fah., and each pound can in falling to 212 deg. give up 108 units. But each pound of steam will represent 998 units, so that 9·1 lb. of water will represent 1 lb. of steam; and each unit in the steam representing about 4 units in the air, the weight of water to be carried is 220 lb. But the statement that steam is used is erroneous. As a constant pressure of at least 90 lb. is maintained in the receiver, no steam can be produced at the stated temperatures. The receiver holds but 200 lb. of water, which can give up 320 — 212 deg., or 108 units per lb., or in all 200 × 108 = 21,600 units, and each unit will suffice to raise about 4 lb. of air through 1 deg. There is heat enough in the water to raise 21,600 × 4 = 86,400 lb. of air 1 deg., or 461 lb. over 187 deg. In practice then it is evident that the water can give up enough heat to raise the air through 150 deg. at least, and its initial temperature being 60 deg., we have 210 deg. as the temperature delivered to the cylinder. Moist air may be expanded four times down to the atmospheric pressure without falling below 32 deg., if its initial temperature be 120 deg. The air in the Mekarski engine has an initial pressure of 105 lb. absolute, and being expanded with the ordinary slide and link motion, its pressure cannot fall much below 25 lb. on the square inch, if so low, in the cylinder; and so long as its initial temperature is even 160 lb., there is, of course, no danger of the ports becoming blocked with ice.

We have not attempted to go into any minute calculation of temperature and pressure. Indeed, we have not the data necessary to make the calculation. We have, however, given figures which are approximately exact, and quite sufficient to show that nothing more seems to be claimed for the Mekarski engine than it can perform. At the same time we feel confident that any attempt to put such an engine as that shown on the tramways of the metropolis must end in disappointment and loss. The design of the engine is open to all the objections we have urged over and over again against tramway engines. We have foretold disaster continuously, and we have invariably been correct, and the Mekarski engine will prove no exception to the rule, unless those who are in authority take warning in time. The whole of the gear is worked as close to the road as it can well be; the cylinders being horizontal, with external link motion. It is true that great care has been taken to box the gear up; but the mud in winter and the dust in summer will get in and cut brasses to pieces, and render the cost of repairs enormous. The crank brasses, &c., are all of the ordinary type, no attempt being made to render the bearings dirt-tight, which might easily have been done. Furthermore, the engine weighs 7½ tons ready for work, and none of the metropolitan tramways could stand such a load on four wheels for a month. There is no analogy at all between the Wantage road and the track laid in London, which, with a very few exceptions on particular routes, is quite unfit to carry anything heavier than an ordinary tram car. In many of our large towns the chances of success are much greater, for the roads there are really good and strong. The system appears to be all right, and to have been worked out very carefully, but the general design of the engine has nothing to do with the system, and must be modified, about which there need be no difficulty which cannot be overcome.

THE INTERNATIONAL ELECTRICAL EXHIBITION.

An important meeting of the Technical Committee of the International Exhibition of Electricity took place on the 28th ult., when M. Georges Berger gave further information relating to the coming exhibition in the Palais des Champs Elysées and its annexes. He gave particulars of the motive power which will be provided for all exhibitors who require it. All the systems of lighting will be employed at the same time, and for this and other purposes 800-horse power will be supplied and over 50 kilometres, or about 30 miles, of conducting wires. The committee at the same time settled the classification in the catalogue of the objects exhibited. These will be divided into six groups and sixteen classes. The groups will be thus entitled: (1) Productions de l'Electricité; (2) Transmission de l'Electricité; (3) Electrometric; (4) Applications de l'Electricité; (5) Mecanique general—in its applications to the electrical industries; (6) Bibliographie et Historie. The offices of the Commissariat-Général are in the Palais des Champs-Elysées—division No. 4. The offices are open from 10 a.m. to 5 p.m., where M. Georges Berger may be addressed. The Commissariat-General receives on Mondays, Wednesdays and Fridays from 3 p.m. to 5 p.m. All interested in the advancement of electrical science and electric engineering in its practical details must feel great satisfaction in the nature of the answer of the Secretary of the Treasury, Lord F. Cavendish, to the question put by Sir Henry Tyler, on Tuesday night in the House of Commons. Apparently South Kensington has this time been baulked of its prey, and a scientific exhibition is consequently not to be marred by the conspicuous inability which marked the conduct of the Loan Exhibition, for instance, and the subsequent inability of those concerned to explain the expenditure incurred. It is now generally well known that the chief Governments of Europe have signified their intentions concerning the exhibition, and have named their representatives. An attempt to get the control of the British departments seems to have been made by those of South Kensington, and the idea that to South Kensington it was likely to go caused general dissatisfaction, especially as while other countries possessed full information concerning the instructions as far as yet issued by the Commission, the English electricians were without any. The question therefore asked by Sir Henry Tyler was whether any, and if so, what, arrangements had been made to afford facilities and to meet the requirements of British exhibitors at the forthcoming international exhibition of electrical apparatus at Paris. In reply he was informed that "it is not intended to appoint a commission for the purposes named. The Government," Lord Cavendish said, "has never yet undertaken the task of affording facilities to British exhibitors at foreign exhibitions of a special character. Past experience in connection with international exhibitions of a general character has shown that there is no kind of expenditure more difficult to keep within bounds. The expenditure so incurred has varied between the limits of £28,000 spent in connection with the exhibition at Vienna, and £115,000 spent on that of Paris in 1867. Although the expenditure upon exhibitions of a special character would, doubtless, be of a very much smaller amount, it would be equally difficult to control, and if the precedent were once to be set it would be impossible for the Government to refuse equal facilities in the case of the numerous exhibitions of a similar character that will doubtless be held hereafter. In coming to the conclusion that they have done, the Government in no way wishes to disparage the importance of the proposed exhibition. Upon the contrary, they recognise its great interest, and the Postmaster-General has been authorised to accept the invitation which has been addressed to him to exhibit specimens of telegraph appliances, both past and present. Delegates will also be sent from the Post-office to take part in the Congress of Electricians, which will be held at the same time as the exhibition." He further added, "there is nothing to prevent the formation of a committee to afford facilities to British exhibitors, as was done on the occasion of the Brussels exhibition, and on some others when the Government took no direct part," and he hoped that such a committee may be formed. It is clear that the school department has no mission in this exhibition, and it is further clear that those who represent the electricians and electrical engineers of this country should at once take the matter up, and by calling a special meeting ascertain the views of those concerned. The Society of Telegraph Engineers and Electricians should plainly, through its council, be the prime movers in securing an efficient scheme of representation of the British exhibitors, this society acting with others with which it may be advisable to concur. This society, or these societies should form a committee, as proposed by Lord Cavendish, and intending exhibitors would then be properly represented, and would be able to obtain in London information and facilities for which they must now write or go to Paris.

PERSUASION BY GUNPOWDER.

Broadhead, of notorious memory, believed in the elevation of the working classes by gunpowder. When his favourite plans for the "improvement" of the saw grinders were interfered with by what he considered the obstinacy of a minority, he took care to convince the minority that their obstinacy was unpardonable. He began gently by "rattening" them—that is to say, he had their bands removed and grinding stones smashed, so that they could not work. If this did not answer, he had them slightly maimed by bludgeons or frightened by fire-arms. If they were still "stupid," to use the accepted term of the locality, he had them blown up. With his decline and fall—mainly brought about by the spirit and courage of Mr. Leng, of the *Sheffield Telegraph*—elevation by gunpowder ceased to be so fashionable among trade unionists. It is now, we regret to notice, being revived at Hackenthorpe, a village five miles from Sheffield. There Messrs. Thomas Staniforth and Co. have for many years carried on an extensive business as manufacturers of sickles, reaping-hooks, scythes, and similar agricultural implements. They work under a trade mark granted as far back as 1743, and at present employ over 100 men. Some time ago they were successful in initiating a reduction of wages in the sickle trade, and were then threatened by letter signed "Grinder Joe, of Sheffield"—that they had better insure their lives, and send their wives and family to the sea-side, as they would be shot some night coming over the Moor. Some of their non-union workmen had also cans of gunpowder exploded in their houses. The last outrage is the worst of all. A gallon bottle of powder was placed in a boiler, a fuse attached, and the train fired from a neighbouring field. The intention was to blow up the entire factory; but the miscreants neglected to make the door of the boiler fast, and the explosion, beyond doing a good deal of damage to the boiler and brickwork, had few other consequences. The cause of this diabolical affair is said to be the introduction of a bending machine to dispense with manual labour. Though it put no extra work on the men, they claimed ½d. per dozen extra. The demand was refused on the Friday, and on the Sunday the effort was made to blow up the whole establishment. It is believed that the outrage was planned and carried out by some central association, and that it was not the work of the Hackenthorpe men, though it is believed the refusal of their demand was the cause of the crime.

CURIOSITIES OF AMERICAN PATENTS.

It can hardly fail to strike those who are familiar with the pages of the official gazette of the United States Patent-office, that by far the larger portion of the inventions patented are worthless. They are, as a whole, of a much lower quality than the patents of either France or England. Some of them, however, if they have no other merit, possess that of being not a little amusing. For example, Mr. John Hare, of Baltimore, patented on the 26th July, 1880, an invention the claim for which is thus stated, "A cake of soap having a string or other suspensory attachment moulded or pressed into the soap for the purpose set forth." The idea involved is that the soap should be hung up on a nail over the washstand; the invention has the merit of originality at all events. It used to be said of George IV., that to secure a good fit he had a coat put on; then the tailor went all over it, and cut away wrinkles with a pair of scissors; the gashes were then sewn up, and the coat thus treated was used as a pattern. Whether Mr. R. F. Halleck, of New York, has heard this anecdote or not we cannot say. It is evident that the official examiners did not, for they have granted a patent for the same idea to him. Mr. Halleck claims "the method herein described of making and fitting garments, consisting in making a loose frock to fit the neck and shoulders, then securing a body fit by folding in and sewing the superfluous parts, then cutting the body of the garment by the pattern so fitted and combining the latter finally with the outside portion as a lining." It does not appear that George IV. made any use as a lining of the pattern coat, and there is so far a point of novelty in Mr. Halleck's invention. We cannot call to mind anything in recent English inventions like this, save an application for a patent, which was refused, for keeping trousers clean by sticking spikes into boot heels on which the lower edges of the trousers might rest, and so be kept up out of the mud. Another American gentleman, Mr. Henry Leisler, patented on the 7th of August, 1879, the use of a half waistcoat as a "garment sample," while yet another American inventor has patented a neck scarf which can be converted into a travelling cap at pleasure. We could very easily extend this list of protected puerilities, for cheap patents are a direct encouragement to the patenting of such stuff.

LITERATURE.

Steam Boilers: Their Design, Construction, and Management. By William H. Shock, Engineer-in-Chief, U.S.N. New York, Van Nostrand. London: Sampson Low, Marston, Searle, and Rivington. 1880.

Mr. Shock is chief of the Bureau of Steam Engineering of the United States Navy, and thus holds the position once held by Mr. Isherwood. It appears to be considered in some sense right and proper that the gentlemen who successively hold this important position should write books, and furthermore that these books should be good, all the resources of their department being available to help them. Thus Mr. Isherwood, in his "Experimental Researches in Steam Engineering," gave us two large volumes, containing much which was ridiculed at the time, but the truth and accuracy of which is now beginning to be recognised. Indeed, he was one of the first, if not the first, to publicly expose the fallacy involved in treating steam as though it were a permanent gas. Mr. J. W. King, in his turn, gave the world a book which astounded it, and rendered his name famous—to wit his "Report on European Ships of War," containing information which it was held previously that no one could obtain for publication; and now Mr. Shock has written the most important treatise on boiler engineering with which we are acquainted. It is majestic in its dimensions, being a great quarto, containing 473 pages, and illustrated by thirty-six large plates and 148 woodcuts; and here, before going further, we may say that all the illustrations are of the highest quality, while the paper, printing, and binding are worthy of the engravings. The plates are working drawings, which only require to be enlarged to be fit to send into the shops; and in the matter of constructive details they show much that will be found novel and useful by English engineers. A curious example of what may be called misplaced ingenuity is supplied by Plate 18, showing the details of the bracing of the huge rectangular low-pressure boilers of the U.S. ship Plymouth. Each boiler is 17ft. 6in. wide, 10ft. 3in. long, and 9ft. high, and contains five furnaces, 6ft. 6in. long, and 3ft. wide. It is proper to say that this book ought to be called a treatise on marine boilers; for it deals with no others.

The scheme of Mr. Shock's book is very simple. He begins with the materials formerly used in the construction of boilers, and goes on to explain the influence on form and dimensions which the introduction of large plates of iron and steel has exercised. He next treats of combustion, and in doing so he follows Rankine very closely. Next he explains the transmission of heat and the laws of evaporation. In his next chapter he returns again to materials, and in a succeeding chapter he explains the mode of testing them to be adopted. Then we have chapters on the strength of boilers, designs, drawings, and specifications, laying off, flanging and rivetting. Next comes a chapter on boilers, shells, furnaces, and back connections. To stays and braces a chapter is devoted, while another treats of flues and tubes. Chimneys, uptakes, fan blowers, &c., are then dealt with, while the remaining chapters treat of steam room and superheaters; the setting and erection of boilers; boiler mountings and attachments; tests, inspections, and trials of boilers; the management of boilers; the causes and prevention of the deterioration of boilers; and the nineteenth and last chapter is devoted to the consideration of boiler explosions.

It would be quite impossible within reasonable limits to give our readers minute information concerning the way in which Mr. Shock has done his work. We can do little more than deal in generalities. In some places we find, and find with regret, that our author has followed very closely in the footsteps of Rankine; and this is peculiarly true of the chapter on combustion and the transmission of heat, and evaporation. Rankine was a giant in dealing with theoretical investigations of all kinds, but his practical acquaintance with combustion in boilers was very small; and he never wrote a line, so far as we are aware, which would enable a furnace to be proportioned so as to give the best results, *all things considered*, in a marine boiler. The rules given for finding chimney draught are reduced to formulæ which are terrible to look at, and quite useless for all practical purposes. They are no improvement on Rankine's, and it seems to us that they have been simply worked in to give an air of erudition to the work, which it certainly does not need. In dealing with the transmission of heat, we are glad to find our author departing a little from the old lines, and giving particulars of certain experiments made by Isherwood, which gave very different results from those obtained by other experimenters. We perceive with regret that Mr. Shock reproduces the threadbare statement that vertical are not as efficient steam generators as horizontal surfaces. He cites as his authority an experiment made by Mr. Armstrong, and described by Tredgold, which experiment has really little or nothing to do with the matter. As simple an experiment would have sufficed to convince our author that vertical surface, if properly treated, is just as good as any other. That in ordinary steam boilers it is not as good as horizontal surface is due principally to the fact that the heated products of combustion move in horizontal or vertical planes parallel with the plates. If the heated currents impinged on the plates at, or nearly at, right angles, the case would be different. Thus, for example, the tube plate of a locomotive is the most efficient heating surface about it.

We turned to the section on materials with some interest, in the hope that our author would throw some light on the use of steel for boilers; but the engineers of the United States Navy know nothing about it, save what they have learned from our own practice, and Mr. Shock has to content himself with quoting from the report of the Engineer Surveyors of Lloyd's Repository, published in 1878. This is not quite as it should be.

In dealing with the strength of boilers much weight is attached, and very properly, to experiments made in 1874 at Washington on the strength of flues. The particulars of these experiments have not, we think, been before made public in this country. The experimental boiler, consisted of a shell 63in. diameter, made of iron $\frac{3}{8}$in. thick, a cylindrical flue 77$\frac{1}{2}$in. long and 54in. diameter inside was rivetted into the shell; it was of $\frac{1}{4}$in. iron in two rings connected by an interior butt strap 7$\frac{3}{4}$in. wide and $\frac{1}{4}$in. thick. Each ring was made of two plates united by butt straps inside. The unsupported length of the flue was 71$\frac{1}{4}$in. By Fairbairn's rule the flue should have withstood a pressure of 118·42 lb. It collapsed at 105 lb. A second flue was then made, the rings of plates being connected by flanges. This gave way with 130 lb., while by Fairbairn's formula it should have withstood 240 lb.

As to the management of boilers, Mr. Shock has nothing new to say. The rules he gives are almost all derived from English practice.

To sum up, the book may be regarded as a species of encyclopædia of boiler engineering; but it cannot be said to possess any novel features. It contains, perhaps, all that can be put into a treatise on marine boilers, and the matter it contains is very well arranged, and the volume is provided with a copious index. It is to all intents and purposes the most complete treatise on the marine boiler ever written; and it cannot fail to prove extremely useful as a work of reference. There is little in it to call for adverse criticism. It is only to be regretted that its author has displayed little or no originality in dealing with his subject. It brings our knowledge of it down to the latest date, and the questions which may be asked, and the answers to which cannot be found between its covers, must be few and far between. But we must add, that concerning many problems which now distract the minds of marine engineers, it supplies no information whatever. For example, concerning the mysterious failure of steel boilers it is silent, on corrosion it throws no new light, and on the coming down of furnace crowns while there is plenty of water in the boiler, our author is quite silent. As to the merits of the engravings, type, and paper, we have already spoken. They leave nothing to be desired.

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Lighthouse Construction and Illumination. By Thomas Stevenson, F.R.S.E., C.E. London: E. and F. N. Spon. 1881.

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Magnetic Surveying and Angular Surveying. By W. Lintern. Weale's series. London: Crosby Lockwood and Co. 1881.

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WOOD-CENTRE WHEELS AND CONTINUOUS BRAKES.

A GREAT many years' experience has shown that there are many very valuable features in the wood-centre wheel known as the Mansell wheel. An accident, however, which might have been attended with very serious results took place on the London, Brighton, and South Coast Railway on the 24th September last which shows that the application of continuous brakes, especially when engines are not fitted with correspondingly powerful brakes, may be attended in many cases with the necessity for alteration, if not renewal, of all the wood centre wheels as at present employed. It has long been known that the Mansell wheel would not stand the work of a brake van, and wheels with iron bodies have accordingly been employed on those vehicles. The necessity for strengthening the wood-bodied wheel becomes, however, more apparent every day as the use of continuous brakes extends.

"From Colonel Yolland's report on the accident, it appears that the 4.40 p.m. up passenger train from Portsmouth to Victoria, on the 24th September last, consisted of an engine and tender, seven carriages, and two brake-vans, one at each end of the train, with a guard riding in each van. The carriages in this train were fitted up with the Westinghouse brake, but the engine was not so fitted, and there was no brake on the engine, and only an ordinary hand-brake on the tender and in each of the brake vans. The train of carriages was also fitted with the electric means of communication between passengers and the servants of the company, from van to van, and there was also a cord communication between the front van and a bell on the engine. The train travelled all right up to Barnham Junction, 23$\frac{1}{4}$ miles from Portsmouth Harbour; but as it was approaching Ford Junction station, travelling at the rate of from thirty to thirty-five miles an hour, the guard riding in the rear van observed ballast thrown out from the 4ft. space into the 6ft. space, and he states that he immediately jumped up off his seat, and gave his mate—riding in the front van—two rings of the electric bell for him to stop the train immediately, and he put on his hand-brake, and the wheels of his van skidded as soon as he got his brake on. The electric signal was heard in the front van by the guard as a short single ring, and he transmitted the signal to the engine, and it was heard by the fireman. The front guard put on his brake, the fireman put on the tender-brake, and the driver reversed his engine, and on looking back saw that the train had separated into two parts, and two carriages and the brake van behind them stopped alongside of Ford Junction station, with the front wheels of the leading vehicle, a third class carriage, No. 646, off the rails, and running in the 4ft. space. On examination it was ascertained that the woodwork of the leading-off wheel of the third class four-wheeled carriage—a Mansell wooden wheel—had broken away entirely from the boss of the wheel, and the leading pair of wheels had dropped off the rails, and had been running for a considerable distance in the 4ft. space. The wheel was fitted with the Westinghouse brake; but as this brake was not used on this occasion, the strain on the wheels produced by the application of the brakes could have had nothing to do with the actual breaking up of this wheel.

"The accident affords an instance of the advantage of having, and being enabled to use, a connection between the servants of the company with a passenger train."

This wheel was made in the year 1874, by the Leeds Wheel and Axle Company, according to the designs then sanctioned by the inventor, Mr. Mansell. The mileage which it had run up to the time of the accident is not known. The central portion connecting the tire of the wheel with the boss of the wheel is entirely of teak wood, about 3$\frac{1}{2}$in. in thickness, the tire being fastened to the wood by two circular plates or rings of wrought iron 3in. wide by $\frac{5}{16}$in. thick, one on each side, by sixteen wrought iron bolts $\frac{5}{8}$in. in diameter, with nuts; and the central part of the woodwork is secured to a circular cast iron plate, about 20in. in diameter, and 1$\frac{1}{8}$in. thick, forming part of the inside of the boss of the wheel, by means of eight wrought iron bolts $\frac{3}{4}$in. in diameter, passing through this cast iron plate, through the wood, and through a circular plate or ring of wrought iron, 5$\frac{1}{2}$in. in width, and $\frac{3}{8}$in. thick, on the opposite or outside of the boss of the wheel, the bolts being fastened by nuts on the inner side. This teak wood had broken away, or been ripped away, throughout the whole circumference from the boss of the wheel, and was left never less than 1in., and in some parts nearly 3in., from the boss of the wheel, as illustrated in our impression for the 12th December, 1879. The wood was perfectly sound and hard.

The accident is one amongst many, showing the necessity for some improvement in the construction of these wheels when they are likely to have continuous brakes fitted on them. Mr. Stroudley, locomotive superintendent of the London, Brighton, and South Coast Railway Company, has introduced what he considers will be a great improvement on the present mode of constructing these wheels, by causing the eight connecting bolts to pass through circular cast iron tubes forming part of the cast iron plate of the boss of the wheel, thus making the bearing surface so much larger as to render it unlikely that these tubes will cut away the teak wood and destroy the wood centre, which the bolts have apparently done in both these cases.

The improvement made by Mr. Cleminson, who has produced a composite wheel, as illustrated in THE ENGINEER for 12th December, 1879, by which the boss of the wheels is directly connected with the wrought iron circular plates or rings, used for fastening the tires to the Mansell wooden wheels, and also for preventing the tires from slipping round the wooden centres, by the action of the brakes when applied, seems, however, to be the most satisfactory method of overcoming the evident weakness of the wheels when brakes are used. Colonel Yolland remarks that the subject is a very important one as regards the safe travelling of the public. It will, he says, be satisfactory to find that no failures do take place in wheels constructed on Mr. Stroudley's design, but he thinks it possible that it may be found absolutely necessary to connect the boss firmly with the outer circumference of the wheel in the manner proposed by Mr. Cleminson, or in some similar method.

LEGAL INTELLIGENCE.

HIGH COURT OF JUSTICE.—CHANCERY DIVISION.

(*Before* VICE-CHANCELLOR BACON.)

February 9th to 11th, 14th to 18th.

NICKEL PLATING COMPANY, LIMITED *v.* FARQUHARSON.

IN our last impression we gave a report of this case down to the close of the evidence for the plaintiff company. We now give the conclusion.

Mr. Aston, Q.C., and Mr. Seward Brice were counsel for the plaintiffs; and Sir Henry Jackson, Q.C., and Mr. Macrory for the defendants.

For the defendants Mr. Elmore was called and stated that he manufactured the double salt of nickel from ordinary commercial materials. He dissolved common commercial nickel in sulphuric or nitric and hydrochloric acid as the case might be. The crystals of salt, sulphate for instance, were then collected and mixed with an equal quantity of ordinary sulphate of ammonia. He took no steps to purify the latter salt before using it. The mixed salts were then dissolved in hot water, and upon cooling the double sulphate crystallised out, and that was the salt he sold. Sometimes they were re-crystallised to remove acid. Other impurities were always left in the mother liquid. He had not supplied any double chloride salt to the defendants. It was not much used. He supplied the defendants with anodes which he got from Sir Josiah Mason. He did not make them himself. He had had some analysed, and they showed 98 to 99 per cent. of pure nickel. He admitted in cross-examination that it was desirable to have the salt as pure as it could be got, and that the introduction of impurities into the bath should be guarded against. Mr. Robert Wilkinson, of the firm of Bradbury, Evans, and Wilkinson, proved an engraved printing-plate coated with nickel which he said had been done in 1857 or 1858, by means of a solution of double chloride of nickel and ammonia. His firm had nickel-faced printing surfaces for Messrs. Bradbury and Evans in 1868, and for the South Kensington Museum in 1862. The process was not kept a secret. Mr. C. E. Rider, of Messrs. Elkington and Co., stated that it was in 1858 that the firm first did nickel-plating, but it had not been practised as a trade until recently. In 1866, 1867, and 1868, the witness had coated many articles with nickel, using the double sulphate solution. He used pure nickel anodes and a Wylde machine. Mr. Stephen Parker, of Birmingham, deposed that in 1853 he had made nickel anodes. Mr. M. J. Smith stated that the firm of Josiah Mason and Co. had supplied Mr. Elmore with anodes. They were made of ordinary commercial nickel.

Mr. Timothy Morris, formerly a member of the firm of Surshaise, Johnson, and Morris, of Birmingham, Electro-depositors, said that his firm successfully practised nickel plating as an art as far back as 1853. They used a galvanic battery and solutions of double sulphate, double chloride, but generally double cyanide of nickel and potassium. In preparing the double sulphate they used Brande's formula, which they found sufficient, care being taken to get pure materials. Between 1853 and 1857 they did such work to the extent of some hundreds per annum. In cross-examination he stated that at this interval of time he could not remember the names of customers for such articles except Sir Josiah Mason and Mr. Charles Hall. During the cross-examination of this witness a specification was referred to having on its cover a title purporting to be Morris and Jackson's patent for depositing metals, but inside the cover the document was a copy of the specification of Ware and Payne's improvements in the manufacture of glue, an instance of carelessness which Sir Henry Jackson observed ought to be brought to the notice of the Master of the Rolls.

Mr. A. H. Allen, of Sheffield, who proved having read a paper at the Society of Arts, which paper is published in Vol. 26 of the Society's "Transactions," said he had made the double sulphate of nickel according to Adams's method before 1869. The same result would be obtained in a somewhat different way by Brande's process.

Mr. Charles Tookey proved analyses he had made of the piece of a nickel anode previously referred to.

Mr. W. Parkes, of Birmingham, stated that he had plated with nickel as far back as 1842. He prepared his solution with sulphate of ammonia and a nickel plate, and a piece of carbon, by means of a strong electric current. He plated large numbers of lasso rings for Mr. Chas. Shaw, of Birmingham. In cross-examination he said he could not produce any of the articles coated by him or books showing that he sold them.

Mr. John Spiller, late of the War Department, had seen the plating operation at Messrs. Bradbury and Wilkinson's in 1862.

The defendant, Capt. Farquharson, said he first became acquainted with nickel plating in Brussels. He confirmed what had been previously stated as the practice of his firm in purchasing from Mr. Elmore. They used a Weston dynamo machine. They did not use the chloride or cyanide solution. They added another material to the bath of sulphate solution, but he preferred not to say what it was except to the Court. It was not anything "directed" by Adams's specification to be used. In cross-examination he admitted that it was "mentioned" in the specification. Under the advice of counsel he declined to say where it was mentioned or what it was. The witness was strongly pressed, and the question whether he was or was not obliged to answer was argued. The Vice-Chancellor held that he could not exonerate him from answering the question so put in cross-examination. Sir Henry Jackson desired that it should be communicated to the judge, who would then open Professor Dewar's report and compare the two. Mr. Aston offered to submit to this course, and to leave it to the judge to decide whether the ingredient was such as without the use of the solution it would be an infringement. If so it would be equally an infringement with it. But if it were not an infringement without the solution, and was an infringement with it, he should desire to be told what the ingredient was. The Vice-Chancellor expressed an opinion deprecating the kind of order made by the Master of the Rolls, and observed that he could not act on evidence that was not submitted to the parties at some time or another. Ultimately he opened the report, and having read it to himself said that there was no trade secret, and handed the report to counsel for their inspection, observing, *Parturient montes nascitur ridiculus mus.* It was then suggested that Professor Dewar might be called, but his lordship held that Professor Dewar was an officer of the Court and he should not allow him to be called.

The VICE-CHANCELLOR, in giving judgment, observed that there were two issues for determination—the first as to the validity of the plaintiffs' patent, the second as to the infringement by the defendants. Now as to the first issue, the evidence was clear that prior to 1869 nickel plating was well known, and it seemed to him to be clear it was a most useless knowledge, for to no useful purpose had it been applied. Witnesses had stated that articles had been plated prior to that date, but no one of such articles had been produced. It was equally clear that since that date a most valuable trade had been established. Numerous books had been referred to, but no one of such books had been shown to give information which could be made useful for a commercial purpose. Brande's statement was that upon which the most reliance was placed, but that did not state how the method of preparing the salt could be made use of. He said you might make a solution which he described, and then you might practice electroplating if you could. Now in his specification the inventor had stated in detail the kind of improvements which he had made. He said they were, first, the method of making certain solutions; secondly, to the method of preparing nickel anodes; thirdly, to the character of the deposits obtained. He particularly pointed out the necessity of purity, and he had been entirely corroborated by the witnesses. The same observation applied to the anodes. In his lordship's opinion all that had been said against the validity of the patent had been said without effect. He took it to be clearly a patent for a new manufacture, proved to be a new manufacture, proved to have come upon the mercantile world in Birmingham and Sheffield by surprise when the patent was taken out, and to have been successfully practised from that time to this. With reference to the plate produced by Mr. Wilkinson, that was coated merely with a film. It was possibly well known that such a film could be deposited, but what the patentee taught the world was to make a reguline deposit. Next, had there been any infringement? He thought it was not in fact disputed. It was impossible to distinguish the articles made by the parties, and he said, therefore, they were made by the same process. What was said against that? Not a workman of the defendants had been produced, and no information was given as to their process. Mr. Elmore, who knew everything, said nothing about a secret process. The defendants simply stood on the defensive and said "prove it if you can." In his lordship's opinion the plaintiffs had proved their charge of infringement. Upon the subject of the trade secret he looked with dissatisfaction. But for that allegation of a trade secret the plaintiff would have had their legal right, namely, full discovery of the defendants' process. When the report of the referee is opened what does it turn out to be? The processes are the same, except that the defendants add some common salt to the solution, which admixture the referee says makes no difference to the practice of the invention. He held that the plaintiffs had established their case, and were entitled to the relief claimed with costs. The expenses of Professor Dewar must form part of the costs of the action.

A discussion as to costs followed the judgment. It was stated that a certificate had been made in a former action that the validity of the patent had come into question, and that, therefore, the plaintiffs in this action were entitled to costs as between solicitor and client. On the other hand it was alleged that such certificate had been granted without full consideration, because the former action had not been tried out but compromised. The Vice-Chancellor, however, declined to make any special order.

The operation of the injunction was also stayed upon the application of the defendants, the plaintiffs not opposing, for ten days, to enable the defendants, if they should be so advised, to give notice of appeal, the Vice-Chancellor observing that he did not like to stop a going trade.

Solicitors for the plaintiffs, Mr. W. Foster; solicitors for the defendants, Messrs. Chapman, Turner, and Prichard.

LETTERS TO THE EDITOR.

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

THE EFFICIENCY OF A TANDEM ENGINE.

SIR,—I have read the article bearing the above written title in your issue of 25th February, and the arguments contained therein by which you prove that "the total consumption of steam" accounted for by the indicator, must have been either in excess of that stated by me, or within a small fraction of the consumption, no margin worth naming being left for condensation or leakage. I have also noted the conclusion you have arrived at, namely, that my figures require revision and that my measurement of the feed to the boilers was incorrect. As the bases of your argument you have taken the sample diagrams of the 6th October given in the report of the trial, and from them you deduce in the third paragraph of the article that the consumption of steam per indicated horse-power per hour must have been at least 21·3 lb., in the fourth paragraph that it must have been 12·13 lb., and in the fifth 17·92 lb. I certainly think it will surprise many of your readers to learn that three results so widely different can be correct deductions from one and the same set of indicator diagrams, and they will probably come to the conclusion that there is something about your figures which requires explanation. This I will give immediately, but before doing so I wish to remark, that the results for this particular day, the 6th October, are not given as absolutely correct but as having been obtained on the assumption that the average power indicated by the engine during the morning, when, for reasons explained in my report, no diagrams were taken, was the same as in the afternoon. The figures may, therefore, differ somewhat from the truth, but it is hardly likely the difference can be much, seeing that the weight of water measured into the boiler per indicated horse-power per hour, viz., 16·7 lb., was within 0·75 per cent. of the consumption of the following day when the same boiler pressure was maintained. The higher rate of consumption on the 8th, viz., 18·14 lb., was due to the reduced boiler pressure and lower ratio of expansion used. I notice also that you have adopted as a standard of comparison the number 15·32, which is the calculated weight of dry saturated steam supplied to the engine, per indicated horse-power per hour, after allowing not only for priming but also for drainage from the steam pipe and for condensation therein. Surely it would be better to take the feed-water to the boiler as the standard, for it is a quantity determinable by direct measurement, and is given in all experiments, whereas the other is not often ascertained, and at best determined from data which, as those who are conversant with the subject know, cannot be relied on as very exact.

Proceeding now to consider the figures and arguments given in the last three paragraphs of the article, and taking the third paragraph first, I may explain that I could not supply any information as to the ratio of expansion, other than what can be gathered from the diagrams; for since the cut-off in the non-condensing cylinder was regulated by the governor, it varied slightly every stroke, though, as may be seen by referring to the column headed I.H.P. of the table at the end of the report, the variation was very small. It is true the cut-off in the condensing cylinder was fixed, and might have been ascertained, but until I read your article I was not aware that the total expansion depended upon it, any more than that the "drop between the diagrams" depended upon the size of the receiver. Now as to the figures. You make the ratio of expansion 1 to 13, the volume of the condensing cylinder 133 cubic feet, and the water accounted for by the diagrams 21·3 lb. per I.H.P. per hour. I make the ratio of expansion 1 to 10·95, and the consumption of water 12·85 lb. as under. The clearance in the non-condensing cylinder is 2 per cent., the steam was cut off at ·25 of the stroke, and the relative volumes of the cylinders, including clearances, is as 1 to 2·90; therefore the ratio of expansion was $\frac{1 + \cdot 02}{\cdot 25 + \cdot 02} \times 2\cdot 90 = 10\cdot 95$.

The space swept out by the larger piston is 65·86 cubic feet per stroke, and this volume, plus the clearance, amounts to 68 cubic feet, not 133 cubic feet. The space to be filled with steam at 87 lb. absolute pressure is, therefore, $\frac{68}{10\cdot 95} = 6\cdot 210$ cubic feet per stroke, or $6\cdot 210 \times 84 = 521\cdot 6$ cubic feet per minute, which gives the consumption of steam as $521\cdot 6 \times 60 \times \cdot 2024 = 6{,}334\cdot 7$ lb. per hour, instead of 10,507 lb. Dividing 6,334·7 by 493, the indicated horse-power, we obtain the weight of water accounted for by the indicator as 12·85 lb. per indicated horse-power per hour, or 0·77 of the feed to the boiler. This fraction is rather greater than it would have been if the effect of the compression had been taken into account in the calculation; by leaving this out of consideration the consumption of water comes out rather above its proper value.

Turning now to paragraph 4, I have merely to observe that the quantity, 12·13 lb., given as the weight of steam accounted for by the indicator, is only ·734 of the feed to the boiler, and that this proportion does not appear to me to be at all an incredible one for a non-condensing—not a condensing engine as stated in the article—for both the calculation and result refer to the non-condensing cylinder only.

And lastly, with respect to paragraph 5, in which the indicated horse-power and rate of consumption are calculated on the supposition of a twelve-fold expansion in a single cylinder 45in. diameter by 6ft. stroke. You arrive at the conclusion that under these conditions the indicated horse-power would have been 579 instead of 492·6, and explains that "the difference is, of course, due to the gap in the diagram," and that it in no way affects the argument. It seems to me, however, that it is owing to your having forgotten to make any deduction from the calculated mean pressure for back pressure, or in other words, for imperfect vacuum. Allowing 4 lb. per square inch for this, as shown by the sample diagrams for 6th October, we find the I.H.P. to be $(25\cdot 32 - 4) \times 24\cdot 02 = 512$ instead of 579. To obtain the consumption of water per indicated horse-power per hour, 11,379 is divided by 579. What is 11,379? I suppose it is the quantity of steam used per hour, obtained in a similar way to the figure 10,507 in paragraph 3. If so, it is incorrect, and should be $\frac{10\cdot 95}{12} \times 6334\cdot 7 = 5780\cdot 4$. Dividing this by 512 we obtain the steam accounted for by the indicator per I.H.P per hour as 11·29 lb. = 0·68 of the feed-water. If, however, the correctness of the figures given in my report is to be judged by comparing the ratio—

$$\frac{\text{Steam accounted for by indicator}}{\text{Steam used}}$$

with the same ratio in other experiments, surely it would be better, instead of going into calculation of total expansion and equivalent single cylinder engines, simply to measure the steam accounted for by the indicator from terminal pressure in the condensing cylinder and to compare it with the feed to the boilers in the usual way. If we do this with the sample diagram of the 6th of October and allow for the steam saved by compression, we shall obtain 11·03 lb. as the weight of steam accounted for per indicated horse-power per hour, which is equal to 0·66 of the feed-water.

Let us see how this compares with other experiments. On page 130 of your issue of 25th February, 1876, is given a set of diagrams from the U.S.S. Galatin, which being used to illustrate an editorial argument on the relative efficiency of simple and compound engines, may be supposed to be correctly drawn and described. From the drawing I find the pressure at nine-tenths of the stroke was just about 13 lb. absolute, and from the description I see that the indicated horse-power was 197; the mean piston speed 255·55ft.; the diameter of the cylinder, 34·1in.; stroke of piston, 30in.; diameter of piston-rod, $4\frac{3}{4}$in.; clearance, ·066; and feed per indicated horse-power per hour, 20·49 lb. Calculating the steam discharged from the cylinder per indicated horse-power per hour, I find it to have been 15·24 lb., or ·744 of the feed-water. Thus in a single-cylinder condensing engine working with approximately the same initial pressure, the margin left "to meet losses of every kind" is absolutely less by $8\frac{1}{2}$ per cent. than in the compound engine, and yet it is on the ground of an insufficient margin that you impugn the accuracy of my figures. You may say that the single cylinder of the Galatin was jacketted; so it was, but seeing that you state in the course of the argument referred to that not only did the use of the jacket cause a positive loss, but that in point of fact the engine never did so badly as when the jacket was in use, I do not see that the margin could have been any greater if there had been no jacket.

As to the value of the ratio—

$$\frac{\text{Steam accounted for by indicator}}{\text{feed}}$$

I cannot do better than refer your readers to the 39th line of the tables between pages 120 and 121 of *Engineering* for 18th February, 1876, and to column 18 of the table on page 124 of the same number, where they will find margins considerably less than those given by your methods of calculation. MICHAEL LONGRIDGE.

Manchester, March 2nd.

[We received Mr. Longridge's letter so short a time before going to press, that we must reserve our comment on it until next week.—ED. E.]

SIR,—Mr. Longridge will, I think, not find it an easy matter to supply the verification of his figures which you ask for. I find, on referring to his report, that on the morning of the 6th of October no diagrams were taken, and those you have used refer to another day. The fact that Mr. Longridge knew nothing of the existence of the damper which caused such a waste of fuel, and that he was equally ignorant of the water trap on the steam pipe, is, to say the least, very curious.

The way in which an error in the feed-water calculation might come about is, no doubt, as follows:—The feed-water was drawn from two coupled barrels. A branch from a donkey engine was united to the coupling pipe in the middle. Every time the supply was changed from one barrel to the other, both cocks ought to have been shut. But to do this would have knocked off the feed, with the immediate result of letting the donkey pump race. We all know how troublesome it is to get a donkey pump to work quietly, and I have no doubt that the new feed was turned on before the old was turned off, and thus the donkey might draw a good deal more water than was accounted for. Perhaps Mr. Longridge will explain how the lifting of the damper did not increase the consumption of coal while it augmented the evaporation of water. CRUX.

Leeds, March 2nd.

ANTHRACITE AS A HOUSE COAL.

SIR,—I fear your article on anthracite, which appeared in your issue of the 18th ult., will, besides doing injustice to anthracite coalowners, also mislead those who have little or no knowledge of the properties of this kind of coal, and who may be desirous of utilising it for the abatement of a smoky atmosphere.

The facts you point out are, in my opinion, scarcely consistent, as the question is not one of adopting American or Irish anthracite, for it is highly improbable that either of these coals will or can compete with those that are immediately, as it were, at our doors, but rather a question as between the coals already used in London and Welsh anthracite.

It is not in my province to disparage the various kinds of coal, but when you describe the best varieties of anthracite as from Powell's Duffryn, Bwllfa, and Llangennech, I am sure the statement will be received with astonishment, as those having the slightest knowledge of our coal-fields are perfectly aware that they are not anthracite, neither are they sold as anthracite, nor worked in the anthracite district.

Welsh anthracite—commonly called stone coal—is a hard dense substance of shining blackness, is absolutely free from smoke, and even if burned "improperly," as you state, does not give off smoke. For generations it has been continuously used in Wales as a house coal, and many towns and villages in the vicinity of anthracite, to wit, the county town of Carmarthen, Llandilo, Llandovery, &c., may be seen in the coldest weather without a trace of smoke, the whitewash on the chimney-tops showing no discoloration. Anything more conclusive could scarcely be needed to prove the smokeless character of anthracite, while it goes far to demonstrate this coal to be peculiarly suited to abate smoke nuisance in our large towns. It is true anthracite is not very readily ignited, but servants with little experience are able to light and get up a cheerful fire in half-an-hour, and with a blower the heat can be regulated to suit the required degree of warmth; while its cleanliness and freedom from sulphur will be much appreciated in drawing-rooms, preventing the soiling of furniture, pictures, and delicate paper-hangings so much deplored by the use of smoky coals.

As regards the brittleness of Welsh anthracite experience proves it to be hard, and difficult to break, hence its being called stone coal, thus ranking very low in percentage of slack caused by transit. The coal is now being supplied to London in suitable lumps ready for placing on the fire, avoiding thus the slack, or small coal, usually made by the use of a hammer for breaking it up, a process which has hitherto increased slack infinitely more than occurs in transit, and placing it in the cellars. Whatever the apparent difficulties may be in the adoption of anthracite in London, it is a significant fact that in South Wales it is used as a house coal from the mansion to the cottage; therefore, where there is no prejudice there is no reason why it should not also succeed in London and other large towns. My experience of Welsh anthracite—extending over some sixteen years—and having had the privilege of conducting many experiments upon it, makes me fully recognise the desirability you express that the most reliable information should exist upon this subject, and as one of your constant readers, I am glad to throw what light I possess on a subject which has for its object so desirable an end as the purification of the atmosphere of London. R. H. HEPBURN.

Llanelly, 1st March, 1881.

[We have classed all Welsh smokeless or nearly smokeless Welsh coals together as anthracites, but we have expressely stated that many persons hold that Welsh steam coal is "not an anthracite at all," and we have also added that some Welsh coal closely resembles Irish anthracite. We must continue to hold, until proof be given to the contrary, that such coals as Bwllfa are anthracites. It is a soft in contradistinction to a hard anthracite, and such a coal has more chance, we think, of becoming a popular London fuel than the hard anthracite. We may say that we have recently seen an open firestove for burning anthracite, which does away with many of the objections we have raised to it as a house coal.—ED. E.]

SIR,—I should like to make a few remarks on the above subject, having lived for some years in the United States, and having had during that time experience with anthracite in different kinds of grate, stove, and range. I consider that no coal can be better for domestic purposes if the necessary conditions be observed. Anthracite may be burnt in an open grate, but some form of stove or range is preferable. The coal should be broken and screened to the proper size before delivery to the coal merchant; this is invariably done in Pennsylvania. The sizes most suitable for domestic use are "chestnuts," "range," and "stove," the latter being lumps about as big as a fist. When treated thus, it does not break either in the cellar, the scuttle, or the fire. The fire should never be allowed to go out; this is a matter of no difficulty, as by a proper regulation of the damper the fire burns slowly at night, and is made to burn clear and hot in a few minutes in the morning by clearing out the ashes and opening the damper. As you say, an anthracite fire should be large, and the construction of American houses admits of several rooms being warmed by one fire, the heat being distributed by warm air flues, and regulated by the "hit and miss" gratings. I found 65 deg. a temperature easily maintained in the coldest weather. With houses built as they now are in this country, and the English preference for an open fire in every room, it is not likely that anthracite will come into favour; but those who, like myself, have had practical experience with it under proper conditions will appreciate its many advantages, notably those of cleanliness and absence of necessity of frequent attention. Y. R.

February 23rd.

RIVER CONSERVANCY.

SIR,—In the agitation of opinions regarding the proposed River Conservancy Bill, the proprietors of high lands, I observe from the text of your valuable paper, declare that they will not be benefitted by the carrying out of the provisions of the Bill, and that they would find their advantage in having a part of the water, which passing from their confines deluges the country below them, retained on their lands. The logical deduction from these opinions of the highland lairds seems to be that, if they are called upon to contribute to the funds for the conservancy of rivers, they should get a benefit in the shape of dams raised on their estates to retain a portion of the rainfall there for their use. Any proposal for artificial retention of water among the hills will appear all the more feasible when it is taken into consideration that towns, large and small villages, and solitary houses, are now lifting their eyes to the hills for their water supplies, which causes a demand for the storing of water on high levels hitherto unknown

Glasgow, February 24th. WILL. YOUNG BLACK.

HIGH SPEED ENGINES.

SIR,—In reply to "J." in your last week's issue, Mr. Broadbent feels confident that he can make an engine to run up to 1400 revolutions per minute; but as he has never tried them for long periods of running at once, he cannot say if it would run steadily for a day together, but thinks one could be made to run at 900 revolutions per minute steadily and continuously.

If "J." will write to Thomas Broadbent he will be happy to give him what information he can. H. B.

Huddersfield, February 28th.

HIGH-SPEED LOCOMOTIVES

SIR,—"Running Board" so soon drifted out of "high-speed locomotives" into "fast trains" in his recent letter to you, that "D." and "E. S." have quite lost the thread of the discourse. Might I suggest that such as the latter do keep their remarks on the rival merits of the N. E. S. W. and L. and X.Y.R. fast expresses for the amateur pages of the *English Mechanic*. *Apropos* hereto it certainly is worthy of remark that the old Gooch engine of the 1851 exhibition is still practically a high-speed locomotive in 1881.

Exeter, March 2nd. C. W. VINCENT.

THE INTERNATIONAL WOOL EXHIBITION.—The directors of the Crystal Palace having now allotted the space demanded to the British and foreign applicants who intend to exhibit machinery in motion—which will, we understand, fill the central nave and aisles—have definitively completed arrangements with Messrs. W. and J. Galloway and Sons, of Manchester, to furnish engines and boilers and the necessary shafting, gearing, steam pipes, &c. The satisfactory manner in which this eminent firm carried out the motive power arrangements for British exhibitors at Vienna, Philadelphia, and Paris, is a guarantee that the engineering firms which exhibit will have no cause to complain this year of any shortcomings.

THE INSTITUTION OF CIVIL ENGINEERS.

WEIGHT AND LIMITING DIMENSIONS OF GIRDER BRIDGES.

AT the meeting on Tuesday, the 22nd of February, Mr. Abernethy, F.R.S.E., President, in the chair, the paper read was by Mr. M. am Ende, Assoc. M. Inst. C.E.

The author treated of a formula for the weight of girder bridges, which he based, to some extent theoretically, upon the strains in the principal or primary parts, viz., the flanges, the vertical web, and the wind bracing, and to some extent empirically, upon the experimental construction of the secondary parts or bracing. A distinction was made between the theoretical and the practical weight of girders. The former was the weight of an ideal structure, without connections and lateral stiffening; the latter contained the theoretical weight, together with constants of construction for the various parts, and an item for secondary bracing in addition. The constants of construction, such as the allowances for rivet holes and cover plates, were generally understood, and there was no great variety of practice; but practice varied greatly with regard to the allowance for secondary bracing. It would be inaccurate to draw conclusions from existing structures as to that item, even for structures of equal size; but it would be entirely misleading to do the same with regard to structures of much larger size and of different proportions. The author considered it, therefore, requisite to design such structures in order to ascertain the item for secondary bracing over the whole range of practical construction. Omitting smaller structures, in which the secondary bracing was ruled by considerations apart from strict economy, this range extended from spans of 150ft. to 1500ft. The designs represented spans of 1500ft., 1000ft., 750ft., 500ft., 255ft., and 150ft., the latter two having been executed for the Costa Rica State Railway. The system, common to all, was novel, and great economic advantages were claimed for it. The principal features were—(1) a polygonal form of the top flange composed of only five straight or nearly straight members; (2) in consequence of this form few meshes in the web; (3) the depth of the girders at $\frac{1}{10}$ and $\frac{9}{10}$ of the span was equal to one-half of the depth in the centre as characteristic of the form of the girders; (4) the depth in the centre was equal to $\frac{1}{5}$ and $\frac{1}{6}$ of the span; (5) the widths of the bridges were determined according to a practical formula; (6) the construction in detail was accomplished almost entirely with rolled bars, plates being used only at the junctions of the principal members. Points 1 to 3 were based upon a calculation of the theoretical weights of a number of forms of girders with a polygonal as well as with a curved top flange, the results being stated on a diagram. Point 4 was based upon results derived from the formula referred to in the latter part of the paper. Point 5 required a formula of a curve which was an asymptote to a straight line of an assumed inclination—here 1 in 30; such a curve was a hyperbola. Point 6 was in accordance with the modern style of bridge-building. From these designs six values for the secondary bracings were derived. If, then, the weight was hypothetically put—

$$z' \left(D + z''\right)^{x} \left(B + z'''\right)^{y} L,$$

viz., as a function of the three principal dimensions of the structure, D the depth, B the width, and L the span, five values would be sufficient to determine the five constants. They were found to be the following :—

$$z' = 0{\cdot}007;\ z'' = -10;\ z''' = -6;\ x = y = \tfrac{1}{2}.$$

This constituted the empirical part of the problem. Referring again to the theoretical part, a simple system had to be chosen, since a formula was required equally correct for all proportions of span to depth, besides not being too complicated. Such simple systems were the girder with two parallel flanges, and the bowstring girder with a parabola of the 2nd degree. The latter was preferred as having more points of resemblance with the girder of greatest economy than the former. The weight of the ideal structure mentioned above was determined entirely on theoretical grounds, while the necessary additions for the practical weight were derived from the designs, under the assumption that an equal degree of economy could be observed in the practical construction of the bowstring girder. The formula for the weight of the parabolic girder bridge thus completed could be utilised to ascertain not only the limiting spans of such bridges, but also a point of greater importance, viz., the most economic proportion of the depth to the span of the girders. This influence of the depth upon the weight of girders was illustrated by a diagram, which formed the record of a large number of results obtained from the formula. The author was led by it to conclusions which were in perfect harmony with experience and modern practice, viz., that for very large bridges the best proportion of depth to span was from about 1 in 4 to 1 in 5, and for small bridges 1 in 6 to 1 in 8. With a view of applying the formula to other systems, especially to the system of greatest economy, the theoretical weights of various forms of girders were calculated and the results tabulated on the diagram before referred to. This embraced the parabolic girders of the 2nd, 3rd, 4th, 5th, and ∞th degree—being necessarily all girders with many meshes in the web, and a number of girders with few meshes in the web, among which was the girder of greatest theoretical economy, and the girder illustrated in the design.

A formula was then given analogous to the formula for the common parabolic girder, but containing as a factor the proportion of the theoretical weight of any given form to that of the parabolic girder, and the practical weight could thus be calculated by referring to the table. A diagram was exhibited, showing the limiting depths of all parabolic girder bridges, *i.e.*, the depths at which the weights were infinite; the curve defining these depths was an ellipse. The same diagram showed the depths which limited economy, *i.e.*, at which the weights were a minimum. Another diagram showed in detail the weights of the principal parts of all parabolic girder bridges, the depths of which were most economical.

In the summary the author referred to the incompleteness of the investigations contained in the communication, and expressed his belief that a great deal more might be done in the same direction; but he thought he had succeeded in showing that the construction of a formula generally applicable to girder bridges was not an impossibility, and that even in its present form it would be of practical use for estimating the weights of large bridges. The mathematical part required to determine the theoretical weights of flanges, web, and wind-bracing, was contained in an appendix.

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

(*From our own Correspondent.*)

STAFFORDSHIRE iron has not improved in value upon the week, nor has the output shown an increase; and the business is being carried on upon terms which leave but a narrow fringe of profit. The weekly exchanges in Birmingham to-day, and in Wolverhampton yesterday—Wednesday—were better attended than a week since, and holders of iron showed more readiness to meet buyers' views. Yet buyers sought concessions which makers could rarely yield. Common bars were procurable at as low as £5 15s. per ton, but the price more generally demanded was £5 17s. 6d. and £6. From that figure upwards to £6 10s. and £7 the quotations were numerous, and embraced nearly every quality of serviceable smithy bars. From £7 to £8 2s. 6d. high-class bars of intrinsic value were offered, £7 10s. remaining the crucial figure for "marked bars." Merchant offers for delivery in Liverpool were made to bar firms who were placed in competition with Warrington and other Lancashire ironmasters; but the offers could be accepted in only a few instances.

Hoops were inquired for by agents of the United States consumers, and makers quoted £6 15s. per ton, but buyers expressed confidence in their ability to obtain what they need at 5s. under that price. Hoops of a less valuable kind are reaching Liverpool, where they are placed on board at inclusive figures. Merchant sheets for working up were sought for, but buyers would seldom give the £7 5s. for the single gauge which makers asked. Equal hesitancy was displayed to give £8 10s. for doubles, and £9 15s. for latens of the same class. The galvanisers were in the market for bargains, and in some few instances they were able to buy galvanising sheets of 24 w.g. at £8 5s. per ton; but this was a price which was not generally accepted, the majority of the firms requiring from 5s. to 10s. more.

Leading galvanisers are full of work, and are running night as well as day turns. The sheets upon which they are employed are going mostly to South America and South Africa. One firm is just completing an order for seventy tons of corrugated sheets, with the necessary ledging and guttering, and 500 lengths of gutter down-flow pipes—all for roofing purposes at the Cape. Upon Australian account the work doing shows diminution; yet sheets of good quality for Sidney are also being sent away this week. Similar orders are under execution likewise for New Zealand. For galvanised corrugated sheets of 24 w.g., packed, and delivered at the ports of Liverpool and London, £15 was being asked to-day.

There is a larger current demand for plates to be used in tank-making. Several firms are taking up tank-making for the first time. Conspicuous amongst them stand Messrs. Davies Brothers and Co., of the Crown Galvanising and Roofing Works, Wolverhampton, who are erecting for the purpose new shopping, and are fitting it with modern machinery, including a machine for punching at one descent a row of rivet-holes in tanks capable of holding several thousand gallons of water. The firm's arrangements contemplate a maximum size of 10,000 gallons. Spacious tanks are now in hand for storing water at the Diamond Fields of South Africa. They are completed and put together, and the parts marked. The tanks are then taken to pieces and shipped in sections.

The South African diamond fields are also yielding valuable orders of another sort. This week Messrs. Pigott, of Birmingham, and Messrs. James Russell and Sons, Limited, of the Crown Works, Wednesbury, both well-known tube makers, have received between them an order for $16\frac{1}{2}$ miles of wrought iron tubing of $14\frac{1}{2}$in. diameter from a London merchant firm who have secured it from the Kimberley Waterworks Company, South Africa. The tubes are to be each about 14ft. long, and their manufacture will consume some 2000 tons of iron. The fact that so much iron will be required of one sort exerted considerable influence in Birmingham and Wolverhampton in checking the tendency to weakness which the markets to-day and yesterday showed.

Pigs were to be had yesterday at from 1s. 3d. to 2s. 6d. under the quotations of a fortnight ago. Cinder forge qualities were procurable at a minimum of £1 16s. 3d. The quotations of £2 2s. 6d., £2 12s. 6d., and £3 2s. 6d. for the three descriptions of the Spring Vale pigs were nominal. All-mine pigs by other firms also were less difficult to secure at £3 to £3 2s. 6d. Hematite qualities were to be had upon terms more in consumers' favour than lately. Tredegar forge qualities, for example, were easy at £3 10s. delivered on consumers' sidings in this district.

Coal was plentiful, and there was more readiness to accept orders for good qualities of both forge and furnace kinds at slightly under the rates determined by the recent advance of 1s. per ton.

The relative proportion of payments to be made by employers and employed formed the subject of debate at a sitting just held in Wolverhampton of the Employers' Liability Insurance Committee, which was appointed by the South Staffordshire Mill and Forge Wages Board. No definite solution was attained, and the operatives are going to refer the question to another meeting of the works' representatives.

The miners employed at the Sandwell Park Colliery, West Bromwich, have accepted an insurance scheme, drafted by their employers, which is to take the place of the provisions of the Employers' Liability Bill.

A strong opinion was expressed at the annual meeting of the Wolverhampton Chamber of Commerce a few days ago, that the railway rates from South Staffordshire were altogether excessive. The president announced that there had been a rise in the last ten years in the rates on iron manufactures sent out of this district, varying from 10 to 85 per cent. The companies would deliver iron from Middlesbrough into this district for 12s. 6d. per ton, but on goods sent hence to Middlesbrough the rate was more than 300 per cent. higher.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—Business throughout the iron trade of this district continues as dull as it is possible to be. For pig iron there is still little or no demand, and considerable quantities have recently been thrown into stock by the stoppage of many of the ironworks in this district. Consumers are placing very few enquiries in the market, and makers complain that where iron has already been sold, it is in many cases difficult to get buyers to take their deliveries. Prices continue to show a downward tendency, and where sales are forced, extremely low figures have to be taken.

Lancashire makers of pig iron report that extremely few new orders are at present coming into their hands, and what iron they are now sending away from their works is confined almost entirely to deliveries on account of old contracts. Nominally quotations for delivery into the Manchester district remain at 47s. 6d. for No. 3 foundry, and 46s. 6d. for No. 4 forge less $2\frac{1}{2}$ per cent., but as I intimated last week, local makers are now open to offers, and orders could readily be placed at 1s. per ton under the above figures.

In outside brands of pig iron coming into this district prices are very irregular, and it is difficult to say what sellers in some cases would be prepared to accept. For Lincolnshire and Derbyshire irons the average quoted prices are about 46s. to 47s. per ton, less $2\frac{1}{2}$ delivered equal to Manchester, but I hear of sellers at under these figures, whilst in Middlesbrough iron, although quotations have this week dropped as low as 46s. 4d. net, there are dealers who would be prepared to "bear" at under this figure if they had offers. In finished iron there is still only a moderate business doing, and prices, if anything, are weaker. Bars delivered into the Manchester district can be bought at from £5 17s. 6d. to £6; best hoops at £7 10s. to £7 15s.; common plates at £7 5s. to £7 10s.; ordinary sheets at £7 15s. to £8 5s.; and best qualities at £8 10s. to £9 per ton.

In the engineering branches of trade there is still an absence of what may be termed general activity. Some of the principal firms are, however, well employed, and locomotive and railway wagon builders have recently secured a considerable quantity of work. There are also several large cotton mills either projected or in progress in the district, and there is also a number of tramway projects in hand in the neighbourhood.

The strike in the Lancashire coal trade is now at an end. In the West Lancashire districts the whole of the men have gone in during the week; in the Manchester district gradual resumption of work is going on; and in the Bolton district, where the most determined opposition was shown by the men, it has been resolved to resume work. Although the quantity of coal being sent out from the local collieries is still considerably below their full average, yet fair supplies are now coming into the market, and there is a decided giving way in the exceptional prices which have been ruling of late. Local colliery proprietors have not yet had sufficient time to test the market, so as to enable them to arrive at any actual fixed rates, but the average prices which have during the week been quoted at the pit's mouth are about 10s. 6d. per ton for best Wigan Arley, 8s. 6d. to 9s. for Pemberton 4ft., 7s. 6d. to 8s. for steam and forge coal, 6s. to 6s. 3d. for burgy, and 4s. 9d. to 5s. 3d. for slack. These figures show a considerable advance upon those ruling prior to the strike, but buyers are purchasing only very cautiously at these rates, the general disposition being to wait and see what effect the general resumption of the output will have upon prices before giving out orders for any large quantities.

According to statements made at the monthly meeting of the South Lancashire and Cheshire Coalowners' Association, held in Manchester on Tuesday, there seems to be a desire on the part of a considerable portion of the men to revert to the arrangement for general insurance in place of the Employers' Liability Act, but no steps have yet been taken in this direction.

At the annual meeting of the Manchester Association of Gas Engineers, held on Saturday, the president, Mr. Chew, expressed his conviction that the electric light would not supersede gas for domestic lighting, and even in large spaces he thought gas would hold its own when the novelty of the electric light had worn off. American oil at its present low price was a more formidable competitor, especially in small towns where gas was dearer than the electric light.

The Ditton Brook Ironworks on the river Mersey, near Liverpool, and which comprise six blast furnaces and a foundry, are to be offered for sale by auction next month, but, I understand, there is a scheme for reconstruction in hand.

Barrow.—An easier tone characterises the iron trade this week, and prices are also a trifle easier. Makers of iron have a good number of orders in hand, however, and are in a position to deal with some firmness with buyers; but from what I can hear the sales which have been made at the low figure of 63s. per ton are parcels held by second-hand makers. A good foreign trade will, in all probability, be done during the year. The output of the furnaces is very large and is likely to increase. Steel makers are very busily employed, and several good orders are in hand. Shipbuilders and engineers have large order sheets, and both in the marine and ordinary departments a very large business is being done. Iron ore is in good request at undisturbed prices. Coal and coke in good request at easier prices. The general position of the district is one of considerable satisfaction, as there seems to be reasonable hope that makers will have a plentiful budget of orders, and that prices, although perhaps not much higher than those ruling the market at present, will be an improvement on those now quoted.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

THE tone of the Middlesbrough iron market on the 1st inst. was more depressed than has been the case since the New Year set in. All the sanguine expectations so freely indulged in during November and December have been so far disappointed. The "turn of the year" was expected to work wonders. Wait till "the turn of the year!" was the universal reply to those who seemed wanting in hopefulness. The turn of the year has come, and instead of better things it has brought worse. Long-continued bad weather has put back distribution and consumption a month at least, while production has gone on pretty much as before. The accumulated stocks at producers' works, at public stores, in weather-bound ships, in railway trucks, in consumers' yards, and indeed at every point between producer and consumer, are weighing like an incubus upon the trade. A case has been reported of a Clyde shipbuilder who has or had at one time a thousand tons of plates, angles, and bars, in railway trucks at his yard on demurrage! How can it be wondered at if such a consumer should refuse to take further deliveries and to give out fresh specifications? No. 3 pig iron was freely sold at 38s. per ton, and forge at 37s. for prompt delivery, or a shilling more in each case over the second quarter. Warrants were to be had for 39s. 6d. per ton. What business was done was mainly between consumers and merchants, most producers preferring to hold aloof.

As is usual in a falling market, buyers are now inclined to wait for still lower prices. The stocks for February will be known towards the end of the week, and many will do nothing until they see what influence the announcement may have upon prices.

Shipments have only reached 57,119 tons for the month, as against 48,636 for January and 78,941 tons for February, 1880. Local consumption having also been somewhat curtailed, it is expected the stocks will be found to have increased 30,000 tons at least. Messrs. Connal and Co. report that after accounting for all deliveries from their Middlesbrough store, they still have increased their stock 4874 tons, and that it now amounts to 149,157 tons. At Glasgow they hold altogether 526,922 tons.

The finished iron trade is weaker, in sympathy with pig iron, as well as on account of the recent scarcity of specifications. Plates are quoted at £6 10s. to £6 12s. 6d., bars and angles at £5 10s. to £5 12s. 6d., free in trucks Middlesbrough, cash tenth, less $2\frac{1}{2}$ per cent. discount.

The difficulty with the shearmen's helpers at Stockton continued until Monday. Three meetings of the standing committee of the Board of Arbitration were held during the previous week to consider the situation. At the last, which took place on Friday afternoon, it was decided that at each of the four plate mills at Stockton notice should be given the following day to all hands to terminate their engagements in a week.

By giving notice, it was sought to return to the sliding scale rates, and save the Arbitration Board from the somewhat ignominious position in which it found itself placed. The sliding scale was adopted about a year since, after much patient consideration, both by masters and men. It occupied some months to settle, and included an arbitration and reference to Mr. Dale as umpire. At the reference the terms claimed by the workmen were endorsed by the referee, and the alternative ones suggested by the masters were rejected. As a substantial preliminary consideration for accepting a sliding scale at all, the wages of the ironworkers were advanced $12\frac{1}{2}$ per cent. all round, notwithstanding that the employers had mostly several months' work in hand at the previous low price. The sliding scale was to endure for two years, of which one has now nearly expired. Notwithstanding this solemn and deliberate bargain, certain sections of ironworkers have recently been manœuvring by partial strikes or threats of strikes to obtain rates above what the scale allowed. Some iron manufacturing employers do not belong to the board, but the difficulties in question have occurred at the Stockton Works, where both employers and employed are members. The tactics of the men had already been in some previous but minor cases successful, when a more determined attack, viz., that of the shearmen's helpers, was made. The demand was for a large increase in wages, not only to the shearmen's helpers, but to the employing shearmen also. Instead of having a meeting of the board, and availing themselves of its power and influence to keep the men at work till the matter could be looked into, the Stockton firms almost immediately gave way, and thereby showed that they were not prepared to make the slightest sacrifice to maintain the sliding scale, or to enforce respect for the decisions of the board or of the referee appointed by it. On Monday, however, yet another meeting was held, when it was announced, amid some expression of feeling, that notwithstanding the above decision, one of the firms in question had omitted to give notice. Under these circumstances, the others naturally decided to withdraw the notices they had given, and to yield to the terms demanded by the men. These terms have now become the current rates in the district.

Shipbuilding continues as brisk on the north-east coast as the weather will allow, and fine large vessels continue to be added to our mercantile marine. For instance, one named the Mariner was launched at Messrs. Pearse and Co.'s yard at Stockton on the 1st inst. She is owned by a Liverpool firm, has engines of 120-horse power by Blair and Co., and her capacity is represented by 1420 tons register.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

Our colliers still seem bent on having their own foolish way. At the last meeting held at Barnsley, fresh resolutions were passed in favour of insisting on the 10 per cent. advance, and at several additional collieries notices have been sent in this week, and yet, while they are passing resolutions at Barnsley, the miners are in some cases wisely arranging their differences with their employers. At M nvers Main and the Holmes the sliding scale has been adopted; at Renishaw Park arrangements are expected to be made on an early day; at Aldwarke Main and Carr House—Messrs. John Brown and Co., Atlas Works, Sheffield—the miners, to the number of 800, are to return to work on the old terms this week.

The Lancashire miners have passed a resolution censuring Mr. Wm. Chappell, the miners' agent in this district, who has, through evil report and good report, unflinchingly advocated the adoption of the sliding scale. Mr. Chappell has shown me a letter from a leading miners' agent in Lancashire, in which he is gravely rebuked for not preventing the colliers in the Sheffield and Rotherham district from loading wagons to be sent into Lancashire. In other words, Mr. Chappell is told that he ought to have hindered the works of Lancashire from getting any coal from Yorkshire, and even in the case of coalowners who had made contracts for six months, that he ought to have interfered with them. Against this pernicious doctrine Mr. Chappell vigorously protests.

I hear that the coalowners, though they are confident the miners will have the worst of any strike they may make general, are yet taking precautions in case work should be stopped all over the district. Notice has been given to manufacturers that the prices quoted are only those for the day, and deliveries will not be guaranteed at these rates beyond the date of the price list. Slack is now 6s. 6d. per ton, as compared with 4s. 6d. three weeks ago; and 8s. 3d. for nuts, as compared with 7s. 9d. three weeks ago. House coal will not be so seriously affected. Railway companies who have made contracts up to June for "hards" at 5s. 6d. to 6s., are exceptionally well off.

The four mails which have come in from Australia during the last week have brought good inquiries, principally for commoner qualities, instead of the high-class kinds of cutlery so freely ordered up to last June.

In steel I find very sanguine expectations entertained. Bessemer billets are now making rather less, however, than they were doing a fortnight ago—£6 7s. 6d. per ton, as compared with £6 5s. at works. Bessemer ingots, No. 1, £8 10s.; No. 2, £8 17s. 6d. for cash, both delivered in Sheffield. The fall is accounted for by there having been heavy purchases made at the close of last year. These stocks of materials are now being realised in order to meet engagements.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

The iron trade continues dull in almost every department, and the prospects are not encouraging. The past week's legitimate business has not disclosed any new feature of importance, so far as can be ascertained. Shipments of Scotch pigs have been considerably larger, but the demand is not anything like sufficient to absorb the current production. Indeed, the home inquiry, which has for many months been exceptionally good, seems at length to be assuming a somewhat quieter aspect, although it cannot be doubted that the manufactured ironworks will continue to a steady volume of iron. The exports of pigs for the week were 11,266 tons as against 7404 in the preceding week, and 12,603 in the corresponding week of last year. Only 4090 tons of the whole went abroad. Large deliveries of pig iron continue to be made into store, and whilst I write Messrs. Connal and Co.'s stores in Glasgow contain the heavy aggregate of upwards of 527,000 tons. One furnace has been put out at Almond Ironworks, leaving 120 in blast, as compared with 111 last year, and of the number seven are making hematites. Merchants inform me that the continental trade during the past month has been very disappointing, and that the inquiry from the United States is comparatively poor. The reports telegraphed from New York to the daily papers have for weeks been too favourable, and the quotations from the same source are at least 4s. higher in some cases than what can be obtained for Scotch iron in the American market. Of course this is well understood by merchants, and has no effect upon their operations, although it may in some degree influence outside speculations. The tendency of prices in Glasgow market this week has been downward, and there is nothing in view at present likely to improve them.

Business was done in the warrant market on Friday forenoon at from 50s. 3d. to 50s. 4d. and thence to 50s. cash, which was the closing quotation at the end of the day. On Tuesday forenoon transactions were effected at from 50s. to 49s. 6d. cash, and 49s. 8d. one month, the prices in the afternoon being 49s. 7d. to 49s. 8½d. cash, and 49s. 8d. to 49s. 7½d. one month. Tuesday's business was from 49s. 8d. to 49s. 7d. cash. On Wednesday prices receded to 49s. 4½d. ten days, and 48s. 11d. cash. To-day—Thursday—the market was flat, with business at 48s. 9d. to 48s. 10½d. cash, and 49s. one month.

The demand for makers' iron is quiet, and prices are weaker all round, there being a reduction generally of 6d., and in a few instances of 1s., per ton. Gartsherrie, f.o.b. at Glasgow, No. 1, is quoted at 59s. 6d.; No. 3, 52s.; Coltness, ditto, ditto; Langloan, 59s. 6d. and 51s. 6d.; Summerlee, 59s. 6d. and 51s.; Calder, ditto, ditto; Carnbroe, 56s. and 51s.; Clyde, 50s. 6d. and 48s. 6d.; Monkland, Quarter, and Govan, ditto, ditto; Shotts, at Leith, 60s. 6d. and 52s. 6d.; Carron, at Grangemouth, 52s. 6d.—specially selected, 56s.—and 51s. 6d.; Kinneil, at Bo'ness, 50s. 6d. and 49s.; Glengarnock, at Ardrossan, 56s. 6d. and 51s. 6d.; Eglinton, 51s. and 48s. 6d.; Dalmellington, ditto, ditto.

For manufactured iron the quotations are a shade easier, although only one or two makers appear as yet to have announced an actual reduction. It may be taken for granted that malleable iron is obtainable at about 5s. less than it was a month ago. Last week's foreign shipments of iron manufactures from the Clyde were exceptionally small. They embraced £1500 worth of machinery for the Continent and America, and £8000 other articles, of which £1900 went to Portland, £1300 to Halifax and Boston, £1150 to New York, £800 to Dunkirk, £1000 to the Cape, and £1500 to France and the Mediterranean.

A good steady trade is being done in coals all over the mining districts, but particularly on the West coast, where those engaged in the trade have profitted greatly by the strikes in the North of England. Coastwise shipments have been extensive, and the foreign exports are also more encouraging. All attempts to induce the miners to make a stand for increased wages have hitherto been futile. The men have had plenty of work, and by putting out rather more coals per day than usual, have been making good wages. Their experiences of past strikes have almost invariably been disastrous, and they have been acting during the past two months with commendable prudence and good sense.

In the course of the past month thirteen vessels, with an aggregate tonnage of 21,450, were launched from the Clyde shipbuilding yards as compared with thirteen vessels of 13,000 tons in February, 1880.

WALES & ADJOINING COUNTIES.

(*From our own Correspondent.*)

The wages question is coming to the front, as was expected, and on Saturday last an important meeting of house colliers took place at the Nelson, when initiatory steps were taken by the delegates and men. According to the opinions expressed by the delegates, the house coalmasters do not regard the application unfavourably.

The Ebbw Vale Company have just secured the contract for the supply of 32,000 tons of coal to the Midland Great Western Railway Company of Ireland. I note that this enterprising steel, iron, and coal company have opened offices at Swansea, under excellent direction, for the sale of their pig, &c.

Nearly 10,000 tons of iron and steel were exported from the Welsh ports last week, and good orders remain on the books for New York, New Orleans, and the Brazils. The various ironworks are working full time, and Cyfarthfa, Dowlais, Rhymney, and Tredegar may be cited as doing an exceedingly brisk trade, though rates are not sufficiently advanced yet to pay fairly.

Still better trade might be anticipated if the tin-plate works were in fuller activity. Numbers of tin-plate mills continue closed, and it has been decided, at an important meeting of tin-plate workers held at Swansea, to pay a certain fixed sum from the funds of the Association to each of the firms on strike. The statement widely spread that Cyfarthfa is on the eve of entering into the steel trade is, perhaps, a little premature. It is true that Mr. Crawshay is working a good brand of hematite pig.

The foreign ore trade is not quite so brisk, and large stocks are in hand, particularly in Newport. This is not surprising considering the quantities imported—13,000 tons came to hand last week at Newport and Cardiff. A stock of 50,000 tons is reported on hand at Newport; not a judicious step towards maintaining prices.

The Rhondda Junction Welsh Coal Company began operations this week, and purposes opening out extensively.

It may interest readers to know the project in view at the Harris Deep Navigation Colliery. It is by means of the two shafts ultimately to get an output of 3000 tons per day, and, as a collier averages 1 ton per diem cutting, this will give a working staff of 3000 men. The district of the new colliery is already extending widely, and rows of streets are springing up in all directions.

The Dowlais Company is still unsuccessful with its new colliery at Bedlinog, and has not much encouragement for the persevering efforts carried on by Mr. Truran. It is, however, certain that the seams will turn up all right eventually. Ordinary companies would have retired long ago from the undertaking.

I note among new companies the Dynevor Iron and Tin-plate, Carmarthenshire; the Rhondda Junction Welsh Coal Company—late Fowler's—Pontypridd, capital £40,000, in £10 shares; and the Cardiff Junction Dry Dock and Engineering Company, Limited. This last company proposes to take the well-known business of Parfitt and Jenkins; capital, £60,000, in £50 shares. The concern has been always regarded as one of the best in Cardiff.

The coal trade is brisk in all quarters, and rates firm, but caution is exercised in the making of engagements, as some degree of uncertainty prevails among the men, who are evidently keenly alive to the prospect of advanced wages.

On Monday an important meeting of the Havod, Great Western, Coedcae, and Cymmer men was held at Havod, when it was resolved that in future the men claim yardage for hewing out stalls or new stalls worked off—the yardage to be claimed as in the case of a heading. With reference to the Coedcae men it was stated that differences had again occurred, and that a strike was resolved upon, and the meeting decided to support the strikers.

Some anxiety was expressed to learn what the accountants would state after the books had been examined according to sliding scale arrangements, but Mr. Abraham, the miners' agent, who was present, stated "that the examination would include only dates up to the end of the year. They would have to wait some little time for this to be concluded."

Negotiations are on the carpet for the sale of the Carmarthen and Cardigan Railway either to the Great Western or London and North-Western.

Tin-plate prices are stationary, but trade is moving a little better.

The Earl of Jersey is understood to be actively employed in the promotion of the Rhondda and Swansea Bay Railway scheme. The first hearing of the Bill has taken place. The Marquis of Bute and Taff Vale have agreed to watch the case and cross-examine witnesses.

The export of coal during the past week from all he Welsh ports was slightly in excess of 150,000 tons. A little improvement is setting in at the Forest of Dean collieries. Best coals are being shipped at Lydney for 11s. f.o.b.

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 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.

22nd February, 1881.

747. Stoves, H. Defty, Middlesbrough-on-Tees.
748. Drying Machines, B. Mills.—(*L. Fernow, Chicago.*)
749. Colouring Matters, C. Abel.—(*C. Martius, Berlin.*)
750. Colouring Matters, C. Abel.—(*C. Martius, Berlin.*)
751. Substitute for Tea, &c., R. Stone, London.
752. Lamps, F. J. Costa, Belitha Villas, London.
753. Bicycles, G. Ash, Russell-street, Southsea.
754. Bicycles, G. Singer, Coventry, and A. W. Metcalfe, Clifton.
755. Boxes of Carriage Axles, J. Grice, Birmingham.
756. Knitted or Looped Fabrics, J. Booth, Ovenden.
757. Pumping Apparatus, W. Anderson, Whitehall-place, and W. Airy, Queen Anne's-gate, Westminster.
758. Drying Fabrics, C. Heap, Rochdale.
759. Boilers, W. Thompson.—(*J. Lallemand, Paris.*)
760. Telephones, E. Anderson.—(*J. Goodman, Louisville.*)
761. Treating Iron, &c., W. P. Thompson.—(*A. H. Siegfried, Snyder, and T. H. Purdy, Sunbury, U.S.*)
762. Yard Measures, J. Darling, Glasgow.
763. Pressing Apparatus, J. and J. C. Buckley, Leeds.
764. Dobbies, W. A. Carr, Manchester.
765. Holders for Gas Globes, F. Willoughby, Stockport.
766. Purifying Middlings, J. S. Sutcliffe, Bacup.
767. Steam Boilers, T. Joicey, Gateshead-on-Tyne.
768. Lamps, E. Brewer.—(*T. Edison, Menlo Park, U.S.*)
769. Cooking Apparatus, H. Lecornu, France.
770. Drawing Apparatus, A. Savage, London.
771. Securing, &c., Saws, S. Bastow, Leeds.
772. Railway Buffers, J. W. Howard, London.
773. Heating Air, G. Seagrave and S. Bevington, London.
774. Electric Lamps, J. Fyfe, London.
775. Opera Glasses, &c., C. D. Abel.—(*A. Loiseau and J. B. Germeuil-Bonnaud, Paris.*)
776. Presses, W. Lake.—(*E. B. Welch, Cambridge, U.S.*)
777. Presses, A. Clark.—(*W. H. Golding, Chelsea, U.S.*)

24th February, 1881.

778. Valves, E. O. Mundy, Stratford.
779. Steam Presses, J. P. Cox, Nottingham.
780. Drain Ploughs, G. Bull, Lower Shuckburgh.
781. Extracting Oxygen, H. J. Haddan.—(*E. B. Reynolds, Cleveland, U.S.*)
782. Tobacco Pipes, C. H. Lewis, London.
783. Conductors, J. Perry and W. E. Ayrton, London.
784. Measuring Cocks, W. J. C. Joughin, Walthamstow.
785. Covering Wire, W. E. Ayrton, London.
786. Spanners, &c., G. Jacquemet, Paris.
787. Vulcanising Fabrics, T. Rowley, Manchester.
788. Land Roll. &c., C. T. Tulley, Martley.
789. Gas Retorts, J. West, Manchester.
790. Furnaces, G. E. Vaughan.—(*G. Thomson, Paris.*)
791. Children's Cots, E. A. Brydges, Upton.—(*C. Schmidt, Berlin.*)
792. Lamps, P. Jensen.—(*T. A. Edison, Menlo, Park.*)
793. Oilcloths, W. Ayrton, Ormskirk.
794. Boat Davits, R. Burdes, Sunderland.
795. Packing Cases, F. Myers, London.
796. Boots and Shoes, H. Bland, Luton.
797. Life Buoys, R. Whitby, Greenwich.
798. Gas Engines, R. Ord, Devizes.
799. Gas Engines, J. Graddon, Forest-hill, Kent.
800. Diaspon-gelatine, B. J. B. Mills.—(*J. Anders, Pilsen, Bohemia.*)
801. Diaspon, B. Mills.—(*J. Anders, Pilsen, Bohemia.*)

25th February, 1881.

802. Splints, E. Pace and J. H. Howard, London.
803. Dynamic Apparatus, R. Waller, Leeds.
804. Food, &c., E. and J. Williams, Swansea.
805. Crayons, W. C. Horne, Sunningdale.
806. Purifying Apparatus, G. A. Northcote, London.
807. Aerial, &c., Apparatus, F. Wirth.—(*E. Goehrung, Stuttgart.*)
808. Bushes, J. Gordon, jun., Dundee.
809. Velvet, I. Bamford, Oldham.
810. Roasting Coffee, &c., P. Pearson, Manchester.
811. Gas Engines, W. Haigh and J. Nuttall, Oldham.
812. Lubricators, J. Lumb, Elland.
813. Fastening Brooches, &c., T. Powell, Harrogate.
814. Sugar, J. M. A. L. Bonneville, Paris.
815. Garden Rakes, F. Parkes, Birmingham.
816. Engines, J. Backhouse, Whitchurch.
817. Labels, E. Wright, Lower Sydenham.
818. Substitute for Coffee, S. T. Francis, London.
819. Connecting Ends of Rails, R. Williams, London.
820. Testing Milk, F. Wirth.—(*F. Heeren, Hanover.*)

26th February, 1881.

821. Indicating Apparatus, T. Thorp, Whitefield, and R. Tasker, Prestwich.
822. Socket Pipes, B. C. Cross, Dewsbury.
823. Glazing Windows, &c., B. C. Cross, Dewsbury.
824. Drying Wool, &c., D. Dawson, Milnsbridge.
825. Feeding Wool, &c., W. Cliffe & T. Ainley, Golcar.
826. Tobacco Pouches, J. Burbridge, Tottenham.
827. Type-writing Machines, P. M. Justice.—(*T. Hall, New York, U.S.*)
828. Horn-shavings, F. Wirth.—(*C. Zincke, Hamburg.*)
829. Boring Machine, F. Wirth.—(*I. Liefmann, Germany.*)
830. Tricycles, H. Kinder, Leicester.
831. Stockings, R. P. Robertson, Leytonstone
832. Screen Frames, G. F. Phillips, London.
833. Steam Pumps, J. Shanks and J. Lyon, Arbroath.
834. Organs, H. H. Lake.—(*Automatic Music Paper Company, Boston, U.S.*)

28th February, 1881.

835. Carrying Milk, E. Gaskell & W. Jackson, Wirral.
836. Leather Belting, B. J. Gibney, Nottingham.
837. Knitted Fabrics, F. Caldwell, Loughborough.
838. Tram-cars, A. Shakery, London.—(*J. de Canterac, Madrid.*)
839. Nut Lock Washers, W. G. Gulland, London.—(*N. B. Denny, Singapore.*)
840. Cupolas, &c., B. G. D. Cooke, Colomendy.
841. Dyeing, &c., J. Conlong, Blackburn, and J. Robertshaw, Manchester.
842. Furnaces, H. J. Haddan.—(*B. Sloper and W. M. Jackson, Washington, U.S.*)
843. Mariners' Compasses, H. J. Haddan.—(*J. Lewis and F. A. Brown, Massachusetts, U.S.*)
844. Batteries, F. Wirth.—(*E. Reiniger, Germany.*)
845. Lubricating Compound, F. Engel, Hamburg.—(*Messrs. Lehmkuhl and Wechsler, Hamburg.*)
846. Lock, W. H. Crispin, Stratford.
847. Treating Quartz, W. Gedge.—(*L. Thénot, Paris.*)
848. Sewing Machinery, H. Lake.—(*J. Fair, Buffalo.*)
849. Bituminous Cement, J. H. Johnson.—(*E. J. de Smedt and W. J. Twining, Washington, U.S.*)
850. Steam Boilers, J. Shanks and J. Lyon, Arbroath.
851. Paving, E. Brydges.—(*L. von Hegnenberg, Bavaria.*)
852. Bracelets, G. W. Dawson, Birmingham.
853. Lighting, J. Shallis and T. J. C. Thomas, London.
854. Powder, C. Tuchmann.—(*J. Schambech, Munich.*)

Inventions Protected for Six Months on deposit of Complete Specifications.

728. Magnesia, &c., C. Pieper, Gneisenau-strasse, Berlin.—A communication from M. Sprenger, Berlin.—*19th February*, 1881.
748. Drying Printed Sheets, B. J. B. Mills, Southampton-buildings, London.—A communication from L. A. Fernow, Chicago, U.S.—*22nd February*, 1881.

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

728. Mining Machines, C. Barlow, Southampton-buildings, London.—*21st February*, 1878.
729. Purifying Gas, W. P. Wilson, New Cross, Kent.—*21st February*, 1878.
744. Tiles, &c., W. Boulton, Burslem.—*22nd February*, 1878.
755. Governing Apparatus, D. B. Peebles, Bonnington.—*23rd February*, 1878.
747. Torpedo Boats, W. R. Lake, Southampton-buildings, London.—*22nd February*, 1878.
815. Utilising Bye-products of Soda, J. Mactear, Glasgow.—*28th February*, 1878.
749. Wheels, T. H. King, San Francisco, U.S.—*23rd February*, 1878.
1156. Refrigerating Chambers, T. Greenwood and T. Redman, Calne.—*23rd March*, 1878.
771. Sulphate of Alumina, E. P. Alexander, Southampton-buildings, London.—*25th February*, 1878.
798. Lubricating Spindles, &c., W. and R. Paulson, Mountsorrel.—*27th February*, 1878.
811. Sash Fasteners, A. I. L. Gordon, South Kensington, London.—*27th February*, 1878.
854. Shuttles, J. Greenwood, Huddersfield.—*2nd March*, 1878.
1062. Door Knobs, T. S. Ransom, Massachusetts, U.S.—*18th March*, 1878.
797. Hydraulic Machines, R. H. Tweddel, Delahay-street, London, J. Platt and J. Fielding, Gloucestershire.—*27th February*, 1878.
805. Curvilinear, &c., Movements, G. Fawcus, North Shields.—*27th February*, 1878.
832. Oil Mills, E. R. Walker, Leeds.—*1st March*, 1878.
964. Breech-loading Small-arms, G. Hackett, Birmingham.—*9th March*, 1878.
990. Conveying Coke, T. H. Bell, Middlesbrough, and W. Harle and R. Clough, Durham.—*12th March*, 1878.
1108. Railway Brakes, A. P. Price, Lincoln's-inn-fields, London.—*20th March*, 1878.
1171. Armour for Ships, Sir J. Whitworth, Manchester.—*23rd March*, 1878.
819. Pistons, J. Parker, Wakefield, Bradford.—*28th February*, 1878.

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

698. Sewing Machines, I. M. Singer, Oldway House, Paignton.—*24th February*, 1874.
713. Knitted Fabrics, W. Cotton, Loughborough.—*25th February*, 1874.
752. Steam, &c., Cocks, J. Mallinson, Welwyn.—*28th February*, 1874.
727. Twisting Fringe on Shawls, &c., W. Brooks, Bennington, U.S.—*26th February*, 1874.
772. Centrifugal Machines, St. J. V. Day, Buchanan-street, Glasgow.—*3rd March*, 1874.

Notices of Intention to Proceed with Applications.

Last day for filing opposition, 18th March, 1881.

4257. Velocipedes, E. C. F. Otto, Peckham.—*19th October* 1880.
4259. Utilising Phosphate of Alumina, A. Gutensohn, Southampton-buildings, London.—*19th October*, 1880.
4268. Coating, &c., Paper. T. H. Rees, Westminster Bridge-road, London.—*20th October*, 1880.
4288. Steam Generators, J. Windle, Moston.—*21st October*, 1880.
4290. Casting Articles in Copper, &c., P. M. Parsons, Melbourne House, Blackheath.—*21st October*, 1880.
4293. Combustion of Gas, W. R. Lake, Southampton-buildings, London.—A communication from A. W. Morton.—*21st October*, 1880.
4295. Window Sashes, P. Langridge, Eastbourne.—*21st October*, 1880.
4299. Folding Machinery, &c., E. A. Pallister, Leeds.—*21st October*, 1880.
4310. Magnetic Apparatus, W. R. Lake, Southampton-buildings, London.—Com. from S. Howes, N. Babcock, and C. Ewell.—*22nd October*, 1880.
4312. Temples for Looms, J. Parkinson, Bradford.—*22nd October*, 1880.
4327. Looms for Weaving, J. Cook and W. L. Heaton, Bolton.—*23rd October*, 1880.
4331. Shafts and Axles, C. F. Parsons, Hamilton-terrace, Victoria Park, London.—*23rd October*, 1880.
4332. Bricks and Tiles, P. Bawden, Norland-square, Notting-hill, London.—*23rd October*, 1880.
4335. Artificial Stone, W. R. Lake, Southampton-buildings, London.—Com. from Genuine Naxos-Emery Company.—*23rd October*, 1880.
4336. Spinning Machine Spindles, W. R. Lake, Southampton-buildings, London.—Com. from C. H. Chapman.—*23rd October*, 1880.
4346. Glass, C. N. Blumberg, Cannon-street, London.—Com. from W. Kralik.—*25th October*, 1880.
4399. Packing Permanent Way, F. Jackson and E. R. Austin, Manchester.—*28th October*, 1880.
4407. Boilers, J. Humphrys, Barrow-in-Furness.—*28th October*, 1880.
4411. Cisterns, &c., U. Bromley, G. Crowe, and W. James, Chester.—*28th October*, 1880.
4416. Doubling, &c., Yarns, E. Whalley, Manchester, and J. H. Stott, Rochdale.—*29th October*, 1880.
4420. Weaving Reversible Fabrics, A. and C. H. Rothwell, Bury.—*29th October*, 1880.
4432. Velocipedes, W. Hillman, Coventry.—*29th October*, 1880.
4434. Telegraphic Recording Apparatus, T. M. Foote, Brooklyn, U.S.—*30th October*, 1880.
4597. Silk Dressing Machinery, A. Greenwood, Leeds.—*9th November*, 1880.
4615. Cooling Brewer's Worts, H. Jaeckel-Handwerck, Grimma, near Leipzig.—*10th November*, 1880.
4617. Drying Kiln, E. Walker, Newark-upon-Trent.—*10th November*, 1880.
4628. Type Printing Telegraphs, F. H. W. Higgins, Farleigh-road, London.—*10th November*, 1880.
4807. Cans, T. Dolby, Dulwich.—*20th November*, 1880.
4823. Plaisters, A. H. Mason, Liverpool.—*22nd November*, 1880.
4906. Artificial Stones, H. G. Grant, Market-place, Manchester.—Com. from Dr. F. A. Richter.—*25th November*, 1880.
4943. Explosive Compound, W. R. Lake, Southampton-buildings, London.—A communication from J. M. Lewin.—*27th November*, 1880.
4982. Umbrella Cloths, W. Critchley, Bradford.—*30th November*, 1880.
5257. Burners and Regulators, J. L. Corbett, Glasgow.—*15th December*, 1880.
5350. Salt, &c., J. H. W. Biggs, Liverpool.—*21st December*, 1880.
5372. Salt, &c., J. H. W. Biggs, Liverpool.—*22nd December*, 1880.
222. Purifying Hydrochloric Acid, W. Weldon, Rede Hall, Burstow, and W. G. Strype, Murrough.—*18th January*, 1881.
353. Fixed, &c., Engines, R. Brown, Morton, near Gainsborough.—*26th January*, 1881.
380. Closing, &c., Doors, W. Leggott, Bradford.—*28th January*, 1881.
418. Stoppers for Bottles, B. Zibach, Whitechapel-road, London.—*31st January*, 1881.
497. Electro-magnetic Induction Machines, H. Wilde, Manchester.—*5th February*, 1881.
532. Gas Motor Engines, J. Fielding, Atlas Works, Gloucester.—*8th February*, 1881.
563. Filter-presses, H E. Newton, Chancery-lane, London.—Com. from A. Dehne.—*9th February*, 1881.

Last day for filing opposition, 21st March, 1881.

4322. Boots, &c., J. F. Fryer, Plantagenet-street, Nottingham.—*23rd October*, 1880.

4326. HORSESHOES, L. A. Groth, Finsbury-pavement, London.—A communication from G. Luchaire.—23rd October, 1880.
4362. POTATO DIGGERS, J. Wallace, Glasgow.—26th October, 1880.
4370. WATER-CLOSETS, &c., J. W. Holland, Crossley-street, London.—26th October, 1880.
4374. TABLE CLOTHS, &c., S. Ogden, Manchester, and J. Western, Lancaster.—26th October, 1880.
4377. REPAIRING DOCK WALLS, &c., J. T. Parlour, Fleet-street, London.—27th October, 1880.
4383. ABDOMINAL BELTS, P. W. G. Nunn, Maplestead, Bournemouth.—27th October, 1880.
4388. SCHOOL DESKS, P. M. Justice, Southampton-buildings, London.—A communication from A. E. J. Damman, and A. Cassard.—27th October, 1880.
4394. SPOOL TUBES, W. Ambler, Bradford. — 27th October, 1880.
4429. COILING IRON, &c., B. Talbot, Wellington.—29th October, 1880.
4438. ARTIFICIAL FUEL, J. R. Leaver, Swansea.—30th October, 1880.
4446. DENOTING TIME, &c., R. H. Ridout, Christchurch, Battersea.—30th October, 1880.
4447. VELOCIPEDES, T. F. Best, Birmingham.—30th October, 1880.
4449. BUFFER STOPS, A. A. Langley, Kent-terrace, Regent's Park, London.—30th October, 1880.
4524. TILTING CASKS, P. J. Catterall and J. S. Crowley, Manchester.—4th November, 1880.
4544. FURNACES, &c., H. H. Lake, Southampton-buildings, London.—A communication from La Société Nessi.—5th November, 1880.
4549. BELTS, &c., J. Heap, Ashton-under-Lyne.—6th November, 1880.
4620. LOCKS, &c., E. Pfeiffer, Queen Victoria-street, London.—A communication from Messrs. Huppe and Bender.—10th November, 1880.
4712. GLAZIERS' POINTS, &c., A. M. Clark, Chancery-lane, London.—A communication from G. W. Hubbard.—16th November, 1880.
4796. PERMANENT WAYS, A. Fairlie, King William-street, London.—19th November, 1880.
4889. LIFTING APPARATUS, A. Lafargue, Kensington, London.—24th November, 1880.
4952. FURNACES, &c., A. M. Clark, Chancery-lane, London. — A communication from J. Garnier.—27th November, 1880.
4964. VELOCIPEDES, J. C. Garrood, Fakenham, Norfolk. —29th November, 1880.
4988. ELECTRIC LAMPS, K. W. Hedges, Queen Anne's-gate, London.—30th November, 1880.
5060. REFRIGERATING APPARATUS, A. S. Haslam, Derby. —4th December, 1880.
5175. PERFORATING, &c., A. H. Robinson, Clyde-road, Dublin.—10th December, 1880.
5312. HEATING APPARATUS, W. P. Thompson, Lord-street, Liverpool.—A communication from J. Leiter. —18th December, 1880.
5394. BICARBONATE of SODA, W. Weldon, Burstow. —Com. from A. Pechiney.—23rd December, 1880.
5440. TRICYCLES, J. H. Walsh, The Cedars, Putney.— 24th December, 1880.
5481. SOFA BED, R. E. Parr, Trafalgar-road, Greenwich. —Com. from F. Laeremans.—29th December, 1880.
161. REGULATING APPARATUS, W. Birch, Salford.—13th January, 1881.
180. GAS ENGINES, W. Foulis, Glasgow.—14th January, 1881.
228. CLEANSING WINE, &c., CASKS, M. W. Proudlock, Newcastle-upon-Tyne, and R. Weatherburn, Burton-on-Trent.—18th January, 1881.
266. SURFACES for PRINTING, J. J. Sachs, Manchester. —21st January, 1881.
368. GAS, S. Holman, Queen Victoria-street, London. —27th January, 1881.
385. CHRONOGRAPHS, J. H. Johnson, Lincoln's-inn-fields, London.—A communication from A. L. Strasburger.—28th January, 1881.
422. CHLORATE of LIME, W. Weldon, Burstow.—Com. from A. R. Pechiney.—1st February, 1881.
423. CHLORATE of POTASH, W. Weldon, Burstow.— Com. from A. R. Pechiney.—1st February, 1881.
424. CHLORATE of SODA, W. Weldon, Burstow.—Com. from A. R. Pechiney.—1st February, 1881.
425. CHLORATE of SODA, W. Weldon, Burstow.—Com. from A. R. Pechiney.—1st February, 1881.
448. LAMPS, E. A. and J. D. Rippingille, Aston-juxta-Birmingham.—2nd February, 1881.
450. SEWING MACHINES, A. M. Clark, Chancery-lane, London.—Com. from A. Hurtu.—2nd February, 1881.
466. ARTIFICIAL INDIGO, J. H. Johnson, Lincoln's-inn-fields, London.—A communication from A. Baeyer. —3rd February, 1881.
559. DECORATING BUTTONS, J. H. Johnson, Lincoln's-inn-fields, London.—A communication from C. G. Dobbs.—9th February, 1881.
567. WELDING TUBES, A. and J. Stewart, and J. Wotherspoon, Coatbridge.—10th February, 1881.
611. BREWING, &c., W. W. Davenport, Birmingham.— 12th February, 1881.
613. MOULDS, J. Duncan, Mincing-lane, London, and B. Newlands, Victoria Docks.—12th February, 1881.
641. MOTOR ENGINES, E. M. Strange, Baltimore.—15th February, 1881.
653. STOVES, W. Schönheyder, Flora-terrace, Stoke Newington, London.—15th February, 1881.

Patents Sealed

(*List of Letters Patent which passed the Great Seal on the 25th February, 1881.*)

3098. FORMING TYPE MOULDS, W. R Lake, Southampton-buildings, London.—27th July, 1880.
3463. COAL PICKS, &c., A. R. and H. Strachan, Gateshead-on-Tyne, and R. Oliver, Winlaton. — 26th August, 1880.
3467. BOOTS, &c., C. Morlet, Geneva, Switzerland.— 26th August, 1880.
3471. SEPARATING FERROCYANIDES of IRON, W., T., and J. Chadwick, Manchester, and J. W. Kynaston, Liverpool.—27th August, 1880.
3473. TRANSMITTING, &c., SIGNALS, A. F. St. George, Southampton-buildings, London.—27th August, 1880.
3474. EXCAVATING, &c., COAL, F. Hurd, Wakefield.— 27th August, 1880.
3498. IRON GRILLS, &c., H. W. Perrers, Downshire-hill, Hampstead, London.—28th August, 1880.
3499. LAMPS, &c., W. C. Hughes, Hoxton-street, London.—28th August, 1880.
3501. STEAM, &c., COCKS, J. C. Etchells, Newton Heath, near Manchester.—28th August, 1880.
3502. SAFETY CASES, &c., F. Cooper, Handsworth.— 28th August, 1880.
3503. FLEXIBLE BOATS, W. G. Forster, Pelham-villa, Streatham Common.—28th August, 1880.
3506. INCUBATORS, C. H. Dunn and H. T. Cartwright, Mile End, London.—30th August, 1880.
3510. HEAT REGENERATORS, J. H. Johnson, Lincoln's-inn-fields, London.—30th August, 1880.
3514. CYLINDERS, &c., of STEAM ENGINES, W. Payton, Masbro'-road, Brook Green, and A. Wilson, Vauxhall Ironworks, Wandsworth-road.—30th August, 1880.
3519. DORMER WINDOWS, W. R. Lake, Southampton-buildings, London.—30th August, 1880.
3524. CLEANING SILVER, &c., J. Beresford, Altrincham. —31st August, 1880.
3526. VALVES for STEAM, &c., W. Morgan-Brown, Southampton-buildings, London.—31st August, 1880.
3533. PROPELLING CARRIAGES, E. Edwards, Southampton-buildings, London.—31st August, 1880.
3538. MOULDS, &c., S. Neville, Tynemouth.—1st September, 1880.
3546. WATCHES, L. Dee, Sherwood-street, Golden-square, London.—1st September, 1880.
3550. PREPARING, &c., SACCHARINE JUICES, F. Bonnefin, Leadenhall-street, London.—1st September, 1880.
3564. COMPENSATING APPARATUS, C. Gaunt, York.— 2nd September, 1880.
3568. CLOSING BOTTLES, T. Walker, Sumner-road, Croydon.—2nd September, 1880.
3570. EXHIBITING, &c., GOODS, F. M. B. Bertram, Myddleton-square, London.—2nd September, 1880.
3574. LOOMS for WEAVING, T. Singleton, Over Darwen. —3rd September, 1880.
3575. TAPS for WATER, &c., T. Singleton, Over Darwen. —3rd September, 1880.
3578. VEHICLES, W. J. Fraser, Adelaide-road, Haverstock-hill, London.—3rd September, 1880.
3580. BRAKE APPARATUS, R. Smith, Cardiff.—3rd September, 1880.
3584. HYDROGEN, &c., C. Hessel, Palmerston-road, Kilburn.—3rd September, 1880.
3593. YEAST, J. E. Newby and J. F. Ramsay, Durham. —4th September, 1880.
3606. EXPANSION VALVE GEAR, A. J. Stevens, Newport. —4th September, 1880.
3608. TIN, &c., PLATES, E. Parry, New Bridge-street, London, and T. H. Cobley, Dunstable.—4th September, 1880.
3611. RIVETTING MACHINES, A. C. Kirk, Glasgow.—6th September, 1880.
3626. PIPES, &c., F. Jackson, Nottingham.—7th September, 1880.
3628. TUBE EXPANDERS, F. W. Bond, Lambeth, London.—7th September, 1880.
3635. GOVERNORS, &c., A. S. F. Robinson, Ipswich.— 7th September, 1880.
3637. LIGHTING by ELECTRICITY, P. M. Justice, Southampton-buildings, London.—7th September, 1880.
3672. BANDAGES, J. H. de Bussy, Lordship-lane, Dulwich.—10th September, 1880.
3688. SPRINGS, H. L. Wilson and J. Clegg, Clayton-le-Moors.—10th September, 1880.
3689. ICED AIR INHALATORS, W. Brierley, Halifax.— 10th September, 1880.
3701. LOCKS, &c., J. M. Hart, Cheapside, London.— 11th September, 1880.
3720. LIQUID METERS, H. J. Haddan, Strand, London. —13th September, 1880.
3873. ROLLING STOCK, F. C. Glaser, Berlin.—24th September, 1880.
3883. PRODUCING MOTIVE POWER, W. Prowett, Birmingham.—25th September, 1880.
4188. LOCKS, H. K. Bromhead, Glasgow.—15th October, 1880.
4642. LAMPS, J. Thomas, Caledonian-road, London.— 11th November, 1880.
4932. TREATING ORES, &c., F. M. Lyte, Putney.—26th November, 1880.
5336. VALVES, &c., J. B. Handyside, Glasgow.—20th December, 1880.
5416. COMPRESSED TOBACCO, W. R. Lake, Southampton-buildings, London.—24th December, 1880.
5447. PURIFYING STEAM, &c., J. F. Belleville, Paris.— 28th December, 1880.
38. CASTING METALS, H. J. Haddan, Strand, London. —4th January, 1881.
39. STREET CURBS, H. J. Haddan, Strand, London.— 4th January, 1881.
75. PACKINGS, T. Tripp, East Stoughton, Norfolk, U.S. —6th January, 1881.

(*List of Letters Patent which passed the Great Seal on the 1st March, 1881.*)

3406. VALVES, A. Sweet, Hampstead-road, London.— —23rd August, 1880.
3572. PAPER-MAKING MACHINERY, J. Hawthorn, Newtown.—3rd September, 1880.
3577. CAGES, &c., M. Bauer, Boulevard Magenta, Paris. —3rd September, 1880.
3588. ARTIFICIAL TEETH, P. Jensen, Chancery-lane, London.—3rd September, 1880.
3589. SPINNING, &c., B. Berry and S. S. Freeman, Bradford.—3rd September, 1880.
3595. BOXES, &c., L. Wahltuch, City-road, London.— 4th September, 1880.
3600. PIANOFORTES, J. Gautier, Euston-road, London. —4th September, 1880.
3605. WHEELS for TRAMCARS, J. W. Morgan, Garth, Taffs Well.—4th September, 1880.
3623. DISTRIBUTING, &c., TYPE, J. Dittrich and P. Ganty, Hackney-road, London.—6th September, 1880.
3630. GOVERNING, &c., GAS, D. B. Peebles, Bonnington.—7th September, 1880.
3649. SPRING SOLITAIRES, J. Appleby and A. L. Stamps, Birmingham.—8th September, 1880.
3660. BEAMING YARNS, W. W. Urquhart and J. Lindsay, Dundee.—9th September, 1880.
3691. BINDING, &c., PAPER, G. W. McGill, Southampton-buildings, London.—10th September, 1880.
3695. GAS, &c., J. F. Parker, Gravelly Hill, near Birmingham.—10th September, 1880.
3741. TAPS, &c., E. Ludlow, Birmingham.—14th September, 1880.
3779. PRESSES, C. D. Abel, Southampton-buildings, London.—17th September, 1880.
3823. BUTTONS, J. Cadbury, Birmingham.—21st September, 1880.
3828. STEAM, &c., MOTORS, T. O'Haro, Haydon-square, London.—21st September, 1880.
3839. DRYING-CLOSETS, R. M. Ritchie, Edinburgh.— 22nd September, 1880.
3935. TYPE-WRITING MACHINES, A. M. Clark, Chancery-lane, London.—28th September, 1880.
4180. BRACE-ENDS, A. S. Taylor, Manchester.—14th October, 1880.
4341. OPERATING BELLS, G. Skrivanoff, Paris.—25th October, 1880.
4415. BOTTLE STOPPERS, H. J. West, Brixton.—28th October, 1880.
4614. ELECTRIC LAMPS, C. W. Siemens, Queen Anne's-gate, London.—10th November, 1880.
4939. GARDEN SEATS, A. W. Noel, Stanhoe Rectory, Norfolk.—27th November, 1880.
5252. OVERHEAD SEWING, A. Storer, Vienna.—14th December, 1880.
5263. PREPARING COLOURING MATTERS, J. H. Johnson, Lincoln's-inn-fields, London.—15th December, 1880.
5270. ROTARY PROPELLERS, M. P. W. Boulton, Tew Park, Oxford.—15th December, 1880.
5283. PULLEY BLOCKS, W. R. Lake, Southampton-buildings, London.—16th December, 1880.
5291. SHUTTLES, J. H. Pickles, Burnley.—17th December, 1880.
5299. CALORIC ENGINES, M. P. W. Boulton, Tew Park, Oxford.—17th December, 1880.
5361. WOOD-TURNING MACHINES, W. R. Lake, Southampton-buildings, London.—21st December, 1880.
5367. WOOD-TURNING MACHINERY, W. R. Lake, Southampton-buildings, London.—22nd December, 1880.

List of Specifications published during the week ending February 26th, 1881.

3411, 3s. 6d.; 2423, 8d.; 2483, 2d.; 2556, 6d.; 2773, 6d.; 2819, 8d.; 2823, 4d.; 2829, 6d.; 2845, 6d.; 2849, 6d.; 2850, 6d.; 2851, 6d.; 2853, 6d.; 2855, 6d.; 2859, 6d.; 2868, 6d.; 2870, 6d.; 2876, 6d.; 2888, 6d.; 2890, 6d.; 2893, 8d.; 2896, 8d.; 2898, 4d.; 2899, 10d.; 2901, 4d.; 2903, 6d.; 2905, 6d.; 2910, 6d.; 2912, 8d.; 2913, 6d.; 2915, 6d.; 2916, 6d.; 2919, 6d.; 2920, 6d.; 2926, 6d.; 2934, 6d.; 2935, 6d.; 2936, 8d.; 2946, 8d.; 2948, 6d.; 2953, 6d.; 2954, 4d.; 2960, 8d.; 2962, 6d.; 2969, 6d.; 2970, 6d.; 2971, 6d.; 2972, 6d.; 2990, 6d.; 2995, 6d.; 3013, 6d.; 3014, 6d.; 3018, 4d.; 3020, 6d.; 3023, 6d.; 3030, 2d.; 3033, 6d.; 3034, 2d.; 2039, 2d.; 3041, 2d.; 3043, 2d.; 3045, 2d.; 3046, 2d.; 3047, 2d.; 3049, 4d.; 3050, 2d.; 3053, 2d.; 3054, 2d.; 2055, 2d.; 3056, 2d.; 3057, 2d.; 3059, 8d.; 3061, 2d.; 3062, 6d.; 3065, 2d.; 3066, 10d.; 3068, 2d.; 3070, 8d.; 3071, 6d.; 3072, 2d.; 3073, 2d.; 3075, 6d.; 3081, 6d.; 3083, 2d.; 3088, 6d.; 3089, 2d.; 3090, 6d.; 3095, 6d.; 3096, 2d.; 3097, 2d.; 3099, 2d.; 3100, 2d.; 3101, 2d.; 3102, 6d.; 3103, 4d.; 3105, 2d.; 3106, 6d.; 3107, 4d.; 3108, 2d.; 3109, 6d.; 3110, 6d.; 3112, 4d.; 3113, 2d.; 3114, 4d.; 3115, 2d.; 3118, 2d.; 3120, 2d.; 3138, 2d.; 3139, 8d.; 3181, 4d.; 3216, 6d.; 3220, 4d.; 3240, 6d.; 3361, 2d.; 4665, 6d.

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

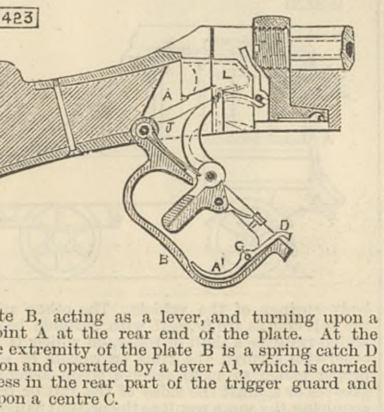
ABSTRACTS OF SPECIFICATIONS.

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

2423. BREECH-LOADING FIRE-ARMS, *J. H. Johnson.—Dated 15th June, 1880.—(A communication from C. A. J. A. Heeren.)* 8d.

The drawing shows a longitudinal vertical section of a portion of a fire-arm with the parts in the position which they occupy after the gun has been discharged and the cartridge case has been extracted. L is a breech-block or obturator, which has a vertical motion imparted to it by a curved arm J forming part of a trigger-plate B, the said arm, in combination with

2423



the plate B, acting as a lever, and turning upon a hinge joint A at the rear end of the plate. At the opposite extremity of the plate B is a spring catch D formed on and operated by a lever A^1, which is carried in a recess in the rear part of the trigger guard and turns upon a centre C.

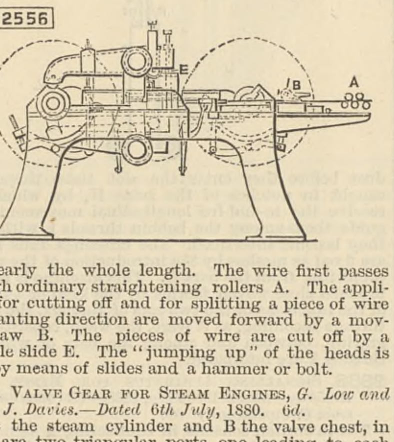
2483. EXPLOSIVE COMPOUNDS, *C. G. Björkman.—Dated 19th June, 1880.—(Void.)* 2d.

Glycerine or other suitable trivalent alcohol is heated and carefully mixed with one-third its weight of a carbo-hydrate such as sucrose or glucose, and then treated with two and a-half times its weight of strong nitric acid. The liquid formed is freed from excess of acid by means of water in which a small quantity of soda has been dissolved, and after separation from water the liquid is mixed with one or more combustible materials, or materials capable of yielding oxygen or other suitable substance, so as to form a solid or pulverulent explosive compound.

2556. MANUFACTURE OF NAILS, *G. W. von Nawrocki.—Dated 23rd June, 1880.—(A communication from T. Kuhne.)* 6d.

The wire is cut off in lengths equal to the length of the nail body, and about double the depth of the head. If the nail is to have an even taper from the head to the point, the piece of wire is split in a slanting direc-

2556

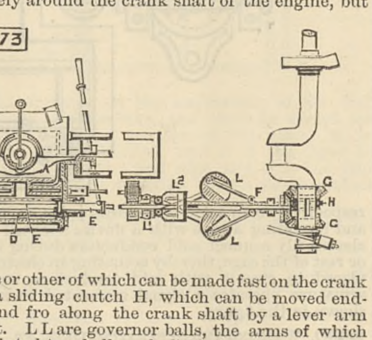


tion nearly the whole length. The wire first passes through ordinary straightening rollers A. The appliances for cutting off and for splitting a piece of wire in a slanting direction are moved forward by a movable jaw B. The pieces of wire are cut off by a movable slide E. The "jumping up" of the heads is done by means of slides and a hammer or bolt.

2773. VALVE GEAR FOR STEAM ENGINES, *G. Low and E. J. Davies.—Dated 6th July, 1880.* 6d.

A is the steam cylinder and B the valve chest, in which are two triangular ports, one leading to each end of the cylinder. Upon these ports rests the tube D open at both ends. E is the valve shaft secured at its end to one end of the tube, so that when the rod is moved endwise, the tube moves with it. In the interior of the opposite end of the tube are lugs with recesses in them, into which projections on the valve shaft enter, so that when the valve shaft is turned, the tube turns with it. The valve shaft E passes out from the end of the valve chest through a stuffing-box, and is coupled to, so as to be revolved by, a continuation F of the shaft. On the shaft F is a bevel wheel gearing with two bevel wheels G of the same size, that can turn loosely around the crank shaft of the engine, but

2773

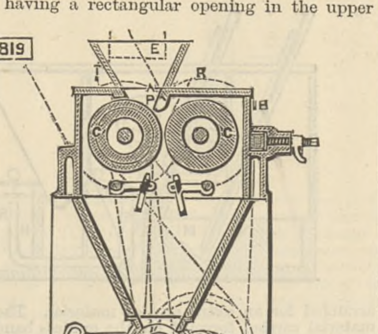


either one or other of which can be made fast on the crank shaft by a sliding clutch H, which can be moved endwise to and fro along the crank shaft by a lever arm on a shaft. L L are governor balls, the arms of which are pin-jointed to a hollow shaft L^1, through which the valve shaft can slide to and fro, but which turns with the valve shaft by reason of a cotter on the shaft E entering slots in arms L^2 which are fast upon the hollow shaft L^1; the arms L^2 are also connected to the shaft F and are driven by it.

2819. GRINDING OR REDUCING GRITS, GRAIN, &c., *J. H. Johnson.—Dated 9th July, 1880.—(A communication from A. F. and A. G. Beger.)* 8d.

The porcelain cylinders C C^1 are enclosed in a case B of wood having a rectangular opening in the upper

2819



side, and the edges of this opening are provided internally with depending ledges forming a hopper A. This hopper may be surmounted by a hopper T receiving the produce to be ground from a shoot E. The even or uniform distribution of the produce over the cylinder C^1, which revolves with less rapidity than the other, is secured by means of an adjustable distributor or feeder R. A rake or comb P is also provided, the same being capable of turning on its axis, and in consequence of the reciprocating movement along their axes of the porcelain cylinder against which it bears, it regulates the feed accurately according to the quantity of produce which it is desired to cause to pass between the cylinders.

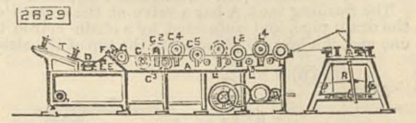
2823. PENHOLDERS, *R. Spear.—Dated 9th July, 1880.* 4d.

An ordinary penholder has fitted to it a kind of brush or comb placed over or under the pen itself, and when dipped into the ink this comb will retain a quantity of ink, which it afterwards supplies evenly to the pen.

2829. FINISHING SEWING THREAD AND TWINE, *H. E. Newton.—Dated 9th July, 1880.—(A communication from A. R. Villain.)* 6d.

At one end of the frame A is mounted an inclined table T which carries the bobbins. At the foot of the table is a trough D containing the glazing material through which the threads have to pass. On leaving the trough the threads are carried over a fixed brush E, and between a pair of feed rollers F and G, which are hollow and heated by steam. The threads then pass between the teeth of a comb and a series of brushes

2829

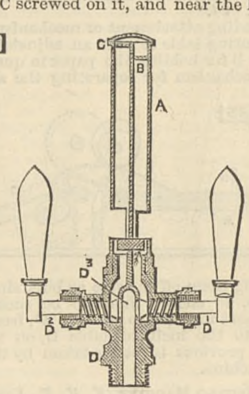


$C^1 C^2 C^3 C^4$. After passing the last brush the threads receive a further rubbing action from a roller C^5 covered with felt, and they then pass completely dry and glazed to the second part of the apparatus to undergo the waxing operation. This apparatus consists of a series of hollow copper rollers or cylinders L^1 L^2 L^3 L^4 placed alternately two above and two below the line of traverse of the thread, and covered with thick felt which is charged with wax. These rollers are heated internally by steam. R is the winding frame.

2845. STEAM WHISTLES, *J. Miller and I. Smith.—Dated 10th July, 1880.* 6d.

The drawing shows a section through the centre of right and left valves of one modification. A is a metal cylindrical bell divided vertically into two chambers: one chamber is provided with a metal stop B capable of adjustment, which serves to regulate the tone or pitch of the sound produced by the chamber in which the stop is placed; the upper end of the cylindrical bell has a cap C screwed on it, and near the lower end

2845

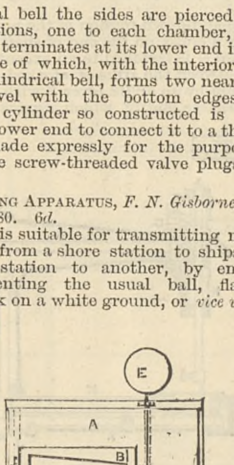


of the cylindrical bell the sides are pierced by two unequal perforations, one to each chamber, and the central partition terminates at its lower end in a disc, the circumference of which, with the interior circumference of the cylindrical bell, forms two nearly semicircular slits level with the bottom edges of the perforations. A cylinder so constructed is screwed interiorly at its lower end to connect it to a three-way valve cock D, made expressly for the purpose, provided with three screw-threaded valve plugs D^1, D^2, D^3.

2849. SIGNALLING APPARATUS, *F. N. Gisborne.—Dated 10th July, 1880.* 6d.

The apparatus is suitable for transmitting messages by visible signal from a shore station to ships at sea, and from one station to another, by employing symbols representing the usual ball, flag, and tennant, in black on a white ground, or *vice versâ*. A

2849

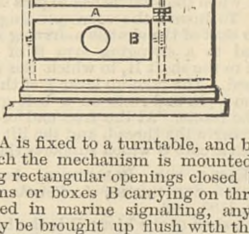


vertical screen A is fixed to a turntable, and behind it is a hut in which the mechanism is mounted. In it are three oblong rectangular openings closed by three four-sided prisms or boxes B carrying on three sides the devices used in marine signalling, any one of which sides may be brought up flush with the screen to fill the openings therein. The boxes are shifted by suitable gearing, and a disc E indicates when the apparatus is in action and when the signalling has ceased.

2850. GLAZING FOR ROOFS, *J. Dewrance.—Dated 10th July, 1880.* 6d.

The sash bars A follow the inclination of the roof, and are formed with a central ridge D with a gutter on either side. The panes of glass B rest upon the sash bars between the ridges, which rise above the surface of the glass, and leaden strips C are attached

2850

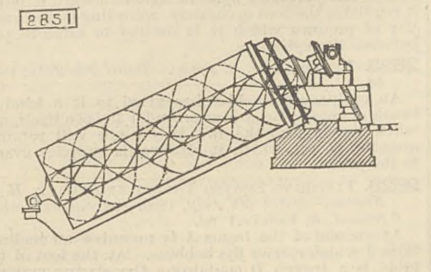


to the ridges over the glass, their edges being bent down until they come in contact with the glass on either side. The lower end of each pane overlaps the upper end of the pane next below, and so as to allow the glass to rest flat on the sides of the sash bars, the latter are stepped down at the upper end of each lower pane.

2851. SCREW PUMPS AND HYDRAULIC MOTORS, *W. Anderson and W. Airy.—Dated 10th July, 1880.* 6d.

The screw consists of the core, the threads, and the envelope, which together enclose passages open at the ends and passing spirally round the core. The screw is mounted in an inclined position, and when caused to revolve takes in water at the lower ends of the passages and delivers it at the upper end; or when

2851

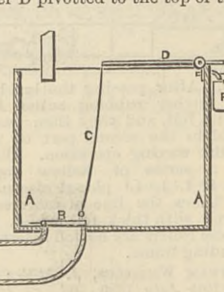


used as a motor, water enters the passages at their upper ends, and flowing down to the lower level causes the screw to rotate.

2853. FLUSHING APPARATUS FOR CLEANING DRAINS, &c., *W. R. Maguire.—Dated 10th July*, 1880. 6d.

The flushing tank A has a valve at the bottom over the drain pipe, and connected by a chain or rod C to one end of a lever D pivotted to the top of the cistern.

2853

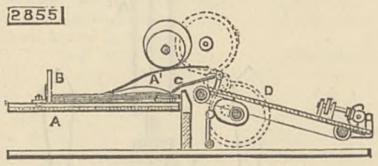


To the other end of the lever is suspended a tank F, which is filled by an overflow pipe I, and emptied by a small pipe in the bottom. When the tank F is full it raises the valve B and so flushes the drain pipe, and as it empties the valve closes again.

2855. FEEDING PAPER TO PRINTING MACHINES, &c., *J. H. R. Dinsmore and F. Hoyer.—Dated 10th July*, 1880. 6d.

The feeding attachment or mechanism consists of a compensating table A with an adjustable mechanism or gauge B for holding the paper in quantity or bulk; C is a mechanism for separating the sheets of paper

2855

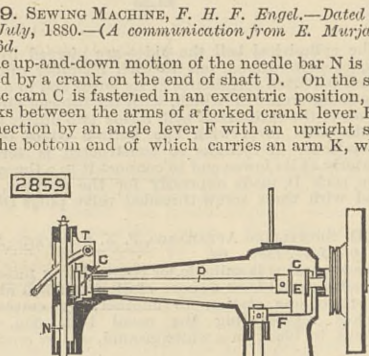


and lifting them off the pile or bulk singly, one sheet at a time, to enable them to be sucked up by the exhaust and raised into position A1, from whence they are led to the inclined table D, on which they are adjusted previous to being taken by the printing or other machine.

2859. SEWING MACHINE, *F. H. F. Engel.—Dated 10th July*, 1880.—*(A communication from E. Murjahn.)* 6d.

The up-and-down motion of the needle bar N is produced by a crank on the end of shaft D. On the shaft a disc cam C is fastened in an excentric position, and works between the arms of a forked crank lever E, in connection by an angle lever F with an upright shaft H, the bottom end of which carries an arm K, which

2859

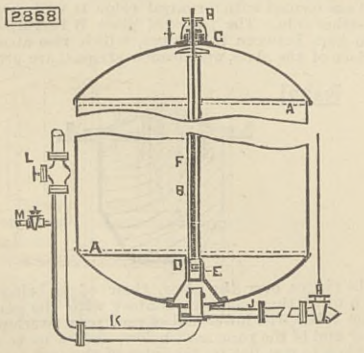


supports at its free ends the shuttle placed in its carrier. By this means when the shaft D is turned in either direction, the forked lever and shaft as well as the shuttle will always be in the same direction at the moment when the shuttle has to pass behind the upper thread. To insure the corresponding motion of the feeder to that of the shuttle a driving lever J, which is connected to a swinging arm R of the feeder, is fastened to the shaft H, to which the shuttle lever K is attached. The take-up lever T of the upper thread swings on a pin and rests on a bolt guided within a slot of the frame. At the free end of this lever is a hole to receive the thread, and the lift is produced by an excentric cam G which supports the bolt.

2868. KIERS FOR BLEACHING, &c., GOODS AND FIBROUS SUBSTANCES, *J. Hawthorne.—Dated 12th July*, 1880. 6d.

A is the shell of the kier; B is the buffer pipe; and C is a nozzle. The lower end of the buffer pipe is secured to a base or fixing D, in which is formed a chamber, which in the example is partly cylindrical and partly conical in form. The cylindrical part of the chamber is bored to receive a hollow cylindrical valve E which is attached to the lower end of a rod F. The upper end of the said rod passes out through a

2868

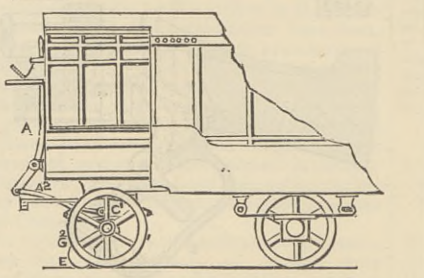


stuffing-box at G, and is screwed to suit a screw thread which is formed in the boss of a hand wheel H. The upper part of the nozzle projects through a hole in the bottom of the kier, the said hole being larger than the nozzle, so that there is space for the flow of liquor through openings in the base D, and through an annular passage left around the nozzle to the discharge pipe J. The lower end of the nozzle communicates with a pipe K, into which the liquor can be admitted through a branch pipe M, and into which steam can also be admitted through a valve L.

2870. WHEELED VEHICLES FOR ROAD, RAIL, OR TRAMWAY, *J. Wood.—Dated 12th July*, 1880. 6d.

A is a vertical lever centred on the bracket fixed to the front of the vehicle. The lower end of the lever is connected by link A2 to a cross bar or shaft, to the ends of which are secured the short arms C1 of a pair of bell-crank levers. These are mounted on the ordinary axletree or on studs or bearings secured to the

2870

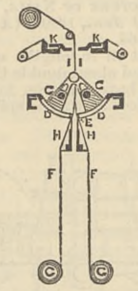


body springs of the vehicle. The other arms C2 of the bell-cranks are formed with suitable bearings, in which revolves a shaft or roller, on which is keyed or otherwise secured the rims or wheels E, set to the proper gauge so as to revolve when lowered in the grooves or against the sides of the rail or tram, thus acquiring the same result as the present flanged wheel, viz., keeping the vehicle on the rails.

2876. TEXTILE FABRICS, *C. D. Abel.—Dated 12th July*, 1880.—*(A communication from L. S. la Serre.)* 6d.

The drawing illustrates the character of a machine for the manufacture of tulle by the interlacing of two sets of threads, one set of weft derived from bobbins, and the other set constituting, as it were, the warp. The bobbins are mounted in carriages C, which slide to and fro along curved slotted guides D, each set of which form together a kind of comb, having in the middle between them a longitudinal slot E, through which pass the warp threads F coming from beams G.

2876



Just before they enter the slot these threads are caught in notches of the rules H, by which they receive the to-and-fro longitudinal movements that guide them among the bobbin threads I, with which they become interlaced. The crossings thus formed are fixed as meshes by the introduction of the needles projecting from the bars K. This machine is made to produce close woven fabrics by the kind of exchange of the functions of the two sets of threads, the bobbin threads becoming, as it were, the warp, constituting a grating, between and among the bars of which the threads F are interlaced.

2888. SIGNALLING APPARATUS FOR MINES, *H. J. Haddan.—Dated 13th July*, 1880.—*(A communication from C. Cummings.)* 6d.

The invention consists in connecting a signal with the armature of an electro-magnet and placing the latter in an open electric circuit, which extends down a shaft, so that by closing said circuit at will the signal may be operated; also in extending electric conductors,

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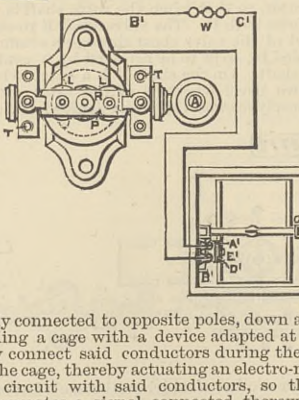

respectively connected to opposite poles, down a shaft, and providing a cage with a device adapted at will to electrically connect said conductors during the travel or rest of the cage, thereby actuating an electro-magnet placed in circuit with said conductors, so that its armature operates a signal connected therewith, as shown in the figure.

2890. WASHING AND SEPARATING ORES, &c., *F. Wirth.—Dated 13th July*, 1880.—*(A communication from H. Hochstrate.)* 6d.

H is a water basin communicating with clearing pool, in which the level of the water is held uniform by a continual flow of fresh water through the pipe I, and an overflow of sufficient height. The pipes R receive their water from the apparatus S, each being

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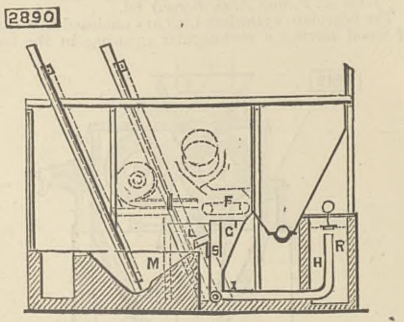


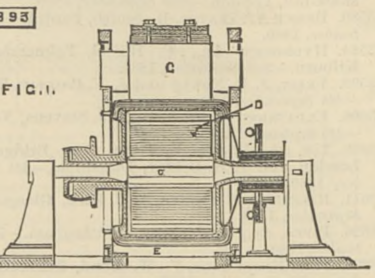
arranged for an extra size of material. The lumpy material carried forward on the endless band F falls through G1 into the apparatus, and sinks into the water according to the specific gravity, where it meets the upward flow of water, by which the smaller pieces are carried up S and over the spout L to an elevator M.

2893. APPARATUS FOR GENERATING ELECTRIC CURRENTS, *Baron Elphinstone and C. W. Vincent.—Dated 13th July*, 1880. 8d.

The invention relates to improvements in a dynamo machine previously patented. Steadiness and uniformity of action with the production when required of alternating currents are the inventor's aims. The machine is so arranged that the following coils enter the magnetic field before the preceding coils have left. A definite current is sent through coils. Figs. 1 and

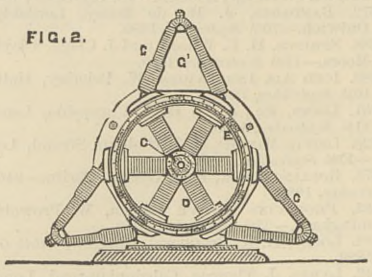
2893

FIG. 1.



2 show respectively a longitudinal and a transverse section of the machine. D D are stationary magnets bolted on shaft C; E is an armature; and G G the field magnets. The opposite poles of the internal and

FIG. 2.



field magnets differ in sign. The heads of the armature drum consist of open discs cast with elongated hubs fitting into coned shoulders on shaft

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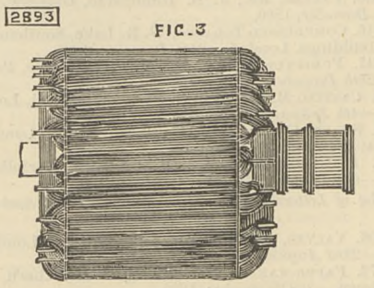
FIG. 3



C. Hanks of insulated wire laid diagonally cover the periphery of the drum. The arrangement of wires of hanks to commutator is shown in Fig. 3.

2896. STEAM STEERING GEAR, *C. R. Simey.—Dated 13th July*, 1880. 8d.

To the crosshead fixed on the piston rod of the steam cylinder A is fixed a rack D sliding in a grooved way and gearing with a pinion E hinged on an upright shaft, to the lower end of which the tiller chain drum

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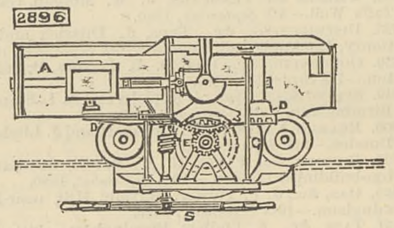

G is keyed. On the upright shaft is a pinion I gearing with a quadrant keyed on a tubular spindle forming part of the valve gear described in patent No. 1586, A.D. 1879. A hand wheel S is employed, so as to be able to steer by hand.

2898. FOLDING CHAIR, &c., *J. and N. Blezard.—Dated 14th July*, 1880. 4d.

The seat is secured to an X-shaped frame, one side of which extends upwards and serves as a back. Where the frames cross they are pivotted together. To the top of the shorter arm the front edge of the seat is pivotted, its back edge working in a slot in the longer arm, so that by moving it upwards the whole of the chair folds up.

2899. TREATMENT AND UTILISATION OF FUEL, &c., *W. Gorman.—Dated 14th July*, 1880. 10d.

The fuel is filled into the chamber A at top, which is covered by a cup and cone valve, and the fuel is ignited at the doors B, through which air is admitted. The gases produced pass through the flues C and are supplied with air for their further combustion by

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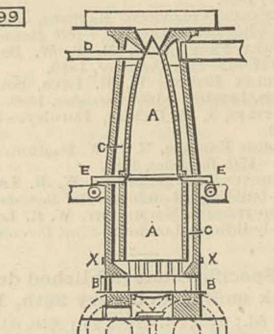

valves X. The heat thus produced distils the fuel in chamber A, and the condensable gases pass through the passage D and are led away and condensed to obtain their liquid products. When the permanent gases are required they are withdrawn by the passages E, and may be led away and purified for lighting or heating, or for producing power.

2901. DIFFERENTIAL MICROMETRICAL GAUGE, *G. Cucco.—Dated 14th July*, 1880.—*(Not proceeded with.)* 4d.

This relates to an apparatus which is placed between two surfaces, one of which is perfectly level, and the other is to be made parallel with it.

2903. CHILDREN'S CRADLES, *J. Friborg.—Dated 14th July*, 1880. 6d.

The cot or cradle is suspended to a suitable frame and connected by two or more rods to a treadle movement, so that the cradle can be caused to move in a horizontal direction by foot instead of being rocked by hand.

2905. SPRINGS FOR RAILWAY CARRIAGE SEATS, &c., *G. D. Peters.—Dated 14th July*, 1880. 6d.

This relates to improvements on patent No. 1389, A.D. 1877. Each spring consists of a rigid longitudinal bar A of wood, which has attached to it a series of transverse strips B of steel bent into an elliptical or oval shape, and confined between bar A and a longitudinal strip of steel C of semi-elliptic or bow shape, which connects the strips B and is combined with the bar A through the metal sockets or end pieces D.

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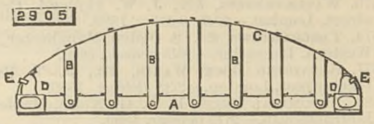

Between the ends of the strip C and the sockets D a piece of felt or other suitable flexible and absorbent material E is interposed.

2912. PURIFYING FLOUR AND MIDDLINGS, &c., *W. R. Lake.—Dated 14th July*, 1880.—*(A communication from D. B. Moseley.)* 8d.

A A represent windows placed on each side of and above the main frames; B is a sliding door for regulating the quantity of air drawn into the suction fan C, which is employed to draw the air through the dust-collector or parallel strips of cloth at O; D is the frame containing the dust-collector; E represents one of two fans placed at the tail end of the machine to

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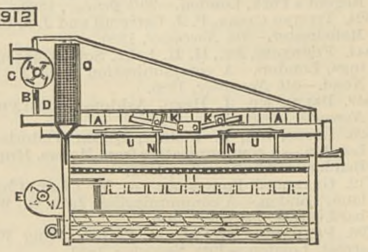

supply the required pressure of air under the bolting cloth. The cloth is fastened to sectional frames which rest on india-rubber springs, for the purpose of allowing the cloth to vibrate; K K are wooden levers or hammers for striking a blow on bars U, which communicate the blows through ports N to the edge of the sectional screen frame.

2913. FRAMES OF DOUBLE SKEPS OR BUCKETS FOR AUTOMATIC FILLING AND DISCHARGING, *G. Allix. Dated 14th July*, 1880. 6d.

The bucket is formed so that it can be automatically lowered and filled, and raised and discharged by the use of one chain or rope connected to any hoisting mechanism. The bell-crank lever A is keyed on to the rocking cross bar C set in the suspension frame D of

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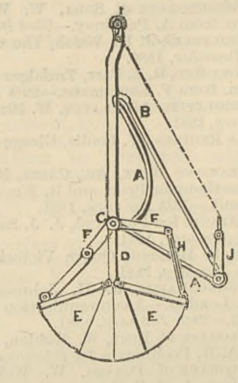

the skep or bucket E. To the cross bar are attached levers F, to which links H are secured, such links being also attached to and working the halves of the skep or bucket. To rock the lever A so as to open the skep or bucket, the angled bar B is provided with a notch at either end, and intermediate notches, so that a sliding shackle catch J, to which one end of the actuating chain is attached, will engage with the notch at either end as required, and thereby with one end of the bar B.

2915. SORTING ORES, COAL, &c., *J. H. Johnson and W. Haydock.—Dated 15th July*, 1880. 6d.

This consists in the manufacture or use of revolving sorting tables, which receive the rough material from

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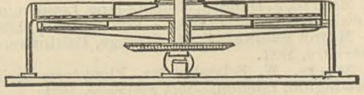

a spout or otherwise, and slowly revolve while the sorters sort the various qualities into the different zones of the tables, each of which, if more than one in number, is capable of being emptied separately by stationary scrapers.

2916. GOVERNING APPARATUS FOR MARINE ENGINES, *J. Coutts and H. Adamson.—Dated 15th July*, 1880. 6d.

So at to prevent racing by means of the difference of pressure at or close to the propeller, a stand pipe is placed at the stern and dips down to the level of the keel immediately in front of or behind the propeller. From this pipe, which is open at bottom, a small pipe

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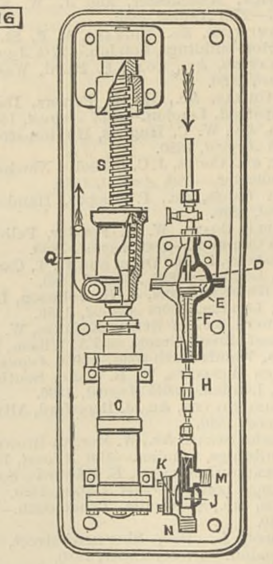

filled with air passes to a diaphragm chamber D having a flexible diaphragm E and spring F. To the diaphragm is secured the valve rod H; J is an equilibrium valve with passages for steam to pass through its centre and and press equally above and below; K, port leading to cylinder; M, exhaust to condenser; N, steam passage; O, single-acting steam cylinder open to the atmosphere; Q, connecting rod, connected by levers with the throttle valve; and S a spring to assist in bringing the valve back. When the normal pressure is in the stand pipe the valve J keeps the cylinder O open to the condenser, but when through absence of pressure in the pipe, and consequently on the upper side of diaphragm E, the spring F raises the diaphragm and valve rod, the exhaust is cut off and communication opened between K and the steam pipe N.

2919. Horseshoes, *C. Wittenström.—Dated 15th July, 1880.* 6d.

This consists in manufacturing horseshoes of steel or malleable iron by casting in moulds of cast iron or some other suitable material, which moulds are con-

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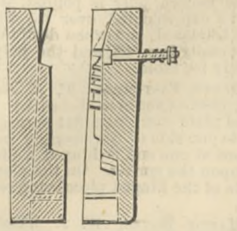

structed in such a way that they can be quickly op ned, and that a horseshoe which has been cast in such mould can easily be taken from the mould without being damaged or broken by shrinking. The holes for the nails are cast in the shoe at the same time.

2926. Combined Harvesting and Threshing Machines, *W. R. Lake.—Dated 15th July, 1880.—(A communication from D. Houser.)* 6d.

Fig. 1 is a plan of the machine with the top of the threshing chamber removed to show the internal arrangement of the machine, and Fig. 2 is an elevation of the side of the threshing portion of the machine and parts attached thereto adjacent to the header or sickle bar, the harvesting machine portion being removed. The threshing cylinder J is caused to

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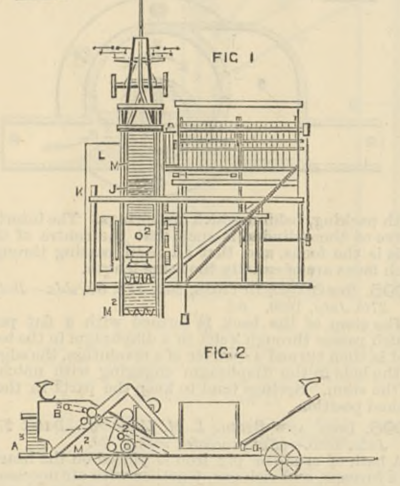

revolve by suitable gearing. The pulley K is connected by a belt with a pulley L, which gives motion to the self-feeding apron M, or to a cylinder for conveying the grain to the cylinder J. This cylinder threshes the grain and delivers it to a grain carrier or elevator O^2, whence it is carried to the vibrating screen or sieve M^2, with which is combined a spiral conveyor. With this grain carrier and the straw carrier B^3 in some cases are combined a straw picker and beater; A^3 represents a waste straw and chaff elevator or carrier.

2934. Safety Guards for Window Cleaning, &c., *T. Rochford.—Dated 16th July, 1880.* 6d.

The guard is collapsible, and consists of a metal tube frame, the bottom of which is cranked to rest on the window sill, and carries two screws connected by a nut in the middle, and being right and left-handed, so that by turning the nut, the screws are moved in opposite directions, and their ends, which carry plates with roughed or spiked surfaces, made to grip the window frame and hold the guard in position. The frame may be surrounded by wire gauze, canvas, or wood.

2935. Wire Fencing, &c., *J. Westgarth.—Dated 16th July, 1880.* 6d.

A wire of a double head rail section is formed by drawing or rolling, and is pierced with holes at intervals through the web, to receive pointed barbs which are passed through the holes and locked by pressing both sides of the wire between them. A coupling for fastening the ends of wire fencing is made in the form of a link pierced with four holes. Through the inner holes the ends of the wires to be joined are passed and return through the outer holes.

2936. Rotary Engine, &c., *D. Gallafeut.—Dated 16th July, 1880.* 8d.

The annular cylinder B is excentric to the shaft A, which revolves in bearings and carries a concentric disc C, large enough to divide the cylinder into two chambers, and revolving in a chamber D formed in the cylinder. E are pistons—preferably four in number—and each in the form of a segment of the

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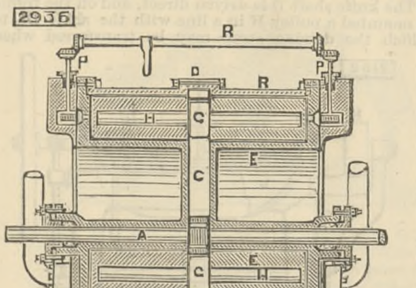

annular cylinder in which they revolve. These pistons are arranged in duplicate sets at opposite sides of the disc C, to which they are connected in pairs by means of pins H fixed to blocks G sliding in slots in the disc C. The induction and eduction pipes are connected with passages in the covers of the cylinder. To insure the simultaneous and uniform adjustment of the two valves at opposite ends of the duplicate cylinder, their two shafts P are operated by the shaft R.

2946. Hem-stitching Machines, *D. McGlashan.—Dated 17th July, 1880.* 8d.

Upon the shaft B are fixed two wave cams. The cam C is of the general figure of the frustrum of a cone, and is provided with raised and depressed portions to give the ordinary motions to the presser foot for presenting the cloth in the proper position beneath the needle for the formation of the hem-stitch; but in addition to these raised or depressed portions for giving the ordinary motions, the said cam is provided with a raised portion for moving the presser foot and feeding the cloth forward, whilst the

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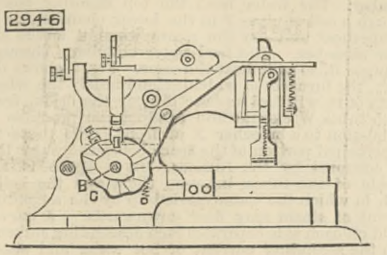

needle is in the cloth at the part where the veining is to be introduced, so as to cause a packing or pressing of the weft or warp thread in one direction. The other cam for acting upon the needle bar to give the necessary throw to the needle is also a wave cam.

2948. Handles for Teapots, &c., *J. Ridge.—Dated 17th July, 1880.* 6d.

The sockets to which the handles are usually attached are made separate from the body of the vessel, and have the interior hollow and tapering to the end to which the handle is attached. The ends of the handle are set down to form a shoulder, and are screw threaded. These ends are passed into the sockets, when a conical nut made of wood, horn, or bone, and fitting the interior of the sockets, is screwed over each end. The sockets with the handles thus attached are then soldered to the side of the vessel.

2953. Steam Engines, &c., *R. S. Candlish and W. J. Norris.—Dated 17th July, 1880.* 6d.

So as to separate air or other gases and impurities from the water supplied to steam boilers by air and feed pumps, such water is subjected to a vacuum. As applied to the suction branch of the air pump, the apparatus for this purpose consists of a close vessel, divided into two parts by a partial division plate A rising from the bottom to a little below the intended water level in the boiler. Another partial division plate B is carried from near the bottom to a few inches below the top of the chamber and above the water level, a space being left between the two plates. On one side or on top of the chamber, and between the plate B and the side or end nearest to it, is an opening, through which the water, &c., from the condenser is made to pass, and on the opposite end or top of the chamber is another opening, to exhaust the chamber by means of a displacement pump, shown at Fig. 2, or by the ordinary air pump. The water entering this chamber at C is retained on one side of plate B, and the oil or fatty matter can be drawn off at intervals. The water then rises between the division plates, and flows over plate A as the water in the other half of the chamber falls in supplying the feed pumps. The water thus passes in a film twice under a vacuum in the first and second half of the chamber respectively. So as to assist in freeing the water from oxygen, a steam coil may be placed in the second half of the chamber. The feed pumps take

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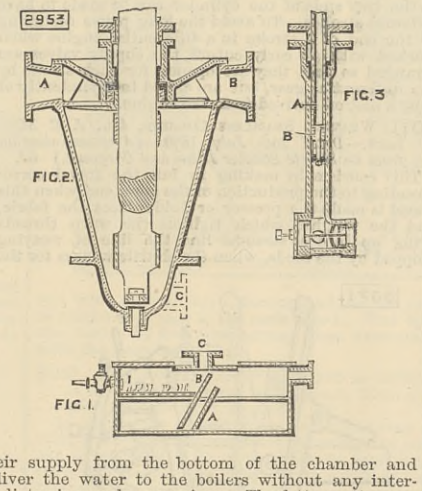

their supply from the bottom of the chamber and deliver the water to the boilers without any intermediate air vessels or receivers. The fatty matters are drawn off into an air-tight tank, having connections to the vacuum space of the condenser, and to the surface of the water in the chamber through I. Fig. 2 shows the displacement pump by which the air or gases are drawn off from the condenser, with the water discharging the former into the chimney, and the latter through pipe C to the feed pump. A is the suction and B the discharge branch for the air or gases. Fig. 3 shows the feed pump, the barrel of which is bored its entire length, and the ram works therein, its bottom being reduced and recessed to receive a spring. Over the reduced part fits a cap, retained by bolt B fast in the cap, but loose in the plunger, so that the spring is compressed by the contact of the cap with the water, when the cap forces the water before it.

2954. Preventing Waste of Water in Water-closets, &c., *A. Cole.—Dated 17th July, 1880.* 4d.

This consists in the application and use to an ordinary supply cistern A of a syphon B, one leg of which works by a sliding water-tight joint over a stand-pipe C fixed in the bottom of the cistern A communicating

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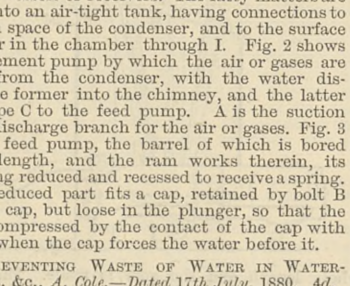

with the water-closet. The other or shorter leg of the syphon is immersed in the water of the cistern. By means of a lever D furnished at one end with a counterbalance weight E and attached at its other end to the syphon B, the bend of the latter is nominally kept above the level of the water in the cistern.

2960. Pumps, *R. Hoskin, jun., and W. Blackwell.—Dated 17th July, 1880.* 8d.

Fig. 1 is a side elevation of the upper part of a pair of balanced pumps, one pump being in the up stroke and the other in the down stroke. Fig. 2 shows the bottom portion of the pumps, this view being a continuation of Fig. 1. A A^1 are bell-crank levers or pump bobs for working the pumps; A^2 A^3 are rods or links for connecting the pump bobs with the tubular shafts or columns B and B^1 respectively; the pump bobs are so mounted and connected by the connecting-rod or link S, that the hollow shafts or columns B and B^1 receive an alternate up-and-down motion, one ascending while the other is descending. N N^1 are bearings or guide tubes with stuffing-boxes for the tubular shafts B B^1. At the lower end of each tubular shaft B B^1 there is a branch, leg, or plunger G G^1 which works through a stuffing-box. On the valve casing J J^1, containing the suction valve M M^1 and provided with a strainer Q Q^1, the delivery valve L L^1 is in a lateral rising extension K K^1 of the valve casing J J^1;

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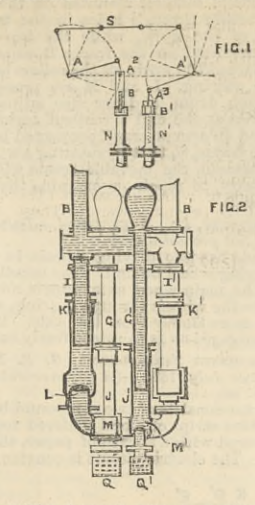

each part K and K^1 is formed with a stuffing-box for the sliding pipe I I^1 to work up and down in.

2969. Mechanism for Spinning, *H. J. Haddan.—Dated 19th July, 1880.—(A communication from W. Mason.)* 6d.

This relates to means for supporting, guiding, and lubricating the spindles of ring spinning frames. A is the spindle tubular bolster screw threaded at its upper end; B is the spinning frame rail, the hole to receive the bolster being somewhat larger than the bolster. At the lower part the bolster has a convex shoulder upon which rests a concave ring C, the upper surface of which bears against the lower surface of the rail, while a ring D also encloses the bolster and rests on the top surface of the rail. A screw nut E enters

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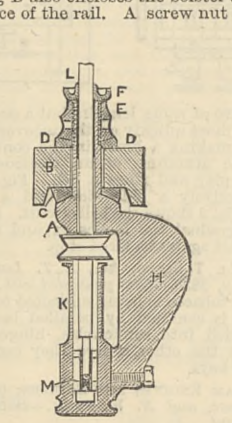

a concavity in the ring D and screws upon the thread of the bolster. From the lower part of the bolster an arm H projects and has at its lower end a socket to receive an oil reservoir K. The spindle L extends into the reservoir K and up through the bolster and the bushing F, its foot being sustained by a loosely-fitting step M constructed to allow oil to flow from the oil chamber into a cavity below it and thence up through the step into the spindle foot bearing.

2970. Raising Water, &c., *J. B. Duckett.—Dated 19th July, 1880.* 6d.

This consists in the employment of a flexible steam chamber or chambers alternately expanding by the admission of steam, and contracting on the condensation of such steam, and so arranged in combination with a rigid liquid chamber and suitable feed and delivery pipes that liquid shall be drawn into the said

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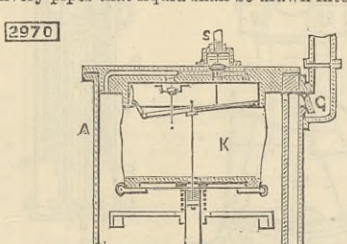

liquid chamber on the contraction of the flexible chamber or chambers, and shall be forced out or elevated on the expansion of the same. K is the flexible steam chamber, and A is the rigid liquid chamber; F is the feed pipe and G is the delivery pipe. Steam is admitted to the flexible chamber at S.

2971. Metal Eyelets, *W. R. Harris and J. G. Cooper.—Dated 19th July, 1880.* 6d.

This consists of hard eyelets A, each formed with a cutting edge or with a sharp edge which can be forced through some materials without preliminary

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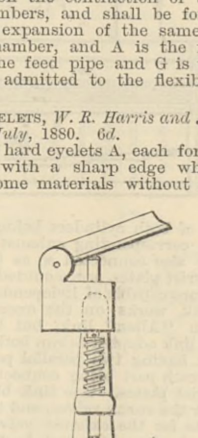

punching of the material. In the lower disc C of the eyletting machine is formed a groove which surrounds the piston D, which is forced upwards by means of a strong spring E. When using the apparatus one of the eyelets is placed upon the piston, and the material is brought over the eyelet. When the upper die is brought down, the eyelet is forced through the material and fixed therein by one operation.

2972. Kneading or Mixing Dough &c., *T. Lindop.—Dated 19th July, 1880.* 6d.

A cast iron mixing chamber of globular form has running through its centre a revolving shaft, on which is fixed a series of mixing blades shaped to suit the interior of the chamber. The blades vary in size, one passing close to the inner surface of the chamber, and the others projecting varying distances from the shaft. Each blade is bent to a spiral form as well as being curved to the form of the chamber. The materials are introduced at the top of the chamber, and leave through a hinged door at the bottom.

2990. Stamping or Pressing Sheet Metal into Moulds, *A. Scherb.—Dated 20th July, 1880.* 6d.

The apparatus shown is for stamping cups, plates, &c., from metal by an ordinary press. The cup is stamped with a raised flange, as shown at Fig. 3, by means of

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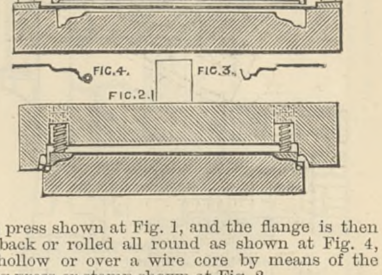

the fore press shown at Fig. 1, and the flange is then turned back or rolled all round as shown at Fig. 4, either hollow or over a wire core by means of the finishing press or stamp shown at Fig. 2.

2995. Expanding and Stopping Boiler or other Tubes, *D. J. Morgan.—Dated 20th July, 1880.* 6d.

The object of the invention is to expand and stop leaky tubes from the smoke box or front whilst under steam pressure, so as to leave the repaired tube as effective for continued heating purpose as an ordinary stay tube. The drawing shows the apparatus in place within a burst pipe L. It consists of an inner and lighter tube K, the end of which nearest to the operator is first expanded, the farthest end being left with its diameter originally smaller than the tube L. The tube K can thus be easily introduced, and the expanded end serves to close the near end to cause all

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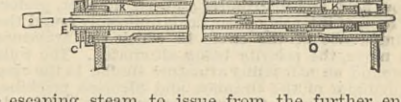

the escaping steam to issue from the further end, thus enabling the operator to work without inconvenience from escaping steam. An ordinary tube expander A may now be used to make a proper steam-tight joint between the two tubes at the nearer end. The ordinary tube expander is afterwards used to expand the further end of tube K by fitting to the expander a tube B by means of a coupling or socket O, such tube being screwed at its outer end, and fitted with nut C and check nut C^1. The nut C carries a bridge R projecting beyond the tube to bear upon the tube plate. The ordinary mandril D of the expander is fitted by a socket to a rod E projecting beyond the tubes, so that the mandril may be rotated by a tommy bar through the eye of the extended mandril rod E.

3013. Aquatic Life-saving and Sporting Dress, *G. B. Thornton.—Dated 22nd July, 1880.* 6d.

The dress consists of waterproof garments covering the wearer, and a buoy or float to encircle the waist and keep the wearer waist high in the water, when he can propel himself along by any suitable appliance. The float is fitted with air-tight compartments, and can carry four persons on it, and it is fitted with supports for a gun for sporting purposes.

3014. Incubators, *R. Challinor and W. H. Mawdsley.—Dated 22nd July, 1880.* 6d.

The drawer A in which the eggs are placed has a perforated bottom B, and is supported above a shallow tray C having an air tube D at the centre, and containing water to promote moisture. Above the tray C

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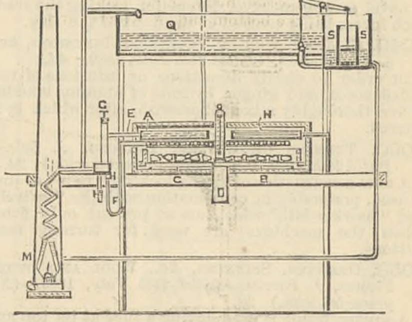

and drawer A is a coiled copper pipe E containing air, and communicating by means of a tube F with a heat regulator G, and through the latter with a hot water reservoir H. M is the boiler, Q a cold water cistern, and S a hot water cistern.

3018. Dyeing Yarn, *T. C. Firth and W. Sunderland.—Dated 22nd July, 1880.* 4d.

The body of the bobbins A on which the yarn is wound is perforated, and these bobbins are placed in

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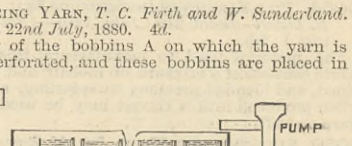

holders C connected to a pipe E leading to an exhaust pump, by which the dye liquor is drawn through the yarn, thereby dyeing it.

3020. Treating Maize, Flour, &c., *J. G. Wilson.—Dated 22nd July, 1880.—(A communication from P. Bahr and R. Brock.)* 6d.

The maize dough is heated so as to transform the starch it contains before being mixed with corn or wheat flour. The apparatus employed consists of a tank A steam jacketted and containing a central shaft, to a crosshead on which shovels or blades are

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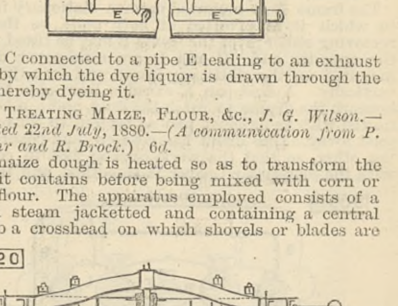

attached, and when the shaft is revolved the maize flour is thoroughly kneaded and raised to a temperature of 104 deg. Fah., after which it is removed and allowed to cool. When cool half the maize dough is mixed with leavened dough, the other half being mixed with it during the final preparing of the dough.

3023. ROLLING METAL, *W. R. Lake.—Dated 22nd July, 1880.—(A communication from W. Wenstrom.)* 6d.

The compression is effected on all four sides at directly opposite points of the metal at the same time. A is the upper and B the lower roll, the former being adjustable vertically, while the latter can slide in grooves in the bed, being moved by a feed screw and

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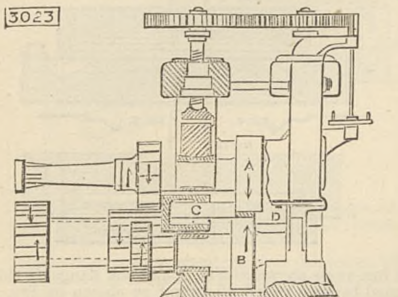

gearing; C and D are two edge rolls, the former being fixed to the standards, while the latter follows the upper roll in its vertical adjustment, and the lower roll in its lateral adjustment.

3041. APPARATUS FOR PRODUCING AND DIRECTING ELECTRIC CURRENTS, AND FOR APPLYING THEM TO STEERING VESSELS, *C. G. Gumpel.—Dated 24th July, 1880.—(Not proceeded with.)* 2d.

For producing the currents the inventor makes use of a dynamo or magneto-electric machine constructed so as to obtain with a given velocity of the rotating armature more numerous and powerful currents than are usually obtained, and to avoid heating. He concentrates the polarity as much as possible into a narrow field, and distributes an even number, preferably four, of intensely polar fields uniformly round the circumference of the circle in which the armature coils move, the polarity being alternated. The coils are wound on a rotating armature similar to the ring and cylinder of the Gramme and Siemens machine. For steering vessels the machines are thus arranged:—The dynamo or magneto-electric machine in the engine-room; as near as possible to the rudder, an electro-dynamic machine, moved by electric currents sent to its coils; this is connected to the rudder, so that according as the armature is revolved one way or the other, the rudder goes over to port or starboard.

3046. PUMPING APPARATUS, *F. H. Greeven.—Dated 24th July, 1880.—(A communication from G. A. Greeven.)—(Not proceeded with.)* 2d.

This relates to improvements of pumping apparatus known as "pulsometers," and consists in regulating the supply of steam to the chambers for the alternate receipt and discharge of liquid, so that steam may be supplied to each of a pair of them alternately from the main, whilst there is also constant supply of a certain quantity of steam to both by a small boring through the valve itself.

3047. LOOMS, *C. Smith.—Dated 24th July, 1880.—(Not proceeded with.)* 2d.

The take-up and letting-off motions are placed one over the other, the healds move to and fro horizontally by cams or tappets and lever, and revolving temples keep the cloth distended while being woven. The sley is caused to rise and fall to beat the weft by cranks or cams, and the throw of the shuttle is effected by levers and tappets. The mechanism for stopping the loom on the absence or breakage of the weft is similar to the weft motion now used. A second part of the invention relates to the weaving-off of the bottoms of cops; and a third part consists in the mechanism for actuating or picking the shuttles across the shed. A fourth part of this invention consists in a novel arrangement of levers for locking the reed, such levers being centred at the front of the sley.

3049. CLARIFICATION OF VEGETABLE INFUSIONS, &c., *S. C. Davidson.—Dated 24th July, 1880.* 4d.

In order to clarify decoctions or infusions of tea, coffee, cocoa, and ginger, hydrate of alumina is added to and thoroughly mixed therewith, after which it is filtered.

3050. TURNING OR CUTTING BUTTONS, *J. Lyle.—Dated 24th July, 1880.—(Not proceeded with.)* 2d.

A new construction of spring locking "rein" or link is used, preferably in combination with the "swivel" and "hawkes-bill," which are at present only fitted when the machines are used for turning bone buttons.

3053. DRAWING, SPINNING, &c., WOOL AND OTHER FIBRES, *J. Porritt.—Dated 24th July, 1880.—(Not proceeded with.)* 2d.

A square frame is used having a tube at its top and bottom end, through which the fibre is passed. On the bottom tube is fixed a wharle which rotates the tubes and frame, and on the same tube is a loose collar driven by a wheel and worm, and driving one of the nipping rollers by another worm and wheel.

3054. PILE FABRICS IN IMITATION OF SEAL SKIN, &c., *H. Lister.—Dated 24th July, 1880.—(Not proceeded with.)* 2d.

The material used to manufacture this class of fabric consists of a mixture of mohair and silk combined, and blended previous to spinning, and which when produced into a thread may be used either as warp or weft.

3059. SAND-PAPERING WOOD, &c., *M. Benson.—Dated 24th July, 1880.—(A communication from W. H. Doane.)—(Complete.)* 8d.

The frame B is mounted upon a stationary frame, to which it is pivotted at both ends, so that by removing either pivot the frame B may be tilted up on the opposite end. C and D are sand-paper drums mounted on the stationary frame, and are adjustable vertically. A dust-pan E extends from side to side beneath the drums to catch the dust, and can be connected with an exhaust pan at bottom to convey the dust away. One drum has coarser sand-paper than the other, so that the work coming first in contact with the coarser sand-paper is smoothed, and then in

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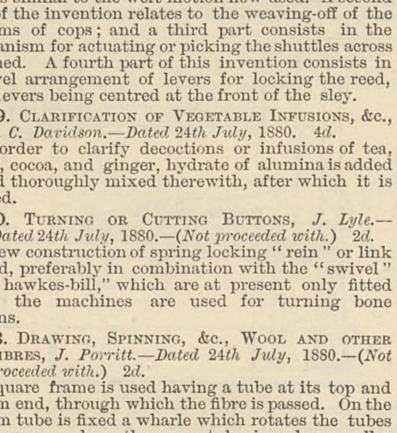

contact with the finer paper is polished. The frame B forms the table through which the upper surface of the drums slightly projects, so as to act on the under surface of the work. Three sets of feed rollers F are employed, one of each set mounted on the stationary frame and acting through holes in the table on the under side of the work, while the top rollers are adjustably mounted on the frame B, so as to bear on the top surface of the work, all the rollers being driven by suitable gearing. L and M are pressure rollers, one over each drum, and are also adjustable. The shaft N carries at one end a toothed segment, and at the other end an arm or crank connected by rods with the movable frame, so that by rotating a worm gearing with the segment the movable frame will be raised, when necessary, to repair or examine the sand-paper drums C and D.

3061. TRICYCLES, &c., *S. Chatwood.—Dated 24th July, 1880.—(Not proceeded with.)* 2d.

The tricycle has two driving wheels in front and a central steering wheel behind. The treadle cranks are formed on the main wheel axle, which communicates its motion to the wheels through gearing, so that they may rotate more slowly than the axle. Both wheels may be disengaged so as to rotate freely on their axle.

3062. AUTOMATIC FIRE-ALARMS, *G. R. T. Brown.—Dated 24th July, 1880.—(A communication from F. Bogen.)* 6d.

The detector consists of two compound blades; each blade is of two strips of metal soldered together; one blade is covered with a sheath of paper, the other left uncovered. The electric circuit is constant so long as

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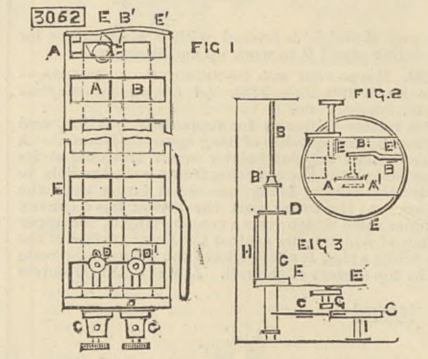

the blades are of same length; but a sudden increase of heat acts more quickly on the uncovered blade than on covered, making a break in the continuity of the circuit. The armature of an electro-magnet then comes into play and rings a bell. Fig. 1 and Fig. 2 show respectively a side view and a plan of the detector. Fig. 3 shows the bell circuit. If the increase of heat is gradual the blades expand similarly, and ultimately act against a fixed stop.

3065. ROLL TOBACCO, &c., *A. T. Lendrum.—Dated 26th July, 1880.—(Not proceeded with.)* 2d.

While the tobacco is being subjected to the action of the press it is confined by paralleled beaded rings of metal, divided into semicircles, hinged at one end, but open at the other, where they can be fastened together by keys.

3066. STEAM ENGINES AND BOILERS, *G. H. Babcock, S. Wilcox, and N. W. Pratt.—Dated 26th July, 1880.* 10d.

A single piston rod D extends through both cylinders, and by a connecting rod drives the crank shaft. A single excentric E is mounted on the crank shaft, and gives motion to the valves of the two engines, the upper steam valves of both cylinders being tied together, so as to work in unison, the lower

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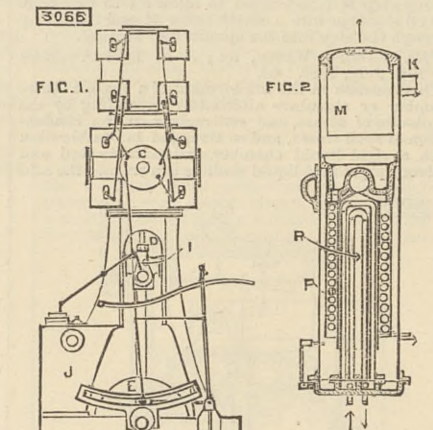

steam valves of both cylinders being similarly connected. The corresponding exhaust valves of both cylinders are also connected so as to work always alike. Two wrist plates are mounted on a common centre C, but are capable of independent motions. A compound link works on the excentric E, and is similar to an "Allen" link, but besides being a double-ended link adapted to run both ways, it is also a duplex link having two parallel parts, a separate link block in each part being connected by a rod to one of the wrist plates. One link block works the wrist plate for the steam valves, and the other works the wrist plate for the exhaust valves. By shifting both link blocks from one end to the other of its respective link the engine is reversed. Both blocks are of course shifted simultaneously, but each one is capable of being shifted to and from the centre, either simultaneously with the other or independently thereof, so as to regulate the throw of the steam valves, and thus change the expansion, without changing the throw of the exhaust valves. The air pump is formed to allow of rapid motion without injury, and is worked by a link I connected at one end to the crosshead, and at the other to a lever turning on a fixed centre and connected by a rod with the hollow plunger of the air pump J, which forms part of the framework. Fig. 2 shows a vessel through which the steam from the boiler passes on its way to the upper cylinder and parts with any water it may have brought over from the boiler, and in being transferred from the upper to the lower cylinder, the steam again passes through another part of this vessel, and first parts with its water of condensation, and is then thoroughly dried and slightly superheated by contact with surfaces heated by the hotter steam above, before being used in the lower cylinder. The steam enters at K, and issuing through a tangential nozzle is caused to whirl round in the space between the shell and the curtain M, the water it contains being deposited and trickling down the shell, while the steam rises inside the curtain and leaves the vessel at top. After being used expansively in the upper cylinder the steam enters the bottom chamber of the vessel through another tangential nozzle, being whirled round between the shell and a curtain, as in the top chamber, and then escaping at the top of the lower chamber. The water from the top chamber passes through a coil of pipes P in the lower chamber, so as to superheat and dry the steam when it enters the latter chamber. The feed-water circulates through the pipes R, so as to heat the same. Fig. 3 shows the boiler, the furnaces of which extend nearly the whole length of it, with an uptake T near the back, from which tubes W extend and conduct the products of combustion to a breecher X at front. The tubes fill the principal portion of the space below the water line not occupied by the furnace, but a space is left outside of the tubes, between them and the boiler shell, in which the water carried up by the ascending current of steam may flow downwards. A curved shield on each side separates such descending currents from the ascending current of hot water and steam arising about the tubes.

3070. DIFFERENTIAL VALVE GEAR OF STEAM ENGINES, *H. Davey.—Dated 26th July, 1880.* 8d.

This relates to improvements on a previous patent, in which the subsidiary piston, which conspires with the main piston to work a differential lever connected to the main slide, is controlled in its movements by a cataract. According to this invention, stops are applied to one of the fulcra of the differential lever E, so that it is capable of a limited amount of movement. This lever, which is connected at F to the crosshead of the main engine, is linked at Z to the auxiliary piston B, controlled by the cataract piston A. To the end of E is linked a rod G connected to the valves of the main engine, and limited in its movements by the stops K and L, which are adjustable. By this means the piston B is prevented from completing its stroke until after the point F has moved with the engine, and thus by adjusting the stops K and L, the piston B can be given a definite lead in advance of the engine. When a compound engine having a differential valve gear is unequally loaded, having more duty to perform in the one stroke than in the other, the balance weights usually employed to equalise the load are abolished, and to the low-pressure slide is adapted an adjustable plate or shutter, set so as to throttle more or less one of the steam ports. When lift valves are used to

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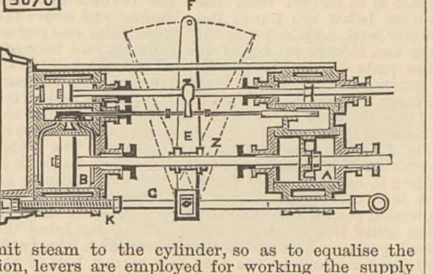

admit steam to the cylinder, so as to equalise the action, levers are employed for working the supply valves of the low-pressure cylinder, such levers having adjustable fulcra, which can be shifted nearer to or farther from the valve stems, whereby the inlet valves at the two ends of the cylinder can be made to have different strokes. To avoid the long pause occurring at the end of a stroke in a differential engine when worked with an early cut-off, the supply valves are arranged so that they are opened for each stroke by the differential gear, but are closed independently of it by a motion derived from the engine.

3071. WEAVING SEAMLESS CORSETS, &c., *J. C. Mewburn.—Dated 26th July, 1880.—(A communication from La Société Stiegler Jeune and Cargemel.)* 6d.

This consists in making in full the travel corresponding to the production of the gore, and when this travel is made the presser or holder frees the fabric, and the weights which tighten the warp threads bring up into a straight line the line of weaving stopped by the reeds, when the shuttle weaves for the

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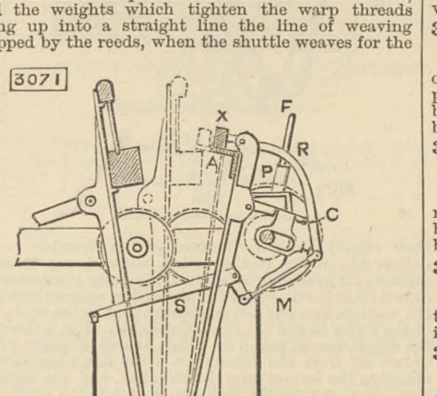

whole length and the gore is made. The lengths woven in the course of the formation of the gore are determined by the jacquard. This arrangement allows of the employment of fly shuttles, and its characteristic feature is the application to power looms of a movable presser or holder, which draws the fabric by the action of the loom itself. This presser consists of a supporting bar A connected to a frame free to oscillate on a shaft N and fitted with an elastic band, on which is placed the fabric which the presser is to draw. The fabric is pressed on the bar by another bar X, having teeth to prevent the fabric slipping, and kept pressed against A by levers R S T and weights G. To the frame carrying the bars are fixed two racks C, with which gear the wheel M, near to which is a rod P traversed by the tail of a hooked bolt, the nut of which carries a handle F to tighten the hooked bolt and cause the wheel M to revolve with its shaft, such wheel being moved by the regulator of the loom, and causing the racks C to draw forward the frame and with it the fabric.

3075. BOTTLE WASHERS, *A. Clark.—Dated 26th July, 1880.—(A communication from G. D. Dows.)* 6d.

A tubular shaft C is mounted in suitable bearings on a table and driven by a pulley D. To its end is

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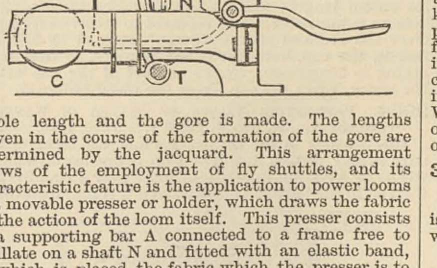

screwed the brush or scraper shown in the second figure, and consisting of a tubular hub, spring arms, and an elastic and flexible connecting tie formed preferably of leather. The other end of the shaft is fitted with a cock to admit water, such cock being automatically opened and closed when the bottle is pushed into the sleeve N. For this purpose a rectangular frame formed by side rods J and cross rods K can slide in the pillars on the table, and being forced backward by the bottle when placed over the brush, opens the cock. When the bottle is withdrawn the springs M force back the rectangular frame, which closes the cock.

3081. JELLY MOULDS AND PACKAGES, *T. F. Blackwell.—Dated 26th July, 1880.* 6d.

The bottom of the mould is made of thin sheet metal soldered in, and in it is a filling-in hole through which the molten jelly is poured, after which it is closed by a cap soldered over it. The jelly is thus ready for transport, and when desired to be eaten, the bottom is easily torn off, and the jelly turned out in shape ready for table.

3083. GLOVE FASTENERS, *W. F. Hall.—Dated 27th July, 1880.—(Not proceeded with.)* 2d.

A metal plate carrying a flat spring in a groove is secured to one side of the opening in the glove, and to its front at one end is hinged a piece with a heel bearing upon the spring. On the plate is a stud, the underside of the hinged piece being recessed to receive the stud.

3088. MATCH BOXES, *W. J. Webster.—Dated 27th July, 1880.* 6d.

The box is connected to the case so as to be capable of only partly sliding out, and the sides near one of its ends are cut, so that when projected the end may be turned down into the same plane as the bottom, thus exposing the matches.

3089. ELEVATORS FOR RAISING WATER FROM MINES, &c., *J. and G. Day.—Dated 27th July, 1880.—(Not proceeded with.)* 2d.

The apparatus employed is in the form of an injector, the motive power being water.

3090. ROTARY ENGINES, &c., *M. G., A. M., and S. M. Imschenetzki.—Dated 27th July, 1880.* 6d.

The shaft S is hollow in the cylinder U and solid at each end. P is the inlet, R the outlet, and D an air vessel on the delivery side. The piston K is fitted

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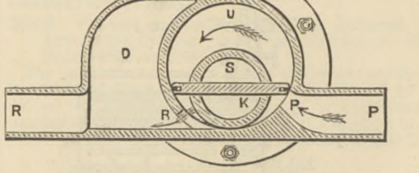

with packing, behind which are springs. The interior curve of the cylinder is such that the centre of the axis is the focus, and that all radii passing through such focus are of exactly the same length.

3095. SEPARABLE BUTTONS, &c., *J. L. Garside.—Dated 27th July, 1880.* 6d.

The stem of the back is formed with a flat part which passes through a slot in a diaphragm in the top, and is then turned a quarter of a revolution, the edges of the hole in the diaphragm engaging with notches in the stem. Springs tend to keep the parts in their locked position.

3096. IRON AND STEEL, *L. M. Lindberg.—Dated 27th July, 1880.—(Not proceeded with.)* 2d.

A bath of crude or pig iron is placed on the hearth of a furnace, and rich gas, together with air necessary for its combustion, is caused to enter the furnace with great velocity, and in such manner that a sharply lighted flame is formed and directed against the surface of the molten iron, its velocity removing the slag and its concentrated heat and oxidising power converting the iron to steel or malleable iron.

3097. COMPOSITION FOR CLEANSING BOILERS, &c., *W. Seymour.—Dated 27th July, 1880.* 2d.

The composition is a preparation of lime, sulphate of salt, chalk and coal in equal proportions, the whole pulverised and roasted in a furnace, after which it is boiled in water till greatly reduced in bulk, and brought to the consistency of clay.

3099. REVOLVING LIQUOR, FRUIT, AND CONFECTIONERY STAND, *J. Seelig.—Dated 28th July, 1880.—(Not proceeded with.)* 2d.

The stem is of metal, and a tube is fixed in the foot, round which revolve frames or trays containing the bottles containing the liquors or the other objects to be held.

3100. TOOLS FOR DRESSING STONES, *T. Wood.—Dated 28th July, 1880.—(Not proceeded with.)* 2d.

The tool consists of a thin flat cutting chisel fixed in the head by set screws and a wedge, so as to allow of its adjustment therein.

3101. PAPER-MAKER'S DRYING FELTS, *J. Porritt.—Dated 28th July, 1880.* 2d.

The cloth is made four, five, six, or more folds to the thickness required, and is woven so as to form one cloth. To join these cloths the ends of the warp threads of the inner folds are knotted together, and the knots pressed or beaten together to make them imperceptible. The warp threads from end of the outer fold are drawn over the joining of the inner folds, and into the other end of the outer fold, from which corresponding warp threads are drawn out so as not to increase the thickness of the cloth at the joining. When the ends of the outer end have been joined on one side the cloth is turned, and the outer fold of the other side is joined in a similar manner.

3102. CUTTING AND MINCING SAUSAGE MEAT, &c., *T. Williams, jun.—Dated 28th July, 1880.* 6d.

The knife shaft D is driven direct, and on the frame is mounted a pulley H in a line with the shaft D^1, to which the driving strap may be transferred when

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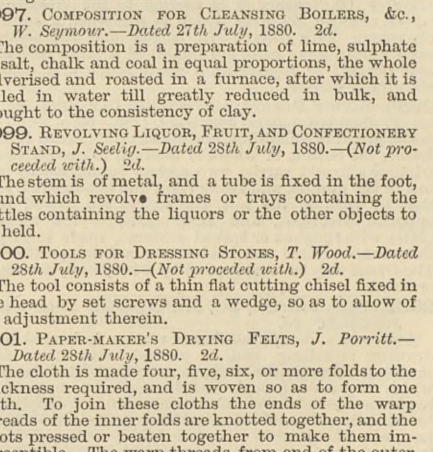

desired to turn back the cover and with it the knife shaft. The bowl L is mounted on shaft M, and is adjustable by a screw O. It is rotated by worm and spur gearing from shaft.

3103. TREATING LEATHER SCRAP, &c., *H. Lissagaray.—Dated 28th July, 1880.* 4d.

The scraps are treated with a solution of an alkali at a temperature of from 70 deg. to 100 deg. Centigrade, from one-quarter to one hour, and when saturated the solution is drawn off, and the scraps raised to from 120 deg. to 140 deg. Centigrade, thus drying it, when it is powdered and used as manure.

3105. BICYCLES, &c., *J. Bonner.—Dated 28th July, 1880.—(Not proceeded with.)* 2d.

The foot pedal consists of an elliptical ring, the underside of which carries the upper half of an excentric clip, connected by snugs to the lower half of the clip, which is fitted with a weight to keep the pedal in a horizontal position.

3106. ATTACHING DOOR KNOBS TO THEIR SPINDLES, *G. Hookham.—Dated 28th July, 1880.* 6d.

On that end of spindle B which is to receive the movable knob a series of angular notches are made on each angle, the notches on one angle being in advance of those on the adjacent angle, by which means a fine adjustment can be effected by causing the screw in the

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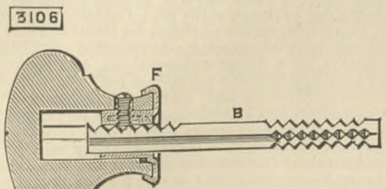

movable knob to engage with any one of the four series of notches. The end to receive the fixed knob is formed with only one set of notches. F is a metallic mount used when the knobs are not metallic, the hole through which the spindles pass being of the same form as the spindle. A spring clip serves to prevent the screw working loose.

3107. HYDRAULIC MAIN FOR THE DISTILLATION OF GAS, *G. W. von Nawrocki.—Dated 28th July, 1880.—(A communication from J. Foerster.)—(Complete.)* 4d.

The hollow cone A during distillation assumes the lowest position under the tar level in the hydraulic main X. It is suspended to the end of a rod B which passes out through the lid of the rising gaspipe D, and is connected to an outlet C and rod E, by means of

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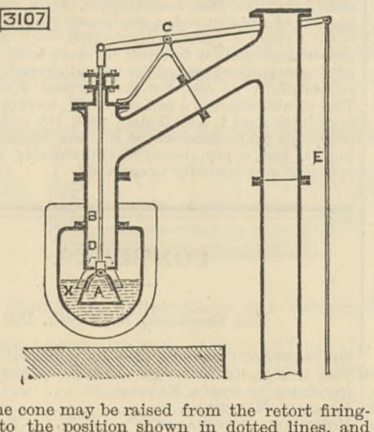

which the cone may be raised from the retort firing-room into the position shown in dotted lines, and brought into connection with the gaspipe D before the retorts are opened. The tar flowing down D will then make a joint between A and D.

3108. FASTENINGS FOR WINDOW-SASHES, &c., *T. H. Austin.—Dated 28th July, 1880.—(Not proceeded with.)* 2d.

Two pieces of metal are so curved as to form a complete circle together, the top and bottom surfaces being flat. One piece forming about two-thirds of the circle is fitted to the lower sash, and the other piece is fitted to the top sash. A hole is drilled through both pieces and passes right round them, the larger piece containing a curved bolt by which the window is secured.

3109. WRINGING MACHINES, *E. Clements.—Dated 28th July, 1880.* 6d.

The articles to be wrung are placed in a revolving cage A made of wire and fixed to a central support mounted on the upper end of shaft B, on the lower end of which is a bevel friction pinion, which rests

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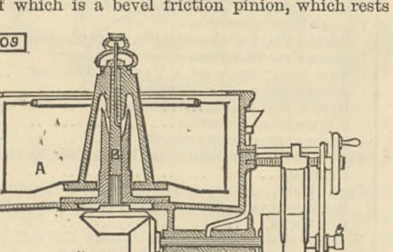

(with the weight of the cage and its contents) on another pinion driven by a pulley and strap. As the weight of the cage increases, the adhesion between the surfaces of the frictional driving wheels will correspondingly increase.

3110. ABATING SMOKE, &c., *H. Walker.—Dated 29th July, 1880.* 6d.

The products of combustion from the coke ovens C are led by short chimneys B and branch pipes to a hydraulic main A, the end of the branch pipe dipping below the level of the liquid in the main, from which

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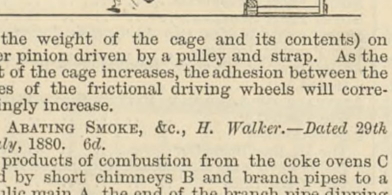


the tar as it accumulates is withdrawn so as to keep a constant level. The valuable volatile products are thus condensed, while the combustible gases can be utilised for heating or illuminating purposes, or they may be burned without generating dark smoke.

3112. PRODUCING LIGHT AND HEAT BY THE COMBUSTION OF HYDROCARBON OILS, &c., *F. Wilkins.—Dated 29th July, 1880.—(Not proceeded with.)* 4d.

This consists of a novel method of impregnating air with the vapour of an inflammable liquid, such as light hydrocarbon oil, the air passing over a series of trays containing the liquid, and placed at a level above the place where the light is to be produced, so that the mixture of air and inflammable vapour is sufficiently heavy to descend a pipe communicating with the burner.

3113. RECORDING MUSIC, *E. Hoyer.—Dated 29th July 1880.—(Not proceeded with.)* 2d.

A marker is attached to each key, so that as it is struck, the marker will form marks or indentations on a paper band caused to move slowly along under the markers.

3114. MOTIVE POWER APPARATUS FOR WORKING DRILLING, RIVETTING, HOISTING, AND OTHER MACHINES, *A. C. Kirk.—Dated 29th July, 1880.* 4d.

Water or other suitable liquid is supplied to the machines under pressure by a flexible pipe communicating with a set of pumps worked by a steam engine, the pump, engine, and boiler being combined together on a framing mounted on wheels, so as to move it to the drilling or other machine.

3115. SPINNING AND WINDING COTTON, &c., *J. Parker—Dated 29th July, 1880.—(Not proceeded with.)* 2d

This consists of a machine for spinning yarn and winding it into the form of a cop at one operation, and it is somewhat similar to that used for putting twist into rovings and winding the same on to bobbins.

3118. SEWING MACHINES, *H. J. Haddan.—Dated 29th July, 1880.—(A communication from A. Döring.)—(Not proceeded with.)* 2d.

The catcher or looper of the mechanism forming the meshes is connected with the base plate, on which it rests only by a small part of its circumference so as to leave a clearance between the two. The catcher is oscillated by toothed gearing and is made hollow to receive a spool kept in position by a plate perforated, and fitted with a spring to regulate the tension.

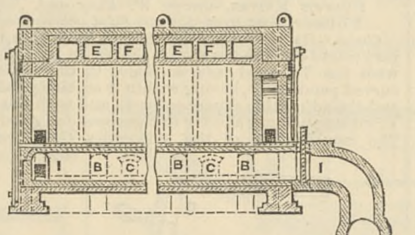
3120. TENNIS MARKER, *J. Appleby and A. L. Stamps.—Dated 29th July, 1880.—(Not proceeded with.)* 2d.

A disc bearing on its edge the numbers and letters by which the progress of the game is indicated is attached to the bat, and over it moves an index finger, a spring acting thereon so as to prevent it being moved accidentally.

3139. KILNS FOR DRYING AND BURNING GLAZED BRICKS, &c., *W. Holcroft.—Dated 30th July, 1880.* 8d.

A is a closed chamber of the kiln with an arched top, in which the drying and burning of the bricks are effected. Firegrates B are formed in one side, and others C in the other side of the kiln, both sets being below the floor of the kiln, and those of one set being

3139



situated midway between those of the other set. Flues E and F communicate respectively with the grates B and C on one side, and with horizontal side flues G and H on the opposite side of the kiln, the flues G and H running along under the floor the whole length of the kiln, and communicating at one

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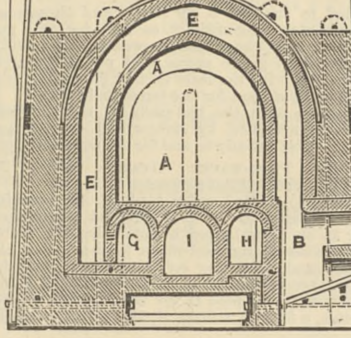

end with central flue I, through which the products of combustion pass to the main flue L. The ends are also heated by firegrates having flues communicating with the flues G and H.

3181. MANUFACTURE AND TREATMENT OF COPPER, &c., *J. H. Johnson.—Dated 3rd August, 1880.—(A communication from P. Manhes.)* 4d.

As applied to the treatment of sulphurous copper ores, this invention consists in reducing the ore without submitting it to a preliminary roasting. This reduction is preferably effected in a cupola or half-high blast furnace, and it has for its object the elimination of the earthy gangues by the formation of slag or cinder, and concentrating the metallic parts into a matt more or less rich in copper, but also containing iron and a large proportion of sulphur. The liquid matt thus obtained is run direct from the melting furnace into the converter—previously heated to the requisite temperature—and the manipulation of the converter, the admission and pressure of the blast of air, are regulated and conducted in the same manner as when cast iron is treated by the Bessemer process.

3216. MOULDS FOR THE MANUFACTURE OF PAVING AND OTHER BRICKS, &c., *W. Batten.—Dated 6th August, 1880.* 6d.

The drawing shows the mould open for the removal of the brick, and the arm carrying the frog lifted from the cover of the mould. The mould is made in two parts A and B hinged together, and forming a closed box. The part A is fitted with a hooked catch D to engage a projection on part B. The depressions F when the mould is closed form passages for the escape of excess of molten slag or scoria, of which the bricks

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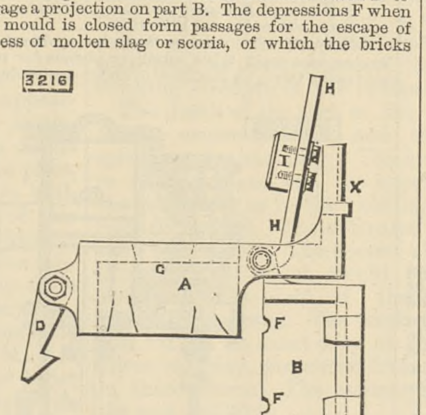

are made. When the mould has been closed and filled with molten slag or scoria, the lever H is brought down and its frog or plunger I enters the hole G in part A and consolidates and forces the slag into all parts of the mould. By the bracket X the moulds are attached to a revolving frame to bring them successively under a vessel containing the slag or scoria.

3220. TREATMENT OF WOOL, &c., *C. Kesseler.—Dated 6th August, 1880.—(A communication from A. Werner.)* 4d.

The wool is placed in tepid water, and when saturated the water is expressed, but without drying the material, which is then passed to a bath of cold water and sulphuric acid and left for three or four hours, after which it is passed through cold water and pressed out. It is then placed in a bath consisting of sodic thiosulphate in cold water for three or four hours, and then rinsed and dried, when it is ready for use. The wool thus prepared is impregnated with sulphur, and can be used in the shape of garments as a substitute for sulphur baths or ointments.

3240. UPHOLSTERY NAILS, *W. Pitt.—Dated 7th August, 1880.* 6d.

The head and body of the nails are made in one piece, from brass or other ductile metallic wire by means of dies and pressure, the bodies being made to the required shape and size, and the heads flat. The heads are afterwards operated on by dies and pressure, so as to give them a dome or mushroom shape.

3361. REFINING SUGAR, *A. Sauvée.—Dated 19th August, 1880.—(A communication from E. Courmerson.)* 2d.

The object is to convert all the syrup from the first boiling into sugar fit for sale. In the case where loaf sugar is manufactured, instead of treating the residuums from each boiling one after the other, whereby sugars poorer and poorer in quality are obtained, all the necessary operations for purifying and obtaining a better colour are performed at the same time on the green syrup, so as to obtain a mass much purer in colour and much nicer to the taste than that usually obtained. The mass is then disintegrated, and after being dried to the required point is reduced to powder by any suitable apparatus.

3411. KNITTING MACHINES, *W. Morgan-Brown.—Dated 25th August, 1879.—(A communication from B. F. Shaw.)* 3s. 6d.

This relates to cylindrical knitting machines wherein the cam for operating the knitting needle may be made to revolve continuously about the needle bed to operate the needles to form a circular web, or may be made to reciprocate about a portion of the needle bed and needles to knit a flat web, or to fashion a web as in the production of heels and toes of socks. The portion of the circular series of needles (less than half), which knit the instep of the stocking, are actuated by the working cam which operates only when circular knitting is taking place, and the remainder of the series placed under the control of the jacquard are actuated by a jacquard cam through suitable levers and connections. During reciprocating knitting the jacquard cam is the effective one. The jacquard surface determines the number of fashioning needles selected for operation at each reciprocation of the machine, and the number of revolutions and of reciprocations, and consequently the lengths of the circular and fashioned portions of the web, are controlled by a pattern chain. A second pattern chain controls the application of tension to the yarn at certain portions of the web to knit some parts of it closer than others, the operation of take-up reciprocating knitting, the introduction of a thickening thread at suitable intervals in the web, its severance, and the stoppage of the machine when the web is of proper length. The cam ring is driven by a rack when it is reciprocated for fashioned work, and by a spur gear when rotated for knitting a circular web.

4665. BREECH-LOADING FIRE-ARMS, *W. R. Lake.—Dated 12th November, 1880.—(A communication from D. Kirkwood.)—(Complete.)* 6d.

The barrels are hinged to the breech piece, and to the same pin is pivotted the hammer C, one arm of which bears a spur A that projects upon the shoulder

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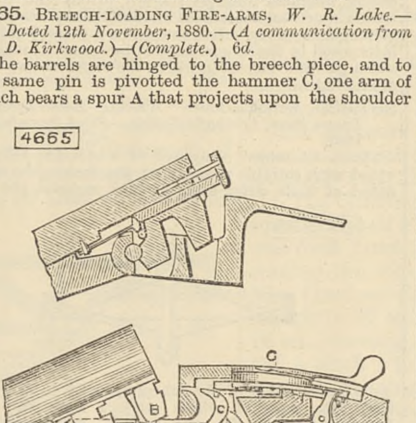

B on the locking lug attached to the barrel. Upon the downward movement of the breech the shoulder B is disengaged and the hammer tripped upon releasing the trigger. The sliding bar G serves to lock the trigger before the cocking of the hammer. Fig. 2 shows an improved cartridge shell ejector.

SELECTED AMERICAN PATENTS.

From the United States' Patent Office Official Gazette.

237,020. MECHANISM FOR MOVING THE CRANKS OF ENGINES AND OTHER SHAFTS FROM OFF THEIR DEAD CENTRES, *Josephus F. Holloway, Cleveland, Ohio.—Filed December 10th, 1880.*

Claim.—(1) The combination, with a crank shaft having a friction drum or wheel secured thereto, of a starter D, and devices for forcing said starter snugly against the periphery of the friction drum or wheel and imparting a partial rotary movement to the crank shaft, substantially as set forth. (2) The combination, with a crank shaft having a friction drum or wheel secured thereto, of a starter D and devices for utilising steam or hydraulic power to actuate the starter and impart a partial rotary motion to the crank shaft, substantially as set forth. (3) The combination, with the

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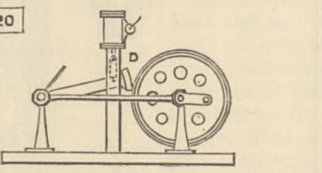

crank shaft having a friction drum or wheel secured thereto, of a starter D, a power cylinder, and a link connecting the piston rod and starter, substantially as set forth. (4) The combination, with a crank shaft having a friction drum or wheel secured thereto, of a starter D, connected with a vibrating arm and a steam or hydraulic actuated piston for imparting movement to the vibrating arm and starter, substantially as set forth. (5) The combination, with a crank shaft having a friction drum or wheel secured thereto, of a starter D connected with a vibrating arm, and an excentric journal bearing for said vibrating arm, substantially as set forth. (6) The combination, with a crank shaft having a friction drum or wheel secured thereto, of a starter D connected with a vibrating arm, and a steam actuated piston for raising and depressing the starter, substantially as set forth.

237,046. TELEPHONIC RECEIVING APPARATUS, *Charles A. Randall, New York, N.Y.—Filed November 3rd, 1880.*

Claim.—(1) In a telephonic receiving apparatus, the combination of an electro-magnet arranged for connection with a main line, a tension changer operated by said magnet, and arranged to control a local circuit, including a receiver and a bell-wringing apparatus arranged for operation by said magnet, substantially as described. (2) The combination of the magnet A, arranged for connection with a main line, the magnet A^1, included in a local circuit, a tension changer arranged for operation by magnet A, for varying the tension of said local circuit, and a receiver diaphragm arranged for operation by said magnet A^1, the said magnets, tension changer, and diaphragm being mounted upon a single base, substantially as described. (3) The combination of the adjustable magnet A, arranged for connection with a main line, the armature F, provided with a stud, the carbon block K, the adjustable magnet A^1, having one terminal of its helix connected with said block and the other with one pole of a local battery, the opposite pole of which is connected with the armature F of the magnet A, and a receiver diaphragm arranged for operation by said magnet A^1, substantially as described. (4) A magnet

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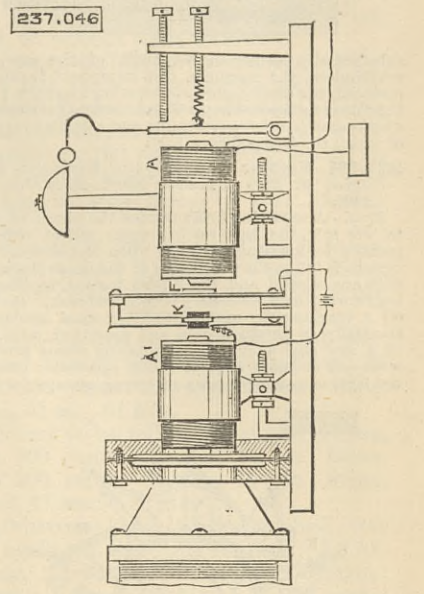

supported upon a pedestal provided with an opening or eye, in combination with a suitable supported screw extending through said opening or eye, and adjusting nuts arranged upon said screw for adjusting and securing said pedestal and magnet in position, substantially as described. (5) A carbon contact piece carried by an elastic non-metallic support, in combination with a movable pressure device arranged to act upon said carbon for controlling the flow of an electric current therethrough, substantially as and for the purpose set forth.

237,099. LAWN MOWER, *Francis E. Drury and Charles H. Paxson, Cleveland, Ohio; said Paxson assignor to said Drury.—Filed January 28th, 1879.*

Claim.—(1) A lawn mower having a loose ground wheel and an independent internally-toothed gear wheel, the latter forming, in combination with the main frame, a protecting case for the gearing, substantially as shown. (2) The combination of a forked

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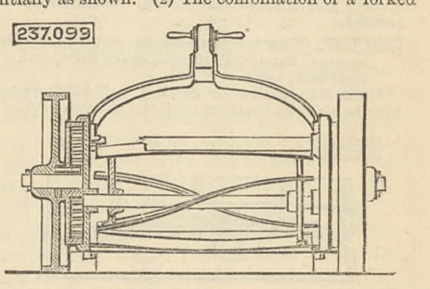

spring handle and lugs on the main frame extending beyond the sides of the handle stops to allow the reversal of the driving handle, substantially as described. (3) In combination with a lawn mower, a detachably-attached bent pole or driving handle, by reversing which its height may be regulated, substantially as shown.

237,107. STRAW BURNING BOILER FURNACE, *James H. Gillett and Harrison Gillett, Lake City, Minn.—Filed November 17th, 1880.*

Claim.—In an agricultural furnace, the combination of an extensible ash-pit or fire-box constructed of

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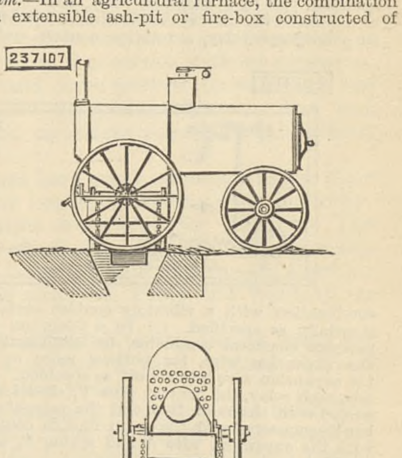

telescopic sections, with suitable devices for raising and lowering said pit or fire-box, substantially as and for the purpose set forth.

237,132. ELECTRICAL TELEPHONE, *Allen W. Rose, New York, N.Y., assignor to Chas. A. Cheever, same place; said Cheever assignor to himself as trustee.—Filed October 26th, 1880.*

Claim.—The combination, substantially as herein set forth, of the case, the magnet, the plunger, the

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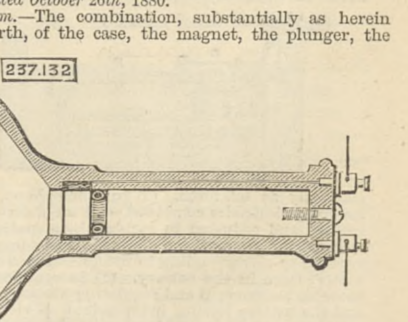

interposed buffers or sustaining springs, and metallic filings susceptible to inductive or magnetic action in a magnetic field, and constituting part of a galvanic circuit.

237,131. TRANSMITTING TELEPHONE, *Allen W. Rose, New York, N.Y., assignor to Chas. A. Cheever, same place; said Cheever assignor to himself as trustee.—Filed October 26th, 1880.*

Claim.—(1) The combination, substantially as herein set forth, of two elastic or yielding diaphragms, constituting magnetic poles and included in a galvanic circuit, with metallic filings capable of magnetic or inductive action interposed loosely in the magnetic field between said diaphragms. (2) The combination,

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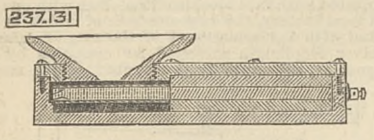

substantially as herein set forth, of the case, the mouthpiece, the magnets, the interposed insulating material, the diaphragms constituting magnetic poles, the filings interposed in the magnetic field between said diaphragms in a loose condition, and a galvanic circuit, of which the filings form a part.

237,161. MACHINE FOR SAWING KINDLING-WOOD, *James H. Brown, Boston, Mass.—Filed July 7th, 1880.*

Brief.—A revolving drum carries the pieces of wood to the saw, the logs resting upon rollers arranged radially in longitudinal rows upon the drum. At a certain point in the revolution of the drum the spring dogs are tripped and the rollers turned, feeding the log forward by a stationary tripper and rack. *Claim.*—(1) A machine for sawing kindling-wood made substantially as herein shown and described, consisting of a saw and a cylindrical rotating frame provided with one or more rows of radial rollers for carrying the logs, one or more rows of spring clamps for hold-

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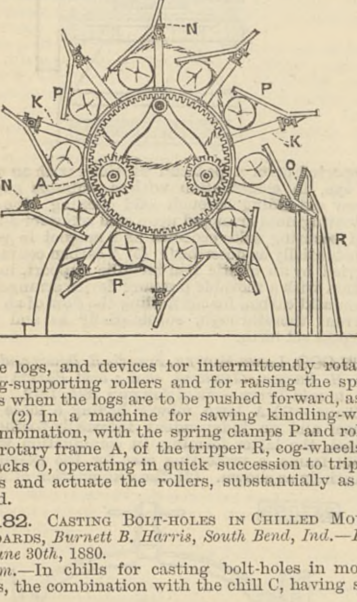

ing the logs, and devices for intermittently rotating the log-supporting rollers and for raising the spring clamps when the logs are to be pushed forward, as set forth. (2) In a machine for sawing kindling-wood, the combination, with the spring clamps P and rollers K, on rotary frame A, of the tripper R, cog-wheels N, and racks O, operating in quick succession to trip the clamps and actuate the rollers, substantially as described.

237,182. CASTING BOLT-HOLES IN CHILLED MOULD-BOARDS, *Burnett B. Harris, South Bend, Ind.—Filed June 30th, 1880.*

Claim.—In chills for casting bolt-holes in mould-boards, the combination with the chill C, having sand

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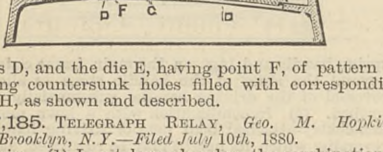

holes D, and the die E, having point F, of pattern G, having countersunk holes filled with corresponding cup H, as shown and described.

237,185. TELEGRAPH RELAY, *Geo. M. Hopkins, Brooklyn, N.Y.—Filed July 10th, 1880.*

Claim.—(1) In a telegraph relay, the combination of the expansion wire A, friction piece G, spring, and arbour, as shown and described. (2) The method of augmenting the expansion of an electrical conducting wire by the application of external heat, as herein specified. (3) In a telegraph relay, the combination of a heater with an expansion wire, as specified. (4) In a telegraph relay, a rotative contact surface, in

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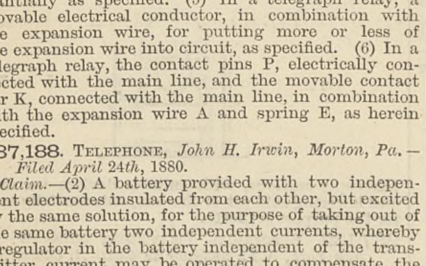

combination with a vibratory contact surface, substantially as specified. (5) In a telegraph relay, a movable electrical conductor, in combination with the expansion wire, for putting more or less of the expansion wire into circuit, as specified. (6) In a telegraph relay, the contact pins P, electrically connected with the main line, and the movable contact bar K, connected with the main line, in combination with the expansion wire A and spring E, as herein specified.

237,188. TELEPHONE, *John H. Irwin, Morton, Pa.—Filed April 24th, 1880.*

Claim.—(2) A battery provided with two independent electrodes insulated from each other, but excited by the same solution, for the purpose of taking out of the same battery two independent currents, whereby a regulator in the battery independent of the transmitter current may be operated to compensate the effect of fluctuations of electro-motive force, sub-

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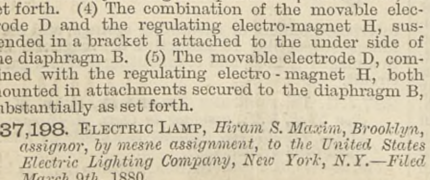

stantially as set forth. (2) In a telephone, variable resisting electrodes combined with an electro-magnet, applied and adjusted to regulate independent of the transmitter current the electrode resistance with a variability corresponding to the fluctuations of electro-motive force in the battery. (3) In combination, the movable electrode D and regulating electro-magnet H and the battery having independent + electrodes, as set forth. (4) The combination of the movable electrode D and the regulating electro-magnet H, suspended in a bracket I attached to the under side of the diaphragm B. (5) The movable electrode D, combined with the regulating electro-magnet H, both mounted in attachments secured to the diaphragm B, substantially as set forth.

237,198. ELECTRIC LAMP, *Hiram S. Maxim, Brooklyn, assignor, by mesne assignment, to the United States Electric Lighting Company, New York, N.Y.—Filed March 9th, 1880.*

Claim.—(1) The combination of the globe A with the platinum connections C C^1, and the capillary spaces A filled with gum or wax, substantially as described. (2) The combination, with the globe of an incandescent electric lamp, of glass tubes extending up into said globe and surrounding the supporting conductors of the incandescent part of the lamp, the spaces in the said tubes being packed with a solid sealing substance. (3) The combination of the base, carrying the plug K, with sub-base and the ring R, substantially as de-

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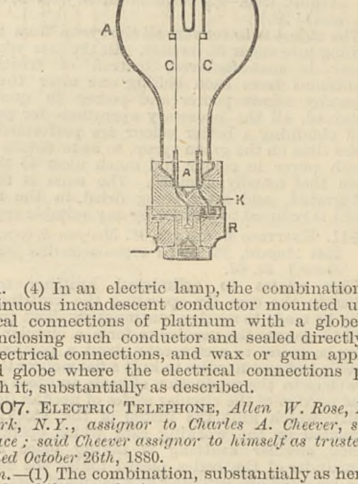

scribed. (4) In an electric lamp, the combination of a continuous incandescent conductor mounted upon electrical connections of platinum with a globe of glass enclosing such conductor and sealed directly to said electrical connections, and wax or gum applied to said globe where the electrical connections pass through it, substantially as described.

237,207. ELECTRIC TELEPHONE, *Allen W. Rose, New York, N.Y., assignor to Charles A. Cheever, same place; said Cheever assignor to himself as trustee.—Filed October 26th, 1880.*

Claim.—(1) The combination, substantially as herein set forth, of the enveloping case, a magnet or magnets inclosed therein, and filings susceptible of magnetic or inductive action, in a loose condition, interposed in the magnetic field, to vary the electric current

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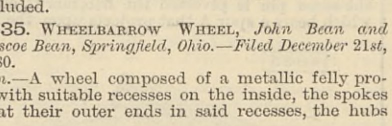

traversing the circuit in which they are included by changes in their condition by molecular vibrations transmitted through the casing. (2) The combination, substantially as herein set forth, of the enveloping casing, magnets inclosed therein, placed end to end, with a space between them, metallic filings susceptible of magnetic or inductive action, in a loose condition, interposed in the magnetic field between the magnets, and a galvanic circuit in which the magnets and filings are included.

237,235. WHEELBARROW WHEEL, *John Bean and Roscoe Bean, Springfield, Ohio.—Filed December 21st, 1880.*

Claim.—A wheel composed of a metallic felly provided with suitable recesses on the inside, the spokes fitted at their outer ends in said recesses, the hubs

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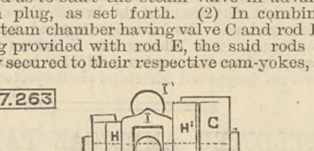

on opposite sides of the wheel secured to a suitable shaft, the ends of which project from the hubs, forming journals for the wheels, substantially as specified.

237,263. INJECTOR, *James Fergus, Philadelphia, Pa.—Filed September 1st, 1880.*

Claim.—(1) In an injector, a steam valve and steam plug actuated by means of connected cams, which are so arranged as to start the steam valve in advance of the steam plug, as set forth. (2) In combination with the steam chamber having valve C and rod B, the steam plug provided with rod E, the said rods being adjustably secured to their respective cam-yokes, as set

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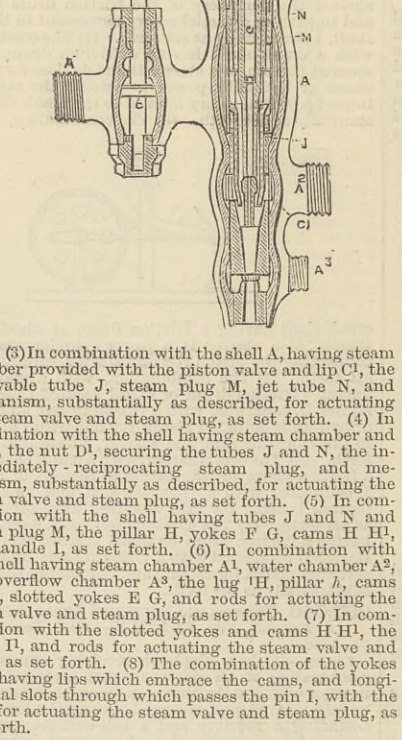

forth. (3) In combination with the shell A, having steam chamber provided with the piston valve and lip C^1, the removable tube J, steam plug M, jet tube N, and mechanism, substantially as described, for actuating the steam valve and steam plug, as set forth. (4) In combination with the shell having steam chamber and valve, the nut D^1, securing the tubes J and N, the intermediately-reciprocating steam plug, and mechanism, substantially as described, for actuating the steam valve and steam plug, as set forth. (5) In combination with the shell having tubes J and N and steam plug M, the pillar H, yokes F G, cams H H^1, and handle I, as set forth. (6) In combination with the shell having steam chamber A^1, water chamber A^2, and overflow chamber A^3, the lug H, pillar *h*, cams H H^1, slotted yokes E G, and rods for actuating the steam valve and steam plug, as set forth. (7) In combination with the slotted yokes and cams H H^1, the lever I^1, and rods for actuating the steam valve and plug, as set forth. (8) The combination of the yokes F G, having lips which embrace the cams, and longitudinal slots through which passes the pin I, with the rods for actuating the steam valve and steam plug, as set forth.

237,251. REFRIGERATING APPARATUS, *Alexander Concacher, Augusta, Ga.—Filed January 3rd, 1880.*

Claim.—(1) In ice-making machinery provided with a double-acting pump and a vertical column at each end of the pump cylinder, the use of a body of glycerine on each side of the pump piston to be constantly intervening between the said piston and the gas to be compressed, and to render the gas valves liquid-sealed, substantially as described. (2) In a refrigerating apparatus, the combination of the horizontal cylinder of a double-acting pump with hollow vertical columns at each end thereof, and two valves at the

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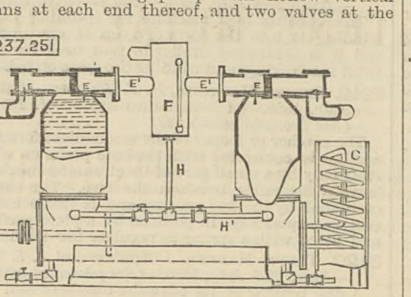

upper end of each column, substantially as and for the purpose described. (3) In a refrigerating apparatus, the combination of the horizontal cylinder of a double-acting pump, hollow vertical columns at each end thereof, and valves E with pipes E^1, liquid trap F, and pipes H H^1, substantially as and for the purpose described. (4) In a refrigerating apparatus, the combination of the horizontal cylinder of a double-acting pump and hollow vertical columns at each end thereof, having two valves at their upper end, with coiled pipe G, having its two extremities secured to the end of the pump cylinder, substantially as and for the purpose described.

237,292. MACHINE FOR GRINDING MOWER AND REAPER KNIVES, *George W. King and John R. Williams, Fort Scott, Kans.—Filed October 4th, 1880.*

Claim.—(1) The adjustable rod D, having its upper part round and the lower part square, in combination with the T-shaped tube or sleeve C, the adjustable curved pendent E^1, having within it an elongated slot, and the adjustable square collar E, and with the shaft F, substantially as and for the purpose described. (2) The combination of the side rails G, adjustably

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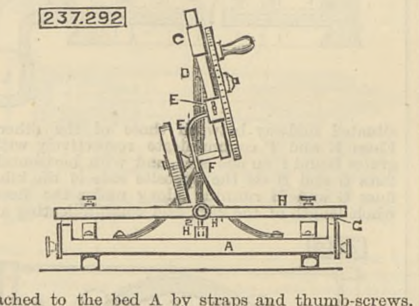

attached to the bed A by straps and thumb-screws, and buttons, substantially as and for the purpose described. (3) The knife supporter H, having the back piece and guide pieces, and pendent pin H^1, in combination with the rails G and grooved guides H^2, substantially as and for the purpose described. (4) In combination with the bed-plate A, the side rails G, adjustably attached by straps and set screws, and buttons, substantially as and for the purpose described.

237,299. FEED-WATER HEATER, *Henry Mason, Chicago, Ill.—Filed September 20th, 1880.*

Claim.—(1) A feed-water tank F, in combination with a pipe H, to conduct exhaust steam into the water in such tank, and a pipe O leading from such tank, for supplying feed-water to the boiler, all constructed and operating substantially as and for the purposes specified. (2) A feed-water tank F in combination with the pipe H for discharging steam into the tank, a filter I, a filter M, and pipes O and P, sub-

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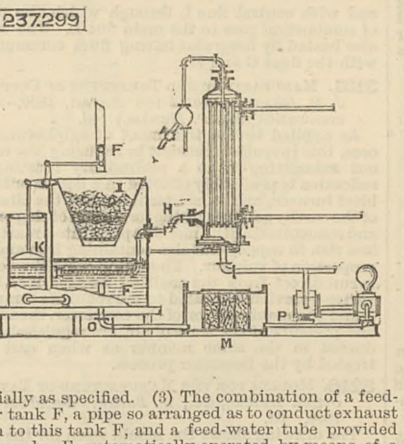

stantially as specified. (3) The combination of a feed-water tank F, a pipe so arranged as to conduct exhaust steam to this tank F, and a feed-water tube provided with a valve F, automatically operated by means of a float K, substantially as and for the purposes specified.

237,323. STEAM-ACTUATED VALVE, *George H. Reynolds and Thomas J. Rider, New York, N.Y., assignors to Cornelius H. Delameter and George H. Robinson, same place.—Filed October 16th, 1880.*

Claim.—(1) The combination, in a direct-acting engine, of a main valve, auxiliary pistons for moving said main valve, an auxiliary cylinder containing both

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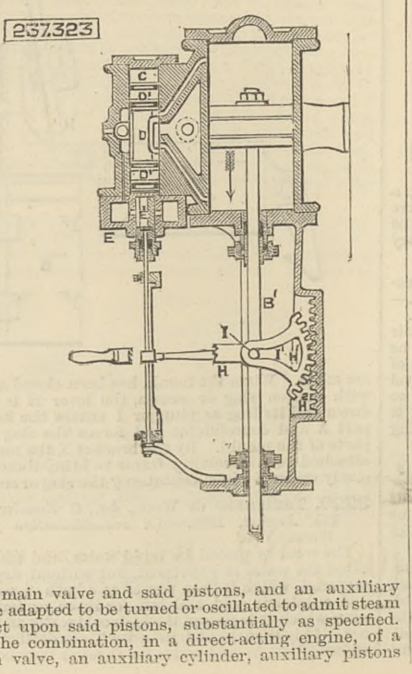

said main valve and said pistons, and an auxiliary valve adapted to be turned or oscillated to admit steam to act upon said pistons, substantially as specified. (2) The combination, in a direct-acting engine, of a main valve, an auxiliary cylinder, auxiliary pistons for moving said main valve, and an auxiliary valve adapted to be turned or oscillated to admit steam to act upon the auxiliary pistons, and arranged with its axis in line with said pistons, substantially as specified. (3) The combination, in a direct-acting engine, of a main valve, an auxiliary cylinder, auxiliary pistons for moving said main valve, an auxiliary valve to admit steam to act upon said auxiliary pistons, and an auxiliary valve chest arranged at the end of said cylinder and forming a head therefor, substantially as specified. (4) The combination of an auxiliary cylinder C, a main valve D, auxiliary pistons D^1, an oscillating auxiliary valve E^1, an auxiliary valve chest E, comprising steam and exhaust chambers and ports, all arranged substantially as specified. (5) The combination, in a direct-acting engine, of a main valve, an auxiliary cylinder having an exhaust port at some distance from its end, and an auxiliary piston constructed with an annular groove near its end, and with a port or passage leading from said annular groove through the end of a piston, whereby said piston is cushioned by the exhaust steam at the termination of its stroke, substantially as and for the purpose specified. (6) The combination, in a direct-acting engine, of a main valve, an auxiliary cylinder having an exhaust port at some distance from its end, an auxiliary piston constructed with an annular groove near its end, and with a port or passage leading from said annular groove through the end of the piston, and a plate or washer having a hole or aperture corresponding to said port or passage, and adapted to be adjusted to more or less close said port or passage, substantially as and for the purpose specified. (7) The combination, in a direct-acting engine, of a main valve, an auxiliary piston or pistons for moving the same, an independent auxiliary valve for admitting steam to act upon said piston or pistons, a valve stem for said auxiliary valve, a reciprocating piston rod, a bar attached to said valve stem and constructed with a slot having a cam-like face at each end, and an arm fixed to said piston rod and engaging with the slot in said bar, substantially as and for the purpose specified. (8) The combination, in a direct-acting engine, of a piston rod, a stationary rack, and a hand-lever having a pivotal connection with said piston rod, which forms a fulcrum for said lever, and comprising a toothed sector for engaging with said rack, substantially as and for the purpose specified. (9) The combination of a piston rod B^1, having a projecting pin or stud I, a stationary rack H^2, and a lever H, comprising a toothed sector H^1, and having an opening I^1, and a pin, inserted transversely across said opening, substantially as specified.

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THE ENGINEER, March 4th, 1881.

THERE are nine jetties in course of construction by the Public Works Department of South Australia, one of which, that of Kingston, will be 4000ft. in length and of iron.

SOUTH KENSINGTON MUSEUM.—Visitors during the week ending Feb. 26th, 1881:—On Monday, Tuesday, and Saturday, free, from 10 a.m. to 10 p.m., Museum, 10,122; mercantile marine, building materials, and other collections, 2606. On Wednesday, Thursday, and Friday, admission 6d., from 10 a.m. till 4 p.m., Museum, 1208; mercantile marine, building materials, and other collections, 152. Total, 14,088. Average of corresponding week in former years, 15,185. Total from the opening of the Museum, 19,721,175.